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ECCC File: 6100 000 008/022
NWB File: 2AM-MEA1530

October 16, 2024

via email at: licensing@nwb-oen.ca

Richard Dwyer
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Dear Richard Dwyer:

RE: 2AM-MEA1530 – Agnico Eagle Mines – Meadowbank Gold Project – Operational Notice of the Development of a Site-Specific Water Quality Objective for Total Dissolved Solids

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Nunavut Water Board (NWB) regarding the above-mentioned development of a site-specific water quality objective for total dissolved solids.

ECCC provides expert information and knowledge to project assessments on subjects within the department's mandate, including climate change, air quality, water quality, biodiversity, environmental preparedness and emergencies. This work includes reviewing proponent characterization of environmental effects and proposed mitigation measures. We provide advice to decision-makers regarding a proponent's characterization of environmental effects, the efficacy of their proposed mitigation activities, and may suggest additional mitigation measures. Any comments received from ECCC in this context does not relieve the proponent of its obligations to respect all applicable federal legislation.

ECCC appreciates the opportunity to review the interim site-specific water quality objective and effluent quality criteria, however, it is noted that supporting studies are still in progress and may impact the information presented. Specifically, the absence of information on mixing in the receiving environment is a significant gap that has yet to be assessed. All comments are related to the proposed SSWQO and EQC are preliminary in nature, pending review of the final versions and the evaluation of the assimilative capacity studies.

The following comments are provided:

1. **Topic: Consideration of Mitigation and Management Options**

Reference(s)

- Operational Notice of Development of a Site-Specific Water Quality Objective for Total Dissolved Solids
- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum

Comment

The Operational Notice for development of a site-specific water quality objective (SSWQO) notes that the implications of increased contaminant loading would run the risk of not being able to meet the Pit water quality criteria at closure. As a result of this risk, the Proponent has developed a site-specific water quality objective for application during operations, closure, and post-closure. However, there is no mention of other alternatives that were considered, such as mitigations or management actions, that could be utilized to improve overall water quality and reduce any potential impacts to the receiving environment.

ECCC Recommendation(s)

ECCC recommends the Proponent provide a discussion of potential mitigation or management options that could be implemented to improve water quality during operations, closure, and post-closure.

2. Topic: Comparison to Existing Conditions and Predicted Future Effluent and Water Quality to Effluent Quality Criteria and Site-Specific Water Quality Objectives

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum

Comment

The technical memorandum provided proposes effluent quality criteria (EQC) to apply at the point of discharge for treated effluent as well as a site-specific water quality objective (SSWQO) to apply at the edge of the mixing zone in the receiving environment. This response is based on measured concentrations of total dissolved solids (TDS) exceeding the forecasted model predictions in the pits by more than 20%. However, the submission does not include any comparison or analysis of how the proposed EQC compares to measured and forecasted water quality in the pits, or how the SSWQO compares to existing measured and forecasted water quality in the receiving environment. Comparison of existing conditions and future water quality predictions to the proposed EQC and SSWQO provides context for expected water quality, the relative change to the aquatic environment, necessity, achievability, and understanding of overall site conditions.

ECCC Recommendation(s)

ECCC recommends the Proponent provide a comparison of how both measured and predicted concentrations in the pits and receiving environment compare to the proposed EQC and SSWQO, respectively.

3. Topic: Effluent and Water Quality Model Update

Reference(s)

- Operational Notice of Development of a Site-Specific Water Quality Objective for Total Dissolved Solids
- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
    - Section 1-2.0 – Site Specific TDS Composition
    - Table 1-1 – Simulated ion concentrations in effluent and estimated ion concentrations at the edge of the mixing zone

Comment

Development of the proposed SSWQO and EQC for TDS were undertaken as a result of measured concentrations of TDS in Pit E and Goose Pit exceeding forecasted model predictions by more than 20%. Given that the model is not providing accurate predictions of the expected conditions, it is likely necessary to review and update the model to obtain a better understanding of expected conditions as the mine proceeds towards closure. It is unclear whether these results of measured concentrations exceeding predictions have triggered the Proponent to complete a model update. Footnote 1 in Section 1-2.0 states, “draft treated effluent predictions modelled by Lorax Environmental Services for the Vault Pit (base waters; active closure; October 2040) were provided to WSP by Agnico on 30 March 2024” but this is the only reference to model predictions that has been included in the technical memorandum. The referenced predictions for Vault are included as the effluent predictions in Table 1-1 and include a TDS concentration of 2655 mg/L. ECCC notes that this predicted effluent concentration for TDS is considerably below the proposed interim criteria, therefore it is unclear whether the effluent and water quality model has been updated.

ECCC Recommendation(s)

ECCC recommends the Proponent clarify whether an update to the effluent and water quality model has been undertaken as a result of measured concentrations exceeding predictions. If not, ECCC recommends that a model update be completed to refine source terms and predictions to address measured concentrations exceeding predictions.

4. Topic: Data Inconsistencies

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum

- Attachment 1, Section 1-3.0 – Acute Toxicity Data for TDS
- Table 1-2: Acute toxicity data for Mock Treated Effluent (Pit E, ST-19), Meadowbank Mine
- Figure 1-3: Measured total dissolved solid composition in Mock Treated Effluent Blends of Pit E water 2022 to 2023

Comment

Section 1-3.0 of Attachment 1 presents acute toxicity test results for total dissolved solids (TDS) including corresponding water chemistry (Table 1-2) as well as ionic composition (Figure 1-3). However, ECCC notes that there are inconsistencies in the data presented.

Section 1-3.0 refers to an observation of reduced survival in *Daphnia magna* (40% in full-strength sample) and Rainbow Trout (20% in full-strength sample) for a sample collected on November 7, 2022 at TDS concentration of 2834 mg/L. In addition, reduced survival in Rainbow Trout (20% in full-strength sample) was observed in a sample collected on December 7, 2022 with a TDS concentration of 2383 mg/L. However, while Table 1-2 provides a summary of the acute toxicity test results, these instances of reduced survival are not included in the table. Specifically, Table 1-2 indicates 100% survival of both *D. magna* and Rainbow Trout on November 7, 2022 and does not provide any data for December 7, 2022. In addition, two dates provided in Figure 1-3 (December 7, 2022, February 1, 2023) are inconsistent with the sampling dates that are presented in Table 1-2. Errors and inconsistencies in how the results are presented result in confusion and uncertainty in interpretation of results.

ECCC Recommendation(s)

ECCC recommends that the Proponent:

1. Provide clarification on why the observations of reduced survival referred to in Section 1-3.0 are not included in Table 1-2;
2. Complete a review of Table 1-2 and Figure 1-3 for accuracy, and provided updated tables/figures, as required.

5. Topic: Justification for Effluent Quality Criteria

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
  - Section 3.1 – Interim Effluent Quality Criteria
  - Attachment 1, Section 1-3.0 – Acute Toxicity Data for TDS

Comment

The report proposes an EQC for Meadowbank ranging from 4000 to ~10,200 mg/L, but that further refinement to a single value will be informed by evaluation of the assimilative

capacity in the receiving environment. The report indicates that the lines of evidence provide “high confidence that no acute lethality is expected at the point of discharge at 4000 mg/L” and “given the conservatism of the assessment, the results could support an extension of the EQC above 4000 mg/L.” However, ECCC notes that *Daphnia magna* treated with Pit E water on November 7, 2022 had 40% mortality at 2834 mg/L TDS. While 40% mortality does not constitute acute lethality as per the definition provided in footnote 5, this is still considered a severe effect. This result of an observed severe effect does not support the proposed upper bound of 10,200 mg/L for an effluent quality criteria. The upper bound concentration appears to be derived only from the cryo-concentration lab tests, however, those results conflict with the results referenced in Section 1-3.0 using pit E water where some level of effect was observed at much lower concentrations. It is understood that the values presented are interim, however ECCC questions the protectiveness of the upper bound, based on the information and justification provided to date.

In addition, while these results of <100% survival are referenced in the text of Section 1-3.0, there is no in-depth discussion of these results. The Proponent only states, “in both cases, mortality did not exceed 50%, and several other samples have been tested with measured TDS concentrations greater than 2812 mg/L, all of which indicated no acutely toxic effect to Rainbow Trout and *D. magna.”* Just because these results did not align with other tests does not mean that they do not provide important information related to the potential for toxicity. Interpretation of these results should be provided.

ECCC Recommendation(s)

ECCC recommends that the Proponent provide an interpretation of the results of acute toxicity testing resulting in <100% survival

6. Topic: Chronic Toxicity and Existing Guidelines

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
    - Attachment 1, Section 1-4.0 – Chronic Toxicity Data for TDS

Comment

Section 1-4.0 provides a summary of chronic toxicity data for TDS, and notes that there are currently no federal, provincial, or territorial water quality guidelines for TDS in Canada, but includes a discussion of criteria that have been developed for other sites across Canada.

ECCC notes that while there are no water quality guidelines for TDS, there are guidelines available in Canada for sulphate, the predominant ion in the Meadowbank effluent. The British Columbia Minister of the Environment (MOE) sulphate guideline includes hardness as a toxicity modifying factor, allowing for a degree of site-specificity.

In addition, the Proponent has referenced two other Canadian Mines (Faro Mine and Elk Valley Coal Mining Operations), both of which based their SSWQO on sulphate ion instead of TDS. These two mines operate with high sulphate concentrations and very high hardness, similar to the scenario described at Meadowbank. In the cases of these two mines, Faro set their SSWQO at 800 mg/L sulphate with hardness of 432 mg/L and Elk Valley at 500-600 mg/L sulphate at hardness of > 800 mg/L. Given that hardness based site-specific sulphate guidelines are available and have been approved in other jurisdictions within Canada, and it is unclear why a similar, consistent approach is not proposed for Meadowbank.

A TDS EQC and SSWQO would rely on the ion mixture remaining consistent in future years. Basing the EQC and SSWQO on sulphate would give us more certainty that the main component of the TDS (sulphate) is adequately characterized and monitored and would easily identify any divergences in the effluent and water quality. While the Proponent has provided some rationale for the inclusion of an overall TDS guideline rather than a sulphate guideline, they have also demonstrated that other similar projects in Canada have utilized an ion-specific guideline rather than a TDS guideline. Given that a guideline within Canada exists for sulphate, and that other jurisdictions and projects have used sulphate instead of TDS, additional justification is required for why this approach was not also followed in this case.

ECCC Recommendation(s)

ECCC recommends the Proponent:

1. Provide additional justification for proceeding with a TDS EQC and SSWQO, rather than sulphate, given existing precedence for similar projects within Canada.
2. Consider a combined approach of including EQC and SSWQO for both sulphate and TDS.

7. Topic: Receiving Environment Predictions

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
    - Attachment 1, Section 1-2.0 – Site Specific TDS Composition

Comment

Section 1-2.0 provides some general attributes that are anticipated to influence toxicity of TDS for the site-specific mixture. This includes assumptions about future conditions at the edge of the mixing zone. Specifically, ion concentrations were estimated by applying a 0.75 dilution factor to the predicted effluent (2655 mg/L) to target an upper bound for edge of mixing zone as a simulated scenario of 2000 mg/L TDS. No rationale was provided for the 0.75 dilution factor or why the Proponent targeted a 2000 mg/L edge of mixing zone concentration, given that this is double the proposed SSWQO. Generally speaking, it is unclear what Table 1-1 is intended to demonstrate. The simulated edge of mixing zone is not only above the proposed SSWQO, but also exceeds water quality

guidelines for the protection of aquatic life for other parameters (e.g. chloride, sulphate, fluoride, nitrate). ECCC notes that the Proponent has stated that studies are ongoing to generate edge of mixing zone predictions based on assimilative capacity modelling results that are not yet available. This information is a vital piece in understanding overall water quality and the potential for effects in Wally Lake and Third Portage Lake.

ECCC Recommendation(s)

ECCC recommends the Proponent provide additional details on the source of the dilution factor used to generate the predictions provided in Table 1-1 and additional clarity on what this table is intended to demonstrate.

8. Topic: Measured vs. Calculated TDS

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
    - Attachment 1, Section 1-3.0 – Acute Toxicity Data for TDS

Comment

Table 1-2 provides acute toxicity data for mock treated effluent and includes a comparison of measured TDS to calculated TDS. The Proponent has proposed to use calculated TDS instead of measured TDS for the basis of their EQC. Based on the data provided in the table, measured TDS is generally lower than calculated TDS, therefore calculated may provide a conservative measure of TDS. However, there is a large discrepancy between the measured and calculated concentrations for the October 3 and December 2 samples and the calculated TDS is considerably lower than the measured TDS. No explanation has been provided for this discrepancy.

ECCC notes that measured TDS provides the most accurate representation for TDS as it includes all possible sources of ions. While calculated TDS includes the largest chemical contributors, it is not exhaustive and may become unreliable if the chemistry of the sample changes. All analytical methods are subject to interferences; however, the measured TDS method is designed to mitigate sources of error. Measured TDS methods include requirements to store samples in desiccators and decrease sample volume if there is a potential for the sample to form a water trapping crust (caused by high TDS values).

ECCC Recommendation(s)

ECCC recommends the Proponent provide a discussion on the large differences in measured and calculated TDS that were observed on October 3 and December 2.

9. Topic: Chronic Toxicity Dataset

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
    - Attachment 1
        - 1-4.0 – Chronic Toxicity data for TDS
        - Table 1-3 – Chronic Toxicity test dataset for sulphate-dominant total dissolved solids mixture

Comment

Table 1-3 provides the chronic toxicity test dataset for sulphate-dominant total dissolved solids mixtures. The Proponent has compiled these studies based on their screening criteria and have presented an interpretation of trends for generic TDS mixtures. ECCC notes that the data provided in this table could be used to plot chronic toxicity data on a species sensitivity distribution (SSD). Creation of an SSD would provide a more statistically robust justification for the proposed SSWQO.

ECCC Recommendation(s)

ECCC recommends that the Proponent consider the development of a species sensitivity distribution to provide statistically robust justification for a proposed site-specific water quality objective.

10. Site Reference Chemistry

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
    - Attachment 2 –
        - Section 2-2.2.1 – Source Water for Testing
        - Table 2-3: Site Reference Chemistry for Major Ions

Comment

Section 2-2.2.1 states that the source water for testing was collected from a raw drinking water intake pipe connected to Third Portage Lake. Table 2-3 provides Site Reference Chemistry for Major ions, and it is assumed that the data presented in this table is the chemistry of the sample referenced in Section 2-2.2.1, but this is not explicitly stated. However, the concentrations for sulphate and TDS in Table 2-3 appear to be inconsistent with what was reported in other sections of the report. Section 1-2.0 indicates calculated TDS for Wally Lake and Third Portage Lake as <40 mg/L and according to Figure 1-2 sulphate should represent approximately 20% of ion mixture and alkalinity should dominate. This contrasts Table 2-3, which indicates a sulphate concentration of 74 mg/L (60% of the TDS mixture).

ECCC Recommendation(s)

ECCC recommends the Proponent clarify the source of the site reference chemistry for major ions that is provided in Table 2-3. This should include a discussion/clarification on the discrepancies between this table and other sections of the report.

11. Topic: Report Inconsistencies

Reference(s)

- Appendix F – TDS Site Specific Water Quality Program Technical Memorandum
  - Section 3.2.3 Proposed Chronic Site-Specific Water Quality Objective
  - Attachment 1, Section 1-2.0 – Site Specific TDS Composition
  - Table 1-3: Chronic Toxicity Test Dataset for Sulphate-Dominant Total Dissolved Solid Mixtures

Comment

ECCC has noted the following inconsistencies in the report:

- Section 3.2.3 provides a list of considerations supporting the proposed SSWQO. The first bullet includes the statement, “Meadowbank Mine TDS during treated effluent discharge is expected to contain primarily calcium and sodium cations.” This statement is contradictory to Attachment 1, Section 1-2 which indicates predicted end-of-mine life treated effluent will have the following ion composition: 49% sulphate, 16% chloride, 10% calcium, 10% sodium and 4% potassium.

- Attachment 1, Section 1-2.0 states that, “with treated mine effluent discharge, it is expected that the relative proportion of total alkalinity would decline with corresponding increases of calcium, sodium, and sulphate.” It is unclear why chloride is not included with this list of increasing ions in the receiving environment

ECCC Recommendation(s)

ECCC recommends that the above noted sections are reviewed for accuracy, and clarifications provided as needed.

If you need more information, please contact Russell Wykes at (867) 445-1263 or Russell.Wykes@ec.gc.ca.

Sincerely,

Wykes, Russell

Digitally signed by Wykes, Russell
Date: 2024.10.17 13:36:44 -06'00'

Russell Wykes
Senior Environmental Assessment Officer

Attachment(s):

cc: Eva Walker, Head, Environmental Assessment North (NT and NU)