



Gartner Lee Limited

June 20, 2005

Mr. John McCullum
Diavik Environmental Monitoring Advisory Board
2nd Floor, 5006 Franklin Avenue
P.O. Box 2577
Yellowknife, NT X1A 2P9

Dear Mr. McCullum:

Re: GLL 50-506 – Review of 2004 DDMI Aquatics Effects Monitoring Program Report

Please accept this letter as a summary of our review of the report on the 2004 Aquatics Effects Monitoring Program (AEMP) that was submitted by Diavik Diamond Mines Inc. (DDMI) in April 2005. Our review incorporates the following documents:

- 2004 Aquatic Effects Monitoring Program Technical Report, DDMI, April 2005.
- Aquatics Effects Monitoring Program, DDMI, July 2001. (The final AEMP design, modified following the Diavik Technical Committee (DTC) Meeting of June 19, 2001 and accepted on July 17, 2001.)
- Letter to EMAB from GLL (October 8, 2004) regarding review of 2003 AEMP.

This review also incorporates our initial review, provided to yourself and EMAB on May 25 2005, which was intended to guide participation and questioning at the EMAB meeting, and issues, comments and concerns raised during the meeting.

1. Overall Assessment

The review of the 2004 AEMP focused on a) how well the 2004 program, as carried out, conformed to the original terms of the AEMP as approved by the MVLWB, b) interpretation of the AEMP results presented and c) assessment of the significance of the results reported. The conformity of the AEMP to the conditions of the Water Licence is not covered by this review. As highlighted in our review of the 2003 AEMP, the AEMP program as approved does not meet all the requirements of the Water Licence and it is therefore difficult to hold Diavik accountable to all the terms of the licence. Details of these deficiencies can be found in our review of the 2003 AEMP provided in Attachment A.



Overall, the 2004 AEMP program, with minor exceptions, conformed to the requirements of the Final AEMP Program Design as accepted by the MVLWB upon recommendation of the DTC, on July 2001. The 2004 AEMP is an improvement over the 2003 report and DDMI has incorporated several of the suggestions raised during the review of the 2003 report including:

- Summary of treated effluent and compliance report results including a comparison to CCME guidelines;
- Summary of general lake and environmental conditions at the site during 2004 which provides valuable context to the remainder of the report;
- Addition of cumulative effects and Quality Control/ Quality Assurance (QA/QC) sections to the report;
- Statistical analysis of all AEMP benthic invertebrate data by an outside consultant; and
- Explicit reference to other reports and making them available on CD.

2. Specific Review Comments

This section outlines a series of detailed comments, recommendations and requests for clarification and follow-up. These comments highlight that there are still some outstanding technical concerns with respect to the AEMP and room for improvement in data collection, presentation and interpretation. Where applicable, recommendations for edits and/or clarifications to the 2004 report are identified. We recommend that EMAB encourage DDMI to incorporate these comments and recommendations into the AEMP to ensure the integrity of the program and a thorough assessment of the response of Lac de Gras to their operation.

2.1 Sampling during discharge shutdown

Due to elevated ammonia levels, discharge from the NIWTP was discontinued on March 13, 2004 and did not resume until June of 2004. Therefore all under-ice sampling events taken for the AEMP in 2004 took place during a period of no effluent discharge. This adds an element of variance to the comparison of results from periods of operation to those from the baseline period. In the 2004 AEMP report, no discussion has been provided regarding this and its implications on the interpretation of the 2004 AEMP data. It may be more appropriate to provide a summary of the near field results for the under-ice samples for both periods: during effluent discharge and during no effluent discharge.

Recommendation:

DDMI should add to the 2004 AEMP report a discussion on the implication of the under-ice samples being collected during a period of no discharge to Lac de Gras on the interpretation of the 2004 AEMP results. DDMI should provide separate statistics for



under-ice sample at Station 19 for both periods: discharge and no discharge for all AEMP water quality parameters. This should also be carried forward to all subsequent AEMP reports when AEMP sampling occurs during periods of no discharge.

2.2 AEMP as a “stand alone” document

Overall, more information should be provided in the AEMP report such that it can be a “stand alone” document and all the information is made available to the reviewers which will enable them to clearly see how each conclusion was reached. For example, the water quality predictions made in the environmental assessment and used in Step 3 of the four step AEMP method should be included in the document. Furthermore, any water quality data being summarized and used in the AEMP, such as data from SNP 19 and BHP Stations S2 and S3, should also be provided.

Recommendation:

In subsequent AEMP reports DDMI should provide sufficient information and such that the report is a “stand alone” document.

2.3 Inconsistencies in Water Quality Summary Tables (3-2 to 3-15)

In the summary tables for the far-field water quality results there are some inconsistencies in the number of samples used to calculate the LDG FF summary statistics. For example, for total suspended solid (TSS), a total 16 sample results have been used to determine the median, 25th and 75th percentile, for pH, 14 of 16 results have been used, and for turbidity only 4 out 16 sample results were used. It is unclear why some sample results have not been included in the calculation of the summary statistics or if this is just a typographical error.

Recommendation:

DDMI should clarify in the 2004 AEMP report this discrepancy and provide a rationale for why some sample results are not included in the summary statistics and document which samples were excluded. This should be carried forward to all subsequent AEMP reports.

2.4 QA/QC

The GLL review of the 2003 AEMP highlighted that the QA/QC data for the program was provided in an appendix but there was no discussion of this data or evaluation of whether or not the data were reasonable. At that time it was requested that DDMI provide a QA/QC summary in



subsequent AEMP reports. A discussion, although limited, has been provided as part of the 2004 AEMP documentation with the results reported in an appendix. DDMI provided a preliminary discussion of the results but no details were provided on methods used for assessment, such as the use of Relative Percent Difference (RPD). The writer also states that some of the water quality results have been removed as being outliers. It is not clear in the report which results have been removed (although there is reference to pH), the rationale for excluding individual results and what methods (statistical) were used to determine outliers. At the meeting DDMI clarified that the outliers were identified visually and then an assessment was carried out to see if other parameters in the same sample exhibit the same behaviour.

Recommendation:

DDMI should provide details in the AEMP reports on the methods used for evaluating QA/QC as well as methods, including statistical, used to determine outliers and the rationale for removing them from the data set. Furthermore, as part of the QA/QC section, DDMI should provide a table summarizing all outliers that have been removed from further data analysis

2.5 QA/QC

As requested during the review of the 2003 AEMP report, a section on how the monitoring program assesses cumulative effects was added for water quality, phytoplankton and zooplankton. The same method of analysis is used for this assessment (3 consecutive results above the 75th percentile and/or a statistically significant trend). No changes were detected in water quality and zooplankton but changes were seen in the open water chlorophyll levels at the BHP site (S2/S3) and the far-field site LDG46. DDMI needs to separate out the contributions of Ekati versus Diavik at these stations to provide an assessment of Diavik's contribution to loadings at these locations and it is unclear how this will be carried out. This concern was raised in our review of the 2003 report and the relevant comments are provided below:

“Diavik includes BHP's stations S2 and S3 (near Slipper Lake outlet) as Far Field Stations for their own project and so risks confounding project – related effects of the two mines. The minutes of DTC meetings record that Diavik preferred to us Far Field Stations as a surrogate for reference sites... This provides another confounding factor, when potential impact sites from the Ekati mine are used as part of the reference sites for Diavik... Nevertheless, these sites are not adequate far field surrogates for a proper reference site, as claimed by Diavik. They are a) impact sites for Ekati and b) cumulative effects sites for both mines.”

Recommendation:



DDMI should provide details in the AEMP reports on how the contribution of Ekati versus Diavik will be separated out during the assessment of cumulative effects. The discussion of cumulative effects should also be expanded to include all components of the AEMP, specifically benthics and invertebrates.

2.6 Ammonia in Water

The report states on page 53 that “the ammonia levels at Station 19 for ice-cover show a larger variance in 2004 than in any of the previous years as a result of the higher ammonia concentrations in the NIWTP discharge.” Given that during parts of the under-ice program there was no effluent discharge, it would be more useful to separate out the results for under-ice that were taken both during and without the discharge. This mixture of under-ice results for both discharge and non-discharge may be a cause of the larger variance seen in 2004. This data for under-ice during discharge (prior to March 13th) would better represent the near-field conditions for the AEMP.

Recommendation:

As outlined in Section 2.1, DDMI should add to the 2004 AEMP report a discussion on the implication of the under-ice samples being collected during a period of no discharge to Lac de Gras on the interpretation of the 2004 AEMP results. DDMI should provide separate statistics for under-ice sample at Station 19 for both periods: discharge and no discharge for all AEMP water quality parameters. This should also be carried forward to all subsequent AEMP reports when AEMP sampling occurs during periods of no discharge.

2.7 Seasonal Variability

There is an obvious seasonal variability in some of the parameters (such as ammonia), with the under-ice concentrations being substantially higher than those during open water. There is also an apparent increasing trend in the concentrations of under-ice ammonia (See Figure 1). Given that there are now 3 years of post-baseline data, it may be more appropriate to consider under-ice and open water samples separately, particularly for non-conservative substances such as ammonia.

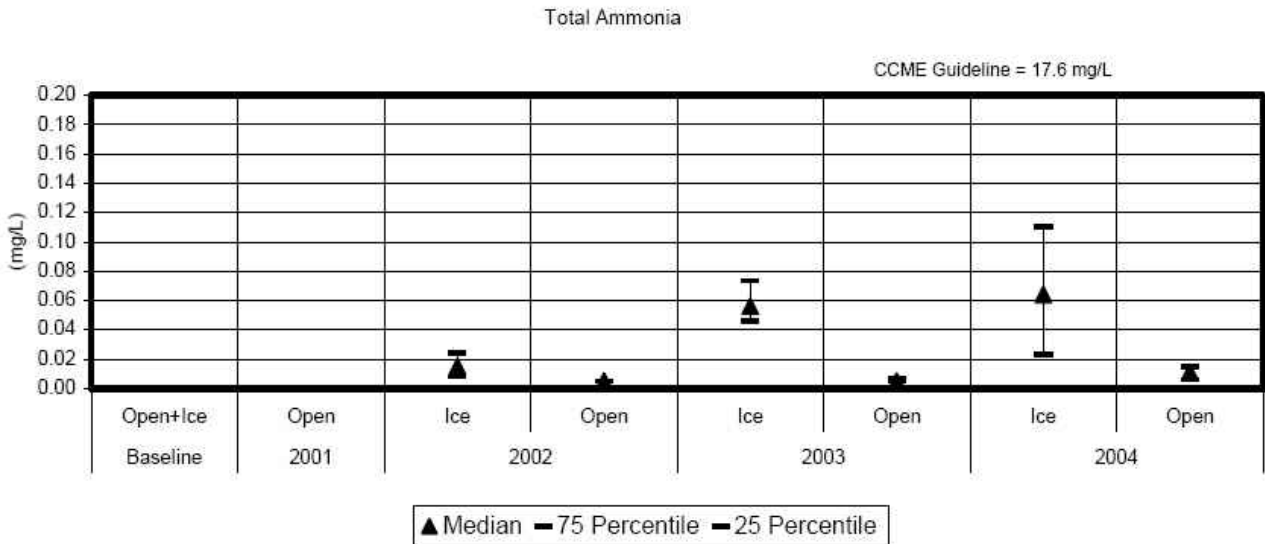


Figure 1: Total Ammonia – Near Field Results

Recommendation:

Given that there are now 3 years of post baseline data, DDMI should apply the AEMP data analysis to the under-ice and open water samples separately to delineate any seasonal trends in Lac de Gras.

2.8 Diffuser and Water Balance

On page 23 of the report it is stated that "...ice-cover dilution factors continue to be lower than the performance intended in the diffuser design of 60."

Recommendation:

EMAB should seek answers from DDMI for the following questions:

- 1. Can Diavik comment on the effectiveness of the diffuser and why it is not performing as predicted?*
- 2. If the discharge volumes remain greater than predicted, what actions will Diavik commit to (study, improve performance, evaluated design and sizing)? Our*



understanding is that Diavik are carrying out the plume delineation studies that are required of their water licence in 2005 with the under-ice component already complete. Will the results of these studies be used to optimize diffuser performance and how will this be carried out?

- 3. Can DDMI clarify the methods used to calculate the monthly average total barium concentrations for each of the near-field monitoring stations (i.e. averages or depth – integrated averages)?*

DDMI should incorporate the results of the plume delineation study into the AEMP program for subsequent years including additional monitoring locations to adequately monitor impact due the DDMI activities.

The average pit water volume discharged in 2004 was 10,645 m³/day. This is well above the estimated pit inflow volume in the EA and Water Licence applications and DDMI have now finished discharging the pool water from the A154 dike. GLL acknowledges that these increases above predicted inflows are related to an unanticipated fracture zone in the wall of the A154 pit and are the subject of an ongoing investigation.

2.9 Biomass for Assessment of Aquatic Communities

GLL continue to reiterate our concern that biomass is a very coarse and insufficient indicator of change on the phytoplankton and zooplankton communities and that each years samples should be analyzed for community composition, in line with the Water Licence Requirement 5 (h iii) that the AEMP measure project related effects on phytoplankton and zooplankton communities, and the practices of other diamond operators in the NWT. Full details are provided in the attached 2003 AEMP Review. We are pleased to see that a taxonomist has been identified and will hopefully be used in upcoming the AEMP program. DDMI stated, at the meeting, that the taxonomist will review the entire program this summer. We would encourage DDMI to use the services of the taxonomist for phytoplankton and zooplankton, as well as benthos. In 2004, chlorophyll concentrations at 5 of the 7 mid-field sites and 1 of the 3 far field sites were the highest measured to date, further emphasizing the need to assess the community composition to determine project related effects.

Recommendation:

DDMI should utilize the services of the taxonomist for phytoplankton and zooplankton, as well as benthos, and analyze each years samples for community composition. The review by the taxonomist should be complete in a timely manner so that the any documentation



summarizing the review and any recommendations can be reviewed by EMAB prior to this summers sampling event.

2.10 Benthics

GLL is pleased to see the report by Golder Associates on benthic invertebrate monitoring data collected in Lac de Gras and found the report to be acceptable. Benthic invertebrates are showing signs of enrichment.

2.11 Sediment

GLL's review of the 2003 AEMP highlighted the concern that the use of 5 cm cores as this depth of sample represents decades to centuries of sediment accumulation in an arctic lake. Analysis of the top 5 cm will dilute all but the most severe project-related effects. Recommendations were made for revisions to the sediment sampling program to deal with this issue. These included:

- Determination of sediment accumulation rates using standard dating techniques such that sub-sampling could then be restricted to the relevant periods (since 2001);
- Reduction of sampling frequency to 5 years due to the low accumulation rate and difficulty to sub-sample at a resolution finer than 1 cm; or
- Monitoring of one cm slices for the top five cm of numerous cores from different locations (this is likely the more workable solution).

These recommendations were not carried forward into the 2004 AEMP although in the 2004 AEMP DDMI recommends the following for the 2005 AEMP:

- Collect samples in 2005 using both the 5 cm thick approach and a 2 cm sample and submit both for analysis to ensure the results of the 2 cm sample aren't substantially different. If the results are comparable then DDMI would change the procedure for future AEMP programs.
- Compare the results from particle size analysis from both the 5 cm core and the Ekman benthic samples. If comparable then DDMI will recommend changing to Ekman samples for particle size analysis.

DDMI does not propose the determination of sediment accumulation rates to determine the adequate thickness of samples that would be representative of post-mine development conditions.



Recommendation:

DDMI should provide clarification of why a 2 cm approach is being taken as opposed to the recommended 1 cm which is thought to be more representative of post-mine development sediment accumulation. Clarification is also required on the proposed comparison of the 5 cm and 2 cm results. Specifically DDMI state that they will only recommend a change if the two sets of results are comparable.

We note that, if there are any project-related effects, they would be evident in the top 2 cm sample when it was compared to the 5 cm sample. DDMI's preferred method of comparison reduces the possibility of detecting any project related effect and is not recommended.

For some of the metals in sediment (cadmium, lead, nickel and zinc) concentrations at the near-field monitoring locations are elevated above the baseline 75th percentile. Some of these metals (nickel and zinc) are also present at elevated levels at the far-field location, which also had the highest median concentration in 2004. DDMI states that it is unlikely that the NIWTP effluent was the source since the higher concentrations are found in the far field not the near field. Higher concentrations in the far field do not negate the potential impact of the effluent in the near field as the far field locations may also be influenced by sources other than Diavik.

Recommendation:

DDMI should clarify and provide further detail on how it is determined whether elevated levels in lake bed sediment are due to the operations as Diavik and provide elaboration on how to distinguish DDMI effects from cumulative effects.

As outlined in the AEMP, total lead concentrations in sediment in the near-field are greater than baseline and seem to be increasing (not significant). Total lead concentrations at the far-field are also greater than baseline and have a significant trend. Levels of lead in the effluent remain near detection levels and DDMI state that it is unlikely that the changes in lead levels in sediment is due to Diavik's activities.

Recommendation:

DDMI should provide clarification on why the lead levels in both the near field and far field are elevated above baseline and increasing.



2.12 Baseline Data

There was significant discussion, initiated by DIAND, on the baseline data used to establish the triggers for the AEMP, specifically the validity of the numbers used due to changing detection limits, inclusion of duplicate results as independently obtained data, and transcription errors. DDMI committed to, and has subsequently provided this data to DIAND for review by an outside consultant.

3. Specific Review Comments

Overall, the 2004 AEMP report does not indicate any significant or adverse responses of Lac de Gras to the Diavik Diamond Mine operation. The 2004 AEMP program, with minor exceptions, conformed to the requirements of the Final AEMP Program Design as accepted by the MVLWB upon recommendation of the DTC, on July 2001, but our review has noted and highlighted areas of deficiency in the program design, interpretation and reporting. EMAB are encouraged to consider and pursue the recommendations proposed.

Thank you for the opportunity to review this document on your behalf and we look forward to discussing it with you in more detail at the EMAB meeting on June 23rd. Following the meeting, a final version of this review document will be issued.

Yours very truly,
GARTNER LEE LIMITED

Leslie Gomm, Ph.D., P.Eng.
Senior Environmental Engineer

LSG:lsg

Attachment A – 2003 Review



Gartner Lee Limited

October 8, 2004

Mr. John McCullum
Diavik Environmental Monitoring Advisory Board
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P.O. Box 2577
Yellowknife, NT X1A 2P9

Dear Mr. McCullum:

Re: GLL 40-303 – Review of 2003 DDMI Aquatic Effects Monitoring Program Report

Please accept this letter as our final review of the report on the 2003 Aquatic Effects Monitoring Program that was submitted by Diavik Diamond Mines Inc. in March of 2004. Our review incorporates the following documents:

- 2003 Aquatic Effects Monitoring Program Technical Report, March 2004. DDMI.
- Section K Requirements for the AEMP from the Diavik Water Licence N7L2-1645.
- Aquatic Effects Monitoring Program, July 2001. DDMI. (The final AEMP Design, modified following the Diavik Technical Committee (DTC) Meeting of June 19, 2001).
- Notes from Diavik Technical Committee Meetings in 2001, 2002 and 2003.
- Memo to File from yourself (October 10, 2003) regarding review comments on 2001 and 2002 AEMP reports.
- Letter (Wooley to Turner, Feb. 11, 2004) outlining commitments by the MVLWB to undertake an independent review of the AEMP program.
- Review comments on the 2001 AEMP report from myself (on behalf of DIAND), Peter McCart (on behalf of EMAB) and Mark Lange (DFO).



This review also incorporates the following materials:

- My initial review comments, provided to yourself and Mr. Eric Denholm, of Gartner Lee's Yellowknife Office on April 13, 2004 which were intended to guide participation and questioning at the April 14 meeting of the DTC.
- Mr. Denholm's notes from the April 14 DTC meeting that he provided to me on April 15.
- Review comments from Dr. Dennis Gregor, an experienced northern scientist who has worked on Ekati's AEMP. Dr. Gregor joined Gartner Lee in June of 2004.
- The independent review of Diavik's 2002-2003 AEMP that was prepared for the MVLWB by Rescan, in June of 2004.

1. Overall Assessment

We have provided a series of detailed comments and requests for clarification and follow-up. These are intended to ensure continuity in the program and its interpretation over the long term, as membership in EMAB and DTC change and to encourage all parties to ensure that the AEMP fulfils its role.

Although our report contains numerous and detailed comments we conclude that the 2003 AEMP Report is fundamentally an acceptable report. We support a conclusion that, for the parameters measured, there are no indications of significant or adverse effects to the aquatic environment of Lac de Gras related to construction or operation of the Diavik Diamond Mine.

Our comments do, however, highlight that there are some technical concerns and room for improvement in data collection, presentation and interpretation, and that there are some specific requirements of the licence that have not been carried forward. We recommend that EMAB encourage DDMI to incorporate these recommendations into the AEMP, to provide a complete and thorough assessment of the response to Lac de Gras to their operation. This is especially important in light of two recent developments:

1. Diavik's intention to increase the production rate from the mine (Northern Miner March 26-April 1, 2004), with resultant increases in the work force at the mine and the volumes of wastewater discharged.



2. Diavik's application for increased Licence Limits for ammonia in their discharge to Lac de Gras in the winter of 2004, which suggests that their estimates of wastewater quality were not realized during production.

2. Specific Review Comments

Our review comments are focused on the following issues, as outlined in our April 1, 2004 work plan to EMAB. In each case, I have provided questions that could be asked of Diavik. Some of these were pursued by Eric Denholm in the April 14 meeting of the DTC. I have incorporated Eric's notes on their response into each section.

2.1 How well the 2003 Program, as carried out, conforms to the Original Terms of the AEMP Program

There are two issues of note under this question.

The first is that the AEMP program that was approved by the MVLWB, did not meet all of the Water Licence requirements. It is therefore difficult to hold Diavik accountable to all of the terms in the Licence (although it was they who chose to develop a program that did not meet Licence requirements). In this regard I would note the following:

- Condition 3 of the AEMP required completion of "a report that interprets the existing baseline information and provides a comprehensive, integrated description of the limnology and ecology of Lac de Gras." Diavik submitted a compilation of baseline data but the report fell far short of a "comprehensive and integrated description". I raised this issue at the June 19, 2001 DTC meeting but was informed that the DTC had already accepted Diavik's report. As the Ekati and Diavik mines continue to produce and add effluent to Lac de Gras, it is critical that a serious effort be directed towards characterizing and understanding the lake by both mines.
- Condition 5b of the AEMP requires a description of the study area that includes maps of the "overall predicted zones of influence of the project". This has not been provided as part of the AEMP report.
- Condition 5h iii requires a process for measuring project-related effects in "phytoplankton, periphyton, zooplankton and benthic invertebrate communities". Diavik have not included periphyton monitoring in the AEMP and provided a rationale for their decision (AEMP Final Design Report, July



2001). Although I do not support their rationale, the MVLWB apparently accepted the AEMP without periphyton monitoring. Comments provided below cover my assessment that Diavik's use of biomass as a metric (instead of community composition or species richness) for phytoplankton and zooplankton monitoring is inadequate and does not meet the Water Licence requirement 5,h, iii.

- Condition 5 I vii requires Diavik to develop a Special Effects Study (SES) to evaluate eutrophication monitoring tools. In their July 2001 AEMP Final Design report, Diavik provided a rationale to exclude this, on the basis of the regulatory limit for phosphorus that was added to the Water Licence and this was accepted by the MVLWB
- The Water License under Part K, subsection 5k indicates that “an evaluation of contaminant loads associated with dust deposition and its effects on the aquatic environments” are to be investigated. The AEMP (2001) states that snow quality studies will be undertaken annually to assess loadings. There is no mention of this aspect of the work in the 2003 report. Notwithstanding the absence of this information, our assessment of snow chemistry data from the BHP Ekati project, suggests that the positioning and density of the snow samples proposed for the Diavik site are likely inadequate to assess the impacts of the mine on the local environment. Diavik (according to the AEMP (2001)) plan includes nine (9) snow quality stations but none of these are closer than 2 km from the main mine. In contrast, BHP has utilized over 30 sites with five distant control sites. An analysis of the BHP data allowed the consultants to conclude that the main impact of dust was within 5 km of the mining activity centres (e.g., the main camp and Misery Pit). However, a deposition pattern could not be assessed for gaseous substances (e.g., ammonia or nitrate). Diavik should therefore submit a revised dust monitoring program for discussion.

I have judged the 2003 AEMP Report against the AEMP Program that was approved by MVLWB and not against the requirements of the Water License itself.

The second issue is how well the 2003 AEMP Report conforms to the specific conditions of the approved AEMP Program. I would first note the July 17, 2001 letter of approval from the MVLWB to DDMI. It contained a list of 7 conditions and modifications, which were imposed as a condition of AEMP approval. I have listed each condition below and provided my assessment of how well the 2003 report conformed:



MVLWB Requirement #1 - Addition of a section to the AEMP to describe how the monitoring program assesses cumulative effects

The 2003 report does not explicitly discuss or address cumulative effects but this requirement may refer to the overall AEMP program and not require CE reporting each year. The Water Licence requires (Section 5j) an assessment of “project-related cumulative effects of multiple stressors in the aquatic environment of Lac de Gras”. Diavik’s July 2001 AEMP Program contains a statement (Section 2.4) that the proposed program and its spatial extent will consider multiple stressors from Diavik and from other projects and the design does contain sites that will include effects from BHP-Ekati. At the April 14 meeting, Gord Macdonald stated that cumulative effects were not specifically discussed but the data are represented by the station at the outlet of Lac de Gras. Although Diavik have not been explicit the 2003 report is adequate, in that there is no need to consider cumulative effects in the absence of individual effects.

Diavik includes BHP’s stations S2 and S3 (near Slipper Lake outlet) as Far Field Stations for their own project and so risk confounding project – related effects of the two mines. This issue needs to be elaborated in each AEMP report and these AEMP sites need to be added to Figure 1-1 of the AEMP report. The minutes of the DTC meetings record that Diavik preferred to use Far Field Stations as a surrogate for reference sites. This provides another confounding factor, when potential impact sites from the Ekati mine are used as part of the reference sites for Diavik. At the April 14 meeting, Gord Macdonald of DDMI agreed that these sites should be added to the map and noted that these sites are sampled by BHP with the results passed on the DDMI for inclusion into DDMI’s report and that they feed into the general understanding of the lake and the cumulative effects of the 2 mines. Nevertheless, these sites are not adequate far field surrogates for a proper reference site, as claimed by Diavik. They are a) impact sites for Ekati and b) cumulative effects sites for both mines.

Furthermore, if BHP information is to be used to assess cumulative effects, there must be a discussion of methods used by BHP and whether or not they provide comparable data. Comparison with BHP becomes especially important in the vicinity of LDG 45 which is close to the Misery Pit of BHP. The dust plume from Misery can be anticipated to impact this site. As well, there are releases to the LdG from the Misery Camp that need to be considered when evaluating water quality data at this location.



MVLWB Requirement #2 - The lake monitoring station LDG50 be relocated to co-ordinates 7149000 518000 to reflect deep waters in Lac de Gras.

Table 1-1 in the 2003 report shows that LDG50 is located at 7149023 517986.

Action Required: Ask DDMI to confirm a) if this location represents the deepest portion of the lake and b) why it does not correspond to the Board's requirements.

MVLWB Requirement #3 - Add a requirement for the annual AEMP report to address the need/schedule for additional delineation [of the discharge plume from the mine] as discharge changes.

This requirement is vague regarding timing but the first year of mine discharge would appear appropriate. No plume delineation studies are referenced in the 2003 report and so I assume that they have not yet been carried out. At the April 14 meeting, Gord Macdonald of DDMI stated that the plume study would be done when effluent conductivity levels allow for a good delineation – this was not the case in 2003. The July 2001 Final AEMP Program Report states (p. 26) that plume delineation studies will be implemented in 2004. This is acceptable.

MVLWB Requirement #4 - Add a requirement for the annual AEMP report to include an evaluation of flushing flows based on the previous year's monitoring data

The 2003 report contains no estimate of water retention time or flushing time in Lac de Gras, and so does not meet the Water Licence requirements. At the April 14 meeting, DDMI acknowledged that this was not covered in the 2003 report. We recommend that this shortcoming be addressed in subsequent AEMP reports.

MVLWB Requirement #5 - Add a summary table to clarify sampling frequency

Table 1-1 provides the required summary.

MVLWB Requirement #6 - Change from an r-squared measure of slope significance for detecting trends

DDMI have done this and now use an F statistic to see if the regression is significant. The statistical validity of this should be addressed in bullet #2 (Feb. 11, 2004) of the independent review being undertaken by the MVLWB.



MVLWB Requirement #7 - Revise Section 4.2 to address chronic and acute toxicity monitoring

This has been done, in that DDMI provided toxicity testing plans in Section 4.2 (p. 26) of the July 2001 AEMP Program Design Report and they carried out acute and chronic toxicity monitoring in 2003.

Summary – Overall, Diavik’s 2003 AEMP program does not completely conform to the requirements of the Water Licence and to the Final AEMP program design, as accepted by the MVLWB upon the recommendation of the DTC, on July 17, 2001.

2.2 Was the 2003 program adequate to detect Aquatic Environmental Effects resulting from operation of the Diavik Diamond Mine?

I have several comments to make under this heading.

QA/QC Results

The first is that DDMI have provided QA/QC data in a vast appendix but make no evaluation on whether or not the data were reasonable. This is not just academic – in several sections they make reference to poor quality of baseline data in dismissing potential project-related changes in water quality. The report should include a discussion and evaluation of the results from duplicate samples, laboratory and field blanks in order to substantiate conclusions regarding project-related effects. At the April 14 meeting, Diavik commented that QA/QC results were brought forward into the report in a few instances where specific issues needed to be discussed but were generally provided only in bulk in Appendix A2. This is not an adequate approach to evaluation of QA/QC results.

At the April 14 meeting, Diavik provided further comment that highlights the need for explicit consideration of QA/QC results and methodological changes:

- In 2003, ultra-low detection limits were not possible for some parameters (Cr, Cd) because of interfering substances in the water. This is anticipated for the rest of the mine life for effluent, and should be considered when making comparisons back to pre-2003. Diavik should provide specific guidance regarding this in subsequent AEMP reports.



- The 4-step assessment method (see July 2001 AEMP Program, Figure 2-1) provides lots of “false-positives” and some changes at mid and far field stations were suggested by the method in 2003. Baseline values have to date been taken on a station-specific basis and this has caused some of the false positives; this leads to the recommendation to use average baseline values for mid, far-field areas in the future.
- The few baseline TSS values are too low and should be updated with the widespread observations of 2 mg/L that are coming out of the monitoring program.

Future reports should include explicit discussion of QA/QC results and how they influence interpretation of the monitoring program. This is a specific requirement of Conditions 5c and 5e of Part K of the Water Licence. The discussion should include the relationship of QA/QC data to “false positives” and a formal procedure for interpretation (i.e., a change must exceed the sample value plus analytical variability before it is assessed against historical data to determine if an impact or change is occurring). An evaluation of the QA/QC data may also indicate clear limitations of the QA/QC program in that the use of duplicates does not provide statistics sufficiently robust to assess against the very low concentrations being analyzed here.

Biomass is an Inadequate Metric for Assessment of Aquatic Communities

I will repeat my concerns from presentations made to the DTC in 2001, that biomass is a very coarse and insufficient indicator of change in the phytoplankton and zooplankton communities and that each year’s samples should be analyzed for community composition, in line with the Water Licence Requirement 5 (h iii) that the AEMP measure project related effects on phytoplankton and zooplankton communities. There are several sub-issues here but:

- a) my queries to a Canadian expert on the response of zooplankton communities to mining stress confirms that biomass is a coarse indicator of community response;
- b) in 2001 I told the DTC that zooplankton biomass cannot be estimated without a measurement of the sampling efficiency of the sampling net. The DTC commented that sampling consistency was also important (see notes from June 19, 2001 meeting). Measuring net efficiency, however, will in no way compromise consistency, especially given the near, mid and far field approach favoured by Diavik. Diavik continue to monitor zooplankton biomass with no indication that sampling efficiency is constant from one sample to the next. This is not adequate for detecting changes in biomass;



- c) DDMI commented (2002 DTC meeting) that they were unsure if samples could even be preserved properly over the long term. This compromises the possibility of assessing future changes in community composition and invalidates their response (April 14 2004 meeting) that all samples are preserved and stored if someone wants to do taxonomy in the future. Diavik's concerns over sample storage are not warranted, however, - it is entirely possible to store zooplankton and to maintain sample integrity over the long term. In spite of this, taxonomy should be done and reported each year as a more sensitive metric of community change and samples preserved and stored for verification over the long term;
- d) Diavik are providing a coarse level of taxonomic analysis for the benthic data (Section 5 of 2003 AEMP report) and so, even though the analysis has not been done in detail, they would appear to support using community composition as a biological metric; and
- e) assessment of community composition would appear to be standard procedure for other diamond operators in the NWT. Ekati assess species diversity of zooplankton as part of their program and recorded changes in zooplankton diversity and % cladocera in Moose Lake between 1996 and 2002. Debeers committed to undertake full assessments of the biological community in Snap Lake as part of their AEMP and, in their EA submission, likened potential project related changes in the zooplankton community of Snap Lake to a "buffet" in which the sizes of individual portions may change, but the overall buffet would contain the same amount of food (i.e., community composition may change but biomass will not). They therefore consider that community composition is an important component of the environmental response and so committed to monitor it.

Diavik's program is therefore inadequate to detect project-related effects on the biological community. This concern is emphasized upon examination of Table 4-2, which shows that zooplankton biomass increased by 2-9 times in 2003. Diavik concluded (p. 55) "Zooplankton biomass levels remain within the ranges measured during baseline studies". How can they detect any project-related changes against such a coarse indicator as zooplankton biomass? At the April 14 meeting, Diavik commented that the data in the 2003 report resulted from a back calculation method assuming an average of 450 mL sample in a 500 mL sample jar. It is very difficult to interpret that a 10% difference in assumed sample volume can be manifest as 2-9 fold differences in biomass. Some changes in the zooplankton community are therefore suggested by the data, especially for station LDG42. While this may not be indicative of an impact, these sharp changes in 2003 are not adequately addressed in the text (p. 55). Until these changes are adequately explained, it may not be unreasonable to err on the side of caution and assume that there has been an impact.



Diavik's AEMP program, and the 2003 results, are inadequate to detect changes in the phytoplankton and zooplankton communities in Lac de Gras and therefore do not meet the requirements of Condition 5 h iii of Section K of the Project Water Licence. Diavik have not provided reassurance that samples are being stored to allow future assessments of community composition and their AEMP program does not meet current industry practice for the NWT. EMAB should therefore recommend that Diavik incorporate annual measures of taxonomic composition of the zooplankton and phytoplankton communities of Lac de Gras into their AEMP.

Sediment Sampling Program is Inadequate to Detect Change

The lake sediment sampling program is based on sampling and analysis of the top 5 cm of lake sediment. The biggest problem with this approach is that sampling the top 5 cm of sediment likely represents decades to centuries of sediment accumulation in an arctic lake. Consequently, analysis of the top 5 cm will obscure all but the most severe project – related effects because so much historical deposition data are masking or diluting current data. Consequently, the sediment monitoring needs to be revisited. First, if the information is not already available, the sediment accumulation rate needs to be determined for each of the three locations. In this way, sub-sampling can then be restricted to relevant periods (e.g., since 2001). However, since accumulation is expected to be less than a cm per year, it will likely be necessary to slice the cores at 1 or 2 cm intervals. Subsampling at a resolution finer than 1 cm, especially in fresh sediment is very difficult but anything greater is not adequate. The frequency of sediment sampling could be reduced to once every five (5) years with additional sites being added to better reflect the complex lake system. Alternatively, divers could collect shallow cores and bring them to the surface and the surface layer scraped off for analysis. Such sampling must be done very carefully and a short half-life isotope must also be measured (for example ^7Be which has a half life of approximately 54 days) to ensure that only recent sediments have been collected. Likely, the more workable solution is to monitor one cm thick slices for the top five cm of numerous cores from different locations. Additionally, replicates will need to be analyzed to provide a good understanding of natural variance.

2.3 Were any Aquatic Environmental Effects detected or identified by the 2003 AEMP?

Although the 2003 AEMP results support a conclusion that there are no project-related aquatic environmental effects of the Diavik Diamond Mine, I would offer several comments for consideration.



Chronic Toxicity Testing

In our April 13 memo, we noted that chronic toxicity was observed in the September 2003 tests and asked Diavik to comment on potential reasons for this. The subject of sub-lethal toxicity tests was discussed at the April 14 meeting. Diavik noted that the test procedure is sophisticated and requires the co-ordinated transport of eggs and water. Some control samples showed poor results due to various issues around logistics and “egg delivery”. This may have produced control mortality in the September 2003 tests and this would alter interpretation of results from effluent streams. The test procedures are under ongoing discussion with Environment Canada. We cannot, therefore, provide a firm conclusion on the implications of the September 2003 results.

Diffuser and Water Balance Issues

Page 19 of the 2003 AEMP report stated that the diffuser for the effluent from the NIWTP did not meet the design and EA criteria for initial mixing of effluent into Lac de Gras in 2003. “*The initial ice-cover dilution factors are lower (32-39) than the performance intended in the diffuser design (60)...that for the majority of 2003 the NIWTP was discharging at the upper end of its capacity*” Three questions relating to this were raised in my April 13 memo:

- 1. Why is the NIWTP operating near the limit of its capacity in Year 1 of operation? We acknowledge that A-154 pool water was treated and discharged in 2003 but DDMI accounted for this water volume when designing the plant. We also note that the treatment system is modular and can be scaled up as required.*
- 2. The average pit water volume discharged in 2003 was 7,856 m³/day (p. 5). The EA predictions and Water Licence application estimated approximately 2400 m³/day of pit water in 2003, and that volumes would not increase to >7,856 m³/day until 2006. Table 2.1, p. 13 of Diavik’s Water Management Plan, Version 1, August 1999, provides the following volumes of pit inflow:*

<i>Year 1</i>	<i>1900 m³/day</i>
<i>Year 2</i>	<i>3800 m³/day</i>
<i>Year 3</i>	<i>4700 m³/day</i>
<i>Year 4</i>	<i>5500 m³/day</i>



Can Diavik explain the difference between estimated and observed pit water inflows? How do the 2003 results change the predictions of maximum pit water inflows used to develop the Licence and approve the project?

Can Diavik comment on the effectiveness of the diffuser and why it is not performing as predicted. If the discharge volumes remain greater than predicted, what actions will Diavik commit to a) study and b) improve diffuser performance to meet their predictions? Is there a possibility that the diffuser is too small?

At the April 14 meeting, Diavik stated that the high volume in 2003 originated about 2/3 from residual construction water. The residual construction water needed treatment for turbidity and was passed through the plant instead of being discharged into the lake as planned. This should not occur in future years.

This interpretation is not supported by the 2003 report, which stated (p. 5) that “*Mining proceeded in A154 down to the 350m elevation. Average pit water pumping rate was 7,856 m³/day*”. This statement indicates that the water volumes were pit water and not pool water or “residual construction water” as stated at the April 14 meeting. Diavik also stated (April 14) that seepage into the pit (through the kimberlite) was higher than anticipated and that this may be related to a deep fault zone that is currently being investigated and that seepage of lake water through the dyke is lower than anticipated and decreasing.

EMAB and Diavik are encouraged to resolve the reasons why pit water discharge volume was higher than predicted in 2003, to monitor pit water volumes against EA predictions in subsequent years and to assess the implications of this to the capacity of their diffuser and to the response of Lac de Gras.

Dissolved Oxygen in Lac de Gras

Figure A15 in the 2003 AEMP report presented profiles of temperature and dissolved oxygen made in Lac de Gras in 2003. No comment or interpretation was provided in the report and no data on baseline dissolved oxygen levels were provided for comparison. Station LdG40 showed declines in spring dissolved oxygen to as low as 2-3 mg/L, well below criteria for protection of aquatic life, and oxygen depletion was also recorded at stations LdG 44 and LdG41.

At the April 14 meeting, Diavik commented that the low reported concentrations were in line with the background readings. Diavik should be encouraged to provide the background data and make this comparison explicit in subsequent AEMP reports.



2.4 Trends and Significance of Observed Changes

Gartner Lee's Terms of Reference for the 2003 review also include comment on:

- a) the significance of any aquatic environmental effects reported by Diavik and;
- b) trends in environmental monitoring that may become significant in the future,

Diavik provide no interpretation of results or assessment of significance in their 2003 report, but none of the responses reported are considered significant. It is still too early in the mine life to assess trends. At the April 14 meeting, Diavik noted that Arsenic was the only parameter to indicate a change that could be sourced to DDMI. The source was likely stockpiled till on the upstream side of the dyke from which runoff reports to the treatment system, but the values were less than the EA predictions. They will continue to monitor and watch these results. Arsenic was not discussed in the 2003 report but the results do show increases from values measured in 2002 at the near-field site (Table 3-3). The median ammonia concentration also increased at the near-field site (Table 3-11).

Our comments on pit water volume do support a need for Diavik to review AEMP results against EA predictions. This will assist in determining the likelihood of change in the future and help develop an Adaptive Management Program, which is one of the goals of a good AEMP program. Diavik should also clearly state and discuss all project related changes in the AEMP report.

2.5 Adequacy of follow-up activities proposed by Diavik

The AEMP report is weak regarding interpretation and follow-up activities. Diavik initially objected to incorporating CCME guidelines as a basis for interpreting AEMP results (response to Tim Byers of YDFN in John McCullum's file report of October 10, 2003). Nevertheless, they incorporated this minimal interpretation into the 2003 report and it is very useful. EMAB should therefore encourage Diavik to consider other follow-up activities focussed on:

- a) completing the required plume delineation study;
- b) assessing why observed initial plume mixing under-ice was less than predicted;
- c) assessing the pit water volumes observed in 2003 against the EA predictions of pit water inflows and accounting for the differences;



- d) comparing groundwater quality from samples collected in upwelling areas near the A154 pit in 2003 (p. 8) against the groundwater quality used to derive EA predictions, particularly for total phosphorus. It is reported to have “increased marginally” (p. 8) but no data are provided; and
- e) confirming the reasons for chronic toxicity in the September 2003 samples and implications to study design and testing protocol.

Diavik have proposed to gain the assistance of a “qualified invertebrate biologist” to assist with program design and interpretation of the benthic data (p. 62). This is a welcome addition to the program. This analysis should revisit Diavik’s conclusion (p. 61) that only one year of reference data was suitable for comparison with the AEMP program. The biologist should also help Diavik develop an adequate program to assess potential project-related changes in the phytoplankton and zooplankton communities in Lac de Gras.

2.6 Revisions to the AEMP for Future Years

Our review concludes that the 2003 AEMP report does not meet all of the requirements of the AEMP program that was approved by the MVLWB. EMAB should therefore ensure that the recommendations made in this review are incorporated into subsequent AEMP programs.

Diavik have also committed to a welcome review of their AEMP program for benthic invertebrates by a qualified invertebrate biologist. Diavik and EMAB should work together to ensure that any recommendations that arise are incorporated onto subsequent AEMP programs.

The MVLWB have also agreed to undertake an independent evaluation of certain aspects of the AEMP: sampling frequency, statistical methods’ ability to detect change, ability to test and confirm impact assessment predictions and reasons for exclusion of a control site and eutrophication monitoring. This is a welcome initiative and Diavik and EMAB should work together to ensure that the review is thorough and that any recommendations that arise are incorporated into subsequent AEMP programs.

3. Rescan Review

In your correspondence of August 10, 2004, you provided a copy of the June 2004 review of the Diavik AEMP that was completed by Rescan on behalf of the MVLWB. You asked for specific comment on the following recommendations made by Rescan:



1. Increase water quality sampling to 4 times per year to be consistent with baseline sampling schedule.
2. Establish a reference site upstream.
3. A revised AEMP Action Plan to detect changes in Lac de Gras sooner.

Overall, the Rescan report provides a thoughtful analysis of the AEMP program and it is particularly strong in its statistical and logical approach to the detection of change and the AEMP program. It is clearly written, and well argued, and benefits from Rescan's obvious familiarity with the Ekati program. I do not support all of the recommendations made, however, and think it important that I address those, in addition to the specific points that you raised.

3.1 Increase water sampling frequency

Rescan concludes that Diavik should increase their sampling frequency for water quality to four times per year: once under ice, plus once in each of July, August and September. Their rationale is presented on page 4-2 and includes:

- a) the fact that Diavik are aggregating data from near, mid and far field sites in part to increase the sample size for comparison against baseline data;
- b) the need to better reflect the seasonal breadth of baseline data for before and after comparisons; and
- c) the precedent set by other Canadian diamond mines (i.e., Ekati).

The last point is particularly important because Diavik are including several BHP (S1 and S2) sites as part of their monitoring program (See Section 2.1, above). As such, co-ordination of sampling programs and sampling frequency would improve the interpretation of results.

I support this recommendation.

3.2 Reference Lake

The strongest reason for including a reference lake in Diavik's AEMP is to account for external factors that may influence water quality, independently of mine activities. A valid reference site works in Diavik's favour, as it reduces the possibility that regional changes in water quality will be interpreted as Diavik-related changes. Diavik discarded Lac du Sauvage as a reference lake for legitimate reasons, of which the potential influence of Ekati's Misery Pit operation was the strongest. As time goes by, however, their alternative of using far-field sites within Lac de Gras



as reference sites is questionable – although the water replacement time of Lac de Gras is 12 years, wind mixing of the water mass in lakes plays a far larger role than hydraulic replacement of water. This is even more pronounced in a weakly stratified lake and one cannot assume that far field sites will not be influenced by near field water quality. Rescan are correct to point out the ambiguous logic in Diavik’s statements regarding the meaning of a “valid control site in close proximity to the mine site”.

I support Rescan’s recommendation that Diavik implement a reference water quality site in another lake.

3.3 Revised AEMP Action Plan

I do not see any great differences in the AEMP action plan proposed by Rescan and that used by Diavik, although the Rescan AEMP and interpretation is very clearly laid out. Rescan support: Diavik’s use:

- a) of control chart analysis (p. 4-12);
- b) of trend analysis (with perhaps increased emphasis on parametric statistical testing, p. 4-14);
- c) of pooling open water and under-ice samples (p. 4-15, we do not support this, see below); and
- d) of spatial gradient analysis between near, mid and far field sites although they recommend it as part of Step 1, to justify pooling data between sites, instead of Step 2 (p. 4-17). I support this

Rescan feel that the main objective of Diavik’s AEMP should be to “*detect and assess changes in Lac de Gras, and not to test and confirm impact assessment predictions.*” (p. 4-18). This statement is somewhat semantic – one cannot test impact predictions without first determining whether or not a change has occurred and so the two objectives are not mutually exclusive. Diavik did predict changes in the water quality of Lac de Gras but concluded that the changes were not likely to be significant.

Rescan feel that that Diavik’s four step action plan is a good start and they make suggestions to improve it. Diavik’s four steps are:

1. Determine if there has been a change from baseline.
2. Determine if the change is the result of Diavik activities.
3. Determine if the change exceeds EA predictions.
4. Determine if the change is significant.



Rescan's plan is as follows:

1. Determine if there has been a change and if it is due to Diavik's activities, with use of a valid reference site.
2. Determine the source of any Diavik-related changes, their significance and relationship to EA predictions. This step includes communication with stakeholders and the potential for Special Effects Studies and the potential use of a risk assessment approach. Rescan propose an interesting approach to determining risk through a "Risk Quotient" to assess magnitude and significance of change. This concept is worth pursuing. The use of the 10-fold difference between CCME Guidelines and measured values to assign "low" risk is presented with a logical rationale but may not be sufficiently protective. The approach is worthy of discussion.
3. Review and Revision of Mitigation Measures.
4. Communication and Reporting.

I do not disagree with anything Rescan have proposed but do not see a great difference between it and the Diavik approach. What I like about the Rescan plan, however, is that it puts less emphasis on EA predictions and more on an independent assessment of the significance and magnitude of any changes that are observed.

3.4 Pooling Data Between Seasons

Rescan make a proper distinction between pooling data from the open water and under-ice seasons in the context of ecological relevance vs the ability to detect change and conclude that it is reasonable for Diavik to continue pooling the two.

I do not support this approach. The natural variance in water quality between seasons is well documented for arctic lakes and pooling data may confound the detection of project related effects. Any increase in open-water concentrations may be obscured by comparison against under-ice data where cryoconcentration increases concentrations naturally. For example, in Figure 3-3 of the AEMP, total Al shows considerable variability between ice and open water and to simply pool the baseline data in this way results in a wide range against which it is difficult to assess any change. The first step in the analysis should be to determine whether or not the project has changed open water or under-ice water quality. This should be done by comparing under-ice to under ice and summer to summer. Only if there are no project-related effects, or if the difference is consistent between seasons, should these data be pooled to assess the ecological significance if, for example, open water increases are in the same range as the under ice increases. Detection of change should not be confounded with determination of significance.



3.5 Periphyton and Eutrophication Monitoring Tools

Periphyton were originally proposed as a eutrophication monitoring tool, in part to address First Nation concerns for visible (vs measurable) indicators of project effects. Rescan are correct in stating that periphyton is not a suitable biomonitor for metals and toxins but it was not proposed for that. A periphyton program was proposed as a supplement to phytoplankton monitoring to assess Diavik's predictions of no significant changes in the nutrient status of Lac de Gras.

Rescan appear to support the development of eutrophication monitoring tools because phosphorus, on its own, is not a suitable indicator of changes in nutrient status. I support this opinion, but note that the biological responses discussed by Rescan are all components of the existing AEMP program. I would also note that Rescan have misinterpreted the predicted environmental effects of the mine. The concentration of 0.2 mg/L (p. 4-11) refers to the effluent limit from the North Inlet Water Treatment Plant, and not to a 100-fold increase in phosphorus concentrations in the lake itself.

Diavik's rationale is correct - the evaluation of eutrophication monitoring tools was originally put forward to address Diavik's position that enhanced phosphorus removal was not required. That is – special studies were proposed to evaluate whether or not enhanced phosphorus removal was warranted. The decision to impose a limit of 0.2 mg/L of phosphorus in the effluent, and the inclusion of phytoplankton monitoring in the AEMP, do supercede the need for these studies. Nevertheless, phytoplankton and zooplankton monitoring should include taxonomic analysis., as discussed above.

4. Summary

Overall, the 2003 AEMP report does not indicate any significant or adverse responses of Lac de Gras to the Diavik Diamond Mine operation. The AEMP meets most requirements of the Water Licence, as modified by DDMI and the MVLWB but our review, and that of Rescan, have noted areas of deficiency in the program design, interpretation and reporting. These have not changed substantially from the concerns raised in our April 13, 2004 report. EMAB are encouraged to consider and pursue these recommendations and concerns.



Please review this report and do not hesitate to contact me if you have any questions or concerns.

Yours very truly,
GARTNER LEE LIMITED

Neil J. Hutchinson, Ph.D.
Senior Aquatic Scientist
Principal

NJH:tmc
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