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MVEIRB File Number: EA1011-001

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Re: Technical Report – Avalon Thor Lake Project – EA1011-001

Aboriginal Affairs and Northern Development Canada (AANDC) is pleased to submit the attached technical report to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) on the proposed Avalon Thor Lake Rare Earth Element Project – EA1011-001.

AANDC would like to thank the Board for the opportunity to present our technical review of the proposed Avalon Thor Lake Mine. The Department looks forward to presenting its technical intervention at the upcoming public hearings.

If you have any questions about this technical report, please do not hesitate to contact Mr. Nathen Richea at (867) 669-2657 or Nathen.Richea@aandc.gc.ca or Mr. Paul Green at (867) 669-2402 or Paul.Green@aandc.gc.ca.

Sincerely,

Robert Jenkins
A/Director
Renewable Resources and Environment
NWT Region

ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT
CANADA
TECHNICAL REPORT

for

AVALON RARE METALS INC.
PROPOSED THOR LAKE RARE EARTH ELEMENT PROJECT
EA1011-001

November 29, 2012

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ACRONYMS

Aboriginal Affairs and Northern Development Canada	AANDC
Aquatic Effects Monitoring Program	AEMP
Best Available Treatment Technology	BATT
Canadian Council of Ministers of the Environment	CCME
Closure and Reclamation Plan	CRP
Contaminants of Potential Concern	COPCs
Developer's Assessment Report	DAR
Environmental Assessment	EA
Effluent Quality Criteria	EQC
Initial Dilution Zone	IDZ
Mackenzie Valley Environmental Impact Review Board	MVEIRB
Mackenzie Valley Land and Water Board	MVLWB
Mackenzie Valley Resource Management Act	MVRMA
Metal Mining Effluent Regulations	MMER
Northwest Territories	NWT
Northwest Territories Waters Act	NWTWA
Site Specific Water Quality Objective	SSWQO
Tailings Management Facility	TMF
Water Quality Objective	WQO

NON TECHNICAL SUMMARY

Aboriginal Affairs and Northern Development Canada (AANDC) has legislated responsibilities for water management and protection that stem from the *Northwest Territories Waters Act* (NWTWA). AANDC provides expert technical advice to regional resource management boards and is a Responsible Minister under the *Mackenzie Valley Resource Management Act* (MVRMA).

AANDC conducted focused reviews on water related aspects of the project. This review included all documentation related to the Environmental Assessment of Avalon's proposed Thor Lake Project up to and including the responses to the second round of Information Request responses dated October 31, 2012.

In this report, AANDC provides specific comments on the following three topics:

1. Site Specific Water Quality Objectives (SSWQOs)
2. Aquatic Effects Monitoring Program (AEMP)
3. Closure and Reclamation

Where possible, AANDC has provided recommendations to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) to assist in its decision making process and in the preparation of the Report of Environmental Assessment.

INTRODUCTION

AANDC has a mandated responsibility to protect the environment and promote sustainable development in the Northwest Territories. AANDC's legislated responsibilities for water management and protection stem from the *Northwest Territories Waters Act* (NWTWA). AANDC provides expert technical advice to regional resource management boards and is a Responsible Minister under the *Mackenzie Valley Resource Management Act* (MVRMA).

In our departmental capacity as an expert advisor, AANDC has completed a technical review of water related components of the documents submitted as part of the Environmental Assessment (EA) for Avalon's proposed Thor Lake Rare Earth Element Project. Within this technical report, AANDC will discuss its concerns and present recommendations regarding:

1. Site Specific Water Quality Objectives (SSWQOs)
2. Aquatic Effects Monitoring Program (AEMP)
3. Closure and Reclamation

In conducting our review, AANDC participated in one round of information requests, one technical session, and several meetings directly with the proponent, in an attempt to resolve issues identified herein.

Where possible, AANDC has provided recommendations to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) to assist in its decision making process. The Department respectfully requests that all its recommendations be placed as measures within the Report of Environmental Assessment.

Site Specific Water Quality Objectives

Issue:

Avalon has proposed Site Specific Water Quality Objectives (SSWQOs) for the Thor Lake Project, as described in several documents, most recently in Table 1 in the October 31, 2012 response to information requests submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB).

The proposed SSWQOs are of two types:

- A combination of background concentrations and Canadian Council of Ministers of the Environment (CCME) guideline values for the protection of aquatic life for more common parameters such as metals, ions and nutrients, where available; and
- Toxicity based values for the rare earth elements.

The SSWQOs are to apply at the outlet from Drizzle Lake.

References:

1. Developer's Assessment Report (DAR) Section 6.4;
2. IR Responses: AANDC #1, AANDC #31;
3. SSWQO for Metal, Nutrients, Major Ions and REE as presented at the Technical Sessions, August 14 & 15, 2012;
4. Response to the September 2012 Round 2 Information Requests from the Mackenzie Valley Review Board for the Thor Lake Rare Earth Element Project Developer's Assessment Report, October 2012; and,
5. Response to the October 26, 2012 Round 2 Information Requests from the Mackenzie Valley Review Board for the Thor Lake Rare Earth Element Project Developer's Assessment Report (EA1011-0001), October 31, 2012.

Developer Conclusion:

Avalon has made the following "commitments" related to SSWQOs for the Thor Lake Project:

- The proposed SSWQOs will be met at the outlet of Drizzle Lake; and
- Avalon will treat the effluent from the TMF, if required, in order to meet the SSWQOs at the outlet of Drizzle Lake.

Avalon stated that if the effluent concentration in the Tailings Management Facility (TMF) final discharge is approximately 3 times (or more) above CCME guidelines or proposed SSWQO's, then treatment will be required. AANDC assumes this cut-off is

based on the expected buffering capacity of Drizzle Lake. Avalon has identified that there will be approximately 1 year of storage in the TMF before effluent will first be discharged, which is sufficient time to determine if treatment of the final effluent will be required to meet the proposed SSWQOs.

Avalon has proposed potential water treatment processes that could be used to treat effluent which is to be released from the TMF if regulatory limits or SSWQOs are not being consistently met. SSWQOs for parameters that are typically higher under ice are to be developed for specific seasons using seasonal background information.

Review Conclusion:

AANDC views SSWQOs, as the “Standard for Water” which should be maintained in order to preserve the present and future integrity and uses of an aquatic ecosystem.

The water management scheme proposed for the Thor Lake Project has evolved over the course of the Environmental Assessment (EA). AANDC remains concerned that effluent quality over the life of the mine may degrade if pre-treatment of process water for the Flotation Plant and operational controls in the TMF are solely relied upon to mitigate Contaminants of Potential Concern (COPCs) during operations. However, Avalon has committed to meeting SSWQOs at the outlet from Drizzle Lake, and has also committed to implementing treatment in the event that monitoring indicates that the SSWQOs may not be met (Avalon Response to the October 26, 2012 Round 2 Information Requests, October 31, 2012).

To this end, AANDC’s conclusion is that Avalon’s commitments should be adopted as measures of this EA. Further, AANDC provides additional recommendations regarding monitoring and assessing change and trends in the receiving environment during operations to ensure conditions do not cause harm to aquatic organisms over time. AANDC believes including these commitments as measures of the EA will mitigate the potential for this project to have adverse effects on the receiving environment.

Rationale:

SSWQOs and EQC

Terms commonly used in the context of mine effluent discharge include: WQOs or SSWQOs and Effluent Quality Criteria (EQC). EQC represent a regulatory limit that applies at a company’s last point of control, which is typically the end of the effluent discharge pipe. AANDC acknowledges that numerical EQC will be determined by the Mackenzie Valley Land and Water Board (MVLWB) during the water licensing processes. However, SSWQOs should consider both environmental and social factors and be addressed during the EA process.

AANDC agrees with the proponent that SSWQOs for rare earth elements needed to be specifically derived for the project. However, the Department believes that reasonably achievable concentrations (considering requirements for operational flexibility) should be considered in lieu of automatically defaulting to a toxicity derived concentration.

AANDC also agrees with the proponent that the adoption of CCME generic WQOs could be acceptable as objectives for more common parameters (i.e. metals- except cadmium, iron, zinc & mercury; nutrients; and, major ions). However, the Department feels this should be on a “provisional” basis, pending the results of aquatic monitoring data and impact assessments. In this instance, the national guidelines become the “standard” for water protection in the downstream receiving environment (i.e. National standard values are adopted as “provisional” SSWQOs). However, in-line with the CCME non-degradation policy, these values should not be relied upon as “pollute-up-to” limits.

AANDC has added mercury to the list of metals above as the Department is concerned strictly adopting the CCME guideline value. AANDC recommends that the SSWQO for mercury should be specifically derived for the site, as CCME guidelines only consider exposure of the contaminant to aquatic organism (i.e. toxicity based assessments). It is well known that mercury may cause impacts through pathways other than direct aquatic exposure. Mercury has the potential to bioaccumulate and biomagnify in aquatic organisms and toxicity based assessments do not account for these factors. The accumulation of mercury in fish tissue downstream of the TMF is a concern as this could interfere with downstream uses. AANDC acknowledges that deriving a SSWQO for mercury will likely require additional baseline sampling in Drizzle, Murky and Thor Lake using lower detection limits.

AANDC's position regarding SSWQOs above is based on both national and NWT specific documents. These documents include: the NWT Water Strategy, the Mackenzie Valley Land and Water Board Water and Effluent Quality Management Policy, and, documents produced by CCME (1991; 2003).

Drizzle Lake and the Downstream Environment

Drizzle Lake will be the immediate receiving environment as mining effluent will be discharged from the TMF to the northern portion of the lake. Drizzle Lake is shallow with an area of 455,993 m² and a total volume of 622,734 m³. The existing catchment is limited, and parts of it have been removed by the mine and water/tailings management facilities. The most updated water balance suggests that mining effluent discharge will be 321,300 m³/yr (Knight Piesold Memo, August 23, 2012).

AANDC has reviewed the mixing model that was prepared by the company to assess how concentrations of contaminants would behave as they move through Drizzle,

Murky, Thor Lake and beyond. AANDC notes that the model was prepared when the plan was to include a polishing pond between the TMF and Drizzle Lake and the volume of mine effluent discharge was 148,300 m³/yr. Comparing the updated effluent discharge volume to the volume of Drizzle Lake suggests that, over time, water quality within Drizzle Lake will slowly be overcome by water discharged by the TMF. As a result, the mine effluent discharge will reduce the buffering capacity of Drizzle Lake. Therefore, Drizzle Lake will likely not provide the 3-4:1 mixing ratio presumed in recent information provided by the company (Avalon Response #1, October 31st, 2012). Consequently, the need to implement water quality enhancements or a water treatment facility may be required following the first several years of operation.

AANDC acknowledges that the company has suggested that the edge of the mixing zone should be the outlet of Drizzle Lake. National guidance on mixing zones suggests the extent of the zone should be limited in spatial extent (CCME, 2003). However, as discussed above concentrations within Drizzle Lake will become representative of the TMF over time. Thus, the condition and quality of water in Drizzle Lake will represent what will be moving through at the outlet and into the downstream receiving environment. AANDC agrees the edge of the mixing zone or Initial Dilution Zone (IDZ) could be the outlet of Drizzle Lake. However, the concentrations within Drizzle Lake must be monitored to assess changes and trends over time. This is essential as it will provide early warning in the event that SSWQOs can no longer be met at the Drizzle Lake outlet. Assessing monitoring results and trends within Drizzle Lake must be used to trigger effluent quality enhancement including implementing water treatment, as committed to by the company in response to the MVEIRB Information Request (Avalon Response to the October 26, 2012 Round 2 Information Requests, October 31, 2012). Similarly, water quality within the TMF must also be monitored and trends assessed to provide an early indication of whether effluent would require treatment (Avalon Response to the October 26, 2012 Round 2 Information Requests, October 31, 2012).

Flotation Plant Treatment and the TMF

AANDC remains concerned with the ability of Avalon's reliance on the pre-treatment process and TMF to maintain effluent concentrations of sufficient quality to achieve SSWQOs over the life of mine (MVEIRB Round 2 Information Requests, September 2012 & October 2012; Avalon Responses to September & October Round 2 Information Requests, October 2012 & October 31, 2012). AANDC understands that optimization of the flotation process and TMF is ongoing and Avalon is confident that the final concentrations of contaminants of concern will be sufficient to meet objectives at the Drizzle Lake outlet. Avalon does not believe that a water treatment facility is required to meet these proposed objectives but insists that if objectives are not met water treatment will be implemented.

AANDC recommends improving our understanding of plume mixing behavior in Drizzle

and Murky Lakes as well as concentrations of contaminants within the TMF during operations. This will provide an enhanced understanding of potential deviations from the projected effluent quality and the resultant downstream impacts of effluent discharge. This monitoring and assessment should be required as a measure of the Report of EA to ensure that Avalon's commitment to meeting objectives is maintained for the life of the project.

Based on the above, AANDC makes the following recommendations regarding SSWQOs for the proposed Thor Lake Project:

RECOMMENDATION #1

AANDC recommends that the outlet of Drizzle Lake should be the assessment boundary or Initial Dilution Zone (IDZ) boundary. All SSWQOs should be met at this location.

RECOMMENDATION #2

AANDC recommends that water quality in TMF, Drizzle Lake and Murky Lake be monitored year round to assess the average condition and trends during open water and under ice. Comparisons should be made to Environmental Assessment concentrations and predictions to assess changes in water quality. If trends indicate the proposed SSWQOs will not be achieved, water treatment options should be implemented.

RECOMMENDATION #3

Dissolved oxygen and metal concentrations under ice must be regularly assessed to ensure they do not become harmful to aquatic life in Drizzle, Murky and/or Thor Lake.

RECOMMENDATION #4

During operations, if conditions in the receiving environment become detrimental to aquatic organisms (particularly during winter), mitigation options must be implemented. Potential mitigations should include but not be limited to effluent treatment, additional water storage to curtail winter discharge volumes and rates, and/or aeration of downstream lakes.

RECOMMENDATION #5

AANDC recommends that the Report of EA should include narrative statements

that describe the level of protection to be afforded to the aquatic receiving environment in Thor Lake. These statements could include:

- Water quality changes due to mining activities will not significantly affect benthic macro-invertebrate and plankton abundance, taxonomic richness or diversity.*
- Water quality changes due to mining activities will not significantly alter fish abundance or diversity or fish consumption at current levels.*
- Water quality changes due to mining activities will not negatively affect areas utilized as traditional drinking water sources.*
- Water quality changes due to mining activities will not significantly affect mammals or wildfowl using the area as a drinking water, food source or habitat, or the current ability for people to harvest these animals.*

RECOMMENDATION #6

AANDC recommends that SSWQOs for cadmium, iron, zinc and mercury should be set based on background concentrations and, where appropriate, include consideration of seasonality. SSWQOs for Rare Earth Elements should be set at the limits proposed by the company unless further investigation and assessment of toxicity becomes available during the life of mine. SSWQOs for other parameters should be “provisionally” based on CCME Guidelines for the Protection of Aquatic Life or future updates to such guidelines. All SSWQOs should be assessed during operations to ensure that the level of protection as described in Recommendation #5 is maintained.

RECOMMENDATION #7

AANDC recommends that loading limits be evaluated, and if necessary established, if impacts to the downstream environment are driven by both contaminant concentrations and loadings.

Aquatic Effects Monitoring Program (AEMP) and Adaptive Management

Issue:

An aquatic effects monitoring program will be developed for the project, however, Avalon has not clearly committed to following AANDC's Aquatic Effects Monitoring Program Guidelines (2009).

References:

1. DAR Section 6.14.1: Aquatic Effects Monitoring;
2. IR Responses: AANDC #7, AANDC #8.

Developer Conclusion:

Water quality and biological monitoring will be carried out according to the requirements of the water licence and the Metal Mining Effluent Regulation (MMER). The conceptual AEMP will be subject to engagement activities with a number of interested parties and stakeholders.

Reviewer Conclusion:

AANDC agrees with the Developer that an AEMP is required for the Thor Lake Project, and is encouraged the Developer has indicated a willingness to work with interested parties to develop a suitable monitoring program. Although monitoring under the MMER is required by regulation, it represents the minimum legal standard for monitoring at northern mine sites. AANDC has developed the "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories – 2009" (AEMP Guidelines) which the Department recommends should be used for developing an AEMP at the Thor Lake Project. An AEMP developed using these guidelines would include the requirements of the MMER, and would not result in duplicate, parallel monitoring programs. Furthermore, the AEMP would require incorporation of Traditional Knowledge and stakeholder input into the program design.

Rationale:

AANDC believes that its AEMP Guidelines provide a solid basis for first identifying the potential for and then monitoring for project related effects on the downstream receiving environment. This first goal is critical to the AEMP design and is directly related to the effects assessment that is developed in the Environmental Assessment (EA). The AEMP Guidelines clearly outline the importance and mechanisms for incorporating Traditional Knowledge in an effective manner. Further, AANDC's AEMP Guidelines detail how the monitoring program and its results must feed into an Adaptive

Management loop, or what is referred to as a Management Response Framework. This requires that monitoring information addresses questions related to potential changes and impacts which then are assessed against effects and action levels. These key aspects are intended to streamline the AEMP development process and ensure that all interests and needs are effectively met.

AANDC's AEMP Guidelines define an eight-step process for designing and conducting monitoring of the water environment. This step-by-step process is referred to as the AEMP framework. AANDC believes that this framework should be followed during the development of the final AEMP for the Thor Lake Project.

STEP 1: IDENTIFICATION OF ISSUES AND CONCERNS

The first step in the AEMP development process involves identifying issues and concerns regarding the water environment that Aboriginal governments/organizations and interested parties may have about a development project. By asking for input from all interested parties at this stage, a preliminary list of stressors that may be of concern is documented and the Developer can make changes to the project description while considering the issues and concerns. This process would include formulating appropriate statements about the acceptable level of change in the downstream environment as a result of the project.

STEP 2: PROBLEM FORMULATION FOR AQUATIC EFFECTS MONITORING

During the second step, the final list of possible stressors is completed, and then each stressor is looked at to see if it could have effects on the water environment or human health. Next, the ways a stressor can affect the water environment need to be determined (such as elevated levels of a chemical changing the quality of the water). The parts of the water environment that could be affected, such as fish, plants, birds, sediment, water quality, need to be recorded. These are called receptors. Diagrams are prepared that show how each stressor is linked to parts of the water environment that could be affected. These diagrams are called conceptual site models. These models are then used to identify the parts of the water environment that need to be protected and what will be measured to determine if the water environment is being adequately protected.

STEP 3: DEVELOPMENT OF DATA QUALITY OBJECTIVES AND CONCEPTUAL STUDY DESIGN

This step of the process identifies the important parts of an AEMP and helps determine what the monitoring program will look like. This step also determines what types of information and how much data are needed to evaluate the effects of the development project on the water environment. The levels of stressors that would

harm the water environment (called Action Levels) are identified. The data quality objectives also describe how the AEMP results will be used to determine if the development project has caused negative effects on the water environment.

STEP 4: DEVELOPMENT OF DETAILED AEMP DESIGN

Step four in the AEMP development process builds on the conceptual study design to develop a detailed AEMP design through:

- Selection of an appropriate monitoring program design;
- Selection of sampling locations;
- Confirmation of appropriate effects sizes;
- Determination of necessary sample sizes; and,
- Identification of appropriate sampling frequencies.

A variety of design options are available for AEMPs in the NWT. All of these designs rely on comparison of data collected in an exposed area(s) (i.e., impacted areas) to data collected in an unexposed area (i.e., reference area).

STEP 5: DOCUMENTATION AND VERIFICATION OF THE SAMPLING DESIGN

Various plans will be prepared during this step to describe the procedures to be followed by the people conducting field sampling since it is important that the data is collected properly. There will be specific guidance for all field work (to collect high quality data and information), and a plan to make sure the people collecting samples or visiting the site take all safety precautions necessary. Changes to any of these plans by the Developer should be reviewed by interested parties and approved by the regulatory boards.

STEP 6: IMPLEMENTATION OF THE AEMP

This step begins following the approval of the AEMP by the regulatory board. It involves the collection of environmental samples, Traditional Knowledge, and other information and the analysis of the results to produce data (for example, laboratory measurements for water quality data). The plans developed in Step 5 must be carefully followed for all types of data and information collection.

STEP 7: EVALUATION, COMPILATION, ANALYSIS, INTERPRETATION AND REPORTING OF AEMP RESULTS

Once data and information have been collected under the AEMP (both Traditional Knowledge and western science based), it needs to be evaluated, compiled, analyzed, interpreted and reported by the Developer. This data is compared to

baseline data to see if there are changes.

STEP 8: APPLICATION OF AEMP RESULTS WITHIN A MANAGEMENT RESPONSE FRAMEWORK

Management response, also commonly known as adaptive management, is a way to continually improve the management of the development project by learning from the information collected year after year by the AEMP. For example, the results of the AEMP could lead to a change in the amount or location of waste that is released from a development project, if the AEMP results show that a certain chemical being discharged had a negative effect on the water environment.

AANDC provides the following recommendation in regards to aquatic effects monitoring and adaptive management, and looks forward to working with the Developer and other interested parties in designing a comprehensive and appropriate AEMP and Management Response Framework for the Thor Lake project.

Recommendation #8

AANDC recommends that Avalon be required to follow the “Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories, June 2009” in the development of its Aquatic Effects Monitoring Program, effects levels, action levels or triggers, and related Management Response Framework for the Thor Lake Rare Earth Element Project.

Closure and Reclamation

Issue:

At the end of mining there will be two operating sites requiring closure; the Nechalacho Mine site and the Pine Point Metallurgical site. Both sites will require decommissioning of buildings and infrastructure including the Tailings Management Facilities.

References:

1. DAR Section 6.1.1.6; Section 10.6.3 and Section 11 Closure and Reclamation;
2. List of Commitments, DAR Table, pp. xxxv
3. Technical Session Discussions Day 2 & 3, Aug. 15 & 16, 2012
4. IR AANDC_32, IR AANDC_33, IR AANDC_34, IR AANDC_35.

Developer Conclusion:

Reclamation planning is an integral component of a sound environmental management system for any development. Avalon has committed to achieving a number of goals for the progressive reclamation of the development area following closure of the Project (see Commitment Table included in the DAR). The goals for reclamation will be consistent with AANDC's guidelines for closure and reclamation for mines.

Regarding reclamation of mining facilities, closure and reclamation of all the Nechalacho Mine, Flotation Plant and Hydrometallurgical Plant facilities will be conducted in accordance with the terms and conditions of the future MVLWB Land Use Permit and Water License, the "Mine Site Reclamation Policy for the Northwest Territories" and the "Mine Site Reclamation Guidelines for the Northwest Territories and Nunavut" (Commitment # 64)

Regarding post-closure monitoring, monitoring will be limited to evaluating the success of the re-vegetation effort. Post-closure monitoring for re-vegetation success is envisioned to be conducted the 1st and 5th year post closure (Commitment # 68).

Reviewer Conclusion:

AANDC's position on closure and reclamation related issues are based upon the "Mine Site Reclamation Policy for the Northwest Territories, Indian and Northern Affairs Canada, 2002". This policy was developed in response to a number of insolvencies and abandoned mine properties for which the Crown assumed environmental liability of the sites. The Policy describes the Department's expectations regarding mine site

reclamation and forms the basis of a second document, AANDC's Mine Site Reclamation Guidelines for the Northwest Territories.

Several of the principles contained within the Reclamation Policy are of particular importance for the proposed Thor Lake Mining Project, including the following:

"Following mine closure, mining companies or their future owners should continue to be responsible for the site, including the remediation of any additional environmental complications which develop."

"The total financial security for final reclamation required at any time during the life of the mine should be equal to the total outstanding reclamation liability for land and water combined"

"The required standard of reclamation should be based on the 1994 Whitehorse Mining Initiative definition: "returning mine sites and affected areas to viable and, wherever practicable, self sustaining ecosystems that are compatible with a healthy environment and with human activities.""

Rationale:

AANDC's primary concerns related to the closure of the proposed Thor Lake Mining Project relate to the post-closure water quality and tailings covers at both the Nechalacho Mine Site and the Pine Point Hydrometallurgical Site. One of the proponent's reclamation goals is to establish conditions that lead to acceptable long-term physical and chemical stability of all reclaimed areas. In addition, the proponent correctly noted that the site and site facilities should be designed for closure (Technical Session Transcripts, Day 3). AANDC notes that there were several commitments made by the company regarding closure cover designs and contingencies during the technical sessions.

However, AANDC believes that there is a lot of work to be done to ensure that designs are appropriate to ensure the sites can be closed to these standards. The interaction between surface water pools, marshes and wetlands, the tailings, and the covers need to be further developed to determine if they can meet physical and chemical stability goals. To provide assurance that these goals will be met, operational monitoring and reclamation research is required during the early years of operation. This monitoring and research will identify if there are any difficulties or issues with the proposed strategies. AANDC believes that Avalon must ensure that the percent saturation of tailings (i.e. water/solid content) is stable and that the tailings are trafficable such that a cover can be placed as part of reclamation (note, specific technical concerns and potential issues will be different between the Nechalacho Site and Hydrometallurgical Site due to respective tailings consistency and percent water in the discharge slurries).

Further, water quality monitoring will be required post closure to assess the impacts of potential seepage and release of water from these facilities over time. Upon questioning at the technical sessions, the company indicated it would conduct post closure monitoring for 5 years. However, AANDC's closure guidelines require that the performance of the covers and site reclamation must be demonstrated through data collection as part of closure Performance Assessments. The requirement for Performance Assessments is outlined in AANDC's Mine Site Reclamation Guidelines. The results of these assessments will determine if there is a need to enhance the closure of certain facilities but also determine the overall length of the post closure monitoring period. Monitoring must occur until the company can demonstrate that closure goals, objectives and criteria are achieved and will be maintained over time.

Regarding post closure monitoring at the Pine Point Hydrometallurgical Site, groundwater monitoring may be required for several years following completion of mining operations. This is due to the slow movement of the Presqu'île Aquifer which is the proposed discharge location of the tailings water. The proponent has used a model to predict groundwater movement and mixing. This model suggests that it will take up to approximately 80 years for the tailings water plume to reach Great Slave Lake. AANDC notes that these predictions suggest that the concentrations of the tailings effluent plume will dissipate and become non-recognizable from the natural Presqu'île Formation water over time. However, to detect if water quality concentrations in the Presqu'île Aquifer are in line with model predictions the proponent has committed to monitoring the tailings effluent plume during operations. If conditions deviate from the model the proponent has indicated it would conduct mitigation.

In considering these points, AANDC makes the following recommendations regarding the proposed closure scenario Thor Lake Project:

RECOMMENDATION #9

AANDC recommends that the closure goal for the Nechalacho Mine Site and Pine Point Hydrometallurgical Site be based on the 1994 Whitehorse Mining Initiative definition: returning mine sites and affected areas to viable and, wherever practicable, self sustaining ecosystems that are compatible with a healthy environment and with human activities.

RECOMMENDATION #10

AANDC recommends that the company be required to place tailings covers during the winter and design them sufficiently to maintain long-term stability, including during summer thaw periods, for both the Nechalacho and L-37 tailings facilities.

RECOMMENDATION #11

AANDC recommends that the company be required to monitor tailings during operations within the L-37 tailings facility to confirm saturation levels and ensure trafficability for closure and placement of a cover.

RECOMMENDATION #12

AANDC recommends that the company be required to implement monitoring during operations to verify the modeling predictions of the effluent plume downgradient of the L-37 tailings facility, assess the modeling parameters and initiate mitigation, if required.

RECOMMENDATION #13

AANDC recommends that the proponent be required to conduct post closure monitoring and maintenance until such time as closure goals, objectives and criteria are achieved and maintained.

CONCLUDING REMARKS

Avalon is proposing the development of a Rare Earth Element mine, situated at Thor Lake in the Northwest Territories (referred to as Nechalacho Mine site). AANDC has conducted a technical review of the water related aspects of the proposed project. Where possible, AANDC has provided recommendations to the Mackenzie Valley Environmental Review Board to assist in their decision-making process.

AANDC has provided recommendations within this report that relate to water quality with the intent of minimizing potential impacts from the proposed development both in magnitude and temporal extent. Setting WQOs/SSWQOs with the goal of minimizing environmental degradation, to the extent feasible, will minimize the potential impacts and provide a higher level of confidence that mine site will not harm the downstream aquatic receiving environment.

AANDC thanks the Board for providing an opportunity to participate in this process, and looks forward to reviewing the Board's Report of Environmental Assessment for this project.

SUMMARY OF RECOMMENDATIONS

Site Specific Water Quality Objectives and Effluent Quality Criteria

RECOMMENDATION #1

AANDC recommends that the outlet of Drizzle Lake should be the assessment boundary or Initial Dilution Zone (IDZ) boundary. All SSWQOs should be met at this location.

RECOMMENDATION #2

AANDC recommends that water quality in TMF, Drizzle Lake and Murky Lake be monitored year round to assess the average condition and trends during open water and under ice. Comparisons should be made to Environmental Assessment concentrations and predictions to assess changes in water quality. If trends indicate the proposed SSWQOs will not be achieved, water treatment options should be implemented.

RECOMMENDATION #3

Dissolved oxygen and metal concentrations under ice must be regularly assessed to ensure they do not become harmful to aquatic life in Drizzle, Murky and/or Thor Lake.

RECOMMENDATION #4

During operations, if conditions in the receiving environment become detrimental to aquatic organisms (particularly during winter), mitigation options must be implemented. Potential mitigations should include but not be limited to effluent treatment, additional water storage to curtail winter discharge volumes and rates, and/or aeration of downstream lakes.

RECOMMENDATION #5

AANDC recommends that the Report of EA should include narrative statements that describe the level of protection to be afforded to the aquatic receiving environment in Thor Lake. These statements could include:

- Water quality changes due to mining activities will not significantly affect benthic macro-invertebrate and plankton abundance, taxonomic richness or diversity.*
- Water quality changes due to mining activities will not significantly alter fish abundance or diversity or fish consumption at current levels.*
- Water quality changes due to mining activities will not negatively affect areas utilized as traditional drinking water sources.*
- Water quality changes due to mining activities will not significantly affect mammals or wildfowl using the area as a drinking water, food source or habitat, or the current ability for people to harvest these animals.*

RECOMMENDATION #6

AANDC recommends that SSWQOs for cadmium, iron, zinc and mercury should be set based on background concentrations and, where appropriate, include consideration of seasonality. SSWQOs for Rare Earth Elements should be set at the limits proposed by the company unless further investigation and assessment of toxicity becomes available during the life of mine. SSWQOs for other parameters should be “provisionally” based on CCME Guidelines for the Protection of Aquatic Life or future updates to such guidelines. All SSWQOs should be assessed during operations to ensure that the level of protection as described in Recommendation #5 is maintained.

RECOMMENDATION #7

AANDC recommends that loading limits be evaluated, and if necessary established, if impacts to the downstream environment are driven by both contaminant concentrations and loadings.

Aquatic Effects Monitoring Program (AEMP) and Adaptive Management

Recommendation #8

AANDC recommends that Avalon be required to follow the “Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories, June 2009” in the development of its Aquatic Effects Monitoring Program, effects levels, action levels or triggers, and related Management Response Framework for the Thor Lake Rare Earth Element Project.

Closure and Reclamation

RECOMMENDATION #9

AANDC recommends that the closure goal for the Nechalacho Mine Site and Pine Point Hydrometallurgical Site be based on the 1994 Whitehorse Mining Initiative definition: returning mine sites and affected areas to viable and, wherever practicable, self sustaining ecosystems that are compatible with a healthy environment and with human activities.

RECOMMENDATION #10

AANDC recommends that the company be required to place tailings covers during the winter and design them sufficiently to maintain long-term stability, including during summer thaw periods, for both the Nechalacho and L-37 tailings facilities.

RECOMMENDATION #11

AANDC recommends that the company be required to monitor tailings during operations within the L-37 tailings facility to confirm saturation levels and ensure trafficability for closure and placement of a cover.

RECOMMENDATION #12

AANDC recommends that the company be required to implement monitoring during operations to verify the modeling predictions of the effluent plume downgradient of the L-37 tailings facility, assess the modeling parameters and initiate mitigation, if required.

RECOMMENDATION #13

AANDC recommends that the proponent be required to conduct post closure monitoring and maintenance until such time as closure goals, objectives and criteria are achieved and maintained.

REFERENCES

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