

---

**Date:** December 21, 2007

# Memorandum

**To:** John McCullum  
Executive Director  
Environmental Monitoring  
Advisory Board (EMAB)  
P.O. Box 2577, Yellowknife, NT  
X1A 2P9

**From:** Karl Kroeker  
North/South Consultants Inc.  
83 Scurfield Blvd.  
Winnipeg, MB, R3Y 1G4  
Telephone: (204) 487-5636  
Fax: (204) 477-4173  
Email: [kkroeker@nscons.ca](mailto:kkroeker@nscons.ca)

**Project:** DDMI MONITORING PROGRAM  
REVIEW FOR EMAB

**Subject:** Technical Review of DDMI 2006  
Aquatic Effects Monitoring Program  
Data Compilation Report

---

Document Reviewed: DDMI. 2007. 2006 Aquatic effects monitoring program data compilation report. March 2007.

---

The following provides technical comments on the 2006 Aquatic effects monitoring program data compilation report including data from both 2005 and 2006 (DDMI 2007). As the report is solely a data compilation report and does not include data analysis or interpretation, the review focused on a general overview of the results, with emphasis on identifying results from 2006 that may indicate any substantive environmental changes observed since the previous years of monitoring (i.e., from 2005). The review is not intended to be comprehensive.

## **REPORT SUMMARY**

The DDMI (2007) report presents the results of aquatic monitoring of treated effluent discharge, water quality, chlorophyll a, zooplankton, benthic invertebrates, and lakebed sediments conducted in 2006.

Results are generally presented as tables and/or figures. Tables and figures presented in the report provide a comparison to baseline data and data obtained in previous years of Post-Project monitoring. No interpretation of the results is provided.

## **2006 TREATED EFFLUENT DISCHARGE MONITORING RESULTS**

- Treated effluent discharge volume was higher in 2006 than all other years of operation;
- Total arsenic and total phosphorus were higher in effluent in 2006 than previous years of operation (i.e., 2002-2005);

- As supporting variables for the effluent were not provided (i.e., water hardness) direct comparison to CCME water quality guidelines for the protection of aquatic life (PAL) for some variables could not be undertaken for the effluent monitoring data;
- However, aluminum and nitrite were present at concentrations exceeding the CCME PAL guidelines;
- Effluent toxicity testing results indicate that generally, the effluent was not acutely or chronically toxic to biota. However, acute toxicity (96 hr trout) was observed in one sample in December 2006 and chronic toxicity (*Ceriodaphnia* assay) was observed on three occasions (March, September, and December 2006). It would be useful to examine the quality of the effluent used for that assay to potentially identify the agent(s) that may have caused the toxicity and to determine if the effluent quality was considerably different than other periods in 2006;

### **WATER QUALITY MONITORING RESULTS**

- Water quality monitoring results were presented for the near-field, mid-field, and far-field sites in a summary table format as well as in graphical format;
- Most parameters were below the CCME PAL guidelines at all sites, including:
  - Aluminum;
  - Arsenic;
  - Chromium;
  - Copper;
  - Lead;
  - Nickel;
  - Zinc;
  - Ammonia;
  - Nitrite;
  - Turbidity;
  - Total suspended solids (TSS).
- Other parameters were either outside the CCME PAL guidelines (pH) or direct comparisons could not be made due to analytical detection limit issues (i.e., cadmium);
- Most parameters did not qualitatively appear to be increasing over time. The exception appears to ammonia in winter, where the median concentration has been increasing since 2002. However, the concentrations have remained well below the reported water quality guideline of 17.6 mg/L.
- It is difficult to ascertain whether TP may be higher than pre-Project as the pre-Project data are pooled for both the open-water and ice-cover seasons;
- pH may be increasing over time;
- The values for total arsenic presented in Figure 3-3 indicate much higher concentrations at the far-field sites in winter 2006. However, the values presented in Table 3-3 indicate lower concentrations for individual stations. It appears there was an error in calculating the far-field statistics for arsenic in winter.
- Figure 3-3 indicates a higher median and 75<sup>th</sup> percentile for lead in the open-water season. Comparison to Table 3-7 indicates that this may reflect higher concentrations measured at the

BHP Station. Pooling of these data may not be appropriate if effects of the BHP operation are included in this summary.

- Baseline data statistics presented in Tables 3-2 to 3-15 represent pooled open-water and ice-cover season data. This does not allow for direct comparison to the post-Project monitoring data which are presented for each season separately.
- There is some indication that chlorophyll a has increased post-Project at the mid-field stations (Figure 3.2).

### **ZOOPLANKTON MONITORING RESULTS**

- Zooplankton biomass monitoring results were presented for the mid-field and far-field sites in a summary table format (by sampling site) as well as in graphical format (averaged for each zone);
- Qualitatively, mid-field zooplankton biomass has been lower the last three years (2004 to 2006) compared to baseline information and to the 2001 to 2003 results;
- Results were similar in the far-field excluding BHP's stations, which have the reverse trend (i.e., biomass is increasing compared to baseline).
- At each sampling site, 2005 and 2006 replicates appear to have good agreement.

### **BENTHIC INVERTEBRATE MONITORING RESULTS**

- Benthic invertebrate results were presented for the near-, mid-, and far-field sites; each summarized in a summary table as well as in graphical format with each depicting # of taxa, total density, and the total density for the most abundant invertebrate groups.
- Density values were presented in organisms/m<sup>2</sup>; however, for the 2005 and 2006 data the 'Total Density' values for each sampling area have mistakenly not been converted to organisms/m<sup>2</sup>.
- After performing the conversion and calculating the corresponding median and percentiles, the total invertebrate abundances are within ranges previously encountered with the exception of the 2006 mid-field totals, which are lower than prior results.
- Sorting efficiency was over 96% in 2005 and over 99% in 2006; each in excess of 90%, which is within the QA/QC limit specified by the metal mining EEM program.

### **LAKEBED SEDIMENTS MONITORING RESULTS**

- Many parameters exceeded the CCME interim sediment quality guideline (ISQG) and some exceeded the probably effect level (PEL) at near-field sites in 2006. Major observations are:

#### Near-Field Sites

- Arsenic has consistently exceeded the PEL for sediment quality pre- and post-Project. However, concentrations have been increasing, most notably from 2004-2006. The median concentration for 2006 is approximately 10 times the PEL.
- Although cadmium has remained below the ISQG, the concentrations measured in 2006 are notably higher than previous years and are approaching the ISQG;

- Copper has exceeded the ISQG pre- and post-Project but it is notably higher in 2006 indicating enrichment may be increasing;
- Similarly, nickel is notably higher in sediments in 2006;
- Zinc is higher in 2006 than previous years and is approaching the ISQG;
- The median TP and TKN concentrations for 2006 are more than twice and five times the median baseline concentration, respectively, indicating that nutrient enrichment is occurring in this area. TOC is also considerably elevated in 2006.

#### Mid- and Far-Field Sites

- Many parameters have exceeded the median baseline concentrations at mid- and far-field sites since 2001. However, with the exception of cadmium at mid-field sites, concentrations measured in 2006 were similar to previous years of monitoring.
- Total arsenic concentrations were lower in 2006 than 2005 at both mid- and far-field sites.
- Lead was higher at far-field sites in 2006.

#### Summary Comments

- Possibly the most "noteworthy" of the results were the elevated concentrations of some metals and TP in near-field sediments. However, it is not unusual to see enrichment of sediments near a wastewater outfall, and it could have been expected in this case.
- It would be worthwhile following up on is the effluent toxicity observed in 2006. As noted in this memorandum, it would be worthwhile to compare the toxicity results with detailed effluent quality for those dates. This would assist in determining if there was some unusual condition that might explain the toxicity.
- The benthos and plankton results were basic and no potential issues were indicated.