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Prairie & Northern Region
Environmental Protection Operations Directorate
Room 200, 4999-98th Avenue NW
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Martin Gavin
Manager, Giant Mine Remediation Project
Aboriginal Affairs and Northern Development
P.O. Box 1500
Yellowknife, NT, X1A 2R3

Dear Mr. Gavin:

Subject: Metal Mining Effluent Regulations – Evaluation of 3rd Environmental Effects Monitoring (EEM) Interpretative Report, Giant Mine, Northwest Territories

This letter is to advise you that the report entitled, '*Giant Mine Environmental Effects Monitoring Phase 3 Final Interpretative Report*', has been evaluated and meets the requirements specified in the Metal Mining Effluent Regulations of the *Fisheries Act* for environmental effects monitoring studies. The evaluation is based on the review of the report by a Technical Advisory Panel consisting of representatives from Environment Canada, Fisheries and Oceans Canada, Aboriginal Affairs and Northern Development Canada and Mackenzie Valley Land and Water Board.

The compiled review comments are appended. These comments should be addressed in the form of a simple addendum to the interpretative report.

Please be reminded that an EEM study design must be submitted in writing at least 6 months before the biological monitoring study is conducted. Mines planning biological fieldwork for the summer/fall of 2012 should submit study designs during winter/spring 2012. Please refer to Schedule 5, Section 22 of the regulations for submission timelines for the next interpretative report.

If you have any questions concerning the evaluation of your EEM interpretative report, please contact Shelly Boss, the EEM Coordinator for this facility [Email: Shelly.Boss@ec.gc.ca, Tel: (780) 951-8754, Fax: (780) 495-2444].

Sincerely,

for David Ash
Acting Regional Director
Environmental Protection Operations Directorate
MMER Regional Authorization Officer

cc.

Chad Harden	Environment Canada, Yellowknife
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Kathleen Graham	Mackenzie Valley Land and Water Board, Yellowknife

Technical Advisory Panel (TAP) review comments on "Environmental Effects Monitoring (EEM) Program, Phase 3, Final Interpretative Report, Giant Mine – June 2011"

General Comments

1. The third Environmental Effects Monitoring (EEM) Interpretative Report for Giant Mine was well-organized and comprehensive. Components such as detailed appendixes, plume conductivity delineation, and analysis of sediment metals added to the report and aided in the interpretation of biological data.

2. The results of biological monitoring studies presented in the 2008 and 2011 Interpretative Reports indicate similar types of effects on the fish population. Thus, the next study should include biological monitoring studies (i.e., site characterization, fish and fish tissue (as applicable), and benthos) (S.19(1)(a)(b)+(c)) and "a description of one or more additional sampling areas within the exposure area that shall be used to assess the magnitude and geographic extent of the effect." (S.19(1)(d)). Please refer to the Metal Mining Effluent Regulations (MMER), Schedule 5, Sections 19 to 22.

3. A study design must be submitted to the authorization officer at least 6 months before the biological monitoring study is conducted (MMER Schedule 5, Section 19(1)). Please refer to MMER Schedule 5, Section 22 for submission timelines for the next interpretative report.

4. Executive summary and elsewhere: The following clarifications are provided regarding the cited rationale for the facility conducting periodic monitoring for phase 3. Although the Bray-Curtis Index (BCI) was significant in the initial phase, in the second phase the statistical significance of the BCI was dependent on the inclusion or exclusion of outliers. After due consideration, it was concluded that the effect on the BCI was not confirmed in two consecutive studies. Note also that although the TAP did agree that confirmation of the fish study would be appropriate this was not based on concerns regarding confounding habitat factors.

5. Executive summary and elsewhere. The report tends to place emphasis on the possible influence of factors such as temperature and historically contaminated sediments within the exposure area. It should be noted that a number of parameters of concern are elevated in the effluent and occur at concentrations in exposure area water samples above guidelines set for the protection of aquatic life (Canadian Water Quality Guidelines (CWQG), or similar guidelines). Of particular note are nitrate, arsenic, copper, chloride and sulphate.

Site Characteristics

6. P. 18. The report notes the future plans for a new discharge location. Further information on the proposed diffuser and its location would be appreciated. Similarly, information on any other plans that could affect the EEM program at Giant Mine, e.g., possible re-diversion of Baker Creek, is relevant information for the TAP and would be appreciated.

7. P. 19. Please clarify the discharge start and end dates for 2010.

8. P. 21. The report indicates that arsenic and copper in effluent exceed CWQG. Note also that cyanide and selenium are slightly higher than guideline concentrations in some or all samples.

9. P. 21. For your information, CWQGs have now been finalized for the chloride ion. Canadian Council of Ministers of the Environment set guidelines of 120 and 640 mg/L chloride for long- and short-term exposure, respectively, for the protection of aquatic life.

10. P. 22. Table 2-4 lists the CWQG for nitrate (as nitrogen) as 13 mg/L. The CWQG of 13 mg/L is for mg of NO_3^-/L; the equivalent guideline for nitrate as nitrogen would be 2.9 mg/L. This value is exceeded for all of the 2010 effluent samples listed in Table 2-4.

11. P. 29. The report notes the high levels of sulphate in effluent on page 21, however data on sulphate are absent from Table 3-2 regarding water quality in Baker Creek. Please provide these data if available.

12. P. 29. The text notes that arsenic and copper were higher than applicable guidelines in Baker Creek exposure area samples. The TAP notes that other parameters, such as cyanide, nitrate, selenium and chloride, exceeded applicable guidelines in one or more samples.

Fish Survey

13. P. 52 (also P. 76). Please clarify the method used when the slopes of regression lines were not parallel during ANCOVA. Is the reported difference in R^2 values a comparison between the full and reduced regression models, as described in Barrett et al. (2010)?

14. P. 56 (and page 114, benthic section). The discussions provided on water quality QA/QC, and identification of any related issues, were detailed and informative.

15. P. 73. The report states that the proportion of parasites in slimy sculpin was higher in the exposure area than in the reference area for females, and that the reverse was true for males. From table 4-12, it appears that parasites were present in higher proportion in exposure females (45%) and males (62%) than in the reference area (females 6%, males 34%). Please confirm if this is correct.

16. P. 75-76. The thorough approach taken to data screening and testing and efforts to deal with significant statistical interactions are commended. Please note that a significant interaction (i.e., non-parallel regression slopes) is considered a statistically significant effect for the fish survey. Chapter 8 of the 2011 metal mining technical guidance document (MMGD, Environment Canada, 2011) provides a third possible approach for significant statistical interactions, in cases where removal of outliers has been attempted and the parallel model cannot be used. This involves estimating effects separately for small and large fish.

17. P. 84, 89. The report indicates that female liver weight at body weight (p.84) and YOY condition (p. 89) were not analyzed due to highly unequal variance. Were non-parametric tests considered? Please discuss further.

18. P. 85, 87-88. The graphs provided for relationships of length-weight, size at age and relative gonad relationships were informative, particularly in cases where there were statistical interactions. It would be appreciated if similar graphs for relative liver data could be provided, as these appear to have been omitted from the report.

19. P. 86. As noted in the report, growth appears to be higher for younger sculpin in the exposure area and lower for older age classes. The TAP recommends analyzing size at age by t-test within age classes to confirm site differences in growth.

20. P. 86. Please clarify the magnitude of effect on male relative gonad size. Text on page 86 indicates the difference was <20%, whereas Table 4-18 reports a magnitude of 38.66%.

21. P. 96, Table 4-23. Where there is only one age class fish, such as for male and juvenile sculpin in 2006, differences in size at age can be compared as weight (or length) within the age class using t-test/ANOVA. Also, as noted in comment 14, significant interactions should be listed in the table (see also Table 4-24) as an effect.

Benthic Invertebrate Community Survey

22. P. 112. Were benthic samples sorted in there entirety? If laboratory sub-sampling was performed, please provide details on the methods used and QAQC performed.

23. P. 112. What was the realized precision (abundance and richness) of the benthic station sub-samples?

24. P. 118. Please confirm whether nitrate should also be listed in Table 5-4 as having near-field concentrations more than two times those of the reference area.

25. P. 119. The presentation of sediment data by station is appreciated. To meet requirements under Schedule 5, section 16(a)(iii), please also provide descriptive statistics of mean, median, standard deviation, standard error, and minimum and maximum values for sediment measurements (TOC, particle size) by area.

26. P. 125-126. There are a few discrepancies between the descriptions of family presence/absence on page 125 and information in table 5-10 (e.g., Hydridae also found only in the reference area, Pisidiidae present in near-field but not far-field area). Please confirm whether the information in Table 5-10 is correct, and clarify any discrepancies between page 125 and table 5-10.

Toxicity Testing

27. P. 136. The summary of sublethal toxicity results for this and previous phases is appreciated. It is indicated in the report that effluent concentrations of <30% elicited sub-lethal toxicity to *Ceriodaphna dubia*, *Pseudkirchneriella subcapitata* and *Lemna minor* in Phases 1 and 2 but not in Phase 3. It would appear from the information presented in Tables 6-2 and 6-4 that this was the case for *P. subcapitata* growth and *L. minor* biomass, but that toxicity did occur in Phase 3 at <30% effluent concentrations for *C. dubia* reproduction and *L. minor* frond number.

28. P. 138. The numbers discussed under "Potential Effects in Baker Creek" appear to be those from phase 2, rather than phase 3.

Synopsis and Conclusions

29. P. 139. The TAP notes several consistencies in sculpin results between the 2006 and 2010 surveys. In particular, young fish in the exposure area appear to have higher growth (age-1 exposed fish almost 25% heavier in 2006, bigger in 2010 judging from Figure 4-6) compared to reference fish, there is a near-absence of older age classes in the exposure area and

corresponding lower CPUE (evident in 2010). Older fish that are present in the exposure area may have slower growth than reference fish.

30. P. 139. The synopsis and conclusions for the invertebrate community do not make reference to the differences found in the assemblages between areas. Notwithstanding the risk posed by historical contamination, current effluent appears to have contributed to some changes in benthic assemblage composition, e.g., a higher proportion of chironomids and lower proportion of mayflies in the near-field area relative to the reference area and far-field area.

Further Recommendations

31. P. 140. The report notes concerns regarding confirming effects based on age for sculpin and size for ninespine stickleback. Further information would be needed to fully evaluate these concerns. Note that some of the ideas presented regarding examining age and size structures of the populations could be appropriate as part of an investigation of cause study.

32. Previous correspondence from the mine had indicated that preliminary studies may be undertaken upstream of the discharge on Baker Creek to assess suitability as a reference area for the fish and benthic studies. As noted in previous reviews, the TAP is in favor of locating a reference area that is more similar to the Baker Creek exposure area, such as the upper reaches of Baker Creek.

Minor points and errors

- P.52. Table 4-2 should also list weight at age, which is an effect endpoint.

- P. 67. The report states that species richness of fish was equal between the Exposure and Reference areas at 9 species. It would appear from Table 4-8 that a total of 8 species were caught in the Exposure Area and 7 in Reference area.

- P. 97, Table 4-24. Length and weight of young-of-the-year fish at the end of the growth period are considered endpoints used for determining effects for a non-lethal survey. Length and weight are listed as support endpoints in the table.

- P. 128. The report states that there were no families present in 2010 that were absent in 2004 and 2006. From Table 5-10, this does not appear to be the case (e.g., Perlidae, two families of Oligochaetes).

- P. 134. There are some inaccuracies in the first paragraph under 6.3.4. Note that sublethal toxicity data are submitted once per year, by March 31st for tests conducted the previous year, and are entered into Environment Canada's electronic reporting system, Regulatory Information Submission System (RISS). Hard copy reports are submitted to the Regional Authorization Officer.

References

Environment Canada. 2011. Metal Mining EEM Guidance Document (MMGD).