INFORMATION REQUEST RESPONSE

EA No: 0809-001 **Information Request No: MVEIRB #1-3**

Date Received: February 7, 2013

Date: March 14, 2013

Preamble

The Review Board included the following requirement in the Terms of Reference for the Developer's Assessment Report (DAR):

Terms of Reference

3.5.2 Fish and Aquatic Habitat
"Potential effects to fish and fish habitat were identified as issues of concern during the Review Board's scoping exercise. Public concern focused on the development's potential to contribute to the contamination of local fish stocks and aquatic habitat, including concerns about health impacts on traditional harvesters and other harvesters of fish"

ToR 3.4.2 Health and Human Safety
"During scoping, many participants raised concerns about potential adverse impacts to human health and safety linked to exposure to arsenic trioxide. Both real and perceived risks to human health and safety can have a significant impact on the populations that live in proximity to the Giant Mine site."

The DAR included the following information:

Reference

The DAR (PR#139 s8.10.1, s8.10.2, p8-93) recognizes that "certain types of remediation activities have the potential to generate concern which, in turn, may lead to adverse effects on community well-being" and identifies "community perceptions of environmental health" as an evaluation criteria for adverse effects on Aboriginal communities. This may occur "regardless of the positive effects of the remediation project" (s.8.10.2.1 p8-94). Table 8.10.2 states that "the discharge of treated mine water into North Yellowknife Bay may generate concern among traditional land users who fish there".

A previous information request about the diffuser asked (Round 1 Review Board IR#24, PR#178 p32):

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 N'Dilo, 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.

In the technical sessions of Oct. 2011 the developer indicated it would conduct further research on far-field currents in Great Slave Lake with respect to the diffuser. In June 2012, the Review Board reminded the developer of the importance of having at least preliminary results of the studies on currents and water quality in time for the public hearings. In the Sept. 2012 hearing, the developer indicated that this study had not been completed. The developer indicated that it had also not yet completed its diffuser design, among other things, and had not yet conducted its public engagement on the subject of the diffuser with potentially affected communities. Because of this, there are several outstanding uncertainties about the potential for the diffuser to contribute to arsenic loadings in Yellowknife Bay, and about other effects resulting from the release of arsenic in the water treatment plant effluent.

These matters were also canvassed at the Review Board's public hearing and in response to a hearing undertaking #3, the developer submitted a document titled "Best Available Practical Technology for Water Treatment for the Giant Mine Remediation Project". This includes technical criteria and evaluation matrices for the evaluation of water treatment alternatives for specific stages of water treatment, and recommends the proposed approach.

In the hearing, the developer was asked specifically what constraints, including financial constraints, were considered when the developer chose the level of contaminants it would release from the diffuser (PR# 576 p121). The developer's response to this question did not provide sufficient information to fully address these concerns.

The analysis of alternative treatment options submitted by the developer as Hearing Undertaking #3 on Sept.25, 2012, considered several technical criteria and cost, but did not include direct consideration of potential environmental impacts of the alternatives identified in the Undertaking.

The record indicates that several parties and members of the public have expressed concern with the proposal to deliberately release water containing arsenic and heat into Great Slave Lake, effectively relying on further dilution to deal with the arsenic in water treatment plant effluent. They do not agree with the developer's view of the role that the lake should play in arsenic dilution.

The Board requires additional information on alternative methods of water treatment and management that do not rely on the diffuser or on Yellowknife Bay.

Request

1. Please describe in detail and graph the relationship between water treatment costs and arsenic concentrations in treatment plant effluent, ranging from the current proposal to concentrations as near zero as possible. Please indicate the treatment cost at which such treatment is no longer financially feasible, for the next 100 year period.

2. Please provide a detailed description of the best three alternative technologies for water treatment and management that do not directly or indirectly involve effluent disposal in Great Slave Lake, and do not rely on Baker Creek for dilution. For each one, please include:
    a. a detailed description of the method
    b. estimated costs for construction and ongoing maintenance for each alternative (that is, capital and operating expenses), with a discussion and graph of the relationship between water treatment costs and arsenic concentrations in treatment plant effluent. This analysis should include a graph of total arsenic released over a 100 year period as a function of capital and operating expenses.
    c. its implications to the overall project, considering interrelated components
    d. a description of the potential impacts on the environment, including an assessment of risks, and the developer's views of the significance of those impacts.

3. Please provide the following documents:

    a. Golder Associates Ltd. 2012. *The 2011 Baker Creek Assessment, Giant Mine, Yellowknife NWT.* Submitted to the Department of Public Works, Yellowknife.
    b. Golder Associates Ltd. 2008. *Giant Mine Environmental Effects Monitoring Phase 2. Final Interpretive Report*. Prepared for Indian and Northern Affairs Canada.

Response

Response 1

A screening level analysis was conducted on four potential water treatment alternatives that range from the current proposal with treatment to 100µg/L of arsenic to an option that would result in treatment to 0µg/L. These options included the following:

- Option 1 – The Current/Existing Treatment Process Train - outlined in the Developer's Assessment Report (DAR) - 100µg/L;
- Option 2 – Ion Exchange (Drinking Water Standards) - 10µg/L ;
- Option 3 – Reverse Osmosis (Aquatic Standards) - 5µg/L; and
- Option 4 – Zero Discharge Treatment - 0µg/L.

The options were assessed based on project design criteria, environmental impacts and risks as well as costs. This analysis is summarized in the attached report entitled "Giant Mine Water Disposal" prepared by AECOM (March, 2013). The report is submitted as a part of the response to the information requests and includes a graph of the relationship between the water treatment costs and arsenic concentrations of the effluent under each of the options outlined above – Figure 3.6.

The analysis shows that all of the assessed options, including the current water treatment proposal, would not result in significant impacts to the environment. The analysis also clearly indicated that Option 3 and Option 4 were not considered to be economically feasible, particularly given the very minimal reduction of environmental risk. The analysis did demonstrate that Option 2 (Ion Exchange – Drinking Water Standards - 10µg/L) is a viable approach as it provides a large reduction in the treated arsenic levels for a relatively small increase in both capital and net present value costs (Figure 3.6, Figure 3.7 and Table 3.2).

This analysis on water treatment options needs to be considered with respect to several of the concerns that were raised during the Public Hearings. The notable concerns included the request not to use Great Slave Lake as a mixing zone, the perceived concerns regarding the use of a diffuser for dilution of treatment effluent, concerns regarding the intake for the City of Yellowknife's drinking water, and the Yellowknives Dene First Nation (YKDFN) request that water treatment effluent meets drinking water standards.

While the approach proposed in the DAR is considered to be appropriately protective of the environment, based on the analysis conducted on alternative options and the concerns raised during the public hearings, Aboriginal Affairs and Northern Development Canada (AANDC) on behalf of the federal government and the Government of the Northwest Territories (GNWT) are willing to revise the approach to water treatment and work to implement Option 2 – Ion Exchange. This option directly responds to the YKDFN request for effluent to meet drinking water standards as the water discharged at the end of the pipe would have an arsenic concentration of 10µg/L. By meeting these high standards, this approach would address concerns regarding the intake of drinking water for the City of Yellowknife. Lastly, this approach does not require the use of a diffuser.

Response 2

(**2a & 2b)** As described in Section 4.4 of the supporting document (AECOM March 2013), options that avoid direct/indirect discharge to Great Slave Lake and do not rely on Baker Creek for dilution are very limited. A key challenge in this regard is the fact that any effluent discharged on surface within a very large catchment area would eventually drain to Great Slave Lake. Similarly, options involving sub-surface discharges are not considered feasible because it is unlikely that the Precambrian shield would be capable of accepting a sustained discharge of treated effluent.

The only options capable of avoiding direct/indirect discharge to Great Slave Lake and use of Baker Creek for dilution involve evaporation into the atmosphere. The evaluation concluded that passive evaporation from ponds is not feasible due to the very large land requirements, sub-optimal climate and difficulties associated with storing untreated water on surface. Active (i.e., fuel-fired) evaporation processes are technically feasible and would completely eliminate the release of arsenic and treated effluent to surface water receivers. However, the active evaporation option has been excluded from further consideration for the following reasons: 1) incremental arsenic loading reductions are relatively modest compared to other options and other arsenic sources; 2) prohibitively high capital/operating costs; and 3) adverse environmental impacts associated with transporting and combusting very large quantities of fuel.

As noted in the response to the first question, the analysis did identify a viable water treatment alternative that was financially feasible and capable of meeting national drinking water standards for arsenic (10µg/L) at the end of the discharge pipe – Option 2, Ion Exchange (Drinking Water Standards). While effluent would be released into Great Slave Lake using this approach, the impacts would be greatly minimized given the high standards that would be met.

The report also included an assessment of constructed wetlands as a potential option for water treatment/polishing (Section 3.6). This brief assessment concluded there is general uncertainty regarding the approach and there is currently no evidence to suggest that this would be a viable option for the Giant Mine site. As a result of this uncertainty, AANDC and the GNWT prefer to continue implementing a remediation approach that relies on proven technologies. However, there is a possibility that constructed wetlands could play a role at the Giant Mine site in the future. As a result, AANDC and the GNWT are therefore willing to continually evaluate this approach and where possible work to advance the understanding of wetland performance, particularly in northern contexts. The objective is that these efforts will provide the Project Team with the knowledge necessary to determine if and how wetlands can be used to in the long-term water management strategy for the site.

(**2c**) The analysis conducted also went further by considering the implications to the overall project and the consideration of a number of interrelated factors/components. This was specifically demonstrated in the analysis and assessment of potential options for effluent disposal (Section 4). This work was completed in order to directly address the public concerns regarding the release of arsenic in Yellowknife Bay, the concerns regarding the use of a diffuser/mixing zone in order to meet discharge limits, and concerns related to the potential for thermal impacts from the effluent on the receiving water body (e.g., ice thickness). The report provides a summary of potential outfall locations and the potential issues related with each approach (Table 4.2). The analysis shows that a near shore outfall for treated water with a discharge target of 10µg/L (Option 2) could be considered given that the effluent meets national drinking water standards (i.e., no mixing is required). This outfall location can also be easily defined and marked in order to effectively inform the public regarding safety issues related to ice thickness.

(**2d**) As a part of the overall analysis, an assessment of the potential environmental impacts of the various treatment and discharge options was also conducted. The overall conclusions regarding the residual risks associated with each of the four treatment options are as follows:

- **Option 1** is the Developer's Assessment Report (DAR) base case treatment to 100 µg/L average arsenic concentration and discharge through a diffuser in Great Slave Lake. Previous risk assessments have shown there are no significant risks associated with this option. Predicted arsenic concentrations in the mixing zone are expected to fall below the lowest toxicity reference value for aquatic species and below the Canadian Water Quality Objective for protection of Freshwater Aquatic Life of 5 µg/L within a short distance of the diffuser. Annual arsenic loadings from this option represent less than 7.5% of the total post-remediation arsenic loadings entering Great Slave Lake from the Giant Mine site or via Baker Creek. For context, the baseline arsenic loadings attributable to the Yellowknife River are approximately five times greater than Option 1.

- **Option 2** is the Ion Exchange (Drinking Water Standards) with treatment to 10 µg/L. Dilution or mixing would not be required with this option as the quality of the effluent at the end of the discharge pipe would be non-toxic to even the most sensitive species. Furthermore, the discharge meets Health Canada's drinking water quality guidance of 10 µg/L for arsenic and would therefore pose a very low risk of adverse health effects to people who might come in contact with the effluent, drink the treated water or catch and consume fish that come in contact with the effluent. Annual arsenic loadings from this option would be approximately 10% of the relatively low loadings already achieved by Option 1.

- **Option 3** is the Reverse Osmosis (Aquatic Standards) with treatment to 5 µg/L. Similar to Option 2, this approach does not a require dilution or mixing. The arsenic level in the effluent would be below the Canadian Water Quality Guideline of 5 µg/L for the protection of freshwater aquatic life and also below Health Canada's drinking water guideline. The annual arsenic loadings from this option would be approximately 5% of the relatively low loadings already achieved by Option 1. The key concerns related to this option are performance uncertainty and the environmental impacts of managing the reject stream. Given the uncertainty regarding the performance of this option (e.g., consistently meeting the 5 µg/L target) and the significant financial costs, this option is not considered as a viable option.

- **Option 4** is the Zero Discharge Option with treatment to 0 µg/L using evaporation. This approach would reduce arsenic loadings and risks associated with the treated effluent to zero in the aquatic environment but would result in significant adverse impacts through the release of greenhouse gases and other combustion pollutants to the atmospheric environment, in addition to the enormous financial cost. As noted in the response to the first question, this option was not considered as financially or environmentally feasible.

All four of the potential water treatment and disposal options, including the current proposal, do not pose a risk of significant adverse effect to ecological species or to people. As noted, the analysis did show that Option 2, Ion Exchange with treatment to 10 µg/L is a viable option that meets drinking water standards and can be implemented in a manner that addresses public concerns.

Response 3

(**3a**) Please see the attached for a copy of *The 2011 Baker Creek Assessment*. This report was developed using both historic and new information in order to assist in the decision-making process on determining how best to remediate sediments in Baker Creek. The conclusions and recommendations of this report serve as a guide to future assessment work and provide the biological and physical site information and risk analysis necessary for discussing the fate of the sediments within Baker Creek with regulators, communities and stakeholders.

Thus far, the work on Baker Creek has involved government departments and the work of expert technical contractors. Going forward, the dialogue will be expanded to include the involvement of local communities and stakeholders. In the coming weeks, an engagement plan with detailed timelines will be developed that will outline the specific opportunities for interested stakeholders to become involved in these discussions.

The intent of ongoing site assessments, regulator involvement and community engagement is to define the remediation options for Baker Creek and ultimately select a viable option that is consistent with the overall objectives of the Giant Mine Remediation Project.

(**3b**) Please see the attached for a copy of the 2008 *Giant Mine Environmental Effects Monitoring Phase 2 – Final Interpretive Report.*