Gartner Lee Limited

memorandum

to: Sarah Baines
from: Neil Hutchinson, Eric Denholm and Don Hart (Ecometrix)
date: February 28, 2007
ref: GLL 60233
re: **Ekati AEMP Initial Review**

This memo represents our initial observations on the revised AEMP for the Ekati Mine. These observations arise mostly from our review of the December 2006 document (Changes to the AEMP), intervenor comments, conversations between GLL and Ecometrix and our conference call of February 26. The outline for this memo was prepared by Don Hart of EcoMetrix and modified by Neil Hutchinson and Eric Denholm.

Issues

1. Eliminate July/September lake water samples, focus on August, triplicate samples at that time.

   The issue of timing and number of open water sampling events is challenging in a short ice-free season. The Diavik AEMP has, until now, used 1 open water sample but they are now proposing monthly (July-August-September) sampling for variable parameters of key interest (some nutrients and primary producers) and one open water sample for conventional parameters. It is important that sampling be removed from the immediate freshet effect to reduce variability, especially in the smaller, more frequently flushed lakes sampled by Ekati. An August sample is more likely to represent a "steady state" than a July sample and is likely adequate for the purpose of detecting a long-term change due to mining operations. We support triplicate samples but recommend that Ekati consider the seasonal variability of individual parameters before confirming to monthly or one open water sample. We also note Environment Canada's comment that the actual improvement in reliability that would be achieved at this site by moving to duplicate or triplicate samples could be investigated and assessed on the basis of its actual benefit to the program.

   Our recommendation is that the established schedule be retained until such time as it may be demonstrated by BHPB that one open water sample in August is representative of the open-water season and an investigation of the statistical increase in reliability of moving to duplicate or triplicate samples is assessed. This work could be linked with the variability study proposed by BHPB, which is discussed under item no. 8 below.

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2. Investigate the option to improve taxonomic identification of nematodes. Meanwhile, perform evaluations with and without inclusion of nematodes.

   This is new science and was a DFO suggestion to explore whether something could be done with nematodes. Nematode identification is not easy, QA/QC issues and availability of qualified taxonomists may be important. BHPB notes that, even if detailed taxonomy proves useful, there will be no baseline data of this type. We would also add that interpretation of changes and their ecological significance is not straightforward. We would suggest that it is premature to commit to nematode taxonomy without a review of DFO's rationale and any case studies.

   Our recommendation is that nematodes not be incorporated into the AEMP at this time. We suggest that DFO, as the originator of the request, provide additional information regarding methodology, analytical techniques and any examples or case studies to demonstrate how the results of such analysis will be meaningful and beneficial to this program.

3. Continue sampling and analyzing planktonic and benthic community composition.

   All parties agree with this. The AEMP suggests that it might be possible to judiciously select sensitive biota as indicator species. Although adding an element on indicators is useful, it is important to continue looking at the community as a whole and this should be maintained as the focus.

   Our recommendation is that analysis of complete community composition should be continued.

4. Eliminate "shallow" samples from lake sediment and benthos.

   The rationale is that the shallow samples are too variable to provide useful data. This is not obvious from examination of Figures 3.2-3 and 3.2-4 in the November 2006 AEMP, although there seems to be missing data for this zone in some lakes. Shallow samples must also be carefully stratified by sediment characteristics (grain size and organic content) as sources of variability. Again, the key question is whether BHPB would be likely to miss a mine-related effect that would only occur in this zone. This is doubtful as the shallow zone is usually less depositional and sediments (and any associated contaminants) will focus to the deepest basin in the lake. The shallow samples could likely be safely eliminated from the program as long as the deep samples were retained.

   Our recommendation is that the shallow zone sediment samples can be eliminated as proposed.

5. Fish plugs not recommended.

The use of non-destructive sampling for fish tissue has much merit. Although the argument has been made that we are interested in a suite of metals and therefore need larger tissue samples, this argument must be weighed against the few metals that actually bioaccumulate and are of concern (i.e. Hg, Cd, Pb) and which may be present in the Ekati effluent stream. The majority of analytes returned from a conventional metals scan are of little interpretive value and we must ask if the sacrificed fish add value to the AEMP.

We agree that fish plugs should not be instituted at this time, largely for the reasons put forward by BHPB. However, we feel that there may be potential for this approach to be integrated into the AEMP in the future as part of an overall optimization of the program. If BHPB were to propose, with rationale, a short-list of key parameters for fish tissue that were sufficient for monitoring purposes, then the approach of sampling fish plugs could provide the benefit of reduced fish mortality. This could be linked to the proposed study of using sculpin as a sentinel species as an alternate means of achieving the same goal: reducing mortality in top predator species. This analysis should also consider the need for, and frequency of, monitoring liver samples in addition to muscle.

6. Fish tissues instead of taste testing.

We are not sure there is any reason to anticipate palatability effects from a mining operation (such effects usually relate to organic contaminants); nevertheless, concern has been expressed. A meaningful taste-testing program is a very large effort, and should not be undertaken without good reason. Having said this, the BHPB concern about putting humans at risk through taste testing seems unlikely. Existing data on metal residues in fish tissues could be reviewed (see also comment 5) to address the likelihood of any human health concern.

Fish palatability testing by tasting is a requirement of the Water Licence (Part I, Item 3a,vi). The MVLWB's Reasons for Decision on this item link the requirement for palatability testing to recommendations provided, at the time of the Licence renewal in 2005, by the Lutsel K'e Dene First Nation (LKDFN) and to similar requirements in other Water Licences (i.e., Snap Lake). *"The Board is of the opinion that these studies complement the knowledge gained through science-based monitoring, as well as encourage First Nations people to directly participate in the monitoring of their traditional lands."(*RfD, page 19/20 of 28) BHPB has proposed an alternate means of measuring palatability without tasting by measuring various organic compounds that reportedly relate to flavour and taste and by conducting a DELT analysis that could include the direct participation of First Nations.

We note that BHPB reports that the LKDFN again raised this as a concern during the November 2006 AEMP workshop and that BHPB subsequently attempted, but was unable, to arrange a meeting with the LKDFN in time for the December 31 filing of the AEMP.

Our recommendation at this time is that this issue be highlighted to the WLWB as regards the condition of the Water Licence.

7. Investigate pseudo-replication issue.

The proposed study in two lakes to examine spatial variability is worthwhile. The whole question of pseudo-replication depends on how the data are being used. For example, if we are testing hypotheses about differences between lakes, then the replicates should adequately represent the within lake variability. This issue can be resolved through design of the monitoring program.

In their cover letter dated December 31, 2006, BHPB propose that they conduct a study of sample variability and report to the WLWB in February 2008 (i.e., one-year). That report will also include any proposed revisions to the AEMP that may result from the study. In this way, the study results and proposed changes to the AEMP can be reviewed by the WLWB in time for implementation in 2008.

Our recommendation is that the proposed variability study be undertaken by BHPB as proposed. As described above under item no. 1, we feel that this variability study could also be used to resolve issues relating to lake sampling during the open water season.

8. Evaluate critical effect sizes.

This issue was raised by INAC, and the investigations proposed by BHPB seem to be supported by IEMA and NSMA. The latter notes that aboriginal groups should be consulted. While the AEMP does not say why critical effect sizes are needed, INAC points to the need to relate them to an adaptive monitoring program and that they will guide decisions about whether meaningful change has occurred. The critical effect size will also have implications for sampling effort (is the effort adequate to detect the degree of change that is deemed meaningful?). All this is tied up with how we are statistically testing for change (e.g., lake x time interaction in ANOVA? See No. 20). These questions should be resolved on a going-forward basis, rather than going back to amend the EIS as suggested by INAC. The EIS has been approved by the Minister and cannot be revisited by the WLWB. It is fair to consider critical effects sizes as part of the AEMP, however, and how they relate to adaptive management.

The Water Licence requires "*statistical design criteria ... that ensures both accurate characterization of short-term variability and the collection of sufficient data to establish*

*long-term trends"(*Part I, Item 2e). BHPB suggests that this aspect of the AEMP will be improved through their proposed study of critical effect size.

In their cover letter dated December 31, 2006, BHPB propose that they conduct a study of critical effect sizes, with community consultation, and report to the WLWB in February 2008 (i.e., one-year). That report will also include any proposed revisions to the AEMP that may result from the study. In this way, the study results and proposed changes to the AEMP can be reviewed by the WLWB in time for implementation in 2008.

We agree that this issue is directly related to adaptive management and, thereby, to the forthcoming Adaptive Management Plan (AMP) that is required to be submitted by May 1, 2007. We anticipate that there will need to be links between the AMP and the AEMP. The Water Licence, in fact, anticipates this by explicitly linking the two programs (Part H, Item 7f).

We provide detailed comments regarding adaptive management below.

Our recommendation regarding critical effect size is that this is required information for the AEMP. However, approval and implementation of the proposed AEMP should not be withheld over this issue. We agree that resolution of this issue will take time and effort for technical derivations and community consultations. Therefore, we recommend that a study of critical effect size be undertaken by BHPB, to be completed and reported no later than the February 2008 deadline proposed by BHPB. The study should be linked with development and finalization of the Adaptive Management Plan, the WLWB review of which is schedule to begin in May 2007.

We provide related recommendations regarding adaptive management below.

9. Multivariate analyses every three years.

There seems to be general consensus that the multivariate analysis is useful. We agree, and would support the BHPB notion of doing it every three years. IEMA suggests doing it annually, but it is a considerable effort and it is probably not needed every year. It should be regarded as a "higher level" evaluation of overall spatial-temporal patterns, and of relationships between biological and chemical patterns. There is still a need for univariate statistical approaches in deciding what parameters show meaningful change, and where these changes have occurred.

Our recommendation is that the multivariate analysis be carried out on a 3-year cycle that complements the cycle for review and revision of the AEMP.

10. Switch from BACI to broader spatial-temporal design for long time series.

    A BACI design does not lend itself to trend analysis on its own. We agree that looking for lake x time interactions, without the before-after constraint, makes sense when trends are continuing to develop in the post-startup period. We note, however, that a change has to occur before any trend becomes apparent.

    Our recommendation is that BHPB adopt a design that investigates temporal-spatial aspects of response, considering lake x time interactions, as suggested. BHP should also consider how critical effect sizes will be defined within this design (item no. 8).

11. Step-wise elimination for biotic data.

    The AEMP is not clear about how this would be done. The DFO expressed some concern about eliminating sensitive taxa. We must distinguish, however, between sensitive and rare taxa. Rare taxa may not be that useful for detecting effects and could be eliminated but sensitive taxa are critical. A step-wise procedure is valid in principle, as long as the procedure is retaining species (rare or not) that suggest a mine response pattern.

    Our recommendation is that BHPB provide a rationale and procedure for stepwise elimination of taxa from analyses of community biotic response.

Other Issues Raised by Stakeholders but not Addressed in the AEMP

12. Need for completed LLCF water quality studies.

    The IEMA has indicated they need to see the new LLCF study to be able to evaluate the AEMP. This is an enhanced source modeling study that will forecast future contaminant releases. The study is not a requirement of the Water Licence and is anticipated to be released by BHPB in 2007. The IEMA concern is that any parameter forecast to increase in the receiver should be added to the monitoring program.

    There has been previous consideration of source loadings to arrive at the present monitoring list, which is quite comprehensive. From this list, we know which parameters actually are increasing in the receiver at present. It would be reasonable to expect a commitment to ensure the monitoring list includes any new parameters expected to increase in the receiver based on the LLCF studies in progress. BHPB has committed to report <u>all</u> measured parameters. Although advance warning is useful, the existing monitoring program is comprehensive and this issue need not hold up approval of the AEMP.

    Our recommendation is that BHPB commit to incorporating appropriate revisions to the AEMP that may result from the LLCF study as part of their February 2008 submission to

the WLW. This submission is already proposed as a means to propose changes that may relate to the variability study and the critical effect size study.

13. Scope of cumulative effects discussion.

The Water Licence requires that a "description of how the Project-related cumulative effects … will be evaluated …"(part I, Item 3h). We believe that this condition requires BHPB to consider all potential contaminant pathways from the project to the aquatic environment and to assess the additive effects of these multiple stressors on the aquatic environment. This condition does not require BHPB to conduct a regional cumulative effects assessment incorporating mining or other activities conducted by others. We note that this condition is similar to a requirement of the Diavik AEMP, where the condition has been interpreted in the manner described above.

Regional cumulative effects for diamond mining and other developments in the Lac de Gras region are beyond the purview of any one operator, although all Parties (including government) should participate. Monitoring response to multiple stressors from one operation is the responsibility of that operator.

The past and proposed AEMP programs appear to monitor various potential contaminant pathways such as effluent and fugitive dust emissions. It is not clear that past AEMP reporting has provided an integrated assessment of the additive effects of potential multiple stressors. The AEMP proposes to integrate SNP data into the multivariate analyses.

Our recommendation is that BHPB be required to fulfill this reporting and analytical requirement as it is described above.

Adaptive Management

14. Links between AEMP and Adaptive Management Plan.

An important requirement for any AEMP is to be directly linked to a response and decision-making process through which the monitoring results are evaluated and appropriate response measures are developed and implemented in a timely manner, before detrimental impacts occur. This process can be a part of the AEMP itself or external to the AEMP.

The Water Licence requires a "description of how the results of the AEMP will be incorporated into the overall adaptive management strategies … (Part I, Item 2h). Also, the Water Licence requires a "detailed description of how the data collected in the AEMP will be used to identify the need for additional mitigation strategies …"(Part I, Item 3f). We are unclear on how these conditions have been fulfilled in the past. Going forwards, BHPB refers these requirements to the forthcoming Adaptive Management Plan (AMP), which is

due for submission to the WLWB by May 1, 2007 under Part H, Item 7 of the Water Licence.

In their December 2006 AEMP proposal, BHPB state that the AMP will *"describe how AEMP data will be used within the framework of adaptive management, and how the results of adaptive management will be reported in the AEMP"(*Appendix 3).

The Water Licence conditions for the AMP (Part H, Item 7) require that response thresholds and triggers be established for "contaminants of interest" that must include at least the 15 water chemistry parameters listed (Item 7 b). Part H Section 7f requires "linkage with the AEMP …".

It is unclear, at this time, how BHPB intends to satisfy the conditions of both the AEMP (Part I) and the AMP (Part H, Item 7) through the May 1, 2007 submission. The AEMP provides much more data than the 15 parameters listed in Part H Item 7b that could be effectively used in adaptive management through the establishment of thresholds and triggers.

Further, we feel that these issues related to linking the AEMP to adaptive management responses are also linked to the issues described above regarding critical effect size. We have recommended (above) that the proposed study of critical effect size should also be linked to the AMP because of the direct relationship between adaptive management thresholds and triggers to effect sizes.

Therefore, we see that the AEMP, the AMP and the study of critical effect size are all linked together. However, per our comments above, we do not feel that approval and implementation of the proposed AEMP should be withheld on this basis. Resolution of the AMP and its links to the AEMP will take some time and effort by BHPB, including regulatory and community consultation.

Our recommendation regarding an adaptive management response plan is that this is a required linkage for the AEMP. We feel that this could be effectively accomplished through the forthcoming AMP. However, approval and implementation of the proposed AEMP should not be withheld over this issue. Therefore, we recommend that a condition of approval of the proposed AEMP be that BHPB provide a detailed description of how the Water Licence conditions relating to a link between the AEMP and AMP are being achieved and how the AMP relates to the study of critical effect sizes. This information should be reported no later than the February 2008 deadline proposed by BHPB.

NJH, DRH, EJD