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April 25, 2007 Our File: **4780 005 050 050**

Wek'eezhii Valley Land and Water Board
#1 4905 – 48 St.
Yellowknife, NT X1A 3S3

Attention: Sarah Baines By Email

Re: Ekati Diamond Mine Proposed Chloride Discharge Criteria for the Sable Kimberlite Pipe Development – Water Licence MV2001L2-0008

The above-noted Rescan report dated January 2007 has been reviewed on behalf of Environment Canada (EC) by Uwe Schneider of the National Guidelines and Standards Office and by myself, and the following comments are provided for your consideration.

EC would like to commend BHP Billiton for initiating this research and for taking steps to publish the results in the primary literature. This work has been done in support of developing site-specific discharge criteria for the proposed Sable pit development, and it is not the intent that this be used as a general discharge objective.

EC's comments and concerns cover four basic areas in respect of development and application of the criteria:

1. relationship of test species to biota in the Horseshoe Watershed;
2. toxicity-modifying factors (hardness and temperature);
3. derivation methodology
4. potential for accumulation of chloride over time; and,
5. the issue of setting end of pipe discharge criteria based on dilution capacity available to meet receiving environment objectives.

1. Test Species:
Even though the resident biota have been identified, the connection of this information to the species tested in the toxicity experiments is not made clear. For example, resident fish are round whitefish, lake trout, and arctic grayling, plus some unidentified lower trophic level fish. Tested fish species are rainbow trout and fathead minnows. While acceptable, it is unfortunate, as resident species testing would have resulted in a more appropriate site-specific water quality guideline. It is acknowledged that sourcing native species is often difficult, but would be worth attempting.

The report notes that testing of resident species of cladocerans may be warranted if chloride concentrations approach the proposed objective. As cladocerans appear to be more sensitive than fish, this would be an appropriate contingency plan.

2. Toxicity modifying factors:
One factor that should be considered more closely is the water hardness. Horseshoe Lake is a fairly soft water lake (hardness measurements were 7-9 mg/L), while most of the toxicity testing was done with moderately hard synthetic water (hardness of 80-100 mg/L). While the document indicates that toxicity is decreased in hard water, it does not give any quantitative analysis (acknowledging this may not be even possible) of how much toxicity could be increased in the softer water of the lake. However, it is unlikely that the difference will be significant enough to be a major cause of concern by itself. We note that hardness in the effluent is predicted to be in the order of 10^3 mg/L and this will modify receiving water values upward. It would be helpful to have an estimate of the extent and effect of this, to help evaluate the effect of hardness on chloride toxicity.

Another factor to consider is the water temperature of the lake and the test waters. Most of the tests were made at 20, 23, or 25 degrees, only the rainbow trout test was done at 14 degrees. For a national guideline, this would be considered acceptable, and for many site-specific guidelines as well. However, to be a truly site-specific guideline for Northern waters, more toxicity testing at lower temperatures would be required. Toxicity is generally higher in warmer water, so this may become another small safety factor.

The influence of other toxicity modifying factors (besides temperature and hardness) should be assessed. For this, an effluent characterization is necessary, and potential interactions with other water parameters and substances should be assessed (e.g., the concentration of what other substances (cations and anions) will increase), especially if hardness increases significantly.

3. Derivation methodology:
Other reviewers have raised questions regarding the protectiveness of the 313 mg/L value, and have questioned the derivation in that there have been deviations from the cited protocols. To address this, the HC_5 should be recalculated using the cited protocols (specifically, using the distribution approach rather than the non-parametric approach used) and results compared to see if they are significantly different.

There needs to be further discussion between experts on the derivation, and steps should be taken to address some of the concerns, (such as identifying what was used in the dataset, what was excluded (and why), and re-estimate using the CCME approach). We note that the HC_5 used is the absolute value rather than the lower 95% confidence limit, which would be a more conservative approach.

4. Potential for accumulation of chloride and lake concentrations evaluated:
Rescan showed through their calculations that the chloride mixes in the receiving lake and the resulting dilution should not result in a concentration that exceeds their derived safe threshold value. This is acceptable as long as the calculations were done properly (which was not examined in our review), however concern arises due to the fact that chloride is persistent, and it is not clear whether this was properly taken into account. The study shows what the dilution is, but not really what the overall inflow and outflow to the lake is. How much chloride by mass will be added to Horseshoe Lake, how much is

flowing out, and could this result in a gradual salination over time? If it does result in a gradual increase in chloride concentration, it could pose a problem.

The use of a 21 day average is also of concern, as this could incorporate wide fluctuations in concentrations. It would be useful to have confidence intervals attached to the predictions around flow and chloride concentrations. The concern with pulse exposures of the chloride is also raised as a factor that should warrant a lower endpoint estimate, i.e. the HC_5 would be expected to go down if testing had been done under non-static conditions.

5. Point of application of criteria:
Under Section 36(3) of the *Fisheries Act* (and the terms of the water licence) the effluent must be non-acutely toxic at end of pipe, and this is generally established using the standard rainbow trout bioassay test. (It is noted that there is also precedent for chronic tests to be used in defining deleteriousness.) *Fisheries Act* authorizations issued under Section 35 for the harmful alteration, disruption or destruction of habitat cannot be granted in respect of chemical alteration of waters frequented by fish.

The proposed end-of-pipe criterion of 1332 mg/L is based on meeting the HC5 value of 313 mg/L 100 m into Horseshoe Lake. This effectively seeks to ensure there is no chronic toxicity to 95% of the species in the lake at that point. Use of a 100 m mixing zone in the lake is somewhat arbitrary, and does also incorporate the stream connecting Two Rock Lake and Horseshoe Lake.

In the 2000 Environmental Assessment Report (EAR), the discussion of effects on Horseshoe Lake was limited to TSS, sediment-associated parameters, and nitrogenous compounds. On page 4-94 the statement is made: "Changes in hydrology and water quality can be expected but are likely to be restricted to the immediate area of the development and downstream to Horseshoe Lake. Adverse effects below Horseshoe Lake will likely not be detectable." Table 4.5-1 rates the significance of residual effects as "Minor" for discharges from Two Rock Lake. From a review of the information requests subsequent to the EAR, it appears that stakeholders did accept that there could be some changes to Horseshoe, but were not to be detectable at the end of the watershed (i.e. by Exeter inflow). Use of a mixing zone is consistent with other mine sites in the NWT and NU, but further evaluation is needed as to what the extent should be of such a mixing zone.

Next Steps:

Given the questions raised with the information provided in the Rescan report, the proposed water quality threshold for chloride of 313 mg/L and the resulting back-calculated effluent value of 1,332 mg/L require further review and work to ensure they are protective of aquatic life in Horseshoe Lake. Quantifying uncertainty and further investigating modifying factors would be useful.

Modeling should also be reviewed to ensure that loadings are sufficiently accounted for and that the chloride concentration would not slowly increase over time due to insufficient outflow from the lake.

Recommendations:

EC would like to suggest that the Board postpone setting the chloride criteria in accordance with the proposed values, until further validation or refinement of the proposed criteria can be done. We would also ask that BHPB confirm applicability of the criteria at ambient hardness, temperature and flow regimes.

BHPB has produced new data on acute and chronic toxicity which will be immensely valuable in determining the final discharge criteria; there are simply questions with respect to the approach chosen. We look forward to working with BHPB and other stakeholders on this important issue, to take this to the next steps.

Please do not hesitate to contact me at (867) 669-4735 with any questions or comments regarding the foregoing.

Yours truly,

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cc: Carey Ogilvie (Head, EA - North, EPOD)
Uwe Schneider (A/Senior Environmental Quality Guidelines Analyst, National Guidelines and Standards Office)