Environmental Protection Operations Directorate
Prairie & Northern Region
5019 52nd Street, 4th Floor
P.O. Box 2310
Yellowknife, NT X1A 2P7

ECCC File: 6100 000 115/002
NWB File: 2AM-BRP1831

January 29, 2021

via email at: licensing@nwb-oen.ca

Stephanie Autut
Executive Director
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Dear Stephanie Autut:

RE: Licence #2AM-BRP1831 – Sabina Gold & Silver Corp. – Back River Project – Technical Review of the Amendment Application and Supplemental Information

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Nunavut Water Board (NWB) regarding the above-mentioned Water Licence Amendment Application.

ECCC is providing the following specialist advice, based on our mandate pursuant to the *Canadian Environmental Protection Act* and the pollution prevention provisions of the *Fisheries Act.*

1. Topic – Tailings Production and Storage

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE
  - Attachment IR-D Tailings Management Plan
    - Section: 5.1 TAILINGS PRODUCTION AND STORAGE

Comment

The Proponent states, "*the purpose-built TSF* [Tailings Storage Facility] *is located on Crown land and in the area of a natural depression about 2 km south of Goose Main Open Pit. Containment will be achieved with construction of a frozen foundation dam with a geosynthetic clay liner (GCL) on the northern end of the facility (TSF Containment Dam), and a small control structure at the south end of the facility (TSF South Dyke). Three small streams and four ponds are located within the footprint of the TSF and will be covered by*

the facility as shown on 2020 Modification Package Appendix A, Figure 3. A plan view of the TSF Containment Area is shown in Figure A-01."

It is not clear whether the three streams and four ponds are water bodies frequented by fish that will require listing in Schedule II of the *Metal and Diamond Mining Effluent Regulations* (MDMER).

ECCC Recommendation(s)

ECCC requests that the Proponent confirm that the three streams and four ponds have been assessed and determined not to be waterbodies frequented by fish.

2. Topic – Tailings Storage Facility

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE
    - Attachment IR-D Tailings Management Plan
        - Section: 5.2 TAILINGS STORAGE FACILITY; 5.2.3 Seepage Analysis

Comment

The Proponent states, "*During the 2015 drill program, small zones of fractured bedrock (2 to 3 m thick) were found in some of the drill holes near the west abutment of the dam, which may provide a pathway for seepage through the foundation of the dam. However, the thickness of dam bulk fill present in this specific portion of the TSF Dam, as well as along most of the TSF Dam alignment, will far exceed the minimum thermal cover requirement to maintain the underlying overburden materials in a frozen state; therefore seepage is unlikely to occur*."

ECCC notes that the 2-3m fracture zone is of potential concern, depending on how fractured and altered the zone is. From the above description, it appears that the zone may be highly fractured and could be a major conduit pathway for water. The mitigation of bulk fill will not prevent the flow of water through the zone because the fracture zone connects to a recharge source and may be permeable enough to allow flows. It is also not clear whether the Proponent intends to seal off the fracture zone completely using grout. Bulk fill alone may not be enough to prevent flow through the zone.

ECCC acknowledges the Proponent intends to complete "*Packer testing… in select drillholes to evaluate bedrock hydraulic conductivity*." However, it is unclear whether bedrock hydraulic conductivity test will provide a determination of the hydraulic conductivity of the 2-3 m fracture zone in order to assess the rate of flow through the fracture zone.

ECCC Recommendation(s)

ECCC requests the Proponent:

- Provide clarification on whether the packer testing will provide a determination of the hydraulic conductivity of the 2-3m fracture zone.

- Provide additional information on how the bulk fill will prevent flow through the 2-3m fracture zone.

3. Topic – Waste Rock Storage Area Design

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE,
  - Attachment IR-E: Waste Rock Management Plan
    - Section: 5.4 WASTE ROCK STORAGE AREA DESIGN

Comment

In section 5.4.1.1 (Umwelt Waste Rock Storage Area), the Proponent indicates, "*One small stream and two ponds are located within the footprint, or immediately upstream, of the Umwelt WRSA and will be covered by the facility (2020 Modification Package Appendix A, Figure 3). The stream and ponds are less than 2 m deep and freeze to the bottom annually during winter*." In section 5.4.1.3 (Tailings Storage Facility Waste Rock Storage Area), the Proponent indicates, "*Three small streams and four ponds are located within the footprint of the TSF WRSA and will be covered by the facility (2020 Modification Package Appendix A, Figure 3). Except for one pond, these streams and ponds are less than 2 m deep and freeze to the bottom annually in winter*."

It is not readily clear whether the streams and ponds referred to above are water bodies that are frequented by fish. If they are water bodies frequented by fish, they will likely require listing in schedule II of the MDMER.

ECCC Recommendation(s)

ECCC requests the Proponent confirm they have assessed the streams and ponds in the Umwelt Waste Rock Storage Area and Tailings Storage Facility Waste Rock Storage Area, and determined the streams and ponds are not water bodies frequented by fish.

4. Topic – Changes to Outputs of the Water and Load Balance

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE
  - CIRNAC-8
  - ECCC-4

Comment

In response to ECCC-4 and CIRNAC-8, the Proponent has provided a table outlining the changes in model assumptions from the 2015 model to the 2020 Modification package. However, the response does not outline how the changes in model assumptions have influenced the outputs of the modelling compared to the 2015 prediction. A comparison of the updated 2020 modification outputs (water quality concentrations) to the 2015 model at key modelling nodes provides a more fulsome understanding of how the changes to the

mine plan and corresponding changes to assumptions in the Water and Load Balance have resulted in changes to water quality on site.

ECCC Recommendation(s)

ECCC recommends that the Proponent provide a comparison of changes in outputs from the water and load balance (changes to water quality) as a result of the changes to model assumptions included as part of the 2020 Modification.

5. Topic – Establishment of Meromixis in Umwelt Reservoir

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE
  - ECCC-3

Comment

In response to ECCC-3 the Proponent provided additional rationale for their assumption that meromixis will establish and remain stable within Umwelt reservoir. In the previously approved mine plan, Llama was intended to be used for saline water management, and analysis was completed on the overall stability of the meromixis in this pit. During the previously approved plan, "*meromixis in Llama Pit (then called Llama Reservoir) is initiated with a large inflow of freshwater (839,700 m3) and melting ice cover (estimated 1.1 m of ice) from breaching the surrounding Llama management structures in Year 4. The melting ice and freshwater inflow result in a freshwater cap of approximately 7.5 m over the surface of the reservoir*." However, while the ice thickness and surface area of Umwelt is similar to Llama, the 2020 modification indicates that Umwelt will require additional inflow of freshwater at surface to develop meromixis. As noted by the Proponent, Umwelt reservoir will receive approximately 350,000 m^3 of freshwater from the Primary Pond Breach in Year 3, resulting in a freshwater cap of 3 m.

Due to the reduction in initial freshwater cap (previously 7.5m, now 3m) as well as reductions in annual inputs due to runoff (previously 839,700m^3, now 350,000 m^3) it is unclear whether the two layers will remain stratified during the filling of the pits due to the lower annual inputs and increased time for mixing/diffusion between the layers. According to the water and load balance (Section 6.4) the 95th percentile volume of saline water that would be deposited into Umwelt Reservoir is 3,486,000 m^3. The Proponent does not discuss how this volume may differ from the Approved Project, which describes depositing saline water into Llama Pit (more/less saline water) or how the these changes to the initial conditions and filling over time may impact the potential to develop meromixis.

In the previous analysis of establishment of meromixis in Llama Pit that is referenced, the potential for stratification is examined once the pit has filled, assuming that the energy of deposition was dissipated, and that the freshwater cap is 55 m thick over a lower saline layer 75 m thick. It is not discussed whether the thickness of the freshwater cap over the thickness of saline layer continues to be applicable to the Umwelt Pit.

ECCC Recommendation(s)

ECCC recommends that the Proponent:

- Provide a discussion of how the changes to the initial conditions and reduced annual freshwater inputs may impact the development of meromixis in Umwelt pit as compared to Llama pit.
- Provide information on the final ratio of freshwater to saline water in Umwelt Pit as compared to Llama Pit.

6. Topic – Hydrodynamic Modelling and Water Quality in Goose Lake

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE
  - KIA-11
  - CIRNAC-11
  - Attachment IR-C: Water Quality Prediction Results

Comment

In KIA-11, additional information was requested on the extent of elevated water quality concentrations within Goose Lake as water from PN-04 and PN-05 moves through towards PN-03. In addition, this comment requested additional clarity on what “maximum” represents in the tables provided in Appendix D of the Water and Load Balance (maximum concentration vs. maximum average monthly concentrations). In response, the Proponent has identified that the location within Goose Lake where quality will meet water quality guidelines (CCME and site-specific water quality objectives (SSQWO)) has not yet been determined and will be proposed based on results of ongoing hydrodynamic modelling and mixing zone assessment. In addition, maximum values provided in the water and load balance are maximum monthly average concentrations.

CIRNAC-11 also requested additional details regarding upcoming hydrodynamic modelling, and in response, the Proponent stated that the hydrodynamic model will be provided during the review process for this amendment application prior to the technical meeting.

ECCC notes that while the modelling results presented in Attachment IR-C (Water Quality Prediction Results) are consistent with the statement provided by the Proponent that SSWQO are met at PN-03 (maximum average - Arsenic = 0.009219 mg/, copper = 0.004088 mg/L), the predicted concentrations for Goose Lake are above the SSWQO for both arsenic and copper (maximum averages of 0.01875 mg/L and 0.009474 mg/L, respectively). Given that this modelling indicate that exceedances of the SSWQO in Goose Lake are expected, a completed hydrodynamic model would aid reviewers in understanding the extent of water quality above guidelines within Goose Lake.

ECCC Recommendation(s)

ECCC supports the submission of an updated hydrodynamic model in advance of the technical meeting in order to aid in interpretation of modelling results and understanding of the extent of aquatic impacts within the Project Area.

7. Topic – Inconsistencies in Water and Load Balance

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE
    - ECCC-5
    - Attachment IR-C

Comment

In the completeness review and as outlined in ECCC-5, ECCC identified several anomalies in the data presented in Appendix D of the Water and Load Balance including: unrealistically high concentrations, inconsistencies with data presented in the body of the report, and modelling outputs appearing to not incorporate treatment in "with treatment" scenarios. In response, the Proponent has provided an updated Appendix D in Attachment IR-C.

Upon review of the data provided in Attachment IR-C, there still are inconsistencies in the data presented that potentially question that validity of the conclusions made from this modelling. For example:

- Umwelt Reservoir
    - Maximum concentration
        - Nitrite = 10 mg/L
        - Mercury = 0.89 mg/L
    - Maximum concentration (with treatment)
        - Nitrite = 276 mg/L
        - Mercury = 167.4 mg/L

In the example above, it is unclear how the maximum concentrations presented for the same modelling node could be so substantially different between the "with" and "without" treatment scenarios. In addition, although the differences in concentration are large, the 'with-treatment' modelling concentrations are higher than the 'without.' It is unclear whether these potential errors are prevalent throughout the model and therefore impact all model nodes or if potential errors are limited to a small number of inputs or parameters. In addition, it is unclear how potential errors in the modelling have influenced other model outputs and the interpretation of water quality conditions related to the Project.

ECCC Recommendation(s)

ECCC recommends the Proponent review the outputs of the water balance model presented in Attachment IR-C to ensure that information presented is accurate.

8. Topic – Updated Modelling Predictions and Comparison to Water Quality Guidelines

Reference(s)

- 201130 2AM-BRP1831 Responses to WL Amendment IRs-IMLE

- ECCC-5
- Attachment IR-C

Comment

The Water and Load Balance indicates that water quality at PN04 and PN05 will meet MDMER criteria and that PN03 will meet SSWQO. However, ECCC notes that SSWQO are only included for arsenic and copper and therefore the Water and Load Balance does not address whether CCME water quality guidelines for the protection of aquatic life will be met at PN03. In addition, there is no discussion provided on expected water quality compared to guidelines, SSWQO, or other criteria for any of the other modelling nodes or modelled water bodies included in the Water and Load Balance.

In response to ECCC-5, the Proponent has provided updated output concentrations from the water and load balance addressing inconsistencies and incorrect assumptions that were identified in the completeness review (Attachment IR-C). Although predicted PN03 (with treatment) water quality does not exceed the SSWQO for copper or arsenic, the predicted maximum average concentrations exceed several CCME water quality guidelines (e.g.,, aluminum, nitrate, nitrite, iron, mercury). In some cases (nitrite, mercury), these concentrations are considerably above guidelines, in the range where serious effects to aquatic life may be expected and call into question the validity of the model outputs. However, if these exceedance of guidelines are accurate this represents a large deterioration in water quality at PN03 compared to the Approved Project, and the impact of such concentrations to aquatic life have not been discussed or evaluated by the Proponent.

PN03 is specifically used as example for this comment given that the Proponent stated that SSWQO would be achieved at this point. However, ECCC also notes that additional modelling nodes also indicate maximum average concentrations exceeding CCME Water Quality Guidelines. Additional clarity on guideline exceedances should be provided for all nodes where CCME/SSWQO are applicable.

ECCC Recommendation(s)

ECCC recommends the Proponent:

- Clarify which modelling nodes are intending to meet which criteria (eg. CCME, SSWQO, MDMER, etc.) and provide clear comparison of modelled water quality to the relevant guidelines and criteria;
- Provide a discussion of sources of exceedances of CCME Water Quality Guidelines for the Protection of Aquatic life and whether assumptions used in the model have resulted in accurate predictions of water quality;
- Provide a discussion of the modelled exceedances of CCME Water Quality Guidelines for the Protection of aquatic life at PN03 and other relevant nodes, and potential impacts to aquatic life if these concentrations are realized.

9. Topic – Air Quality

Reference(s)

- KIA-WLA-IR-03 (Upgraded WIR summer water and dust management)

Comment

The Proponent notes that the upgraded gravel sections of the winter ice road will be negligible contributors of fugitive dust emissions. The Proponent relies on appropriate emissions guidance to reach this conclusion and no further comment is required at this time.

If you need more information, please contact Orlagh O'Sullivan at (431) 276-4506 or Orlagh.OSullivan@Canada.ca.

Sincerely,

[original signed by]

Orlagh O'Sullivan
Environmental Assessment Officer

cc: Jody Small, Acting Head, Environmental Assessment North (NT and NU)