Mackenzie Valley Review Board

September 21, 2012

Note to File

EA1011-001
Avalon Rare Metals Inc., Thor Lake Rare Earth Element Project

To parites:

Re: Second round information requests

Please find attached second round information requests from the Mackenzie Valley Review Board directed to Avalon Rare Metals Inc. and Transport Canada.

The due date for responses to these information requests is **October 11, 2012**.

Correspondence related to this assessment should be directed to:
Paul Mercredi, Environmental Assessment Officer
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Sincerely,

(original signed by)
Paul Mercredi
Environmental Assessment Officer
Mackenzie Valley Review Board

IR Number: MVRB #2.01
To: Avalon Rare Metals Inc.
Subject: Modeled Concentrations vs. SSWQOs

Source:

DAR, Section 6.3.4.2 Mine Operations, Figure 6.3-6

DAR, Section 6.4.2.5 Model Results, Table 6.4-2

DAR, Appendix C.13, Thor Lake Project – (Updated) Feasibility Study Water/Solids Balance Analysis Results, p.3, Water Management Constraints

Response to Deficiency MVEIRB #41 (Part 2)

Response to Information Request MVRB #1.2, TMF Tracer Concentrations

Avalon handout in the Technical Session titled "Day 1 & 2 (Aug 14 & 15), Nechalacho, Thor Lake, SSWQO's", Table "Rare Earth Element Concentrations".

Avalon response to Technical Session Homework Items #4, #5, and #10.

Terms of Reference Section

3.3.2 Key line of inquiry: water quality

Impacts to Water Quality after mitigation and Avalon's last point of control

Both sites

> 19. For the local watershed and downstream water bodies (up to and including a reasonable local area after the confluence with Great Slave Lake), describe impacts to water quality and quantity from final effluent discharged to the environment during all phases of the Thor Lake Rare Earth Element Project life cycle, incorporating:
>
> > h. identification of the uncertainties and confidence levels in the predictions, the assumptions used, and the likely range of variation for the parameters identified.

Preamble

The table labeled "Rare Earth Element Concentrations" in the handout titled "Day 1 & 2 (Aug 14 & 15), Nechalacho, Thor Lake, SSWQO's" that Avalon presented during the Technical Session presents updated modeling results for the maximum concentrations of rare earth elements in Drizzle Lake and in Thor Lake over the life of the proposed mine and compares these results to Avalon's proposed Site Specific Water Quality Objectives (SSWQOs).

The table shows that the modeled concentrations exceed the values of the SSWQOs for cerium and lanthanum in Drizzle, Murky and Thor Lakes[1]. The modeled concentrations exceed or nearly equal Avalon's proposed SSWQOs for iron, mercury, neodymium, and praseodymium in Drizzle Lake (in addition to the cerium and lanthanum mentioned above). Mercury may also exceed the SSWQO in Drizzle Lake.

[1] The proposed SSWQO for thulium appears to be incorrect. When corrected, thulium would also exceed the SSWQO in Drizzle, Murky and Thor Lakes.

Request

a. Given the much higher concentrations in the corrected modeling results, please explain how Avalon intends to meet the proposed SSWQOs.

b. During Day 1 of the Technical Session (14 August 2012), Avalon said “They're actually concentrations selected from the approximate centre of the water body, and it's spatially resolved in horizontal and vertical. But there's so much wind mixing, I guess small amount of winds, that most of lakes were pretty well homogeneous in -- in plan view in terms of the concentration.” Please clarify the definitions of the Modelled Maximum 20-yr Values shown in the table. For example, should the reported values for Drizzle Lake be interpreted as a fully-mixed average value for the lake? Should the reported values for Drizzle Lake be interpreted as essentially equal to the values at the outlet from Drizzle Lake which will be assessed against the SSWQOs? Should the reported values for Thor Lake be interpreted as essentially equal to the values at the outlet from Thor Lake?

c. The modeling shows that the concentrations in the lakes increase over the proposed 20 year life of the mine. Please predict, by extended tracer modeling or other means, the rate at which the lakes will recover to background conditions after mining operations cease.

IR Number: MVRB #2.02
To: Avalon Rare Metals Inc.
Subject: Contribution of Mine Water to TMF Effluent Concentrations

Source:

Response to Technical Session Undertaking No. 1: Water Balance Flow Sheet, Average Precipitation Conditions (Years 1-20)

Technical Session transcript, Day 2, p.61ff.

Terms of Reference Section

3.3.2 Key line of inquiry: water quality

Thor Lake

Potential Pathways for Impacts to Water Quality from Project Components

For the locally impacted watershed and downstream water bodies (up to, and including a reasonable local area after, the confluence with Great Slave Lake) Avalon must:

1. Describe impacts to water quality from the following sources:

    b. mine water quality and quantity from interaction with underground operations;

Preamble

The water quality modelling does not appear to account for the contaminant load coming from mine water, an input which the water balance indicates contributes 157,700 m^3/yr to the TMF. The ground water quality results show a lot of variability, but overall there are large quantities of TDS, TSS, chlorides, sulphate, fluoride, aluminum, iron etc. The input of contaminants from groundwater should be factored into the water quality to provide a more accurate prediction of downstream water quality. The quantity of REE's in the groundwater should also be accounted for in the water quality model predictions.

The Technical Session transcript says "...the [5-day decant] numbers in the DAR that we [Avalon] used for the modelling that you saw in the DAR, and now -- of course now you see numbers that are next to that, those are and still remain to be the worst-case scenarios."

Request

a. Please provide concentration data for the constituents and water quality parameters of the mine water, including but not limited to TDS, TSS, chlorides, sulphate, fluoride, metals, explosive residues, and REEs.

b. Please clarify whether inputs from the mine water were used, simulated, or otherwise considered in the determination of the 5-day decant values. If so, how were the inputs used, simulated, or otherwise considered?

c. If not, please demonstrate that the 5-day decant concentrations used reflect the worst-case scenario for each constituent or parameter by providing a table comparing the expected concentrations in the mine water to the 5-day decant concentrations. If the expected

concentrations in the mine water were not determined from actual measurements, please describe how they were estimated.

IR Number: MVRB #2.03
To: Avalon Rare Metals Inc.
Subject: Chronic Toxicity Values and SSWQOs

Source:

Avalon Rare Metals Inc., *Response to the April 16, 2012 Clarifications Letter from Mackenzie Valley Environmental Impact Review Board for the Thor Lake Rare Earth Element Project Developer's Assessment Report*, 10 May 2012. Attachment 4 "Review of Aquatic Effects of Lanthanides and Other Uncommon Elements" by Tania Ng, D. Scott Smith, Anthony Straus and James C. McGeer, Wilfrid Laurier University, 2011,

Avalon handout in the Technical Session titled "Day 1 & 2 (Aug 14 & 15), Nechalacho, Thor Lake, SSWQO's", Table "Rare Earth Element Concentrations".

Avalon response to Technical Session Homework Items #4, #5, and #10.

Terms of Reference Section

3.3.5 Fish and aquatic habitat

Both sites

> 1. For Drizzle, Murky, Thor Lake and downstream water bodies (up to and including a reasonable local area after the confluence with Great Slave Lake) describe – incorporating seasonal variation - the impacts to fish, aquatic life and respective habitats from project-related changes to water quality, any changes to water quantity from project use, any introduction of contaminants to aquatic food chains from effluent discharge, project related changes to riparian areas, or other potential pathway(s) ...

Preamble

The table labeled "Rare Earth Element Concentrations" in the handout titled "Day 1 & 2 (Aug 14 & 15), Nechalacho, Thor Lake, SSWQO's" that Avalon presented during the Technical Session presents SSWQOs for 19 elements. The table footnote says "Based on 10% of 7-day (Chronic) LC-50 Testing H.azteca (Borgmann et al., 2005)". Table 5 of Attachment 4 in the 10 May 2012 response includes data for H. azteca attributed to Borgmann 2005. Some of the data do not match in the two tables.

Request

a. Thulium: The handout table shows an SSWQO for thulium (Tm) of 6.9 ug/L, implying a chronic toxicity value of 69 ug/L. The Wilfrid Laurier paper lists a toxicity value of 0.001 ug/L. Please correct the handout table or explain the basis for the proposed SSWQO.

b. Tantalum: The handout table shows an SSWQO for tantalum (Ta) of 0.2 ug/L, implying a chronic toxicity value of 2.0 ug/L. The Wilfrid Laurier paper does not list a H. azteca toxicity value for tantalum. Please explain the basis for the proposed SSWQO.

c. Scandium: The handout table shows an SSWQO for scandium (Sc) of 2.9 ug/L, implying a chronic toxicity value of 29 ug/L. The Wilfrid Laurier paper does not list a H. azteca toxicity value for scandium. Please explain the basis for the proposed SSWQO.

d. Hafnium: The handout table shows an SSWQO for hafnium (Hf) of 4.4 ug/L, implying a chronic toxicity value of 44 ug/L. The Wilfrid Laurier paper does not list a H. azteca toxicity value for hafnium. Please explain the basis for the proposed SSWQO.

e. Holmium: The handout table shows an SSWQO for holmium (Ho) of 0.7 ug/L, implying a chronic toxicity value of 7.0 ug/L. The Wilfrid Laurier paper lists a toxicity value of 143 ug/L. Please correct the handout table or explain the basis for the proposed SSWQO.

f. Zirconium: The handout table shows an SSWQO for zirconium (Zr) of 11.2 ug/L, implying a chronic toxicity value of 112 ug/L. The Wilfrid Laurier paper does not list a H. azteca toxicity value for zirconium. Please explain the basis for the proposed SSWQO.

IR Number: MVRB #2.04
To: Avalon Rare Metals Inc.
Subject: Surficial Geology

Source:

DAR, Appendix A.3, Figure 3

Terms of Reference Section

3.2.4 Description of the existing environment

Biophysical environment

Both sites

15. Terrain, surficial geology, structural geology, mineralogy, bedrock geology (type, depth, composition, and permeability), seismic activity records and risk factors, permafrost locations and types within the environmental assessment study area. In particular:

h. include maps, cross-sections and figures to illustrate geological features, where appropriate.

Preamble

The surficial geology map in DAR Appendix A.3, Figure 3 (Stantec 2010) shows the presence of various geologic materials as required in the TOR. However there are several abbreviations for rock and surficial deposit types that are not described in the explanation. For example General Rock groupings C, R and M, and Surficial Expression types j and p are not explained in the figure key.

Request

Please provide an explanation of the abbreviations for all rock and surficial deposit types in DAR Appendix A.3, Figure 3.

IR Number: MVRB #2.05
To: Avalon Rare Metals Inc.
Subject: Groundwater Elevations and Drawdown Effects

Source:

DAR, Section 2.7.1.2, Groundwater Level Measurements (Nechalacho Mine Site)

DAR, Section 2.7.2.2, Site Hydrogeology (Hydrometallurgical Plant Site)

DAR, Section 6.5.1.2, Groundwater Inflow Model

DAR, Figure 6.5-1, Predicted Groundwater Drawdown due to Mine Dewatering

Terms of Reference Section

3.2.4 Description of the existing environment

Both sites

7. Hydrology and hydrogeology, including surface water and groundwater amounts, direction of flow, likely surfacing points/discharge area (for groundwater), and maps and descriptions of associated watersheds, both in the local area of the project site as well as downstream until the confluence with Great Slave Lake. Discussion should focus in particular on:

j. a water table elevation map and a map detailing drainage patterns for surface and groundwater for both project sites, and mine workings.

3.3.2 Key line of inquiry: water quality

Thor Lake

Other Potential Pathways for Impacts to Water Quality

8. Describe effects to the local water table. Include a discussion of:

c. the effects from groundwater loss through inflows to the underground mine;

d. any other mechanisms for groundwater loss to occur, as well as changes to groundwater flow regimes;

e. how the above changes may affect the refresh rates for Drizzle, Murky, Egg and Thor Lakes and other lakes in the vicinity of the mine site these changes may potentially affect;

f. how the above changes may contribute to changes in local permafrost and active layers; and

g. how the above changes may translate into surface water impacts, groundwater impacts or effluent water quality.

Preamble

A groundwater map for the mine site has not been provided in accordance with the TOR requirements. DAR Section 2.7.1.2 indicates that only seven locations were used for groundwater level measurements at the Nechalacho Mine Site.

DAR Section 6.5.1.2 describes the modeling for the groundwater inflow into the underground mine and states "Groundwater inflow was modeled by Knight Piésold (2011f) using Visual MODFLOW software. The model was run in steady state. Boundary conditions included: constant head cells for nearby lakes, recharge boundaries for precipitation at surface and drain cells for the proposed underground workings".

Figure 6.5-1 shows groundwater drawdown in excess of 10 m as a result of mine dewatering and a significant area shows drawdown in excess of 2 m. The drawdown contours are clearly affected by the presence of Long Lake, North Tardiff Lake, and South Tardiff Lake. Because these lakes are either small or narrow, the assumption of constant head may not hold.

Request

a. Please provide a groundwater contour map of the Nechalacho mine site using available well, boring, seep, or surface water elevations as appropriate.

b. Please justify the constant head assumption for the lakes which drain into the mine. It would be useful to have estimates of the predicted flow quantities from the lakes and a comparison to existing inflow, outflow, precipitation, and evaporation data, i.e. current and predicted water balances for the potentially impacted lakes.

c. The magnitude and areal extent of the drawdown is apt to dewater shallow water bodies, wetlands, or other saturated environments. Please indicate the extent of the predicted dewatering, how the above changes may contribute to changes in local surface water bodies, wetlands, permafrost or active layers; and how the above changes may translate into surface water impacts, groundwater impacts or water quality impacts.

IR Number: MVRB #2.06
To: Avalon Rare Metals Inc.
Subject: Long Term Effects of Paste Backfill on Groundwater Quality

Source:

DAR, Section 6.5.1.5 Groundwater Quality

Response to Deficiency MVEIRB #37 (Part 2)

Technical Session transcript, Day 2, p. 46.

Golder Associates, *Report on Feasibility Study for Paste Backfill, Avalon Rare Metals* (Draft), 30 July 2012.

Terms of Reference Section

3.3.2 Key line of inquiry: water quality

Thor Lake

Potential Pathways for Impacts to Water Quality from Project Components

1. Describe impacts to water quality from the following sources:

    c. interaction of water with paste backfill and resulting effects to water quality;

Preamble

Avalon has stated that "Any water interaction with the paste is expected to make the pH slightly basic during the short time needed for the paste backfill to harden." and "it will be essentially inert and is not expected to affect the existing or future groundwater quality". The Review Board was unable to find chemical test results or detailed analysis of geochemical reactions that support these statements.

During Day 2 of the technical session, Avalon was asked to provide information on the constituents and physical characteristics of the paste backfill, the chemical composition of the pore water, and the amount of bleed water.

The Golder Associate draft feasibility study contains information on the physical characteristics of the paste backfill, but not the chemical characteristics. This information is needed to assess potential impacts on groundwater.

Request

a. Please provide or confirm the the chemical characteristics of the paste backfill pore water and the amount of bleed water per ton of solids.

b. Based on the results, please present a discussion of the chemical interactions that are predicted to occur between the paste backfill and the existing groundwater. The analysis should present support for statements regarding the short term and long term interactions and effects on water quality.

IR Number: MVRB #2.07
To: Transport Canada
Subject: Barge Incidents

Source:

Avalon Day 3 Technical Session Transcripts

Terms of Reference Section

3.5 Accidents and malfunctions

2. Describe and predict the potential impacts to the local water quality of Great Slave Lake from concentrate spillage at both barge loading/unloading sites, both in the short term and over the life of the mine.

4. Describe consequences of accidents, malfunctions, or "impacts of the environment on the development" that may affect water quality and quantity and the ability of the water management system to function. For both sites the following scenarios, at a minimum, will be considered:

h. potential impacts to water from tailings spills or leaks;

i. potential impact to any valued components from any spill of any product.

6. Conduct a best-practice risk assessment for the project, exploring the potential for events listed in points 1 through 5. Discuss systems, components, hazards and associated failure modes. The developer will assess likelihood and severity of each risk identified from the points 1-5.

7. Describe the impacts of any other potential accidents or malfunctions not listed here.

Preamble

Several potential barge accident or malfunction scenarios other than sinkings could have negative impacts on water quality or other valued components. To assess the likelihood of such scenarios, a review of the past record of barge incidents is warranted.

Request

Please provide statistical information on past barge incidents in Great Slave Lake or other representative areas, including but not necessarily limited to cargo spills, fuel spills, collisions, groundings, and hull leaks.