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ECCC File: 6100 000 008/021
NWB File: 2AM-MEA1530

December 20, 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 Mine – Response to comments on the site-specific water quality objectives 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 comment responses.

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 provides the following responses to comments provided:

1. Consideration of Mitigation and Management Options

ECCC recommended 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.

The Proponent states "*Further mitigation other than what is currently outlined in management plans is not necessary*" without justifying why. They Proponent does not describe which of the mitigation or management options in the plans will be or has been implemented. The Proponent

concludes with "*Mitigation measures currently in place are expected to keep TDS* [total dissolved solids] *concentrations at acceptable levels including closure and post-closure.*" Acceptable TDS concentration levels are the subject of discussion so it is premature to determine if current measures will be sufficient to meet them, once they are determined.

ECCC's recommendation remains unchanged.

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

ECCC recommended the Proponent provide a comparison of how both measured and predicted concentrations in the pits and receiving environment compare to the proposed effluent quality criteria (EQC) and site-specific water quality objectives (SSWQO), respectively.

The Proponent's reference to Table 4.1 of the Water Management Plan V.13 allows us to compare measured and predicted concentration in the pits for 2020-2023 with the proposed EQC. Forecasted concentrations in the pit for the remainder of operations and closure should also be provided for comparison with the proposed EQC.

The Proponent has not provided current or predicted conditions in the receiving environment because they "*are not discharging to the receiving environment.*" If the Proponent is not discharging to the receiving environment and doesn't plan to do so for operations, it is not clear why it is necessary to develop EQC and SSWQO through a water licence modification request.

If TDS criteria are developed, it will be necessary to understand conditions in the receiving environment in order to evaluate the appropriateness of proposed EQC and SSWQO.

ECCC recommends the Proponent provide:

1) a comparison of forecasted parameter concentrations in the pits with the proposed EQC; and
2) a comparison of measured and predicted concentrations in the receiving environment with the proposed SSWQO.

3. Effluent and Water Quality Model Update

ECCC recommended 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 recommended that a model update be completed to refine source terms and predictions to address measured concentrations exceeding predictions.

The Proponent acknowledged that an updated effluent and water quality model will be submitted in 2025.

ECCC requests opportunity to review the updated model once it is submitted.

4. Data Inconsistencies

ECCC recommended 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 provide updated tables/figures, as required.

The Proponent's response to part 1) is that the table was intended to show "*the lethal concentration to 50% of the test organisms (LC50) at 100% concentration of TDS (%vol/vol) and that is why reduced survival was not presented in this summary table.*" It is still not clear why the 7 December 2022 test referred to in the paragraph above Table 1-2 is not included in the table. The answer generates a follow-up question regarding reduced survival for the other tests listed in Table 1-2.

The Proponent's response to part 2) is that neither Table 1-2 nor Figure 1-3 require updating, even though inconsistencies have not been explained. Both the table and figure report on eight tests, however they are not the same 8 tests based on the dates, so it appears that data is missing.

ECCC recommends the Proponent:

1) Provide survival rate data for the following toxicity tests: 17 May 2022, 27 May 2022, 3 October 2022, 24 October 2022, 2 December 2022, 7 December 2022 (for *Daphnia magna*), 2 January 2023, 1 February 2023, and 13 April 2023.
2) Provide the measured total dissolved solid compositions for toxicity tests performed on 2 December 2022 and 2 January 2023?
3) Provide the toxicity test results for TDS compositions reported for 7 December 2022 (for *D. magna*) and 1 February 2023 (for both *D. magna* and rainbow trout)?

5. Justification for Effluent Quality Criteria

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

The Proponent responded, "*the cause of toxicity in the previous 2022 testing is likely not due to TDS itself, but rather another constituent in the Mock Effluent*" because the 2024 testing "*exhibited no acute toxicity to Daphnia magna or Rainbow Trout at calculated TDS concentrations of <10,233 mg/L*". It is not clear what other constituents are being considered.

ECCC notes one of the areas of uncertainty identified in the 2024 report (Attachment 2) is TDS as a surrogate for ion toxicity. There are differences in the mix ions contributing to TDS between the 2024 samples and the 27 May 2022 sample, including lower proportional sulphate concentrations and the presence of nitrate. The total dissolved solids composition was not provided for the 7 December 2022 sample (see comment #4), so it is not yet possible to compare its composition to that of the 2024 samples. Understanding the effects of variable ion mixture proportions is important when evaluating potential impacts of proposed EQC and SSWQO.

ECCC recommends the Proponent discuss possible influence of different ion mixtures contributing to TDS on the results of acute toxicity testing resulting in <100% survival.

6. Chronic Toxicity and Existing Guidelines

Reference - *Mathematical Models for Mixture Toxicity. Environmental Toxicology and Chemistry. 37(1) p. 247–259 Erikson et al., 2017)*

ECCC recommended 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.

The Proponent responded, "*it would be redundant to generate both a TDS SSWQO and a sulphate SSWQO for this site.*" They propose "*evaluating the full effects of major ion concentrations and ratios of major ions (such as calcium-to-magnesium ratios) in a site-specific manner*" because research by Mount et al. (2016, 2018) and Erickson et al. (2106a, b) reports on two mechanisms for major ion toxicity.

The research referenced does highlight the complexity of mechanisms and interactions for major ion toxicity. It does not conclude that TDS is a good surrogate for determining sample toxicity, but instead proposes a mathematical model for predicting the median lethal concentration for any ion mixture, excepting those dominated by potassium-specific toxicity (Erickson et al., 2017).

The specific ion mixture can have a critical role in determining toxicity, which the proponent accounted for: "*The TDS mixture used in the 2024 testing was formulated to investigate site-specific ionic compositions.*" Using only a criterion for TDS assumes that the ion mixture will remain constant. As noted in Section 2-4.0 of the Site-Specific Toxicological Study for Total Dissolved Solids Using Mine-Impacted Waters report (August 15, 2024), "*Should future ion mixtures shift away from the current sodium-calcium-sulphate-chloride dominant composition a revaluation of the applicability of the toxicity data presented in this report should be evaluated.*" Accounting for potential changes to ionic mixture composition is necessary when setting criteria and is not addressed by a single criterion for TDS.

ECCC recommends the Proponent suggest how their proposed TDS EQC and SSWQO could be modified or augmented to account for varying ionic mixture composition.

7. Receiving Environment Predictions

ECCC recommended 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.

The Proponent responded Table 1-1 "*was to show both the full-strength effluent predictions, and the edge of the mixing zone predictions*" and specified the dilution factor of 0.75 was chosen to represent a worst-case scenario.

The information provided answers ECCC's questions. As noted in our initial comment, the ongoing studies to generate edge of mixing zone predictions based on assimilative capacity modelling results will provide a vital piece in understanding overall water quality and the potential for effects in Wally Lake and Third Portage Lake. Presently there is insufficient information to evaluate the SSWQO.

ECCC requests the opportunity to review the mixing zone model and predictions after they are submitted.

8. Measured vs Calculated Total Dissolved Solids

Reference - *ALS Limited. November 2022. Techniques for Accurate Measurement and Estimation of Total Dissolved Solids. EnviroMail Canada. 42.*

The Standard Methods for the Examination of Water and Wastewater 24th Edition (American Public Health Association (APHA), 2023)

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

The Proponent responded that "*This difference in using the gravimetric method and measuring the mass of residue left after evaporation for TDSmeas, compared to the TDScalc method of summing major ion constituents, would result in two different numbers being reported.*" It is understood that measuring and calculating TDS will give different results, however the ratio of the values is expected to remain relatively constant. The ratio of measured to calculated TDS in Table 1-2 vary from 0.81 to 1.47 which highlights that in the case of these toxicity studies, the TDS values are not reliably equivalent. The Standard Methods for the Examination of Water and Wastewater 24th Edition (American Public Health Association (APHA), 2023) explain "*the measured TDS concentration is expected to be larger than the calculated one because the calculation may not include a significant contributor*" and specify an acceptable measured to calculated TDS ratio is between 1.0 and 1.2.

The Proponent also re-iterates their preference for setting criteria for calculated TDS rather than measured TDS, referring to the sum of ions calculations described in the Standard Methods for the Examination of Water and Wastewater 22nd Edition (APHA, 2012). In the 24th Edition, the sum of ion calculation is described in APHA 1030E as a tool for checking analyses' correctness, not as a test method for determining total dissolved solids (ALS Limited, 2022). A method for measuring total dissolved solids is included as APHA 2540C.

ECCC notes that the TDS measurement method MA. 115-S.D 1.0 gravimetric method (Governement de Québec 2023) used by the Proponent measures both TDS and volatiles. This would not be equivalent to a method measuring only TDS such as APHA 2540C or BC Environmental Laboratory Manual (2023) method for total dissolved solids/filterable residue 1.0 µm. It will be important to consistently use the same test method for TDS.

ECCC recommends that any criteria for TDS be for measured TDS.

9. Chronic Toxicity Dataset

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

The Proponent responded "*A species sensitivity distribution (SSD) will be generated to aid in the justification for the proposed SSWQO.*" Presently there is insufficient information to evaluate the SSWQO and the SSD will contribute to filling some of the gaps.

ECCC requests the opportunity to review the species sensitivity distribution once it is submitted.

10. Site Reference Chemistry

ECCC recommended 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.

The Proponent clarified that the site reference chemistry for major ions provided in Table 2-3 is for "*Site water was collected from a raw drinking water intake pipe connected to Third Portage Lake (station DW-RAW-KIA) by Agnico on 27 March 2024.*" Additionally, they "*do not believe there are any discrepancies between Table 2-3 and the other sections of the report.*"

The discrepancies noted by ECCC are between the water chemistry provided in Table 2-3 of Attachment 2 of the TDS site-specific water quality program technical memorandum and Section 1-2.0 and Figure 1-2 bottom of Attachment 1 of the same memo. In Attachment 1, water from Third Portage Lake is described as having calculated TDS <40 mg/L. In Attachment 2, water from Third Portage Lake is characterized as having a calculated TDS of 122 mg/L, and the ion proportions have changed. As well as the change in the sulphate ion noted in our initial comment, ECCC notes the proportion of calcium ions has approximately doubled and that of alkalinity is reduced to approximately a third. It is not clear why the water chemistry in Third Portage Lake has changed in the 2023 to 2024 time period between which the attachments reports were produced. Understanding the variability of site conditions is important when evaluating potential impacts of proposed EQC and SSWQO.

ECCC recommends the Proponent discuss why water chemistry of the reference site, Third Portage Lake, has changed between the work in Attachments 1 and 2. Attachments 1 and 2 should address both the difference in TDS and difference in ionic mixture proportion.

11. Report Inconsistencies

ECCC recommended that sections noted in the original comment be reviewed for accuracy, and clarifications provided as needed.

The Proponent proposes to include applicable revisions in a revised TDS Report.

ECCC requests the opportunity to review the revised TDS Report when it is submitted.

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: 2024.12.20 15:09:01 -07'00'

Russell Wykes
Senior Environmental Assessment Officer

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