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November 14, 2019

Mackenzie Valley Land and Water Board  
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Yellowknife, NT  
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Attn: Ms. Shannon Allerston, Regulatory Officer

[sallerston@mvlwb.com](mailto:sallerston@mvlwb.com)

Dear Ms. Allerston:

**Re: Giant Mine Remediation Project**

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As described in the May 3, 2019 letter from Ms. Kerry Penney at the City of Yellowknife, I am writing as the Technical Advisor to the Giant Mine Working Group (the “Working Group”). I have served as the Working Group’s independent technical advisor for over five years, with the following purpose:

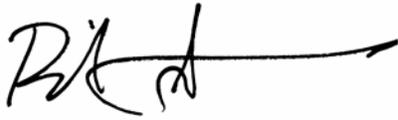
*“The Independent Technical Advisor will provide independent technical expertise and advice about the Giant Mine Remediation Project to the Working Group upon request.” (2018-19 Terms of Reference, Independent Technical Advisor to Giant Mine Remediation Project Working Group. February 13, 2018)*

In accordance with the Terms of Reference, the work of the Independent Technical Advisor is to focus on adding value while being guided by the principles of independence, transparency, and collaboration. It is important to recognize that, as the Independent Technical Advisor I do not speak on behalf of the Working Group or its individual members. I provide advise to the Working Group and its members, with the expectation that they will articulate their specific conclusions, views, and recommendations after having considered the input.

As the Independent Technical Advisor, I am providing the attached report with recommendations for licensing of the Giant Mine Remediation Project. The recommendations should not be interpreted as the position of the GMWG or any of its members. Instead, they represent my independent recommendations based on my review of the information and knowledge of the project. They are provided for consideration by the Board and by the members of the GMWG. In accordance with the discussions by the GMWG, I do intend to attend the hearing and respond to any questions related to my recommendations. However, I do not intend to take specific positions about the application or question other parties about their positions at the hearing.

Thank you for the opportunity to provide input for consideration by the Board and other parties during the review of the applications for the GMRP.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Bill Slater', with a long horizontal line extending to the right from the end of the signature.

Bill Slater  
Independent Technical Advisor, Giant Mine Working Group

cc. Giant Mine Working Group

Att. 1. Licensing Recommendations, Giant Mine Remediation Project. November 14, 2019.

# **Licensing Recommendations Giant Mine Remediation Project**

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**November 14, 2019**

**Completed by Bill Slater, Slater Environmental Consulting**

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## 1.0 Introduction

Bill Slater of Slater Environmental Consulting (SEC) reviewed documents submitted in support of the water licence and land use permit applications for the Giant Mine Remediation Project (GMRP). Crown-Indigenous Relations and Northern Affairs Canada's (CIRNAC) and the Government of the Northwest Territories (GNWT) are co-proponents for the proposed project. SEC completed the review on behalf of the Giant Mine Working Group (GMWG), in the role as independent technical advisor for the Group, a role Bill Slater has held since 2014. This report provides the results of the review, including recommendations for the Mackenzie Valley Land and Water Board's (MVLWB) consideration in its deliberations about the water licence and land use permit applications. The report builds upon SEC's initial review completed in May 2019, as described in a report titled "*Review of Post-EA Information Package – Giant Mine Remediation Project*" and dated May 25, 2019. The May 2019 report, submitted through the Online Review System, addressed topics raised by a series of nine questions posed by the GMWG. This report provides further consideration of licensing issues and recommendations after having considered responses and additional information submitted since May 2019, as well as the discussions at technical sessions and workshops. Each of the sections in this report includes a recommendation, followed by supporting discussion and rationale.

## 2.0 Future Land Use Constraints

**Recommendation:** When issuing authorizations for the GMRP, the Board should incorporate conditions that require the co-proponents to establish appropriate definitive administrative constraints on future land use in parts of the project area that have soil arsenic concentrations that exceed residential standards but do not include physical barriers. This should include updating of Closure Objectives and Criteria to focus on land use actions rather than only knowledge of risks, and the development and implementation of actions aimed at achieving these Objectives and Criteria. The Board should require progress reporting on the establishment of these constraints and monitoring of their effectiveness.

### Discussion and Rationale

Research since the completion of the Environmental Assessment has demonstrated that it is not practical to remediate soils on the site to the industrial remediation objective of 340<sup>1</sup> mg/kg of arsenic. Data indicate that soil contamination is much more widespread than thought during the Environmental Assessment, extending beyond areas that were directly disturbed by mining activities. For example, some soils in forest/wetland areas have arsenic concentrations as high as 3000 mg/kg. Soils with concentrations above the industrial objective are widespread across the site and extend outside the site boundaries. The cleanup of these soils would cause extensive

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<sup>1</sup> 340 mg/kg is the Industrial Remediation Objective defined in "Determining Natural (Background) Arsenic Soil Concentrations in Yellowknife, NWT, and Deriving Site-Specific Human Health-Based Remediation Objectives for Arsenic in the Yellowknife Area", Risklogic Scientific Services Inc., April 2002.

additional disturbance and the volumes of soil requiring long-term storage would overwhelm available storage locations at the site.

The DAR estimated the volume of contaminated soils requiring remediation as approximately 328,000 m<sup>3</sup>, while the current estimate for areas that the GMRP now proposes to remediate is almost four times larger at 1,299,500 m<sup>3</sup> (Closure and Reclamation Plan [CRP], Table 5.4-5). Even with this larger volume the proposed GMRP will still leave extensive un-remediated soils in place with arsenic concentrations that are well above the industrial remediation objective, in some cases 3000 mg/kg and higher. For large areas of the site, the GMRP proposes to rely on administrative controls and does not include any form of physical barrier (e.g., fence, cover) for soils with elevated arsenic concentrations. Exposed soils in areas outside the proposed fence will continue to be a long-term contaminant exposure source for humans and the environment. There is no practical way to restrict wildlife use and the restrictions on human use must rely on rules or advisories about what people can/should do in specific areas. The remaining contaminated soils will leave a long-term negative legacy for future generations, a legacy that will create challenges for long-term management of human activities. In order to maintain acceptable health risk, people must restrict their land use activities in these areas – restrictions that people must continue to apply for the very long term.

The Human Health and Ecological Risk Assessment (HHERA) Report (CRP Appendix 2E) includes a range of scenarios for the human health component of the assessment, considering different locations, different groups of people, different diets and different activities. Attachment 1 of SEC's May 2019 report summarizes information about the scenarios modelled and the definitions and assumptions underlying the pathways included in the scenarios.

The conclusions of the HHERA are premised on the scenarios modelled and the assumptions underlying the scenarios. As a result, the HHERA conclusions are not directly applicable to scenarios that are inconsistent with the assumptions underlying the modelling. The HHERA scenarios considered areas outside of the fence, including some remediated disturbed areas (e.g., covered TCAs) as well as un-remediated, un-disturbed areas with various arsenic concentrations (including areas with elevated concentrations from Roaster emissions). The human health risk assessment of future conditions assumes that local people<sup>2</sup> will use the area within the lease (and outside the fence) for recreational purposes. The modelling assumes that recreational activities in this area will be limited to moving through the area: "*walking, cycling, running, etc.*" (HHERA, Section 3.3.3.2). The recreational soil exposure associated with these types of activities assumes exposure during the summer months (i.e., when the soil is not snow covered) with use occurring on weekends. The specific assumption is for recreational activities ½ day in length, two days per week, 10 weeks per year. The future scenario also assumes that people will collect berries from this area and that these berries will make up 5% of a person's total berry consumption in a year.

Based on these assumptions, the Human Health Risk Assessment concludes that the future risks are acceptable provided that people only use the site casually for short periods of time with activities

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<sup>2</sup> With the exception of Yellowknives Dene First Nation (YKDFN) people. The HHERA assumes that YKDFN people will not use the site for recreational purposes because they have indicated that they will continue to consider the site to have unacceptable risks.

that have little likelihood for contact with/ingestion of soil. The high arsenic concentrations greatly exceed both industrial and residential remediation objectives, suggesting that more intensive human use of the area would create unacceptable risks. Nonetheless, it does appear that the proposed administrative approach is likely the only practical approach for addressing the widespread elevated concentrations of arsenic in soils, which leads to the question of what measures are needed to “risk manage” these areas.

The CRP includes Objective SW4 aimed at making sure that people understand the residual risks at the site: “*Residual risks are identified, and local residents have been, and continue to be, informed of residual hazards (post-remediation).*” To be effective for the long-term, the objective needs to include focus on people’s actions rather than only their knowledge. For example, that “Residual risks are identified and local residents use this information to make and implement land use decisions that avoid unacceptable risks from post-remediation hazards, including risks associated with contaminant sources.” As with other environmental/socio-cultural components, the co-proponents’ responsibilities extend beyond information sharing. The responsibilities also include actions to bring about appropriate human behavior in the long-term, and monitoring to confirm that the actions are working – i.e., that people are using the land only in ways that limit their exposure to contaminants.

For Objective SW4, the GMRP proposes three closure criteria to provide some guidance about what measures should be taken to establish and maintain a public and government understanding of residual risks like the extensive areas of un-remediated contaminated soils:

- *SW4-1 Public communication initiatives as outlined in the Perpetual Care Plan/ Engagement Plan are undertaken and evaluated*
- *SW4-2 A land map with residual risks identified and available at Land Titles and project websites*
- *SW4-3 Perimeter barriers are installed near risk areas to reduce inadvertent access and are visually displeasing to communicate that residual risk is present (e.g., large grey boulders, earth embankments). Refer to Objective SI3-2 (In development) regarding post-closure access.*

The GMRP had proposed a fourth criterion, but now proposes that it is redundant with SW4-2:

- *SW4-4 Landowners are provided with necessary information for Land title caveats, zoning (administrative controls)*

Like the Objective, the Criteria focus on communication and information sharing – informing citizens of adverse conditions and hoping that they will make appropriate decisions. None of the Criteria would require any definitive action by the co-proponents to constrain land use activities. Two types of criteria are needed – ones that require administrative constraints on people’s land use, and ones that lead to appropriate individual land use decisions. In both cases, the criteria need to focus on people’s actions rather than just delivery of information. People need to be informed so that they make appropriate day-to-day land use decisions (e.g., not camping in the area, or letting children play in the dirt). Land dispositions need to be constrained (e.g., residential development is not allowed). Only SW4-4 goes beyond pure communication and information sharing, but the GMRP proposes to delete this criterion. Instead of deleting, this criterion should be strengthened to identify the need for establishment of permanent legal impediments and constraints. The criterion

should not focus on providing landowners “with necessary information.” Instead it should focus on prohibiting land use activities that would lead to unacceptable risks.

It may be appropriate for the specific approaches for establishing land use constraints to be defined as part of the Perpetual Care Plan that is currently under development. Achieving the closure objectives (i.e., managing the risks, keeping people informed of the risks and making sure people act accordingly) throughout the life of the proposed project will require a robust approach to administrative controls for areas where there are no physical controls on land use activities (i.e., outside the fence). Putting effective administrative controls in place will likely require the co-proponents to use broader government authority, not constrained by the scope of authority currently granted specifically to the GMRP. Nonetheless, these types of constraints appear to fall within the authority of the co-proponent organizations – GNWT and the Government of Canada.

Past experience, for example at the Love Canal in State of New York illustrates the importance of robust administrative controls and long-term vigilance for managing contaminated site legacies. In the 1940’s, Hooker Electrochemical Corporation used an abandoned canal as an industrial waste dumpsite. They lined the canal with concrete and filled it with chemical waste (Kuyek, 2011). Once the canal was filled, they covered the site with an “impermeable cap” and sold the land to the Niagara Falls School Board. Upon closure of the site, zoning restrictions were implemented restricting the area from residential use. In the land deed, a clause precluded Hooker Chemical from any liability due to damage from the land and noted that the School Board had been made aware of the site conditions. Despite the information and restrictions, the School Board built a school on the land and sold the remainder for residential use (Kuyek, 2011).

In the 1960’s, residents started to notice signs that the impermeable cap was leaking. Both Hooker Chemical and the city officials were informed. Hooker Chemical conducted investigations and identified uncontained toxins, but they did not share the information due to concern for liability. Likewise, the local government did not take any specific actions, regardless of numerous complaints for residents (Kuyek, 2011). It was not until the late 1970’s that a public health emergency was declared by the State of New York, after the significant effort by The Love Canal Homeowners Association; an advocacy group formed by local residents (Kuyek, 2011).

An administrative regime for the Giant Mine site needs to be robust enough that land use restrictions continue for the very long term and also that local people make appropriate land use decisions on a day-to-day basis because they are well-informed about the risks.

With a few exceptions (e.g., Ingram Trail area near the Yellowknife River crossing), the HHERA does not appear to specifically evaluate risks of land use activities, including recreational activities, outside of the lease boundary in areas that are known to have elevated concentrations of arsenic. Figure 5.4-2 in the CRP illustrates existing soil chemistry in Bedrock/Forest/Wetland terrain within the lease boundary and shows areas with soil concentrations of arsenic in the 340 to 3,000 mg/kg range abutting the lease boundary in many areas. Elevated concentrations are known to extend beyond the lease boundaries. While remediation and risk management of these contaminated areas may be outside of the scope of the GMRP, the mechanisms used to achieve land use related closure objectives for the GMRP are equally applicable to the areas outside the lease and should be

extended to affected areas. The GNWT has indicated that a human health risk assessment is underway for these areas and that this information will be used to guide future decision-making.

### 3.0 Potential Ecological Risks

**Recommendation:** The Board should incorporate conditions in authorizations that require completion of future investigations, as proposed in the Ecological Risk Assessment (HHERA Report), aimed at gaining a better understanding of terrestrial effects of mine-related contaminants both currently and in the future.

#### Discussion and Rationale

The proposed approach for managing contaminated soils also has potential effects on the biophysical environment because of exposed soil with elevated arsenic concentrations. The Ecological Risk Assessment (HHERA Report; CRP Appendix 2E) evaluated potential risks for terrestrial vegetation and wildlife, and concluded that some effects will continue after the remediation is complete:

*“At the Giant Mine, the assessment determined that there is the potential for the smaller animals at the site to be affected by arsenic and antimony. This is a particular concern for those animals that consume insects. As animals can adapt to living in areas of high concentrations, the effects may not be as significant as predicted. The remediation will improve the situation, but adverse effects are still predicted in the future.”* (HHERA Report, Section 5.2)

The HHERA Report recommends future monitoring and investigations to confirm the conditions and predictions:

*“Based on the results of the Ecological Risk Assessment, the following activities are recommended:*

- *completion of biological studies to examine the health of vegetation at the site;*
- *collection of insect data to verify assessment assumptions; and*
- *examination of any differences in abundance and diversity of vegetation and mammals, particularly small mammals (shrews at terrestrial sites and muskrat in aquatic environments) by conducting biological surveys at the site compared to an appropriate reference area.*

*Significant changes are expected to habitats at the site due to remedial activities. It is recommended to update the wildlife surveys, including the presence of species at risk, after the remediation activities are completed. It is also recommended to complete postremediation monitoring to determine whether any adverse effects are occurring in ecological species.”* (HHERA Report, Section 5.2).

### 4.0 Adaptive Management

**Recommendation:** Adaptive management is seen as a key part of the GMRP. The Board should incorporate conditions that require development and submission (for approval) of a

comprehensive adaptive management plan (AMP) that identifies key areas of performance uncertainty (e.g., cover performance, loading from pit runoff, conditions in the aquatic environment in Baker Creek, Trapper Creek, Yellowknife Bay, and other key locations, etc.) and for each of these defines appropriate indicators, monitoring, thresholds/action levels, analysis/interpretation methods and timing, responses, and reporting. For consistency with other NWT projects, it may be appropriate to retain the aquatic response framework in the Aquatic Effects Monitoring Program (AEMP). However, the more proactive adaptive management components aimed at identifying and responding to unexpected and/or unacceptable performance of project components and the closure landscape should be clearly defined and described for this project, at least through to the end of Phase 2. Requirements for Phase 3 would be difficult to define at this time because there is too much uncertainty about the conditions and performance at the end of Phase 2.

### **Discussion and Rationale**

The CRP identifies Adaptive Management as a key component of the GMRP. Phase 2 of the project is identified as the Active Remediation and Adaptive Management Phase, whereby the active construction phase will be followed by a period of observation and adjustment to make sure that the closure measures are performing satisfactorily.

The Post-EA Information Package provides some general descriptions of the adaptive management process (e.g., CRP, Section 5.13; Tailings Monitoring and Management Plan, Section 2.6) but it lacks detail about how this important part of the project will be implemented. The *“Conceptual AEMP Design Plan for Yellowknife Bay”* describes the need for a response framework, but does not provide details. The Proposed Type A Water Licence defines requirements for several of the Monitoring and Management Plans to include information about contingency activities including thresholds, action levels and responses, but again there are few details in the versions of the Monitoring and Management Plans provided.

Response frameworks and/or AMPs will be required for a range of site components and valued components. The proposed response framework for aquatic effects is one part of the overall AMP needed for the site, but there should be other key components. The AEMP response framework measures performance in the aquatic receiving environment, which is certainly important, but a proactive AMP should identify and address issues closer to contaminant sources, well before they reach response thresholds in the receiving environment. There should be adaptive management frameworks aimed at identifying failures of specific closure components before the effects are ever measurable in the receiving environment. The Dust Monitoring and Management Plan provides a good example of a tiered, adaptive management approach with monitoring and thresholds set for the causes of dust (e.g., wind), and at locations close to sources, at site boundaries and in the broader airshed. Adaptive responses are defined for exceeding thresholds in each circumstance and location. This same type of proactive approach is needed for other environmental components and potential mechanisms of failure, certainly for water/aquatic components and possibly for soil related contamination.

Information provided with the application and discussions at the technical sessions and workshops indicate that the GMRP intends to rely primarily on conditions in the aquatic receiving environment to trigger management responses for water-related matters. Criterion SW2-2 pertains to water

related contamination: “*water quality objectives in the receiving environment are met.*” For example, during discussions about this criterion at the September 9-10, 2019 Closure Criteria Workshop, CIRNAC indicated that it does not “*plan to collect and sample from other remediated areas (e.g., areas where contaminated soil has been excavated; this water would drain into Baker Creek)*” and that:

*“GMRP is proposing on showing they are meeting WQOs through EQC. GMRP indicated that if they see they are not meeting WQOs at the edge of the mixing zone (for example during spring freshet) they will look at other responses (e.g. through an action level).”* (Workshop Summary Notes. Closure Criteria Workshop. P.23)

A proactive adaptive management approach cannot rely on these receiving water thresholds alone. If either Effluent Quality Criteria (EQC) or Water Quality Objectives (WQOs) are exceeded, the conditions have already deteriorated to unacceptable conditions. An additional challenge is that the GMRP proposes WQOs at the edge of the mixing zone in Yellowknife Bay. While this location integrates most of the mine-related sources, the potential contaminant loading (with the exception of the Water Treatment Plant [WTP] effluent) occurs on a much more local scale.

The AMP should be designed to identify changing conditions within a timeframe that will allow implementation of effective responses well before any exceedance of EQC or WQOs. This will require identification and monitoring of potential contaminant sources at source and in the immediate receiving environment, evaluation of trends and changes, establishment of thresholds and development/implementation of responses. The aquatic environment response framework is an important component of an effective site management/response system, but it should be the final component – one that is supported by many predecessor components such that responses are well underway to avoid or minimize any detection of adverse conditions at the edge of the mixing zone.

## **5.0 Licence Term and Post-Remediation Funding**

**Recommendation:** The Board should grant authorizations that have terms limited to the duration of the proposed Phase 2 of the GMRP. As part of the authorizations, the Board should include conditions that require development of appropriate long-term administrative and funding regimes that will be in place to support relicensing for Phase 3 (Post-closure Monitoring and Maintenance) of the project. The Board should specifically define requirements for a process to develop long-term administrative and funding regimes that includes engagement with the public, and consideration of a range of administrative regimes and funding mechanisms. Consistent with the Report of Environmental Assessment, there should be a requirement to consider delivery and funding mechanisms that rely on use of trust funds with multi-year up-front funding.

### **Discussion and Rationale**

The co-proponents have defined administrative and financial mechanisms and regimes for delivery of Phase 2 of the GMRP. The co-proponents intend to deliver the project using funds that come from the government appropriations process through the Federal Contaminated Sites Action Plan, and have engaged a Main Construction Manager as the project manager for the project. This

appears to be an appropriate mechanism and funding approach for delivery of the active remediation phase of the project.

However, as discussed in the “*Report of Environmental Assessment*” (Mackenzie Valley Environmental Impact Review Board [MVEIRB]. 2013), there are challenges, risks and concerns associated with funding reliability for projects like the GMRP with very long-term monitoring and maintenance requirements. The issues and concerns are described in the Report of Environmental Assessment and the MVEIRB included Measure 6 requiring additional consideration of long-term funding mechanisms:

*“Measure 6: The Developer will:*

- *investigate long-term funding options for the ongoing maintenance of this Project and for contingencies, including a trust fund with multi-year up front funding,*
- *involve stakeholders and the public in discussions on funding options; and,*
- *make public a detailed report within three years that describes its consideration of funding options, providing stakeholders with the opportunity to comment on the report.”* (MVEIRB. 2013)

The MVEIRB also included Suggestion 5, recommending a particular focus on up-front funding for long-term costs through use of a trust fund:

*Suggestion 5: To ensure long-term funding throughout the life of the Project, the Developer should create an independently managed self-sustaining trust fund with multi-year up-front funding for the ongoing maintenance of this Project and for contingencies. A third-party expert should independently manage this trust fund. Annual reports on the condition of the fund should be provided to stakeholders and the public. (MVEIRB. 2013)*

The GMRP has completed an investigation of long-term funding options, culminating in a report “*Development of Options for Consideration for Long Term Funding for Giant Mine*” (Deloitte. July 2019). While the report considered a range of funding options, the work demonstrates that administrative delivery mechanisms and funding mechanisms are closely linked. It is not possible to complete an effective evaluation of funding mechanisms without also defining administrative delivery mechanisms. For example, the use of trust funds may be effective if the project is delivered by an agency that is independent of government, but would have little or no benefit if the project is delivered directly by government. Decisions about administrative delivery and funding need to be considered in combination, something that has not been done to-date. Additional work is needed to address the issues raised in, and the intent of, the “*Report of Environmental Assessment.*”

The issues and concerns identified in the “*Report of Environmental Assessment*” need to be addressed prior to licensing of Phase 3 of the GMRP, when alternative delivery and funding mechanisms may be appropriate. Decisions about delivery and funding should be made well in advance of Phase 3 licensing so that they can be incorporated in the licensing process. As described in the “*Report of Environmental Assessment*”, the long-term funding issues are an area of significant public concern. Decisions about delivery and funding need to consider the views of the community and affected parties – the people who will be most affected by the success or failure of long-term

operations, who are also the people that are most likely to be vigilant about long-term performance of the project and keep a focus on applicable funding priorities.

## 6.0 Pit Backfilling and Covers

**Recommendation:** As part of authorizations for the GMRP, the Board should incorporate conditions that require further analysis and design related to pit remediation, including about materials for pit filling and the need for pit covers. Conditions should also require the development of a material management plan that addresses monitoring and decision-making related to borrow materials used for pit filling and covers.

### Discussion and Rationale

The project information leaves a lot of uncertainty about remediation of pits, including about the water quality implications of fill materials and whether backfilled pits will be covered. It would be beneficial to have a better understanding of the process and criteria that will be used to make decisions about what material will be used to fill pits, whether pits will be filled, whether backfilled pits require covers, and what those covers will be intended to achieve.

Reports submitted in 2019 provide some information about geochemical characteristics of potential pit fill material:

- “Giant Mine Contaminated Granular Fill – Results of Static Geochemical Tests” (Golder. 2019)
- “Giant Mine Coarse Grain Borrow Source Acid Rock Drainage / Metal Leaching Geochemical Assessment” (AECOM. 2019)

These reports identify the need for further testing and analysis to support decision-making about pit fills and the potential need for covers. Once decisions about made about design, there will also be a need for material management plans that describe construction related monitoring and decision-making about material handling and placement.

The “Notice of Preliminary Screening Determination” (MVLWB. September 2019) includes proposed additional work as mitigation to support the screening conclusions:

*“Should these analyses indicate that long-term leachate chemistry differs substantially from what was assumed in the EQC, additional modelling will be undertaken. Results of that modelling will be used to determine if pit cover and caps require re-evaluation.”*

*“The type of cover or cap will be decided upon on a pit-by-pit bases, depending on pit fill, dust control, flood risks, monitoring and maintenance requirements, the risk of settlement, and the durability.”* (Notice of Preliminary Screening Determination. September 2019. P. 5-6)

Licence conditions will help to ensure that the mitigation is completed and the results evaluated.

## 7.0 Land Reclamation and Re-vegetation

**Recommendation:** The Board should require the development of appropriate closure objectives and criteria that define expectations for land reclamation and future conditions of the terrestrial environment.

### Discussion and Rationale

There is no site-wide objective that defines the overall outcome for site reclamation, for example with respect to re-vegetation, surface disturbance, wildlife habitat, land use capacity, etc. This seems like a substantial gap for a reclamation project. The gap has led to uncertainty and confusion about the basis for decision-making about land reclamation and expectations for future conditions of the terrestrial environment.

In the absence of objectives and criteria, the GMRP proposes a minimalist approach to reclamation and re-vegetation of areas that are disturbed as part of the closure project. For example, Table 4-4 of the Updated Project Description (UPD) states that “*where soils are removed down to bedrock, fill materials will not be replaced to minimize issues with erosion and sedimentation as well as pooling of runoff water.*” In general, the GMRP does not propose to carry out active re-vegetation except in areas where it is required to prevent erosion (e.g., Table 4-5 of the UPD states that re-vegetation efforts, if any, will be minimal and that the GMRP will not actively develop wildlife habitat as part of site remediation). This approach to reclamation and re-vegetation will result in landscape changes and loss of wildlife habitat. It will also affect the long-term aesthetic condition of the post-closure site.

In part, the proposed reclamation and re-vegetation approach arises from input received during the Surface Design Engagement (SDE) process, specifically that: “*First Nations feedback included a desire to avoid promoting vegetation growth, such that the site would have the appearance of an abandoned site, helping to communicate risks to future generations*” (CRP Appendix 5.6A, p.4). The desire for a “grey and ugly” appearance at the site is an important outcome from the SDE process. However, it is not clear whether this should be applied to all areas of the site or just to areas that present specific risks that people are concerned about, for example the TCAs. More active reclamation and re-vegetation efforts may be warranted in areas that present little post-reclamation risks, for example pits that are backfilled with clean material, or areas where contaminated soil will be removed for safe storage in other locations.

Consistent with an objectives-based closure planning process, decisions about land reclamation and post-reclamation conditions of the terrestrial environment should be made within a framework defined by clear site-wide objectives and criteria. These types of objectives are typically part of closure planning processes.

## 8.0 Water Treatment Residuals

**Recommendation:** The Board should incorporate conditions that require further testing of water treatment residuals for the proposed new WTP to confirm that the proposed long-term storage methods are appropriate.

### **Discussion and Rationale**

Testing of water treatment sludge to-date has relied on samples collected from the existing Effluent Treatment Plant (ETP). While these samples may be suitable as a surrogate to provide an initial estimate of characteristics, they may not be fully representative of the characteristics of sludge from the new WTP.

In its July 2019 “ETP Sludge and WTP Media Waste Characterization Results” memo, AECOM identifies the need for additional characterization using more representative samples, and reconsideration of disposal methods if necessary:

*“It is recommended that analysis of both waste residual streams be completed to confirm there is no significant deviation from the results presented here during full-scale operation of the WTP. If follow up testing reclassifies the waste as hazardous, an alternate disposal strategy will need to be determined.”*

## **9.0 Management and Monitoring Plans**

**Recommendation:** The GMRP has requested approval of several management plans with issuance of the water licence. Before approving these plans, the Board should consider comments provided on these management plans in the SEC report dated May 25, 2019.

### **Discussion and Rationale**

As requested by the Giant Mine Working Group, “Giant Mine Remediation Project - Review of Post-EA Information Package” (SEC. May 25, 2019) provides detailed comments on the AEMP Design Plan – Baker Creek, Erosion and Sediment Management and Monitoring Plan, Surveillance Network Program, Tailings Management and Monitoring Plan, Water Management and Monitoring Plan, Wildlife and Wildlife Habitat Monitoring and Management Plan, and Engagement Plan. The GMRP has requested approval of each of these plans as part of Phase 1 licensing. Many of the comments provided in May 2019 remain relevant and should be addressed.

## **10.0 Scope of AEMPs**

**Recommendation:** The Board should require the development and implementation of AEMPs for both Yellowknife Bay and Baker Creek throughout all phases of the project. The development of a long-term AEMP for Baker Creek should be supported by closure criteria that directly define expected environmental outcomes in Baker Creek.

### **Discussion and Rationale**

The GMRP proposes that the AEMP for Yellowknife Bay would apply after the new WTPs is operational. The Giant Mine site is currently contributing loading to Yellowknife Bay through the Baker Creek discharge from the existing ETP, and also from Baker Creek sediments, site runoff, and loading from Foreshore Tailings and Sediments. Given the current impacts in Yellowknife Bay, an AEMP for Yellowknife Bay should be initiated now because it may help to provide guidance through the implementation phase of the project.

The scope of the “*Impact Hypotheses*” described in Section 7.6 of the “*Conceptual AEMP Design Plan – Yellowknife Bay*” are currently limited to effects of loading from Baker Creek and the proposed WTP outfall. The scope should be expanded to include other potential sources of loading from the site, including Foreshore Tailings and site runoff that is entering Yellowknife Bay. The scope issue should be addressed for both phases of the AEMP – before and after the new WTP is operational.

The GMRP proposes that the AEMP for Baker Creek would apply only during the period while the ETP continues operating. However, the Giant Mine site will continue to contribute loading to Baker Creek in the long-term, albeit less than the current load. Nonetheless, it will be important to have ongoing evaluation of conditions in Baker Creek to confirm that aquatic effects are not occurring and that the project is performing as expected. It may be appropriate for a Baker Creek long-term AEMP to be incorporated into a site-wide AMP.

The development of a long-term AEMP for Baker Creek should be supported by closure criteria for the Baker Creek component of the project that directly define expectations for environmental outcomes in the stream for important environmental components, for example water quality, sediment quality and benthic communities. Such criteria would be helpful for developing a more proactive AMP.

## **11.0 Effluent Quality Criteria**

**Recommendation:** The Board should include EQC for sulphate and chloride in any water licence issued for the GMRP. Criteria proposed by the GMRP in October 2019 appear reasonable.

### **Discussion and Rationale**

The process for selection of Parameters of Potential Concern (POPCs) is described in Section 5.2.2 of the Effluent Quality Criteria Report. The process includes a pre-screening step followed by three specific water quality comparisons. The pre-screening step identifies a long list of parameters that will be considered in the water quality comparison steps because they are typically associated with mining activities and other activities that are occurring at the Giant Mine. Once the pre-screening is complete, the following water quality comparisons are part of the POPC selection process used by the GMRP:

1. Compare 95<sup>th</sup> percentile WTP discharge concentrations with the 95<sup>th</sup> percentile of background concentrations in Yellowknife Bay. Are the peak concentrations in the WTP effluent higher than the peak concentrations that currently occur in Yellowknife Bay? If so, the WTP has potential to increase concentrations of the parameter in Yellowknife Bay.
2. Compare 95<sup>th</sup> percentile WTP discharge concentrations with WQOs that are applicable in receiving waters of Yellowknife Bay. Are the peak concentrations in the WTP effluent higher than WQOs established to protect water uses in Yellowknife Bay? If so, the WTP effluent has potential to cause exceedances of WQOs in Yellowknife Bay.
3. Compare 95<sup>th</sup> percentile of predicted future concentrations in Yellowknife Bay (at the edge of the mixing zone) with 95<sup>th</sup> percentile of background concentrations in Yellowknife Bay. Does the modelling predict that peak concentrations in effluent discharge from the Site will

increase concentrations in Yellowknife Bay at the edge of the mixing zone so that they are above the peak concentrations that currently occur in Yellowknife Bay?

SEC recommends that the selection of POPCs for which EQC should be established should be based on the pre-screening step and the first two comparisons. The first two comparisons identify parameters for which the project will increase loading to the receiving environment (comparison No. 1) at concentrations that could affect water uses, for example use by aquatic life (comparison No. 2).

The third comparison eliminates parameters because the modelling does not predict that the Project will cause concentrations in Yellowknife Bay to exceed the peak background concentrations. A proactive approach to water quality management should leave these parameters on the “watch list” by establishing appropriate WQOs and EQC. These are parameters that the project expects to influence in the receiving environment. There is substantial uncertainty in the modelling predictions. Removing parameters because the uncertain modelling does not predict that the project will lead to exceedance of peak background concentrations (i.e., 95<sup>th</sup> percentile) at the edge of the mixing zone in the receiving environment is not precautionary. SEC recommends that this comparison should be removed from the process for selecting POPCs. In the end, the third comparison results in removal of zinc and cobalt from the list of parameters that require EQC, but the GMRP adds zinc back into the list because it is required under the *Metal and Diamond Mining Effluent Regulations* (MDMER).

The pre-screening step of the process did not identify Total Dissolved Solids (TDS) as parameter for evaluation through the water quality comparisons, based on the following statement: “*Until further information is available on potential changes in ionic composition of TDS, ions that have a WQG (i.e., sulphate, chloride, nitrate, fluoride, potassium) were screened individually*” (Effluent Quality Criteria Report, Section 5.2.2.1). This is not an unreasonable approach given that the “*Water Quality Guidelines for the Protection of Aquatic Life*” (CCME) do not include a guideline for TDS and key constituents of TDS for the Giant Mine (e.g., sulphate) appear to be addressed in the list of specific ions that are included after the pre-screening.

All of the ions identified during the screening step of the POPC process were carried through after the first comparison because concentrations in the WTP effluent are expected to exceed the concentrations in Yellowknife Bay background. Fluoride, potassium and nitrate were removed from further consideration after the second water quality comparison because concentrations in the WTP effluent are not expected to exceed the WQOs, which appears to be a reasonable conclusion (although nitrate may warrant further consideration based on sources not related to the WTP). The concentrations of chloride and sulphate in WTP effluent are both expected to substantially exceed the WQOs, and they were carried through to the third comparison. For both parameters, the modelling predicts that the effluent discharge will lead to exceedance of the 95<sup>th</sup> percentile of background concentrations at the edge of the mixing zone, meaning they should be included on the list of POPCs.

For these two parameters however, the GMRP adds an additional screening test that it uses to determine that EQC are not necessary. The additional test is a water quality comparison between the predicted concentrations of contaminants at the edge of the mixing zone with the WQOs. Since

the predicted concentrations at the edge of the mixing zone are well below the WQOs, the GMRP concludes that there is no potential for these parameters to cause effects and EQC are therefore not required. The GMRP also argues that its proposed water treatment process is not intended to treat ions and will not be effective for this purpose. The EQC Report describes potential implications of choosing to use reverse osmosis treatment technology to reduce ion concentrations. Given the predicted concentrations, it appears that treatment would not be necessary and that adverse effects are unlikely to occur even within a fairly short distance of the outfall. As a result, the proponents' concerns about the ineffectiveness of the proposed WTP to treat ions and the implications of alternative treatment technologies are not relevant to the determination of whether a parameter is a POPC. The GMRP will contribute loading of these contaminants to the environment, and the changes from background will likely be measurable. Establishing EQC, and tracking performance of the project with respect to the predicted performance makes sense for these parameters. This seems particularly relevant since the concentrations of TDS and chloride in treated effluent have increased since 2011 (CRP, Section 2.3.3.4).

In its October 2019 response to information requests, the GMRP proposes EQC for sulphate and chloride. The rationales for the proposed criteria seem reasonable.

## **12.0 Nearshore Sediments in Yellowknife Bay**

**Recommendation:** The Board should require refinement of closure criteria for remediation of the nearshore sediments in Yellowknife bay. It should also require a robust, long-term monitoring program for proposed covers on nearshore sediments.

### **Discussion and Rationale**

Closure objective T2 addresses the reclamation of the foreshore tailings. One key aspect of the proposed design is to ensure that the toe of the covered area remains below the elevations that could be affected by wave action or contacted by people wading. Historic lake level data show substantial variability and change, and demonstrate that there is uncertainty about future lake levels, especially when considering potential future climate change and variability.<sup>3</sup> Furthermore, the shoreline is a dynamic area. A criterion that specifies the minimum water depth above the toe of the covered tailings would be beneficial and help to define long-term expectations.

Additional specific criteria should also be considered. Section 5.6.7 of the CRP identifies some design criteria that should be added to the list of closure criteria for the Foreshore Tailings:

*“Preliminary design work for this area considers extending the cover such that it would provide coverage of the tailings that would be mobilized for up to a 1-in-500-year wave event. This was a combination of a 1-in-50-year low water level (elevation of 156.04 masl) and 1-in-10-year southeast wind in Yellowknife Bay.”*

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<sup>3</sup> “The water elevation in Yellowknife Bay has decreased since 2001 when the cover was placed. In 2015, a hydraulic assessment was carried out to estimate the average open water low (1-in-2-year return period) to be 156.4 masl (Golder 2016a), which is below the toe of the existing cover.” (CRP, Section 5.6.3.2)

The GMRP proposes covering of nearshore sediments in the Shoreline Lands – along the Yellowknife Bay shoreline from the Townsite to (and including) the Foreshore Tailings. The cover on sediments and tailings is intended to be a long-term solution that will limit direct human contact with arsenic-containing waste. Lakeshores are dynamic areas and even robust designs will likely deteriorate over time. Any covers for lakeshore sediments will require long-term monitoring and maintenance programs, for as long as the materials present risks from arsenic exposure. The CRP proposes that monitoring will include visual monitoring for settlement, erosion, vegetation growth or deposition of sediment (Table 5.12-6).

It is likely that more robust monitoring methods will be required to fully understand the condition of the cover. Also, finding mechanisms to make sure that monitoring and maintenance happens in the long-term will be challenging because the Shoreline Lands will be outside of areas that are subject to substantive administrative controls – the area is to be remediated to residential standards so that people using the area should not be subject to unacceptable health risks. It would be useful for the CRP to describe how the proposed monitoring will specifically address the ongoing status of the covers and the extent of maintenance that will be required. It should also describe what types of administrative measures may be required to ensure that nobody disturbs these areas in the long-term, and who will be responsible for making sure the administrative controls, monitoring and maintenance happen.

### **13.0 References**

Deloitte LLP. 2019. Development of Options for Consideration for Long Term Funding for Giant Mine

Health Canada. 2012. Federal Contaminated Site Risk Assessment in Canada. Part 1: Guidance on Human Health Preliminary Quantitative Risk Assessment, Version 2.0.

Kuyek, J. 2011. The Theory and Practice of Perpetual Care of Contaminated Sites. Yellowknife, NT: Alternatives North.