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September 13, 2019

Derek Donald
Technical Advisor
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU,
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Sent via Email: licensing@nwb-oen.ca

Re: TMAC Responses to 2018 Nunavut Water Board Annual Report Comments

Dear Mr. Donald

TMAC Resources Inc (TMAC) is pleased to present to the Nunavut Water Board (NWB) responses to comments received on the 2018 NWB Annual Report.

On August 23, 2019 TMAC received comments from the following interested parties:

1. Kitikmeot Inuit Association (KIA);
2. Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC); and
3. Environment and Climate Change Canada (ECCC).

All responses to comments can be found in Attachment A of this submission.

Should you have any questions please feel free to contact me at Oliver.curran@tmacresources.com

Sincerely,

Oliver Curran
Vice-President, Environmental Affairs TMAC Resources Inc.
Cc:
Kyle Conway / Sarah Warnock (TMAC)
Ashley Mathai (TMAC)/Adam Grzegorczyk (TMAC) /Shelley Potter (TMAC)

Attachments

- Attachment A – TMAC Responses to 2018 NWB Annual Report Comments

Attachment A – TMAC Response to 2018 NWB Annual Report Comments

TMAC Resources Inc.

HOPE BAY PROJECT

Proponent's Response to Comments Received on the 2018 Annual Report

September 2019

Prepared by:

TMAC Resources Inc.
Toronto, Ontario

Citation:
TMAC. 2019. *Hope Bay Project: Proponent's Response to Comments Received on the 2018 Annual Report*: Toronto, Ontario.

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HOPE BAY PROJECT

Proponent's Response to Comments Received on the 2018 Annual Report

TABLE OF CONTENTS

1. KIA-NWB-1

1.1 SUBJECT

Corrective action for spills of flotation tailings

1.2 REFERENCE

Hope Bay Belt Project, 2018 Nunavut Water Board Annual Report:

- Section 11, Table 11-1.

Hope Bay Project, 2018 Nunavut Impact Review Board Annual Report:

- Section 7.2, Table 7.2-1.

1.3 SUMMARY

In 2018, there were four reportable spills of flotation tailings. The corrective actions for all of these incidents included investigation/evaluation of lead detection system(s) (LDS) that could be installed to improve leak detection capability and decrease response time in the event of a spill. What is the timeline for installing an appropriate LDS on the tailings line?

1.4 DETAILED REVIEW COMMENT

Section 11 and Table 11-1 of the 2018 NWB Annual Report describe 15 reportable spills in 2018, four of which involved flotation tailings, ranging from 150 L to 30 m^3 (30,000 L) in volume and dating from Aug to Dec. The corrective actions for each of these spill incidents included investigation of various leak detection systems (LDS) that may be installed on the tailings line to improve leak detection capability and decrease response time in the event of a spill. After the last spill of flotation tailings in 2018 (spill no. 18-475), the event details indicate that TMAC has completed investigation of LDS and "is in the process of evaluating operational effectiveness of these options in order to determine which system will be most suitable given the tailings pipeline alignment and operation in arctic conditions."

There is no further information within the 2018 NWB Annual Report as to when TMAC will complete their evaluation and when the LDS will be installed. Corrective actions should include an expected timeline of completion to ensure that follow-up activities are undertaken as planned, and that adaptive management and mitigation can be implemented as soon as possible to reduce the environmental impacts of future spill incidents.

1.5 RECOMMENDATION/REQUEST

The KIA requests that TMAC provide an expected timeline for the installation of a leak detection system on the tailings pipeline.

1.6 TMAC RESPONSE TO KIA-NWB-1

TMAC anticipates that the installation of a leak detection system on the tailings pipeline will occur in Q3 2019.

2. KIA-NWB-2

2.1 SUBJECT

March 2019 revision of Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan.

2.2 REFERENCES

Hope Bay Belt Project, 2018 Nunavut Water Board Annual Report

- Section 12, Table 12-1

Hope Bay Project, 2018 Nunavut Impact Review Board Annual Report

- Section 10, Table 10-1

2.3 SUMMARY

Section 12 of the 2018 NWB Annual Report indicates that the Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan was last revised in March 2019; however, this plan was not included in the document package for review.

2.4 DETAILED REVIEW COMMENT

In their cover letter to the NWB, dated March 29, 2019, TMAC indicated that seven Hope Bay management plans were updated in March 2019. These plans have been made available on the NWB public registry. However, Section 12 of the 2018 NWB Annual Report indicates that the Waste Rock, Ore and Mine Backfill Management Plan was also revised in March 2019. This plan was not included within the 2018 NWB Annual Report package of documents for review. The KIA wishes to review these plan revisions to ensure that waste rock management has not been modified in such a manner that will negatively impact the environment and traditional land use.

2.5 RECOMMENDATION/REQUEST

The KIA requests that the March 2019 revision of the Hope Bay Waste Rock, Ore and Mine Backfill Management Plan be submitted to the NWB, KIA, and other regulatory bodies for review.

2.6 TMAC Response to KIA-NWB-2

The March 2019 Waste Rock, Ore and Mine Backfill Management Plan was submitted to the NWB for regulatory approval on January 25, 2019. Following this, a notification for comment was sent out on January 25 2019 and a second notification was sent out on March 8, 2019. On February 13 2019 the KIA submitted a confirmation email to the NWB indicating no comment.

3. KIA-NWB-3

3.1 SUBJECT

Immediately reportable spill volume for miscellaneous products, substances, or organisms.

3.2 REFERENCES

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Immediately Reportable Spills, page iv; and
- Section 3.3, page 18.

3.3 SUMMARY

There is a discrepancy in the spill amount-reporting threshold for "miscellaneous products, substances, or organisms" that needs to be resolved. The table of Immediately Reportable Spills (p. iv) refers to the "NU Spill Contingency Planning and Reporting Regulations", a document on the GN DOE website that was created by the GNWT for the GNWT's use in 1998. These regulations specify a 50 L or 50 kg reporting threshold. However, Section 3.3 of the Plan also implies that the Immediately Reportable Spills Table follows the current GNWT ENR "Report a spill" website, which states that this limit is ≥ 5 L or 5 kg. Unless there is a typo on the GNWT website, the more conservative values should be used in TMAC's Spill Contingency Plan.

3.4 DETAILED REVIEW COMMENT

In the Mar 2019 Hope Bay Spill Contingency Plan, there is a table showing Immediately Reportable Spills following "Schedule B of the NU Spill Contingency Planning and Reporting Regulations". This document is available on the GN DOE website – it is a 1998 consolidation of the 1993 regulations created by the GNWT. In Schedule B of this document, the immediately reportable amount of "miscellaneous products or substances, excluding PCB mixtures" is 50 L or 50 kg, which are the values listed in the Plan.

However, the Plan also references the GNWT ENR "Report a spill" website within Section 3.3 when discussing the Immediately Reportable Spills Table. On this website, the reportable quantities for spills of "miscellaneous products, substances or organisms" are ≥ 5 L or 5 kg. These values are 10x lower than those listed in the Regulations, suggesting that the Hope Bay Spill Contingency Plan, or the website itself, contains a typo. It seems more likely that the values on the website are correct, and that those in the Plan are incorrect, based on precedents seen in other projects. Note also that the cited website link in Section 3.3 is broken. The current URL is:

https://www.enr.gov.nt.ca/en/services/report-spill

The correct spill amount threshold for miscellaneous substances needs to be resolved with regulators. The Immediately Reportable Spills table in the Hope Bay Spill Contingency Plan should then be updated, if necessary.

3.5 RECOMMENDATION/REQUEST

The KIA recommends that TMAC confirm spill-reporting thresholds with the GN and GNWT, and to update the information presented in the Immediately Reportable Spills, if needed.

3.6 TMAC RESPONSE TO KIA-NWB-3

TMAC will investigate to determine the correct reportable quantity and include in the next update of the Spill Contingency Plan if required.

4. KIA-NWB-4

4.1 SUBJECT

Missing or incorrect contact information for external reporting audiences.

4.2 REFERENCES

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Key Government Contacts, page iii;
- Section 3.3; and
- Conformity Tables (Modules A, B, C, D).

4.3 SUMMARY

The Plan states that a marine spill report will be submitted to a Transport Canada (TC) Marine Safety Inspector if required. There is no further information regarding these reporting requirements; and the table showing Key Government Contacts does not include the TC Inspector's contact information. In addition, the CIRNAC Inspector's phone number in the Key Government Contacts table is different from the number listed in the Type A/B Water License conditions within the Conformity Tables.

4.4 DETAILED REVIEW COMMENT

Section 3.3 of the Hope Bay Spill Contingency Plan states that in the event that a spill has occurred to the marine environment, a written report will be submitted within 24 hours to the Canadian Coast Guard, and a copy of this report will be submitted to a Transport Canada Marine Safety Inspector "if required". There are no further details regarding the situation(s) in which a TC Marine Safety Inspector will need to be notified. There is also no contact information for the TC Marine Safety Inspector within the table of Key Government Contacts on p. iii of the Plan.

The Conformity Tables within Modules A, B, C, and D include conditions of the Type A and B Water Licenses that the Spill Contingency Plan is intended to address. Among these conditions is the reporting of any unauthorized deposits or foreseeable unauthorized depots of waste and/or discharges of effluent to "the Inspector at (867) 975-4295" (in addition to the 24-Hour NT-NU Spill Reporting Line and the KIA). However, the phone number listed in Key Government Contacts (p. iii of the Plan) for the CIRNAC Inspector is (867) 983-5115. Please confirm which phone number is correct and update the list of key contacts, if needed.

4.5 RECOMMENDATION/REQUEST

The KIA requests additional information about spill reporting requirements for Transport Canada, and that contact information be included in the Plan for TC's Marine Safety Inspector.

The KIA also recommends that TMAC confirm the correct contact information for the CIRNAC Inspector and update the table of Key Government Contacts, if needed.

4.6 TMAC RESPONSE TO KIA-NWB-4

TMAC will ensure the correct contact information for the CIRNAC inspector is up to date with key Government Contacts in the next annual update of the Spill Contingency Plan.

5. KIA-NWB-5

5.1 SUBJECT

Spill kit locations at Doris and Boston.

5.2 REFERENCES

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Module A: Doris, Plate A.4;
- Module D: Boston, Plate D.1; and
- Section 2.4.1.

5.3 SUMMARY

It is difficult to judge from the plates in Modules A and D whether TMAC is complying with their own policy of making spill kits available within 200 m of fuel and chemical storage locations. TMAC should ensure that spill kits are available as described.

5.4 DETAILED REVIEW COMMENT

Section 2.4.1 of the Hope Bay Spill Contingency Plan states that spill response kits will be available near (within 200 m) any areas where chemicals are stored and used on site, including near all bulk fuel berms and smaller fuel tanks. In addition, all active construction areas where equipment is operating will have a spill kit located within 200 m.

Modules A through D within the Plan describe the specific conditions of Doris, Windy, Madrid, and Boston operations relevant to spill response, including chemical storage volumes and locations, and photographs of the sites. Plate A.4 shows the Reagent Berm at Doris, and an Explosive Berm is indicated to the right, outside of the photo. It is unclear whether the spill kit located at the Reagent Berm is also intended to serve spill incidents at the Explosive Berm, and it is also unknown whether the Explosive Berm is located within 200 m of the Reagent Berm (and spill kit). Furthermore, the lack of scale, and possible forced perspective, of Plate D.1 (Boston Camp) makes it difficult for a reviewer to determine whether the spill kit in the middle-left is located within 200 m of the chemical storage locations to the farthest left of the photo.

It would be useful to have updated photos or site diagrams, for all Hope Bay project locations, that encompass all infrastructure and activities and have a scale to assess distances. These would allow for a more comprehensive review of TMAC's spill response plan.

5.5 RECOMMENDATION/REQUEST

The KIA recommends that updated photos or site diagrams, with appropriate scale indicators, be included in the next version of the Hope Bay Spill Contingency Plan.

5.6 TMAC RESPONSE TO KIA-NWB-5

TMAC will ensure updated site diagrams will be included in the next annual update of the Spill Contingency Plan.

6. KIA-NWB-6

6.1 Subject

Emergency response for a Jet-A fuel spill to water.

6.2 References

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Appendix 1, Jet-A Specific Spill Response Plan, page 8.

6.3 Summary

The Jet-A Specific Spill Response Plan needs more information and subsequent steps for emergency response to a spill to water. Currently, the plan is limited to advising responders not to attempt to contain or remove spills, and to use booms to prevent spread. Even if TMAC staff are not responsible for cleaning up a Jet-A spill, there should be further information about who to contact for proper treatment.

6.4 Detailed Review Comment

TMAC has developed a Product Specific Spill Response Plan for Jet-A fuel because spills of this substance could be immediately harmful to humans and/or the environment and has the potential to cause pool fires and vapour cloud explosion. Within the Jet-A plan, the instructions for spills to water include three bullet points:

- Jet-A fuel floats on surface of water.
- Do not attempt to contain or remove spills (high explosion potential).
- Use booms to prevent spread of spill.

The subsequent generic steps regarding Jet-A fuel spills are to properly dispose of PPE and to thoroughly wash skin with soap. This is the end of the Jet-A spill response plan.

Further details are needed regarding Jet-A spills to water. It is perhaps implied (though this should be clarified) that no Hope Bay Project staff within the Spill Emergency Incident Command System (Figure 3, p. vii) is qualified to clean up Jet-A spills to water. If this is the case, information about who should be contacted, and who will be responsible for clean-up, should be included in the Plan.

6.5 RECOMMENDATION/REQUEST

The KIA requests that additional information regarding spills to water be included in the Jet-A Specific Spill Response Plan, such as the party(ies) responsible for clean-up/treatment.

6.6 TMAC RESPONSE TO KIA-NWB-6

TMAC will provide additional information to the Aviation Fuel (Jet-A)Specific Spill Response Plan in the next annual update of the Spill Contingency Plan.

7. KIA-NWB-7

7.1 Subject

Proposed hierarchy for spill response prioritization and environmental resource maps.

7.2 References

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Section 2.2.16;
- Appendix 3; and
- Appendix 4, KIA Comment 2 (KIA-7), page 24.

7.3 Summary

TMAC's revisions to the Spill Contingency Plan in response to the previous KIA comment #2 are incomplete. There are ambiguities between Section 2.2.16 and the Environmental Resource Maps provided in Appendix 3, which would prevent a clear understanding of priorities in the event of a spill.

7.4 Detailed Review Comment

In response to previous KIA review comment KIA-7, TMAC proposed a prioritization hierarchy for environmental sensitivities. (Note that there is a typo in TMAC's response on p. 24 – it should refer to Section 2.2.16 rather than 2.3.10.) The proposed hierarchy of protection will attempt to favour:

1. Waterbodies;
2. Sensitive habitat types;
3. Archaeological sites;
4. Rare plants; and
5. Active raptor nest or wildlife den.

In addition, for spills in water, prioritization will attempt to avoid vegetated and finer substrate shoreline areas (sand, gravel, cobble).

TMAC's proposed hierarchy is not detailed enough in comparison to the Environmental Sensitivity Maps A-C, which include rare plants, raptor nests, and wildlife dens. Are the "sensitive habitat types", indicated as the second highest priority, the other features on these maps, i.e., eskers, slopes of 40-90% (possible cliffs), or certain TEM classes? For example, would the TEM class of Dry Carex-Lichen be prioritized over others because this is important forage for caribou?

Furthermore, the Environmental Resource Maps in Appendix 3 may not be at a size, scale, or resolution that is useful for emergency spill response. For example, Figure 3.1 (Map A) is very difficult to read; the need for 12 insets may indicate that larger scale maps are needed to cover the study area in sufficient detail. Map A also shows that Hope Bay is within the study area; however, only Roberts Bay was mapped for shoreline fish habitat values (Figure 3.4, Map D).

7.5 RECOMMENDATION/REQUEST

The KIA requests that the proposed prioritization hierarchy in Section 2.2.16 of the Spill Contingency Plan be revised to a level of detail that is compatible with the Environmental Sensitivity Mapping for this project.

The KIA also requests that Environmental Sensitivity Maps be provided to Project personnel in a larger format and at higher resolution, such that they are useful for emergency spill response.

7.6 TMAC RESPONSE TO KIA-NWB-7

TMAC would like to take the opportunity to re-visit the response hierarchy to reflect operational experience. TMAC's first priority in any spill incident is to stop the source of the spill (if not already accomplished at the time discovered), then to prevent the spread and contain the spill and then to assess the best method to remove as much of the spilled substance as possible taking into consideration numerous factors including but not limited to land, water, topography, substrate depth, location and season. Safety of personnel is the paramount consideration in all efforts and workplans. Based on the review of Appendix 3 and experience to date, TMAC will re-visit the Environmental Sensitivity Mapping to account for the abiotic and biotic factors that practically guide spill response at Hope Bay. KIA will be engaged on this matter and the potential timing of the next update in the plan.

8. KIA-NWB-8

8.1 SUBJECT

Stronger wording needed for spill-related monitoring.

8.2 REFERENCES

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Section 3.4; and
- Appendix 4, KIA Comment 4 (KIA-9), page 26.

8.3 SUMMARY

TMAC has made some revisions to the Spill Contingency Plan regarding spill-related monitoring. However, the wording is weak and does not reflect a commitment by TMAC to conduct monitoring activities.

8.4 DETAILED REVIEW COMMENT

In response to previous KIA review comment KIA-9, TMAC responded that more details on spill related monitoring have been included in Section 3.4 of the Spill Contingency Plan. However, the revisions to Section 3.4 do not fully address the KIA's concerns. While TMAC has deleted the phrase "completely removed" and has added more information about monitoring triggers and locations for spills to water, the wording in this section still needs to be stronger. The current wording throughout Section 3.4 is that "monitoring may be triggered". TMAC should commit to conducting monitoring activities for spills that potentially have negative environmental impacts, and that are unlikely to be (completely) recovered, whether or land or in water. While monitoring for all spills may not be feasible, especially for small spills with little expected impact, TMAC could develop spill thresholds for various substances or situations for which "monitoring will be triggered".

Without a strong commitment from TMAC to monitor the potential effects of spilled substances that cannot be recovered, there is no guarantee that monitoring will occur at all. The KIA's right to compensation for damages to their lands and waters makes prompt and effective monitoring important to both TMAC and the KIA in the event of a spill or unplanned discharge.

8.5 RECOMMENDATION/REQUEST

The KIA recommends that TMAC use stronger wording within Section 3.4 of the Spill Contingency Plan, i.e. "monitoring will be triggered" rather than "monitoring may be triggered" for various spill response scenarios.

8.6 TMAC RESPONSE TO KIA-NWB-8

TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many, and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.

9. KIA-NWB-9

9.1 SUBJECT

Triggered Monitoring of spills to water.

9.2 REFERENCES

Hope Bay Project Spill Contingency Plan:

- Section 3.4 Monitoring and Restoration P. 18.
- Appendix 4: Responses to comments on Previous Plan Versions P. 26.

9.3 SUMMARY

Conditions for triggering of monitoring of spills into water is unclear.

9.4 DETAILED REVIEW COMMENT

TMAC states that *"monitoring may be triggered in the event of spills to water of substances that dissolve or sink where substance recovery unlikely"* and that *"monitoring may also be triggered in the event of externally reportable spills to land for which recovery of spilled material is unlikely or may be incomplete"*.

In Appendix 4, under Comment #4 (KIA-9), the KIA requested that *"TMAC should include triggers which require monitoring activities, and provide details of the type of monitoring that will be undertaken as part of adaptive management to spills and unplanned discharges…the discussion should be specific to the type of spill, volume, mobility of the spilled material and proximity to various habitat features. Triggered monitoring should be implemented as quickly as possible"*.

TMAC responds that it *"has provided more detail on spill related monitoring in Section 3.4"*.

We do not believe TMAC has satisfactorily responded to our original concern regarding monitoring spills. We are concerned with the use of discretionary language in the guidelines for monitoring spills under Section 3.4 ("may be triggered"). Furthermore, it is not clear what conditions will actually trigger monitoring under the two scenarios presented in this section (e.g., type of spill? volume? mobility? proximity to sensitive environmental features?). TMAC also has not indicated how soon after a spill triggered monitoring would be implemented, or what parameters will be collected.

9.5 RECOMMENDATION/REQUEST

Please remove the discretionary language in Section 3.4 to so that monitoring is required for (i) all spills to water of substances that dissolve or sink which are unlikely to be recovered and (ii) all externally reportable spills to land of substances unlikely to be fully recovered.

Please specify under what conditions monitoring will be triggered for spills (i) and (ii) (e.g., type of spill, volume, mobility, proximity to sensitive environmental features), what parameters will be collected, and how soon after a spill triggered monitoring will be implemented.

9.6 TMAC RESPONSE TO KIA-NWB-9

TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many, and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.

10. KIA-NWB-10

10.1 Subject

Spill kit location at Patch Laydown Facility.

10.2 References

Hope Bay Project Spill Contingency Plan:

- Module B: Windy.
- B3 Windy Fuel and Chemical Storage Locations P. B-2.

10.3 Summary

Photograph does not indicate location of spill kit at Patch Laydown Facility.

10.4 Detailed Review Comment

Plate B.2 shows a photograph of the Patch Laydown Facility. The caption indicates that the red circle is for the fuel storage location and the yellow star is for the spill kit location. However, no red circles or yellow stars are shown on the photograph.

10.5 Recommendation/Request

Please clarify whether any fuel storage and spill kit locations exist at the Patch Laydown Facility.

10.6 TMAC Response to KIA-NWB-10

Fuel and chemical storage facilities have been removed from the Patch Laydown Facility. Plate B.2 will be removed in the next annual update of the Spill Contingency Plan.

11. KIA-NWB-11

11.1 Subject

Mitigation measures for settlement of tanks.

11.2 References

Hope Bay Project Spill Contingency Plan:

- Module D: Boston (Exploration and Operations); and
- D3.1 Issue: Bulk Fuel Tank Farm P. D-1.

11.3 Summary

No mitigation measures are stated for settlement of tanks.

11.4 Detailed Review Comment

Eight fuel tanks at the Boston site are situated on a lined fuel berm on the permafrost. TMAC indicates that there are concerns that the permafrost may degrade over time due to thin areas of the crush pad, which could cause settlement of the tanks, making them unstable and prone to tipping.

TMAC states that regular monitoring of the fuel tanks for differential settlement occurs during seasonal visits, annual geotechnical inspections, and as needed. However, TMAC does not discuss what mitigation measures are in place should settlement of the tanks be detected.

11.5 Recommendation/Request

Please explain what management action is taken if settlement of the fuel tanks at the Boston site is detected during routine monitoring.

11.6 TMAC Response to KIA-NWB-11

If settlement of the fuel tanks at the Boston site are detected beyond an acceptable limit, TMAC will discontinue the use of the tank(s) that are effected by settlement and engage the Engineer of Record (SRK Consulting) for guidance and recommendations for correcting the settlement issue. TMAC will continue to monitor permafrost and physical stability of site infrastructure on an ongoing basis and will take a proactive approach to risks identified

12. KIA-NWB-12

12.1 SUBJECT

Comparison to all previous years' data for exposure areas to baseline data.

12.2 REFERENCES

2018 Aquatic Effects Monitoring Program Report:

- Section 2.2 Evaluation of Effects Methodology P. 2-3.

12.3 SUMMARY

Data from previous years is not presented in comparison to baseline conditions.

12.4 DETAILED REVIEW COMMENT

Data from exposure areas are compared to baseline data and Reference Lake B. However, the results are not compared to results from 2017 when the mine commenced operations.

12.5 RECOMMENDATION/REQUEST

Please include a comparison to all previous years' results including 2017 to provide the reviewer with greater context to help establish if trends noted are due to the mine or natural variability.

12.6 TMAC RESPONSE TO KIA-NWB-12

For the purposes of the AEMP, true baseline data are considered to be data collected prior to 2010, as Doris Mine construction began in 2010. However, all available historical data from 1995 to 2018 were included in the trend analysis (including data from 2017). Table B.1-1 in Appendix B summarizes all the data used in the analysis, and provides a rationale for any data that were excluded from the analysis. Figures 3.2-1 to 3.4-1 in the main body of the 2018 AEMP report show all the years of data used in the evaluation of each parameter.

13. KIA-NWB-13

13.1 SUBJECT

Measurement of water conductivity under ice.

13.2 REFERENCES

2018 Aquatic Effects Monitoring Program Report:

- Appendix A; and
- Section A.1.4 Physical Limnology P. 9 of 47.

13.3 SUMMARY

Water conductivity under ice is not being used as a measure of water quality.

13.4 DETAILED REVIEW COMMENT

Only temperature and dissolved oxygen were measured for physical limnology parameters under ice. Specific conductivity is a useful indicator parameter to detect changes in water quality due mine related influences in Doris Lake, specifically under-ice to assess cryo-concentration.

13.5 RECOMMENDATION/REQUEST

Please add specific conductivity to the physical limnology parameter list specifically for under-ice conditions or provide a rationale as to why this parameter was not included.

13.6 TMAC RESPONSE TO KIA-NWB-13

Although field measurements of conductivity were not always collected due to the type of profiling Sonde used, conductivity was consistently included in the suite of water quality parameters analyzed by the laboratory (ALS). Therefore, conductivity data are available for any future assessment of mine-related effects or cryo-concentration.

14. KIA-NWB-14

14.1 Subject

Handling of QA/QC data that fails to meet RPD threshold of 50%.

14.2 References

2018 Aquatic Effects Monitoring Program Report:

- Appendix A; and
- Section A.4.1.1 Field QA/QC P. 26 of 47.

14.3 Summary

Lack of details provided for QA/QC data that exceed RPD limits.

14.4 Detailed Review Comment

TMAC states, "Three sets of duplicate parameter concentrations had an RPD of >50%: total manganese in Doris Lake North in April (RPD of 54.9%), dissolved orthophosphate in Doris Lake North in July (RPD of 118%), and total nickel in Doris Lake North in August (RPD of 69.0%)." Exceeding an RPD of 50% introduces concern as to the quality of those data and whether those parameters accurately reflect environmental conditions. Details should be provided if the data was considered contaminated and what considerations were used if they were included in the overall dataset for analysis.

14.5 Recommendation/Request

Please describe how QA/QC data that failed to meet the RPD threshold of 50% were handled including:

1. if they those samples were considered contaminated; and
2. whether they were included in the effects analysis.

If these samples were included in the analysis, please provide rationale was to why they were deemed appropriate to evaluate conditions in the aquatic environment what the implications their inclusion may have on when characterizing the aquatic environment.

14.6 TMAC RESPONSE TO KIA-NWB-14

For each of the three parameters for which the RPD was greater than 50% total manganese in Doris Lake North in April (RPD of 54.9%), dissolved orthophosphate in Doris Lake North in July (RPD of 118%), and total nickel in Doris Lake North in August (RPD of 69.0%), the questionable data were examined to determine whether any of the conclusions of the effects analysis could have been impacted by these potentially contaminated samples. In all three cases, there was determined to be no need to exclude these samples as the questionable results had no impact on final conclusions. Total manganese and dissolved orthophosphate are not evaluated parameters in the AEMP, so the raw data results are included only the appendices and are not discussed in the main report. Total nickel is an evaluated parameter; however the August data were within the range of historical concentrations, and the statistical and graphical analyses did not find any evidence of a change in nickel concentrations over time. Therefore, potential contamination issues in August of 2018 did not lead to unusually elevated concentrations and did not influence the results of the effects analysis. As the potentially contaminated samples did not affect the conclusions of the AEMP, the samples were not excluded, but simply flagged in the QA/QC section.

15. KIA-NWB-15

15.1 Subject

Contamination of water samples.

15.2 References

2018 Aquatic Effects Monitoring Program Report:

- Appendix A; and
- Section A.4.1.1 Field QA/QC P. 26 of 47.

15.3 Summary

GO-FLO sampler maybe source of contamination.

15.4 Detailed Review Comment

TMAC states: *"Any residual aluminum in the GO-FLO sampler was likely flushed out by the time Reference Lake B was sampled seven days after the equipment blank and Doris Lake North samples were collected, as the mean August Reference Lake B total aluminum concentration of 0.0073 mg/L was lower than the equipment blank concentration."* This suggests the GO-FLO is a source of contamination and rinsing protocols should be put in place to prevent future contamination.

15.5 Recommendation/Request

Please update the aquatic effects monitoring program to include protocols to prevent future contamination from the GO-FLO sampler. These protocols should be adopted for the remainder of the 2019 monitoring season and the updated AEMP should be included with the 2019 annual report.

15.6 TMAC Response to KIA-NWB-15

A thorough rinsing protocol for the GO-FLO is already in place and documented in the AEMP (e.g., see sections A.1.5 and A1.5.1 of the 2018 AEMP). The same protocol will be in place during the 2019 AEMP, therefore, no change to the AEMP is warranted. The protocol is as follows: prior to initiation of the sampling program, the GO-FLO is sent to ALS for acid washing to remove potential contaminants from handling, storage, and/or previous sampling programs. Once at site, the GO-FLO is again rinsed 3 times with lab-provided deionized water prior to the collection of an equipment blank. To collect an equipment blank the GO-FLO is again filled with lab-provided deionized water and subsamples are decanted from the GO-FLO using the same manner as for field collected samples. During sampling, the GO-FLO sampler is lowered into the water column in an open configuration, allowing lake water to pass through the sampler. This process thoroughly rinses the GO-FLO with site-specific water prior to sample collection. Therefore, even if some contamination is occasionally present in the sampler prior to sample collection (which would be detected in the equipment blank), it is unlikely that contamination would be introduced to the water quality sample because of this thorough rinse with site-specific water.

16. KIA-NWB-16

16.1 SUBJECT

Exclusion of earlier water quality data.

16.2 REFERENCES

2018 Aquatic Effects Monitoring Program Report:

- Appendix B;
- Section B.1.1 Water Quality; and
- Table B.1-1 P. 4 of 95.

16.3 SUMMARY

No rational is provide for exclusion of earlier water quality data.

16.4 DETAILED REVIEW COMMENT

Analysis of water quality in Appendix B is provided for data collected in 2003 and in subsequent years. Table B.1-1 provides rationale for why earlier data was excluded from the analysis for the reviewer to assess. Data from 1998 was excluded from analysis yet no rationale was provided in BB.1-1 as to why it was excluded.

16.5 RECOMMENDATION/REQUEST

Please provide rationale for excluding any data, which has been collected but not brought forward for additional analysis as part of the assessment of aquatic effects in the annual report.

16.6 TMAC RESPONSE TO KIA-NWB-16

The rationale for exclusion of April 1998 data was accidentally omitted from Table B.1-1. The 1998 sampling site location is the same as the 1997 location (see Figure 2.2-3 of the 2018 AEMP report), and the rationale for exclusion of 1998 data is the same rationale given for the exclusion of 1997 data *"samples were collected from a sampling location further south than current AEMP site"*.

17. KIA-NWB-17

17.1 Subject

Triggers for low action level.

17.2 References

2018 Aquatic Effects Monitoring Program Report:

- Section 2.2.3.2 Water Quality;
- Page 2 of 7;
- Appendix B; and
- Section 3.1 Water Quality Page 14 of 95.

17.3 Summary

Statistical analysis is not performed for Reference Lake B when parameter measures fall below CCME guidelines.

17.4 Detailed Review Comment

In Section 2.2.3.2 of the Aquatic Effects Monitoring Program TMAC states: "*The benchmarks applied to water quality are the CCME freshwater water quality guidelines for the protection of aquatic life (Table 2.2-2; CCME 2018). CCME guideline values are meant to be protective of all aquatic life, including the most sensitive organisms (CCME 1999). Exceedance of these benchmarks could adversely affect the most sensitive freshwater organisms; therefore, the trigger for a low action level is defined as 1) identification of a statistically significant increase in the AEMP effects analysis, 2) exceedance of 75% of the benchmark or CCME guideline, and 3) the absence of a similar change at the reference location (TMAC 2016).*"

In Appendix B of the 2018 Aquatic Effects Monitoring Program Report TMAC states, "*Analysis not performed if greater than 60% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2018) were censored.*"

In situations where parameter measurements in Reference Lake B are below the detection limit for over 60% of the samples statistical analysis was not performed. Therefore, comparison between Doris North and Reference B cannot be performed and qualification 3 for triggering a low action level will not be completed. In such instances concentrations at Doris North may be increasing due to mine influences, but not recognized due to low concentrations at the reference site.

17.5 RECOMMENDATION/REQUEST

Please, provide an alternate method of triggering a low action level when concentrations of a parameter at Reference B are below detection for more than 60% of samples and statistical comparison between Doris North and Reference B cannot be performed.

17.6 TMAC RESPONSE TO KIA-NWB-17

In a situation where the analysis cannot proceed for the reference lake because of the high proportion of censored data, a trend analysis would still proceed for Doris Lake North provided that less than 60% of the dataset was censored for this exposure lake; however, it would not be possible to compare the trend in Doris Lake North to the reference lake trend.

If the trend analysis shows that there is an observed increase in a parameter concentration in Doris Lake North and it is not possible to compare this trend to the reference lake because of the high proportion of non-detects, the conservative approach of not ruling out a mine effect is taken. In this case, condition 3 of the low action level trigger would me met (the absence of a similar change at the reference location) simply because the analysis could not be undertaken for the reference station. This was the case for total molybdenum concentrations in the 2018 AEMP (see Section 3.3-19). There was evidence of an increase in total molybdenum concentration in Doris Lake North (so condition 1 was met), more than 60% of the reference lake concentrations were below detection so it could not be confirmed that a similar change occurred at the reference location and a mine-effect could not be ruled out (so condition 3 was met); however, since total molybdenum concentrations remained far below 75% of the CCME guideline, condition 2 was **not** met, and the low action level was not exceeded.

This example demonstrates that the conditions for triggering a low action level are robust to situations where concentrations are mostly below detection limits in the reference lake, but are potentially increasing at the exposure lake. A low action level can still be exceeded if the reference site data are highly censored and cannot be included in the analysis.

18. KIA-NWB-18

18.1 SUBJECT

Water quality trends over seasons.

18.2 REFERENCES

2018 Aquatic Effects Monitoring Program Report:

- Section 3.3 Water quality P. 3-6; and
- Section 2.2.3.2 Water Quality P. 2-7.

18.3 SUMMARY

The statistical differences between seasons is not being addressed.

18.4 DETAILED REVIEW COMMENT

In Section 3.3 TMAC states, *"Water quality trends over the open-water season and under-ice season were assessed separately since large seasonal changes could confound the identification of inter-annual trends."*

Statistical differences identified between the two seasons is not addressed in the qualifications for triggering a low action level response.

In Section 2.2.3.2 of the Aquatic Effects Monitoring Program TMAC states, *"The benchmarks applied to water quality are the CCME freshwater water quality guidelines for the protection of aquatic life (Table 2.2-2; CCME 2018). CCME guideline values are meant to be protective of all aquatic life, including the most sensitive organisms (CCME 1999). Exceedance of these benchmarks could adversely affect the most sensitive freshwater organisms; therefore, the trigger for a low action level is defined as 1) identification of a statistically significant increase in the AEMP effects analysis, 2) exceedance of 75% of the benchmark or CCME guideline, and 3) the absence of a similar change at the reference location (TMAC 2016)."*

18.5 RECOMMENDATION/REQUEST

Please provide text describing how TMAC will react if all three triggers for a low action level occur for one season (either under-ice or open-water), but not the other to provide the reviewer with confidence that changes in water quality and possible adverse affects to biota are being properly managed.

18.6 TMAC RESPONSE TO KIA-NWB-18

The analysis of effects is undertaken separately for each season to increase the likelihood of detecting an effect where an effect is present. If data for all seasons were pooled into a single analysis, variability would be increased and the ability to detect an effect where an effect is present would be reduced. The low action level is triggered if the trends and concentrations in either of the two seasons meet the conditions outlined in the Doris AEMP response framework. As written, the conditions apply to each individual analysis (or parameter-season combination) undertaken as part of the evaluation of effects. This is a conservative approach that is most protective of the environment.

19. KIA-NWB-19

19.1 SUBJECT

Variation in under ice nitrate concentrations in Doris North Lake.

19.2 REFERENCES

2018 Aquatic Effects Monitoring Program Report:

- Section 3.3.7 Nitrate; and
- Figure 3.3-7 P. 3-12 and 3-16.

19.3 SUMMARY

Under-ice nitrate concentrations appear to be increasing.

19.4 DETAILED REVIEW COMMENT

TMAC states: *"Under-ice season nitrate concentrations in Doris Lake North were variable over time, but were generally similar to concentrations in Reference Lake B (Figure 3.3-7). Although the trend over time in under-ice nitrate concentrations was significantly different from a slope of zero ($p < 0.0001$) and from the trend in Reference Lake B ($p = 0.0001$), there was no indication of an increase in concentrations over time as 2018 concentrations were similar to baseline concentrations (Figure 3.3-7), suggesting that Project activities have not adversely affected under-ice nitrate concentrations in Doris Lake North."*

Based on the Figure 3.3-7 under-ice nitrate concentrations in Doris North decreased between 2007 and 2013, but have been increasing since 2015, with 2018 having the highest concentrations measured. Therefore, there is graphical evidence to suggest nitrate concentrations are increasing at the exposure site. This should be assessed as a possible change in water quality due to mine related activities (construction and operation).

19.5 RECOMMENDATION/REQUEST

Please provide text describing the possible source of nitrate at the mine in the context of increased under-ice nitrate concentration at Doris North and mitigation measures that may be implemented if concentrations continue to increase.

19.6 TMAC RESPONSE TO KIA-NWB-19

We disagree that the graphical evidence suggests that nitrate concentrations are increasing at the exposure site. Although the concentration of nitrate in the deep sample from Doris Lake North in April 2018 was the highest recorded nitrate concentration to date (0.201 mg/L), this concentration was only slightly higher than the deep water concentration in Doris Lake North in May 2007 (0.187 mg/L). Furthermore, the average water column nitrate concentration in April 2018 (0.115 mg/L) was nearly identical to the average for May 2007 (0.117 mg/L). Looking only at the data form the last three years, deep water nitrate concentrations appear to be increasing, but looking more broadly at the trend from 2006 to 2018, concentrations seem to oscillate and are highly variable among years and between depths. Recent data from April 2019 (top: 0.0230 mg/L; bottom: 0.0266 mg/L; unpublished) show that deep-water concentrations have dropped by nearly an order of magnitude between April 2018 and April 2019, further supporting the observation that concentrations are variable and there is no increasing trend.

20. KIA-NWB-20

20.1 SUBJECT

Aquatic monitoring program – water quality.

20.2 REFERENCES

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

20.3 SUMMARY

The 2018 water quality sampling does not appear to follow the Hope Bay Project: Doris Aquatic Effects Monitoring Plan (TMAC 2016).

20.4 DETAILED REVIEW COMMENT

The Hope Bay Project: Doris Aquatic Effects Monitoring Plan (TMAC 2016) states that water quality monitoring samples under the SNP program will be used to evaluate potential mine effects to Doris Lake (page 6) … SNP samples have been collected monthly since 2009 at station ST-7 (page 8) … water quality data collected in 2015 and prior will be used as the before data (page 12). This differs from the sampling completed in the 2018 report (e.g. samples only collected four times).

20.5 RECOMMENDATION/REQUEST

If applicable, please provide information about how/why the water quality monitoring that occurred is different from what was set out in the Plan.

20.6 TMAC RESPONSE TO KIA-NWB-20

We were not able to find any mention in the AEMP Plan on page 6 or elsewhere that monitoring samples collected under the SNP program would be used to evaluate effects to Doris Lake (TMAC 2016). Could the reviewer please double-check where they might have found this statement?

It was stated in the AEMP Plan that data collected in 2015 and prior will be used as before data; however, the categorization of data into "before" and "after" groups was only relevant when the statistical method being used was a BACI (before-after control-impact) analysis. Starting in the 2017 assessment year, it was concluded that sufficient data had been collected at the reference and exposure sites to estimate long-term temporal trends, so a trend analysis approach was used instead of a BACI approach which tends to obscure inter-annual trends. With the trend analysis, there is no need to categorize data into “before” and “after” groups.

21. KIA-NWB-21

21.1 SUBJECT

Water Quality

21.2 REFERENCES

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

21.3 SUMMARY

Future water quality figures can be improved.

21.4 DETAILED REVIEW COMMENT

The water quality figures could be improved by including vertical lines depicting the time periods/phases of the project (e.g. baseline = before 2010). In addition, there are dashed lines on the water quality figures, which represent annual means. This information would be better presented as separate figures to improve the readability of the figures.

Some figures could also be simplified by presenting the data by period (e.g. median plus variance/deviation for baseline, mine construction, operations).

21.5 RECOMMENDATION/REQUEST

Please incorporate the above suggestions where applicable.

21.6 TMAC RESPONSE TO KIA-NWB-21

TMAC will take these recommendations into consideration for future monitoring reports.

22. KIA-NWB-22

22.1 SUBJECT

Water Quality

22.2 REFERENCES

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

22.3 SUMMARY

The water quality guideline for dissolved oxygen in Table 2.2-2 should be changed.

22.4 DETAILED REVIEW COMMENT

With respect to the water quality guidelines shown in Table 2.2-2, it is suggested that the dissolved oxygen guideline be changed from 6.5 mg/L to "a minimum of 9.5 mg/L during fish early life stages and 6.5 mg/L for other life stages' to reflect the range expressed in the CCME guideline (CCME, 1999).

22.5 RECOMMENDATION/REQUEST

Please incorporate the above suggestion in future reports.

22.6 TMAC RESPONSE TO KIA-NWB-22

Noted. This change will be incorporated for future AEMP reports.

23. KIA-NWB-23

23.1 SUBJECT

Water Quality

23.2 REFERENCES

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

Summary

The methodology for dealing with non-detect water quality data is not clear.

23.3 DETAILED REVIEW COMMENT

It is unclear to the reviewer how non-detect samples were dealt with in the statistical analysis.

23.4 RECOMMENDATION/REQUEST

Please provide additional information on the methodology used to deal with non-detect water quality data for statistical analysis.

23.5 TMAC RESPONSE TO KIA-NWB-23

The treatment of non-detects is detailed in Appendix B, Section B.2.1.1 of the 2018 AEMP. The text from this section is reproduced here:

> *"If all data in the current assessment year (2018) were below the detection limit, no regression analysis was performed for that variable. If a large amount of data (> 60%) from a lake were below the detection limit, the lake was removed from the analyses and inference was based on plots of the observed data.*
>
> *In cases where the reference lake was removed, it was not possible to make comparisons with the monitored lake and inference was based on plots of the observed data. Linear mixed effects (LME) regression or Tobit regression analysis was used to test whether or not there was evidence of time trend at each monitored lake. Tobit regression was used when a moderate amount of data (between 10 and 60%) from a given lake were below the detection limit. For LME models, observations below the analytical detection limit were substituted by half the detection limit. Then, the lake, year (as well as depth and season, if applicable) average was calculated. For Tobit models, the fact that each censored measurement falls between 0 and the detection limit was used to*

obtain the estimated range for the average in a given lake and year (as well as depth and season, if applicable). This interval was used in the Tobit regression analysis."

24. KIA-NWB-24

24.1 SUBJECT

Water Quality

24.2 REFERENCES

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

24.3 SUMMARY

Possible increases in water quality parameters other than molybdenum.

24.4 DETAILED REVIEW COMMENT

Generally, the report shows that, up to 2018, there has been no discernible impacts from mining operation non-point source inputs to Doris Lake. There is, however, concern that molybdenum is increasing in Doris Lake. Molybdenum has increased from <0.002 µg/L to approaching 0.003 µg/L over time but it is still well below the 0.0073 µg/L Canadian Environmental Quality Guideline (CCME 1999). This increasing trend was not evident in Reference Lake B. In addition to molybdenum, the turbidity and boron should also be watched closely as there appears to have been an increase during the construction phase of the mine. Iron also appears to be increasing slightly over time. Chromium values in Doris Lake should also be monitored closely because prior to 2017, there had been no exceedances of the guideline but since 2017, there have been three exceedances and the data for more recent years appears to be increasing. In addition, chlorophyll a should also be monitored closely. Although $p<0.0898$ when compared to $p=0.05$ is not statistically significant, the chlorophyll a data has a great deal of variability and a p value of 0.10 may be more appropriate as a benchmark for this data. The graph clearly shows that chlorophyll a data has increased a fair amount compared to baseline values in Doris Lake.

24.5 RECOMMENDATION/REQUEST

Please note the additional parameters for future reporting.

24.6 TMAC RESPONSE TO KIA-NWB-24

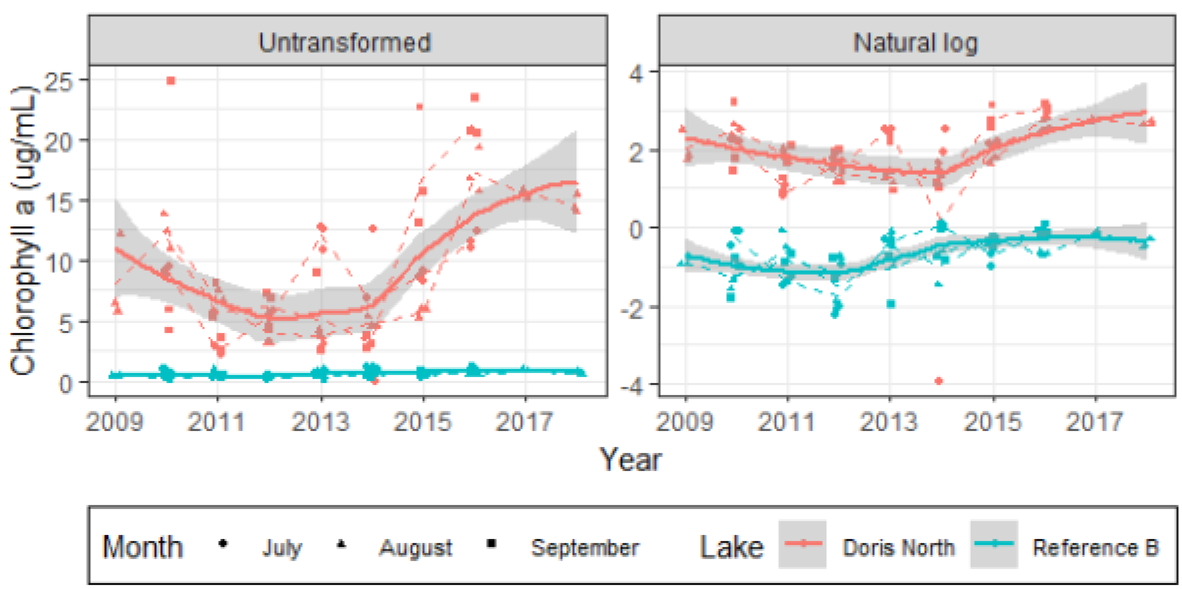
All evaluated water quality parameters including those noted above (turbidity, boron, iron, chromium) are being watched closely and will continue to be watched closely through the AEMP.

The evaluation of effects methodology is based on both statistical analysis and graphical of trends over time, and trends between the reference and exposure sites. For turbidity and boron, based on a visual examination of the trends (graphical analysis), the discussion provided in the 2018 AEMP does state that concentrations of these parameters appear to have increased slightly over time in Doris Lake (at least over certain years), but the statistical analysis reveals in both cases that these potentially increasing trends are not significantly different from the trends observed in Reference lake B, so a Project-related increased is ruled out.

For iron, both the graphical and statistical analyses show that trends in Doris Lake have been generally consistent over time. Iron will continue to be closely monitored for signs of an increase.

Only 2 out of 12 samples collected in Doris Lake in 2018 contained detectable concentrations of total chromium, and due to the high proportion of data below detection limits in the historical dataset, trends could not be evaluated statistically. Although there is no apparent increase over time, there were 2 exceedances of the CCME guideline since 2017. However, sporadic increases above the CCME guideline have also been observed in samples from Reference Lake B, and are not necessarily indicative of a Project effect.

Regarding chlorophyll, although the trend in Doris Lake appears to increase over time, the evidence suggests that a similar change was evident in Reference lake B, as there is no statistical evidence of a differential trend in chlorophyll over time in these lakes. Therefore, the increase was concluded to be unrelated to the Project. It's difficult to see the trend in Ref B in the graph presented in the main report (see left panel below), but Appendix B of the 2018 AEMP Report shows the untransformed data alongside the log-transformed data (see right panel below), and the similarity in trends is much more evident in the log-transformed graph.



Regarding the suggestion to increase the p-value for determination of significance from 0.05 to 0.1, it is difficult to justify using a different p-value for the chlorophyll analysis than the p-value used for all other analyses. The use of 0.05 is already considered conservative given the large number of analyses that are run, as this would result in a false positive rate of 5% (i.e., 5% of statistical analyses would produce a p-value of less than 0.05 by chance alone where an effect is not actually present). Adjusting this to 10% would result is twice the number of false positives if this were applied to all analyses. Here is the justification provided in the 2018 AEMP for the use of a p-value of 0.05 for the determination of significance:

> *"any statistical analysis can result in a type I error (finding a significant effect where an effect is not present, i.e., false positive) or a type II error (failing to find a significant effect where an effect is present, i.e., false negative). In the monitoring context, a false positive is more tolerable than a false negative. There is a direct trade-off between the two error rates, as reducing one type of error generally increases in the other type of error. No correction for the large number of statistical tests was applied to the false positive (type I) error rate. Therefore, there may be false positives in the analyses that were conducted, which is a conservative and environmentally protective approach. For this AEMP, the unadjusted type I error rate (or significance level) was set to 0.05, indicating that approximately 5% of the time, statistical results will show a significant effect (i.e., p value of < 0.05) by random chance alone where an effect is not actually present."*

25. KIA-NWB-25

25.1 Subject

Water Quality

25.2 References

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

25.3 Summary

More information is needed about the statistical methods for determining water quality changes.

25.4 Detailed Review Comment

The reviewer acknowledges that she has limited experience with Linear Mixed Effects (LME) modelling. That being said, she requests some further explanation about why the LME model was chosen for use with this data set. The name of the model includes the word 'linear' yet it is not clear to the reviewer why a monotonic linear trend might be expected since there are multiple phases to the project. For example, what if the recent work (operation) had less of an impact on the lake than the mine construction phase – this could result in a non-linear or step trend. Would it be better to treat this data by phase or before vs. after? Perhaps simple t-tests or ANCOVAs would be more appropriate. How does the LME model deal with seasonality or other 'natural' long-term trends/cycles?

25.5 Recommendation/Request

Please provide additional rationale about why Linear Mixed Effects model is the appropriate statistical test for water quality changes.

25.6 TMAC Response to KIA-NWB-25

A linear mixed effects (LME) model is an extension of the linear regression model with the addition of random effects. A LME model was used to account for potential sources of random variation, such as those that affects all measurements in all lakes in a given year. As mentioned in the methods section on random variation:

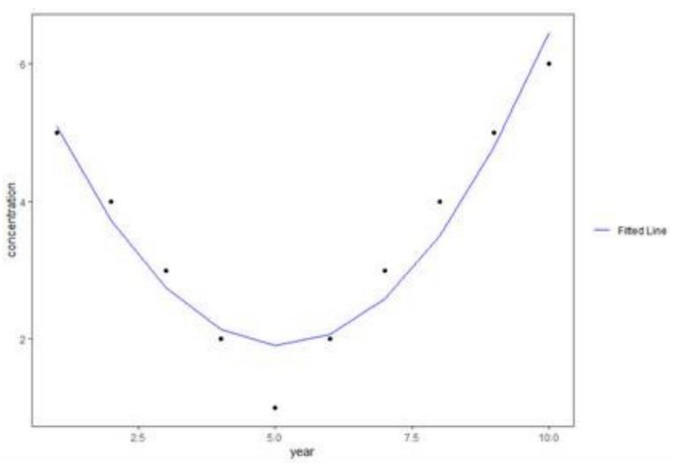
"Random sources of variation can affect variable measurements. Potential sources of variability include environmental factors affecting all lakes equally in a given year, sampling variation that affects samples taken from a lake in a single year, and true measurement errors from laboratory analysis. The main sources of variation can be broken down into two components: yearly effects that affect the measurements in all lakes and effects that affect each lake individually. Random effects are included in the LME model to account for these sources of variation."

A linear model is "linear" in its model parameters, and not in the trend that it fits. For example, a simple linear model can be expressed as:

$Y = B0 + B1X1$,

Where Y is the response, B0 is the intercept, B1 is often called the slope term, and X1 is the explanatory variable (for example, time). In this model, the trend is linear and monotonic. However, higher order terms (for example, squared or cubed) can be included to describe non-linear trends. For example, if time was also included as a squared term in the form:

$Y = B0 + B1X1 + B2(X1^2)$. This model produces the fit shown below:



Therefore, a linear model is not constrained to capture monotonic linear trends. Depending on the model setup, step-wise trends and curvi-linear trends may also be characterized.

The LME model used in the 2018 AEMP utilizes splines to capture trends over time. Splines do not constrain the trends to straight lines or monotonicity. For non-linear trends, spline fits provide a better characterization of the trends over time and capture more of the fluctuation shown in the data. If the data were suggesting step-wise or non-linear trends, the splines would show indication of such patterns.

Treating the data by phase or before vs. after is preferred if the number of years of data is limited. In the 2018 AEMP, up to 14 years of data were available for analysis. If the data were treated by phase or before vs. after, the actual resolution of the data would be lost, as in, an overall average would be assigned to each phase or time period and the variation or change between years cannot be assessed. A simple average may mask the true patterns in the data.

Fitting time trends to the data using LME allows for the graphical and statistical assessment of long term trends. Comparison of trends to reference sites give indication whether trends may be 'natural'. Seasonality (open-water vs. under-ice) was accounted for in the LME as separate time trends and overall averages (intercepts) were estimated for each lake-season group.

26. KIA-NWB-26

26.1 SUBJECT

Water Quality

26.2 REFERENCES

TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)

26.3 SUMMARY

Impacts of morphological differences between Reference Lake B and Doris Lake North need to be addressed in analysis/reporting. Detailed Review Comment

26.4 DETAILED REVIEW COMMENT

Palmer staff notes that Reference Lake B has been approved for use as the reference lake for this project and the suitability of Reference Lake B has previously been discussed as part of the Phase 2 Environmental Impact Statement Comments. The morphological differences between Reference Lake B (e.g. more than twice the size (surface area 769 ha) and shallower (average depth 4.7 m)) and Doris Lake North (surface area 338 ha, average depth 7.3 m) appear to be quite substantial. Differences in morphology can affect a variety of lake functions including sedimentation, stratification, circulation, wave action. For example, morphology and catchment size (watershed area compared to lake area) can impact nutrients inputs.

26.5 RECOMMENDATION/REQUEST

Going forward, it is requested that impacts of the morphological differences between Reference Lake B and Doris Lake North be discussed in more detail in the results.

26.6 TMAC RESPONSE TO KIA-NWB-26

Where relevant to the discussion of observed differences between lakes, morphological characteristics could be discussed in the AEMP to explain these differences. In the 2018 report, molybdenum was the only variable for which a possible mine effect was identified. In this case, molybdenum concentrations in the Reference Lake B could not be assessed or compared to the concentrations in Doris Lake due to the high proportion of concentrations below detection limits in the reference lake; therefore, a discussion of morphological differences between these lakes was irrelevant.

27. CIRNAC-1

Crown Pillar Recovery Trench Capping RocK

27.1 REFERENCES

Hope Bay Belt Project 2018 Nunavut Water Board Annual Report, TMAC Resources Inc., March 2019: Section 8.1.1.2; Appendix.

2018 Waste Rock, Quarry and Tailings Monitoring Report, SRK Consulting Ltd., March 2019.

Hope Bay Project, Waste Rock, Ore and Mine Backfill Management Plan, TMAC Resources Ltd., December 2017.

27.2 ISSUE/RATIONALE

Section 8.1.1.2 of the 2018 Annual Report describes the quality of leachate from crown pillar recovery trench (CPRT) waste rock that is stockpiled on the western extent of Pad T and will be used as capping rock for the CPRT. The rock is classified as non-PAG with higher than the screening criteria for arsenic, gold and sulphur. Shake flask extraction test leachate for two samples had ammonia concentrations (1.5 & 1.97 mg/L) above the screening criteria for ammonia (0.55 mg/L), which was set at 10 times the CCME guideline for the protection of aquatic life.

The Waste Rock Management Plan does not include provisions for using waste rock as a capping material. The CPRT is close to Doris Lake and it may be necessary to create positive topography to the fill so that water does not pond where the trench was. This may generate run-off rich in ammonia that reaches the lake.

27.3 RECOMMENDATION/REQUEST

CIRNAC recommends that TMAC manage their waste rock according to their approved Waste Rock, Ore and Mine Backfill Management Plan, and cap the CPRT with rock that will not potentially generate ammonia rich run-off.

27.4 TMAC RESPONSE TO CIRNAC-1

The Hope Bay Project maintains regulatory approval to be conducted, in part, via compliance with Type ‘A’ Water Licences: 2AM-DOH1335 (Doris & Madrid) and 2AM-BOS1835 (Boston), issued the Nunavut Water Board (NWB). As per Part D, Item 2 of 2AM-DOH1335, fill material for construction must meet the following requirements:

1. from approved sources that have been demonstrated to be non-potentially acid generating (non-PAG),

2. be non-metal leaching (non-ML),
3. and to be free of contaminants.

To facilitate compliance with requirements, the Waste Rock for Construction Flow Chart was developed and appended to the Hope Bay Project, Waste Rock, Ore and Mine Backfill Management Plan (TMAC, 2019). The flow chart provides TMAC with a regimented approach to determine if waste rock within a requested footprint can be used in construction. The criteria to make this determination is presented in Table 2 of the Waste Rock for Construction Flow Chart. The criteria and determination process presented in the Waste Rock for Construction Flow Chart was approved for use by the NWB on March 25, 2019 after consultation with regulators and other stakeholders.

As per the Waste Rock for Construction flow chart, the supporting geochemical data that characterizes the CPRT waste rock as non-PAG and non-ML is provided in the 2018 Geochemical Monitoring of Doris Mine Waste Rock (Appendix A of 2018 NWB Report Appendix F). TMAC does not use brine during CPRT drilling and blasting is in accordance with quarry practices. As a result, leaching of salts and blasting residues from the CPRT waste rock is not expected to be an issue.

The purpose of comparing values to the screening criteria is to highlight parameters that are enriched in the samples, however enrichment should not be interpreted to be representative of seepage quality or an exceedance. Comparisons to ten times the CCME water quality guidelines for the protection of aquatic life (freshwater; long term) are not directly applicable because SFE tests do not represent natural waters. The screening criteria developed for ammonia is calculated at room temperature (20°C) and is not indicative of seepage conditions. Doris seepage samples collected as part of the 2018 annual seep survey had an average temperature of 3.6°C and an average pH of 7.8 (Appendix B – Table 2 of 2018 NWB Report Appendix F). At these conditions, ten times the CCME guideline for total ammonia – N is 12.6 mg/L.

28. CIRNAC-2

28.1 SUBJECT

Geochemical Seep Surveys

28.2 REFERENCES

Hope Bay Belt Project 2018 Nunavut Water Board Annual Report, TMAC Resources Inc., March 2019:

Chapter 9: Geochemical Seepage Surveys;

Appendix E. Doris Mine Annual Water and Load Balance Assessment –2018 Calendar Year;

Appendix F. 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project;

Appendix G. 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project;

2AM-DOH1335 HB TL-7 Supplementary Memo.

28.3 ISSUE/RATIONALE

At the Boston site, ore was used to resurface areas of the camp pad and airstrip. Four seepage samples were collected in 2018 and arsenic concentrations in certain samples were elevated (i.e., up to 0.71 mg/L), exceeding the pre-determined screening limit as well as the Metal and Diamond Mining Effluent Regulations (MDMER) criterion (i.e., 0.2 mg/L for grab sample). The results of two samples taken from the same location a week apart seemed to indicate that dilution was a factor in the observed concentrations. However, CIRNAC notes that no estimation of the quantities or volumes of the seepage were provided. CIRNAC also notes that no discussion on potential impacts and mitigation measures were provided when the quality of seepage did not meet the screening or MDMER criteria

28.4 RECOMMENDATION/REQUEST

CIRNAC recommends that TMAC continue monitoring the quality and quantity of seepage, and implementing appropriate mitigation measures if the quality of the seepage does not meet the MDMER criteria.

28.5 TMAC RESPONSE TO CIRNAC-2

MDMER regulation does not apply until all the final discharge points of the mine exceed an effluent flow rate of 50 m^3 per day, which was not the case for TMAC in 2018. Additionally, seepage flowrates could not be measured on either day of the seep survey due to the seeps being too shallow, which also precludes loading calculations. Ephemeral streams downgradient of the waste rock pile have been monitored during spring freshet since 2009 as a proactive measure to monitor the attenuation capacity of the tundra and to provide an indication of chemical stability of the pad. The 2018 concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate parameters of potential concern. TMAC will continue monitoring quality of this seepage with flow characterization.

29. CIRNAC-3

29.1 Subject

Follow-Up from 2017 Annual Report Review: Inspector Contact Number

29.2 References

TMAC Resources Inc., Hope Bay Project Spill Contingency Plan, March 2019.

TMAC Resources Inc., TMAC Response to 2017 NWB Annual Report Comments, October 9, 2018.

29.3 Issue/Rationale

In reviewing the 2017 Annual Report, CIRNAC commented that a table of key government contacts was presented in the Hope Bay Project Spill Contingency Plan which required an update. This contact information has not been updated to the recommended phone number in the 2019 revision.

29.4 Recommendation/Request

CIRNAC recommends that the contact numbers for the inspector be updated. Candice Peterson is now responsible for this file. She is based out of Cambridge Bay, her phone number is 867-983-5115, and her fax number is 867-982-4307.

29.5 TMAC Response to CIRNAC-3

During the upcoming annual review and update of the Spill Contingency Plan, TMAC will update the Inspector contact information, as well as any other key government contacts, as required to ensure they are current.

30. CIRNAC-4

30.1 SUBJECT

Aquatic Effects Monitoring Program Report

30.2 REFERENCES

Doris Project 2018 Aquatics Effects Monitoring Program Report, ERM Consultants Canada Ltd., March 2019.

30.3 ISSUE/RATIONALE

The aquatic effects monitoring program report clearly presents data collected in 2018 and analyses described in the program. Details of the analyses are unambiguously explained. CIRNAC agrees with the conclusion of the report, no project related adverse effects were detected. As noted in the report, molybdenum concentrations have increased over time, and though they are well below guideline concentrations, it will be relevant to follow their evolution.

30.4 RECOMMENDATION/REQUEST

CIRNAC recommends that TMAC monitor the evolution of molybdenum concentrations through the Aquatics Effects Monitoring Program to ensure concentrations remain within guidelines

30.5 TMAC RESPONSE TO CIRNAC-4

TMAC will continue to monitor molybdenum concentrations as outlined in the Aquatics Effects Monitoring Program to ensure concentrations remain within guidelines.

31. CIRNAC-5

31.1 SUBJECT

Annual Reporting for 2AM-BOS1835

31.2 REFERENCES

Hope Bay Belt Project 2018 Nunavut Water Board Annual Report, TMAC Resources Inc., March 2019.

31.3 ISSUE/RATIONALE

The introduction of the 2018 Annual Report states that the licences covered by this report include only 2AM-DOH1323, 2BB-MAE1727, 2BB-BOS1727, and 2BE-HOP1222. Activities under 2AM-BOS1835 are not included in the report because the licence was issued in December, 2018. However, the 2018 Annual Report also states that "Annual reporting for 2AM-DOH1335 and 2AM-BOS1835 will be included in the 2019 annual report to the NWB."

31.4 RECOMMENDATION/REQUEST

CIRNAC supports the approach of annual reporting being inclusive of both Type A licences 2AM-DOH1335 and 2AM-BOS1835 to cover related activities over the same project and recommends that all further reports are inclusive of all sites at the Hope Bay project site.

31.5 TMAC RESPONSE TO CIRNAC-5

Noted.

32. CIRNAC-6

32.1 SUBJECT

Tranches for Posting Security at Boston Site

32.2 REFERENCES

Hope Bay Belt Project 2018 Nunavut Water Board Annual Report, TMAC Resources Inc., March 2019.

Nunavut Water Board Type A Water Licence 2AM-BOS1835, TMAC Resources Inc., Boston Project, Signed December 7, 2018

32.3 ISSUE/RATIONALE

Under Section 13.2.3 of the Hope Bay Belt Project 2018 Nunavut Water Board Annual Report, it is stated that security will be posted for Boston "… across nine (6) installments or tranches based on distinct project components" (pg. 59 or 13-4). From the licence it is clear that the security is to be installed in six (6) tranches for the following stages: Earthworks, Buildings, Commercial Mining, Boston TMA Phase 1, Boston TMA Phase 2, and Boston TMA Phase

32.4 RECOMMENDATION/REQUEST

CIRNAC recommends that TMAC provide consistent and accurate information on the security installment tranches for Water Licence 2AM-BOS1835.

32.5 TMAC RESPONSE TO CIRNAC-6

TMAC appreciates CIRNAC's identification of this inconsistency and confirms that this was a typo and TMAC understands Water Licence 2AM-BOS1835 requires security installments posted across six (6) tranches, not nine (9). TMAC will clarify this statement in its next Nunavut Water Board Annual Report.

33. CIRNAC-7

33.1 SUBJECT

Compaction tests during construction

33.2 REFERENCES

TMAC Resources Inc., Hope Bay Belt Project 2018 Nunavut Water Board Annual Report, March 2019:

Appendix A – Doris 2018 Construction Summary Report

Appendix B – Phase 1 South Dam As-Built Report DRAFT

33.3 ISSUE/RATIONALE

The Construction Summary Report was well prepared and addressed most of the requirements found in Schedule D of the water licence. One aspect on which we were not able find information was compaction tests. Compaction tests and sieve analysis should have had bee executed during the construction as per the Technical Specifications Earthworks and Geotechnical Engineering Report.

The South Dam Report made reference to non-standard compaction methods and tests in sections 3.9, 5.5 and 6.4.2. Explanations were generally provided why industry best practises could not be followed, but they should be applied whenever possible.

33.4 RECOMMENDATION/REQUEST

CIRNAC recommends that future construction reports mention if compaction tests and sieve analysis are done during construction.

33.5 TMAC RESPONSE TO CIRNAC-7

TMAC agrees to mention if compaction tests and sieve analysis are done during construction, in future construction summary reports, as per the Technical Specifications Earthworks and Geotechnical Engineering Report.

34. CIRNAC-8

34.1 SUBJECT

Results of Management Plan Review – SNP Stations

34.2 REFERENCES

TMAC Resources Inc., Hope Bay Quality Assurance and Quality Control Plan, March 2019.

34.3 ISSUE/RATIONALE

Figures A1 and B1 in the Hope Bay Quality Assurance and Quality Control (QA/QC) Plan, Module A, are aerial photographs which demonstrate the locations of the SNP Stations. However, all sampling stations are not shown in these photo-maps. Also, in Module B, Table B1 has SNP Stations, some of which have an asterisk symbol (*) next to them. An asterisk is usually used to indicate an omission or call attention to a footnote, however there is no footnote by the table to explain what these asterisks indicate.

34.4 RECOMMENDATION/REQUEST

CIRNAC recommends that the photo-maps be updated to include all new sampling points, and that a footnote be written under table B1 that explains the significance of the asterisk, for clarity

34.5 TMAC RESPONSE TO CIRNAC-8

TMAC will update the photo-maps to include all new sampling points in the next annual update of the Quality Assurance and Quality Control Plan.

The asterisk in Table B1 indicates monitoring points that are no longer active (facilities have been removed/dismantled). A footnote detailing this will be added to Table B1 in the next update of this plan.

35. CIRNAC-9

35.1 SUBJECT

Flow Monitoring

35.2 REFERENCES

TMAC Resources Inc., Hope Bay Project Doris-Madrid Water Management Plan, March 2019

35.3 ISSUE/RATIONALE

The 2017 version of the Hope Bay Project Doris-Madrid Water Management Plan includes the following quote under Section 3.2.4 (pg. 20): "Water level in the pond should be measured weekly during the open water season, and more frequently during intensive rainfall or snowmelt periods. The pumps should have in-line flow meters to quantify total discharge."

It is not clear why this information has been removed in the 2019 revision.

35.4 RECOMMENDATION/REQUEST

CIRNAC recommends that TMAC provide justification for the removal of in-line flow meters to quantify discharge in the pumps from the 2019 revision of the Hope Bay Project Doris- Madrid Water Management Plan.

35.5 TMAC RESPONSE TO CIRNAC-9

TMAC has not discontinued the use of in-line flow meters to quantify total discharge volumes for water management structures. Readings on flow meters are recorded routinely during periods of discharge and volumes tracked and reported in monthly and annual reports. This will be corrected in the next update of the Doris-Madrid Water Management Plan and TMAC apologizes for this miscommunication.

36. CIRNAC-10

36.1 Subject

Glycol Contaminated Snow and Sump Water

36.2 Reference

TMAC Resources Inc., Hope Bay Project Aircraft De-icing Management Plan, March 2019.

TMAC Resources Inc., Hope Bay Spill Contingency Plan, March 2019.

36.3 Issue/Rationale

In Module A of the Hope Bay Project Aircraft De-icing Management Plan, TMAC states the following (pg 15):

All glycol contaminated snow and sump water will be transported to the TIA in accordance with the below:

- All glycol must be discharged to the TIA pond at least 300 m away from any dams and as far from the shoreline as practical.
- The maximum discharge of propylene glycol is 30m3 per 6 months.
- All product disposal into the TIA must be recorded with the product details, disposal volume, location of discharge and date.

The Spill Contingency Plan, however, does not specify the procedure for disposal of glycol contaminated snow and sump water

36.4 Recommendation/Request

CIRNAC recommends that TMAC provide information regarding the procedure for disposal of glycol contaminated snow and sump water in the Spill Contingency Plan

36.5 TMAC Response to CIRNAC-10

The Spill Contingency Plan (Section 2.3) refers to the Hazardous Waste Management Plan and Non-Hazardous Waste Management Plan to provide guidance for disposal of materials during spill response and clean-up. The management of glycol contaminated snow and water from the de-icing facility is part of normal operations for this facility. The de-icing facility is a lined area, therefore TMAC does not believe waste material generated during operation of this facility to be considered a spill or that specifics of the management of this waste material be detailed in the Spill Contingency Plan.

The Hazardous Waste Management Plan will be updated therefore to clarify the management of glycol contaminated snow and water from the de-icing facility to reflect that it will deposited in the TIA in alignment with the Hope Bay Project Aircraft De-icing Management Plan (March 2019).

37. ECCC-1

37.1 Subject

Surveillance Network Program Station for Tailings Impoundment Area effluent

37.2 Reference

Appendix D-1 – Table D1-1

37.3 Issue/Rationale

It is unclear based on the table of the Surveillance Network Program (SNP) stations provided which SNP station is intended to quantify the concentrations of parameters within the tailings impoundment area (TIA) effluent prior to discharge. Based on the eventual water management strategy, whereby the two effluent streams, TIA and mine water, will discharge via a single outlet pipeline. It is important that both effluents be sampled prior to combining in order to have an understanding of the composition of each effluent separately, as well as overall combined discharge to Roberts Bay.

37.4 Recommendation/Request

ECCC recommends the Proponent clarify which SNP station will be used to assess overall TIA effluent quality prior to discharge and mixing with the mine water discharge.

37.5 TMAC Response to ECCC-1

TL1 will be used to assess overall TIA effluent quality prior to discharge.

38. ECCC-2

38.1 Subject

Under-prediction of Ammonia Concentrations

38.2 Reference

Appendix E (Doris Mine Water and Load Balance Assessment -2018 Calendar Year); Tables 4-6

38.3 Issue/Rationale

The Final Environmental Impact Statement (FEIS) model predictions significantly underestimated the concentrations of total ammonia in the process water and mine water. The FEIS predicted total ammonia concentrations of 0.52 mg/L in the process water and 3.4 mg/L in the mine water while 2018 sampling results indicate an average of 23 mg/L in the process water and 29 mg/L in the mine water. The water and load balance assessment provides no discussion on the sources of the greater-than-anticipated ammonia concentrations, or any steps that will be taken by the Proponent to reduce ammonia concentrations in effluents.

38.4 Recommendation/Request

ECCC recommends the Proponent provide a discussion on the sources of ammonia in the process water and mine water and outline any current or planned measures being undertaken to reduce ammonia concentrations

38.5 TMAC Response to ECCC-2

The FEIS model included mine water and process water inputs based on the best available data at the time of preparation. It was expected that monitoring data collected during operations would differ to some extent from those initial inputs. Deviations in ammonia concentrations will be discussed separately for mine water and process water in the following paragraphs. Updated estimates for mine water and Doris TIA water, using adjusted source terms based on recently available measured data with higher ammonia concentrations, show that discharge will meet the MDMER limits for unionized ammonia. Regardless, TMAC will continue efforts to reduce ammonia concentrations.

Process Water

Process water at the Doris Mine Site is sent to the Doris TIA and subsequently reclaimed for use in the Doris process plant. Throughout 2018, TMAC was able to source all process plant make-up water from the Doris TIA maximizing reuse of the Doris TIA water.

Process plant water ammonia loading originates from two sources:

- Blasting residue on ore entering the process plant, and,
- A by-product of the cyanide degradation circuit.

During the 2018 review, it was noted that the cyanide leaching circuit and subsequent cyanide destruction circuit had yet to achieve steady state conditions. Cyanide is added to the process to remove gold and is converted to ammonia in the cyanide destruction process. The likely cause of elevated ammonia concentrations in the process water input to the Doris TIA is the performance of the combined cyanide leach and destruction circuit in the process plant. TMAC will continue to optimize these circuits and monitor the contribution and creation of ammonia from the Process into the TIA.

Mine Water

Mine water has been directed to the Doris TIA since it was first intercepted in February of 2018. When compared to the FEIS model, flowrates were much lower than initially modelled. This was due to some discrepancies in modeled versus actual mine development and due to model uncertainty. The reduction in mine water flow rate is likely to have resulted in increased ammonia concentrations in lesser volumes of water.

Mine water ammonia loading originates from two sources:

- Blasting residue on the ore and waste rock mined, and,
- Backfilled material (waste rock and detoxified tailings).

Given the small volume of backfill material compared to the ore and waste rock produced, the likely source of ammonia loading is from blasting residue. The use of an emulsion-based explosive is being investigated by TMAC, which decreases blasting residue relative to ANFO. In addition to this TMAC is continually working to improve the efficiency of explosives.

39. ECCC-3

39.1 SUBJECT

Updated Water Quality Predictions

39.2 REFERENCE

Appendix E (Doris Mine Water and Load Balance Assessment -2018 Calendar Year); Section 5 – Comparison to MDMER

39.3 ISSUE/RATIONALE

The current mine water management at Doris Mine consists of mine water being transferred from the underground to the Doris Mine TIA for storage prior to discharge to Roberts Bay. Discharge to Roberts Bay from the TIA is anticipated to begin in October 2019. The future mine water management plan shifts from this strategy to having the effluent instead discharged to Roberts Bay concurrently with the TIA process water discharge (post- treatment) instead of being transferred first to the TIA.

Section 5 of the Water and Load Balance Assessment states that "updated water quality predictions for the TIA were compared to the MDMER limits." However, based on this statement and the subsequent analysis, it is unclear whether the "Doris TIA" water quality prediction includes just process water or the combination of mine water and TIA process water. If mine water is not included in the "Doris TIA" current water quality predictions, then the mine water predicted water quality concentrations should also be compared to Metal and Diamond Mining Effluent Regulations (MDMER) limits.

39.4 RECOMMENDATION/REQUEST

ECCC recommends the Proponent clarify whether Doris Mine TIA water quality predictions include inputs from the mine water. If not, the predicted mine water quality should also be compared to MDMER limits.

39.5 TMAC RESPONSE TO ECCC-3

TIA water quality predictions include inputs from the mine water. Modelling assumes that mine water is discharged to the TIA when not able to be directly discharged to Roberts Bay. This was considered in the water quality predictions for the TIA.

Under Water Licence No: 2AM-DOH1335, Schedule B Item 4, a summary of the results for the monthly TIA Water balance and water quality model assessments and any re-calibrations that have been carried out are required. The model assessment accounts for mine water including, when it is discharged directly to the Doris TIA (February 2018 until present) and therefore it was included in the previous Doris TIA comparisons presented in Table 10 and 11 of the Doris Mine Annual Water and Load Balance Assessment – 2018 Calendar Year.

40. ECCC-4

40.1 SUBJECT

Phytoplankton and Trophic Status

40.2 REFERENCE

Doris Project 2018 Aquatics Effects Monitoring Program Report; Section 3.3.9 (Total Phosphorus); Section 3.4 (Phytoplankton)

40.3 ISSUE/RATIONALE

Using the Canadian Council of the Ministers of the Environment (CCME) phosphorus guidelines, the concentrations of total phosphorus in Doris Lake indicate a trophic status of mesotrophic to eutrophic. However, Reference Lake B has a total phosphorus concentration that is indicative of an ultra-oligotrophic lake. These differences in the two waterbodies are further illustrated by the difference in phytoplankton biomass as assessed using chlorophyll a. In the analysis of the phytoplankton biomass, "statistical analysis and graphical analysis were used to determine if there were changes in phytoplankton biomass over time compared to baseline conditions. Biomass trends were also compared between exposure and reference sites to determine whether a low action level was exceeded according to the Response Framework."

Given the differences in trophic status between the two lakes, it is unclear what potential implications tropic status may have on the analysis of phytoplankton biomass, and potentially other biotic variables. There is no discussion on how the difference in trophic status is managed and/ or accounted for within the study design or any implications this may have going forward.

40.4 RECOMMENDATION/REQUEST

ECCC recommends the Proponent:

- Discuss the applicability of Reference Lake B to act as a reference lake for Doris Lake, given the differences in trophic status. This should include a discussion on how differences in trophic status are accounted for within the study design.
- Discuss the comparability of phytoplankton biomass trends between reference and exposure lakes.

40.5 TMAC RESPONSE TO ECCC-4

ECCC was party to the development of the AEMP and Reference B was selected as a reference lake for not only Doris Lake, but also other lakes in the study area. Table 4.2-7 of the Freshwater Water Quality Section of Volume 5 of the Madrid-Boston Project FEIS shows that Reference Lake B trophic status has historically ranged from ultra-oligotrophic to mesotrophic, while Doris Lake trophic status has ranged from oligotrophic to eutrophic (including data collected from various sites within Doris Lake). The historical range of phosphorus concentrations measured in Reference B overlaps with concentrations observed in many of the lakes in the study area, including Doris Lake.

The study design used for the AEMP is not affected by differences in the magnitudes of parameters such as chlorophyll a or phosphorus concentrations between lakes, as parameters are not directly compared between lakes. Rather, the trend analysis compares the temporal trend in Doris Lake to the temporal trend in Reference Lake B to determine whether there are differential trends occurring between exposure and reference lakes, which could be indicative of a mine effect. Therefore, the study design is robust to differences in trophic status or phytoplankton biomass levels between lake sites.

41. ECCC-5

41.1 SUBJECT

Seepage Survey Results

41.2 REFERENCE

TMAC Appendix F – 2018 Waste Rock, Quarry and Tailings Monitoring Report –Section 5.2 (Seepage Survey Results)

Appendix B – 2018 Doris Waste Rock, Ore and Infrastructure seep monitoring; 2018 Seep Survey Memo

41.3 ISSUE/RATIONALE

The seepage survey monitoring results for the waste rock pile are compared to historical monitoring results as well as the 2015 source terms used in modelling. Monitoring results indicate concentrations exceeding screening criteria for chloride, nitrate, nitrite, ammonia, sulfate, copper, and selenium. Of those that exceed the screening criteria the median concentrations for sulfate, copper, selenium, and nitrate exceed the source term inputs that were used in the 2015 modelling. There is no discussion provided on the implications of these exceedances of source term inputs on the overall mine water management and mine water quality."

41.4 RECOMMENDATION/REQUEST

ECCC recommends the Proponent provide a discussion on any implications to water balance and water quality predictions if concentrations in seepage continue to exceed the 2015 source term concentrations

41.5 TMAC RESPONSE TO ECCC-5

In Appendix B – 2018 Doris Waste Rock, Ore and Infrastructure seep monitoring, the 2018 seepage data were compared to 2015 source term input concentrations (mg/L) that represent the mean of the Pollution Control Pond (ST-2) data collected between 2011 to 2013.

At the time of model source term development, both the Sediment Control Pond (ST-1) and the Pollution Control Pond (ST-2) were both directly transferred to the Doris TIA via pump or truck. Runoff and seepage from the ore and waste rock stockpiled onsite flowed to the Pollution Control Pond, while runoff and seepage from the Doris Pad flowed to the Sediment Control Pond. The median and 75th percentile statistics of Station ST-1 were applied to any runoff and seepage from the Doris Pad. For the ore and waste rock, source terms were developed based on ST-2 data during the period of 2011 to 2013 after ore and waste rock had been placed on the mine surface in 2011. Ore and waste rock source terms were applied in the model as a load rate (mg/kg waste rock per day) that is directly added to the Doris TIA without a paired model flow.

Therefore, a direct comparison of seepage could not be completed as the model source term would change for each sampling event based on the amount of waste rock placed on the pile at the time of sampling. Operationally, waste rock seepage flows to the Solution Control Pond (ST-1) which is pumped over to the Sediment Control Pond (ST-2), which is then pumped to the Doris TIA. The comparison of 2018 seepage data with the 2015 source term input concentrations was therefore a check on the current samples collected compared to historical sampling events.

The Doris TIA has three major inputs during the period of 2018:

1. Water pumped from the pumpbox in the Doris Process Plant (excluding any mine water),
2. Doris mine water from the underground, and,
3. Doris Sediment Control Pond water (excluding any mine water), which collects runoff of seepage from the Doris pad, ore stockpile and waste rock stockpile.

A summary of volumes added to the Doris TIA in 2018 by month and according to the three aforementioned inputs is presented in Table 1. Flows from the Sediment Control Pond and ultimately the waste rock, vary between 5% and 21% of the total inflows between June and September and 4% of the total inflows on an annual basis.

A load analysis was conducted from the four parameters identified by Environment and Climate Change Canada: sulfate, copper, selenium and nitrate. Water quality concentrations were averaged for each month from the following three stations:

1. **Water pumped from the pumpbox in the Doris Process Plant (excluding any mine water)** – **sample station TL-5**. The sample location is the underflow of the tailings thickener. In reality, some process water is also pumped to the pump box along with the thickener underflow. The analysis assumes that the process water chemistry is the same as the thickener underflow water. In the process plant the tailings thickener overflow is directed back to the process water tank for reuse along with reclaim water. The use of the model is to produce water quality results in the TIA, and this assumption is conservative for the intended use of the model, however, it may slightly overpredict loading from the process plant for this analysis.
2. **Doris mine water from the underground – sample station TL-12**. Sulfate data was missing for April, May and June in 2018 and July data was used in the absence of measured data for the analysis.

3. **Doris Sedimental Control Pond water (excluding any mine water) sample station ST-1** – reflective of all surface runoff and seepage from the Doris Pad, ore stockpile and waste rock stockpile. For the period of July 29, 2018 to September 9, 2018 mine water was routed through the Sediment Control Pond. An effort was made to account for this, however Total Suspended Solids in the mine water was settling out of solution and conservation of mass was not possible. Instead the loading was double counted which would increase the percentage of loading from the Sediment Control Pond for this month. Therefore, the August data should be excluded in further analysis.

Monthly loadings were calculated by multiplying the monthly flows by the average monthly chemistry. A summary of the annual loadings for total copper, total selenium, sulfate and nitrate are presented in Figure 1. Overall the Sediment Control Pond makes up to 10% of the 2018 annual loading to the TIA.

Waste rock seepage flow rates were sufficiently low that they could not be measured and precluded the use of the seepage data in this assessment because the model requires the waste rock source term to be in unit of mg/kg. ST-1, however includes 2018 loadings from waste rock and ore, therefore the assessment addresses the objective of the IR.

As part of the 2018 annual water and load balance review (Appendix E of the NWB annual report package submitted by TMAC), TL-1 measured water quality was compared to model results. Parameters that did not track well with the model and were under-predicted were addressed during the evaluation by updating source terms based on measured data. The result was an update to some parameters in the mine water and process plant source terms, however no change was required for the Doris Sediment Control Pond, ore stockpiles or waste rock stockpiles.

Uncertainty in any source term is expected and since the Sediment Control Pond represents a comparatively small load to the TIA, there would be little impact if the source term was underestimated on the validity and conclusions of the water and load balance. TMAC is committed to review the annual water and load balance each year and will update source terms accordingly based on deviations in measured data when compared to model results.

Table 1. Measured Inflows to the TIA

Date	Volume Added to the Doris TIA (m^3)		
	Pumpbox Water[1]	Doris Mine Water	Doris Sediment Control Pond[1, 2]
January	92,000	-	-
February	85,000	2,700	-
March	120,000	9,300	-
April	77,000	7,500	-
May	69,000	7,100	-
June	150,000	9,700	12,000
July	110,000	11,000	6,900
August	74,000	9,800	22,000
September	71,000	6,800	10,000
October	74,000	19,000	-
November	79,000	22,000	-
December	85,000	20,000	-
Total[3]	1,100,000	130,000	51,000

Source: \\van-svr0\Projects\01_SITES\Hope.Bay\1CT022.036_2019 General Compliance\02_NIRB_2018AnnualReport_Comments\ECCC4\HopeBay_ECCC4_AnnualReport2018_1CT022-036_R00_ajb

Note: 1 – Values presented exclude mine water contributions.

2 – Doris Sediment Control Pond includes water pumped from the Pollution Control Pond that contains ore and waste rock seepage.

3 – Values presented are rounded to two significant figures, totals may not add up accordingly.

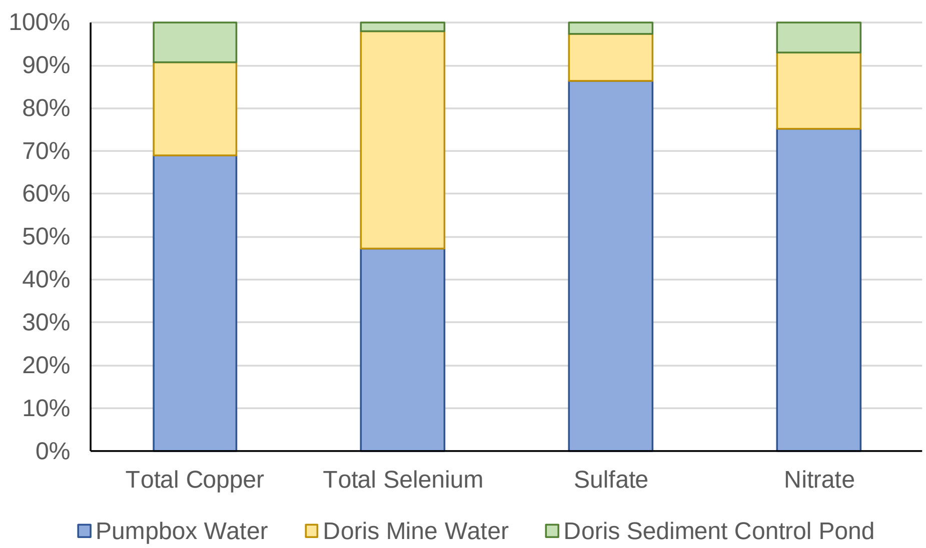


Figure 1. Comparison of Loading Sources to the TIA for Copper, Selenium, Sulfate and Nitrate

Source: \\van-svr0\Projects\01_SITES\Hope.Bay\1CT022.036_2019 General Compliance\02_NIRB_2018AnnualReport_Comments\ECCC4\HopeBay_ECCC4_AnnualReport2018_1CT022-036_R00_ajb

Note; Doris Sediment Control Pond includes water pumped from the Pollution Control Pond that contains ore and waste rock seepage.

42. ECCC-6

42.1 Subject

Seepage Monitoring

42.2 Reference

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project. Section 6 Conclusions

42.3 Issue/Rationale

In the Waste Rock, Quarry and Tailings Monitoring Report Appendix F, Section 6 the Proponent concludes that the monitoring of the seepage from the camp pad and the ore stockpiles indicates that the water quality for the contaminants of concern are within the range of the historical data. However, the Proponent did not indicate whether they comply with the required limits.

The Proponent also indicates that "some contaminants of concern are not attenuated by the tundra as predicted", but then further states that "the concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern and the breakthrough of the effectiveness of the attenuation process has not occurred." The tundra is part of the environment, so it is not clear how the tundra is being used to attenuate the contaminants of concern, and whether the tundra is being used as a treatment option, or as an alternative to treatment.

42.4 Recommendation/Request

ECCC recommends that the Proponent clarify the apparent contradicting statements about the water quality and contaminants of concern

ECCC recommends that the proponent provide an explanation of why the tundra is being used or relied on to attenuate contaminants of concern rather than using an actual treatment option.

42.5 TMAC Response to ECCC-6

TMAC notes that the IR is in reference to Appendix G - 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project, Section 6 (Conclusions).

The majority of the seepage and runoff from the camp pad flows along poorly defined ephemeral drainages.As part of the annual geochemical monitoring program, seepage samples are collected at the toe of the camp pad with the objective of monitoring the near source "contact water" or flushing of oxidation products from ore and waste rock whereas the objective of the ephemeral sampling program is to monitor the seepage that are upstream of the receiving environment. Sections 4 and 5 of Appendix G present the results of the seepage and ephemeral monitoring programs, respectively.

The seepage and ephemeral monitoring programs were designed in the context of validating a water and load balance (WLB) model for the Boston camp pad (SRK 2009). The objective of the WLB was to evaluate potential impacts of seepage from the ore and waste rock at key locations downstream of the Boston camp pad. The geochemical inputs to the WLB were seepage samples collected in 2009, with contaminants of concern (e.g. modelled parameters) identified based on review of the seepage data.

In support of the WLB, an aquatic specialist from Rescan (now ERM) assessed the downstream environment of the Boston Camp to define environmental receptors and where water quality guidelines should be applied. The ephemeral drainage locations were concluded not to be fish habitat and Aimaokatalok Lake was defined as the receiving environment. The WLB indicated that modelled concentrations for contaminants of concern in the receiving environment were below CCME water quality guidelines for the protection of aquatic life. Accordingly, the trend analysis of contaminants of concern and comparisons to the WLB in Appendix G is a method of assessing potential impacts to the downstream environment.

Attenuation of the parameters in the tundra is not presented as a treatment option but as a geochemical mechanism that explains the decrease in concentrations of arsenic and other contaminants of concern in the ephemeral drainage compared to seepage at the toe of the camp pad.

43. ECCC-7

43.1 SUBJECT

Sample Testing Program

43.2 REFERENCE

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project; Section: 5.2 Sampling and Testing Program; 5.2 Results

43.3 ISSUE/RATIONALE

The Proponent states that "This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, copper and selenium may be attributed to the presence of ore, which has higher sulphide content than waste rock." Concentrations of arsenic and iron for the 2018 waste rock seepage samples were higher than the screening criteria; however, this was attributed to the presence of colloids. When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable.

Colloid is defined as "A homogeneous noncrystalline substance consisting of large molecules or ultramicroscopic particles of one substance dispersed through a second substance. Colloids include gels, sols, and emulsions; the particles do not settle, and cannot be separated out by ordinary filtering or centrifuging like those in a suspension. Or simply a mixture in which one substance of microscopically dispersed insoluble particles is suspended throughout another substance."

If this definition is correct, it is unclear how the higher concentration of arsenic and iron in the analysed seepage can be attributed to the presence of colloids. Even if these metals are adsorbed to the surfaces of the colloids, they are still present in the water columns it is unclear how their increase would be because of the presence of colloids.

It is also unclear what is meant by the following statement "When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable.

43.4 RECOMMENDATION/REQUEST

ECCC recommends that the Proponent explain why the higher concentration of arsenic and iron in the waste rock has been attributed to colloids and provide rational for this conclusion including how these high concentrations occur.

ECCC recommends that the Proponent provide the source of the colloids present in the seepage.

ECCC recommends that the proponent clarify what is meant by "when the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable

43.5 TMAC RESPONSE TO ECCC-7

The definition of colloid as stated above is out of context. Dissolved metals is an operational definition, whereby a water sample is passed through a 0.45 micron filter prior to trace element analysis. A colloid in the context of operationally defined dissolved metals is a suspended particle that can pass through a 0.45 micron filter. Sampling turbid waters can result in elevated concentrations of operationally defined dissolved metals due to the presence of colloids.

Seepage samples concluded to contain colloids had the following characteristics: i) high TSS concentrations indicating that seepage samples contained sediment prior to filtration through the 0.45 micron filter. This was further supported by visual observations of turbid seepage; ii) dissolved iron and aluminum concentrations above mineral solubility limits for pH neutral and oxygenated samples, and iii) high arsenic and iron concentrations. Arsenic concentrations are controlled by adsorption to ferric iron hydroxide therefore elevated concentrations of both iron and arsenic suggest colloids. On this basis, selected samples were interpreted to contain colloidal materials (i.e. dirt).

The objective of seepage monitoring is to assess potential metal leaching due to sulphide oxidation. Accordingly, each sample was assessed or "screened" for the presence of colloids, as defined above, as colloids in the seepage samples are not indicative of sulphide oxidation and metal leaching processes. The screened samples had concentrations that are consistent with historically measured concentrations of iron and arsenic.

44. ECCC-8

44.1 SUBJECT

Rock Sampling Depths

44.2 REFERENCE

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project; Section: 3 Ore Stockpiles Rinse Survey; 3.1 Sampling and testing Program

44.3 ISSUE/RATIONALE

The Proponent indicates that rock samples were collected from approximately 25 cm depth. If waste rock samples have been exposed to the elements of the environment for a long time a sampling depth of 25 cm may not be deep enough to collect a representative samples, given that the contaminants in the top layer of that waste rock would have been flushed out and washed away. The rinse testing of samples from the top layer (25 cm) will yield results that do not accurately reflect the state of the waste rock oxidation in the ore and waste rock.

44.4 RECOMMENDATION/REQUEST

ECCC recommends that the Proponent provide clarification on the rationale that led to not selecting samples from a depth deeper than 25 cm and why these samples are considered representative.

44.5 TMAC RESPONSE TO ECCC-8

Sulphide oxidation is due the reaction of sulphide minerals with air (oxygen). Samples collected are considered representative of sulphide weathering based on the following:

- Visual observations of secondary minerals on the surface of the selected stockpiles indicates that weathering products are present (not flushed from the stockpile).
- The ore stockpiles contain fine material that physically limit oxygen ingress into the deeper stockpile materials. Samples and sulphides located near the surface of the stockpile are exposed to the highest concentrations of oxygen and therefore are the most weathered.
- Values of rinse conductivity for the sample set ranged from 99 to 4,100 µS/cm in the 2018 survey. Rinse conductivity in this case indicates the presence of soluble oxidation products in the samples collected. Lower values of rinse conductivity do not necessarily indicate that flushing of oxidation products, but rather, low sulphide content within the sample.

45. ECCC-9

45.1 Subject

2018 Waste Rock Monitoring and Ore Monitoring Report, Boston Camp, Hope Bay Project

45.2 Reference

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project; Section 3.2 Results

45.3 Issue/Rationale

ECCC notes that the "tarnishing of the sulphide crystals" mentioned in Appendix F- Section 3.2 of the Waste Rock and Ore Monitoring Report is likely evidence of oxidation of the sulphide minerals, which will lead to Acid Rock Drainage/ Metal Leaching (ARD/ML). It is not clear why the Proponent has compared the monitoring results from 2008 to the results from

2018, and not compared the results for any of the years in between where seepage samples may have indicated ARD/ML activities

45.4 Recommendation/Request

ECCC recommends that the Proponent analyse the monitoring results of the years in between 2008 and 2018 in order to check for evidence of ARD/ML or verify trends, if any.

ECCC also recommends that the Proponent provide an explanation as to why the only the 2018 monitoring results are being compared to that of 2008 and not the years in between.

45.5 TMAC Response to ECCC-9

TMAC notes that the IR is in reference to Appendix G - 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project, Section 3.2 (Ore Stockpile Rinse Survey – Results).

The rinse test survey of the waste rock pad and ore stockpiles is conducted every ten years, i.e. 2008 and 2018. Geochemical characterization of the waste rock and ore indicates that all waste rock and the majority of the ore is non-PAG with a small proportion of ore having an uncertain potential for ARD. However, there is a low risk of acidic seepage developing due to the high carbonate content in the underlying pad.

The objective of the rinse test survey is to assess if locally acidic conditions are developing in the ore stockpiles. The 2018 rinse test survey confirmed that all stockpile are pH neutral and consistent with the initial survey conducted in 2008.

TMAC would like to clarify that seepage monitoring is conducted and results reviewed annually, e.g. Appendix G - 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project, Section 4.2 (Monitoring of Boston Seepage – Results). Annual seepage monitoring has consistently indicated pH neutral drainage from the ore stockpiles and waste rock.