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

January 17, 2014

EC file: 4708 001 063
NIRB file: 05MN047
NWB file: 2AM-DOH0713

Amanda Hanson; Director, Technical Services
Nunavut Impact Review Board
PO Box 1360
Cambridge Bay NU X0B 0C0

Via: info@nirb.ca

Attention: Ms. Hanson

RE: TMAC Resources Inc.'s Proposed Modifications to the Doris North Gold Mine Project and Reconsideration of the NIRB Project Certificate No. 003 Terms and Conditions

Please find attached Environment Canada's (EC) submission to the Nunavut Impact Review Board (NIRB) with comments on the modifications to the Doris North Gold Mine Project proposed by TMAC Resources Inc. ("the Proponent") in response to NIRB's request for comments dated December 19, 2013. EC's specialist advice is provided pursuant to the *Canadian Environmental Protection Act 1999*, the pollution prevention provisions of the *Fisheries Act*, the *Migratory Birds Convention Act*, and the *Species at Risk Act*.

For further clarification on any aspect of this submission, please contact Michael Mohammed at (867)-975-4637 or michael.mohammed@ec.gc.ca.

Sincerely,

Michael Mohammed
Senior Environmental Assessment Coordinator

Attachment – "EC's Comments on the Proposed Modifications to the Doris North Gold Mine Project"

cc: Carey Ogilvie, Head Environmental Assessment North (NT & NU), PNR-EPOD
EC Internal Distribution

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Environment Canada's Comments on the Proposed Modifications to the Doris North Gold Mine Project

Canada

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1. Issue: Water Quality Parameters and Discharge Criteria

References:
Project Proposal Amendment Changes Summary, Sections 4.3, 4.4
Appendix 4 – Roberts Bay Report, Section 5.2.3
Appendix 10 - Water Quality Model, Section 3.1; Section 3.2.7; Section 3.4, Section 4.1, Section 5.1.2

Proponent's Conclusion:
A number of significant changes to water management are proposed, including moving to a year-round discharge from the Tailings Impoundment Area (TIA) to the marine environment, co-disposal of cyanide treated tailings with flotation tailings, and extended production and associated increases in water use and wastewater disposal.

Table 4-1 of Appendix 10 presents a summary of TIA Discharge Standards and Targets. The standards are taken from the existing Type A water licence discharge criteria (Section G, Clause 26) and the targets are taken from a 2011 evaluation of discharge concentrations back-calculated to maintain the water in Roberts Bay at CCME concentrations for contaminants.

EC's Conclusion and Rationale:
With the change from a seasonal, freshwater effluent discharge to a year-round marine discharge to Roberts Bay there is a need to re-evaluate the discharge criteria and regulated parameters. Metal Mining Effluent Regulations (MMER) limits would not be inappropriate for the marine receiving environment provided protective water quality objectives for a broader range of parameters can be met at the edge of a defined mixing zone in Roberts Bay. It should be noted that the MMER is undergoing review, and the Proponent should be aware of discussions regarding additional regulated parameters and changes to the criteria (lowering allowable discharge concentrations).

EC has a number of concerns with the revised effluent quality predictions:

1. Ammonia
   - Ammonia was modeled taking into account contributions from the groundwater, degradation of cyanide, blasting reagents, and from camp wastewater. Subsection 3.2.7 of Appendix 10 models increases to groundwater concentrations from blasting, but does not appear to carry that forward to the TIA for the first 4-5 years of operations (see Subsection 4.1 of Appendix 10 which states that groundwater doesn't report to the TIA until year 5).
   - Considerable reliance is placed on natural degradation processes to reduce ammonia concentrations in the TIA during the open water season.

Subsection 3.4 of Appendix 10 addresses the cyanide contributions and uses removal rates which are based on enhanced removal using the addition of phosphorus. The enhanced removal was carried through the modeling as the base case in order to meet the 6 mg/L discharge criteria. EC's concern is that enhanced removal has not been demonstrated to occur at high salinity, nor at such high latitudes and cooler temperatures where biological activity is limited by light and temperature.

- Under the base case scenario, winter discharge must be stopped for various periods of time to comply with the ammonia discharge limit. As modeled, there was sufficient water retention capacity to accommodate periodically halting discharge, but if concentrations are higher than modeled, the ability to discharge may be further limited, and TIA capacity may become an issue.

2. Selenium
   - Selenium levels in the proposed mill effluent (Appendix 10, Table 3-7) are as high as 0.25 mg/L, and range from 0.002 to 0.0051 mg/L in the predicted TIA discharge (Appendix 10, Table 5-1). Selenium concentrations should be closely tracked through monitoring, as these values are approaching levels that could cause reproductive impacts to fish.

3. Toxicity Testing
   - The current water licence requirement for effluent to be non-acutely toxic relies on tests using freshwater organisms; this will need to be re-evaluated and marine-appropriate tests discussed.

4. Zinc
   - Subsection 4.2 Closure shows a target of 0.50 mg/L rather than the CCME value of 0.03; please confirm that this is in error.

5. Nitrate/Nitrite
   - Please confirm that Appendix 10, Table 3-8 numbers for nitrate and nitrite have been switched.

6. Use of base case water inputs
   - Section 4 of Appendix 10 introduces three discharge scenarios for water management options. These are base case groundwater inflows, low flow groundwater, and no flow groundwater. It would be prudent to include a high flow (i.e. greater than base case) scenario and evaluate implications for effluent quality.

Recommendations:
Reconsideration of the Project Certificate will be necessary to amend the discharge criteria set for Doris Creek and set appropriate discharge limits for Roberts Bay. Further work is needed on contaminant concentration predictions.

EC recommends that:
1) Further evaluation be done for ammonia concentrations in the effluent discharge;
2) The Proponent be prepared to track selenium concentrations closely and implement treatment if necessary;
3) Marine-appropriate species be used for the effluent bioassay tests;
4) Nitrate and zinc errata be clarified; and
5) High groundwater flow be evaluated.

2. Issue: Marine Water Quality Objectives

Reference:
Table 5.2-3. Calculated Treated TIA Discharge Water Quality Targets to Ensure that Roberts Bay Water Quality Remains Below Marine CCME Guidelines

Proponent's Conclusions:
A limited list of parameters have been evaluated (oxygen, pH, nitrate-N, salinity, arsenic, cadmium, chromium, and mercury) with allowable concentrations presented in Table 5.2-3.

EC's Conclusion and Rationale:
EC acknowledges that there are limited marine guidelines for the protection of aquatic life and that the Proponent has listed those available from the CCME. Where guidelines are lacking, objectives may be set for other parameters of concern using other procedures, such as the background approach, reviewing guidelines from other jurisdictions, or developing site-specific objectives based on the resident species and literature toxicity data. In the original Environmental Assessment, the receiving environment was evaluated for effects of a wide range of parameters (both with and without CCME guidelines) and acceptable environmental concentrations determined. The change to a marine receiving environment does temper concerns given the ocean's large assimilative capacity and the opportunity for avoidance. None-the-less, effluent must be non-deleterious at end of pipe, and the mixing zone around the diffuser must be minimized to reduce the zone where some chronic toxicity might occur. To this end, review of the relevant chemicals of potential concern should be done and objectives identified. At a minimum, this should include ammonia, BOD5, selenium, zinc and lead, nickel and copper.

Recommendations:
EC recommends that a more comprehensive list of contaminants be evaluated in the receiving environment and discharge targets identified for a defined area in Roberts Bay.

3. Issue: Section 2.2 Marine Discharge Outfall

Reference:
Appendix 4 – Roberts Bay Report

Proponent's Conclusion:
The proposed marine outfall will be designed to disperse effluent at a depth of 40 m, such that mixing is optimized and effects on the upper productive layer of the water column are minimized.

EC's Conclusion and Rationale:
The diffuser will be anchored on the seafloor by counter-buoyancy weights that will hold the diffuser pipe 40 cm above the sediments. Discharge of the effluent is through 20 lateral ports at a rate of approximately 120 L/s. The seafloor sediment composition is predominantly sand but also includes silt and clay. The turbulence caused by the effluent flow will cause scouring of the adjacent sediments, especially if the pipe rests on the floor of Roberts Bay between the ballast weights, and this will result in disturbance to benthic areas and turbidity in the water column for a period of time.

Recommendations:
EC recommends that mitigation measures be developed to prevent or minimize disturbance of the sediments at the diffuser site.

4. Issue: Changes to Inputs to TIA and Water Transfer System

Reference:
Project Proposal: Doris North Mine Modifications and Related Amendments to Project Certificate No. 003 and Type A Water Licence No. 2AM-DOH1323
Section 4: Description of Proposed Doris North Mine Changes, Subsection 4.4.2, Page 42-43

Proponent's Conclusion:
The proponent states in Subsection 4.1 (Extended Mine Life) that the new project proposal amendment will add an *additional* 2-4 years of mine life to the project (in addition to Miramar's original 2 year mine-life estimate).

The proponent also states their new TIA plan (modelled and detailed in Appendix 14 - Tail Lake Water Design) will allow for approximately 58 months of use of the TIA (which is approximately 4.83 years).

EC's Conclusion & Rationale:

EC is concerned about a lack of contingency planning in the event that the TIA reaches capacity within the proposed 4-6 years of mine operation (e.g. the mine runs for 6 years or more yet the TIA only has capacity for 4.83 years). There does not appear to be much leeway built into the capacity predictions from the time of first use to the end of deposition.

In Section 2, Page 31, it states that "…the actual extent of mining in this phase will ultimately be limited by the amount of subaqueous tailings storage that is available based on the current designs for the TIA." EC also notes that the Proponent states the following on Page 41 of the new project proposal: "In the original application for the Type A Water Licence, it was stated that the cyanide destructed slurry would be filtered and trucked to the underground stope for final deposition and the flotation tails would be pumped to the TIA for subaqueous deposition. TMAC now proposes that the cyanide destructed slurry will be pumped to the flotation tailings pump box where it will be blended with flotation tailings prior to discharging in the TIA."
This amended practice will increase the requirement for capacity in the TIA.

Recommendations:
EC recommends that the NIRB add a condition to the Doris North Gold Mine Project Certificate, under Section 4: Project Specific Terms and Commitments, that commits the proponent to developing a contingency plan for alternatives for tailings disposal should the project approach the capacity of the TIA before the end of mine life.

EC also suggests that it be noted under the same section (suggesting Section 4: The Assessment of Alternatives to Tail Lake for Tailings Disposal, Point 5), that the proponent be required to update the NIRB on the status of the volume of Tail Lake (versus their projections for tailings storage) on a yearly basis as part of an update on current, planned and future phases of Hope Bay Belt Development. This could be tied into the commitment to report on January 1st of each calendar year to the Board.

In addition, EC recommends that the proponent be asked to provide additional information on the increase in tailings volume that is anticipated as a result of the revised proposal to deposit the cyanide destructed slurry in the TIA and the proportion of total tailings volume from each of flotation tailings and cyanide destructed slurry over life of mine.

5. Issue: Closure TIA Water Cover Depth

Reference:
Subsection 4.5 - Reduction of water cover in tailings impoundment area (Project Proposal Page 45; Appendix 14 - Tail Lake Water Cover Design)

Proponent's Conclusion:
As originally proposed by Miramar, a water cover depth of 4 m would have been maintained over the tailings in the TIA, and a depth of 2.42 m was considered the minimum possible. The proponent now states that in order to maximize the capacity of the TIA they plan to maintain a final water cover of 2.3 m in the TIA. The proponent states that revised modeling supports a conclusion that the 2.3 m water cover is "adequate to prevent re-suspension of tailings under all conditions". In the supporting Appendix 14 Tail Lake Water Cover Design (SRK, November 2011), the Proponent has provided the details of their analysis for arriving at the proposed depth of 2.3 m of water cover in the TIA.

EC's Conclusion and Rationale:
EC is concerned that the revised model for the depth of the TIA water cover does not allow for variability in weather patterns due to the effects of climate change. Changing climatic patterns may result in more drastic or extreme fluctuations than the averages used in the Proponent's model (for temperature, wind speed, etc), even within assumptions the model deemed "conservative". EC recommends that the Proponent select a larger minimum water cover and have a contingency plan that addresses variability in weather patterns due to climate change, e.g. extreme cold events resulting in greater ice thickness than the model's most conservative case (2.05 m thick, which would result in greater risk of ice entrainment of tailings particles) and greater wind-speeds than the conservative case, etc.

Recommendations:
EC recommends to the NIRB that the Proponent be required to consider a deeper minimum water cover and have a contingency plan that helps address variability in weather patterns due to climate change, e.g. extreme cold events resulting in greater ice thickness than the model's most conservative case (2.05 m thick) and greater wind-speeds than the conservative case, etc. A comprehensive analysis of the far-future predictions for climate change should be provided in support of the Proponent's recommended cover depth.

The requirement for a re-evaluation of the minimum water cover could fall under the Doris North Gold Mine Project Certificate, Section 4: Project Specific Terms. Contingency plans for events that may result in weather patterns outside of the models range/expected values could be added as a requirement under Section 4: Project Specific Terms, Environment, Health and Safety Management System (Point 32).

It is also unclear to EC how the proponent would operate the proposed TIA in the winter if a water cover of 2.3 m is maintained. If there are 2 m of ice cover, this would leave a very small under-ice capacity for tailings disposal through the winter months. What are the proponent's operational plans for under-ice tailings disposal in the winter months? For example, would the tailings spigot be moved through the winter months, and if so, how?

6. Issue: Camp Wastewater Treatment

Reference:
Subsection 4.7 - Increased Wastewater Treatment Capacity (Project Proposal, Page 46)

Proponent's Conclusion:
The Proponent states they are requesting an expansion of the wastewater treatment plant (servicing the Doris Camp) to meet the increase (doubling) in staff at the camp site. They state that the second Waste Water Treatment Plant (WWTP) the Nunavut Water Board (NWB) approved in 2010 to serve as a backup unit for the camp will, however, meet the needs required to treat wastewater for the expanded camp.

EC's Conclusion and Rationale:
EC is concerned that there has not been an actual increase in the proponent's wastewater treatment capacity. By utilizing this backup treatment plant for full-time waste treatment, the Proponent now effectively does not have a contingency (backup) unit or plan if one of the systems fails or needs maintenance. In the event of a system failure or required maintenance shutdown, waste will be temporarily disposed of into the tundra and may have adverse effects on that environment. EC recommends that the Proponent have enough wastewater treatment capacity available at the site to treat waste should one of the units either fail or be required to shut down for maintenance.

Recommendations:
EC recommends the NIRB require contingency plans from the Proponent in the event of a wastewater treatment failure or maintenance situation (under Section 4: Project Specific Terms, Environment, Health and Safety Management System (Point 32).

7. Issue: Accommodation Barges

References:
Subsection 4.9 - Roberts Bay: Laydown, Accommodation Barges, and Winter Fuel Barges (Project Proposal, Page 48; Appendix 3 - Mine Infrastructure Changes, Page 2-7)

Proponent's Conclusion:
The proponent proposes to extend the use of accommodation barges that were "previously on Roberts Bay and operated in fully compliance with applicable laws." The proponent states in the Mine Infrastructure Changes document that they were

used in 2010 through 2012 to house extra personnel needed for construction of the Doris North Mine.

EC's Conclusion and Rationale:
EC is concerned with the ongoing use and disposal of what were previously "temporary" accommodation barges, so they do not pose a hazard to the marine or terrestrial environment. It is not clear whether modeling of Roberts Bay water quality for nutrients includes barge inputs, or if these would be negligible.

Recommendations:
EC recommends that the NIRB make an addition to the Doris North Gold Mine Project Certificate (Section 4: Project Specific Terms and Commitments) that requires the proponent to evaluate impacts associated with extended use of the barges (i.e. waste disposal and potential spill risks).

8. Issue: Water Management – Contingency Planning

Reference:
Appendix 19 - Design Brief: Doris North Project Expanded Waste Rock Storage Pad, Subsection 3.5 - Pollution Control Pond (Page 3)

Proponent's Conclusion:
The proponent intends to design a lined Pollution Control Pond to capture subsurface and surface drainage emanating from the proposed Waste Rock Dump Pad U. The pond will be designed for the containment of up to 100-year return duration storm events ($2708m^3$ or 48.99mm precipitation events).

EC's Conclusion and Rationale:
EC questions the potential capacity of the pollution control pond(s) in light of climate change considerations and potential increased frequency of previously statistically valid "100 year events". EC recommends contingency planning, regardless of pond size, in the event of a precipitation (or other) event that would exceed the pollution control pond(s) design capacity.

Recommendations:
EC recommends the NIRB require contingency planning for all pollution control ponds in the event that a greater volume of precipitation than the ponds are designed for occurs at the Doris North Project site. EC recommends this requirement be part of the project certificate (Section 4: Project Specific Terms and Commitments).

9. Issue: Waste Rock Classification and Volumes

Reference:
Doris North Mine Modifications and Related Amendments to Project Certificate No. 003 and Type A Water Licence No. 2AM-DOH1323 - Subsection 3.2 Geochemistry (Page 38)

Proponent's Conclusion:
The Proponent plans to backfill some waste rock in the stopes of the underground mine and store the remaining in waste rock storage areas located on-land.

EC's Conclusion and Rationale:
EC requests the Proponent to provide the following information:

- Breakdown of the total volumes of waste rock from the project expansion that would be classified as mineralized and non-mineralized and how they will be managed.
- The total volume of mineralized waste rock from the proposed expansions that will be potentially acid generating (PAG) and non-PAG.
- The total volume of mineralized waste rock that will end up being stored on-land in the waste rock storage pads and whether there will be any PAG materials in these on-land pads.

10. Issue: Waste rock storage

Reference:
Doris North Mine Modifications and Related Amendments to Project Certificate No. 003 and Type A Water Licence No. 2AM-DOH1323 - Section 7, Environmental Effects Assessment (Page 60)

Proponent's Conclusion:
The Proponent states that there are no water bodies in the proposed ore storage pads expansion area (Pad T).

EC's Conclusion and Rationale:
The Proponent should confirm that this is also the case for the proposed waste rock storage pad expansion area (Pad U).

11. Issue: Nitrogen Species Degradation

Reference:
Appendix 10 Water Quality Model, Subsection 3.4 – Natural Degradation Reactions (Page 28)

Proponent's Conclusion:
As stated in the Executive Summary of "Doris North Mine Modifications and Related Amendments to Project Certificate No. 003 and Type A Water Licence No. 2AM-DOH1323" the proponent anticipates an initial ore milling rate of 800 tonnes per day (tpd) but that this rate may ultimately increase to 1,800 tpd. As described in Subsection 4.5, the proponent is also proposing a shallower water cover in the TIA of 2.3 m.

EC's Conclusion and Rationale:
Given the revised shallow water cover and the rate of tailings inflow into the TIA resulting from the increased ore milling rate, EC is concerned that the retention time in the TIA would be reduced. This could result in reduced effectiveness of natural degradation in the TIA concurrent with increased inputs of residual cyanide and blasting residues.

It is not clear to EC if the possibility of reduced retention time has been accounted for in the consideration of natural degradation reactions (e.g. cyanide, ammonia) when modeling discharge water quality.

Recommendations:
Environment Canada recommends that the proponent clarify:

- Whether reduced retention time is predicted, given the shallower water cover and the likelihood of increased ore millings rates over the mine life;
- Whether a reduced retention time has been taken into account in consideration of natural degradation; and
- What are the implications of reduced retention time for the effectiveness of natural degradation of nitrogen species.

If the proponent has not taken reduced retention time into account in consideration of natural degradation, they should clarify why, or reconsider their estimates for natural degradation in light of the potential for reduced retention times.

12. Issue: Migratory Birds and Species at Risk

Reference:
Project Proposal: Doris North Mine Modifications and Related Amendments to Project Certificate No. 003 and Type A Water Licence No. 2AM-DOH1323

Proponent's Conclusion:
The Proponent states that: "Mitigation for wildlife will include preferentially scheduling construction activities during the least risk work timing windows" and that "Wildlife monitoring activities will occur during construction activities that have the potential to cause negative impacts on wildlife or their habitat. Pre-construction surveys will also be required in the nesting season to ensure that no incidental wildlife or nests were present".

EC's Conclusion and Rationale:
EC maintains that the best mitigation measure to ensure compliance with Subsection 6(a) of the *Migratory Birds Convention Act* is to complete activities which have a risk of disturbing or destroying nests or eggs outside of the migratory bird nesting season. EC provides the following information and advice related to incidental take and the *Migratory Birds Convention Act*:

> EC's mandate includes the protection of migratory birds and their habitat. Regulations pursuant to the *Migratory Birds Convention Act* provide for the conservation of migratory birds and the protection of their nests and eggs; Subsection 5(1) of the *Migratory Bird Regulations* states that no person shall hunt a migratory bird except under authority of a permit. "Hunt" means to chase, pursue, worry, follow after or on the trail of, lie in wait for, or attempt in any manner to capture, kill, injure or harass a migratory bird, whether or not the migratory bird is captured, killed or injured; and Paragraph 6 (a) of the *Migratory Birds Regulations* states that no one shall disturb or destroy the nests or eggs of migratory birds;
>
> Activities that physically disturb or destroy terrestrial habitat during the breeding season can result in the inadvertent harming or killing of migratory birds and the disturbance or destruction of their nests and eggs. This is known as *incidental take*. There is no legal mechanism available which could authorize via permit or exemption the incidental take of migratory birds, or their nests and eggs. As a result, project proponents are responsible for taking appropriate measures to ensure that they comply with the legislation. To reduce the risk of incidental take of nests and eggs of migratory birds, EC recommends that Proponents avoid engaging in potentially destructive or disruptive activities during the migratory bird nesting period. The following nesting periods are provided as general guidance to assist proponents in planning their field activities. It is important to note that breeding periods may vary from year to year due to climatic conditions and some species may nest outside the dates provided if conditions are favourable;.
>
> In the southern Arctic region of the Northwest Territories and Nunavut, migratory birds may be found incubating eggs from May 14 until July 30, and young birds can be present in the nest until September 12;
>
> If nests containing eggs or young of migratory birds are located or discovered, all disruptive activities in the nesting area should be halted until nesting is completed. Flushing nesting birds increases the risk of predation of the eggs or young, or may cause the parent bird to abandon its nest. Any nest found should be protected with a buffer zone appropriate for the species and the surrounding habitat until avoided until nesting is complete (i.e., the young have left the vicinity of the nest).

Figure 12.1. Boreal, Northern and Southern Arctic Ecozones within the Northwest Territories and Nunavut.

The following setback distances are recommended to minimize disturbance to nests for different bird groups nesting in tundra habitat (see footnotes for adjustments to setbacks for sensitive species and species at risk):

Species Group	**Pedestrians /ATVs (m)**	**Roads / Construction / Industrial Activities (m)**
Songbirds	30	100
Shorebirds	50[a]	100[a]
Terns/Gulls	200[b]	300[b]
Ducks	100	150
Geese	300	500
Swans/Loons/Cranes	500	750

[a] If project activities are within the breeding ranges of American Golden Plover or Ruddy Turnstone, these setbacks should be increased to 150 m for Pedestrians/ATVs and 300 m for Roads/Construction/Industrial Activities respectively. If project activities are within the breeding ranges of Black-bellied Plover, Whimbrel or Red Knot (a Species at Risk), these setbacks should be increased to 300m for Pedestrians/ATVs and 500m for Roads/Construction/Industrial Activities. If field crew are trained in the identification of these species then these higher setbacks need only apply to these more sensitive species, and lower setbacks can be used for the remaining shorebird species. In areas where several species are nesting in proximity, setbacks for the most sensitive species should be used if they are present.

[b] If project activities are in proximity to breeding colonies of Ross's Gull (SAR) or Ivory Gull (SAR) these setbacks should be increased to 500m Pedestrians/ATVs and 750m for Roads/Construction/Industrial Activities.

For further advice on how to avoid incidental take or reduce risks to migratory birds and their nests and eggs, refer to the avoidance guidelines and frequently asked questions related to the protection of migratory bird nests and eggs as well as the

fact sheet “Planning Ahead to Reduce Risks to Migratory Bird Nests” at: http://www.ec.gc.ca/paom-itmb/

Recommendations:
Comments previously submitted regarding NIRB file 05MN047 related to migratory birds and species at risk still apply.