MEMORANDUM

To	**David Abernethy, INAC** **Sarah Forte, INAC**	File no	**TV154011**
From	**Jane Doucette, Chris Milley, Tracy Cochrane, Amec Foster Wheeler**	Copy	
Email			
Date	**June 21, 2016**		

Subject **Application for Amendment No. 1 to Nunavut Water Board Licence No. 2AM-DOH1323 and Nunavut Impact Review Board Project Certificate No. 003 Technical Review and Evaluation of *Aquatic Effects Management Plan*, Freshwater Component, and Proposed *Surveillance Network Program* Revisions – Option 3**
Doris North Project
Hope Bay, Nunavut

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler) was retained by Indigenous and Northern Affairs Canada (INAC) to carry out a technical review and evaluation of the Doris North Project Aquatic Effects Management Plan – Freshwater Component, and the Surveillance Network Program (SNP) for the Doris North Project submitted as part of the Application for Amendment No. 1 to the Nunavut Water Board (NWB) Licence No. 2AM-DOH1323 and the Nunavut Impact Review Board (NIRB) Project Certificate No. 003.

This work was carried out under Standing Offer Agreement 46-0000-1035, Call-up No. 1, Option 3. The scope of work is in accordance with the Statement of Work received from INAC (dated May 26, and Amec Foster Wheeler's quote dated May 30, 2016.

2.0 Background

The Doris North Project is owned by TMAC Resources Inc (TMAC). TMAC is applying to amend its NWB Type A Water Licence 2AM-DOH1323 and the NIRB Project Certificate 003. The amendment application will allow increased production rates, an increased mine size, changes to the management of tailings, the discharge of effluent reporting from the tailings impoundment area to the marine environment rather than to an approved creek, and other associated project changes.

Earlier phases in the amendment review process have included:

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Completeness Review submission, September 9, 2015
This preliminary phase was carried out to determine if additional information would be required to carry out the Technical Review phase of the application. Amec Foster Wheeler technical experts reviewed the water licence amendment application and relevant documents, and generated Information Requests (IR's) that were considered necessary to complete sufficient analysis.

Technical Review submission, December 8, 2015
The Technical Review phase of the review process involved an assessment of information presented in the water licence amendment application and the Information Request (IR) responses submitted by TMAC was carried out. Amec Foster Wheeler technical experts carried out the assessment to determine whether the measures proposed would be sufficient to protect the quality and quantity of freshwater from the mining project activities.

Technical Meeting, January 28-29, 2016
Amec Foster Wheeler participated in a technical meeting to discuss outstanding issues with INAC, TMAC and other stakeholders. During the meeting, a list of commitments to resolve remaining issues were made, and which would be carried forward to the Final Hearing.

3.0 Scope of Work

Together with other deliverables, the overall goal of Option 3 work is to provide support to INAC's review of the Proponent's water licence amendment application, and:

- Determine if activities identified in the application include mitigation measures that will protect the quality and quantity of surrounding freshwater sources;
- Determine if commitments made by the Proponent during the application review process to date are sufficient for the protection of surrounding freshwater sources; and
- Identify any outstanding issues pertaining to water management that need to be addressed.

The scope of work for this portion of the assignment was to carry out a review of the Aquatic Effects Monitoring Plan (AEMP) for freshwater discharge, and the Surveillance Network Program (SNP) for the Doris North Project, which was submitted to INAC in June 2016. The documents provided for this review are:

- 2AM DOH1323 Doris Aquatic Monitoring Workshop Pres 20160606
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part1-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part2-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part3-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part4-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part5-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix A_1of 3-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix A_2of 3-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix A_3of 3-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix B-IACE

- 150301 2AM-DOH1323 2014 Seepage Report-IACE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part1-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part2-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part3-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part4-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part5-IMLE
- 150505 2AM-DOH1323 Cover letter AEMP and Seepage Mon Report-IMLE
- 150505 2AM-DOH1323 Seepage2014_AppendixA_1 of 3-IMLE
- 150505 2AM-DOH1323 Seepage2014_AppendixA_2 of 3-IMLE
- 150505 2AM-DOH1323 Seepage2014_AppendixA_3 of 3-IMLE
- 150526 2AM-DOH1323 Email Distro 2014 AEMP and Seepage Monitoring Report-OACE
- 160601 2AM-DOH1323 A 1 Doris AEMP-IAAE
- 160601 2AM-DOH1323 Doris proposed SNP revisions w notes-IAAE

This review included Amec Foster Wheeler's participation in a workshop (via teleconference) on June 6-8, 2016. The purpose of the workshop was to afford TMAC an opportunity to present the Aquatic Effects Management Plan, Freshwater Component and proposed revisions to the SNP , and to be available to address questions or issues.

Other tasks that are included in the work for Option 3 include:

- A review of the Groundwater Management Plan and related documents;
- A review of the updated Tailings Management Plan and related documents;
- A review of the Interim Dike filter design trade-off study and detailed design of selected filtering method; and
- Preparation of a revised Reclamation Cost Estimate prepared by Amec Foster Wheeler Environment & Infrastructure in 2015.

Separate memos are being prepared for the other tasks.

4.0 Review of Aquatic Effects Monitoring Plan (AEMP) for Freshwater Discharge

4.1 General Comment

The document submitted to, and presented by TMAC at the workshop is entitled the Hope Bay Project, Doris Aquatic Effects Monitoring Plan (AEMP), June 2016. This plan is required as a submission under Part 7, Item K of the water licence.

As a result of the proposed changes under the licence amendment application, all mine and groundwater will be discharged into the marine environment. Proposed revisions to the AEMP for marine discharge were discussed in the Environmental Effects Assessment package of the water licence amendment No. 1 application.

Based on the results of discussions in an Aquatic Monitoring Workshop (AMW) held in March 2016, a revised AEMP for freshwater discharge was developed. The purpose of the revised plan is to assess the potential effects of Doris Mine activities on the freshwater environment, as the

proposed changes to the scope of the mining project will see expansion of the underground mine into the talik under Doris Lake.

4.2 Review of Content

The AEMP document provides information on the proposed changes to the mine plan. The document also presents potential changes to environmental effects as a result of the changes to the mine plan, and defines how these effects will be handled in terms of monitoring and surveillance, reporting requirements and response / alert levels.

Based on the review of the revised AEMP, Amec Foster Wheeler offers the following observations and recommendations:

1. **Downstream monitoring**: Under the revised AEMP, the Proponent proposes to eliminate water quality monitoring downstream from Doris Lake. However, the Proponent also states that water will be discharged directly into Doris Creek if the mine enters into Care and Maintenance, and the water quality meets minimum standards. In this situation there would be no water quality monitoring of effluent if the downstream monitoring points are removed. It is therefore recommended that the downstream monitoring points be maintained as part of a robust AEMP.

2. **Cross referencing with SNP Report:** It is recommended that the results from the two Doris Creek sample locations included in the SNP (TL-2 and 3) be included in the AEMP report with a discussion of temporal trends.

3. **Sediment sampling:** The proponent has removed sediment sampling in the revised AEMP. Considering that dust from mine tailings, roads and other aspects of mine operation will settle into the lake, it is recommended that sediment sampling be continued as an integral activity in the AEMP.

4. **Testing parameters:** It is recommended that all water samples be tested for sulphate and major ions in solution. Although these parameters are not typically regulated parameters, analysis of the major ions (e.g. Ca, Na, Cl) provides an opportunity to assess the quality of the data and identify potential matrix interferences that may not be noticeable otherwise (i.e., quality control). Sulphate analysis is recommended since it provides an indicator for sulphide oxidation.

5. **Reference point monitoring**: The proponent has removed the reference stations from the revised AEMP. While it is understood that reference lakes have provided some historical baseline information, removing the use of reference lakes undermines the potential for determining effects resulting from widespread environmental changes. It is, therefore, recommended that TMAC continue to use reference lakes as an integral activity in the AEMP.

4.3 Review for Outstanding Issues

Based on the earlier review phases of the amendment application documents (the completeness review and technical review), information requests (IR's) and technical comments (TC's) were generated. The IR's and TC's, and the responses provided by TMAC, have been tracked throughout the review process. The tracking table has been reviewed to determine if any IR's or TC's were outstanding:

TC4 – This technical comment stated the need for reviewing post-closure monitoring requirements for water flowing from Tail Lake to Doris Lake. However, the current water licence expires in 2023, prior to closure. It was noted that monitoring discharge to the freshwater environment after closure is a matter which should be addressed at the time of water licence renewal.

Based on the updated TMAC submission this issue is considered to be resolved.

5.0 Review of Surveillance Network Program (SNP)

Amec Foster Wheeler has reviewed the materials presented at the June 2016 workshop and offers the following observations and comments at this time:

1. The overall rationale for changing the SNP has not been fully explained. The proposed changes reduce the overall sampling strategy without providing sufficient detail on why sample sites have been removed or sampling frequency reduced.

2. Sampling at TL-5, ST-1, ST-2 has been eliminated – TMAC indicated that sampling in regard to the load balance model calibration it is being conducted under the Water Management Plan, but it has not been included in the June 2015 version of the WMP. TMAC has committed to providing a new WMP in Sept. 2016. It is not possible to determine the appropriateness of the sampling strategy at this time without the updated WMP.

3. TL-1 and 2: TMAC has reduced sampling to the construction phase only, and have removed sampling during operation and closure.
    a. Sampling should be required post-closure sometime before TIA water is discharged to Doris Creek. It is recommended that to ensure completeness in the monitoring strategy, sampling should be conducted at these locations should the project enter into Care and Maintenance.
    b. There is some concern that the removal of TL-1 during operations will reduce the robustness of the sampling strategy. It is important that sampling be conducted at the point where water can enter the marine outflow box before discharge to environment.

4. TL-3: Post-closure sampling frequency is only annual. It is recommended that sampling be conducted more frequently (several times per year) before and for a few years after TIA discharge to Doris Creek restarts.

5. TL-12: TMAC has removed this sample from the SNP and included it into the GWMP. Under this plan mine water will be sampled weekly for only 3 parameters (Cl, TDS, NO_3). It is recommended that sampling parameters be expanded as noted in our GWMP review memorandum.
6. It is recommended that all water samples submitted for inorganic testing include analyses for sulphate and major ions in solution. This provides an opportunity to assess the quality of the data and identify potential matrix interferences that may not be noticeable otherwise (i.e., quality control). Sulphate is an indicator for sulphide oxidation.

6.0 Summary

With respect to the review of the Aquatic Effects Monitoring Plan (AEMP) for Freshwater Discharge, the following conclusions are that:

- The activities identified in the application include acceptable monitoring measures that will facilitate protection of the quality and quantity of surrounding freshwater sources;
- In general, reasonable commitments have been made by the Proponent during the application review process, however for the protection of surrounding freshwater sources these commitments can be enhanced by additional attention to downstream monitoring, sediment sampling and cross referencing samples with a reference lake; and
- Amec Foster Wheeler has not identified any further outstanding issues pertaining to the AEMP that should be addressed at this time.

With respect to the review of the Surveillance Network Program (SNP), the following conclusions are that:

- Greater detail of the rationale for changes to the number of sampling sites and frequency of sampling in the revised SNP should be provided.
- The number of parameters analysed from samples should be increased to include sulphate and major Ions in solution for TL-12 and sites where samples are analysed for inorganic testing.
- Sampling of sites on Doris Creek should be conducted under Care and Maintenance and Post closure.