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2014 TO 2016 AQUATIC EFFECTS RE-EVALUATION REPORT

PLAIN LANGUAGE BRIEFING AND TECHNICAL REVIEW COMMENTS

Technical Memorandum # 367-18-01

Prepared for:

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1.0 BACKGROUND AND SCOPE OF WORK

Diavik Diamond Mines (2012) Inc. (DDMI) submitted the 2014 to 2016 Aquatic Effects Re-Evaluation Report (AERR) Version 1.0 (report dated March 14, 2018) to the Wek'eezhii Land and Water Board (WLWB) and the report was distributed on May 11, 2018.

DDMI is required to produce and submit an integrated Aquatic Effects Monitoring Plan (AEMP) report to the WLWB every three years. The goal of this report, referred to as the Aquatic Effects Re-Evaluation Report (previously the Three Year Summary Report), is *"to meet the requirements of Water Licence W2015L2-0001 Part J Item 9, which has the following three objectives:*

a) To describe the Project-related effects on the receiving environment compared against Environmental Assessment (EA) predictions;

b) To update predictions of Project-related effects on the Receiving Environment based on monitoring results obtained since project inception; and

c) To provide supporting evidence, if necessary, for proposed revisions to the AEMP Design Plan.

The report also must satisfy the requirements of Water Licence W2015L2-0001 Schedule 8 Item 5, which are:

a) a review and summary of AEMP data collected to date including a description of overall trends in the data and other key findings of the monitoring program

b) an analysis that integrates the results of individual monitoring components (e.g., water quality, fish health, etc.) to date and describes the overall ecological significance of the results

c) a comparison of measured Project-related aquatic effects to predictions made during the Environmental Assessment and an evaluation of any differences and lessons learned

d) updated predictions of Project-related aquatic effects or impacts from the time of writing to the end of mine life based on AEMP results to date and any other relevant operational monitoring data

e) a plain language summary of the major results of the above analyses and a plain language interpretation of the significance of those results

f) recommendations, with rationale, for changes to Action Levels as set in the AEMP Design Plan

g) recommendations, with rationale, for changes to any other aspect of the AEMP Design Plan; and,

h) any other information required as requested by the Board."

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

- How well previous EMAB comments and recommendations were addressed and incorporated;
- Quality of data collected, including Diavik review of quality assurance/quality control (QA/QC) issues;
- Methods used to analyze trends in data;
- Adequacy of discussion of results;
- Defensibility of conclusions and recommendations, including recommendations for changes to the AEMP Design Plan;
- Emerging issues, and year-to-year variation in parameters that may indicate environmental change over time;
- Unanticipated project-related effects; and
- Action levels reached, assessment of response framework.

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 Re-evaluation Report represents a large undertaking and presents a large amount of data and information. Given the extent of the report, some errors or discrepancies would be expected. Although a comprehensive documentation of minor errors was not undertaken for this review, it is noted that there were a number of instances where there either figures referenced in the text that are not presented in the report and various instances of incorrect references to tables, figures, and sections. It was also noted that many table and figure captions did not provide sufficient information to determine what is presented. We have noted such discrepancies and other minor editorial comments observed during the technical review in Table 1 to assist the authors with revisions to the document.

The following sections present a plain language briefing of NSC's key comments on the Technical Review, with a focus on the points identified by EMAB for evaluation during the review of AERR Version 1.0 (Section 1.0). Due to the size and complexity of the report, the following comments have been organized according to the report structure (i.e., by monitoring component or major report heading).

2.1 INCORPORATION AND CONSIDERATION OF PREVIOUS EMAB COMMENTS AND WLWB DIRECTIVES

With two exceptions, the report appears to have adequately addressed previous EMAB comments and WLWB directives. The exceptions are described below.

2.1.1 WLWB Directive: Consideration of Additional Dustfall and/or Snow Chemistry Monitoring sites

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 (2017a) 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.

2.1.2 WLWB Directive: Review of Duplicate and Blank Samples for Dustfall and/or Snow Chemistry Program

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:

...Review the location and number of duplicate and blank samples for the dustfall and the snow water chemistry program (W2015L2-0001 update, Commitment B)."

There is no discussion provided regarding a review of blank samples.

Recommendation 1: Include a discussion of blank samples included in the dust monitoring component.

Section 14.2.1 (page 606) indicates: "The relative percent differences among sample duplicates are occasionally high for the snow water chemistry data. This is commonly observed for variables related to dust due to the episodic nature of dust deposition, and the discrete but stochastic nature of particle deposition. Geometric averaging of samples plus their duplicates in the 2014 to 2016 re-analysis effectively accounted for occasionally high RPD [relative percent difference] values observed between duplicate snow chemistry samples collected at the same location. Potential outliers were effectively screened using the Z-score approach, and consequently no additional sample duplicates are proposed."

The sample duplicate results are presented in Table 3-4 (page 29) for only a subset of parameters. The document should include a review of all parameters to provide for an evaluation of QA/QC for the program as a whole. While annual reports discuss details for all parameters, the re-evaluation report is the location where data for numerous years are considered collectively. Issues with and/or patterns in data may not be readily apparent until data are reviewed for all years together.

Recommendation 2: Include duplicate sample results and discussion of these data for all parameters. A table presenting a summary of the analysis of the duplicate results (e.g., relative

percent mean differences) could be provided in an appendix. This would also inform on the need to modify the program.

2.2 DUST DEPOSITION

2.2.1 Parameters Evaluated

The report states (Dust Deposition, Section 3.2.2, Data Handling, page 27): "Analysis was undertaken to evaluate temporal or spatial trends in dust deposition rates, deposition of dustborne nutrients (i.e., total phosphorus [TP], orthophosphate [OP], nitrate plus nitrite [N+N], and ammonia), and deposition of two dust-borne metals indicative of metal deposition in general (i.e., aluminum and lead)."

It is not clear why the evaluation only included two metals (aluminum and lead).

Recommendation: Please provide a detailed rationale for focus on only two metals (aluminum and lead).

2.2.2 Grouping Of Data Sets

In Section 3.2.3.1 (Methods, Data Analysis, Temporal Grouping, page 30), the report states: "Dust deposition data and snow chemistry data were grouped into time periods to reflect changes in mining activities over time at the Mine. The time period groups were as follows:

- 2002 to 2005: open pit mine construction and open pit mining
- 2006 to 2009: underground mine construction and open pit mining
- 2010 to 2013: open pit transition to underground mining
- 2014 to 2016: underground mining with re-mining of the Waste Rock Storage Area – North Country Rock Pile."

While the principle of grouping according to major activities is a logical approach, grouping of years may mask short-term effects. Results for other components of the AEMP are presented by year in the report.

Recommendation: Please provide a discussion of whether more short-term effects have been observed for dust deposition, as it may pertain to pooling of multiple years of data. If short-term recent trends have been observed, these should be presented in the report.

2.2.3 Definition Of Background Data

Dust deposition results for sites not significantly different from control sites were "pooled to form a composite estimate of background dust deposition" (Dust Deposition, Section 3.3.1.1, Results,

Dustfall, page 35). While this approach may be reasonable for some of the sites, at least one site (SS5-4) has a notably high mean rate for the 2014-2016 pooled time period (i.e., more than four times the control sites). The lack of a statistically significant difference between this site and the formal “control sites” may reflect high variability in the data set and identifying this site as "background" does not seem to be appropriate based on the information presented. Inclusion of error bars on the figure (and other similar figures) would assist with review of these data.

In addition, deposition rates for site SS5-4 reported in the 2014, 2015, and 2016 annual AEMP reports (Golder 2016a,b, and 2017) were 47, 43, and 38 mg/dm^2/year, respectively. The mean reported in Figure 3-4 and Table 3-5 (279 mg/dm^2/yr; page 35) contradicts these values.

Recommendation: Include error bars on figures and provide clarification on the appropriateness of the approach for designating sites as "background".

Please verify that the mean deposition rates presented for site SS5-4 are correct. If correct, suggest reconsidering designation of this site as "background".

2.2.4 Temporal Changes

It is indicated that background deposition rates of phosphorus and metals increased from 2010-2013 to 2014-2016 but no explanation is given as to why rates increased (Dust Deposition, Section 3.3.4, Results, Spatial Distribution of Environmental Loadings, pages 53 to 56). This may be indicative of a mine-related influence in the latter period.

Recommendation: Possible explanations for the increase in background deposition rates should be discussed.

2.3 WATER QUALITY

2.3.1 Dissolved Oxygen (DO) Results and Discussion

Section 4.3.2.1.1 (Effluent and Water Quality, Results, Water Quality, Temporal Trends, Depth Profiles, page 129) identifies "...DO concentrations during ice-cover that were at or below the Effects Benchmark of 6.5 mg/L for the protection of aquatic life (PAL) for "other" life stages (i.e., non-early life stages)." During the ice-cover season the Canadian Council of Ministers of the Environment (CCME 1999; updated to 2018) 9.5 mg/L benchmark for early life stages would be more appropriate for fall spawning species such as Lake Trout. In addition, there is no discussion of whether DO concentrations were above or below benchmarks for the open-water season.

Recommendation: The DO data should be compared to the appropriate benchmarks and the findings reported. Include a discussion comparing DO results for the open-water season to PAL guidelines.

2.3.2 Depth Profile Results and Discussion

It is difficult to discern individual years in the depth profile figures presented in Figures 4-35 to 4-38 (pages 130-133). In particular, the figures do not clearly show results for pre-Project data making it difficult to assess whether any changes appear to have occurred post-Project. This confounds evaluation of the results that are presented. For example, it is noted that pH values frequently fell outside of the CCME PAL guideline range (6.5-9). To interpret the implications of this occurrence, it is important to consider baseline conditions in the lake; as the figures are presented, baseline results are not easily visualized in the figures.

Recommendation: Modifications to the figures would be beneficial to assist the reviewer with discriminating annual results and, in particular, distinguishing baseline from post-Project results. Suggest re-formatting figures to render them clearer.

It would also be beneficial to include a brief discussion, where applicable, noting changes between the pre- and post-Project time periods. This would be notably useful for pH and DO results, where monitoring has shown exceedances of benchmarks.

Consider examination of DO results as percent saturation values to evaluate trends over time.

2.4 EUTROPHICATION INDICATORS

2.4.1 Spatial Extent Of Effects – Total Nitrogen

Comment 1:

Section 5.3.1.1 (Results, Summary of Effects, Extent of Effects, page 258) indicates: “The boundary of effects on concentrations of total nitrogen (TN) generally extends to the northwest (to the end of the NF-MF1-FF1 transect) and to the northeast (towards the Lac du Sauvage inlet), with an exception in 2014 when the extent of effects appeared to be localized around the NF area.” This statement appears to be based on incorrect results presented in Figure 5-2 (page 263) and is in disagreement with results presented in Table 5-7 (page 261) and those presented in the 2014 AEMP Annual Report (Golder 2016a). Table 5-7 indicates the affected area was equal to or greater than 40.1% of the lake area.

Section 5.3.1.1 (page 258) further indicates: "Overall, the greatest extent of effects was observed on TN in 2016 (484.9 km^2, or 84.7% of lake area) (Figure 5-2; Table 5-7). The extent of effects on TN increased between 2007 and 2016, and has consistently shown an affected area >20% since 2008, while the spatial extent of effects on other indicators of eutrophication (i.e., TP, phytoplankton and zooplankton biomass) has decreased. The lack of a relationship between areas where TN is greater and areas where biological effects were observed (chlorophyll *a*, phytoplankton and zooplankton biomass) is consistent with N not being the limiting nutrient in Lac de Gras."

However, as noted above, this statement is based on erroneous TN information presented for 2014. With this correction made, spatial patterns for chlorophyll *a* and TN appear to be relatively similar in most years - notably in 2014.

Recommendation 1: Please correct Figure 5-2 for the 2014 data and verify that data for other years are correctly presented. Modify text and data interpretation and conclusions accordingly.

Comment 2:

In a review of the 2016 AEMP Annual Report, NSC (2017a) had commented on the exclusion of data for TN at site LDG-48 in the spatial extent analysis. This comment indicated: "Comment 1: Section 2.1.2 of Appendix XIII (page 5) indicates that no sample was collected from LDG-48 (the outlet of the lake) in the open-water season. As a result the spatial extent of effects on total nitrogen and cumulative effects were not assessed for the northwest area of the lake beyond sites FFA-4 and FFA-5..."

While it is understood that sampling methods employed in the water quality monitoring program are not consistent with those for the eutrophication monitoring program, the TN concentration measured at LDG-48 in August, 2016 (174 µg/L) under the water quality program was above the normal range (122-153 µg/L) for the open-water season. Based on this measurement, the spatial extent of effects extended through the northwest portion of the lake (i.e., effectively 100% of the lake area).

It was recommended to incorporate data collected at site LDG-48 during the water quality monitoring program into the eutrophication analyses and reporting (i.e., spatial extent analysis) and update maps and spatial extent of effects estimates.

This comment is re-iterated for consideration with respect to the current report.

Recommendation 2: Add discussion in the report to note that the spatial extent of effects in 2016 could have extended through the entire lake. Include caveats respecting differences in sampling methods if appropriate.

2.4.2 Spatial Extent Of Effects – Chlorophyll A

Section 5.3.1.1 (page 258) indicates: "The extent of effects on TN increased between 2007 and 2016, and has consistently shown an affected area >20% since 2008, while the spatial extent of effects on other indicators of eutrophication (i.e., TP, phytoplankton and zooplankton biomass) has decreased."

This statement does not apply for chlorophyll *a* where effects were greater in 2014 and 2016 than all other years (see Figure 5-3 and Table 5-7, pages 263 and 261, respectively).

Recommendation: Please review accuracy of results presented and modify text accordingly.

2.4.3 Spatial Extent Of Effects Discussion

Far-field areas were not sampled in 2014 or 2015, as noted in the report. However, as noted in previous review comments (NSC 2016), the lack of data for these sites in these years has limited the ability to accurately define the spatial extent of effects for TN and/or chlorophyll *a* as boundaries of the affected area(s) extended to the edge of MF sites. Without data for the FF sites in 2014 and 2015 it cannot be determined if the affected areas were in fact similar among the last three years of the program (i.e., 2014-2016) or what the actual spatial extent of effects were in those 2 years.

This limitation should be noted in the text and considered in terms of interpretations presented regarding inter-annual differences and/or trends. For example, the text in Section 5.3.1.1 (page 258) reads: "Similarly, the greatest extent of effects on chlorophyll *a* concentrations was observed in 2016 (250.4 km^2, or 43.7% of lake area), closely followed by 2014 (≥242.8 km^2, or ≥42.4% of lake area) (Figure 5-3; Table 5-7)." However, because the boundary for 2014 is actually undefinable due to the lack of data for the FF sites, the affected area may in fact have been larger in 2014 than 2016. This limitation must be clearly identified in the text.

Similarly, the statement on page 259 that reads: "The extent of effects on chlorophyll a concentrations along the NF-MF3-FFB-FFA transect did not extend beyond the MF3-7 station between 2007 and 2016…" should be modified to reflect the lack of data for the FF sites in 2014. In that year, the extent of effects extended to MF3-7 to the west but due to the lack of data for the FFA and FFB site in that year, the western boundary cannot be defined accurately (it may have extended further).

It is also suggested that all figures should be modified to clearly show that FF sites were not sampled in 2014 and 2015. Indicating the extent of effects boundaries with a dashed line to denote the boundary cannot be accurately defined would clarify this point.

Recommendation: Please include discussion of the lack of FF data for 2014 and 2015 and the implications regarding limitations on defining the spatial extent of effects in those years. Modify figures to clearly indicate sites that weren't sampled in a given year.

2.4.4 Weight-Of-Evidence (WOE)

Weight-of-evidence ratings for eutrophication indicators are not presented for 2014 and 2015 in Table 5-8 (page 267). There is no explanation provided for the omission of results for these two years.

Section 5.2.3.3 (page 255) indicates that "The indicators of eutrophication data from 2014 and 2015 were not assessed following the AEMP Study Design Version 3.5 (Golder 2014a) because

only NF and MF area data were collected in those years." However, Table 5-6 (page 255) that follows this text indicates that the effect rating for nutrients is based solely on comparison to normal ranges (and not to FF data). These results should therefore be incorporated into Table 5-8.

Recommendation: Please provide a discussion of the reason for the omission of 2014 and 2015 data in Table 5-8 and add ratings for TN and TP for 2014 and 2015.

2.4.5 Temporal Trends – Total Nitrogen

Section 5.3.4.2 (page 286) indicates: "The more recent elevated concentrations at several NF, MF and FF area stations may in part reflect the change in labs from UofA to Maxxam that occurred in 2013 (Golder 2016a)."

As this factor may have substantive implications with respect to tracking changes in nitrogenous parameters over time, there would be benefit to expanding this discussion to elaborate on potential implications of the laboratory change.

Recommendation: Please provide additional discussion of the implications of laboratory changes on nitrogen monitoring results and trend analyses.

2.5 SEDIMENT QUALITY

2.5.1 Weight-Of-Evidence Effect Ratings Methods

Table 6-3 (Section 6.2.3.2, page 338) indicates a rating of "No action" if an interim sediment quality guideline (ISQG) is not exceeded and an "early warning/low" rating in the NF is statistically higher than the FF for the WOE assessment for sediment quality.

It is unclear what occurs in the event that a statistically significant difference is observed between NF and FF results but the concentrations are below the ISQG. In addition, there are parameters without defined benchmarks. It is unclear how the ISQG comparison is applied in the framework.

Recommendation: Please clarify application of the WOE rankings.

Table 6-3 Effect Level Rations Applied for Sediment Quality the normal range

LOE Group	Measurement Endpoint Analysis	No Response 0	Early Warning/Low ↑	Moderate ↑↑	High ↑↑↑
Sediment Quality (substances of potential toxicological concern)	Comparison to FF Areas, Normal Range, and Guidelines[a]	<ISQG	Statistically significant increase, NF vs FF areas	Low + NF >(ISQG+PEL)/2 (or other appropriate guideline)[b] **AND** NF area median >normal range	MF >(ISQG+PEL)/2 (or other appropriate guideline) **AND** MF area median >normal range **OR** NF >PEL **AND** NF area median >normal range

Notes: NF = near-field; MF = mid-field; FF = far-field; LEL = lowest effect level; PEL = probable effect level, SEL = severe effect level; SOI = substance of interest; ISQG = interim sediment quality guideline; >= greater than; <= less than. Normal ranges for each LOE group and measurement endpoint are defined and provided in the *AEMP Reference Conditions Report Version 1.2* (Golder 2017b).
a) Applied separately for each variable.
b) For example, the OMOEE (1993) [LEL+SEL]/2.

2.5.2 Trend Analysis Methods

Section 6.3.3 (page 344) indicates: "Trend analyses were performed following normalization of the data by TOC [total organic carbon] or percent fines, where applicable, and transformation of data using Box- Cox transformations."

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 (i.e., standardization of data). 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. In addition, from a biological perspective, it is the absolute concentrations that are relevant.

Recommendation: Please clarify if trends were also evaluated on raw data for all of the substances of interest (SOIs). If this analysis has not been done, please provide a discussion of the rationale for excluding these analyses.

2.5.3 Trend Analysis Results - Nutrients

Section 6.3.3.2 (page 350) indicates: “Concentrations of TN were considered atypical in 2013, and inconsistent with other years’ results, most likely due to a difference in laboratory methods in 2013 relative to other years (Golder 2017c).”

We agree that the 2013 TN data for sediments is anomalous (NSC had noted this in comments provided on the Reference Condition Report Supplement v. 1.2 supplement; NSC 2017b) and may indeed be related to changes in the laboratory method. Given this anomaly, it would be more appropriate to exclude the 2013 data from the trend analysis, or at a minimum, present a trend analysis with and without the 2013 data. It was noted in the report: “These trends should be interpreted with caution, due to the uncertainty in the 2013 TN data noted above.”

Recommendation: Conduct trend analysis excluding 2013 TN data.

2.5.4 Trend Analysis Results – Data Presentation

Section 6.5 (Page 371) indicates: "Concentrations of certain metals, such as arsenic and cadmium, in sediments throughout Lac de Gras were above SQGs [sediment quality guidelines]. These variables generally reflected patterns in TOC content of bottom sediments or background variation in sediment quality, and had no clear spatial trends related to the Mine."

Since report figures presenting sediment quality results do not include SQGs, it is difficult to evaluate the occurrence and magnitude of exceedances of SQGs over time. For example, information as presented is inadequate to determine in what years, by what magnitude, and at which sites that cadmium and arsenic exceed SQGs. This visualization is important for critically reviewing the information and examining trends and identifying potential emerging trends.

Recommendation: Add benchmarks (i.e., SQGs) to sediment quality figures.

2.6 PHYTOPLANKTON

2.6.1 Phytoplankton Normal Range Evaluation

The evaluation of the phytoplankton normal range presented in the report concluded (Section 7.3.2.1.3, page 408): "Overall, based on the clear differences in the data sets produced by the two different taxonomists, the “adjusted” 2013 normal range (referred to going forward as the “2013 normal range”) is recommended for comparisons from 2013 onwards."

It would appear based on the information presented in this section, that comparisons to the 2007 to 2010 normal ranges, which were based on data from a different taxonomist, moving forward would be inappropriate (i.e., there is evidence of a laboratory difference). However, as also noted in the report, the use of a single year of data to derive a normal range (2013) is also associated with issues (i.e., it does not incorporate inter-annual variability). Use of more than one year of data to derive normal ranges would be more scientifically appropriate.

Recommendation: Please comment on the appropriateness of deriving updated normal ranges using one year of data and if the normal ranges will be recalculated in the future with additional data to account for inter-annual variability.

2.7 FISH HEALTH

2.7.1 Comparisons To Critical Effect Sizes

Section 9.2.1.3.7 (page 509) states: "As per the MMER TGD (Environment Canada 2012), a Critical Effect Size (CES) is defined as “a threshold above which an effect may be indicative of a higher risk to the environment” (Environment Canada 2012). CES are defined for fish weight, relative liver size and relative gonad size as 25% of the reference area mean, and for condition as 10% of the reference area mean (Environment Canada 2012). The variables that triggered Action Level exceedances in 2016 were compared to the CES."

It would seem appropriate to also compare Action Level exceedances from other years to the CES. In addition, there is no indication of what was defined as the "reference area mean" for making comparisons in the CES evaluation.

Recommendation: Include comparisons to CES for all years in which an Action Level exceedances occurred. Add description of how "reference area mean" was defined.

2.7.2 Magnitude Of Effect - CES Comparisons

With respect to fish health analyses, according to Table 9-12 (page 535), CES values could not be calculated for LSI because of significant interaction (“Area-specific interpretation not possible due to significant interaction”). However, the report indicates there was a minimum of one significant interaction for the ANCOVAs for condition, liver somatic index (LSI) and gonadosomatic index (GSI; page 519). It is unclear why CESs were derived for condition and GSI but not for LSI.

Furthermore, it is unclear what the approach is, and will be in the future, in the event that CESs cannot be calculated for metrics with “significant interactions”. If CESs cannot be assessed for this or other reasons, a metric can never trigger Action Level 3 or beyond since they cannot meet a requirement of Action Levels 2 or 3 according to Table 14-2 (page 6-17),which requires that "an effect size equal to or above the critical effect size defined by the EEM [environmental effects monitoring]".

Recommendation: Please provide a discussion of how action level comparisons will be made in the event of "significant interaction" issues with data analysis.

2.7.3 Weight-Of-Evidence Ratings

Section 9.3.2.4 indicates that the 2010 results were included in the WOE ratings. However, Section 9.2.1.1 (pages 501-502) indicates that 2010 was excluded from the analysis for most variables due to seasonal effects associated with the change in sampling time (i.e., spring versus fall). The report states (page 502) that growth and organ weight were expected to be different due to seasonal effects. Therefore, it is unclear why 2010 has been included in the WOE analysis. It is

more likely the change in endpoints listed in Table 9-11 (growth, condition, and LSI) were related to seasonal effects rather than enrichment.

Recommendation: Update the WOE analysis to exclude 2010 due to methodological differences or provide an explanation for inclusion on 2010 data in this analysis.

2.7.4 Exceedance Of Action Levels And Assessment Of Response Framework

With respect to fish health analyses, according to Table 9-12 (page 535), CES values could not be calculated for LSI because of significant interaction ("*Area-specific interpretation not possible due to significant interaction")*. However, page 519 indicates there was a minimum of one significant interaction for the ANCOVAs for condition, LSI and GSI (page 519). It is unclear why CESs were derived for condition and GSI but not for LSI.

Furthermore, it is unclear what the approach is and will be in the future in the event that CESs cannot be calculated for metrics with "significant interactions". If CESs cannot be assessed for this or other reasons, a metric can never trigger action level 3 or beyond since they cannot meet a requirement of action levels 2 or 3 according to Table 14-2 (page 617),which requires that "an effect size equal to or above the critical effect size defined by the EEM".

Recommendation: Please provide a discussion of how action level comparisons will be made in the event of "significant interaction" issues encountered in data analysis.

Revisit CES calculation for variables analyzed with ANCOVA with significant interaction.

2.8 FISH TISSUES

2.8.1 Methods – Lake Trout

Section 9.3.1.1.2 (page 538) of the report identifies various sources of Lake Trout mercury data included in the report and analyses: "Tissue mercury samples in 2005 and 2008 were analyzed by ALS with a DL of 0.01 µg/g wwt [wet weight]. The 2008 mercury samples were also analyzed by Flett (Flett Research Ltd.), Winnipeg, Manitoba, with a DL 0.0004 µg/g wwt. The 2011 and 2014 mercury samples were analyzed by Flett. The palatability study samples (i.e., 2002, 2003, 2004, 2012 and 2015) were analysed by ALS with a DL of 0.01 µg/g wwt."

However, it is difficult for the reader to ascertain what data were included, what methods were employed, and what analytical laboratory and detection limits are associated with the data presented in the report. For example, page 538 indicates that samples were analysed at both ALS Laboratories and Flett Research in 2008 but the report does not indicate which of the two datasets were incorporated into analyses and the results presented in the report.

The lack of clarity regarding these methods and metadata render it difficult for the reader to critically evaluate the approach taken and subsequent conclusions borne from the analyses

presented in the report. For example, changes in analytical laboratories may affect conclusions and/or interpretation of data, including trend analyses.

Recommendation: Please add a summary table identifying, by year, analytical laboratories used and explicit identification of data incorporated in the analyses.

2.8.2 Lake Trout Mercury Benchmark

The report applies a potential effects benchmark/tissue residue guideline for mercury of 1.0 µg/g wet weight from Jarvinen and Ankley (1998) for evaluating effects on fish (i.e., Lake Trout) health (Section 9.3.1.3.3, page 546). The report states: "This is likely a very conservative benchmark; Environment and Climate Change Canada [ECCC] recently conducted a review of mercury in the Canadian environment and noted that the lowest adverse effect concentrations would be 0.5 to 1 mg/g wet weight in fish species such as Northern Pike and Walleye (ECCC 2016), many times higher than using the generic benchmark."

The report incorrectly states the benchmark - or Lowest Observed Adverse Effect Level (LOAEL) – presented in the ECCC review; ECCC (2016) identifies an LOAEL of 0.5-1.0 µg/g. Section 9.3.1.3.3 indicates an incorrect unit of mg/g (a thousand fold difference).

The conclusion presented in Section 9.3.2.3 (page 570) that "Lake Trout health is unlikely to be affected" and that "on the basis of the most recent mercury concentrations in Lake Trout from each lake (2014), no concerns to .....fish health are expected" is based on a misinterpreted benchmark. Mercury concentrations presented in Figure 9-34 (page 567) and Table 9-25 (page 572) indicate that mercury concentrations in individual Lake Trout from both lakes have frequently been in the range of 0.5-1.0 µg/g between 2005 and 2015.

Recommendation: Reassess conclusions on potential effects of muscle mercury concentrations on fish health based on appropriate guidelines.

2.8.3 Slimy Sculpin Mercury Comparison To Normal Ranges

Section 9.3.2.1, Figure 9-22 (page 551) indicates that mercury concentrations in Slimy Sculpin in the NF in 2007 were almost an order of magnitude higher than in 2013 and 2016 and concentrations in two samples were approaching the Canadian Food Inspection Agency (CFIA) and Health Canada guideline of 0.5 µg/g wet weight for human health consumption (CFIA 2015) applied in the report. Concentrations in sculpin from the far field in 2007 were also substantially higher than the results for 2013 and 2016.

Section 9.3.2.2 (page 556) indicates that: "Many of the variables that had either a significant interaction or a significant year effect decreased over time and are, therefore, not considered further. These variables include arsenic, barium, magnesium, mercury, selenium, sodium, titanium, vanadium, and zinc (Table 9-19)."

The notably high mercury concentrations reported for 2007 should be discussed and potential reasons for these differences should be identified. For example, it is noted in Section 9.3.1.1.1 (page 536) that although all samples for 2007, 2013, and 2016 were analysed at ALS Laboratories, the 2007 samples were analysed at the Edmonton, AB laboratory while samples from the latter two years were analysed at their Burnaby, BC laboratory. Has the change in laboratory been evaluated as a potential cause for the differences or are there environmental factors that may have caused or contributed to the high concentrations in 2007? The high concentrations observed in 2007 also result in a decreasing temporal trend; should there be issues with this dataset, these should be identified in order to avoid biasing trend analyses here and into the future.

Recommendation: Include a discussion of the high mercury concentrations in Slimy Sculpin in 2007 and explore potential explanations for the relatively high concentrations observed in that year, notably for the near field area. If data are deemed to be suspect, trend analysis should be revisited. This is particularly critical given that the results of the trend analysis are the foundation for determining if a Lake Trout mercury survey is to be conducted.

2.8.4 Lake Trout Mercury Temporal Trends

Section 9.3.2.2 (page 566) indicates: "In 2014, mercury was detected at near or below baseline concentrations in both Lac de Gras and Lac du Sauvage."

There is no previous description of what constitutes "baseline" for mercury concentrations in Lake Trout.

Recommendation: Please include a description of what baseline mercury concentrations in Lake Trout are and how they were derived.

2.9 PROPOSED UPDATES TO AEMP DESIGN PLAN

2.9.1 Non-Lethal Fish Survey

It is unclear how the addition of a non-lethal sculpin survey, as described in Section 14.2.2.1 (page 607) will be incorporated into the assessment of effects. There will be no ability to compare the results of the first year of sampling to any previous data as the data collected and sampling strategy are different. Therefore, the first comparison could only be done after 6 years, since the sampling is recommended to occur every three years (Section 14.2.2.2). Furthermore, this dataset will lack baseline or early post-project data with which to compare. If normal ranges are utilized as per the lethal assessment, then the first two sampling years at a minimum will be needed to construct these ranges. If this is the case, then it would not be possible for these data to trigger an Action Level 3 for the first two sampling periods as, according to Table 9-4 (page 509), this requires data to be outside of the normal range.

Recommendation: Provide explanation of how this sampling program will be used within the existing effects assessment structure.

2.9.2 Weight-Of-Evidence

Section 14.2.8 (page 611) 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."

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.

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

2.10 QUALITY ASSURANCE/QUALITY CONTROL MEMORANDUM:

2.10.1 Slimy Sculpin Liver Correction Factors

The Review of the 2016 AEMP report identified the exclusion of sculpin livers from tissue chemistry analysis in 2016 as an issue (NSC 2017a). The methods described in the report and QA/QC memorandum to prevent future sampling errors are acceptable. However, the method to account for the omission of livers in tissue analyses in 2016 is imprecise.

The concentration of elements in the livers of Slimy Sculpin has been estimated through extrapolation from two extremely dissimilar species (Lake Trout and Round Whitefish). It is assumed data for these species were used due to lack of similar data for sculpin. However, it is well established that the accumulation of elements in fish tissue is species-specific (e.g., Djikanovic et al. 2016; Farkas et al. 2000; Jordaan et al. 2016).

There is a precedent in the report regarding treatment of data with similar issues. Section 9.3.1.1.1 (pages 535-536) indicates that the 2004 samples were not included in the analysis as a result of the exclusion of livers (as well as most of the head and gas bladders) from the samples.

Recommendation: Unless it can be reasonably demonstrated that Lake Trout and Round Whitefish are a good model for Slimy Sculpin, it is recommended that the 2016 data be treated in the same manner as the 2004 samples, which also excluded liver tissue (i.e., omit them from future analyses).

2.11 SPECIFIC AEMP COMPONENT REVIEWS

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 AERR.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, General Comment	There are a number of instances where figures cited in the text are not presented (e.g. , Fig 2-1 to 2-5 on p. 13), figures are presented with no reference in the text (e.g., Figures 9-11 to 9-18, Figures 9-27 to 9-32), and tables and figures (e.g., Table 9-11 on p. 570 should be 9-24) or sections (e.g., Section 9.3.2.1 on p. 583) are incorrectly cited in the text .	Complete a careful review of table, figure, and section referencing throughout the document.
MAIN DOCUMENT, General Comment on Temporal Trends (various sections)	The report does not include a discussion of what significant year - area interactions mean for the Fixed Effect Model.	Provide an explanation of the results of statistical analyses in a more lay manner so readers can better understand the results.
MAIN DOCUMENT, Various Sections	There are several instances throughout the document where the construction of the A21 dike is discussed as having had a potential effect on water quality and other components within the MF area. A map showing the location of the dike and other mine related infrastructure in relation to the sampling locations should be presented to assist in explaining why these effects would be seen within the MF areas and not elsewhere.	A map showing the location of the A21 dike in relation to the sampling sites should be added.
MAIN DOCUMENT, AEMP Design Summary and Re-evaluation Methods, Section 2.2.2 Sampling Areas and Stations, page 13	The text references Figures 2-1 to 2-5 but figures are not included.	Add figures to the report.
MAIN DOCUMENT, Dust Deposition, Section 3.2, Methods, page 25	The report states: "Analysis was undertaken to evaluate temporal or spatial trends in dust deposition rates, deposition of dustborne nutrients (i.e., total phosphorus [TP], orthophosphate [OP], nitrate plus nitrite [N+N], and ammonia), and deposition of two dust-borne metals indicative of metal deposition in general (i.e., aluminum and lead)." It is not clear why the evaluation only included two metals (aluminum and lead).	Please provide a detailed rationale for focus on only two metals (aluminum and lead).

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Dust Deposition, Section 3.2.2, Data Handling, page 27	The report states: "Snow water concentrations of some nutrients and metals were below the analytical DL. These data were included in the analysis by substituting values of half of the detection limit (DL) during the re-evaluation. However, in the snow chemistry data, there were different DLs from different testing laboratories and for different years. For example, three DLs were reported for the TP data (0.001 mg/L, 0.005 mg/L and 0.002 mg/L). Data with variable DLs were excluded from the analysis as per Table 3-2. The percentage of below DL data ranged from 1.6% for aluminum to 27.0% for OP." However, the remainder of the section seems to imply that values below the DL were removed (e.g., last line page 28 states "Following the removal of data below DLs and outliers, duplicates were averaged to obtain a representative value"). It is unclear what specific data points were omitted from the analysis.	Text should be reviewed and adjusted as needed to clarify what data were removed and what were retained. Censored values should be retained when possible and not removed unless absolutely necessary.
MAIN DOCUMENT, Dust Deposition, Section 3.2.2, Data Handling, page 27	It is indicated that outliers were identified as data points with Z-scores that were greater than 3. This differs from the Z-score value of 3.5 that was given in Section 2.4.2.3 (page 19) of the AEMP methods for identification of outliers. It is not clear why a different standard was applied to the dust data.	Please verify the Z-score applied and provide an explanation if a different standard was applied for outlier identification.
MAIN DOCUMENT, Dust Deposition, Section 3.2.2, Data Handling, page 29, Table 3-4	The second last column in the Table 3-4 (lead, deposition, mg/m2/yr) requires correction of some values (some values reported as "0.00").	Review and correct results presented in Table 3-4.
MAIN DOCUMENT, Dust Deposition, Section 3.2.2, Methods, Data Handling, page 29, Table 3-4	The sample duplicate results are presented in Table 3-4 (page 29) for only a subset of parameters. The document should review all parameters to provide for an evaluation of QA/QC for the program as a whole. While annual reports discuss details for all parameters, the re-evaluation report is the location where data for numerous years are considered collectively. Issues with and/or patterns in data may not be readily apparent until data are reviewed for all years together.	Include duplicate sample results and discussion of these data for all parameters. A table presenting a summary of the analysis of the duplicate results (e.g., relative percent mean differences) could be provided in an appendix. This would also facilitate a thorough review of the QA/QC program as per the directive from the WLWB and assist with determining if any changes to the program are warranted.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Dust Deposition, Section 3.2.3.1, Methods, Data Analysis, Temporal Grouping, page 30	The report states: "Dust deposition data and snow chemistry data were grouped into time periods to reflect changes in mining activities over time at the Mine. The time period groups were as follows: - 2002 to 2005: open pit mine construction and open pit mining - 2006 to 2009: underground mine construction and open pit mining - 2010 to 2013: open pit transition to underground mining - 2014 to 2016: underground mining with re-mining of the Waste Rock Storage Area – North Country Rock Pile" While the principle of grouping according to major activities is a logical approach, grouping of years may mask short-term effects. Results for other components of the AEMP are presented by year in the report.	Please provide a discussion of whether more short-term effects have been observed for dust deposition, as it may pertain to pooling of multiple years of data. If short-term recent trends have been observed, these should be presented in the report.
MAIN DOCUMENT, Dust deposition, Section 3.2.3.3, Methods, Data Analysis, Normal versus Log-Normally Distributed Data, page 31	The last line states "In these instances, geometric means and SDs are more appropriate for computing statistics and comparing results (e.g., using Student's t-tests)." This thought is incomplete; geometric means and SDs are more appropriate than what?	Please clarify.
MAIN DOCUMENT, Dust Deposition, Section 3.2.3.4, Methods, Data Analysis, Background Deposition Rates, page 31	For dust deposition "background" was defined as rates that were "not significantly different from rates observed at the control stations." This assumes that the control sites were not affected by the mine. This assumption if incorrect could result in an underestimate of the impact of mine dust on Lac du Gras.	Please add a discussion of the validity of this assumption to the report.
MAIN DOCUMENT, Dust Deposition, Section 3.3.1.1, Results, Dustfall, pages 34-35	Dust deposition results for sites not significantly different from control sites were "pooled to form a composite estimate of background dust deposition" (page 34). While this approach may be reasonable for some of the sites, at least one site (SS5-4) has a notably high mean rate for the 2014-2016 pooled time period (i.e., more than four times the control sites). The lack of a statistically significant difference between this site and the formal “control sites” may reflect high variability in the data set and identifying this site as "background" does not seem to be appropriate based on the information presented. Inclusion of error bars on the figure (and other similar figures) would assist with review of these data. In addition, deposition rates for site SS5-4 reported in the 2014, 2015, and 2016 annual AEMP reports (Golder 2016a,b, and 2017) were 47, 43, and 38 mg/dm2/yr, respectively. The mean reported in Figure 3-4 and Table 3-5 (279 mg/dm2/yr) contradicts these values.	Include error bars on figures and provide clarification on the appropriateness of the approach for designating sites as "background". Please verify that the mean deposition rates presented for site SS5-4 are correct. If correct, suggest reconsidering designation of this site as "background".

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Dust Deposition, Section 3.3.1.1, Results, Dustfall, page 35, Figure 3-4 and Table 3-5	Figure 3-4 and Table 3-5 present the mean dustfall deposition rates for control stations and stations where rates were not significantly different from the control sites. Both would benefit from inclusion of a measure of variability to assist the reviewer with understanding the variability of the pooled data sets. This is particularly important given that several years of data were pooled and that variability of the data sets would affect the statistical analyses and ultimately the treatment of data as "background". Table 3-5 has a footnote that does not seem to apply to the table. "N/D = no data; mean = temporal arithmetic mean; geomean = spatial geometric mean". Both the table and figure should indicate what the values presented represent (e.g., arithmetic mean).	Please include bars/values to illustrate variability with the data (confidence intervals or standard error depending on what the data are that are presented) on Figure 3-4 and Table 3-5 and subsequent similar tables and figures. Add additional explanatory information regarding the values presented.
MAIN DOCUMENT, Dust Deposition, Section 3.3.2, Results, Annual and Seasonal Trends, page 41, Figure 3-8	Figure 3-8 presents seasonal plots of dust deposition and includes point measurements and trend lines. Section 3.2.3.5 (page 31) indicates that the medians for each season are plotted for the trend analysis; trends were then visually assessed. Other figures and tables appear to present data as means rather than medians. There does not appear to be a discussion of why medians were used for the trend analysis and it is unclear if this is the most appropriate metric for this assessment. In addition, figures lack sufficient information to determine what is presented (e.g., means or medians) in this section.	Provide a discussion or rationale for the use of medians for trend analysis and add sufficient details to figures and tables to allow the reader to readily identify what is presented.
MAIN DOCUMENT, Dust Deposition, Section 3.3.4, Results, Spatial Distribution of Environmental Loadings, pages 53 to 56	It is indicated that background deposition rates of phosphorus and metals increased from 2010-2013 to 2014-2016 but no explanation is given as to why rates increased. This may be indicative of a mine-related influence in the latter period.	Include a discussion of possible explanations for the increase in background deposition rates.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Effluent and Water Quality, Section 4.2.4.2.2, Methods, Temporal Trends, page 84 and Section 4.3.2.1.1, Results, Temporal Trends, pages 130-133, Figures 4-35 to 4-38	The report states: "Data are provided for DO, temperature, specific conductivity, and pH from 1996 to 2016, when available, at the following locations: NF; MF1-3; FF2-2; MF3-4; FF1; FFB; and FFA; these are the long-term monitoring stations that were selected for the detailed trend analysis." There is no discussion provided as to the rationale for why these sites were selected for trend analysis and it is not clear what individual sites are plotted in Figures 4-35 to 4-38 (pages 130-133). For example, Figure 4-35 (page 130) shows "NF" results but it is not clear what NF site is plotted. This also applies for the FFA, FFB, and FF1 "sites" referred to above.	Please clarify what data were presented and a rationale for selecting a sub-set of sites for analysis.
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3.1.3, Results, Effluent and Mixing Zone, Effluent Toxicity, page 125	Section 4.3.1.3 indicates six effluent samples showed sub-lethal toxicity; however Table 4-10 indicates only five samples showed sub-lethal toxicity, excluding the sample from June 2009 for which a re-test revealed the sample was non-toxic. The text further identifies five dates, including June 2009, for which sub-lethal effects occurred. There are inconsistencies between the text and table that should be corrected.	The text and table should be reviewed and updated as appropriate to clarify the findings.
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3.2.1.1, Results, Water Quality, Temporal Trends, Depth Profiles, page 129	Paragraph 2 identifies "...DO concentrations during ice-cover that were at or below the Effects Benchmark of 6.5 mg/L for the protection of aquatic life (PAL) for "other" life stages (i.e., non-early life stages)." During the ice-cover season the CCME 9.5 mg/L benchmark for early life stages would be more appropriate for fall spawning species such as Lake Trout. In addition, there is no discussion of whether DO concentrations were above or below benchmarks for the open-water season.	The DO data should be compared to the appropriate benchmarks and the findings reported. Include a discussion comparing DO results for the open-water season to PAL guidelines.
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3.2.1.1, Results, Water Quality, Temporal Trends, Depth Profiles, page 129	Paragraph 3 discusses *in situ* pH data and the last line indicates that "…pH values below 5.0 or greater than 8.0 are anomalous." This is likely a valid statement as *in situ* pH data are prone to error due to equipment problems or poor calibrations; however it would be useful to include comparison to or discuss laboratory measured pH values if they are available to justify exclusion of these data as "anomalous".	If laboratory pH data are available, include a comparison to in situ data to justify exclusion of data as "anomalous".

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3.2.1.1, Results, Water Quality, Depth Profiles, page 130-133	It is difficult to discern individual years in the depth profile figures presented on pages 130-133 (Figures 4-35 to 4-38). In particular, the figures do not clearly show results for pre-Project data making it difficult to assess whether any changes appear to have occurred post-Project. This confounds evaluation of the results that are presented. For example, it is noted that pH values frequently fell outside of the CCME PAL guideline range (6.5-9). To interpret the implications of this occurrence, it is important to consider baseline conditions in the lake; as the figures are presented, baseline results are not easily visualized in the figures.	Modifications to the figures would be beneficial to assist the reviewer with discriminating annual results and, in particular, distinguishing baseline from post-Project results. Suggest re-formatting figures to render them clearer. It would also be beneficial to include a brief discussion, where applicable, noting changes between the pre- and post-Project time periods. This would be notably useful for pH and DO results, where monitoring has shown exceedances of benchmarks. Consider examination of DO results as percent saturation values to evaluate trends over time.
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3.2.1.1, Results, Water Quality, Depth Profiles, page 130-131	While it is understood that water quality sites were relocated or replaced over time as part of the AEMP, several sites, as noted in Figures 4-35 and 4-36, were at deeper locations prior to 2007. For some of these sites, depth profile data indicate DO concentrations were relatively low near the bottom of the water column (at depths greater than those sampled after 2007). It is difficult to discern years in Figure 4-35, and therefore identify pre- vs. post-Project results. However, given that DO has been observed to drop to low levels at depth in previous years it would be relevant to monitor DO and temperature at deeper locations in the lake to monitor for changes over time. This is notably relevant given that nutrient enrichment, and increases in primary productivity (i.e., phytoplankton) have been observed post-Project; nutrient enrichment can lead to depletion of DO in aquatic ecosystems in winter due to accumulation and decay of organic materials.	While it is understood that modifications to the program design are outside of the scope of this document, it is noted here that the results presented in the Re-evaluation Report indicate a potential need to expand the DO monitoring in Lac de Gras. It is recommended that this modification be considered moving forward and at a minimum, that an analysis of pre- vs. post-Project DO data be reviewed, focusing on deeper sites within the lake.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3, Results, Water Quality, General	Trend analysis in the main report is based on data collected at mid-depth in the water column. While it is understood this approach renders it more feasible to compare across sites (as sites are not sampled in the same manner), this focus precludes consideration of effects on water quality near the bottom of the water column at the NF sites. Water quality is affected differently at depth at the NF sites due to the influence of the effluent discharge. For example, conductivity is notably elevated in the lower portion of the water column at these sites (see Figure 4-38, page 133 for example). A similar comment was made on the 2016 AEMP Report: "Medians of water quality parameters in the NF area were calculated from data pooled across all sample depths, dates and stations (n = 15 samples; Appendix II, Section 3.4.1, page 64, Table 3-5). When water quality is relatively consistent across depth this approach is reasonable and appropriate. However, in instances where conditions vary across the water column such as in winter when the effluent plume is more evident near the bottom of the water column, it may be more conservative to examine data for each sampling depth separately. If effects are greatest near the bottom of the water column, potential effects on benthos would be better represented by the bottom water quality samples. " (NSC 2017a).	Consider a more in-depth assessment for bottom samples, in particular for the NF sites.
MAIN DOCUMENT, Effluent and Water Quality, Section 4.3.2.1.2, Results, Water Quality, Discrete Samples, page 133	The report states: "Time series plots showing mid-depth concentrations of SOIs at AEMP stations in Lac de Gras and Lac du Sauvage, near the outlet to Lac de Gras, are presented in Figures 4-39 to 4-93. Mid-depth concentrations are presented herein, because that is the depth where the effluent plume is most likely to be present in a typical year considering the full period of record (see Section 4.3.2.1.1, Figure 4-38; Appendix 4C)." It is acknowledged this is accurate for many years and that focus on the mid-depth data are the most appropriate given the information available. However, based on the conductivity depth profile results presented in Figure 4-38, this does not hold under all years. Caution should be taken when interpreting trends for the NF as the depth at which maximum effects on water quality appear (using conductivity depth profiles as a proxy for effluent influence) varies between years.	Consider evaluating a sub-set of parameters in the NF using data collected in bottom samples.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.2.1.4, Methods, Data Sources, page 248	The report states: "Differences in the net dimensions were noted in 2017 among sampling years, which required adjustment of the data for some years. Re-measurement of the net diameter in 2016 determined that the zooplankton net used in 2014, 2015 and 2016 had a mouth diameter of 30.0 cm; therefore, recalculation of the zooplankton community biomass data was necessary for 2015 and 2016. The re-calculation increased the overall zooplankton biomass in 2015 and 2016 by 12.9% and 6.6%, respectively, as the volume of water actually sampled was smaller than that used in the 32 cm and 31.0 cm net diameter calculation (Table 5-3). These adjustments do not affect the conclusions reported in the respective annual reports. Additional discussion and results should be provided to back up the statement that conclusions were not affected.	Provide additional discussion to support the conclusion noted.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.2.3.1, Methods, Data Analysis, page 249	The report states: "The WLWB requested that as part of the 2014 to 2016 Aquatic Effects Re-evaluation Report, an assessment of the reference conditions for the phytoplankton variables be examined (Table 1-1, Section 7). The assessment includes a comparison of the AEMP results to reference conditions as defined using the currently approved 2007 to 2010 reference area data (Golder 2017b), and the 2013 reference area data. Both normal ranges are presented herein." There is no description provided for the "2013 reference area data."	Provide a brief description of why normal ranges were derived using 2013 data and add a reference to the section of the report where this analysis is presented.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.2.3.4, Methods, Data Analysis, page 251	"The extent of eutrophication effects on phytoplankton biomass was not previously calculated or presented in the annual reports before 2016. As directed by the WLWB as part of the Board Directive and Reasons for Decisions re. W2015L2-001 Schedule 8 Update, and as part of EMAB commitment #5 from the Design Plan Version 4.0, and commitment #49 from the 2016 AEMP Annual Report (Table 1-1), the extent of effects on phytoplankton community biomass was estimated and presented to visually evaluate spatial trends for all years from 2007 to 2016." Addition of this analysis is a great improvement and addresses previous comments.	No action required.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.2.3.2, Methods, Data Analysis, page 254	"To assess potential effects from dust emissions, phosphorus concentrations at stations within the estimated zone of influence from dust deposition were evaluated graphically and compared to results at other nearby stations and to reference conditions for Lac de Gras (as defined in the AEMP Reference Conditions Report Version 1.2 [Golder 2017b])." An assessment for TN would also be beneficial. Also note that section heading numbering is repeated (two sets of headings beginning with 5.2.3)	Add discussion of potential effects on TN.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Summary of Effects, Extent of Effects, page 258	Paragraph 2, states that in years other than 2008, 2013 and 2009, "the extent of effects on TP… has extended northeast towards the Lac du Sauvage inflow and northwest along the NF-MF1-FF1 transect". However, based on the figure presented (Figure 5-1) the TP affected area extended southeast of the mine in 2016.	The text and figure should be reviewed and updated as appropriate.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Summary of Effects, Extent of Effects, page 262, Figure 5-1	Figure 5-1 which presents the spatial extent of effects for TP is missing results for 2015. It is understood that the spatial extent of effects in that year was small (<0.6 km2) which may preclude presentation in a map format. However, either a map should be added or at a minimum, an explanatory note/footnote should be included.	Please add an explanatory note for the omission of 2015 data from Figure 5-1.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Summary of Effects, Extent of Effects, pages 258, 261. and 263, Figure 5-2	Section 5.3.1.1 (Results, Summary of Effects, Extent of Effects, page 258) indicates: "The boundary of effects on concentrations of TN generally extends to the northwest (to the end of the NF-MF1-FF1 transect) and to the northeast (towards the Lac du Sauvage inlet), with an exception in 2014 when the extent of effects appeared to be localized around the NF area." This statement appears to be based on incorrect results presented in Figure 5-2 (page 263) and is in disagreement with results presented in Table 5-7 (page 261) and those presented in the 2014 AEMP Annual Report (Golder 2016a). Table 5-7 indicates the affected area was equal to or greater than 40.1% of the lake area.	Please correct figure for the 2014 data and verify that data for other years are correctly presented. Modify text and data interpretation and conclusions accordingly.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Summary of Effects, Extent of Effects, pages 262-266, Figures 5-1 to 5-5 and text pages 258-260	Far-field areas were not sampled in 2014 or 2015, as noted in the report. However, as noted in previous review comments (NSC 2016), the lack of data for these sites in these years has limited the ability to accurately define the spatial extent of effects for TN and/or chlorophyll a as boundaries of the affected area(s) extended to the edge of MF sites. Without data for the FF sites in 2014 and 2015 it cannot be determined if the affected areas were in fact similar among the last three years of the program (i.e., 2014-2016) or what the actual spatial extent of effects were in those 2 years. This limitation should be noted in the text and considered in terms of interpretations presented regarding inter-annual differences and/or trends. For example, the text in Section 5.3.1.1 (page 258) reads: "Similarly, the greatest extent of effects on chlorophyll a concentrations was observed in 2016 (250.4 km2, or 43.7% of lake area), closely followed by 2014 (≥242.8 km2, or ≥42.4% of lake area) (Figure 5-3; Table 5-7)." However, because the boundary for 2014 is actually undefinable due to the lack of data for the FF sites, the affected area may in fact have been larger in 2014 than 2016. This limitation must be clearly identified in the text. It is also suggested that all figures should be modified to clearly show that FF sites were not sampled in 2014 and 2015. Indicating the extent of effects boundaries with a dashed line to denote the boundary cannot be accurately defined would clarify this point.	Please include discussion of the lack of FF data for 2014 and 2015 and the implications regarding limitations on defining the spatial extent of effects in those years. Modify figures to clearly indicate sites that weren't sampled in a given year.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Extent of Effects, page 259	Similar to the previous comment, the statement on page 259 that reads: "The extent of effects on chlorophyll a concentrations along the NF-MF3-FFB-FFA transect did not extend beyond the MF3-7 station between 2007 and 2016…" should be modified to reflect the lack of data for the FF sites in 2014. In that year, the extent of effects extended to MF3-7 to the west but due to the lack of data for the FFA and FFB site in that year, the western boundary cannot be defined accurately (it may have extended further).	Please modify the text to incorporate the limitations of the 2014 data with respect to defining the spatial extent of effects on chlorophyll a.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Extent of Effects, pages 263, Figure 5-2 and text page 258	In a review of the 2016 AEMP Annual Report, NSC (2017a) had commented on the exclusion of data for TN at site LDG-48 in the spatial extent analysis. This comment indicated: "Comment 1: Section 2.1.2 of Appendix XIII (page 5) indicates that no sample was collected from LDG-48 (the outlet of the lake) in the open-water season. As a result the spatial extent of effects on total nitrogen and cumulative effects were not assessed for the northwest area of the lake beyond sites FFA-4 and FFA-5..." While it is understood that sampling methods employed in the water quality monitoring program are not consistent with those for the eutrophication monitoring program, the TN concentration measured at LDG-48 in August, 2016 (174 µg/L) under the water quality program was above the normal range (122-153 µg/L) for the open-water season. Based on this measurement, the spatial extent of effects extended through the northwest portion of the lake (i.e., effectively 100% of the lake area). It was recommended to incorporate data collected at site LDG-48 during the water quality monitoring program into the eutrophication analyses and reporting (i.e., spatial extent analysis) and update maps and spatial extent of effects estimates. This comment is re-iterated for consideration with respect to the current report.	Add discussion in the report to note that the spatial extent of effects in 2016 could have extended through the entire lake. Include caveats respecting differences in sampling methods if appropriate.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Extent of Effects, page 258	The report indicates: "Overall, the greatest extent of effects was observed on TN in 2016 (484.9 km2, or 84.7% of lake area) (Figure 5-2; Table 5-7). The extent of effects on TN increased between 2007 and 2016, and has consistently shown an affected area >20% since 2008, while the spatial extent of effects on other indicators of eutrophication (i.e., TP, phytoplankton and zooplankton biomass) has decreased. The lack of a relationship between areas where TN is greater and areas where biological effects were observed (chlorophyll a, phytoplankton and zooplankton biomass) is consistent with N not being the limiting nutrient in Lac de Gras." However, as noted above, this statement is based on erroneous TN information presented for 2014. With this correction made, spatial patterns for chlorophyll a and TN appear to be relatively similar in most years - notably in 2014.	Please review accuracy of results presented and modify text accordingly.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Extent of Effects, pages 258 , 261, and 263	The report indicates: "The extent of effects on TN increased between 2007 and 2016, and has consistently shown an affected area >20% since 2008, while the spatial extent of effects on other indicators of eutrophication (i.e., TP, phytoplankton and zooplankton biomass) has decreased." This statement does not apply for chlorophyll a where effects were greater in 2014 and 2016 than all other years (see Figure 5-3 and Table 5-7, pages 263 and 261, respectively).	Please review accuracy of results presented and modify text accordingly.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.1, Results, Extent of Effects, page 259	The statement that reads: "The area affected for phytoplankton biomass was greater from 2008 to 2011 compared to more recent years (i.e., 2014 to 2016; Figure 5-4; Table 5-7)" should be modified to reflect the lack of data for 2014 and 2015.	Please modify the text to reflect the lack of data for 2014 and 2015.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.2, Results, Weight of Evidence Effect Ratings, page 267	The document indicates: "The effects ratings for chlorophyll a fluctuated between moderate and high from 2007 to 2016 (Table 5-8). Chlorophyll a concentrations in the NF area were above the upper bound of the normal range from 2007 to 2016, but the affected area only exceeded 20% of the lake in 2009, 2013, and 2016." Table 5-7 (page 261) indicates that the affected area in 2014 was greater than or equal to 42.4%.	Please revise the statement (and other similar statements) to reflect the correct spatial extent of effects on chlorophyll a in 2014.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.2, Results, Weight of Evidence Effect Ratings, page 267, Table 5-8	Weight-of-evidence ratings are not presented for 2014 and 2015 in Table 5-8 (page 267). There is no explanation provided for the omission of results for these two years. Section 5.2.3.3 (page 255) indicates that "The indicators of eutrophication data from 2014 and 2015 were not assessed following the AEMP Study Design Version 3.5 (Golder 2014a) because only NF and MF area data were collected in those years." However, Table 5-6 (page 255) that follows this text indicates that the effect rating for nutrients is based solely on comparison to normal ranges (and not to FF data). These results should therefore be incorporated into Table 5-8.	Please provide a discussion of the reason for the omission of 2014 and 2015 data in Table 5-8 and add ratings for TN and TP for 2014 and 2015.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.1.3, Results, Action Levels, page 267	The report states: "The percentage of the lake with concentrations greater than the normal range plus 25% of the Effects Benchmark (i.e., 1.74 µg/L) was also calculated for each year to determine if Action Level 3 was triggered. Results revealed that <20% of Lac de Gras had concentrations greater than the normal range plus 25% of the Effects Benchmark (i.e., 1.74 µg/L). Because less than 20% of the lake area was above 1.74 µg/L, Action Level 3 was not triggered in any year." It would be useful to present a table showing the area of the lake above the normal range and the area above 1.74 ug/L. This information may illustrate whether the extent of higher concentrations of chlorophyll a are changing over time (i.e., evidence of trends).	Please provide a table presenting the area of the lake above the normal range and the area above 1.74 ug/L for each year.
Eutrophication Indicators, Section 5.3.3, Results, Effects of Dust Deposition and Dike Construction, page 277	It is unclear what is being presented in Figure 5-13 and the conclusion based on the figure that "…the elevated concentrations of TP at the MF stations are most likely related to dike construction, rather than dust deposition" is not discussed in sufficient detail to support this conclusion.	The text and figures should be reviewed and updated as appropriate.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.2, Results, Temporal Trends, Nutrients, page 279	Section 5.3.4.2 states: "Concentrations of TP in the NF area were slightly greater during the ice-cover season compared to the open-water season, while in the MF and NF areas, TP concentrations were generally similar between seasons…" These trends are difficult to see in the figures as they are presented. It also appears that the sentence should read: "while in the MF and FF areas, TP concentrations were generally similar between seasons.."	The text and figures should be reviewed and updated as appropriate.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.2, Results, Temporal Trends, Nutrients, page 280	Section 5.3.4.2 discusses ice-cover soluble reactive phosphorus concentrations and acknowledges that "more exceedances [of the normal range] in the MF areas were observed in the samples taken at bottom depths… compared to those taken at the top or middle depths." If effects at the bottom are different (i.e., a greater effect is observed) than at mid-depth in the MF area, then the mid-depth may not be the most appropriate depth to use for this parameter and considerations of other depths may be warranted.	The data for all forms of phosphorus should be reviewed to determine if the mid-depth data are most appropriate to use in consideration of mine effects on phosphorus concentrations in Lac du Gras.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.2, Results, Temporal Trends, Nutrients, page 286	Section 5.3.4.2 indicates with respect to TN: "In 2016, the NF area was not significantly different from the other areas in Lac de Gras (Table 5-14)." This statement is somewhat misleading as it does not acknowledge that a large spatial extent of effects on TN occurred in that year.	Consider adding a statement indicating that while NF results were not statistically significantly different than other areas, TN was above the normal range throughout the lake in 2016.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.2, Results, Temporal Trends, Nutrients, page 286	Paragraph 3 discusses trends in total dissolved nitrogen (TDN). TDN was not defined nor was a explanation of how it was determined provided in the document. Presumably it was calculated as the sum of ammonia-N and nitrate/nitrite-N. If this is the case, the trends in TDN that are discussed would be subject to the same problems as the ammonia data. This should be acknowledged.	Trends in TDN that are discussed in this section should be interpreted with caution unless it can be shown that the problems with the ammonia data do not affect the TDN values.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.2, Results, Temporal Trends, Nutrients, pages 286	Section 5.3.4.2 (page 286) indicates: "The more recent elevated concentrations at several NF, MF and FF area stations may in part reflect the change in labs from UofA to Maxxam that occurred in 2013 (Golder 2016a)." As this factor may have substantive implications with respect to tracking changes in nitrogenous parameters over time, there would be benefit to expanding this discussion to elaborate on potential implications of the laboratory change.	Please provide additional discussion of the implications of laboratory changes on nitrogen monitoring results and trend analyses.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.2, Results, Temporal Trends, Nutrients, page 293	The nutrient summary states: "Nutrient concentrations remain low throughout Lac de Gras, within the oligotrophic ranges for both P and N." This is the first discussion of trophic status presented in the report. Some additional information should be presented here to qualify the statement. At a minimum, the trophic boundaries applied should be identified for TP and TN.	Please identify the trophic boundaries applied.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.4.3, Results, Chlorophyll a Concentrations, and Phytoplankton and Zooplankton Biomass, page 301	Section 5.3.4.3 (page 301) indicates: "Chlorophyll a concentrations and plankton biomass displayed high variability in recent years, especially since 2014, without an obvious explanation in terms of nutrient concentrations that would account for this observation." The plots shown (Figure 5-28; page 295) indicate that data did not show especially high variability since 2014. Rather, the plots indicate that results for 2015 were somewhat anomalous. This also raises the general question as to why values were notably lower in 2015. Is there any potential explanation for these observations?	Consider revising statement and expand if possible on potential reasons for low values in 2015.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Eutrophication Indicators, Section 5.3.8.3, Results, Phosphorus Management Framework, pages 318-321	The consideration of application of the CCME phosphorus management framework is well presented and the conclusions/recommendations provided by DDMI seem sound and reasonable. Based on the information provided, there does not appear to be any particular benefit to including this framework within the AEMP, particularly given that the primary concern (algal abundance) associated with nutrient enrichment is the foundation of the response framework.	No action required.
MAIN DOCUMENT, Eutrophication Indicators, Section 5.5, Summary and Conclusions, page 329	"Secchi depths were deeper in the NF area compared to the MF and FF areas..." This statement contradicts results presented earlier in Section 5.3.4.1 (page 277) and Figure 5-14 (page 278). Secchi disk depths are generally lower in the NF area - notably compared to the FF areas.	Revise statement.
MAIN DOCUMENT, Sediment Quality, Section 6.2.1, Methods, Data Sources, page 336	"The 2007 to 2016 AEMP samples were collected using a sediment gravity-corer, and the top 1 cm fraction was analyzed for nitrogen, phosphorus and metals. From 2007 to 2010, nitrogen, phosphorus and TOC were analyzed from the top 5 cm fraction of Ekman grab samples, from 2013 onwards, grain size analysis were conducted on top 10 to 15 cm samples, while TOC was analyzed in both the top 1 cm core samples and the top 10 to 15 cm Ekman grab samples." There appears to be a contradiction with respect to the depth of sediment analysed for nutrients in the excised text. It is unclear what sediment depths were analysed for what variables over the years.	Please clarify the methods description or modify if the text is in error. Inclusion of a table may assist with clarifying methods over the years.
Sediment quality, Section 6.2.2.2, Methods, Data Handling, Censored Data, page 336	It is unclear how data for field duplicate samples were handled. The text simply indicates that the data were removed. It should be clarified how these data were removed. Were means of the duplicates calculated or were the first set of data retained and the second set (i.e., "the duplicate") simply excluded?	The text should be clarified.
MAIN DOCUMENT, Sediment Quality, Section 6.2.3.2, Methods, Weight-of-Evidence Effect Ratings, page 338, Table 6-3	Table 6-3 indicates a rating of "No action" if an ISQG is not exceeded and an "early warning/low" rating in the NF is statistically higher than the FF. It is unclear what occurs in the event that a statistically significant difference is observed between NF and FF results but the concentrations are below the ISQG. If this case would be ranked as "No effect" then the approach may be relatively insensitive in terms of the ability to identify early warnings of change. In addition, there are parameters without defined benchmarks. It is unclear how the ISQG comparison is applied in the framework.	Please clarify application of the WOE rankings.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Sediment Quality, Section 6.2.3.4, Methods, Temporal Trends, page 339	Section 6.2.3.4 indicates: "Trends in sediment chemistry over time were evaluated in relation to the normal range for Lac de Gras, which was calculated based on percentiles using reference area data (Golder 2017b). The normal ranges for SOIs were calculated using reference area data collected during the AEMP Study Design Version 2.0 (2007 to 2010; Table 6-4)." Were the normal ranges used for comparisons also normalized to TOC or fines as was done for the monitoring dataset?	Please provide a clarification on normal ranges used.
MAIN DOCUMENT, Sediment Quality, Section 6.3.1, Results, Summary of Effects, page 341	The text (page 341) indicates that the first low effect rating for strontium and vanadium in sediments occurred in 2016. This does not agree with the data presented in Table 6-5 (page 342) which indicates that a low effect rating was observed for strontium in 2008 and 2016, and for vanadium in 2007 and 2008 but not in 2016. Table 6-5 also indicates that 2016 was the first time TN received a low effect rating but it was not included in the previous list.	The text and table should be reviewed and updated as appropriate.
MAIN DOCUMENT, Sediment Quality, Section 6.3.1, Results, Summary of Effects, page 341	The report states (page 341): "Chromium exceeded SQGs (i.e., lowest effects level and ISQG) frequently since 2007, while the PEL was exceeded once in 2008, and the severe effect level was never exceeded. Nevertheless, chromium exceeds guidelines in both NF and FF areas, therefore, these concentrations are likely to reflect elevated background levels for Lac de Gras." Since chromium was statistically higher in the NF area than the FF area in some years, the data suggest a mine-related effect and that the mine may have caused or contributed to exceedances. The magnitude by which the ISQG is exceeded would be useful to demonstrate in the figures (e.g., add ISQG of 37.3 mg/kg to Figure 6-12, page 358).	Please revise text and consider adding ISQGs to sediment quality scatter plot time series figures.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Sediment Quality, Section 6.3.3, Results, Temporal Trends, page 344	Section 6.3.3 (page 344) indicates: "Trend analyses were performed following normalization of the data by TOC or percent fines, where applicable, and transformation of data using Box- Cox transformations." 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. In addition, from a biological perspective, it is the absolute concentrations that are relevant.	Please clarify if trends were also evaluated on raw data for all of the SOIs. If this analysis has not been done, please provide a discussion of the rationale for excluding these analyses.
MAIN DOCUMENT, Sediment Quality, Section 6.3.3, Results, Temporal Trends, Table 6-6, page 344	The table indicates that "fines" were selected as the normalizing variable for boron and tin, but that no normalizing variable was selected for lead. However, this would appear to contradict information presented in Table 6-6. The correlation analysis presented in Table 6-6 shows the following: boron was not significantly correlated with either TOC or fines; tin was significantly correlated with TOC but not fines; and, lead was significantly correlated with TOC. Based on the results presented in Table 6-6 and the methods that appear to have been applied to the other parameters, the following normalizing variables should have been applied: none for boron; TOC for tin; and TOC for lead.	The data should be reviewed and updated as appropriate. If necessary the models for boron, tin, and lead should be recreated and necessary changes made to the document.
MAIN DOCUMENT, Sediment Quality, Section 6.3.3, Results, Temporal Trends, Table 6-9, page 346	The caption indicates that the data presented are for 2001 to 2016 when in fact the actual years of data used in the model for lithium were 2010, 2013 and 2016.	Update the caption to read "… 2010 to 2016"
MAIN DOCUMENT, Sediment Quality, Section 6.3.3.2, Results, Temporal Trends, Nutrients, page 350	In reference to data since 2006, but excluding 2013, the report indicates: "TN concentrations were within the normal range for Lac de Gras." This is contrary to Figure 6-2 which shows that TN concentrations above the normal range occurred at MF3-7 from 2007 to 2016, and at several FF sites in 2016.	The text and table should be reviewed and updated as appropriate, including any conclusions made based on these results.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Sediment Quality, Section 6.3.3.2, Results, Temporal Trends, Nutrients, page 350	"Concentrations of TN were considered atypical in 2013, and inconsistent with other years' results, most likely due to a difference in laboratory methods in 2013 relative to other years (Golder 2017c)." We agree that the 2013 TN data for sediments is anomalous (NSC had noted this in comments provided on the Reference Condition Report Supplement v. 1.2 supplement; NSC 2017b) and may indeed be related to changes in the laboratory method. Given this anomaly, it would be more appropriate to exclude the 2013 data from the trend analysis, or at a minimum, present a trend analysis with and without the 2013 data. It was noted in the report: "These trends should be interpreted with caution, due to the uncertainty in the 2013 TN data noted above."	Conduct trend analysis excluding 2013 TN data
MAIN DOCUMENT, Sediment Quality, Section 6.5, Summary and Conclusions, page 371	Section 6.5 (Page 371) indicates: "Concentrations of certain metals, such as arsenic and cadmium, in sediments throughout Lac de Gras were above SQGs. These variables generally reflected patterns in TOC content of bottom sediments or background variation in sediment quality, and had no clear spatial trends related to the Mine." Since report figures presenting sediment quality results do not include SQGs, it is difficult to evaluate the occurrence and magnitude of exceedances of SQGs over time. For example, information as presented is inadequate to determine in what years, by what magnitude, and at which sites that cadmium and arsenic exceed SQGs. This visualization is important for critically reviewing the information and examining trends and identifying potential emerging trends.	Add benchmarks (i.e., SQGs) to sediment quality figures.
MAIN DOCUMENT, Plankton, Section 7.2.1.1.2, AEMP Version 2.0 Data (2007 to 2011), page 377	Different sampling methods were employed in 2007 than other years of the phytoplankton monitoring. It is stated that: "...the phytoplankton sampling procedure was inadvertently changed to use the Secchi depth to determine the sampling depth (DDMI 2007). Since the 2007 AEMP plankton program used Secchi depth to determine sampling depth, instead of the top 10 m of the water column, sampling depths were approximately 2 m shallower than those between 2003 and 2006. From 2008 to 2016, the methods reverted back to the original sampling protocol of sampling the top 10 m of water column....Secchi depths in 2007 were approximately 8 m; phytoplankton are found within the euphotic zone (estimated as two times the Secchi depth); therefore, it is likely that the 2007 samples are comparable to the 2008 to 2016 samples." According to this text, the 2007 samples were collected at a depth of approximately 16 m which is notably different than 10 m.	Consider revising statement regarding comparability.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Plankton, Section 7.2.1.1.4, AEMP Version 3.5 Data (2013 to 2016), page 378	The laboratory that performed taxonomic identifications and enumerations is not indicated for these sampling years.	Please add a statement identifying the laboratory that performed taxonomic identifications and enumerations for 2013-2016.
MAIN DOCUMENT, Plankton, Section 7.3.1.1, Results, Summary of Effects, Weight-of-Evidence Effect Ratings, page 392	Table 7-9 indicates that based on a recalculation of affected area that was conducted in 2017 a high effect rating should now be applied to phytoplankton biomass in 2010. The text indicates that high effect ratings occurred in 2009 and 2011, but no mention is made of 2010.	The text should be updated to acknowledge this recent finding.
MAIN DOCUMENT, Plankton, Section 7.3.2.1.2, Results, Temporal Trends, Biomass of Major Phytoplankton Groups, page 401	The discussion of trends in cyanobacteria does not match the results presented in the tables and figures. The report indicates (page 401): "...a slight, non-significant decline was observed in the NF area between 2013 and 2016 (Figure 7-4 and Table 7-14)." However, Table 7-14 indicates that cyanobacteria biomass in the NF area was significantly different between 2013 and 2016. In addition, the report states: "Relative cyanobacteria biomass fluctuated with the normal range in all areas between 2007 and 2012 (Figure 7-9)." Figure 7-9 presents results for diatoms not cyanobacteria, and this statement describes trend in diatoms not trends in cyanobacteria. Figure 7-7, which shows cyanobacteria indicates that relative cyanobacteria biomass in both MF and FF areas was, at some locations, above the normal range from 2008-2012.	Please review the text, tables and figures and make appropriate corrections.
MAIN DOCUMENT, Plankton, Section 7.3.2.1.3, Results, Temporal Trends, Phytoplankton Normal Range Evaluation, page 408	The evaluation of the phytoplankton normal range presented in the report concluded: "Overall, based on the clear differences in the data sets produced by the two different taxonomists, the “adjusted” 2013 normal range (referred to going forward as the “ 2013 normal range”) is recommended for comparisons from 2013 onwards." It would appear based on the information presented in this section that comparisons to the 2007 to 2010 normal ranges, which were based on data from a different taxonomist, moving forward would be inappropriate (i.e., there is evidence of a laboratory difference). However, as also noted in the report, the use of a single year of data to derive a normal range (2013) is also associated with issues (i.e., it does not incorporate inter-annual variability). Use of more than one year of data to derive normal ranges would be more scientifically appropriate.	Please comment on the appropriateness of deriving updated normal ranges using one year of data and if the normal ranges will be recalculated in the future with additional data to account for inter-annual variability.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, General Comments Regarding Fish Section 9	A few terms are used inconsistently throughout the report, making it more difficult for the reader to follow. For example, age-2+ is used page 504, but the term adult seems to be used for the rest of the document. It is assumed that these are referring to the same stage. In addition, the sampling period for 2007, 2013, and 2016 is both called late summer and late fall (e.g., 3rd line of Section 9.2.1.3.4 late fall, but late summer in 6th line). Several different terms are used for the concept of CES - called "percent difference" in title of Table 9-12, called CES in footnote of this table, magnitude of difference in heading 9.2.1.3.7, and a critical effect size defined by EEM in Table 14-2.	Use terms consistently throughout document.
MAIN DOCUMENT, Fish, Section 9.2.1.2.3, Fish Health, Methods, Stage Re-classification, Table 9-2, page 505	There are potential errors in the data presented in Table 9-2 (page 505). It states 10 fish were reclassified from the 2007 dataset on page 505; however, Table 9-2 only shows 7 fish (2 age 1+ to YOY, 5 age 1+ to adult).	Review calculations and data tables.
MAIN DOCUMENT, Fish, Section 9.2.1.3.5, Fish Health, Methods, Comparison to Normal Ranges, pages 507-508	There are some discrepancies in the methods described for the temporal trends analysis. It appears from the text that raw carcass weight was used as a covariate for Age-1+ condition, gonad, and liver weight trend analysis. However, it states on page 503 total body weight is more appropriate for this stage. It appears from Figure 9-18 that carcass weight was used.	Confirm appropriate analysis methods were used.
MAIN DOCUMENT, Fish, Section 9.2.1.3.7, Fish Health, Methods, Magnitude of Difference (Critical Effect Size), page 509	Section 9.2.1.3.7 (page 509) states: "As per the MMER TGD (Environment Canada 2012), a Critical Effect Size (CES) is defined as “a threshold above which an effect may be indicative of a higher risk to the environment” (Environment Canada 2012). CES are defined for fish weight, relative liver size and relative gonad size as 25% of the reference area mean, and for condition as 10% of the reference area mean (Environment Canada 2012). The variables that triggered Action Level exceedances in 2016 were compared to the CES." It would seem appropriate to also compare Action Level exceedances from other years to the CES. In addition, there is no indication of what was defined as the "reference area mean" for making comparisons in the CES evaluation.	Include comparisons to CES for all years in which an Action Level exceedances occurred. Add description of how "reference area mean" was defined.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.2.2, Fish Health, Results, general comment	The discussion of the results of the temporal trends is very difficult to follow. There is no discussion of the results of NF temporal trends for Total Length, Fresh Weight, or Carcass Weight even though Table 9-9 shows significant post-hoc results. There is discussion about large and small fish; however, the methods section (Section 9.2.1.3.5) does provide any explanation about how or why these categories were calculated.	Explain the results of statistical analysis in a more lay manner so readers can better understand the results.
MAIN DOCUMENT, Fish, Section 9.2.2.2, Fish Health, Results, CPUE, page 512	CPUE does not appear to be a variable included in the assessment of temporal trends as described in Section 9.2.1.3.5 and normals were not calculated for this variable (Appendix 9A). It is unclear how the temporal evaluation of CPUE described in Section 9.2.2.2 was completed. Based on the text in this section and lack of statistical results, it does not appear that any statistical analysis was performed to support the conclusion of no change to CPUE attributable to the mine. There also appears to be errors in the text. For example, it is stated that mean CPUE at MF3 and F2 were higher than at other sites in 2010, 2013, and 2016; however it is clear from Figure 9-3 that values at FFA were higher, or at least very similar. The CPUE for the Age-1+ catch was not presented in Section 9.2.2.2 - but the abundance of Age-1+ is still listed as an endpoint for WOE in Table 9-5 and a rating of 0 is assigned to this endpoint in Tables 10A-11 to 10A-14.	Provide information on how the ratings and conclusions were derived.
MAIN DOCUMENT, Fish, Section 9.2.2.3, Fish Health, Results, Parasitism, pages 512-513	There is a statement on page 512 that indicates "all sites except FF2 had increased parasite presence in 2013 and 2016 compared to 2007". This statement does not agree with the results presented in Table 9-7. The values are significantly similar between 2007, 2013, and 2016 as indicated by the same letter at NF and and FF2 sites, but are not the same as indicated by different letter for 2007, at the FFA and FF1 sites. The MF sites cannot be compared since due to lack of data for 2007. There also appear to be errors in the gray shading applied to Table 9-7. It states that grey shading indicates a decreasing trend; however, it is clear from Figure 9-4 that the cells highlighted are actually showing an increase in parasite occurrence.	Verify results and update report accordingly.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Results, Sections 9.2.2 and 9.3.2, various sub-sections and pages	According to the text in Sections 9.2.1.3.5 and 9.3.2.1, Figures 9-5 to 9-10 (pages 514-519) and 9-19 to 9-26 (pages 548-555) are used to compare to normal ranges, but the graphs are titled Temporal Trend Plots. This is confusing to readers, as there is an almost identical series of graphs (Figures 9-11 to 9-14 [pages 521-524] and Figures 9-27 to 9-32 [pages 557-561]) that follows. Also, it is not clear from the figure titles or legends what exactly is plotted - are the circles values from individual sculpin? There is no information provided in the methods Section 9.2.1.3.4 and 9.3.1.3.1 explaining how data were compared to normal ranges (it indicates "results" are compared to background values) . The methods also do not explain whether outliers were included in the calculation of the "mean". For example, Figure 9-11 (page 521) shows an outlier for Age-1+ at the FF site in 2016 but Figure 9-5 (page 514) does not indicate this point is an outlier.	Revise figures to make more clear and update figure captions and text.
MAIN DOCUMENT, Fish, Section 9.2.2.6, Fish Health, Results, Weight-of-evidence Ratings, page 533	Table 9-11 (page 533) WOE Effect Ratings includes length frequency in the WOE results but it is unclear how this metric was evaluated as it is not identified in the WOE Effects Ratings presented in Table 9-5 (page 510).	Provide explanation of how ratings were obtained.
MAIN DOCUMENT, Fish, Section 9.2.2.7, Fish Health, Results, Action Levels, Table 9-12, page 535 and Section 14.3.2.2, pages 616-617	With respect to fish health analyses, according to Table 9-12 (page 535), CES values could not be calculated for LSI because of significant interaction (“Area-specific interpretation not possible due to significant interaction”). However, the report indicates there was a minimum of one significant interaction for the ANCOVAs for condition, LSI and GSI (page 519). It is unclear why CESs were derived for condition and GSI but not for LSI. Furthermore, it is unclear what the approach is, and will be in the future, in the event that CESs cannot be calculated for metrics with “significant interactions”. If CESs cannot be assessed for this or other reasons, a metric can never trigger action level 3 or beyond since they cannot meet a requirement of action levels 2 or 3 according to Table 14-2 (page 617),which requires that "an effect size equal to or above the critical effect size defined by the EEM".	Please provide a discussion of how action level comparisons will be made in the event of "significant interaction" issues with data analysis. Revisit CES calculation for variables analyzed with ANCOVA with significant interaction.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.3.1.1.1, Fish Tissue, Methods, Slimy Sculpin, page 536	"In 2007, 2010 and 2013 the samples consisted of fish bodies (i.e., carcass excluding gonads, otoliths, and stomachs). Gonads, otoliths and stomachs were not included, as they were required for separate analyses as part of the fish health assessment. In 2016, the samples consisted of carcass only. The livers were excluded from the samples in 2016 due to a field error." Please clarify what is meant by "carcass only" in 2016.	Provide clarification on what tissues were included in the carcass analysed in 2016.
MAIN DOCUMENT, Fish, Section 9.3.1.1.2, Fish Tissue, Methods, Lake Trout, page 538	"Concentrations in fish in 1996 were measured in composite samples, not individual fish. Because mercury bioaccumulates and biomagnifies in fish tissue and differences in mercury concentrations can be confounded by differences in fish body size, the 1996 data are not appropriate for use. Temporal and spatial comparisons were not conducted with this data." Section 9.3.1.3.2 (Temporal Trend Analysis, page 545) and Section 9.3.2.2 (Temporal Analysis, page 566) include data collected from 1996.	Please clarify or provide correction of text.
MAIN DOCUMENT, Fish, Section 9.3.1.1.2, Fish Tissue, Methods, Lake Trout, page 538	The report identifies various sources of Lake Trout mercury data included in the report and analyses. However, it is difficult for the reader to ascertain what data were included, what methods were employed, and what analytical laboratory and detection limits are associated with the data presented in the report. For example, page 538 indicates that samples were analysed at both ALS and Flett Research in 2008 but the report does not indicate which of the two datasets were incorporated into analyses and in the results presented in the report. The lack of clarity regarding these methods and metadata render it difficult for the reader to critically evaluate the approach taken and subsequent conclusions borne from the analyses presented in the report. For example, changes in analytical laboratories may affect conclusions.	The report would benefit from a summary table identifying, by year, analytical laboratories used and explicit identification of data incorporated in the analyses.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.3.1.1.2, Fish Tissue, Methods, Lake Trout, page 538	Section 9.3.1.1.2 indicates the following data sources for Lake Trout mercury: "Mercury concentrations were measured in muscle, liver and kidney tissue from Lake Trout collected in Lac de Gras in 1996, 2002, 2003, 2004, 2005 and 2008, and Lac du Sauvage in 1996 and 2008. Mercury concentrations were also measured in muscle in 2011 and 2014 in both Lac de Gras and Lac du Sauvage. Additional mercury in muscle tissue data were collected as part of the Mine palatability studies in 2002, 2003, 2004, 2012, and 2015, and these data were incorporated into the analyses, where appropriate." However, Figure 9-34 (Section 9.3.2.2, page 567) presents results for 2009. There is no indication what these data represent. It is also unclear whether 2008 data represent results from ALS or Flett Research.	Please clarify or correct text and figures.
MAIN DOCUMENT, Fish, Section 9.3.1.3.1, Fish Tissue, Methods, Comparison to Normal Ranges, pages 542-544	There is no discussion of normal ranges for mercury in Lake Trout provided in this section. If comparisons to normal ranges for Lake Trout are not part of the formal approved analysis approach, it would be beneficial to add a statement to that effect in the report.	Please provide a clarification as to why Lake Trout mercury data are not compared to a normal range.
MAIN DOCUMENT, Fish, Section 9.3.1.3.1, Fish Tissue, Methods, Comparison to Normal Ranges, Table 9-16, page 544	There appear to be two errors in the normal ranges presented for tissue analysis in Table 9-16. The values given for thorium are from 2010, as there are no values for 2007 or 2013 provided in the AEMP Reference Condition Report, Version 1.2/1.3. Likewise, the lower limit for tin is incorrectly presented in Table 9-16 as the value for 2010 rather than 2013.	Correct table and ensure error is not carried forward to future reports.
MAIN DOCUMENT, Fish, Section 9.3.1.3.2, Fish Tissue, Methods, Temporal Trends, Lake Trout (page 545) and Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Lake Trout, page 568, Figure 9-36	Section 9.3.1.3.2 (page 545) indicates: "Since mercury concentration is length-dependent, to compare mercury between lakes, it was required to account for differences in Lake Trout lengths between lakes. Therefore, the model was used to conduct pairwise comparisons for year and lake, for a mean Lake Trout fork length of 620 mm to assess spatial and temporal differences in mercury concentrations." Figure 9-36 (Section 9.3.2.2, page 568) presents length-standardized mercury concentrations in Lake Trout. Data appear to have been standardized to a fork length of 620 mm. The report does not provide a discussion of the rationale for use of this length of trout for length standardization.	Please provide a discussion of the rationale for inclusion of the 620 mm length.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.3.1.3.3, Fish Tissue, Methods, Guideline Comparison, Fish Health page 546	The report applies a potential effects benchmark/tissue residue guideline for mercury of 1.0 µg/g wet weight from Jarvinen and Ankley (1998) for evaluating effects on fish (i.e., Lake Trout) health (Section 9.3.1.3.3, page 546). The report states: "This is likely a very conservative benchmark; Environment and Climate Change Canada recently conducted a review of mercury in the Canadian environment and noted that the lowest adverse effect concentrations would be 0.5 to 1 mg/g wet weight in fish species such as Northern Pike and Walleye (ECCC 2016), many times higher than using the generic benchmark." The report incorrectly states the benchmark - or Lowest Observed Adverse Effect Level (LOAEL) – presented in the ECCC review; ECCC (2016) identifies an LOAEL of 0.5-1.0 µg/g. Section 9.3.1.3.3 indicates an incorrect unit of mg/g (a thousand fold difference). The conclusion presented in Section 9.3.2.3 (page 570) that "Lake Trout health is unlikely to be affected" and that "on the basis of the most recent mercury concentrations in Lake Trout from each lake (2014), no concerns to .....fish health are expected" is based on a misinterpreted benchmark. Mercury concentrations presented in Figure 9-34 (page 567) and Table 9-25 (page 572) indicate that mercury concentrations in individual Lake Trout from both lakes have frequently been in the range of 0.5-1.0 µg/g between 2005 and 2015.	Reassess conclusions on potential effects of muscle mercury concentrations on fish health based on appropriate guidelines.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.3.2.1, Fish Tissue, Results, Comparison to Normal Ranges, Slimy Sculpin, page 551, Figure 9-22	Section 9.3.2.1, Figure 9-22 (page 551) indicates that mercury concentrations in Slimy Sculpin in the near field in 2007 were almost an order of magnitude higher than in 2013 and 2016 and concentrations in two samples were approaching the Canadian Food Inspection Agency (CFIA) and Health Canada guideline of 0.5 µg/g wwt for human health consumption (CFIA 2015) applied in the report. Concentrations in sculpin from the far field in 2007 were also substantially higher than the results for 2013 and 2016. Section 9.3.2.2 (page 556) indicates that: "Many of the variables that had either a significant interaction or a significant year effect decreased over time and are, therefore, not considered further. These variables include arsenic, barium, magnesium, mercury, selenium, sodium, titanium, vanadium, and zinc (Table 9-19)." The notably high mercury concentrations reported for 2007 should be discussed and potential reasons for these differences should be identified. For example, it is noted in Section 9.3.1.1.1 (page 536) that although all samples for 2007, 2013, and 2016 were analysed at ALS Laboratories, the 2007 samples were analysed at the Edmonton, AB laboratory while samples from the latter two years were analysed at their Burnaby, BC laboratory. Has the change in laboratory been evaluated as a potential cause for the differences or are there environmental factors that may have caused or contributed to the high concentrations in 2007? The high concentrations observed in 2007 also result in a decreasing temporal trend; should there be issues with this dataset, these should be identified in order to avoid biasing trend analyses here and into the future.	Include a discussion of the high mercury concentrations in Slimy Sculpin in 2007 and explore potential explanations for the relatively high concentrations observed in that year, notably for the near field area. If data are deemed to be suspect, trend analysis should be revisited. This is particularly critical given that the results of the trend analysis are the foundation for determining if a Lake Trout mercury survey is to be conducted.
MAIN DOCUMENT, Fish, Section 9.3.2.1, Fish Tissue, Results, Comparison to Normal Ranges, Slimy Sculpin, Figures 9-19 to 9-26, pages 548-555	There are some issues with the presentation of normal ranges in Figures 9-19 to 9-26. The normal range does not appear for several elements that have low normal ranges (antimony, beryllium, and bismuth) - a footnote was provided for one element indicating why the normal range does not appear, but not for the other two. The normal range does not cover 2007 for some elements (boron, tellurium, thallium, and tin); a footnote explaining this would assist the reader.	Revise figures to include missing information.
MAIN DOCUMENT, Fish, Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Lake Trout, page 566	Section 9.3.2.2 (page 566) indicates: "In 2014, mercury was detected at near or below baseline concentrations in both Lac de Gras and Lac du Sauvage." There is no previous description of what constitutes "baseline" for mercury concentrations in Lake Trout.	Please include a description of what baseline mercury concentrations in Lake Trout are and how they were derived.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Slimy Sculpin, pages 556-565	There is no reason provided in Sections 9.3.2.2 or 9.3.1.3.2 (page 542) as to why some of the elements (chromium, lead, lithium, tellurium, zirconium) were not included in the temporal analysis (Figures 9-27 to 9-32, Tables 9-18 and 9-19). A footnote explaining why the 2007 data was omitted from the analysis for some elements (cesium, molybdenum, tin), as described on page 556, would be beneficial. The figures would also benefit from a Y-axis title.	Provide more information in figures/tables.
MAIN DOCUMENT, Fish, Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Lake Trout, pages 567-568	Figure 9-34 and the text indicates substantively lower concentrations of mercury in Lake Trout in 2014. The text indicates: "Raw mercury concentrations in samples collected from Lac de Gras in 2015 were overall greater than those in samples collected in 2014 (Figure 9-34). However, when fish length was accounted for in the analysis, mercury concentrations were generally similar between the two years (see 2014 and 2015 values in Figure 9-35)." It is difficult to discern inter-annual differences from Figure 9-35.	Please verify figure reference.
MAIN DOCUMENT, Fish, Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Lake Trout, page 568	Section 9.3.2.2 indicates: "Similar to the general pattern shown in Figure 9-34, the overall temporal trend in Lake Trout mercury concentration reflected the increase in adjusted mercury between 2002 and 2009/2011, and the decrease in mercury following 2011 (Figure 9-36)." It is unclear what is meant by "adjusted mercury". It is assumed this refers to length-standardized mean mercury concentrations.	Please provide clarification of adjusted mercury (methods and discussion) in the report.
MAIN DOCUMENT, Fish, Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Lake Trout, general comment	The presentation of results for Lake Trout mercury concentrations is difficult to follow. The report switches between results for arithmetic data (sometimes inappropriately referred to as "raw" data and length-adjusted, modeled concentrations, and it remains unclear which analysis is being referred to in the discussion. The finding of a significant difference in Lake Trout mercury concentration between Lac de Gras and Lac du Sauvage in 2014 (but not in 2011) is counterintuitive to what is presented in Figure 9-36 (page 569).	Suggest presenting results for length-adjusted concentrations to describe temporal trends and for spatial comparisons; arithmetic data should be used when discussing concentrations in the context of guidelines. Clearly address if significant difference in Lake Trout mercury concentrations existed between the two lakes and between each lake over time.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Fish, Section 9.3.2.2, Fish Tissue, Results, Temporal Trends, Lake Trout, Figures 9-34 to 9-36, pages 567-569	Figure 9-34 should indicate that it is arithmetic data being presented and a definition of what is meant by 'pooled data" should be included. At the resolution chosen for Figure 9-35, it is very difficult to observe any differences or similarities between years. It is unclear why Figure 9-36 does not include results for 1996. It would be beneficial to present annual means (with confidence limits or standard error) and superscripts indicating the results of statistical comparisons between years (similar to Figure 3-4 in Appendix V of the 2014 annual report; Golder 2016a).	Provide additional details in table and figure captions (and associated text) to adequately define the content of figures and tables. Consider including the results of statistical comparisons in Figure 9-36.
MAIN DOCUMENT, Weight-of-Evidence Section 10.2, Approach, pages 585-586, Appendix 10A	Many of the fish community endpoints shown in Tables 10-1 and 10-2 (pages 585-586) and Table 9-11 (page 533) no longer appear to be measured (e.g., Population structure - survival, Growth - size at age, Reproductive investment - age 1 abundance). It is unclear how these endpoints received Effect Level Ratings in Tables 10A-1, 10A-7, 10A-12, 10A-13). Since a few of these endpoints have been discontinued in more recent surveys as indicated by "n/s" in Appendix 10A tables (Population structure - survival, and -size [2016], and growth- size at age [2013]) - they should be omitted from earlier WOE analyses (i.e., 2007 and 2010).	Update the WOE calculations to reflect the study design.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Weight-of-Evidence Section 10.4, Trend Analysis, pages 590-594	Figures 10-2a to 10-2c are somewhat confusing since they seem to exclude some data; it is assumed that this is because the figures only present "key driver endpoints" (p. 589). For example, Figure 10-2c does not show any ratings for Water or Sediment Chemistry, despite showing increasing ratings in Figure 10-2a and b. There also appear to be some inconsistencies with the information presented in Figures 10-2a to 10-2c and 10-3a to 10-3c relative to results presented in earlier sections. For example, there is a grey diamond for 2010 for GSI in Figure 10-2c (indicating not measured), but none for LSI and body size, which also were excluded for 2010 due to methodological differences (see earlier comment and description of methods on page 502). Additional notes include: Figure 10-3c is not consistent with the text on page 592, which states that the key driver in 2010 was condition factor , but the figure shows an effect for LSI. Table 10A-8 shows moderate ratings for TP and chlorophyll a, but symbols for these do not appear in Figure 10-3c for 2010. Table 10A-12 shows high and moderate ratings for TN and TP, but no symbols appear in Figure 10-3c for 2013, and Table 10A-14 shows a high rating for TN that doesn't appear in Figure 10-3c for 2016. There is also an error in the footnote for Figure 10-3, where it states that * symbol does not indicate toxicity (should be nutrient enrichment). Since pathology - occurrence showed a low increase (see Figure 10-3c), should it have a * symbol in Figure 10-2c for 2016?	Review whether including only "Key Driver Endpoints" is the clearest way to illustrate the results of WOE analysis. Review and cross-check tables and figures against detailed results presented in earlier sections.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, AEMP Summary of Effects, Section 12.2, Toxicological Impairment, page 602	The report indicates: "Weight-of-evidence: The EA predicted that overall, Lac de Gras water would remain at a high quality for use as drinking water and by aquatic life. The main impact was expected to be the introduction of greater concentrations of nutrients, particularly phosphorus, with a concomitant increase in primary productivity over a portion of the lake. The WOE evaluation results are consistent with this prediction." While it is acknowledged that some of the effects benchmarks for water quality were based on drinking water quality guidelines and that guidelines for the protection of aquatic life are typically more stringent than drinking water quality guidelines, the report does not include an explicit analysis of water quality in terms of drinking water quality. This statement may benefit from some additional explanation regarding effects on drinking water quality as this is not the focus of the report.	Consider adding discussion regarding consideration or drinking water quality.
MAIN DOCUMENT, Proposed Updates to AEMP Design Plan, Section 14.2.1, Dust, page 606	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 (2017a) 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)."	Provide a discussion and rationale for the proposal to not add dustfall monitoring sites.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Proposed Updates to AEMP Design Plan, Section 14.2.1, Dust, page 606	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: ...Review the location and number of duplicate and blank samples for the dustfall and the snow water chemistry program (W2015L2-0001 update, Commitment B)." There is no discussion provided regarding a review of blank samples.	Include a discussion of blank samples included in the dust monitoring component.
MAIN DOCUMENT, Proposed Updates to AEMP Design Plan, Section 14.2.1, Dust, page 606	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: ...Review the location and number of duplicate and blank samples for the dustfall and the snow water chemistry program (W2015L2-0001 update, Commitment B)." The sample duplicate results are presented in Table 3-4 (page 29) for only a subset of parameters. The document should include a review of all parameters to provide for an evaluation of QA/QC for the program as a whole. While annual reports discuss details for all parameters, the re-evaluation report is the location where data for numerous years are considered collectively. Issues with and/or patterns in data may not be readily apparent until data are reviewed for all years together.	Include duplicate sample results and discussion of these data for all parameters. A table presenting a summary of the analysis of the duplicate results (e.g., relative percent mean differences) could be provided in an appendix. This would also inform on the need to modify the program.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Proposed Updates to AEMP Design Plan, Section 14.2.2.1, Fish, Non-lethal Slimy Sculpin Survey, page 607	It is unclear how the addition of a non-lethal sculpin survey, as described in Section 14.2.2.1 (page 607) will be incorporated into the assessment of effects. There will be no ability to compare the results of the first year of sampling to any previous data as the data collected and sampling strategy are different. Therefore, the first comparison could only be done after 6 years, since the sampling is recommended to occur every three years (Section 14.2.2.2). Furthermore, this dataset will lack baseline or early post-project data with which to compare. If normal ranges are utilized as per the lethal assessment, then the first two sampling years at a minimum will be needed to construct these ranges. If this is the case, then it would not be possible for these data to trigger an Action Level 3 for the first two sampling periods as, according to Table 9-4 (page 509), this requires data to be outside of the normal range.	Provide explanation of how this sampling program will be used within the existing effects assessment structure.
MAIN DOCUMENT, Proposed Updates to AEMP Design Plan, Section 14.2.8, Weight-of-Evidence, page 611	Section 14.2.8 (page 611) 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." 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.	Incorporate benthic invertebrate density in the WOE, as suggested by the WLWB.

TOPIC	COMMENT	RECOMMENDATION
Appendix 10A, Updated Weight-of-Evidence Analyses	There are inconsistencies among the years in the "A Posteriori Weighting" values. For example, in Table 10A-1 the endpoints for contaminant exposure were assigned a strength of linkage rating of 0.25, but this value is 0.5 in Tables 10A-7 and 10A-11, and 0.75 in 10A-13. Similarly, the a posteriori weighting factors do not match for the nutrient enrichment tables - pathology is rated 0.25 in Table 10A-14 (2016), but 0.75 in Table 10A-8 (2010).	Revise tables and verify WOE calculations.
Memorandum: Review of AEMP QA/QC issues, Section 2.2.2, Fish Liver Tissue Exclusion from Carcass Chemistry Analysis, page 6	The Review of the 2016 AEMP report identified the exclusion of sculpin livers from tissue chemistry analysis in 2016 as an issue. The methods described in the memorandum to prevent future sampling errors are acceptable. However, the method to account for the omission of livers in tissue analyses in 2016 is imprecise. The concentration of elements in the livers of Slimy Sculpin has been estimated through extrapolation from two extremely dissimilar species (Lake Trout and Round Whitefish). It is assumed data for these species were used due to lack of similar data for sculpin. However, it is well established that the accumulation of elements in fish tissue is species-specific (see examples of references below). There is a precedent in the report regarding treatment of data with similar issues. Section 9.3.1.1.1 (pages 535-536) indicates that the 2004 samples were not included in the analysis as a result of the exclusion of livers (as well as most of the head and gas bladders) from the samples. Djikanovic, V., Skorić, S, and Gačić, Z. 2016. Concentrations of metals and trace elements in different tissues of nine fish species from Meduvršje Reservoir (West Morava River Basin, Serbia). Archives of Biological Sciences 68(00): 69. Farkas, A., Salánki, J., Varanka, I. 2000. Heavy metal concentrations in fish of Lake Balaton. Lakes and Reservoirs: Research and Management 5(4): 271-279. Jordaan, L.J., Wepener, V., and Huizenga, J.M. 2016. The major trace element chemistry of fish and lake water within major South African catchments. Water SA 42(1): 112-128.	Unless it can be reasonably demonstrated that Lake Trout and Round Whitefish are a good model for Slimy Sculpin, it is recommended that the 2016 data be treated in the same manner as the 2004 samples, which also excluded liver tissue (i.e., omit them from future analyses).

3.0 SUPPORTING MATERIALS FOR REVIEW

Canadian Council of Ministers of the Environment (CCME). 1999; updated to 2018. Canadian environmental quality guidelines. Canadian Council of Ministers of the Environment, Winnipeg, MB.

Djikanovic, V., Skorić, S, and Gačić, Z. 2016. Concentrations of metals and trace elements in different tissues of nine fish species from Meduvršje Reservoir (West Morava River Basin, Serbia). Archives of Biological Sciences 68(00): 69.

Environment and Climate Change Canada. 2016. Canadian mercury science assessment report. 793 p.

Farkas, A., Salánki, J., Varanka, I. 2000. Heavy metal concentrations in fish of Lake Balaton. Lakes and Reservoirs: Research and Management 5(4): 271-279.

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

Golder. 2016b. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program 2015 Annual Report. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, September 2016.

Golder. 2017. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program 2016 Annual Report. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 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.

Jordaan, L.J., Wepener, V., and Huizenga, J.M. 2016. The major trace element chemistry of fish and lake water within major South African catchments. Water SA 42(1): 112-128.

North/South Consultants Inc. 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.

North/South Consultants Inc. 2017a. 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.

North/South Consultants Inc. 2017b. Aquatic Effects Monitoring Program Reference Conditions Report Supplement – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-17-02.