INFORMATION REQUEST RESPONSE

EA No: 0809-001 **Information Request No: Review Board #24**

Date Received:

February 14, 2011

Date of this Response:

May 31, 2011

Request

Preamble:
The DAR lacks details necessary to understand the effects of the diffuser outflow on public concern, safety and water quality.

Question:

1. For each diffuser location, please describe and illustrate the currents in the bay in the various seasons, at a scale that encompasses the local study area, to identify where effluent ultimately travels. Does this water go to Ndilo, Latham Island, Back Bay, Yellowknife Bay (houseboat community) or Dettah? Describe the potential, over the long term, for this to result in arsenic sediment loading in any of these areas.

2. Please provide the model, if any, that is the basis for conclusion that "thermal loading is not expected to be an issue", considering currents during ice conditions. IF there is no model, please provide a detailed analysis.

3. Is INAC able to restrict access to the surfaces of frozen water bodies, as identified as a possible mitigation in Table 8.4.5? If so, please describe how.

Reference to DAR (relevant DAR Sections):

Figure 6.8.4
S 8.10.1 Evaluation Criteria
S. 8.10.2 Aboriginal Communities
Table 14.2.4.1

Reference to the EA Terms of Reference:

S.3.4.2 Human Health and Safety
S.3.5.1Water
S.3.5.2 Fish and Aquatic Habitat

Response 1 Summary

Water currents in Yellowknife Bay are primarily driven by wind conditions (open water period only) and by the flows from the Yellowknife River (open water and ice cover period). The diffuser will be located within the main area of influence of the Yellowknife River within the Bay, to promote the conveyance of the effluent toward Great Slave Lake and reduce the potential of effluent accumulation within the bay.

Response 1

A mapping of water currents in the Yellowknife Bay will be established during the detailed design phase of the diffuser. Currents in the bay are primarily driven by wind conditions during the open water period (*i.e.,* with no ice cover), with inflows from the Yellowknife River providing an added contribution. A wind rose for the period from May to October is provided below. During the ice cover period, currents in the bay are primarily affected by inflows from the Yellowknife River.

During the open water period, from May to October, winds recorded at Yellowknife Airport station are often coming from the east (45% of wind occurrences for the combined north-east, east and south-east directions), with frequent occurrences from the South (18%) and North (15%). However, winds have been observed in all major directions. Consequently water currents in the bay can be directed in any direction at any given time, depending on prevailing wind conditions. Flows from the Yellowknife River induce water currents to be directed towards Great Slave Lake.

Current velocity and direction are variables that impact effluent dilution and are considered as inputs to the assessment of effluent mixing within the Bay. The assessment of effluent mixing for this design study will include modelling scenarios for a range of expected current velocities, from near stagnant conditions to high velocities due to extreme winds, and a range of current directions (i.e., co-flowing and cross-flowing effluent). The selected final location and configuration of the diffuser will consist of the option that meets the required water quality criteria over these ranges of water current velocities and directions in the Bay.

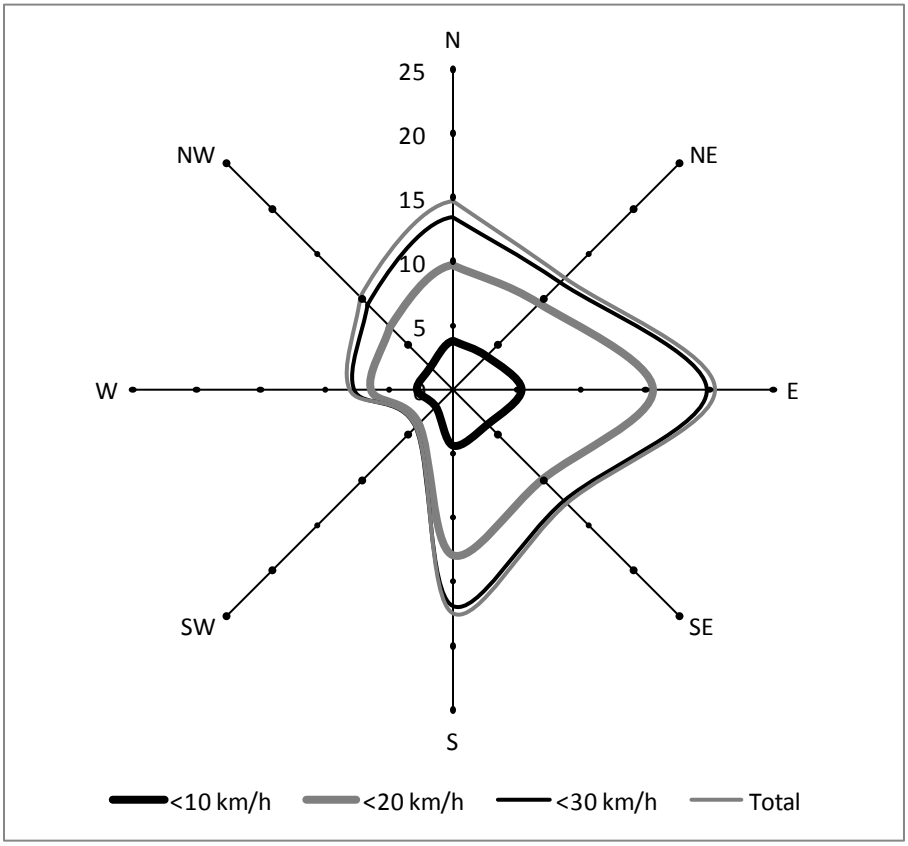

Figure 1: Wind Occurrences (in percent) for Major Directions at Yellowknife Airport Station, for the Period from May to October.

The water quality criteria to be met by the effluent consist of drinking water quality criteria and CCME criteria for the protection of freshwater aquatic life, or being within 10% of ambient water concentrations (i.e., when ambient concentrations of a given substance is above drinking water and CCME criteria). These criteria incorporate arsenic. The diffuser is being designed to meet the water quality criteria within the mixing zone defined based on existing guidelines, including those recently produced in the Northwest Territories (MVLWB 2011), while minimizing the size of that zone. The mixing zone will be at an appreciable distance (e.g. 150 m) from shorelines. Furthermore, the proposed diffuser location will be located within the main area of influence of the Yellowknife River within the bay, in order to promote the conveyance of the diluted effluent towards Great Slave Lake and reduce the potential of effluent accumulation within the bay.

Since substances within the diluted effluent, including arsenic, will be mostly in a dissolved form, they are expected to travel within the water column towards Great Slave Lake, with little or no settling to the bay bottom occurring. The effluent is therefore not expected to contribute any loadings to the sediment in any area of the bay.

Mackenzie Valley Land and Water Board (MVLWB). 2011. Water and Effluent Quality Management Policy. MVLWB, Yellowknife, March.

Response 2 Summary

It is expected that the effects on ice thickness will be minimal primarily due to the low temperature of the effluent during the winter months.

Response 2

The treated mine effluent is anticipated to have negligible impact on the ice cover thickness. The currents under the ice are anticipated to provide a continuous source of ambient water from the bay for the dilution and heat dispersion of the effluent, and consequently erosion of the ice cover from the effluent discharge is not expected.

Most inflows to the proposed new water treatment plant will be from the underground workings of the mine, where the water temperature is expected to be relatively cold. Resulting water temperature is anticipated to be on the order of 2 to 8 °C, while temperature in the Bay are expected to be on the order of 2 to 4 °C. The difference between effluent and ambient water temperature is relatively small. This difference will be further reduced from the mixing of the effluent and ambient waters by the diffuser, before the effluent reaches the elevation of the ice cover.

The mixing model used to assess effluent dilution in the bay (*i.e.,* CORMIX) includes a module for the assessment of heated discharges. This module will be used to further assess the effect of the effluent on the ice cover in the mixing zone.

The CORMIX model system (Doneker and Jirka 2007) is one of the most extensively used models for predicting plume mixing and dilution of substances in surface water bodies. The model also includes modules for the assessment of heated discharges, and has been used for a wide range of applications in estuaries, rivers, reservoirs and lakes (including bays). Effluent dilution and heat dispersion are calculated in CORMIX from semi-empirical formulas that have been considered reliable within applicable ranges, and are based on simplified governing equations for conservation of mass and momentum and on physical laboratory and field modelling data.

Doneker, R.L., Jirka, G.H. 2007. CORMIX User Manual: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters. Report EPA-823-K07-001, U.S. Environmental Protection Agency, Washington, DC.

Response 3 Summary

The effects of the effluent on ice thickness are expected to be negligible (see question #2); however warning signs to users of the bay may be used as mitigation, if required.

Response 3

The effects on ice thickness are expected to be negligible, primarily due to the low temperature of the effluent during the winter months. Ice thickness will be monitored and the resulting information will be made available to the public. If required, signs can be installed on the bay ice surface to warn users from passing through zones potentially affected by the discharge of the diffuser (*i.e.,* zones with a potentially thinner ice cover). Signs may also be posted on the shoreline year-round to provide additional warnings to the users of the bay.