Environment Canada | Environnement Canada

Prairie & Northern Region
Environmental Protection Operations Directorate
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7834-3-37/E77-1

Andrew Mitchell
Development Manager - Canadian Operations
Minerals and Metals Group
200-1159 Alloy Drive
Thunder Bay, Ontario P7B 6M8

Dear Mr. Mitchell:

Subject: Metal Mining Effluent Regulations – Evaluation of 2009 Environmental Effects Monitoring (EEM) Interpretative Report, – Lupin Mine, Nunavut

This letter is to advise you that the report entitled, 'Lupin Gold Mine Environmental Effects Monitoring Cycle 2 Interpretative Report', submitted by June 2, 2009, 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, the Nunavut Water Board, and Indian and Northern Affairs Canada.

The compiled review comments are appended. These comments should be addressed in the form of a simple addendum to the 2009 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. Therefore, mines planning biological fieldwork for the summer/fall of 2010 should submit Study Designs during winter/spring 2010. Note that the Interpretative Report for the next phase at this facility is due no later than June 6, 2011.

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If you have any questions concerning the evaluation of your 2009 EEM Interpretative Report, please contact Erik Allen, the EEM Coordinator for this facility [Email: erik.allen@ec.gc.ca, Tel: (780) 951-8750, Fax: (780) 495-2444].

Yours sincerely,

Cheryl Baraniecki
Acting Regional Director
MMER Regional Authorization Officer

cc:	Anne Wilson	Environment Canada, Yellowknife
	Erik Allen	Environment Canada, Edmonton
	Chris Baron	Fisheries and Oceans Canada, Winnipeg
	David Hohnstein	Nunavut Water Board, Edmonton
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Technical Advisory Panel Review Comments on "Lupin Gold Mine Environmental Effects Monitoring Cycle 2 Interpretative Report, May 28, 2009"

General Comments

1. Overall this report was well organized, clearly written, and made effective use of figures and tables. Comparisons to Phase 1 results were instructive and enhanced the interpretation of Phase 2 data.

2. Results from the 2006 and 2009 interpretative reports indicate that an effect on fish condition has been confirmed in two consecutive monitoring studies. This moves the mine to a 2-year focused monitoring phase. The mine has the option to proceed directly to an investigation of cause (IOC) study, since the results of previous biomonitoring studies have adequately determined the magnitude and extent of the effect.

3. The schedule included on pages 77 and 78 is not correct. Please note that the next IR for Lupin mine is due no later than June 6, 2011, and the study design must be submitted 6 months prior to the start of field work (e.g. early February 2010).

Executive Summary

4. p. ii: There was no mention in the summary of results that condition was significantly lower in arctic grayling and ninespine stickleback in the exposure area. These are key findings and should be included in the executive summary.

Water Quality

5. p. 18: Field chemistry data are missing for certain water quality and biological sampling stations (e.g., depth, air temperature, DO, turbidity). Please comment as to why these data were not collected at certain sites (see Appendix B, Table B1, Field Chemistry Data).

6. p. 18. Please provide water quality QA/QC data for field and trip blanks.

7. p. 19: pH was reported to be lower in exposure (6.26) than reference areas (8.18), however the pH range reported for the reference system was 5.80-10.00 (Table 4). This raises concerns about the accuracy and precision of the field pH meter. Please comment on the wide range of pH values reported for the reference area.

8. p. 21: Conductivity in Dam1a was 25-fold higher than reference areas despite a 3-year absence of effluent discharge. Please provide possible reasons for the elevated conductivity in the exposure area.

9. p. 22: Elevated nitrogen concentrations reported in the water quality data on page 22 suggest a release of nitrogen into the system when the mine is actively discharging effluent. Please comment on potential sources of nitrogen in the effluent.

Benthic invertebrate community survey

10. p. 28: In Phase 2, benthic samples were sorted to size 250 µm (indicated as 212 µm in Table C-2), whereas in Phase 1, benthic endpoints were determined from the 500 µm fraction (250 µm size fractions were included in the appendix). Given that different size fractions were analyzed between Phase 1 and Phase 2, please comment on how this might affect the comparison between Phase 1 and Phase 2 results, as presented on p. 44. Please note that the response to TAP comments submitted by Gartner Lee on behalf of Lupin Mine (dated June 24, 2008) states that benthic samples would be sieved with a 500 µm mesh.

11. p. 28: Were benthic samples sorted to size 250 µm or 212 µm (as indicated in Table C-2)? Note that EEM protocols recommend including the 500+ µm fraction as supplementary data.

12. p. 31: Please note that the 2 SD difference is an interim guidance effect size and that the MMER defines an effect as a statistically significant difference.

13. p. 32: Total invertebrate density in the exposure area was reported as "slightly higher" than the reference but non-significant at $p > 0.05$. In fact, the mean exposure density was 3SD higher than the reference, and the reported p-value was 0.085 (p. 42) which is significant at $p < 0.1$. Note that since the statistical power of the test was set at 0.9, it is recommended to set $\alpha = \beta = 0.1$ (see Chapter 5 of the MMER Guidance Document).

14. p. 30 and 42: Please provide more detail on the approach used for power analysis conducted on the benthic endpoints. As outlined in Chapter 5, Section 5.11.3 of the MMER Guidance Document, for a sample size of 5, p-value of 0.1, and effect size of ±2SD, the power of the benthic analyses is 0.90. Thus it is unclear why the comparisons of benthic density and BCI, which showed differences of 3SD and 1.8SD respectively, were reported to have such low statistical power.

15. p. 30: Why was a non-parametric test (Mann-Whitney) used to compare diversity, evenness and BCI indices?

16. p.41: The p-value reported for BCI is 0.039 on p. 41 and 0.009 on p. 42 (Table 10)- please clarify.

17. p. 39-40: Evenness and diversity means were each skewed by apparent outliers (sites SCP4 and FL5, exposure and reference, respectively). There was also a wide range in density data for the exposure site. Please comment on possible explanations for these outliers such as differences in habitat or other confounding factors (e.g., site FL5 had notably higher in coarse fragments than other reference sites).

Sediment quality

18. p. 28: Please comment on QA/QC procedures for the sediment quality analyses, and provide any relevant data.

19. p. 43: Stating the magnitude of the differences in sediment quality between exposure and reference sites (e.g., As, 3.7x higher in exposure; Co, 3.7x; Cu, 2.4x; Ni, 3x; Zn. 2.7x) would help to provide context for this section.

20. p. 44: Please note, the 2005 benthic invertebrate samples were collected 13 to 20 days after effluent was discharged to the receiving environment.

Fish community survey

21. p. 52: Were 10% of the aging analyses independently verified? The report refers to duplicate analysis of aging structures but it is not clear if the analyses were done independently.

22. p. 63: The liver weight:fork length endpoint was not included in the power analysis, and showed moderate, but statistically significant, differences between areas for both ARGR (4% higher in reference), and NSSB (9% higher in exposure). Please comment on the statistical power of this comparison.

23. p. 61: ARGR condition was reported to be 18% lower in the exposure area. How was the 18% value calculated? Please provide adjusted means for each endpoint compared with ANCOVA.

24. p. 64: Please provide a post-hoc power analysis of the fish data presented in the Phase 2 report, so that sample sizes can be determined for future studies.

25. p. 64: The report states that due to the small size of the NSSB, it was not possible to collect aging structures from immature individuals, and so it was assumed that all fish were the same age. It is noted that all NSSB were classified as immature (see Table D-4), even though the fish ranged in size from 25 mm to 50 mm (e.g., exposure; see Fig. 25). Other EEM studies north of 60 have aged NSSB and determined that fish in that size range could be 2 to 3 years old.

26. p. 75: It is reasonable to suggest that comparisons of NSSB endpoints may be confounded by the fact that NSSB are known to occasionally spawn multiple times in a season, and that fish in the same age class may exhibit different rates of growth depending on their hatch times. However, the size range sampled in this study likely included adults based on the NSSB age data reported from a site in the Northwest Territories. The TAP recommends future study designs include plans to age at least a subsample of NSSB if that species is to be used as a sentinel species.

27. p. 75. The authors suggest that a lower abundance of suitable NSSB habitat in the reference area could contribute to a smaller average body size. Please elaborate on the differences in habitat between exposure and reference areas, as this could be valuable information for site selection in future monitoring studies.

Minor Comments and errata

p. 1: Please note that the timing of submission of EEM studies is not always 3 years, and can vary depending on the results of previous studies.

p. 21: Note that TP concentration in the exposure area was reported to be lower in 2008 vs 2005, but since the detection levels differed between studies, it is not possible to

make this comparison (i.e., the 2005 value was reported as <0.02 mg/L, and the 2008 value was 0.004- see Table 6).

p. 24: The results of Phase 1 toxicity testing were re-stated in the current report, as no effluent had been released since the previous monitoring study. Biological effects were reported to occur at effluent concentrations as low as 6.1%, however reproductive impairment of invertebrates was detected as low as 4.1% in Phase 1.

p. 72: The authors state that NSSB were significantly smaller in Phase 2 compared to Phase 1- note that this was in the exposure area only, since only 1 NSSB was caught in the reference area.