

**Mackenzie Valley  
Review Board**



# **Report of Environmental Assessment And Reasons for Decision**

**De Beers Canada Inc.  
Snap Lake Amendment Project**

**EA1314-02**

**September 2014**



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## List of abbreviations

AEMP	Aquatic Effects Monitoring Program
EA	Environmental Assessment
EC	Environment Canada
EQC	Effluent Quality Criteria
BATEA	Best Available Technology Economically Achievable
CCME	Canadian Council of Ministers for the Environment
DKFN	Deninu Kue First Nation
GNWT	Government of the Northwest Territories
LKDFN	Lutsel K'e Dene First Nation
MVLWB	Mackenzie Valley Land and Water Board
NSMA	North Slave Metis Alliance
PR	Public Registry
REA	Report of Environmental Assessment
SNP	Surveillance Network Program
SSWQO	Site Specific Water Quality Objective
<i>The Act</i>	<i>Mackenzie Valley Resource Management Act</i>
TDS	Total Dissolved Solids
WQO	Water Quality Objective
YKDFN	Yellowknives Dene First Nation

## Review Board decision

To make its decision in this environmental assessment, the Mackenzie Valley Environmental Impact Review Board (Review Board) has relied upon all the evidence and information on the public record. After considering this evidence, the Review Board has made its decision in accordance with s. 128 of the *Mackenzie Valley Resource Management Act*.

Based on the evidence and information on the public record, the Review Board finds that the Snap Lake Diamond Mine Amendment Project proposed by De Beers Canada Inc. (De Beers) is likely to cause significant adverse impacts to the environment, including impacts to the aquatic ecosystem, drinking water, and traditional uses.

The Review Board has set out measures that will mitigate the predicted impacts so that they are no longer significant. A summary of the measures include the following:

1. The Mackenzie Valley Land and Water Board will set water licence conditions that protect the aquatic ecosystem and, traditional uses and drinking water, and will ensure that no TDS originating from the mine is detectable by the time water from Snap Lake enters Mackay Lake, 44 km downstream.
2. De Beers will implement additional water treatment or other mitigations to reduce TDS inputs into Snap Lake, to achieve the levels resulting from the requirements of Measure 1 above.

The Review Board therefore recommends, under subparagraph 128 (1)(b)(ii) of the *Mackenzie Valley Resource Management Act*, that this Project be approved, subject to the implementation of the measures and commitments set out in this Report.



Sept 5, 2014

JoAnne Deneron  
Chairperson  
Mackenzie Valley Environmental Impact Review Board

## Executive Summary

This *Report of Environmental Assessment* (REA) describes the process, evidence, conclusions and decisions of the Mackenzie Valley Environmental Impact Review Board's (the Review Board) environmental assessment (EA) conducted on the Snap Lake Diamond Mine Amendment Project (the Project). The developer for this Project is De Beers Canada Inc. (De Beers).

### *The Development*

The Snap Lake Diamond Mine, located 220 km northeast of Yellowknife, is an underground mine partly under Snap Lake. Measures from the previous EA of the mine resulted in a water licence limit of 350 mg/L for total dissolved solids (TDS) for the whole lake average concentration within Snap Lake. Due to unexpected flows of 'salty' groundwater, De Beers is now unable to meet that limit and has applied to amend its water licence. It proposed an increase to the water licence condition which set a maximum level of 350 mg/L of TDS in Snap Lake, among other changes. The amendment application was referred to the Review Board for EA in December 2013.

The purpose of this EA is to assess the effects that the proposed increase in TDS may have on the environment, and includes impacts to the aquatic ecosystem and traditional uses. This EA addresses the spirit and intent of the measures from the first Snap Lake Diamond Mine EA, completed in 2003.<sup>1</sup>

### *EA Measures and Decisions*

The Review Board carefully considered all the evidence and information on the public record. The evidence De Beers presented in this proceeding did not describe specifically how the mine water effluent will be treated, or how clean that water will be when it is released to the environment. Consequently, the Review Board has assessed the impacts of an unmitigated scenario. The Review Board decided that the proposed Project has the potential to cause significant adverse impacts on the environment. Under section 128 (1) (b) (ii) of the *Mackenzie Valley Resource Management Act* (MVRMA), the Review Board recommend measures requiring the following:

1. The Mackenzie Valley Land and Water Board (MVLWB) will set water licence conditions that protect the aquatic ecosystem, traditional uses and drinking water, and will ensure

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<sup>1</sup> The Review Board intends the results of this EA to replace Measures 5 and 10 from the 2003 EA in order to permit the MVLWB to amend water licence conditions in a manner consistent with the measures set out in this report.

that no TDS originating from the mine is detectable by the time water from Snap Lake enters Mackay Lake, 44 km downstream.

2. De Beers will implement additional water treatment or other mitigations to reduce TDS inputs into Snap Lake in order to achieve the levels resulting from the requirements of Measure 1 above.

These measures do not include numerical site specific water quality objectives. Instead, the Review Board set out narrative statements to describe how much change in the environment is acceptable. These narrative objectives are intended to protect the uses of the water in Snap Lake and downstream. If the REA is approved by the Minister of Lands, the MVLWB will be required by section 62 of the MVRMA to set specific numerical SSWQOs, and effluent quality criteria, which achieve the narrative objectives.

The Review Board is satisfied that these measures will prevent significant adverse impacts on the aquatic ecosystem in Snap Lake and downstream. The Review Board is of the opinion that with the implementation of these measures, the Project may proceed to the regulatory process. The Review Board has also made three suggestions, dealing with thresholds for adaptive management, drinking water and using the best available technology economically achievable (BATEA).

The Review Board's determination that the impacts of this development can be mitigated and that no significant environmental impacts will result also depends on the implementation of the commitments made by De Beers during the proceedings and the measures set out in this *Report of Environmental Assessment*. In the Review Board's opinion, it is important that De Beers, the MVLWB and government agencies ensure that commitments made by De Beers, as described throughout this Report, and the measures in the report, are fulfilled.

## 1 Introduction

This is the Mackenzie Valley Environmental Impact Review Board's (Review Board) *Report of Environmental Assessment and Reasons for Decision* (REA) for the Snap Lake Diamond Mine Amendment Project (EA1314-02). The purpose of this report is to:

- a) review the relevant evidence;
- b) document the environmental assessment process;
- c) set out the Review Board's reasons for decision and determine whether the proposed development is likely to be the cause of significant adverse impacts on the environment or be a cause for significant public concern; and
- d) satisfy the reporting requirements of s. 121 and 128 the *Mackenzie Valley Resource Management Act* (the *Act*)

This REA includes five sections and three appendices, set out as follows:

- **Section 1** sets out the requirements of the *Act*, provides the purpose and rationale for this EA and provides a brief description of the existing development. It provides background information regarding the referral to EA. Section 1 also includes a consideration of previous assessment activities as required by s. 115(2) of the *Act*.
- **Section 2** describes the scope of the assessment and sets out the Review Board's determination of the scope of development as required by s. 117(1) of the *Act*. The scope of development set out below includes changes to the project design that occurred during the assessment.
- **Section 3** describes the steps the Review Board took to coordinate its EA process with the process of the MVLWB and also describes the Review Board's EA process for this Project. In addition, Section 3 provides information about the parties to this assessment and the steps the Review Board took to identify any significant adverse impacts or public concern as required by s. 128 of the *Act*.
- **Section 4** outlines the environmental components that the Review Board examined during the impact assessment. This section includes a summary of the evidence, the Review Board's analysis and conclusions, and any mitigation measures and suggestions recommended by the Review Board. It also considers the extent of, the reasons for, and the significance and likelihood of, any public concern resulting from the proposed development.
- **Section 5** is the conclusion of the REA.

- **Appendix A** summarizes the Review Board’s recommended measures and suggestions to avoid or reduce impacts.
- **Appendix B** is a list of commitments made by De Beers during the EA.
- **Appendix C** contains the public registry index.

## 1.1 Purpose of this Environmental Assessment

De Beers applied to the MVLWB for 17 amendments to Water Licence (MV2011L2-0002) for the Snap Lake Diamond Mine (the mine). In particular, De Beers proposed to amend a specific water licence condition that was the result of measures approved after the first Snap Lake Diamond Mine EA. This amendment application was referred to EA.

The Review Board intends that the measures in this REA, if approved, will replace Measures 5 and 10 from the first Snap Lake Diamond Mine REA<sup>2</sup>. Further, if these measures are accepted, the MVLWB will be required to implement the new measures that replace Measures 5 and 10 from the first EA and set water licence conditions accordingly.

Measures 5 and 10 from the first EA set an upper limit for the whole lake average concentration of total dissolved solids (TDS) in Snap Lake at 350 mg/L.<sup>3</sup> These measures were not based on a site specific toxicity assessment of the effects of TDS on the aquatic environment but rather were based on modelled predictions made by De Beers which suggested that this TDS level would not ever be exceeded in Snap Lake. Additionally, De Beers predicted that TDS concentrations would not exceed this level throughout the life of mine.

De Beers’ amendment application was intended to, among other things, replace the 350 mg/L value from the first EA with a different concentration based on site specific toxicity testing. The intent of this testing was to determine the concentration of TDS, and its constituent ions, that can be discharged to Snap Lake without causing significant adverse impacts to aquatic life or traditional use.

The outcome of this EA is a set of measures which incorporate the spirit and intent of Measures 5 and 10. The Review Board is recommending thresholds of acceptable change, based on narrative water quality objectives, which specifically address the valued components in the aquatic environment the original EA measures from 2003 were intended to protect. Due to the predicted increased concentration of TDS, parties raised

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<sup>2</sup> De Beers Canada Inc., Snap Lake Diamond Mine, EA01-004, completed in 2003.

<sup>3</sup> TDS refers to the total amount of dissolved substances, such as salts or minerals, in water remaining after evaporating the water and weighing the residue.

concerns that significant adverse impacts to traditional uses of Snap Lake and surrounding water bodies were likely. The narrative water quality objectives, recommended by the Review Board, set out limits of acceptable change in order to ensure that traditional activities are not significantly impacted.

## **1.2 Requirements of the *Mackenzie Valley Resource Management Act***

The Review Board administers Part 5 of the *Mackenzie Valley Resource Management Act* (the *Act*) and once an EA referral takes place has responsibilities to make decisions in relation to the proposed development. The Review Board must conduct an environmental assessment that considers the proposed development's biophysical, socio-economic and cultural impacts on the environment, in accordance with s. 114 and 115 of the *Act*. The Review Board conducted this environmental assessment based on its *Rules of Procedure* and *Environmental Impact Assessment Guidelines*.

Under s. 117 (1) of the *Act*, the Review Board must determine the scope of the development and must also consider the factors set out in s. 117 (2) and (3) and satisfy s. 115 (2) of the *Act*. Sections 114 and 115 of the *Act* require the Review Board to consider the biophysical, socio-economic and cultural impacts that result from activities associated with the development included in the scope of the EA in order to determine whether the proposed development is likely to cause a significant adverse impact on the environment or to be a cause of significant public concern.<sup>4</sup> The Review Board must then prepare a *Report of Environmental Assessment and Reasons for Decision* (REA).<sup>5</sup>

The Review Board is required to identify, in the REA, any area within or outside the Mackenzie Valley in which the development is likely, in its opinion, to have a significant adverse impact or to be cause of significant public concern and specify the extent to which that area is affected.<sup>6</sup> The Review Board does not believe that this development will have any significant adverse impacts or cause significant public concern in any area outside of the Mackenzie Valley.

If the responsible Minister accepts the Review Board's REA, De Beers, government and regulatory authorities will be required to ensure that any approved measure is carried out.<sup>7</sup>

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<sup>4</sup> Subsection 128(1) MVRMA.

<sup>5</sup> Subsection 128(2) MVRMA.

<sup>6</sup> Subsection 128(4) MVRMA.

<sup>7</sup> Section 62 and subsection 130(5) MVRMA.

The following are the factors required by s. 117 (2) of the *Act* that the Review Board must be consider:

*s. 117 (2) Every environmental assessment and environmental impact review of a proposal for a development shall include a consideration of:*

*(a) the impact of the development on the environment, including the impact of malfunctions or accidents that may occur in connection with the development and any cumulative impact that is likely to result from the development in combination with other developments;*

*(b) the significance of any such impact;*

*(c) any comments submitted by members of the public in accordance with the regulations or the rules of practice and procedure of the Review Board;*

*(d) where the development is likely to have a significant adverse impact on the environment, the need for mitigative or remedial measures; and*

*(e) any other matter, such as the need for the development and any available alternatives to it, that the Review Board or any responsible minister, after consulting the Review Board, determines to be relevant.*

Subsection 115(2) of the *Act* requires the Review Board to consider any assessment activities previously carried out. A description of prior assessments that the Review Board considered is provided in Section 1.5.1 and includes the first Snap Lake Diamond Mine Environmental Assessment, EA01-004. The Review Board considered information from the previous EA in terms of the general context, the site and larger mining activity, the predictions regarding and measures to protect aquatic life, and the values and uses of the area, among other subjects.

### **1.2.1 Traditional Knowledge**

Subsection 115(1) of the *Act* requires the Review Board to consider any traditional knowledge that is made available to it. Traditional knowledge submitted to the Review Board is important evidence and is given equal weight to that of scientific knowledge. The Review Board recognizes and respects the important role that Aboriginal cultures, values and traditional knowledge play in its decision making.

The Review Board heard from the LKDFN, NSMA, YKDFN, and DKFN during the public hearing. These parties indicated that the area around Snap Lake was used in the past, and

is still used by Aboriginal people for traditional activities including hunting, fishing and traveling. The Review Board heard from these Aboriginal groups that traditional activities have already been impacted by activities at the Snap Lake mine and as a result there is reduced use of the immediate Snap Lake area.

Regarding De Beers' proposal to increase TDS and its constituent ions, there are concerns that traditional uses of Snap Lake and downstream lakes will be further affected. These Aboriginal groups submitted evidence to the Review Board, including the DKFN ethno-history report, which detailed their use of the area and referred to this evidence during the public hearing. The Review Board carefully considered all traditional knowledge that parties shared during the environmental assessment.

### **1.3 Environmental Setting**

The following is a general description of the environmental setting of the Snap Lake area as described in the Review Board's 2003 *Report of Environmental Assessment and Reasons for Decision on the Snap Lake Diamond Mine Project* (PR#15).

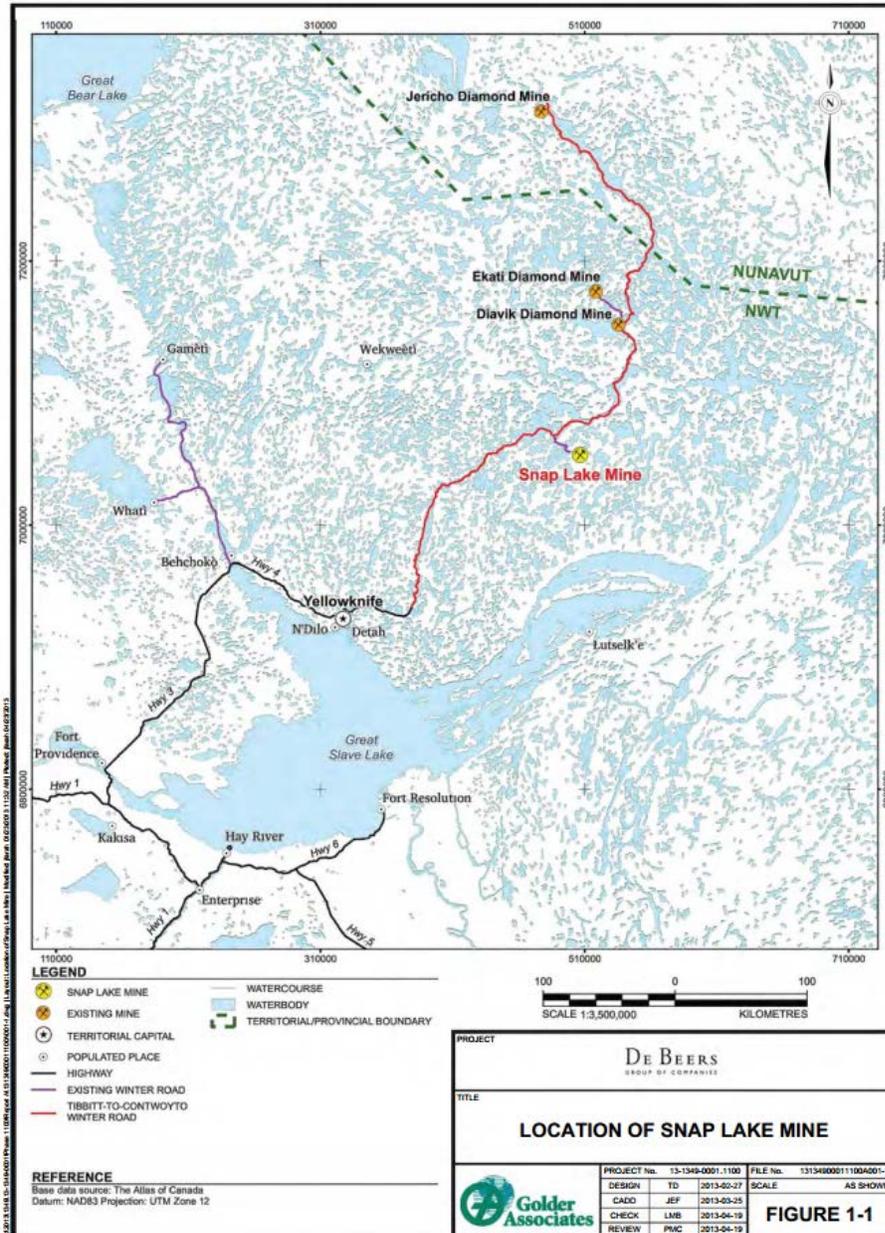
The Snap Lake Diamond Mine is located approximately 220 km northeast of Yellowknife, NWT (Figure 1). The mine is situated in the Slave Geological Province on the south and west sides of Snap Lake, a small lake, found at the headwaters of the Lockhart River water shed. The Lockhart River system flows north to Mackay Lake, east to Aylmer Lake, south to Artillery Lake, through Lady of the Falls, and finally into the east arm of Great Slave Lake.

The topography of the area in which the mine is located is gently sloping with occasional bedrock knolls. Large scattered boulders and frost-shattered rocks dominate the ground. Permafrost features occur in small pockets where poorly drained, peat-filled depressions are present. Snap Lake is found in the zone of continuous permafrost. Mean annual air temperatures are approximately minus six degrees Celsius.

The mine is in the Taiga Shield Ecozone in the High Subarctic Eco-climatic Region. The Snap Lake area is mostly composed of boulder fields and heath tundra. Stunted stands of black spruce and tamarack with white spruce, and ground cover of dwarf birch, willow, cottongrass, lichen and moss are interspersed among the boulders. Tussocks of sedge, cotton grass, and sphagnum moss can be found in poorly drained sites.

The mine is in an area that provides habitat for wildlife including caribou, grizzly bears, arctic and red foxes, wolves, and wolverines. A variety of birds also occur in the Snap Lake area, including small perching birds, shorebirds, gulls, ravens, ptarmigan, raptors (e.g., peregrine falcons and gyrfalcons), and waterfowl.

De Beers recorded 53 archaeological sites in the Snap Lake area. De Beers noted that the area is not regularly used for traditional land use purposes, and that little fishing occurs in the area. In the past, the region has been used for trapping, and as a travel route to hunt wolves, and harvest caribou to the north of the Project area (PR#15 p25-26).



**Figure 1: Location of the Snap Lake Diamond Mine**  
*(PR#63 p1-2 pdf p48)*

## 1.4 Existing Mine Site Components and Management Plans

The layout of the existing Snap Lake Diamond Mine is shown in Figure 2.

The above ground facilities are located on the northwest peninsula of Snap Lake. Facilities include a process plant, materials and ore storage areas, water and sewage treatment plants, water management pond, fuel storage, power plant, and worker accommodation.

Processed kimberlite is disposed of in the North Pile, an aboveground containment facility. A landfarm, landfill, and granite quarries are located within the footprint of the North Pile and runoff from the pile is collected via series a ditches.



**Figure 2: Snap Lake mine layout and water management infrastructure**  
(PR#35 p2)

The mine has been the subject of an environmental assessment, completed in 2003 (PR#15), an initial water licence proceeding, a water licence renewal, and several water licence amendments. The mine is comprehensively regulated and has a number of existing response plans and programs and monitoring and mitigation plans that help to identify

changes to aquatic life, water quality and quantity, and to respond to unforeseen impacts to water with mitigative actions.

## 1.5 Regulatory History

This section describes the regulatory history of the Snap Lake mine including the first EA, subsequent water licences, referral to this EA, and the Review Board's environmental assessment process.

These milestones summarize the history of the mine, which is elaborated on in the following sections:

- 2001 - De Beers Canada applied for a water licence for developing the mine
- 2001 to 2003 - First EA
- 2004 - Type A water licence issued
- 2005 - construction starts
- 2008 - operations begin
- 2011 - water licence renewal
- 2013 - application for water licence amendment
- 2014 - referral to second EA

### 1.5.1 First Snap Lake environmental assessment, EA01-004, and water licence

On February 2, 2001, De Beers Canada Mining Inc. (De Beers) applied to the Mackenzie Valley Land and Water Board (MVLWB) for a Type A water licence, MV2001L2-0002. The application was for a diamond mine that included the mining and milling of kimberlite ore and associated activities at Snap Lake. In May 2001, the MVLWB determined that the application might be a cause of public concern and might have a significant adverse environmental impact on the environment. The application was referred the Review Board for EA.

The Review Board commenced the EA in 2001 and held public hearings from April 28 – May 2, 2003. At that time, De Beers predicted that TDS in Snap Lake would increase from the baseline concentration of approximately 12 mg/L to approximately 350 mg/L on a whole lake average basis (PR# 15 p77). The Review Board observed that there was no agreement among the parties and De Beers regarding the predictions of whole lake concentrations of TDS in Snap Lake because of uncertainty in loadings from underground mine water. There was also no evidence presented about what the effects of exceeding a concentration of 350 mg/L in Snap Lake would be to aquatic life. Therefore, the Review Board concluded that even with the mitigation proposed by De Beers, “there remains a

potential for significant adverse impacts on aquatic life if TDS levels in Snap Lake exceed concentrations predicted by De Beers” (PR#15 p78). The Review Board issued its *Report of Environmental Assessment and Reasons for Decision on the Snap Lake Diamond Mine Project* on July 24, 2003. Based on this conclusion, the 2003 REA recommended that the following measures be implemented:

*(R5) The Production Water Licence for the Snap Lake Project shall specify that the whole lake average TDS concentration in Snap Lake not exceed 350 mg/L at any point in the mine life. This shall be achieved through a total annual load which will not exceed the loads used by De Beers to drive its EA predictions in each year of the mine life. (PR#15 p79)*

*(R10) In order to ensure that the response of the Snap Lake aquatic community remains within the range predicted by De Beers and to prevent significant adverse impacts to the aquatic community of Snap Lake the Board recommends that the Production Water Licence for the SLDP [Snap Lake Diamond Project] shall specify that the whole lake average TDS concentrations in Snap Lake not exceed the 350 mg/L in the EA predictions by De Beers. This can be achieved by an annual loading limit for TDS which is not to exceed the annual load used by De Beers to conduct its impact assessment. (PR#15 p96)*

In a letter dated October 10, 2003, the Minister of Indian Affairs and Northern Development Canada agreed to adopt the Review Board’s recommendations made under s. 128(1)(b)(ii) of the *Act*. The letter stated that the Minister’s decision agreed with the Review Board’s determination, as set out in its REA, that the above noted mitigation measures were necessary to prevent significant adverse environmental impacts (PR#110).

### **1.5.2 Water licencing and referral to second environmental assessment**

The MVLWB initiated the regulatory phase of the Project upon receipt of the Minister’s decision. On January 27 and 28, 2004 the MVLWB held a public hearing for the water licence in Yellowknife and on April 15, 2004 it issued water licence MV2001L2-0002 to authorize De Beers to construct and operate the Snap Lake Diamond Mine. In accordance with the 2003 REA measures, the first water licence MV2001L2-0002, and subsequent water licence MV2011L2-0002, contained conditions which stated that the whole lake average concentration of TDS in Snap Lake was to remain below 350 mg/L at all times.

After the first water licence was issued De Beers began construction of the mine in 2005 and operations commenced in 2008.

As a condition of the water licence, the mine has a surveillance network program (SNP) and an aquatic effects monitoring program (AEMP). The purpose of the SNP is to monitor water quality to ensure that DeBeers is meeting the effluent quality criteria (EQC) prescribed by the water licence. The AEMP is to monitor the effects on the environment such as any changes in water quality beyond what was predicted and any related effects on fish and to ensure that the water quality objectives outlined in the water licence are being met. During early operations at the mine, monitoring conducted as required under the SNP and AEMP indicated that levels of TDS in mine effluent and in Snap Lake were increasing faster than predicted during the first EA and that the trend was expected to continue throughout the mine life. Monitoring further indicated TDS concentrations in Snap Lake would increase beyond the limit set out in the water licence.<sup>8</sup>

In 2011, the mine underwent a water licence renewal process. At that time, from the results of the monitoring described above, it was clear that TDS concentrations were increasing. During this renewal proceeding De Beers acknowledged the increase but did not propose that a response to this trend be included in the new licence. The MVLWB required De Beers to submit a management response plan for TDS, as well as management response plans for other constituent ions of TDS that had increasing trends identified through SNP and AEMP monitoring.

On December 20, 2013, as a response to the increasing TDS concentrations in Snap Lake and impending exceedances of water licence conditions and other regulatory matters, De Beers submitted an amendment application to the MVLWB requesting 17 changes to terms or conditions of the Snap Lake mine water licence (MV2011L2-0004). Included were amendments requesting a change to the effluent quality criteria for TDS derived from Measures 5 and 10 of the Report of EA.

As noted above, these measures, and resulting water licence conditions, specified a whole lake average concentration of 350 mg/L TDS that could not be exceeded in Snap Lake. De Beers stated that these measures were not based on a toxicity assessment of the effects of TDS on the aquatic environment, but rather based on predictions by De Beers that at this concentration there would not be adverse effects. De Beers' intention was to replace the TDS concentration of 350 mg/L, required by Measures 5 and 10, with a different value based on site specific toxicity testing.

Shortly after the amendment application was filed, Aboriginal Affairs and Northern Development Canada provided a legal opinion to the MVLWB which argued that the

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<sup>8</sup> De Beers exceeded its TDS limit in May 2014 and reported this to the MVLWB on June 24, 2014.

MVLWB did not have the authority to amend a term or condition in a water licence that was the result of a measure from an EA that was approved by the Federal Minister. The MVLWB thus ruled that it could not amend the water licence to allow TDS to exceed this limit. Based on this ruling, and concerns from Aboriginal groups, the MVLWB referred the amendment application to the Review Board on January 22, 2014.

## 2 Project Description and Scoping

### 2.1 Initial Project Description and Scope of Development

When determining the initial scope of the development for this EA, the Review Board considered the development that was referred by the MVLWB to the Review Board, that is De Beers' application for 17 amendments to the existing Snap Lake Diamond Mine water licence and other supporting information.

In order to determine which amendments should be included in the scope of the development for this EA the Review Board undertook a scoping process described in detail in Section 3.2. The Review Board determined which of the 17 amendments required consideration in the EA in its *Reasons for Decision for the Scope of the Environmental Assessment* (PR#28). Amendments that were purely regulatory in nature and did not have the potential to cause adverse impacts to the environment were not included in the scope of development for this EA.

The proposed amendments, and associated activities, included in the scope of this EA are the 1) total dissolved solids in Snap Lake and 2) constituent ions of TDS, including, but not limited to, chloride, fluoride, nitrite, nitrate, and sulphate.

In its amendment application, De Beers proposed the following numeric site specific water quality objectives (SSWQOs) be applied to Snap Lake for the purpose of setting effluent quality criteria (EQC) in the water licence:

- TDS 684 mg/L (PR#14)
- Nitrate 16.4 mg/L (PR#13)
- Chloride 388 mg/L (PR#14)
- Fluoride 2.43 mg/L (PR#14)
- Sulphate 427 mg/L (PR#14)
- Strontium 14.13 mg/L (PR#21)

This was the *initial* proposal, but over the course of the EA, De Beers changed its proposal to include the potential release of higher concentrations of TDS and its constituent ions.

### 2.2 Change of Project Description and Scope of Development

This particular EA is unique due to the limited scale and scope of the activities being proposed. It is also important to note that this assessment addresses an amendment to the water licence for the operation of an existing mine which is already fully regulated and which was the subject of an extensive EA process from 2001 to 2003. As a result of this

limited scope of development, and in order to respond to the urgent nature of the amendment requirement, the Review Board, as described below in section 3.1 of this REA, initiated the EA on a limited record, most of that based, at least initially, on the De Beers water licence amendment application and supporting materials.

In most other EAs, the developer describes in detail the development components and activities over the life cycle of the Project, including associated mitigations. However, as explained above, this development is defined to be specific to one activity: what is being assessed relates to the effects of ongoing and increasing discharges of mine water effluent into Snap Lake, with the resulting increase in the whole lake average concentration of TDS. The predicted concentrations are considerably higher than the levels currently allowed by measures approved from the 2003 EA and which are included in De Beers' current water licence conditions.

In this case, De Beers provided a detailed and comprehensive explanation of the likely outcome of continuing to operate the mine without any change. The evidence from the proceeding indicates the potential for significant environmental impact from this "unmitigated scenario".

In order to avoid those impacts, De Beers initially proposed a development based on a SSWQO for a whole lake average concentration of 684mg/L for TDS in Snap Lake, along with other proposed SSWQO's for select constituent ion components of TDS. During the course of the environmental assessment process, De Beers advised that it was continuing to conduct toxicological effects studies on TDS. De Beers then introduced new evidence on the results of these additional studies during the technical session and more during the public hearing (PR#33, PR#35, PR#122, and PR #135). Most of the parties to the proceeding responded to De Beers proposed 684 mg/L limit for TDS and based their evidence and argument on the effects of an increase in TDS to that concentration.

As the proceeding unfolded, however, the new study results produced by De Beers led the company to alter its position. De Beers stated in its closing argument that a SSWQO for TDS in Snap Lake of at least 684 mg/L, and likely as high as 1000 mg/L would not result in any significant adverse impacts to the environment (PR#150 p2). In its closing argument, De Beers did not request that the Review Board recommend a specific value for the proposed amended SSWQOs for TDS and its constituent ions. Instead, the company asked for a non-numeric measure that would allow the Mackenzie Valley Land and Water Board to set SSWQOs that are appropriately protective and reasonably achievable, resulting in an unspecified SSWQO that is protective of the environment (PR#150 p5). This, in the end, was the "mitigated scenario" requested by De Beers in its closing.

De Beers stated during the Review Board's public hearing that in order to achieve a protective SSWQO, mitigation would be required to decrease the loading of TDS in Snap Lake (PR# 131 p55). De Beers had stated that focused grouting and additional water treatment were two of the mitigation options being investigated, but no evidence on the details of the design, cost or effectiveness in protecting the environment of these mitigations or any other mitigative options was submitted to the record by De Beers during the preceding (PR# 150 p4).

### *Mitigated vs unmitigated scenarios*

The mitigated scenario put forward by De Beers, described above in section 2.1, leaves the Review Board with significant uncertainty on the actual concentration or value of the SSWQO being proposed by De Beers for TDS in Snap Lake. The evidence available does not indicate, nor has De Beers adopted and proposed a value, which it suggests will be protective of the environment. This, in combination with the absence of any specific evidence about mitigation techniques, meant the Review Board had to make some difficult determinations, such as: 1) what is the scope and nature of the actual development that is being assessed; and 2) has De Beers committed to mitigation in order to prevent significant adverse environmental impacts?

A careful review of the record by the Review Board does not yield ready answers to these questions. At the conclusion of the proceeding, the Review Board finds itself unable to draw conclusions and to make the determinations required by s. 128 of the *Act* in relation to the mitigated scenario. The Review Board finds that the evidence about TDS concentrations and the mitigation necessary to make these determinations is simply not sufficient to enable it to make a conclusion about impact significance.

The onus is on De Beers in this matter to have provided sufficient evidence to show that its development proposal and any associated mitigations would not cause any significant impacts or significant public concern. The Review Board does not believe that De Beers has been clear enough about the numerical SSWQO it is actually proposing for TDS in Snap Lake. The developer has not provided sufficient evidence on the mitigation that is likely required to ensure that significant impacts will be prevented.

In these circumstances the Review Board could simply reopen the record and instruct De Beers to supplement the evidence it has filed. That would also require that other parties be given the opportunity to respond and considerable delay would likely result. Given the urgency of the circumstances underlying the need for an amendment to the De Beers water licence, however, the Review Board believes that another approach is possible.

The evidence on the record about the unmitigated scenario is clear and there is also good evidence about the impacts of continuing without mitigation. The Government of the Northwest Territories (GNWT) and the other Aboriginal organizations and parties to this proceeding produced ample evidence which clearly sets out the environmental, traditional use and cultural values which need to be protected. The Review Board is of the view that it can set out narrative SSWQOs which will ensure the protection of these values. Indeed, the Review Board has concluded that even with a more complete record, it would not be necessary or appropriate for it to enter into the exercise of developing numeric SSWQOs. It is, in the Review Board's opinion, more appropriate for that work to be done at the regulatory stage of the review of this development.

As a consequence, the Review Board has decided to focus the balance of this REA on the "unmitigated scenario". In addition, the approach to the description of SSWQOs, should any be necessary and recommended, will be narrative. In that way, the Review Board believes that De Beers can be directed through the design of any necessary mitigation measures subject to limits that ensure protection of the environment, but which do not eliminate all the flexibility necessary for the developer to choose the solutions that will work best in the context of its business. De Beers will design the required mitigation and the MVLWB will set appropriate numeric SSWQOs to meet the level of acceptable protection as determined by the EA process.

**In summary, rather than extend the EA process, the Review Board has decided to assess the unmitigated development scenario for TDS loading in Snap Lake.** The Review Board has sufficient evidence on the record to make the determinations required by s.128 of the *Act* in respect of that scenario. The resulting analysis is set out in Section 4 of this REA.

The Review Board has also considered the initial evidence based on the TDS concentration of 684 mg/L (as originally proposed by De Beers) and on proposed concentrations of other parameters. Evidence from parties that assumed the 684 mg/L TDS concentration is presented in its original context in this report. While assessing the unmitigated scenario, the Review Board considered evidence on a range of TDS concentrations, up to the concentration predicted in the unmitigated scenario.

### **2.2.1 Scope of environmental assessment**

The Review Board determined that the scope of the EA includes changes in Snap Lake and the downstream environment as a result of increasing amounts of TDS and its constituent ions in the water and also included the effects of any associated activities. During the EA, the Review Board evaluated how changes in the amount of TDS could have adverse impacts

on water quality, on the people who use the water and on the plants and animals that live in the water. In terms of valued components, the Review Board has focused this report primarily on aquatic life in Snap Lake and downstream waters, and on traditional use of Snap Lake and downstream waters.

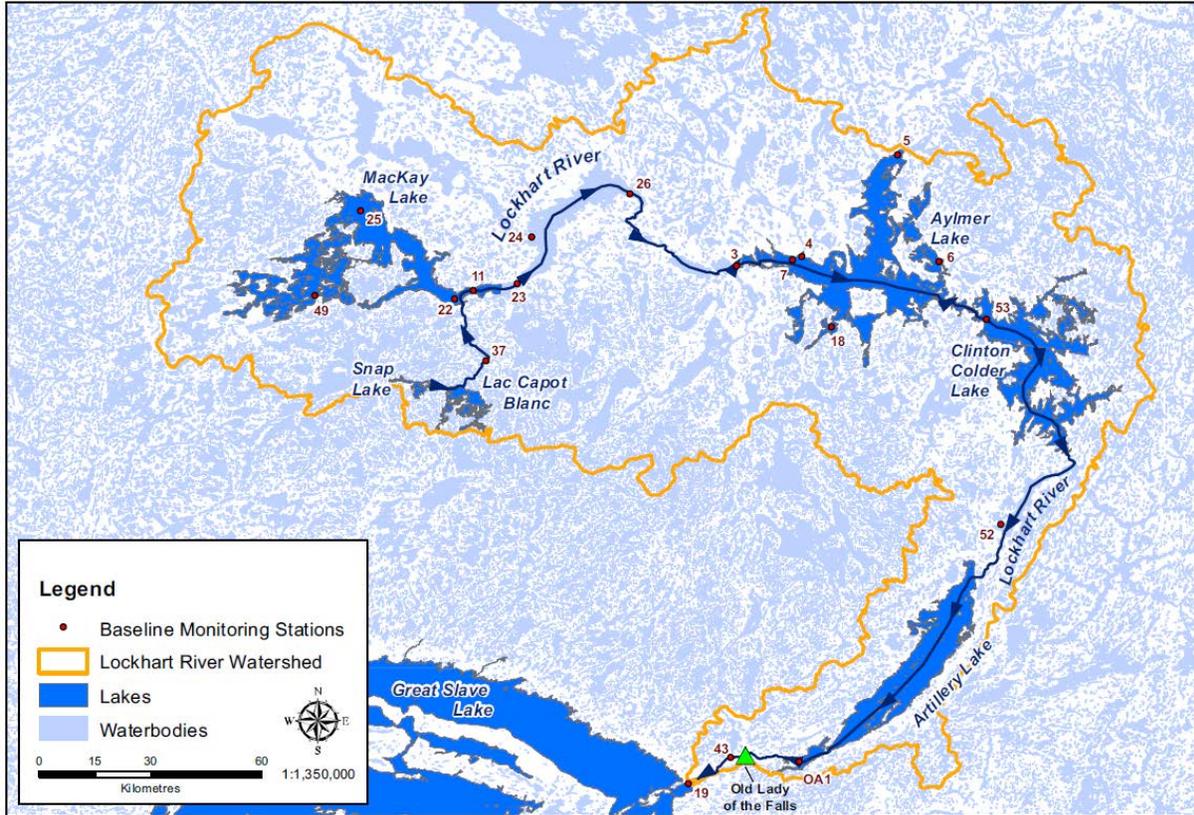
### *Geographic and temporal scope*

The Review Board heard from parties that the geographic scope should include the area potentially affected by the proposed increase in TDS in the unmitigated scenario. This included Snap Lake and downstream water bodies to a point where effects were no longer measurable. Figure 3 shows the watershed for Snap Lake and downstream waters. De Beers suggested, based on its proposal, that effluent would not be detectable further than 44 km downstream (PR#35 p27, PR#150 p5). This scenario was used in De Beers' predictions and assessment of downstream effects and of cumulative effects.

The Review Board has considered the potential impacts to the aquatic environment and to traditional use, and has focussed the geographic scope of this EA on the area in which aquatic effects are most probable, starting in Snap Lake and extending downstream to the outlet of Mackay Lake.

The temporal scope of the EA considered operations, closure and post-closure phases of the Project. Mine operations are scheduled to continue until 2029. Direct contributions of water from the underground mine into Snap Lake will cease when mine operations cease. However, impacts from mine effluent already in Snap Lake and downstream waters will continue after mine operations cease. The period over which these effects will occur is extended due to the location of Snap Lake at the headwaters of a drainage system which has a low recharge rate of approximately 13 years (PR#119 p12). Hence, at closure, the dilution of mine effluent in Snap Lake with fresh water and recovery of Snap Lake and downstream waters to baseline conditions will take many years (PR#119, p10-12). Since the impacts from this amendment to Snap Lake and downstream waters will continue beyond the operations phase, the temporal scope of this assessment included the closure and post-closure phases, until effects from the Project are no longer measurable.

Components of the mine that do not contribute to an increase in TDS were not considered in this EA.



**Figure 3: Snap Lake watershed and location of baseline monitoring stations (PR#87 pF2)**

### 3 Coordinated and Concurrent Regulatory and EA process

#### 3.1 Coordinated and concurrent process

In its January 22, 2014 referral, the MVLWB advised the Review Board that it would be supportive of a coordinated process inclusive of scoping to allow for the efficient and effective review of the TDS measure and the application (PR#1).

On February 24, 2014 the Chairs of both the MVLWB and Review Board co-signed a letter describing a coordinated and concurrent process for the water licence amendment application and EA (PR#18). The coordinated and concurrent parts of the process included:

- scoping;
- application review and information requests; and,
- technical session and information requests.

The two Boards determined this approach was warranted due to a consideration of following factors:

- the limited nature of the water licence amendment application;
- the limited scope of the EA as described in the Review Board's *EA Scoping Reasons for Decision* (PR#28) - to alter the amount and concentration of TDS, and its constituent ions, discharged to Snap Lake;
- the Review Board's determination that a Terms of Reference and Developer's Assessment Report are not required in this case; and,
- consideration by the Review Board and MVLWB that De Beers is likely to exceed water licence limits for TDS in the near future.

This process was expected to result in efficiencies in process steps and reduce the overall time that the EA and regulatory phases take while still allowing for a fair process for reviewers and parties. The EA phase as described in the work plan (PR#25) was completed in 31 weeks.

#### *Application review and scoping the assessment*

The Review Board determined that De Beers' water licence amendment application provided sufficient information to commence the EA on water licence amendments that were scoped into the assessment. Because of this determination a Terms of Reference and a Developer's Assessment Report were not required.

When determining the scope of the EA process the Review Board reviewed all 17 amendments to the Snap Lake mine water licence applied for by De Beers. The Review

Board determined which amendments were scoped into the EA by asking the following questions in relation to each proposed amendment:

1. Would the proposed change [amendment] result in an effect to the environment or is it purely a regulatory or administrative change?
2. If De Beers' proposed change results in an effect to the environment will the proposed change result in an impact that was not assessed previously?

The results of this analysis were set out in the *Draft Review Board Proposed Scope of Environmental Assessment, Snap Lake Mine Amendment Project* (PR#17). This document described which proposed amendments, and associated activities the Review Board determined were likely within the scope of the EA and which ones should likely be dealt with strictly through the MVLWB regulatory process.

The Review Board released this draft document for review and received responses from reviewers and De Beers on March 14 and March 21 respectively. The Review Board issued its *Reasons for Decision on the Scope of the Environmental Assessment of the Snap Lake Diamond Mine Amendment Project*, EA1314-02, on March 28, 2014 (PR#28).<sup>9</sup>

The MVLWB and the Review Board then issued a combined work plan (PR#16) for the Snap Lake water licence amendment EA, EA1314-02, and regulatory phase, MV2001L2-0004.

The Review Board's *Reasons for Decision for the Scope of EA* served to notify De Beers that additional information was required to address outstanding requirements of s. 117 of the *Act* (PR#62). This included:

- cumulative effects;
- accidents and malfunctions;
- alternative means.

De Beers notified the Review Board on April 1, 2014 that supplemental information regarding these topics would be provided on April 11 and presented during the technical session on April 15.

Parties were provided with time to review this information and submit information requests, if required by, April 22, 2014. De Beers responded to the information requests on May 1, 2014.

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<sup>9</sup> See section 2.1 for details regarding the scope of the development and scope of the assessment.

### *Independent consulting firm – Ecometrix Incorporated*

The Review Board and the MVLWB heard parties' concerns regarding their limited capacity to undertake a thorough review of the highly technical application submitted by De Beers during the condensed time frame set out by the coordinated and concurrent process discussed above. In order to mitigate these concerns, on March 28, 2014, the Review Board and the MVLWB advised parties that they had retained an independent consulting firm, Ecometrix Incorporated. The Boards' intent in commissioning an independent third party review was to assist parties in the technical review of De Beers' applications.

The scope of work for Ecometrix was to participate in the technical session held in April and to prepare an independent publicly available report by May 8, 2014 (PR#77). With respect to the report, the Boards requested that Ecometrix review the De Beers application and evidence and answer the following questions:

- a) Are the proposed water quality objectives (WQOs), in your professional opinion, appropriate for the aquatic receiving environment?
- b) Based on the review of the various water quality models, are any of the contaminants of concern likely to exceed WQOs in the aquatic receiving environment?
- c) For those contaminants that are expected to exceed WQOs, what, in your professional opinion, are the potential effects to aquatic life in Snap Lake and the downstream receiving environment?
- d) Based on the review of the Response Plans, are there, in your professional opinion, feasible mitigation measures that can be implemented at the Snap Lake mine site that will either ensure that contaminants do not exceed WQOs, or will minimize effects to the aquatic receiving environment?
- e) Is the proposed method of calculating EQC appropriate, in your professional opinion, to meet the dual objective of minimizing waste discharge and protecting downstream water uses?

The Ecometrix report was placed on the record and the information in this report was available to all parties. Ecometrix also attended the public hearing in order to present its findings to the Review Board and to be available to answer questions from De Beers and parties regarding its report.

### *Technical session and information requests*

On April 15-16, 2014 the Review Board and the MVLWB held a joint technical session in Yellowknife for the purpose of giving parties the opportunity to seek clarification from

De Beers on the proposed water licence amendments in a face-to-face setting. Information requests were also generated during the technical sessions.

## **3.2 Review Board EA process steps**

### ***Prehearing conference***

On May 13, 2014 the Review Board held a prehearing conference to discuss upcoming dates for filing materials, prepare parties for the June 5-6 public hearing and to set the hearing agenda. The prehearing conference was also the deadline for party status applications as described in the section below. All parties and De Beers participated in this conference either in person or via teleconference.

### ***Parties to the environmental assessment***

Six organizations participated as registered parties in this environmental assessment. De Beers was automatically a party. The other parties were (PR#107):

- Government of the Northwest Territories (GNWT)
- Environment Canada (EC)
- Yellowknives Dene First Nation (YKDFN)
- Lutsel K'e Dene First Nation (LKDFN)
- North Slave Metis Alliance (NSMA)
- Deninu Kue First Nation (DKFN)

During the EA, representatives of government departments, Aboriginal organizations and other groups had the opportunity to identify their concerns and notify the Review Board of their intent to participate in the proceeding as an interested party. All information exchanges between the parties and the Review Board can be found on the public registry.

### ***Technical reports and hearing presentations***

Technical reports were submitted to the Review Board by parties on May 21 and De Beers submitted a response to the technical reports on May 28. Parties submitted presentations in advance of the public hearing on May 30 and De Beers submitted its hearing presentation on June 2. The public record was closed from June 2 to June 6 inclusive so that no information would be submitted immediately prior to the hearing.

### ***Public hearing***

The Review Board held a public hearing for the Snap Lake Amendment Project in Yellowknife on June 5-6, 2014. The public was notified of the public hearing in advance through newspaper and webpage announcements. During the hearing, De Beers and parties made presentations to the Review Board. The independent consultant, Ecometrix,

also presented information to the Review Board and answered questions put forward by the parties or by the Review Board and its staff. All parties had the opportunity to question De Beers and other parties after each presentation.



**Figure 4: Snap Lake EA Public Hearing held in Yellowknife**  
(Photo: Review Board)

#### *Hearing follow-up, final argument and closure of the public record*

At the hearing, De Beers made a number of undertakings to submit additional information based on questions that could not be answered during the public hearing. In addition, during the hearing, De Beers referred to new evidence from studies that parties had not had the opportunity to review. In fairness to parties, additional time was granted to review the new studies (new evidence) referred to by De Beers during the hearing. Final arguments were submitted by parties on July 4 and by De Beers on July 8. The Review Board closed the public record on July 8, 2014.

#### *Environmental assessment decision*

After the closing of the public record, the Review Board deliberated on the evidence and submissions on the public record in order to arrive at its decision. The Review Board has prepared this *Report of Environmental Assessment and Reasons for Decision* for submission to the Minister of Lands of the Government of the Northwest Territories as per s. 128(2) of the *Act*. The Review Board's approach to determining significance is discussed in the following section.

## 4 Assessment of Impacts to Water Quality

This section of the report describes the effect that increasing TDS concentrations and loading in Snap Lake and downstream will have on water quality and the resulting impacts to the aquatic ecosystem and traditional uses.

For each issue the Review Board describes:

- De Beers' submissions and predictions, responses to information requests, hearing statements, final submissions and other evidence from De Beers on the public record;
- evidence from the parties and other relevant items on the public;
- the analysis and conclusions of the Review Board pertaining to each issue; and
- any measures or suggestions by the Review Board.

The Review Board considered all issues that parties and the public raised in this EA and all the evidence on the record. The issues discussed in detail in this report are those the Review Board decided warranted further consideration for the purposes of its decision under s. 128 of the *Act* because of impact significance and public concern.

### 4.1 De Beers' Position and Submission on Aquatic Life

The following sections describe the evidence and position provided by De Beers during the EA.

#### 4.1.1 Background

As a result of observations made from SNP and AEMP monitoring, discussed earlier in this report, (Section 1.5.2) the MVLWB required<sup>10</sup> De Beers to undertake a thorough analysis of the predictions, potential effects and mitigations options for TDS (including the TDS constituents of chloride and fluoride), nitrate and strontium. The information, which was used by De Beers in support of its water licence amendment application, documented that:

- inflows to the on-site water treatment plant were predicted to increase;
- the effluent from the water treatment plant would exceed the effluent quality criteria<sup>11</sup> outlined in the current water licence;
- the long-term concentrations of TDS in Snap Lake would increase; and,
- without additional treatment, the increased TDS concentration would have a

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<sup>10</sup> See Part F, items 20-22 of water licence MV2011L2-0004

<sup>11</sup> Effluent quality criteria (EQC) describe the maximum concentrations that can be released from the end-of-pipe, where water from the water treatment plant discharges into Snap Lake

negative effect on aquatic life.

As required by the Snap Lake mine water licence, De Beers proposed SSWQOs for TDS, chloride, fluoride, nitrate, and strontium that were meant to protect all forms of aquatic life from adverse toxic effects including, for example, reduced growth or reproduction. Although the proposed SSWQOs were meant to protect use of the water for fishing, the SSWQOs did not consider drinking water uses.

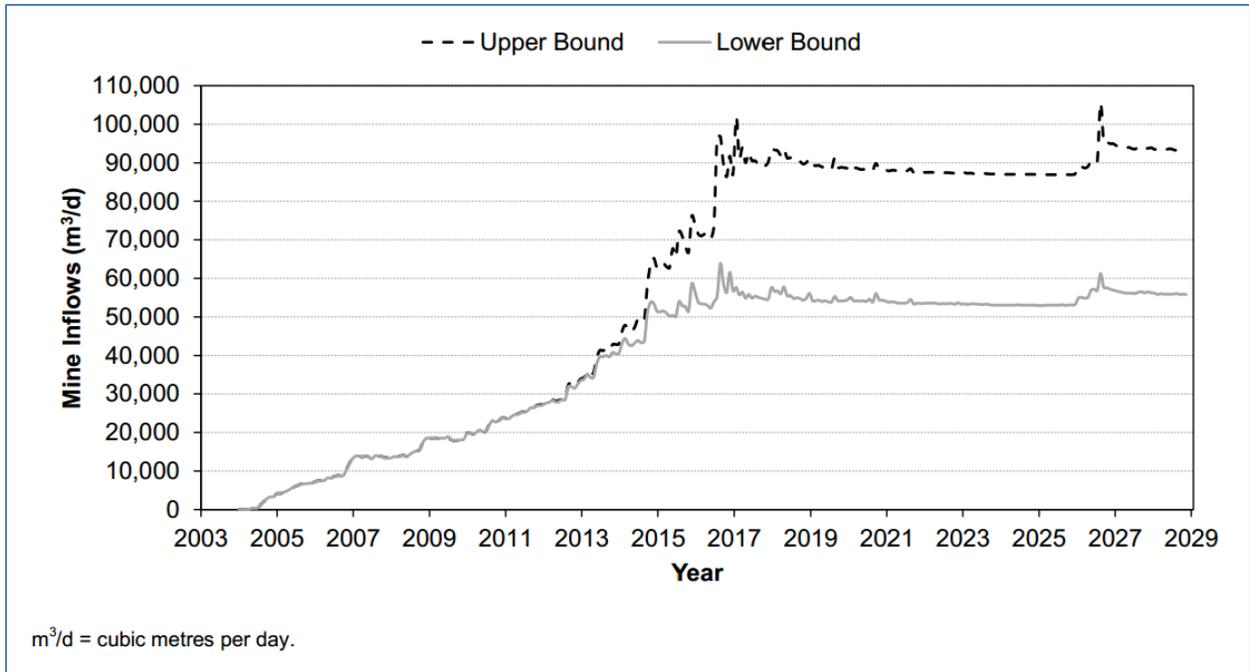
The predictions for TDS and its constituent ions were based on modelling which included:

- a groundwater model;
- a site mine water balance model; and
- a hydrodynamic model.

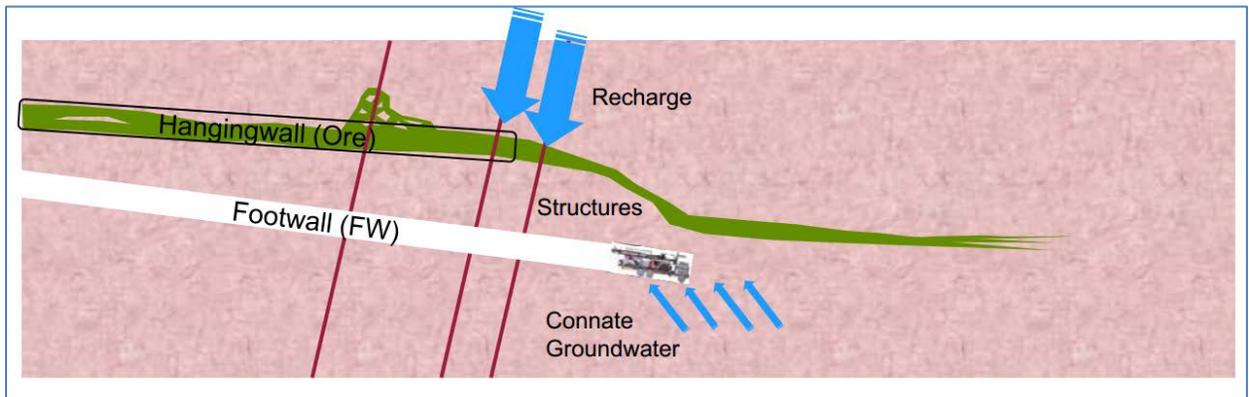
The models were used to estimate the amount of water in the system (the quantity) and predict the contaminant concentrations in water (the quality). The groundwater model estimated the volume and flow rate of water entering into the underground operation. The site mine water balance model simulated the water cycle over the entire mine site and Snap Lake. The site water balance model accounted for surface water flow and the groundwater model results were an input to the site water balance model. The hydrodynamic model simulated the water quality in the system. The models predicted that inflows to the mine would increase by 1.5 times to 2 times within the next four years (Figure 5). The inflows were predicted to range between approximately 60,000 m<sup>3</sup>/d and 96,000 m<sup>3</sup>/d.

Currently, approximately 80 to 90% of the water directed to the existing water treatment plant is from the underground workings (PR#122 p31). Water entering the underground operation is from two sources, the footwall and the hanging wall. Figure 6 shows the underground mine at Snap Lake including the hanging wall and footwall. When De Beers mines the kimberlite ore the tunnel left behind is called the hanging wall. To gain access to the kimberlite ore De Beers creates access tunnels below the kimberlite. These access tunnels are referred to as the footwall.

Water entering the footwall contains high concentrations of TDS. The TDS in this water comes from very old groundwater that is referred to as connate water. It is predicted to contain TDS concentrations in the range of 3,490 mg/L to 5,728 mg/L (PR#12 p2-13). The quantity of water from this source is estimated to be approximately 10% of the water that enters the mine.



**Figure 5: Predicted mine water inflows**  
(PR#33 p22)

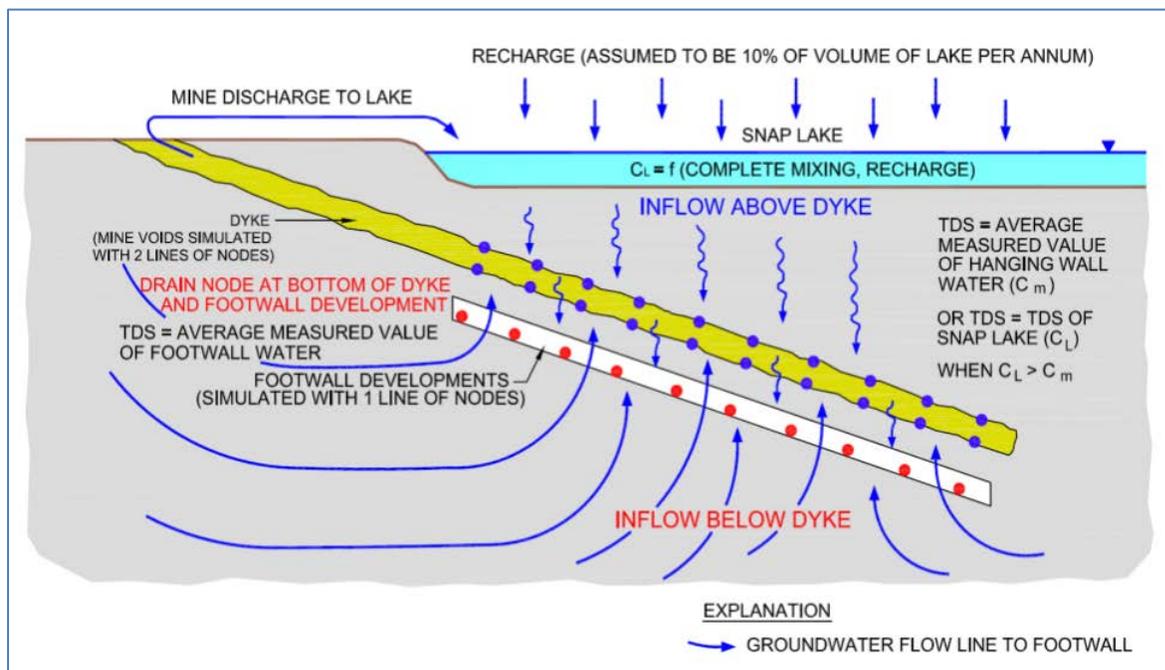


**Figure 6: Diagram of the underground mine workings**  
(PR#35 p9)

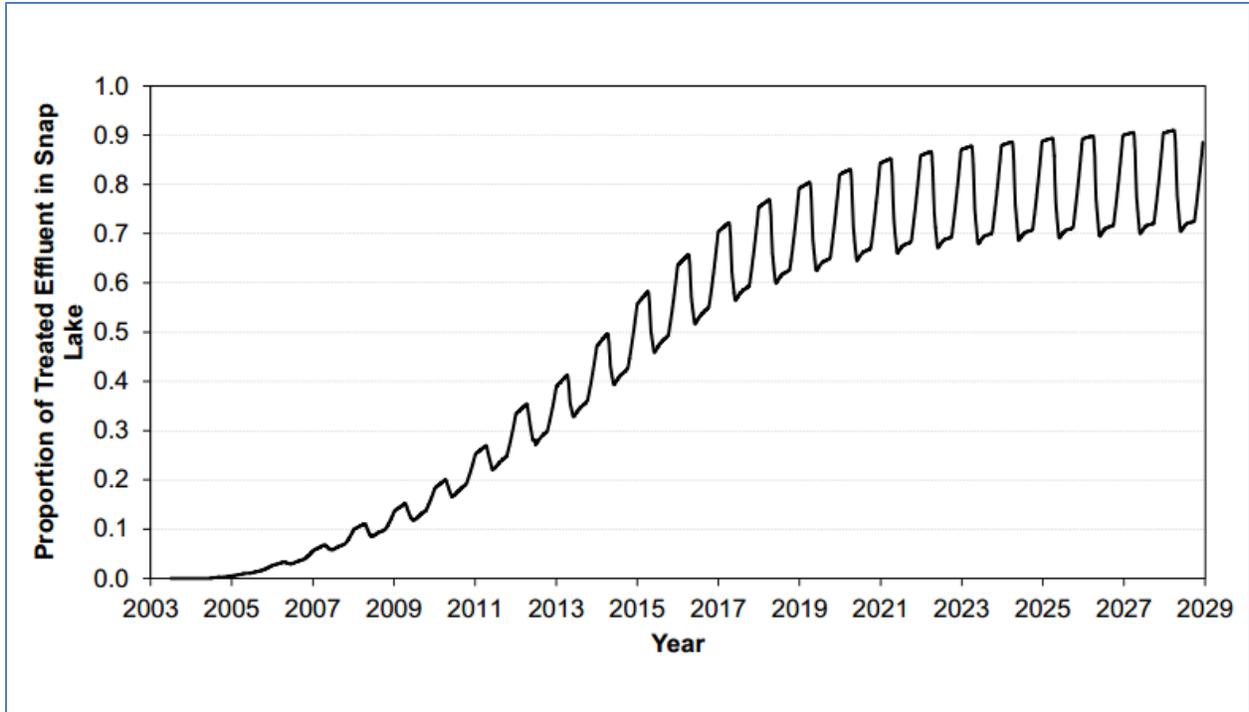
Water entering the hanging wall comes from Snap Lake, and has much lower TDS concentrations. This is approximately 90% of the water that enters the mine.

Currently, water intercepted in the underground is pumped to the surface and directed to the water treatment plant where it is treated to remove total *suspended* solids but not total *dissolved* solids. Effluent from the water treatment plant is then discharged into Snap Lake.

The existing water treatment plant is not designed to treat for dissolved solids. This means that currently, TDS entering the mine from the deep connate waters is discharged to Snap Lake where it is diluted with Snap Lake water and causes the TDS concentration in Snap Lake to increase. The resultant higher concentration TDS water in Snap Lake then infiltrates back into the mine. This water is in turn mixed with the high TDS connate water from the footwall, pumped back to surface and discharged back to Snap Lake, thereby further increasing the concentration of TDS in Snap Lake. This cyclic flow of water is shown in Figure 7. Because the water cycle at Snap Lake is a relatively closed system with very limited inflows and outflows to and from the environment, it is predicted that, by the end of the mine life in 2029, 90% of the water in Snap Lake will be treated mine effluent (Figure 8) (PR#35).



**Figure 7: Water cycle at the mine**  
(PR#35 p20)



**Figure 8: Predicted proportion of mine effluent in Snap Lake (PR#35)**

Other constituents of TDS include nitrogen and strontium. Although they are constituents of TDS found in Snap Lake their source is not from the deep groundwater. The source of the nitrogen is from the explosives used to blast the kimberlite ore (PR#13 pii) and the source of the strontium is from the kimberlite and waste rock (PR#21 p1-1).

To predict the concentrations of TDS, and its constituent ions at the mine, the models were run for a number of scenarios. These scenarios represent De Beers’ predictions of the worst case and best case scenarios for water inflows into the mine and the concentration of TDS found in these waters. The models used a range of water inflow rates and TDS concentrations. The scenarios are described below in Table 1.

**Table 1 Model scenarios of water inflow rates to the mine and TDS concentrations (PR#35 p39)**

	<b>Inflow Rates (m<sup>3</sup>/d)</b>	<b>TDS Concentrations (mg/L)</b>
Upper Limit	96,000	5,728
Lower Limit	60,000	3,490

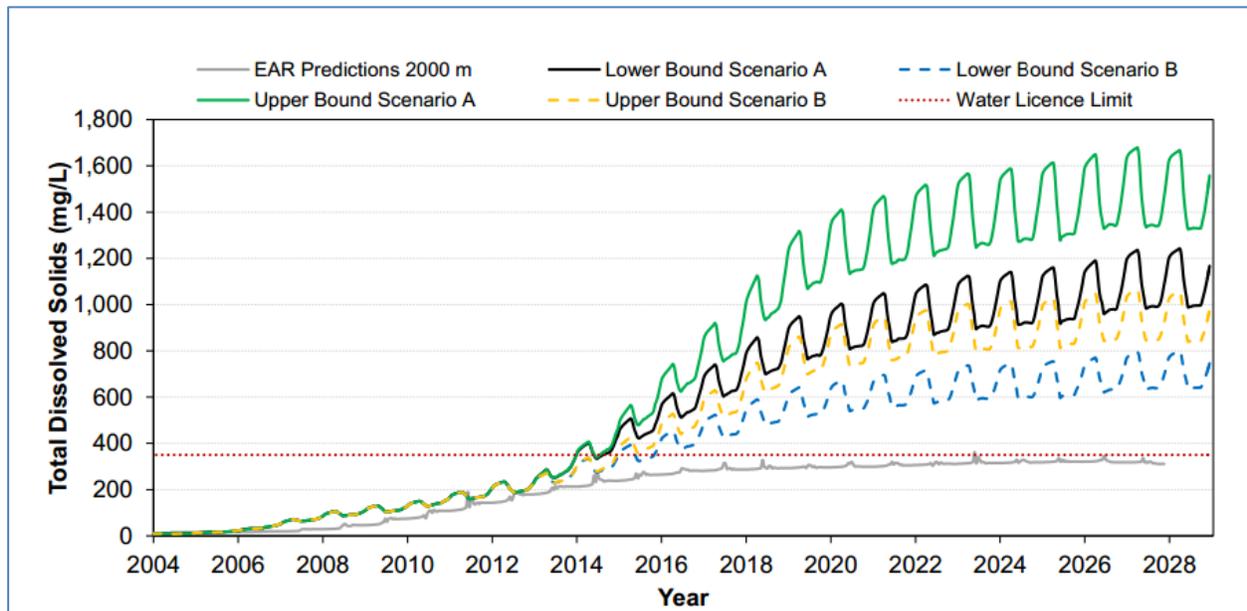
#### 4.1.2 De Beers' submissions on numeric SSWQOs

This section describes the water quality predictions and the proposed numeric SSWQO for TDS, chloride, nitrogen, fluoride, and strontium.

##### *Total dissolved solids*

TDS is the sum of salts dissolved in water. Prior to mining, the TDS concentration in Snap Lake was, on average, 12 mg/L and consisted predominantly of carbonate and sulphate (50% to 60% of TDS). With mining, the TDS in Snap Lake now consists predominantly of chloride (45-47%) and calcium (20-21%). TDS concentrations have been steadily increasing in Snap Lake and De Beers has predicted that it will approach 350 mg/L in the near future (PR#12 p3-2).

Modelling completed by De Beers predicted that if no additional mitigation is put in place that TDS concentrations in Snap Lake would approach 1,700 mg/L near the end of mining (Figure 9). This would exceed the current Water Licence limit of a whole lake average of 350 mg/L.



**Figure 9: Predicted TDS concentrations in the main basin of Snap Lake with existing water treatment**  
(PR#12 p3-5)

Proposed SSWQO and site specific testing

Because the existing limit for TDS of 350 mg/L was not based on toxicity or effects to aquatic life, De Beers investigated the effects of higher TDS concentrations on aquatic life in Snap Lake. De Beers conducted site-specific toxicity testing using CCME guidance to quantify the effects of TDS. In total, three rounds of testing were completed. The species tested included: two fish species, four invertebrates, zooplankton and phytoplankton. The tests involved measuring the survival and growth of each species at various TDS concentrations (PR#12 p3-6).

De Beers conducted tests that mimicked Snap Lake water in terms of the concentrations of effluent expected in Snap Lake over the life of mine and representatives of the organisms found in Snap Lake. This testing determined the concentration at which non-lethal, or chronic, effects occur, such as a decrease in growth or reproduction. This is called the inhibitory concentration (IC). The level at which this concentration is measurable depends on the sensitivity of the test. For some tests, De Beers could detect effects on 20% of the organisms; other tests were sensitive enough to detect effects on only 10% of the organisms. For each test, De Beers indicated if the result was at the 20% concentration, IC20, or the 10% concentration, IC10. Because these concentrations represented a non-lethal concentration (i.e. a concentration at which point organisms only start to feel negative effects), De Beers asserted that they used a suitably conservative approach to setting SSWQOs.

The testing identified *Daphnia magna* as the species in Snap Lake that is the most sensitive to the effects of TDS. *Daphnia magna* is a type of zooplankton which represents approximately 3% of the total zooplankton in Snap Lake. This organism forms part of the food chain that larger organisms, such as fish, eat. A summary of the three test results for *Daphnia magna* is presented below in Table 2.

De Beers asserted that the test results for *Daphnia magna* are the IC20 level (i.e. when 20% of the organisms experience a negative effect) but that, “toxicity lower than a 20% effect level is not considered environmentally relevant” (PR#62 p32).

**Table 2 Summary of *Daphnia magna* toxicity testing**

<b>Test</b>	<b>1</b>	<b>2</b>	<b>3</b>
IC20 Concentration	684 mg/L	1,477 mg/L	1,099 mg/L

Using this method De Beers proposed a SSWQO for TDS of 684 mg/L. It considered this concentration to be protective of aquatic life in Snap Lake as “a reduction in daphnids in the

zooplankton is not likely to have a significant adverse effect on fish because daphnids comprise a relatively small proportion of the zooplankton” ([PR#62](#) p32). De Beers concluded that this SSWQO would not have a significant adverse environmental effect (PR#112 p1). De Beers argued, based on additional testing results, that there will not be a significant adverse impact to the environment at 684 mg/L and likely as high as 1,000 mg/L (PR#150 p2).

To meet the proposed SSWQO of 684 mg/L for TDS, De Beers stated that it would need to implement additional water treatment at the mine. De Beers therefore committed to “implementing mitigation to reduce TDS loading to meet a site specific water quality objective that is achievable, appropriate, and protective of the environment” (PR 131 p55; PR#150 p2 and p4; PR#122 p19 and p22; PR#66 p2). A description of proposed mitigations is found in section 4.1.3 of this REA.

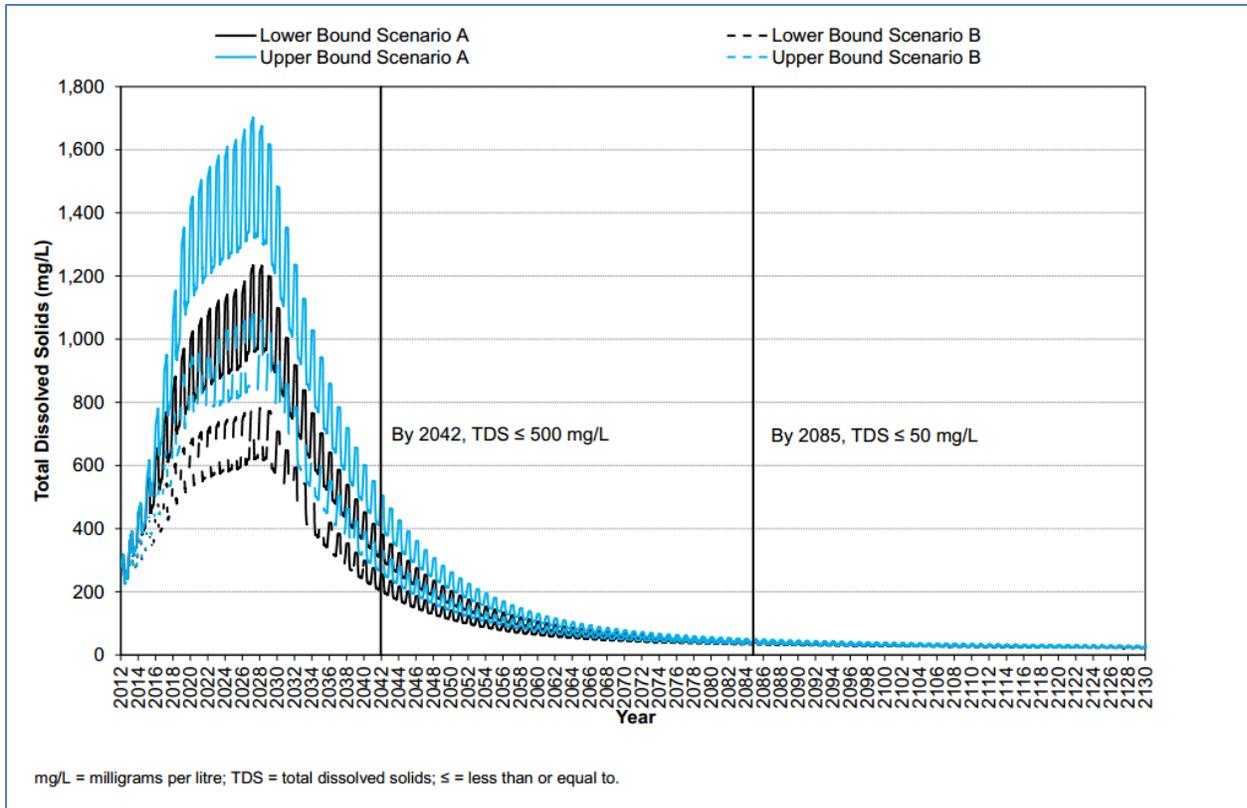
#### *Predicted concentrations with and without mitigation*

De Beers completed modelling to predict the concentrations of TDS in Snap Lake and downstream with additional water treatment to meet an SSWQO of TDS for Snap Lake of 684 mg/L (PR#33 p21).<sup>12</sup> With the implementation of theoretical water treatment, the concentration of TDS in Snap Lake was predicted to be less than the proposed SSWQO of 684 mg/L.

Without additional treatment, the concentrations would range between 800 mg/L and 1,700 mg/L (Figure 10).

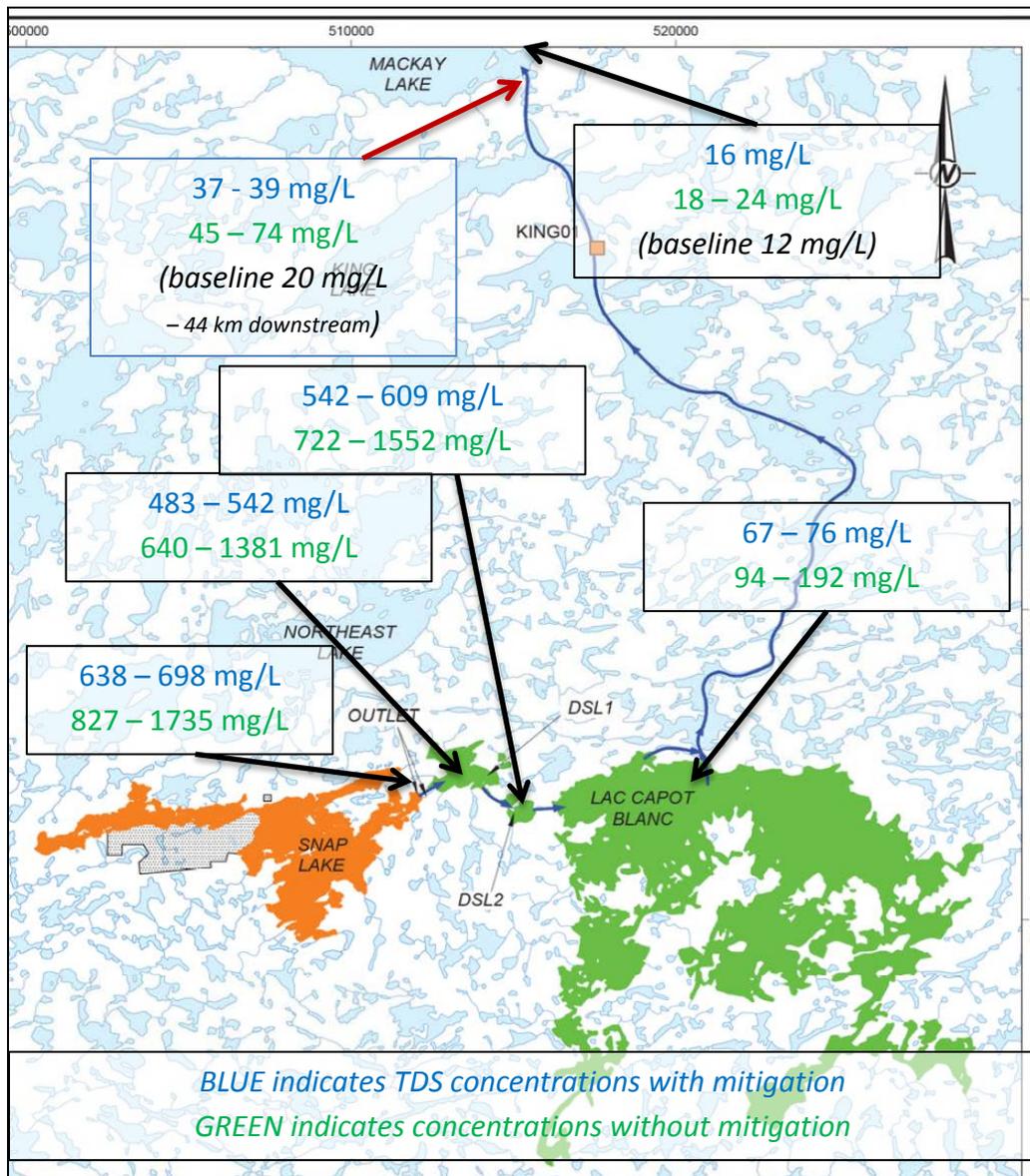
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<sup>12</sup> See section 2.1 for a discussion of the initially proposed concentration of 684 mg/L.



**Figure 10: Predicted TDS concentrations in Snap Lake without mitigation (PR#62 p38)**

To assess the effect on the downstream environment, De Beers completed a downstream lakes model (Figure 11). The lakes considered in detail were the two immediately downstream of Snap Lake (Downstream Lake 1 and Downstream Lake 2) and Lac Capot Blanc (16 km downstream of Snap Lake). A simpler approach was used to assess the effects downstream of Lac Capot Blanc to the Lockhart River outlet. At Lac Capot Blanc, the concentrations of TDS decreased to less than 200 mg/L without additional mitigation and to less than 100 mg/L with additional mitigation (PR#62 p10). By Mackay Lake (44 km downstream of Snap Lake), the effects of the elevated TDS concentrations were predicted to not be measurable (Figure 11) (PR#35 p27; PR#150 p5).



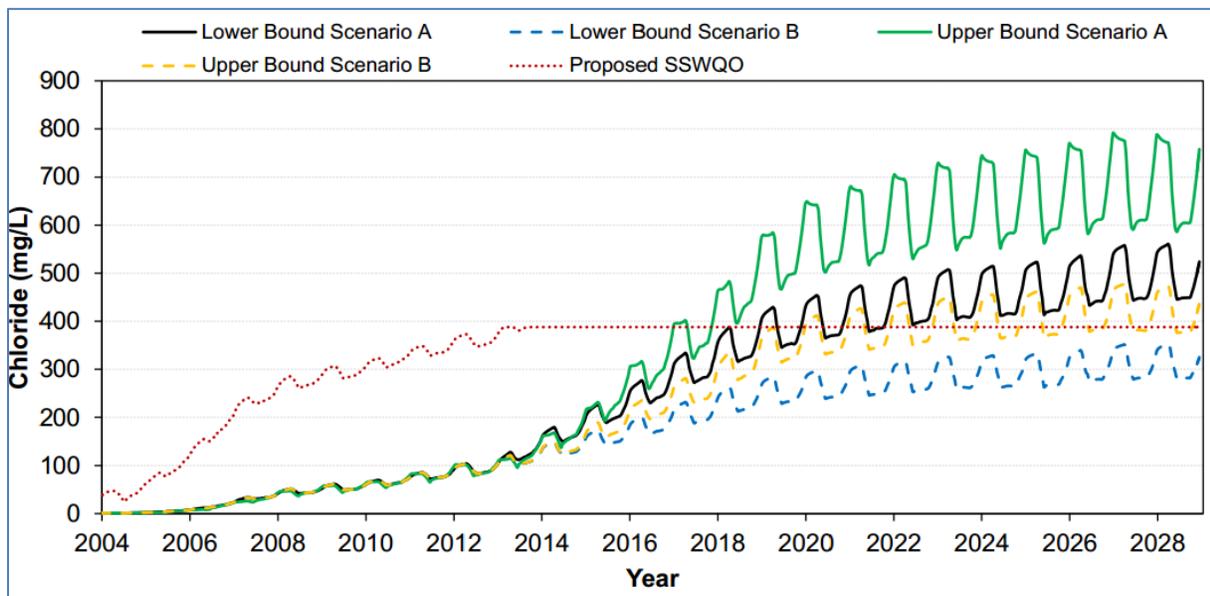
**Figure 11: Predicted TDS concentrations downstream of Snap Lake with and without mitigation**  
(PR#33 p30-49; PR#62 p10-35)

Initially, De Beers asserted that a SSWQO of 684 mg/L is protective of aquatic life. It stated that at that concentration, with mitigation implemented to treat for TDS, the elevated TDS concentrations would be relatively localized and there should be no adverse effects to Snap

Lake or downstream (PR#122 p15 and 21). Based on further testing, De Beers later stated that a higher limit would still be protective of aquatic life (PR#35 p54).

### Chloride

Chloride is the largest constituent of TDS in Snap Lake. The modelling predicted that chloride concentrations would range between 350 – 800 mg/L in Snap Lake at the end of mine life (Figure 12) without further mitigation.



**Figure 12: Predicted chloride concentrations in the main basin of Snap Lake with existing water treatment**  
(PR#12 p3-12)

### Proposed SSWQO

De Beers' proposed SSWQO for chloride was based on studies completed for the Ekati diamond mine. The SSWQO for chloride depended on the water hardness with the SSWQO increasing as hardness increased. The hardness of water works to reduce the toxicity of chloride. This means that as hardness increases more chloride can be added to water without having negative effects to aquatic life. The hardness-dependent function used at the Ekati diamond mine was calculated to a hardness of 160 mg/L (PR#12 p3-13).

De Beers predicted that chloride concentrations will exceed the proposed SSWQO in the near future and therefore mitigation is required.

A summary of the concentrations of TDS, and its constituent ions, in Snap Lake and downstream is set out in Table 3. The range in concentrations account for the four

scenarios that were modelled (Table 1).<sup>13</sup> Results are shown with and without the proposed mitigation. The predicted downstream concentrations were based on the results from the downstream lakes model but were not explicitly remodelled.

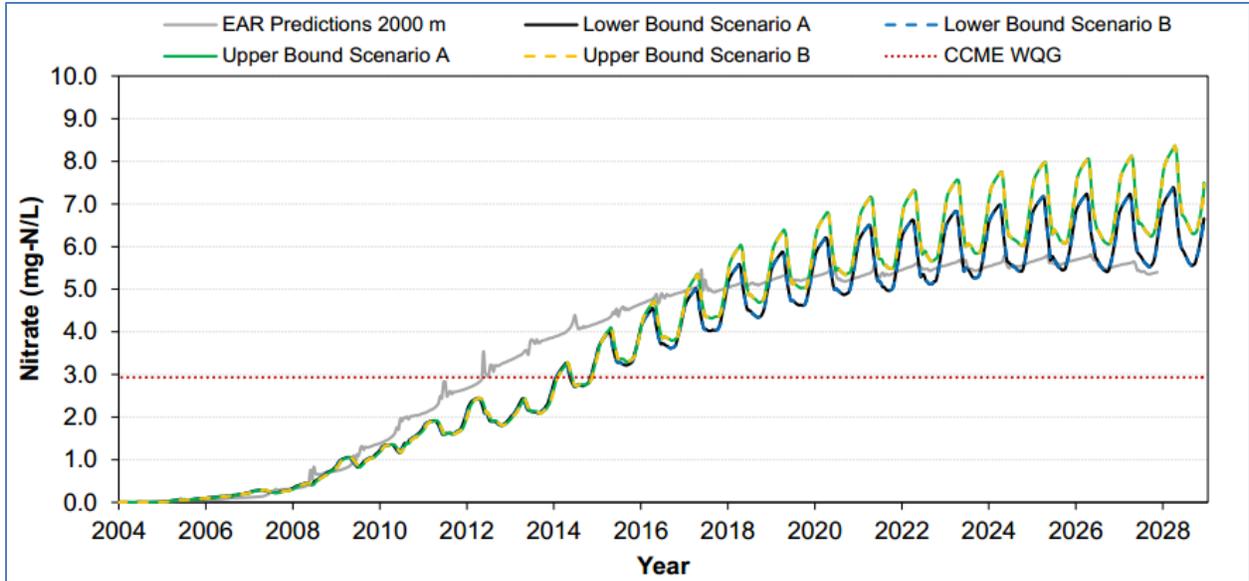
**Table 3: Concentrations of TDS and its constituent ions with and without mitigation (PR#62 -7-11)**

Location	Snap Lake Outlet		Downstream Lake 1		Downstream Lake 2		Lac Capot Blanc	
	min	max	min	max	min	max	min	max
<b>Without Mitigation</b>								
<b>TDS</b>	827	1,735	640	1,381	722	1,552	94	192
<b>Chloride</b>	295	634	228	504	257	567	31	70
<b>Fluoride</b>	0.45	0.47	0.35	0.38	0.40	0.42	0.05	0.05
<b>Sulphate</b>	58	118	45	94	50	106	6	13
<b>Hardness</b>	489	977	378	777	426	874	52	108
<b>With Mitigation</b>								
<b>TDS</b>	638	698	483	542	542	609	67	76
<b>Chloride</b>	287	314	217	244	244	274	30	34
<b>Fluoride</b>	0.29	0.32	0.22	0.25	0.25	0.28	0.03	0.03
<b>Sulphate</b>	46	50	35	39	39	44	5	5
<b>Hardness</b>	372	407	282	316	316	355	39	44

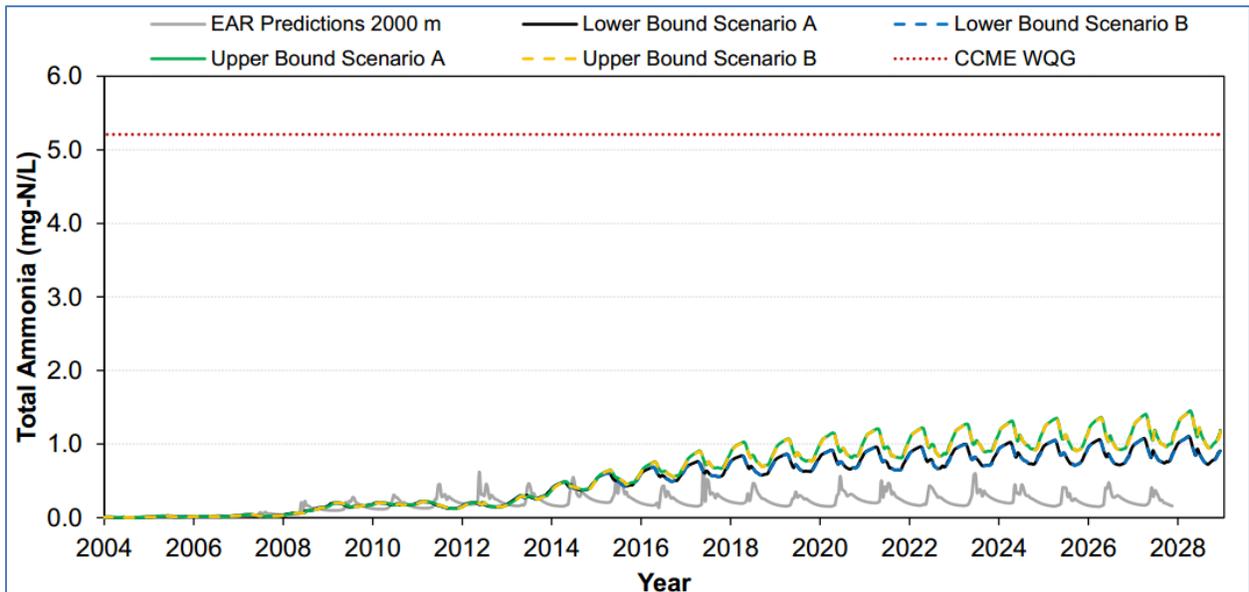
### *Nitrogen*

Nitrogen in the waste water is primarily a by-product of the explosives used for blasting. The two constituents of concern which contain nitrogen were nitrate and ammonia. The nitrate concentrations were predicted to be near 8 mg/L which would exceed the CCME water quality guideline of 2.93 mg/L (Figure 13). The ammonia concentrations were predicted to be less than the CCME water quality guideline of 5.2 mg/L (Figure 14).

<sup>13</sup> See section 2.1 for a discussion of the initially proposed concentrations..



**Figure 13: Predicted nitrate concentrations in the main basin of Snap Lake with existing water treatment (PR#13 p15)**



**Figure 14: Predicted ammonia concentrations in the main basin of Snap Lake with existing water treatment (PR#13 p23)**

### Proposed SSWQO

De Beers' proposed water quality objective for nitrate and ammonia were based on the approach used by Ekati for nitrate and using the chronic CCME<sup>14</sup> and US EPA guidelines for ammonia (PR#13 p iii). The maximum proposed water quality objective for nitrate was 16.4 mg/L (PR#34 p8) and was a function of water hardness (PR#13 p iii). De Beers confirmed the relationship established by Ekati by testing sensitive aquatic species with two types of water: one with a TDS of 228 mg/L and hardness of 140 mg/L and one with TDS of 570 mg/L and hardness of 350 mg/L (350 mg/L represents the maximum predicted hardness at Snap Lake) (PR#13 p16). The proposed water quality objective for ammonia was based on guidance set out by the CCME and was determined to be 5.21 mg/L (chronic guideline) and 21 mg/L (acute guideline) (PR#34 p10).

Estimating the concentrations of ammonia and nitrate in Snap Lake was more complex than for TDS because ammonia and nitrate change in Snap Lake through chemical and biological reactions. These reactions change the chemical makeup of the compounds and consequently the toxicity. The models used to predict nitrate and ammonia concentrations considered the amount of water, the quality of the water, as well as how the water quality would affect the chemical and biological reactions that affect the makeup and toxicity. The models predicted that nitrate and ammonia would remain below the proposed water SSWQO. The maximum nitrate concentration was predicted to be less than 9 mg/L and the maximum for ammonia was less than 2.5 mg/L.

No additional mitigation was proposed to remove nitrogen from the effluent since the predicted nitrate and ammonia concentrations were below the proposed SSWQO. In addition, De Beers stated that it is making efforts to reduce nitrogen loading through improving blast efficiency by:

- reducing the number of holes per blast round;
- reducing the amount of explosives used per hole; and,
- removing and reusing any old emulsion on surface.

### **Strontium**

Strontium originates from the kimberlite and the rocks surrounding the kimberlite, 91% of the strontium comes from the underground. Strontium concentrations were predicted to range between 2.4 mg/L and 4.7 mg/L (PR#21 p4-2).

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<sup>14</sup> CCME, 2003. *Canadian Water Quality Guideline for the Protection of Aquatic Life. Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives.*

### Proposed SSWQO

Currently, there are no national water quality guidelines for strontium. De Beers proposed a site specific water quality objective for strontium of 14.1 mg/L (PR#21 p6-1) based on a review of published studies on the chronic effects of strontium to aquatic life. De Beers did not conduct toxicity testing itself in this case. Modelling at Snap Lake predicted that concentrations would remain below the water quality objective. No additional mitigation was proposed to treat for strontium.

### **Fluoride**

Fluoride was a minor component of TDS (approximately 0.1%) with concentrations expected to reach a maximum of 0.5 mg/L in Snap Lake.

### Proposed SSWQO

De Beers proposed an SSWQO of 2.46 mg/L based on a review of relevant toxicity literature (PR#35 p27).

#### **4.1.3 De Beers' submission on mitigation to meet proposed SSWQOs**

In order to achieve its proposed SSWQOs, De Beers committed to implement mitigation. De Beers reiterated this commitment throughout the EA.

In its technical session presentation, De Beers stated,

*De Beers has committed to implementing treatment to protect Snap Lake and downstream water bodies. The treatment options proposed are proven technologies that are currently undergoing feasibility testing to determine the best treatment option application to the unique setting of the mine. (PR#66 p2)*

In response to parties' technical reports De Beers stated, "De Beers will implement technologically, environmentally, and economically appropriate means to ensure that the SSWQOs and EQC approved by the MVLWB in the subsequent regulatory process are met over the life of mine" (PR#112 p 2).

In the public hearing presentation De Beers stated, "De Beers is evaluating and will implement effective mitigation as appropriate to reduce loadings to ensure that a protective SSWQO for TDS in Snap Lake, as approved by the MVLWB, is not exceeded" (PR#122 p20).

In its closing comments De Beers stated, "De Beers commits to implementing mitigation over the life of mine to meet a protective, yet achievable TDS SSWQO to be established by the MVLWB" (PR#150 p2).

De Beers stated several times that it is committed to implementing ‘treatment’ or ‘mitigation’ to meet the proposed SSWQOs (PR#150; PR#122 p47; PR#62 p1; PR#35 p3 and 18).

With respect to what form this ‘treatment’ or ‘mitigation’ would take, De Beers stated during the public hearing that information on treatment technologies was provided to the Review Board on April 30 in response to information requests that arose from the technical session (PR#131 p100). The cover letter to De Beers’ information request response stated, “the treatment options proposed are proven technologies that are currently undergoing feasibility testing...” (PR#66 p2). With respect to these ‘proven technologies’ the response to information request number three states, “RO (Reverse Osmosis) was selected in the absence of bench/pilot-scale testing to ensure compliance with the 2015 effluent licence requirements for fluoride, chloride, and nitrate” (PR#59 p1-1).

De Beers also stated that it is investigating the feasibility of focused grouting in order to reduce the inflows of high TDS concentration groundwater entering the mine. De Beers stated that full ‘curtain’ grouting, that would isolate the mine workings from outside water inputs, was not feasible.

#### **4.1.4 De Beers submission on impacts to traditional use of Snap Lake and downstream waters**

De Beers proposed to increase TDS concentrations and increase the volume of effluent that is discharged into Snap Lake. De Beers predicted that with mitigation in place, its proposal will not have a significant negative effect on traditional use of Snap Lake and downstream, including the use of water for drinking.

In response to the YKDFN information request that few people use Snap Lake and the area surrounding, De Beers stated:

*[W]hile the development will result in a change in aesthetic drinking water quality in the immediate area of the Mine during operations and closure (2040), the water is safe to drink, there are few users in the immediate Snap Lake area who would be affected, the area will return to a TDS level below the drinking water guideline within 10 years of operations, and the area with elevated TDS concentrations would be localized. (PR#62 p55)*

With respect to fish, De Beers asserted that fish taste and abundance in Snap Lake will not change due to the proposed mitigated increase in TDS. To ensure that these predictions are accurate, De Beers stated that it will continue to monitor Snap Lake and downstream as

a requirement of the existing water licence and any future water licences. Specifically, De Beers stated:

*Fish abundance, health, tissue concentrations and taste in the Snap Lake area are monitored by De Beers (De Beers 2014b). Communities have gathered annually at Snap Lake for fish-tasting since 2004, fish were generally thought to taste good and sometimes rated as excellent (De Beers 2012, 2014b). Monitoring will continue such that the taste of fish can be evaluated annually by Elders. (PR#62 p 56)*

In terms of drinking water quality, De Beers presented its predictions relative to the *Guidelines for Canadian Drinking Water Quality* (August 2012 edition), which contains two types of guidelines: 1) health-based guidelines and 2) aesthetic guidelines. The distinction is described in the introduction of the guidelines as follows: “[H]ealth-based guidelines are established on the basis of comprehensive review of the known health effects associated with each contaminant, on exposure levels and on the availability of treatment and analytical technologies. Aesthetic effects (e.g., taste, odour) are taken into account when these play a role in determining whether consumers will consider the water drinkable.”

De Beers was aware that its proposal may affect how water in Snap Lake tastes and predicted that with mitigation in place, the drinking water quality in Snap Lake will be, in terms of taste, within the ‘fair’ range of the Canadian Drinking Water Quality Guidelines (PR#122 p22). Table 4 shows comparison of De Beers’ proposed SSWQO and Health Canada *Guidelines for Drinking Water Quality (updated to August 2012)* for the mitigated scenario. De Beers acknowledged that without mitigation, waters in Snap Lake and downstream to where the water enters Lac Capot Blanc would be above Health Canada’s aesthetic drinking water guidelines for TDS and chloride (that is, it would not be clean tasting drinking water which people would want to drink) (PR#62 p34). The water would also exceed Health Canada’s maximum acceptable concentration for nitrate (that is, it would be unhealthy to drink).

However, De Beers asserted that the unmitigated scenario was not relevant because its proposal was to apply mitigation to ensure that the water in Snap Lake is safe to drink and aquatic life is protected (PR#150 p2; PR122 p21). De Beers stated that “we are currently evaluating treatment as a feasible technology for what we believe to be protective site-specific water quality objective of 684 [mg/L TDS]” (PR#131 p181).

**Table 4: Comparison of drinking water guidelines (PR#33 p28)**

Parameter	Health Canada Guidelines for Drinking Water <sup>(a)</sup> (mg/L)	Site-Specific Water Quality Objective	Maximum Predicted Concentration in Snap Lake with Proposed Effluent Quality Criteria Are Met <sup>(b)</sup>			
			Lower Bound		Upper Bound	
			Diffuser	Outlet	Diffuser	Outlet
TDS	≤500 (AO)	<b>684</b>	<b>633</b>	<b>638</b>	<b>679</b>	<b>697</b>
Nitrate (as N)	10 (MAC)	<b>16.4</b>	6.2	5.3	7.2	6.4
Chloride (46% of TDS)	≤250 (AO)	<b>388</b>	<b>291</b>	<b>293</b>	<b>312</b>	<b>321</b>
Fluoride (0.06% of TDS)	1.5 (MAC)	<b>2.46</b>	0.38	0.38	0.41	0.42
Sulphate (7% of TDS)	≤500 (AO)	429	44	45	48	49

**Bold** concentrations are above a drinking WQG

a) Guidelines shown are from the Health Canada Guidelines for Canadian Drinking Water Quality (updated to August 2012).

b) Assumes TDS in effluent will be below the AML of 684 mg/L.

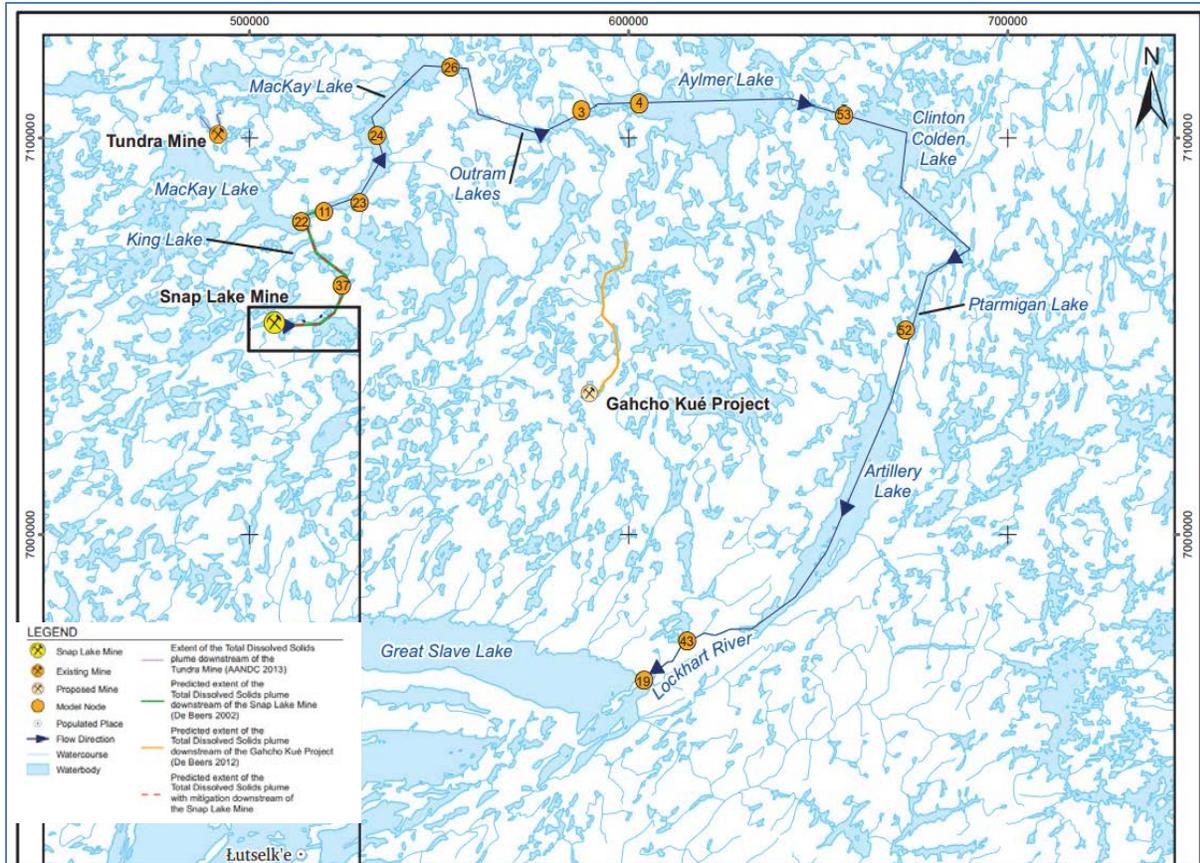
AO = aesthetic objective; MAC = maximum acceptable concentration; % = percent; TDS = total dissolved solids; N = nitrogen; mg/L = milligrams per litre.

With respect to the downstream effects of Snap Lake effluent, De Beers predicted, with mitigation in place to meet an SSWQO of 684 mg/L for TDS, effluent would be measurable up to 44 km downstream of Snap Lake, which is at the inlet of Mackay Lake (PR#122 p23; PR#150 p5). Figure 15 shows the flow path of water from Snap Lake.

De Beers stated that it will monitor water quality at the inlet of Mackay Lake to verify downstream predictions (PR#131 p60; PR#122 p43; PR#150 p4).

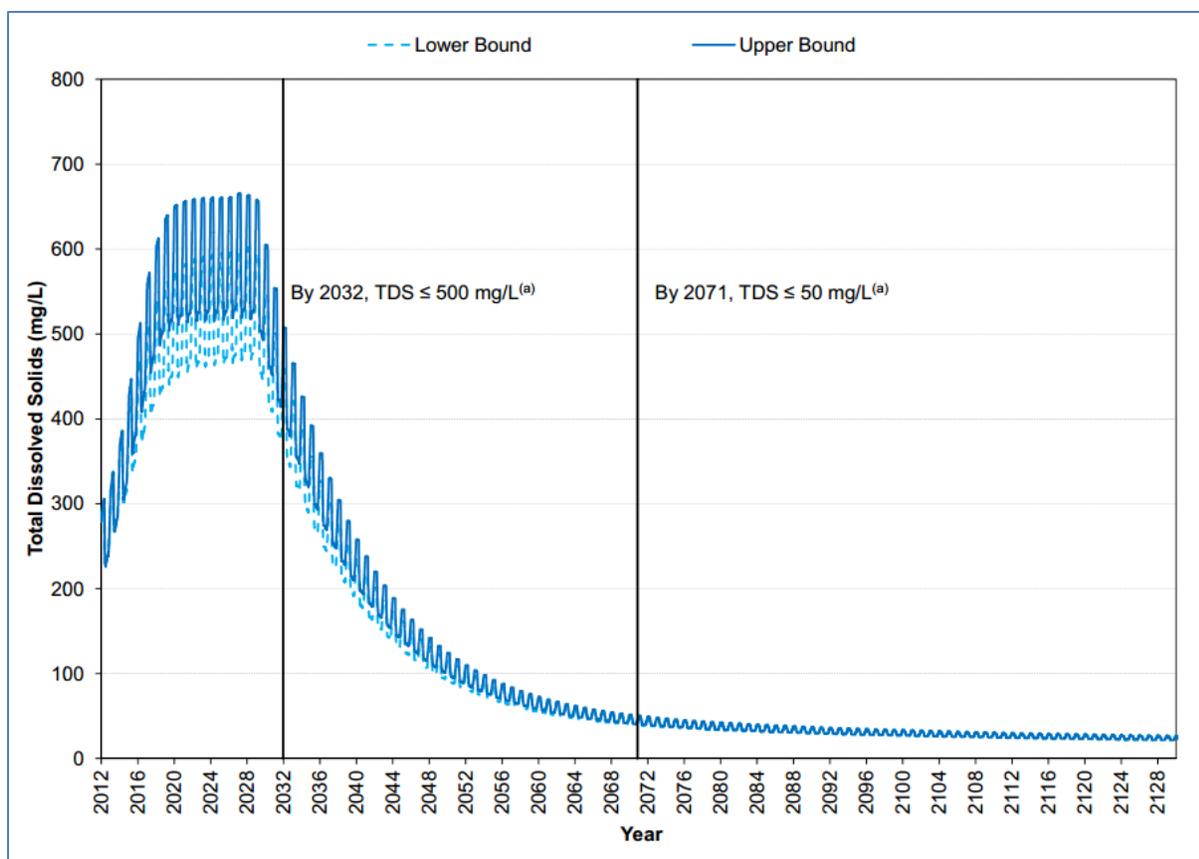
With respect to closure and TDS concentrations in Snap Lake, De Beers provided two modelled scenarios. The first modelled scenario predicted TDS concentration if there was no mitigation. For this scenario, De Beers provided the best case and worst case predictions of TDS. At the worst case scenario, TDS in Snap Lake at closure was predicted at 1,700 mg/L. At this concentration it would take 13 years after mining stops to reach a TDS concentration of 500 mg/L.

The second modelled scenario predicted TDS concentrations if there was mitigation of TDS to 684 mg/L (Figure 16). This model predicted that TDS concentrations would decrease from 684 mg/L to 500 mg/L within three to four years once mining stops. With respect to Health Canada guidelines, De Beers indicated that, after mining, drinking water should return to 'good' (less than 600 mg/L TDS) within four years and excellent within ten years (less than 300 mg/L TDS) (PR#122 p22).



**Figure 15: The predicted flow path of water from Snap Lake.**  
(PR#33 p31)

In order to meet the proposed SSWQO for TDS De Beers will have to implement mitigation, and has committed to do so. De Beers identified “high-efficiency Reverse Osmosis technology as the preferred mitigation alternative...” (PR#62 p59).



**Figure 16: Predicted whole-lake average TDS concentration in Snap Lake, from 2012 to 2013 at the 'mitigated' scenario (PR#135 p4)**

#### 4.1.5 De Beers' submission on best available technology economically achievable

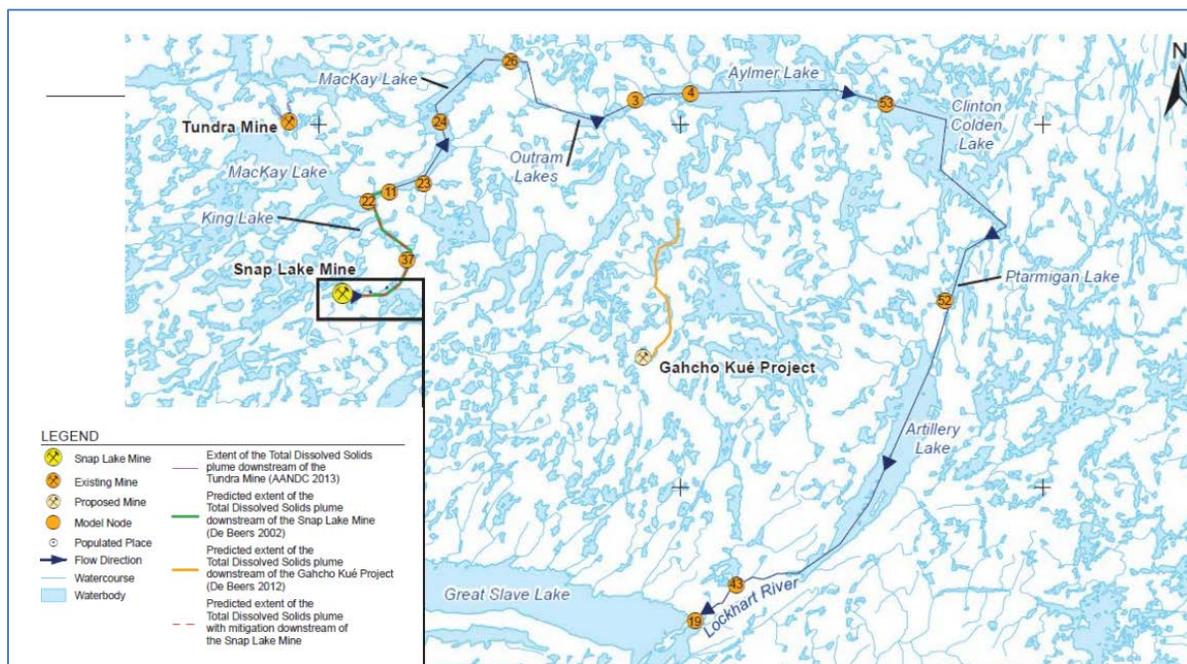
De Beers acknowledged that setting numeric SSWQOs for Snap Lake required understanding the concentration at which effects may occur in the aquatic environment. De Beers also acknowledged that setting numeric effluent quality criteria that will meet those SSWQOs required finding the balance between the maximum concentration that can be safely discharged and potentially a lower concentration that is economically achievable. This approach is referred to as best available technology economically achievable (BATEA). De Beers committed to undertaking a BATEA type study and agreed that the results of this study should be considered by the MVLWB when setting the numeric effluent quality criteria (PR#122 p18, PR#150 p5).

#### 4.1.6 De Beers' submission on cumulative effects

During its presentation to the Review Board at the public hearing on June 5, 2014, De Beers described its views on the potential for cumulative effects to water quality in the Lockhart

River watershed due to mine effluent from its Snap Lake mine (PR#122, p23-24). De Beers stated that since this development (discharging mine water per the proposed amendments) will replace the current situation (under the existing licence), the combined effects of both have inherently been assessed for Snap Lake and downstream waters (PR#122, p23).

Effluent from the Snap Lake mine that meets the proposed SSWQO was predicted to not be measureable 44 km downstream from Snap Lake (PR#150 p4). However, De Beers noted that there are no other past, present, or reasonably foreseeable developments that will have an on impact water quality within this section of the Lockhart River watershed (PR#122, p23). De Beers stated during the public hearing that in its view there was no potential overlap of the Project's effects to water quality with other past and reasonably foreseeable developments if proposed effluent discharge limits are met. It concluded that the current licence amendment application will not contribute to cumulative effects on water quality within the Lockhart River watershed (PR#131, p58). Predicted flow paths from the Snap Lake and Gahcho Kué mines with model node locations downstream of Snap Lake are shown in Figure 17.



**Figure 17: Predicted flow paths from Snap Lake and Gahcho Kué diamond mines with model node locations (PR#122, p24)**

#### 4.1.7 De Beers' submission on accidents and malfunctions

De Beers assessed the potential for the environmental effects from accidents and malfunctions at the Snap Lake Diamond Project in its original *Environmental Assessment Report* dated February 2002 (PR#125, Section 13). In that report, the assessment of risks that are relevant to the current licence amendment application included the failure of the water treatment system and breach of the dams, and further, all other risks from accidents and malfunctions were associated with minor environmental consequences, except for moderate consequence for dam failure, which was considered extremely unlikely (PR#125, p13-13 – 13-28). In its *Report of Environmental Assessment and Reasons for Decision 2003*, the Review Board concluded that significant adverse impacts on the environment due to accidents and malfunctions were not likely to occur (PR#15, p207).

On April 11, 2014 De Beers submitted information on accidents and malfunctions for this licence amendment application as a supplemental filing prior to the technical sessions (PR#33). De Beers assessed the consequences from accidents and malfunctions related to the discharge of treated mine water containing elevated levels of TDS into Snap Lake (PR#33, p41). De Beers concluded that the environmental consequences of the modelled accidents and malfunctions cases were assessed as negligible to low and any effects would be restricted to sensitive species and not to the larger aquatic community (PR#33, p51).

De Beers elaborated on these findings during its presentation on accidents and malfunctions at the technical session on April 15, 2014 (PR#45, p82-93). It concluded that in the event of an accident or malfunction, there may be a small effect to reproduction or growth of a few types of plankton in a small area of Snap Lake but that these effects would be low to negligible and reversible (PR#45, p92).

#### 4.1.8 De Beers' submissions on alternatives

In order to fulfill the requirements of subsection 117(2) of the *Act*, the scope of assessment includes a consideration of alternate means of carrying out the proposed activities. The Review Board notified De Beers of this requirement in *Draft Review Board Proposed Scope of Environmental Assessment, Snap Lake Mine Amendment Project* (PR#17). De Beers provided information on alternatives shortly before the technical session.

De Beers proposed to increase the amount and concentration of TDS and its constituent ions that are discharged into Snap Lake up to a value for concentration that is determined through site specific toxicity testing and to apply mitigation in order to achieve this value.

As part of De Beers' initial application, information was provided on water treatment methods to achieve the proposed numeric SSWQOs for TDS and its constituent ions. This

proposed water treatment centred on using reverse osmosis as the primary means of removing TDS from effluent. In its submissions, De Beers indicated that it was assessing the feasibility of this option but did not provide detailed information. De Beers reiterated that reverse osmosis was likely the most cost effective and reliable treatment method in the technical session (PR#66 p2).

In response to the Review Board's notification that De Beers must provide alternative means for carrying out the development, De Beers submitted documents that evaluated alternative ways to reduce TDS concentrations in Snap Lake mine effluent to meet a proposed SSWQO for TDS of 684 mg/L and likewise SSWQOs for its constituent ions. De Beers provided information on three potential alternatives:

- maintaining the current TDS limit of 350 mg/L using additional water treatment such as reverse osmosis;
- decreasing mining intensity which would decrease the amount of water that requires treatment; and
- use of grouting to decrease the amount of water entering the mine and hence, reduce the amount of water containing TDS reporting to Snap Lake.

The first alternative consisted of discharging effluent at currently licenced limits, which is a whole lake average of 350 mg/L of TDS in Snap Lake (PR#33 p69). De Beers predicted the cost to treat mine effluent over the life of mine to meet the 350 mg/L limit was \$188 million. De Beers concluded this alternative would render the mine uneconomical.

The second alternative focused on reducing the inputs of TDS to the mine workings through reducing advancement of the footwall. This would reduce the largest source of TDS loading to the mine and consequently to Snap Lake. However, De Beers found that this alternative would reduce the amount of ore mined and therefore the amount of diamonds recovered. De Beers concluded that this would render the mine uneconomical in the long term (PR#33 p69).

In addition to the two theoretical alternatives listed above, De Beers provided information about a third method that was implemented in an attempt to reduce TDS inputs to the mine. This method used grout (similar to cement) that was injected into the walls of the mine in order to reduce the inflows of high TDS groundwater entering the mine. De Beers concluded that this approach was only partially effective in reducing TDS inputs to the mine and that full grouting was not feasible (PR#35 p26).

De Beers stated in its closing comments:

*De Beers has noted that decreasing the concentrations of TDS in effluent by treatment methods, while desirable in some respects, will result in other potential environmental impacts such as increased infrastructure, waste storage, handling, transportation, and disposal, and increased energy demands. In plain terms, taking the salt out of the water doesn't make it go away, and it is important that treatment not cause more environmental impacts than it avoids. This consideration of trade-offs will need to take into account what concentrations of TDS continue to maintain the ecosystem function of Snap Lake; again, the fundamental purpose of developing SSWQOs. (PR#150)*

De Beers asserted that consequences and effects on the environment of the chosen treatment option will be assessed during the regulatory phase, including accidents and malfunctions and a risk assessment (PR#66 p2).

## **4.2 Parties' Submissions and Recommendations**

This section of the REA presents parties' submissions and recommendations.

### **4.2.1 Parties' submissions on traditional use**

Aboriginal groups told the Review Board that they were concerned De Beers' proposal will impact traditional uses. The GNWT, in its closing statement, reinforced this evidence when it stated "the GNWT recommends ... that the Review Board determine significance, and recommend measures, according to traditional use standards" (PR#148 p1).

Aboriginal groups asserted that Snap Lake, and the larger area around it, is used for traditional activities (PR#129: PR#84 p7; PR#83 p8; PR#82 p1). This included Snap Lake, downstream to Mackay Lake and to Lady of the Falls. The YKDFN told the Review Board that community members use Snap Lake and Mackay Lake and stressed the importance of Mackay Lake as it is used by a wide variety of community members, including elders and youth (PR#83 p8; PR#132 p87). The YKDFN stated:

*The Band has a number of cabins and has supported harvesting efforts there every year, including schools, Elders. It's an active cultural site. We can't risk further environmental degradation, because that wasn't part of the original assessment that was made. (PR#132 p87)*

Aboriginal groups acknowledged De Beers' commitment to ensuring the water in Snap Lake is safe to drink. However, the YKDFN told the Review Board that perception of the water affects the level of use of the Snap Lake area: "When water tastes bad, people will view the area with suspicion. When you view an area with suspicion, it is no longer part of

the viable and useful land base” (PR#131 p 86). The LKDFN shared this concern and did not want the ability of community members to drink the water compromised (PR#145 p4).

In response to De Beers’ proposed SSWQO for TDS of 684 mg/L, Aboriginal groups proposed a compromise. This compromise would satisfy several Aboriginal concerns including traditional use of Snap Lake and their concerns that there was no safety margin to ensure protection of aquatic life associated with the proposed SSWQO for TDS. This compromise was to adopt the aesthetic standards of Health Canada’s *Guidelines for Canadian Drinking Water Quality* of 500 mg/L (PR#145; PR#140; PR#132 p89; PR132 p111). The YKDFN asserted that beyond this limit “we start to see impacts to the land and water that make it unusable for our members and our land users” (PR#131 p 86). In its closing comments the LKDFN reiterated this request for a 500 mg/L limit (PR#145 p5).

Aboriginal groups emphasized the spiritual importance of the Lady of the Falls. This is discussed in detail in section 4.4.5 below.

Aboriginal groups were concerned that effluent from the mine is traveling downstream and that with a proposed increase in TDS to 684 mg/L the effluent plume will travel even further. At this concentration, De Beers predicted that the plume will not be measurable at Mackay Lake, approximately 44 km downstream from Snap Lake (PR#150 p4). Impacts to Mackay Lake were a concern to Aboriginal groups due to the potential impacts to traditional activities and also because of a lack of trust in De Beers’ predictions. The LKDFN and YKDFN expressed the concern that predictions made by De Beers were based on models and that these models are often wrong (PR#140 p2). The fear was that the plume will travel further than predicted. The LKDFN told the Review Board that “this plume is a source of constant worry for the First Nation” (PR#132 p104).

The LKDFN recommended to the Review Board that in order to mitigate the concern caused by the plume, a hard limit on the end of that plume be required (PR#132 p124). The LKDFN recommend a hard limit of 44 km downstream. This point is a significance threshold for the LKDFN at which the economic benefits of the Project are outweighed by the potential impacts to traditional activities (PR#132 p107, p108). The YKDFN stated in its technical report that “if effluent from Snap Lake never reaches Mackay Lake, this is the best of a bad situation” (PR#84 p6).

The NSMA expressed its concern that the mine is a source of pollution that is impacting Snap Lake and downstream areas. The NSMA told the Review Board about concerns regarding the uncertainties related to De Beers’ models and predictions that were used to set the proposed SSWQOs. Because of the uncertainties the NSMA recommended “that De

Beers develop with stakeholders an official management strategy which includes a suite of precautionary response steps to predict, identify, and manage for increasing trends TDS” (PR#132 p135). Further, the NSMA recommended that De Beers implement additional water treatment to mitigate the effects of TDS (PR#115 p14).

With regard to traditional uses of water in Snap Lake at the end of mine life, Aboriginal groups told the Review Board that they want to use Snap Lake as soon as possible. The Aboriginal groups are concerned that the effects of TDS on Snap Lake after closure will mean that the lake is not useable for a long time. The YKDFN stated, “the Yellowknives have little confidence that the lake will return to its former state in a timely manner” (PR#131 p87).

To mitigate this concern, the YKDFN told the Review Board during the public hearing that Snap Lake should return to a state that is usable as soon as possible and stated, “[H]aving this area return as quickly as possible, and be productive, and the users going back there to access the resources that it will eventually provide, is essential for the well-being of the Yellowknives” (PR#132 p101). The LKDFN stated its wish to use Snap Lake very shortly after closure (PR#132 p125).

#### **4.2.2 Parties’ submissions on “pollute-up-to approach”**

Aboriginal groups told the Review Board that De Beers’ approach to setting SSWQO was a “pollute-up-to-approach” that relied on models and predictions that are often wrong (PR#84 p4). The Review Board heard that in the past De Beers’ predictions were not accurate and Aboriginal groups have little trust in new predictions from De Beers (PR#145, PR#139 p1).

The YKDFN expressed its concern about De Beers’ proposal of setting an SSWQO for TDS that is at the same concentration that De Beers predicted effects may occur to aquatic life. At this concentration, the YKDFN and LKDFN told the Review Board, there is no room for error because there is no safety margin. If the models are wrong and concentrations of TDS exceed this limit there could be significant effects to aquatic life (PR#140 p2). The LKDFN voiced this concern in their closing comments when they stated, “Our values of protection of the long term viability of the lake and its species, and the precautionary principle, shape our conclusion that there is no need to set the effluent discharge at a level where we no longer have any flexibility in the ecosystem” (PR#145 p3).

Regardless of the concerns about safety margins, the Aboriginal groups and the GNWT expressed concern that setting pollute-up-to limits ignores principles and ideals surrounding conservation. The GNWT told the Review Board that this approach appears to

be incongruent with environmental stewardship policies from the government's own water stewardship strategy, which includes in its objective that, "[w]aters that flow into, within or through the NWT are substantially unaltered in quality, quantity and rates of flow" (PR#119 p4).

Environment Canada (EC) expressed concerns that the increasing concentration of TDS in Snap Lake and trends of individual components of TDS are not well understood. The DKFN had similar concerns regarding uncertainties associated with toxicity testing (PR#147 p3). This uncertainty was heightened because De Beers did not provide sufficient information on mitigation options to achieve the proposed SSWQOs and hence, there was doubt whether De Beers can achieve the SSWQOs.

EC recommended that, in light of the uncertainties of how the environment will respond to increasing concentrations of TDS, a precautionary approach should be taken when setting SSWQO and EQCs. EC recommended in its technical report that a best available technology economically achievable study is applied and that this approach should be backed up with a rigorous and comprehensive monitoring program (PR#94 p8-11).

#### **4.2.3 Parties' submissions on SSWQO guidelines**

With respect to the guidelines used for developing SSWQOs, the GNWT recommended that De Beers use the 2003 CCME guidance on the derivation of SSWQOs<sup>15</sup> and the 2007 protocol for the derivation of water quality guidelines<sup>16</sup>. The GNWT's position was that SSWQOs based on this guidance, "should result in levels of contaminants of potential concern, such as TDS and chloride that are protective of aquatic life" (PR148 p2). The GNWT raised the concern that De Beers did not apply the procedures for determining SSWQO correctly and hence, the proposed SSWQOs may not achieve their intended goal - protection of the aquatic life.

#### **4.2.4 Parties' submissions on cumulative effects**

De Beers asserted that there are no other developments within this 44 km plume detection area that also influence TDS. De Beers stated, in its response to information requests following the technical sessions, that:

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<sup>15</sup> CCME. 2003. Canadian water quality guidelines for the protection of aquatic life: Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives. In: Canadian environmental quality guidelines, 1999, CCME, Winnipeg.

<sup>16</sup> CCME. 2007. A protocol for the derivation of water quality guidelines for the protection of aquatic life. In: Canadian environmental quality guidelines, 1999, CCME, Winnipeg.

*“The cumulative effects section of the Supplemental Information identified that, while there are developments in the Lockhart River Watershed, there is no overlap between these and the Snap Lake treated effluent discharge; thus, there is no overlap related to possible cumulative effects from TDS.” (PR#62, p61-62)*

When questioning De Beers after its presentation, LKDFN observed that at a watershed level, if contamination from Snap Lake is detectable 44 km downstream from the mine and Gahcho Kué contamination is, for example, detectable 44 km downstream from that mine, then the total of contamination in the watershed is 88 km. In the view of LKDFN, that is a cumulative effect on water quality (PR#131, p137). In its June 6 public hearing presentation, LKDFN made it clear that the Lockhart River watershed is of tremendously high social and cultural value and that it views the watershed as threatened due to ineffective mitigation to protect water quality from the Snap Lake mine. Lutsel K’e is concerned about the possible impacts of the Lockhart watershed from future mining developments (PR#132, p110).<sup>17</sup>

The Review Board’s analysis and conclusions regarding cumulative effects are provided below in section 4.4.4.

#### **4.2.5 Parties’ submissions on accidents and malfunctions**

During the technical session, discussion by parties on the topic of accidents and malfunctions related primarily to the lack of information from De Beers on what type of treatment technology would be utilized in order to meet water quality objectives in Snap Lake.

At the technical session, in response to questioning from parties who were unclear about the type of additional water treatment needed to treat water to meet proposed SSWQOs, De Beers stated that “we are committed to developing technology that will meet the current proposed EQCs” (PR#44, p215). During the technical session, De Beers stated that in the event of an accident or malfunction at the water treatment plant, “we can always put a lot of water back underground, and that is our emergency fall-back situation” (PR#45, p109) and “even if we had a failure prior to water coming into the water treatment plant, we actually have an option to put everything back underground” (PR#45, p111).

The Review Board’s analysis and conclusions regarding accidents and malfunctions are provided below in section 4.4.6.

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<sup>17</sup> See section 4.4.5 for further details on the spiritual significance of the Lockhart River.

#### 4.2.6 Parties' submissions on alternatives

In response to information regarding mitigation, alternative options included:

- complete curtain grouting;
- focused grouting; and,
- water treatment using reverse osmosis.

Parties raised concerns that De Beers did not provide sufficient information that these methods would work to:

- meet the numeric SSWQOs; and
- allow for an assessment of the effects that may result from implementing these mitigations.

The Review Board's analysis and conclusions regarding accidents and malfunctions are provided below in section 4.4.6

#### 4.3 Review by Ecometrix

The Review Board contracted an independent consulting firm, Ecometrix Incorporated., to review the technical information provided by De Beers. Specifically, Ecometrix reviewed:

- the methodology used to determine the SSWQO;
- the likelihood of exceeding the water quality objectives by assessing the validity of the modelling;
- the effects to aquatic life if the water quality objectives are exceeded;
- the proposed mitigation; and,
- the methodology used to determine the EQC.

The first four items relate directly to the scope of the EA. The first three will be discussed in this section to comment on the validity of the predictions by De Beers.

##### 4.3.1 Methodology used to determine SSWQO and effects to aquatic life

Overall, Ecometrix found the methods used by De Beers to determine the SSWQO to be appropriate and adequately protective of aquatic life.

##### *Total Dissolved Solids*

Ecometrix agreed that an SSWQO based on the lowest concentration that effects could be measured on the test organisms from the site specific tests was reasonable. For the predicted concentrations without mitigation (1,700 mg/L TDS), Ecometrix stated there would likely be a reduction in the abundance of certain aquatic species in Snap Lake and in the lakes immediately downstream (Downstream Lake 1 and 2); however, there was

uncertainty associated with the predictions and that “major changes in the zooplankton community cannot be ruled out” (PR#77 p4.2).

### *Chloride*

Ecometrix agreed with the proposed SSWQO for chloride of 378 mg/L. For the predicted concentrations without mitigation (800 mg/L), Ecometrix stated there would likely be a reduction in the abundance of certain aquatic species in Snap Lake and in the lakes immediately downstream (Downstream Lake 1 and 2); however, Ecometrix also acknowledged that there was uncertainty associated with the predictions and that “major changes in the zooplankton community cannot be ruled out” (PR#77 p4.3).

### *Fluoride*

Ecometrix agreed that the proposed SSWQO for fluoride, 2.46 mg/L, is “adequately protective for aquatic life in Snap Lake” (PR#77 p2.4). However, it also noted that lower targets for fluoride “might be accommodated in the interest of non-degradation” (PR#77 p2.4). The Ecometrix report was careful to state that the Health Canada maximum acceptable concentrations for drinking water for fluoride (1.5 mg/L) should not be exceeded at the drinking water intake of the Snap Lake mine camp (PR#77 p2.4).

### *Sulphate*

Ecometrix agreed that the proposed SWSQO for sulphate, 427 mg/L, is likely “adequately protective against toxic effects in Snap Lake,” but noted that “there was some uncertainty as to protective levels of sulphate” for higher hardness values (hardness > 250 mg/L) (PR#77 p2.10).

### *Nitrogen*

Ecometrix agreed that the proposed SSWQO for nitrate and ammonia were adequately protective of aquatic life in Snap Lake. With respect to nitrate, concerns were raised over the possible effects of nitrate at higher hardness values. Regarding ammonia, Ecometrix noted that the proposed SSWQO for ammonia was 5.21 mg/L and the correct value is 4.6 mg/L (using the same methodology to calculate the value). De Beers agreed with this corrected value.

The Ecometrix report was careful to state that the Health Canada maximum acceptable concentrations for drinking water for nitrates (10 mg/L) should not be exceeded at the drinking water intake (PR#77 p2.4 - 2.7).

### *Strontium*

Ecometrix agreed that the proposed SSWQO for strontium, 14.1 mg/L, was likely adequately protective of aquatic life in Snap Lake. It was noted that there is uncertainty

related to the potential effect of increased sediment concentrations. In addition, Ecometrix commented that “a lower target might be accommodated in the interest of non-degradation” (PR#77 p2.8)

#### 4.3.2 Validity of modelling

Ecometrix was confident that the models provided by De Beers were as accurate as the data allowed (PR#77 p3.7). Ecometrix expressed concerns about accuracy of the groundwater model, specifically the hydraulic conductivity values and TDS concentrations used. Hydraulic conductivity describes how well the subsurface material transmits water and was the main factor which controlled groundwater flow in the model. Ecometrix was concerned about the hydraulic conductivity values used because there was no indication that the values used in the model were consistent with measured values from the mine.

A flag was also raised over the TDS concentrations used in the groundwater model. TDS concentrations were taken from data between 2008 and 2013. The TDS concentrations in groundwater increased between 2012 and 2013. Ecometrix was concerned that the increase in TDS might represent a trend and the model might therefore underestimate the TDS in the future. Ecometrix recommended that the hydraulic conductivity and trends in TDS concentrations be addressed going forward.

As a whole, in the view of Ecometrix, the modelling appeared to be accurate. However, because the groundwater model affected the site water model and the water quality model (hydrodynamic model), the overall results were constrained by the limitations of the groundwater model. Improving the groundwater model, and removing some of the uncertainty associated with the groundwater model, would increase the confidence and accuracy of all of the models (PR#77 p3.1-3.7).

#### 4.4 Review Board Analysis

The Review Board considered De Beers’ initial position that the scope of development included:

- discharging an increased concentration and quantity of TDS, and its constituent ions, to Snap Lake;
- proposing numeric SSWQOs for TDS, and its constituent ions; and,
- applying additional mitigation at the Snap Lake mine site to ensure that TDS concentrations do not exceed proposed SSWQOs.

As discussed in section 2.2, the developer has not described how it will treat water and has not said what the concentrations of contaminants will be in the water it has treated. Because of its approach, the developer has failed to specify how and to what extent it

proposes to mitigate aquatic impacts. In light of the developer's approach, and considering the concerns and recommendations from parties, the Review Board is focussing its analysis on the unmitigated scenario. An analysis of the potential effects in the unmitigated scenario is provided in Section 4.4.1.

With respect to the proposed numeric SSWQOs the Review Board heard concerns from parties and De Beers that the proposed SSWQOs require further refinement and assessment. Further discussion on this topic is provided in Section 4.4.2.

#### **4.4.1 TDS and its constituent ions in the unmitigated scenario**

De Beers and parties provided evidence that, in the unmitigated scenario, there would likely be adverse effects to aquatic life and to traditional uses from TDS and individually from chloride and nitrate. With respect to fluoride, sulphate, ammonia and strontium, significant adverse impacts were not likely.

With respect to TDS, De Beers predicted that without additional mitigation the concentration in Snap Lake may reach 1,700 mg/L in the worst case scenario (PR#62 p30). At this concentration, Ecometrix stated that there would likely be adverse effects to population abundance and distribution of organisms in Snap Lake and that a major change to the zooplankton community could not be ruled out (PR#77 p4.2). The Review Board understands that the organisms likely affected by TDS form the base of the food chain in Snap Lake which supports fish populations and abundance. An adverse effect to the food chain may cause adverse effects to fish population and abundance in Snap Lake.

In the unmitigated scenario the Review Board heard that effluent from the mine would be detectable in Mackay Lake. Aboriginal groups expressed concerns that this would cause a decrease in use of Mackay Lake for traditional uses.

With respect to chloride, De Beers predicted that without additional mitigation the concentration in Snap Lake would approach 800 mg/L, which would exceed its proposed SSWQO of 378 mg/L. Ecometrix stated that in the unmitigated scenario that there would likely be adverse effects to the population abundance and distribution of organisms in Snap Lake.

With respect to nitrate, De Beers predicted that without additional mitigation, nitrate concentrations in Snap Lake would exceed the Health Canada water guideline for drinking water of 10 mg/L. This could lead to potential adverse effects to people who may drink water from Snap Lake.

With respect to fluoride, De Beers proposed an SSWQO that it asserted is protective of aquatic life. Ecometrix noted that the proposed SSWQO was likely protective of aquatic life,

but it exceeded the Health Canada maximum acceptable concentrations for drinking water for fluoride (1.5 mg/L). De Beers predicted that, in the unmitigated scenario, the concentration of fluoride in Snap Lake was not likely to reach the proposed SSWQO or the Health Canada limit. Therefore, significant adverse impacts are not likely.

With respect to sulphate, ammonia, and strontium, De Beers' proposed SSWQOs were likely protective of aquatic life. This was independently confirmed by Ecometrix. In the unmitigated scenario, De Beers predicted that its proposed SSWQOs and Health Canada Guideline for drinking water will not be exceeded for these three constituents. The Review Board accepts that significant adverse impacts from sulphate, ammonia, and strontium are not likely.

#### **4.4.2 Numeric SSWQOs and toxicity testing methods**

The Review Board heard parties' concerns with respect to toxicity testing and the methodology used by De Beers in support of setting SSWQOs. These concerns included: the methods used and how they were applied, the use of a safety factor, the number and species of organisms tested, and the lowest effect levels used in the analyses (PR#86, PR#94, PR#146, PR#147, PR#148, PR#145 p4, PR#141, PR#140 p 2, PR#139 p2).

In addition to these concerns, the Review Board notes various uncertainties in De Beers' predictions. For instance there is the potential for TDS concentration in Snap Lake to reach 1,700 mg/L in the unmitigated scenario (PR#62 p30) and that De Beers conducted toxicity tests in support of setting SSWQOs only to concentration of 1,400 mg/L. In response to this deficiency in testing, De Beers stated, "given the uncertainty of effects to aquatic life beyond 1,400 mg/L TDS, De Beers has proposed mitigation that would result in TDS concentrations below the proposed SSWQO of 684 mg/L in the lake" (PR#62 p34).

The Review Board also heard that there are uncertainties with applying the results of the toxicity tests. Parties noted that effects of TDS on organisms present in Snap Lake that were not directly tested were not known (PR#145 p4). There were further uncertainties surrounding possible adverse effects caused through synergistic effects of TDS, in combination with components of the aquatic environment, that may be present in Snap Lake and that were not investigated through the toxicity tests conducted by De Beers.

Additional uncertainties were noted by parties with respect to the role that water hardness plays in reducing the toxic effects of some of the TDS constituent ions, namely chloride and sulphate (PR#86 p28). De Beers used information from the Ekati mine to determine how hardness reduces the toxic effects of chloride and sulphate up to a hardness value of 160 mg/L. However, De Beers predicted that water hardness in Snap Lake will be much higher. Parties raised the concern that there was uncertainty surrounding the role

hardness plays at these higher concentrations, and further, that the ratio of hardness to TDS may not be constant after closure (PR#86 p28). In these circumstances the mitigating effect of hardness on chloride and sulphate toxicity may be different from what De Beers predicted and hence, there could be significant adverse effects.

As discussed earlier, the GNWT raised the concern that De Beers did not apply the CCME procedures for determining SSWQO correctly for TDS. In making its case, the GNWT referred to two sets of CCME guidance: a 2003 guideline for deriving SSWQO and a 2007 guideline for deriving national water quality guidelines for the protection of aquatic life. The Review Board considers it appropriate that De Beers follow the 2003 CCME guidance for the derivation of SSWQO, but was not convinced that the 2007 CCME guidance was relevant since De Beers was not attempting to derive a national water quality guideline value for TDS. This was supported by the opinion of the independent consultant, Ecometrix, which did not agree with the GNWT's concerns on this issue.

The Review Board heard De Beers' response to these arguments that, under the water licence, monitoring in Snap Lake and downstream will be done to see if predictions about toxicity are accurate. Further, De Beers committed to implement mitigation to meet SSWQOs that will be determined by the MVLWB to be protective of the receiving environment.

During the assessment process, De Beers provided evidence that the SSWQOs initially proposed are conservative and that higher numeric SSWQOs may be warranted, based on further toxicity testing and analysis of existing and new data.

Based on the above, the Review Board concludes there are a number of uncertainties in setting numeric SSWQOs. This is reflected in the Review Board's analysis and conclusions in the following sections.

### ***Mitigation to meet SSWQOs***

De Beers, in its amendment application, committed to implementing additional treatment to reduce TDS in mine effluent, although it did not specify how it would do so. The Review Board considered evidence from De Beers in its *TDS Response Plan* (PR#12), *Nitrogen Response Plan* (PR#13), technical session presentation (PR#35, p5), and response to information request #3 (PR#59) that additional treatment would likely utilize reverse osmosis.

The Review Board agrees with parties' concerns that De Beers did not provide sufficient information to allow for a review of the additional water treatment. However, the Review Board also considered De Beers' position that it might use reverse osmosis. The Board

accepts that reverse osmosis is a proven water treatment technology that will work to reduce TDS from mine effluent, and believes that this would effectively treat water to specific levels once those levels have been identified.

It is clear to the Review Board that some form of water treatment is necessary based on DeBeers predictions on future loading of TDS and its constituent ions in Snap Lake. Without additional treatment, De Beers will likely release contaminants that will cause adverse impacts to aquatic life in Snap Lake and elevate certain parameters over Health Canada's *Guidelines for Canadian Drinking Water Quality* (August 2012 edition).

#### **4.4.3 Traditional use**

Throughout the assessment, impacts to traditional use due to mine effluent were identified by Aboriginal groups and the GNWT as a concern. This position was reaffirmed during the EA through evidence presented at the technical sessions, information requests, at the public hearing, and in closing statements.

The Review Board understands that the primary concerns are the protection of traditional uses and the protection of the aquatic environment. The Review Board heard from Aboriginal groups about the critical role the land and water has in maintaining traditional lifestyles and culture. The Review Board also understands the concerns Aboriginal groups have regarding De Beers' proposed increase in the concentration of TDS in Snap Lake and the related loss of traditional use of Snap Lake and areas downstream.

#### ***Drinking water***

The Review Board heard from Aboriginal groups that Snap Lake, and the area around Snap Lake, is an important area for traditional use. This includes drinking water sources, fishing, and other activities on the land.

De Beers committed to ensuring that water is safe to drink and that the aquatic ecosystem is maintained in Snap Lake. The Review Board understands that De Beers' approach to finding out how much TDS can be added to Snap Lake has two components:

- For limits that will be protective of aquatic life, De Beers determined, through testing and modelling, the concentration of TDS that may start to cause an adverse impact on aquatic life and proposed limits at or below this.
- For protection of drinking water, De Beers proposed to meet the relevant Health Canada guidelines limits.

With respect to Snap Lake, Aboriginal parties told the Review Board that an acceptable level of TDS that will maintain traditional use is Health Canada's drinking water quality

aesthetic guideline of 500 mg/L of TDS. The Review Board understands that Aboriginal groups provided this value of TDS as a compromise to De Beers' initial proposal of 684 mg/L of TDS that it is intended for Snap Lake.

Aboriginal groups told the Review Board that their members are unlikely to drink out of Snap Lake during mine operations (PR#132 p99; PR#132 p125; PR#132 p142; PR#132 p155). This suggests to the Review Board that traditional use has already been adversely affected. The Review Board understands that in the unmitigated scenario, De Beers predicts that the water in Snap Lake will exceed Health Canada's maximum acceptable concentration of nitrate for drinking water. Although there is low potential for traditional users to use Snap Lake as a drinking water source, the Review Board finds this exceedance to be an unacceptable risk for impacts to human health and safety if this were to occur.

Based on the evidence from the parties, and particularly the Aboriginal parties (as described above in section 4.2.1), the Review Board is of the view that it is necessary for water within Snap Lake to meet Health Canada's *Guidelines for Canadian Drinking Water Quality* (August 2012 edition).

#### ***Cultural importance of Mackay Lake***

The Review Board heard from Aboriginal groups that the land and water are of fundamental importance in maintaining their way of life. Aboriginal parties stated that the water needs to not only be safe to drink but also taste clean, the fish need to be healthy and plentiful, vitally important areas of the watershed used for traditional activities need to be protected, and sacred areas of the watershed must not be affected. The Review Board heard that Mackay Lake plays an important role in ensuring that Aboriginal peoples can use the land as they have in the past. Aboriginal groups, including YKDFN, LKDFN and NSMA, stressed the vital importance that Mackay Lake has in maintaining traditional lifestyles, in meeting the basic food requirements of everyday life and also the importance it has in ensuring that traditional knowledge is transferred to future generations. Also, they described the important role Mackay Lake plays in meeting the basic food requirements of everyday life.

Aboriginal groups asserted that this area must be protected so that people feel safe using it for traditional activities. Aboriginal groups argued that to maintain this, effluent from the mine must not be detectable in Mackay Lake. The Review Board understands that Aboriginal groups' apprehensions and perceptions matter because they directly affect the likelihood, frequency and quality of traditional usage. The Review Board heard that for Snap Lake, the apprehension exists that although the water may be tested as safe to drink, it may not be acceptable to Aboriginal users. Aboriginal groups told the Review Board that for Mackay Lake, any detectable effluent would diminish their values for the area.

The Review Board considered evidence from De Beers about how the effluent would travel downstream. De Beers' initial models were based on the prediction that TDS in Snap Lake would be at 684 mg/L. At this concentration De Beers told the Review Board that the effluent would likely not be measurable in Mackay Lake. In De Beers' response to technical reports, modeling predictions indicated that TDS concentrations did not return to near background until approximately 54 km downstream of Snap Lake, within MacKay Lake (PR#112 p31).

Parties are looking to the Review Board to safeguard these traditionally used and valued waters. In its closing statement, YKDFN states: "YKDFN hopes future mitigation action, if indeed necessary will result in action that safeguards the integrity of an important area. YKDFN needs to see action plans that go beyond delaying detectable impacts..." (PR#140 p4).

Based on the evidence from Aboriginal parties, including the evidence pertaining to traditional uses, drinking water, downstream uses and cultural issues, the Review Board's opinion is that if any effluent is measurable relative to the range of natural variability in Mackay Lake, it is likely to cause a significant adverse impact to traditional activities. Mackay Lake is used more than many other areas within the YKDFN traditional territory and is particularly important to the YKDFN for a variety of uses, including cultural transmission across generations. Maintaining the authenticity of experiences on the land is extremely important from a cultural perspective. If Mackay Lake is perceived as contaminated, and traditional activities are reduced in frequency or quality as a result, it could have a significant cultural impact to Aboriginal peoples who have used the area for many generations.

#### **4.4.4 Review Board analysis and conclusions on cumulative effects**

The Review Board agrees with parties that there are other mine developments in the Lockhart watershed, such as the recently approved Gahcho Kué mine, that may affect water quality. The Review Board finds that there are no past, present or reasonably foreseeable developments, apart from the Snap Lake mine, in the section of the Lockhart watershed between Snap Lake and Mackay Lake where measureable change in water quality from the mine is anticipated.

The only other reasonably foreseeable development in the Lockhart watershed is the proposed Gahcho Kué diamond mine located at Kennady Lake. Figure 17 shows that the drainage from the Gahcho Kué mine enters the Lockhart system at Aylmer Lake, located downstream from Mackay Lake. Figure 17 also shows that the predicted extent of the TDS plume from the Gahcho Kué mine will not reach Aylmer Lake. As a result, the Review

Board concludes that there will be no significant cumulative effects on the watershed resulting from this development, because effects will not overlap spatially.

The extent of the TDS plume downstream of Snap Lake in Figure 17 is based on predictions from the previous EA, which the Review Board has considered when reaching its decisions in this EA. With the measures described below, the proposed development is very unlikely to contribute to cumulative effects in the Lockhart River. On this basis, the Review Board does not expect this Project to cause significant adverse cumulative effects.

#### **4.4.5 Review Board analysis and conclusions on Lady of the Falls**

Aboriginal groups and the GNWT told the Review Board that the Lady of the Falls is vitally important. No effluent must be detectable at this site. The LKDFN stated, “no level of change is acceptable at this site regardless of the source”, and described the entire drainage as a “spiritual watershed” (PR#132 p106). The LKDFN stressed the importance of this site during the public hearing when commenting if any effluent is detectable at Lady of Falls, saying: “this impact will be completely devastating to the history and culture of the First Nation” (PR132 p106). During the public hearing LKDFN repeatedly stated that the Lockhart River is an important and sacred watershed to the people of Lutsel K’e and expressed concern with cumulative effects from mine development in the Lockhart watershed on water quality (PR#131, p137-142 and PR#132, p104-110).

During the technical session held on April 14-15, 2014, YKDFN told the Review Board about the cultural importance that Lady of the Falls has to the people of the North Slave area and that any change to the water quality near the site is unacceptable (PR#45, p136-137). The YKDFN reiterated the importance of Lady of the Falls in its closing comments at the hearing (PR#140 p4). The GNWT further reinforced the importance of Lady of the Falls and the absolute need to protect this site and the waters that flow through it during the public hearing.

During the EA, De Beers has also recognized the importance of Lady of the Falls to Aboriginal groups, and provided models and predictions that show the concentration of TDS from Mackay Lake and downstream to Lady of the Falls. The models and predictions show that effluent from the mine will not affect, or be detectable at, Lady of the Falls (PR#45, p137-138; PR#122 p27). During its hearing presentation, De Beers stated, based on its modelling, that Snap Lake effluent will not be measureable beyond Mackay Lake, which is almost 400 km upstream of Lady of the Falls. In order to ensure this modelling is accurate, De Beers committed to verify its predictions by monitoring downstream of the mine as far as the Mackay Lake inlet. This monitoring is to be included in its aquatic effects monitoring program (PR#131, p59).

The Review Board recognizes statements from Aboriginal parties that the Lady of the Falls is a sacred site is of the highest importance. The evidence presented in this EA shows that effects to water quality at the Lady of the Falls from the Snap Lake mine, even in the unmitigated scenario, alone or in combination with other developments such as the Gahcho Kué mine, are highly unlikely. The measures in section 4.4.8 below provide additional protection. The Review Board is satisfied that these measures will ensure that there will be no measurable trace of effluent from the Snap Lake mine anywhere in the Lockhart River, nor at Lady of the Falls.

#### **4.4.6 Review Board analysis and conclusions on accidents and malfunctions**

The Review Board acknowledges statements from De Beers that the primary response to accidents and malfunctions or other emergencies related to the water treatment plant or dams at the site is to put water back underground. The Review Board accepts this as a realistic and practical response that could successfully prevent release of contaminated water into the receiving environment.

The Snap Lake mine is regulated under an existing water licence and has been in operation since 2008. The existing water licence contains various response plans for spills and other response contingencies that can be marshalled in the event of accidents and malfunctions at the mine site.

The Review Board acknowledges that the operation of an additional water treatment plant as proposed by De Beers may increase the risk of accidents and malfunctions, which could include those related to increased fuel transportation and consumption for the treatment plant and waste salt (brine/crystal) management as a waste product from water treatment. The Review Board is confident that the existing regulatory oversight at Snap Lake is adequate to address spills and other accidents and malfunctions associated with this Project. In the Review Board's view, accidents or malfunctions associated with this development are not likely to cause of significant adverse environmental impacts.

#### **4.4.7 Review Board analysis and conclusions on alternatives**

De Beers provided an assessment of alternatives early in the EA based on its initial application (PR#58). The unmitigated scenario assessed here was originally an alternative to the development initially proposed.<sup>18</sup> The Review Board assessed the range of TDS that may be discharged to Snap Lake from 350 mg/L to the unmitigated scenario. The Review Board considered several different concentrations of TDS in effluent, but did not consider the specific mitigations that would be required to achieve those concentrations.

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<sup>18</sup> See discussion of development scope in section 2.1.

#### 4.4.8 Summary of Review Board analysis and measures

The following is a summary of the Review Board's consideration of the evidence, as described above. All of these conclusions are based on the unmitigated scenario for the reasons set out in section 2.2.

The Review Board heard from De Beers and Ecometrix that without mitigation:

- the concentration of TDS, and its constituent ions, will increase to the point of causing adverse impacts to aquatic life;
- the concentration of nitrate in Snap would exceed Health Canada drinking water guidelines; and
- the effluent plume would be measurable in Mackay Lake.

Aboriginal groups spoke to the Review Board about the high importance of Mackay Lake for many traditional activities. They described how measurable mine effluent in the Mackay Lake would adversely affect traditional activities, including fishing and passing traditional knowledge between generations and through other experiences on the land.

Based on consideration of the evidence, including the evidence pertaining to aquatic life and traditional uses, drinking water, downstream uses and issues related to cultural significance of the watershed, the Review Board concludes that the unmitigated scenario is likely to cause a significant adverse impact on traditional use for the reasons described above.

With respect to the aquatic ecosystem the Review Board concludes that in the unmitigated scenario there would likely be adverse impacts to the composition or abundance of aquatic life at the lower trophic level that may impact fish. Because Aboriginal groups are likely to use fish in Snap Lake and downstream areas, adverse effects to fish populations or abundance would likely cause an adverse effect to traditional uses, such as fishing, in Snap Lake and downstream areas.

The Review Board understands that while Aboriginal groups are not likely to use Snap Lake as a drinking water source during mine operation, this does not preclude the possibility of people using Snap Lake as a drinking water source during mine operation. Further, the Review Board considered that in the unmitigated scenario nitrate concentrations in Snap Lake would exceed Health Canada guidelines for drinking water. Therefore, the Review

Board concludes that in order to prevent likely adverse effects to human health that the water in Snap Lake must meet Health Canada's health-based drinking water standards<sup>19</sup>.

Even though only the health-based guidelines must be met in order to ensure that water is safe to drink, the Review Board acknowledges that exceedances of the aesthetic guidelines may affect traditional uses of the water; traditional land users may not want to drink water that does not taste clean, even if it does not pose a health hazard.<sup>20</sup>

The Review Board heard from Aboriginal groups that Mackay Lake is important for traditional use. The Review Board finds that although the mitigated and the unmitigated scenarios are not likely to cause a significant effect to aquatic life in Mackay Lake, any change in water quality in Mackay Lake is unacceptable to Aboriginal groups and would likely result in significant impact to traditional use of Mackay Lake due to cultural reasons that transcend ecology. Based on evidence from Aboriginal parties described in section 4.2.1, the Review Board concludes that the predicted change to water quality in Mackay Lake in an unmitigated scenario would likely result in a significant impact to traditional use of Mackay Lake due to cultural reasons that transcend ecology.

Based on the issues that arose from the measures in the first EA from 2003 and the uncertainties and considerations described in section 2.2, the Review Board holds that numerical SSWQOs are not required for the purposes of determining thresholds of significance for this EA. The Review Board expects that additional testing and further analysis is required to finalize numerical SSWQOs. Considering this, the Review Board has decided not to set specific numerical SSWQOs in the measures for this EA.

The following measure is intended to mitigate likely significant adverse effects to the aquatic environment, drinking water quality, fish health and traditional uses by setting appropriate narrative objectives.

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<sup>19</sup> See section 4.1.4 for a description of the difference between the guidelines and standards for health vs. aesthetics (that is, taste, appearance and smell).

<sup>20</sup> Suggestion 2 below addresses aesthetic objectives for drinking water.

**Measure 1:**

To prevent significant impacts from TDS, and its constituent ions of concern, from the Snap Lake mine on water quality, traditional uses and the aquatic ecosystem in Snap Lake and downstream, the Mackenzie Valley Land and Water Board will set numerical Site Specific Water Quality Objectives for Total Dissolved Solids and constituent ions of concern to apply during mine operations, closure and post closure. The numeric Site Specific Water Quality Objectives will ensure that the following objectives are met:

- a. The aquatic ecosystem is protected so that fish populations and fish species composition are not adversely affected compared to pre-mining conditions;
- b. Water in Snap Lake is safe to drink according to the health-based standards of Health Canada's *Guidelines for Canadian Drinking Water Quality* (August 2012 edition);
- c. Fish are safe to eat in Snap Lake and downstream; and,
- d. No Total Dissolved Solids or its constituent ions from the Snap Lake mine effluent will be detectable, relative to the range of natural variability, at the inlet to Mackay Lake, 44 km downstream of Snap Lake.

In implementing this measure the Mackenzie Valley Land and Water Board will consider the *CCME 2003 Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives*, or any update.

The Review Board considered all the evidence regarding the impacts of TDS in Snap Lake and downstream in the unmitigated scenario. Based on a broad review of this evidence, the Review Board finds that operating the mine without mitigation would cause significant adverse impacts to the aquatic environment, drinking water quality, fish health and traditional uses in the Snap Lake watershed. Therefore, the Review Board recommends the following measure to ensure that these impacts are mitigated and that the objectives of Measure 1 are achieved.

**Measure 2:**

In order to prevent significant adverse impacts, including to traditional uses, in Snap Lake and downstream, De Beers will implement additional water treatment, or other mitigations, to reduce the concentration and loading of TDS and its constituent ions of concern to Snap Lake as approved by the Mackenzie Valley Land and Water Board. The mitigation implemented by De Beers will achieve the numerical Site Specific Water Quality Objectives, and associated Effluent Quality Criteria, set by the Mackenzie Valley Land and Water Board which meet the objectives of Measure 1.

The Review Board notes that while this approach is protective of the aquatic environment, the limits in De Beers' water license could be higher than the 684 mg/L it originally proposed, if regulatory authorities are convinced, based on credible results of research, that a higher concentration will not reduce the level of environmental protection required by these measures.

### *Downstream monitoring*

The Review Board heard from Aboriginal groups about the importance of Mackay Lake and the need to ensure that there is a response mechanism in place to ensure that corrective action is taken, if De Beers' predictions regarding the effluent plume reaching Mackay Lake are inaccurate. The Review Board heard that De Beers commits to monitoring at the inlet of Mackay Lake, 44 km downstream from Snap Lake, and to update its AEMP. The following suggestion is intended to encourage De Beers and the MVLWB to update the AEMP to ensure that appropriate thresholds and action levels are implemented to achieve the objectives of measure 1.

#### **Suggestion 1:**

**De Beers should update its Aquatic Effects Monitoring Program Response Framework, for approval by the Mackenzie Valley Land and Water Board, with appropriate thresholds and actions levels to ensure that appropriate monitoring and management responses are implemented to achieve the objectives of Measure 1.**

### *Closure*

Parties, including the YKDFN and LKDFN, told the Review Board that mining activities will cause Aboriginal members to limit the use of Snap Lake during mining. These parties told the Review Board that Aboriginal users would like to use Snap Lake as soon as possible after mining operations cease. De Beers provided models that show, in the mitigated scenario, that TDS concentrations in Snap Lake would reach a concentration of 500 mg/L approximately four years after mining operations cease. The Review Board is of the opinion that TDS at a concentration of 500 mg/L would allow for traditional uses of Snap Lake. The following suggestion is intended to encourage the MVLWB to set closure objectives that allow Aboriginal users to use Snap Lake as soon as possible after mining operation cease and thus mitigate this concern.

### **Suggestion 2:**

**The Mackenzie Valley Land and Water Board should set closure objectives and criteria that ensure drinking water quality in Snap Lake achieves the Health Canada *Guidelines for Canadian Drinking Water Quality* aesthetic objective for TDS in drinking water within five years of the end of mining operations.**

#### ***Best available technology economically achievable***

Parties, including YKDFN, LKDFN, and EC, told the Review Board that the “pollute-up-to the limit” approach is dangerous and ignores the principles of conservation. De Beers committed to undertake a best available technology economically achievable (BATEA)-type review and committed to adhere to numeric SSWQOs that consider the findings of this review. Guidance on how to conduct and apply the results of a BATEA review was not provided during the EA by either De Beers or parties. The Review Board heard that although EC recommended a BATEA review, it did not have a definition for BATEA or guidance on the subject.

In the absence of specific guidance on this topic, the Review Board recommends the use of Government of Alberta’s 2011 *Guidance for Assessing Best Available Technology Economically Achievable and Developing Technology-Based Standards* or other methods acceptable to the MVLWB.

The Review Board agrees that a BATEA review would be worthwhile and encourages De Beers to undertake this study and submit the report to the MVLWB. The following suggestion is intended to encourage the MVLWB to consider the findings of such a report when setting numeric SSWQOs when implementing Measure 2. In addition to promoting best environmental management practices, this suggestion will also help mitigate the concerns of Aboriginal parties.

### **Suggestion 3**

**De Beers should evaluate best available technology economically achievable (BATEA) to mitigate the impacts of Total Dissolved Solids. Consideration of costs should include examination of the following: energy demands, chemical use, waste management, land disturbance, transportation issues, environmental trade-offs, environmental benefits, collateral emissions, and, capital and operating economic costs. This analysis could be undertaken using methods described in the Government of Alberta’s 2011 *Guidance for Assessing Best Available Technology Economically Achievable and Developing Technology-Based Standards* or another method acceptable to the Mackenzie Valley Land and Water Board.**

## 5 Conclusion

The Review Board has carefully considered all evidence and information on the public record for the Project. The sections above describe the basis and reasons for the Review Board's findings. Because De Beers has not specified what mitigations it is proposing, and has not described numerically how clean its effluent will be, the Review Board has based this assessment on the unmitigated scenario. The approach De Beers has taken may result in further preliminary screenings, when it proposes a specific form of water treatment. Such an outcome could have been avoided if De Beers had been more able to provide greater detail about its proposed mitigation.

The Review Board finds that the Project has the potential to cause significant adverse impacts to the environment. In order to mitigate these impacts so that they are no longer significant, the Review Board has recommended the measures set out in the sections above. In summary, these measures require that:

- the MVLWB set water licence conditions that will achieve the protection of the aquatic ecosystem, traditional uses and drinking water;<sup>21</sup> and
- De Beers will implement water treatment or other mitigations to reduce TDS inputs into Snap Lake<sup>22</sup>

The Review Board intends the results of this EA to replace Measures 5 and 10 from the 2003 EA and allow the MVLWB to amend water licence conditions in a manner consistent with the measures set out in this report.

The Review Board's decision depends on the implementation of the commitments made by De Beers during the proceedings in addition to the measures set out in this Report.

The Review Board concludes that the Project should proceed to the regulatory phase for approvals subject to the implementation of the measures described by the Review Board and De Beers' commitments set out in this Report.

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<sup>21</sup> See Measure 1 in section 4.4.8

<sup>22</sup> See Measure 2 in section 4.4.8

## **Appendix A: List of measures and suggestions**

### **Measure 1:**

To prevent significant impacts from TDS, and its constituent ions of concern, from the Snap Lake mine on water quality, traditional uses and the aquatic ecosystem in Snap Lake and downstream, the Mackenzie Valley Land and Water Board will set numerical Site Specific Water Quality Objectives for Total Dissolved Solids and constituent ions of concern to apply during mine operations, closure and post closure. The numeric Site Specific Water Quality Objectives will ensure that the following objectives are met:

- e. The aquatic ecosystem is protected so that fish populations and fish species composition are not adversely affected compared to pre-mining conditions;
- f. Water in Snap Lake is safe to drink according to the health-based standards of Health Canada's *Guidelines for Canadian Drinking Water Quality* (August 2012 edition);
- g. Fish are safe to eat in Snap Lake and downstream; and,
- h. No Total Dissolved Solids or its constituent ions from the Snap Lake mine effluent will be detectable, relative to the range of natural variability, at the inlet to Mackay Lake, 44 km downstream of Snap Lake.

In implementing this measure the Mackenzie Valley Land and Water Board will consider the CCME 2003 *Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives*, or any update.

### **Measure 2:**

In order to prevent significant adverse impacts, including to traditional uses, in Snap Lake and downstream, De Beers will implement additional water treatment, or other mitigations, to reduce the concentration and loading of TDS and its constituent ions of concern to Snap Lake as approved by the Mackenzie Valley Land and Water Board. The mitigation implemented by De Beers will achieve the numerical Site Specific Water Quality Objectives, and associated Effluent Quality Criteria, set by the Mackenzie Valley Land and Water Board which meet the objectives of Measure 1.

### **Suggestion 1:**

De Beers should update its Aquatic Effects Monitoring Program Response Framework, for approval by the Mackenzie Valley Land and Water Board, with appropriate thresholds and actions levels to ensure that appropriate monitoring and management responses are implemented to achieve the objectives of Measure 1.

**Suggestion 2:**

The Mackenzie Valley Land and Water Board should set closure objectives and criteria that ensure drinking water quality in Snap Lake achieves the Health Canada *Guidelines for Canadian Drinking Water Quality* aesthetic objective for TDS in drinking water within five years of the end of mining operations.

**Suggestion 3**

**De Beers should evaluate best available technology economically achievable (BATEA) to** mitigate the impacts of Total Dissolved Solids. Consideration of costs should include examination of the following: energy demands, chemical use, waste management, land disturbance, transportation issues, environmental trade-offs, environmental benefits, collateral emissions, and, capital and operating economic costs. This analysis could be undertaken using methods described in the Government of Alberta's 2011 *Guidance for Assessing Best Available Technology Economically Achievable and Developing Technology-Based Standards* or another method acceptable to the Mackenzie Valley Land and Water Board.

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## **Appendix B: List of developer's commitments**

This appendix includes a list of commitments provided by De Beers, PR#135 p2-3, and additional commitments identified by the Review Board in the Report of Environmental Assessment. In addition to the commitments listed here, the Review Board considered all other commitments made by De Beers on the public record

<b>#</b>	<b>Commitment</b>	<b>reference</b>
1	"De Beers will continue to monitor the areas downstream of the project and report annually in the AEMP and Environmental Agreement reports on the water quality results"	PR#135 p2-3
2	"De Beers will document community visits particularly information on the perception of Snap Lake and water quality, and submit this information to the Boards."	PR#135 p2-3
3	"De Beers will continue to conduct regional water quality monitoring as it has since 1999, and to report on the regional water quality three times a year reports to the MVLWB, a summary annual water licence report the MVLWB, and annual AEMP report, as well as reporting to Aboriginal groups in the annual Environmental Agreement report. De Beers will also share data with the GNWT and Aboriginal Affairs and Northern Development Canada and communities as part of regional cumulative effects monitoring."	PR#135 2-3
4	"De Beers is committed to protecting aquatic function within Snap Lake"	PR#135 p2-3
5	"De Beers is commits to developing a site specific water quality objective (SSWQO) that is achievable and protective of the aquatic environment"	PR#135 p2-3
6	"De Beers commits to staying below approved SSWQOs and adopting appropriate mitigation to achieve this value."	PR#135 p2-3
7	"De Beers will continue to define the range of natural variability within the impacted area of the Snap Lake Watershed through the AEMP."	PR#135 p2-3
8	"De Beers will undertake monitoring downstream at the inlet of MacKay Lake as a component of the AEMP"	PR#135 p2-3
9	"De Beers will provide draft summaries of community meetings held during May, by June 23, 2014."	PR#135 p2-3
10	"De Beers will hold meetings as appropriate to update stakeholders on progress towards mitigation measure development and implementation. "	PR#135 p2-3
11	"Changes to water quality due to Snap Lake mine discharged of TDS will not be measurable beyond 44 km downstream of Snap Lake."	PR#150 p4
12	"De Beers will present the results of a preliminary evaluation of best applicable technologies that are economically achievable for Snap Lake Mine for consideration by the MVLWB, regulator, and communities, in the establishment of appropriate SSWOs and EQC for TDS."	PR#150, p5
13	The ecosystem function of Snap Lake will be maintained	PR#150 p2
14	The water in Snap Lake will remain safe to drink.	PR#150 p2
15	Fish in Snap Lake will remain safe to eat.	PR#150 p2

## **Appendix C: List of public registry documents**

This appendix contains a list of documents on the public registry for EA1314-02, Snap Lake Water Licence Amendment. Physical copies of these documents are available at the Review Board office. The documents may also be viewed online at [http://www.reviewboard.ca/registry/project.php?project\\_id=675](http://www.reviewboard.ca/registry/project.php?project_id=675)

In this appendix, the following abbreviations are used:

AANDC	Aboriginal Affairs and Northern Development Canada
AEMP	Aquatic Effects Management Program
CAN	Government of Canada
CCME WQG	Canadian Council Ministers of the Environment Water Quality Guidelines
DKFN	Deninu Kue First Nation
EA	Environmental Assessment
EC	Environment Canada
EQC	Effluent Quality Criteria
IR	Information Request
GNWT	Government of the Northwest Territories
GKP	Gahcho Kué Project
LDKFN	Lutsel K'e Dene First Nation
MVLWB	Mackenzie Valley Land and Water Board
MVRB	Mackenzie Valley Review Board
MVRMA	Mackenzie Valley Resource Management Act
NPMO	Northern Projects Management Office
NSMA	North Slave Metis Alliance
NWT	Northwest Territories
SLEMA	Snap Lake Environmental Monitoring Agency
SLRFD	Snap Lake Reasons for Decision
SSWQO	Site Specific Water Quality Objectives
TDS	Total Dissolved Solids
US EPA	United States Environmental Protection Agency
YKDFN	Yellowknives Dene First Nation

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*List of public registry documents*

<b>Public Registry #</b>	<b>Document Name</b>	<b>Date Received</b>	<b>Originator</b>
1	MVLWB Referral Letter	22-Jan-14	MVLWB
2	Snap Lake Water Licence Application	30-Jan-14	De Beers
3	Snap Lake Water Licence Amendment – Table of Contents	30-Jan-14	De Beers
4	Snap Lake Renewal – Mining Industry Questionnaire	30-Jan-14	De Beers
5	Water Licence Concordance Table	30-Jan-14	De Beers
6	Snap Lake Community Engagement Report	30-Jan-14	De Beers
7	Underground Model Memo	30-Jan-14	De Beers
8	Water Balance Report	30-Jan-14	De Beers
9	Mine Site Water Quality Report	30-Jan-14	De Beers
10	Water Model Report – North Pile Long Term Water Storage and Release	30-Jan-14	De Beers
11	Hydrodynamic and Water Quality Model Report	30-Jan-14	De Beers
12	TDS Response Plan	30-Jan-14	De Beers
13	Nitrogen Response Plan	30-Jan-14	De Beers
14	EQC Report	30-Jan-14	De Beers
15	EA01-004 Report of EA and Reasons for Decision 2003	30-Jan-14	MVRB
16	Draft Snap Lake Work Plan	24-Feb-14	MVRB
17	Draft EA Scoping Document	24-Feb-14	MVRB
18	Joint Cover Letter	24-Feb-14	MVRB
19	Snap Lake Online Review Request	24-Feb-14	MVRB
20	Snap Lake Online Review Request – updated letter	25-Feb-14	MVRB
21	Strontium Response Plan	3-Mar-14	De Beers
22	Snap Lake Site Visit	12-Mar-14	MVRB
23	AANDC/GNWT Joint Letter re Snap Lake Technical Session Dates	13-Mar-14	AANDC/GNWT
24	Summary of the March 11 Site Visit	14-Mar-14	De Beers
25	Snap Lake Work Plan	25-Mar-14	MVRB
26	Draft Groundwater Flow Model Update	26-Mar-14	De Beers
27	Government of Canada GNWT Joint Letter regarding participation	27-Mar-14	CAN/GNWT
28	EA Scoping Reasons for Decision	28-Mar-14	MVRB
29	Note to File – independent consulting firm	31-Mar-14	MVRB
30	Snap Lake Technical Session Agenda	1-Apr-14	MVRB
31	Supplemental Information	1-Apr-14	De Beers
32	Note to File- Technical Session teleconference information	11-Apr-14	MVRB
33	Supplemental Filings for Technical Session	11-Apr-14	De Beers
34	Tech Session Presentation – Nitrogen Response Plan	15-Apr-14	De Beers
35	Tech Session Presentation – Amendment Overview	15-Apr-14	De Beers

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<b>Public Registry #</b>	<b>Document Name</b>	<b>Date Received</b>	<b>Originator</b>
36	Note to File – Technical Session Information Requests	17-Apr-14	MVRB
37	First Snap Lake EA 01-004, section 13 Accidents and Malfunctions	16-Apr-14	De Beers
38	North Pile Risk Assessment Report	16-Apr-14	De Beers
39	2014 Poster TDS Lake Trout and Arctic Grayling - final	16-Apr-14	De Beers
40	2013 Water Management Plan – MVLWB denial letter	16-Apr-14	De Beers
41	October 2013 Water Management Plan	16-Apr-14	De Beers
42	Snap Lake Mine – water management schematic April 16, 2014	16-Apr-14	De Beers
43	Snap Lake Tech Session Information Requests	17-Apr-14	MVRB
44	Tech Session Transcripts Day 1 – April 15, 2014	19-Apr-14	MVRB
45	Tech Session Transcripts Day 2 – April 16, 2014	19-Apr-14	MVRB
46	GNWT IR#7 Response	22-Apr-14	GNWT
47	EC Supplemental IRs from Technical Session	22-Apr-14	EC
48	SLEMA Supplemental IR from Technical Session	22-Apr-14	SLEMA
49	GNWT Supplemental IR from Technical Session	22-Apr-14	GNWT
50	YKDFN Supplemental IR from Technical Session	22-Apr-14	YKDFN
51	Note to File Snap Lake Public Hearing	25-Apr-14	MVRB
52	Joint Government of Canada and GNWT letter to NSMA	25-Apr-14	CAN/GNWT
53	US EPA Water Quality Standards Criteria Summary	29-Apr-14	GNWT
54	Pre-hearing Conference Reminder and Instructions	30-Apr-14	MVRB
55	Technical Reports Reminder and Instructions	30-Apr-14	MVRB
56	Party Status Application Request	30-Apr-14	MVRB
57	IR#4 response – predicted TDS in mine water 3 Oct 2013	30-Apr-14	De Beers
58	IR#9 response – water management treatment alternatives	30-Apr-14	De Beers
59	IR#3 response – Alternatives Analysis Final Report 2012	30-Apr-14	De Beers
60	IR responses – Appendices Complete Data Review Findings	30-Apr-14	De Beers
61	IR#18 response – Curtain Grouting Letter – April 2014	30-Apr-14	De Beers
62	Developer Response to Tech Session IRs	1-May-14	De Beers
63	IR#17 response – 2012 AEMP	1-May-14	De Beers
64	IR#17 response – Appendix for 2012 AEMP	1-May-14	De Beers
65	IR#15 response – appended spreadsheets	2-May-14	De Beers
66	Developer’s Technical Session IR cover letter	2-May-14	De Beers
67	SLEMA April 2014 Environmental Update	8-May-14	SLEMA
68	CCME Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life, 2007	5-May-14	MVRB
69	IR#17 – 2013 Snap Lake AEMP Report – Part A	2-May-14	De Beers
70	IR#17 – 2013 Snap Lake AEMP Report – Part B	2-May-14	De Beers
71	First Snap Lake EA01-004, Technical Session Transcripts	6-May-14	MVRB
72	EA01-004 Snap Lake Hearing Transcripts Apr 28-May 2, 2003	7-May-14	MVRB

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<b>Public Registry #</b>	<b>Document Name</b>	<b>Date Received</b>	<b>Originator</b>
73	IR#3 – Treatment for Footwall Water as part of TDS Management Plan	8-May-14	De Beers
74	Pre-hearing conference agenda May 13, 2014	8-May-14	MVRB
75	Technical Report deadline – May 21, 2014 at noon	8-May-14	MVRB
76	Guidance on Water Quality Objectives in BC	9-May-14	GNWT
77	Ecometrix Review of Snap Lake Amendment	9-May-14	Ecometrix
78	Note to file – party status	15-May-14	MVRB
79	Note to file – pre-hearing conference summary	15-May-14	MVRB
80	Deninu Kue request for party status	16-May-14	DKFN
81	Draft agenda for public hearing June 5-6, 2014	16-May-14	MVRB
82	NSMA Technical Report	20-May-14	NSMA
83	YKDFN Technical Report	21-May-14	YKDFN
84	LKDFN Technical Report	21-May-14	LKDFN
85	DKFN Technical Report	21-May-14	DKFN
86	GNWT Technical Report	21-May-14	GNWT
87	GNWT Technical Report Appendix 1-01	21-May-14	GNWT
88	GNWT Technical Report Appendix 1-02	21-May-14	GNWT
89	GNWT Technical Report Appendix 1-03	21-May-14	GNWT
90	GNWT Technical Report Appendix 1-04	21-May-14	GNWT
91	GNWT Technical Report Appendix 2	21-May-14	GNWT
92	GNWT Technical Report Appendix 3	21-May-14	GNWT
93	GNWT Technical Report cover letter	21-May-14	GNWT
94	EC Technical Report	21-May-14	EC
95	EC Technical Report cover letter	21-May-14	EC
96	GNWT Technical Report references Chapman 1992	21-May-14	GNWT
97	GNWT Technical Report references CCME WQG	21-May-14	GNWT
98	GNWT Technical Report references chloride (en)	21-May-14	GNWT
99	GNWT Technical Report references – Derry et al 2003	21-May-14	GNWT
100	GNWT Technical Report references – 5 documents	21-May-14	GNWT
101	GNWT Technical Report references – CCME SSWQO	21-May-14	GNWT
102	GNWT Technical Report references – GKP public hearing	21-May-14	GNWT
103	GNWT Technical Report references - Nitrate	21-May-14	GNWT
104	GNWT Technical Report references – SL RfD – Apr13-12	21-May-14	GNWT
105	GNWT Technical Report references – Tasten Quality	21-May-14	GNWT
106	GNWT Technical Report references – Elphick 2011	21-May-14	GNWT
107	Note to File – updated party status list	22-May-14	MVRB
108	Hearing agenda – Snap Lake amendment June 5-6, 2014	26-May-14	MVRB
109	Hearing Directive June 5-6, 2014	26-May-14	MVRB

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<b>Public Registry #</b>	<b>Document Name</b>	<b>Date Received</b>	<b>Originator</b>
110	GNWT Technical Report references – 2003 Minister letter	21-May-14	GNWT
111	YKDFN hearing presentation	26-May-14	YKDFN
112	De Beers response to Technical Reports	28-May-14	De Beers
113	Golder combined CV's (consultant to De Beers)	28-May-14	De Beers
114	NPMO letter to YKDFN re crown consultation	22-May-14	NPMO
115	NSMA presentation	29-May-14	NSMA
116	LKDFN hearing presentation	30-May-14	LKDFN
117	EC hearing presentation	30-May-14	EC
118	Participation of Y Doolittle as member of Review Board	30-May-14	MVRB
119	GNWT hearing presentation	30-May-14	GNWT
120	DKFN presentation	30-May-14	DKFN
121	Ecometrix presentation	30-May-14	Ecometrix
122	De Beers public hearing presentation	3-Jun-14	De Beers
123	Note to file – scope of development and opening statements	3-Jun-14	MVRB
124	GNWT response to YKDFN re crown consultation	2-Jun-14	GNWT
125	De Beers Environmental Assessment Report 2003	2-Jun-14	De Beers
126	GNWT letter to MVRB re participation of Y Doolittle	4-Jun-14	GNWT
127	SLEMA – May 2014 Environmental Update	6-Jun-14	SLEMA
128	Hearing undertakings	6-Jun-14	MVRB
129	Deninu Kue Ethno History Report	6-Jun-14	DKFN
130	Clarification – MVEIRB participation Y Doolittle	5-Jun-14	GNWT
131	Public hearing transcripts June 5, 2014	5-Jun-14	MVRB
132	Public hearing transcripts June 6, 2014	5-Jun-14	MVRB
133	Note to File – post hearing direction	10-Jun-14	MVRB
134	DKFN letter to the Review Board	10-Jun-14	DKFN
135	Developer response to undertakings	11-Jun-14	De Beers
136	Response to undertaking one – Revised 2013 AEMP Design Plan	11-Jun-14	De Beers
137	GNWT response to new evidence	20-Jun-14	GNWT
138	SLM consultation record, Community Workshops	23-Jun-14	De Beers
139	NSMA Closing Arguments	20-Jun-14	NSMA
140	YKDFN Closing Arguments	25-Jun-14	YKDFN
141	EC response to new evidence	25-Jun-14	EC
	Intentionally left blank		
143	Notice of timeline requirements under the MVRMA	25-Jun-14	MVRB
144	De Beers response to comments on additional evidence	27-Jun-14	De Beers
145	LKDFN Closing Comments	4-Jul-14	LKDFN
146	EC Closing Comments	4-Jul-14	EC

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<b>Public Registry #</b>	<b>Document Name</b>	<b>Date Received</b>	<b>Originator</b>
147	DKFN Closing Comments	4-Jul-14	DKFN
148	GNWT Closing Arguments	4-Jul-14	GNWT
149	Volume II NWT Diamonds Project Environmental Setting - GNWT closing argument attachment for Snap Lake Amendment	4-Jul-14	GNWT
150	De Beers Closing Comments	8-Jul-14	De Beers