Recommendations on Trace Metals Management

Trace Metals and Air Contaminants Working Group
Final - November 2001; Approved – May 2002

1. Background

The Trace Metals and Air Contaminants Working Group (TMAC) has completed a review and assessment of present and future risks posed by trace metals to human health and ecosystems in the north-eastern Alberta oil sands area. Aluminum, cadmium, mercury, nickel, and vanadium were selected for detailed review and assessment based on known metal emissions from the oil sands facilities in the Regional Municipality of Wood Buffalo (RMWB), as well as public concern about metal deposition. The remaining metals are not emitted in the region, or are emitted in such small quantities they appear unlikely to pose an ecological or health risk. Nickel and vanadium were chosen because concentrations of these two metals are known to be elevated in the soils in the vicinity of the oil sands facilities, although there was little indication of uptake by vegetation or animals. Aluminum was selected because soil aluminum may be mobilised if soils are acidified. Mercury was chosen because of the known elevation of mercury concentrations in walleye in the Athabasca River system. Cadmium was selected because it is a concern in Canada's arctic, with respect to native diets.

A consulting firm was commissioned to do the detailed review and assessment of deposition, uptake, and accumulation of the five selected trace metals. This review and assessment is reported in "Review and Assessment of the Deposition and Potential Bioaccumulation of Trace Metals," prepared by Dillon Consulting Limited for the TMAC working group, in July 2001.

This document summarizes the key conclusions in the Dillon report and presents the TMAC working group's conclusions and trace metals management recommendations for consideration by the Cumulative Environmental Management Association.

2. Key Conclusions of the Dillon Report

2.1. Water Quality

- In most cases, Alberta surface water quality guidelines for trace metals have not been exceeded in the tributary rivers in the oil sands area. There have been occasional exceedances of total aluminum and cadmium concentrations, but these exceedances are not correlated to oil sands air emissions.
- While particulate emissions contribute to metal concentrations in regional water bodies the contribution is likely to be very low.

2.2. Sediment

- There were no recorded CCME guideline exceedances of the five trace metals in sediments in the major tributary rivers.
- There does not appear to be a link between existing levels of metals in sediments and air emissions from oil sands activities.

2.3. Fisheries

- Mercury levels in several fish species sometimes exceed the Health Canada subsistence fish consumption guidelines.
- Mercury concentrations in predatory fish (walleye and northern pike), were higher than in non-predatory fish, consistent with biomagnification (i.e. increasing concentrations at higher levels of the food chain).
- There does not appear to be a link between concentrations of mercury in fish and air emissions from oil sands activities, although all fossil fuel burning releases some mercury. Mercury is naturally occurring and is common in sediments in the RMWB.

2.4. Vegetation

- There appears to be a link between oil sands air emissions and aluminum, nickel and vanadium concentrations in lower plants (e.g. lichens and mosses).
- There is no evidence of uptake of nickel and vanadium from soils close to oil sands facilities by higher plants (e.g. trees, flowers, shrubs, fruits.)
- The traditional foods survey by the Terrestrial Environmental Effects Monitoring (TEEM) Program found no elevated metal concentrations in vegetation except for aluminum. Slightly elevated aluminum levels were found in cattail root and ratroot, but it is suspected that some of the aluminum is from clay residues in the roots (i.e. naturally occurring.)

2.5. Wildlife

- Terrestrial wildlife species in the oil sands area do not appear to be accumulating metals, with the possible exception of beavers, deer mice and red squirrels. A study in 1987 showed that deer mice may have elevated aluminum concentrations in locations close to oil sands facilities, but a more recent study failed to show this relationship. In a recent study five beavers close to the oil sands facilities had higher levels of aluminum than in beavers in Fort Chipewyan. Red squirrels both close to and distant from oil sands activities had elevated cadmium concentrations.
- There does not appear to be a link between existing levels of metals in wildlife and air emissions from oil sands activities, except possibly for beaver and deer mice.

3. TMAC Working Group Conclusions

a) The conclusions in the Dillon report are valid.

b) A significant increase in metal-bearing particulate emissions in the oil sands region appears unlikely with current metal emissions controls and with installation of electrostatic precipitators, such as those fully operational at Suncor and Syncrude in 1984, and flue-gas desulphurisation technology, as installed at Suncor in 1996, on new particulate-bearing stack exhaust streams.

c) At current and projected metal emission rates, trace metals appear unlikely to pose risks to human health and ecosystems now or in the future, provided best management practises continue.

d) Regional metal particulate emissions from mine fleet activity and wind-borne dust have not been assessed in this study. TMAC recognises that metals are associated with diesel particulate matter (PM). TMAC will address the entire PM issue, including metals, with their trace air contaminant work.

4. Proposed Adaptive Management Approach for Trace Metals

Goal: To ensure an environmental management system is in place to protect human health, wildlife, fish and vegetation from the deposition and accumulation of trace metals in the environment.

Indicators: Receptor and ambient ($PM_{2.5}$ and PM_{10}) concentrations of aluminum, cadmium, mercury, nickel, and vanadium in emissions from oil sands activities.

Management Objectives: Trace metal emissions should continue to be minimised and there should be no significant increase in exposure risk with respect to metals in regional air emissions.

Management System Implementation: The recommended management system should include the following parts: *management tools* to attain the goal, *research and monitoring* of the indicators and their receptors, and a *system evaluation* of the tools and monitoring/research to assess the success in achieving the goals and objectives.

Management Tools:

TMAC recommends the following tools be implemented to aid with managing trace metal emissions:

- Industry maintain and/or improve current metals emission control technology by pollution prevention and particulate matter controls such as installing electrostatic precipitators and flue-gas desulphurisation technology on new particulate-bearing stack emissions.
- Industry conduct a periodic emission inventory of indicator metals released in stack flue gas streams, and from mobile and other combustion sources.

- Regulators issue approval conditions for particulate matter control (flue gas desulphurisation, electrostatic precipitators, appropriate controls for stockpiled metal sources, such as coke piles), and compulsory monitoring activities.

Research

Studies should be conducted to address uncertainties about current and future metal accumulation, as follows:

- Metals in water samples are commonly quantified by measuring 'total concentration', and less commonly by measuring 'dissolved concentration'. Measurements of the former are not always very meaningful as the metal may be bound to clay and not available to receptors. Studies involving 'dissolved concentration' may more accurately reflect the amount of metals available to organic receptors (i.e. bioavailability).
- One-time survey of metals deposition patterns in the region (e.g. edge and elevation monitoring) to identify high-concentration areas.

Monitoring:

Monitoring should be maintained/implemented to address uncertainties about current and future metal accumulation, as follows:

- Regional programs to conduct long term environmental monitoring for ambient levels of the trace metal indicators in ambient air and regional biotic and physical sentinel receptors. Sentinel receptors are those which most efficiently represent changes in either increases or decreases in metal loadings and are broadly representative of environmental compartments (e.g. lichens and mosses in response to particulate deposition). Such monitoring programs might be well suited under the TEEM program.
- Continuation of the following current RAMP programs: 1) monitoring trace metal concentrations in regional water; 2) monitoring trace metals in sediments in the oil sands area; 3) monitoring metal concentrations in fish tissue in regional water bodies at three year intervals with an expansion to include all fish used by local peoples, including fish resident in isolated regional lakes.
- Follow-up studies to the TEEM traditional foods survey to verify and better quantify observations of elevated aluminum in ratroot and cattail root and elevated cadmium and aluminum concentrations in wildlife.

System Evaluation:

TMAC recommends that in 2005, a regional body (perhaps the TEEM program under WBEA, or a regulatory agency) re-evaluate the linkage between the environmental monitoring results for indicator metals, and oil sands air emissions, as well as compare the monitoring results with the latest environmental and human health benchmarks. If the re-evaluation indicates an adverse trend in environmental quality, or any potential risk to the ecosystem or human health, then it is recommended that a multi-stakeholder group be formed to review and assess the status of deposition and bioaccumulation of trace metals and to recommend appropriate management system changes. This system evaluation should be repeated at a date to be set during the 2005 review.