DE BEERS
CANADA
GAHCHO KUÉ PROJECT

April 5, 2012 File: S110-01-08

Chuck Hubert
Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board
P.O. Box 938
Yellowknife NT X1A 2N7

Dear Mr. Hubert:

Deninu Kue First Nation - Information Request Responses - Gahcho Kué Project Environmental Impact Review

De Beers is pleased to provide the Mackenzie Valley Environmental Impact Review Board with responses to Information Requests submitted by the Deninu Kue First Nation.

Sincerely,

Veronica Chisholm

Veronica Chisholm
Permitting Manager

Attachment

c: M. d'Entremont, Senior Wildlife Biologist, LGL Limited
R. Bjornson, Deninu Kue First Nation

Information Request Number: DKFN_1

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.1 Introduction

Preamble:

Under subsection 10.1.2 Purpose and Scope; the assessment of cumulative impacts is not included.

Request

Provide clarification as to whether cumulative impacts are included in the scope of the assessment for the long-term biophysical effects.

Response

Yes, cumulative impacts are included in the scope of the assessment for the long-term biophysical effects.

Section 10 of the 2010 Environmental Impact Statement (EIS) (De Beers 2010) presents a summary of the long-term biophysical effects, and closure and reclamation, to wildlife and terrestrial habitat, and human health. The summary of residual effects is based on assessments presented in other sections of the 2010 EIS [e.g., Key Line of Inquiry: Caribou (De Beers 2010, Section 7)]. To limit the amount of repetition and still comply with the information requested by the Gahcho Kué Panel (2007) in as efficient a manner as possible, the relevant information presented in other sections has been summarized and is reported herein.

For fish and water quality, there is no potential for cumulative effects in the Kennady Lake watershed (as noted on De Beers 2010, Page 10-114). The projected impacts of the Project on aquatics do not extend beyond the local study area. They do not, as a result, overlap with other regional projects (e.g., Snap Lake Mine) (as noted on De Beers 2010, Page 10-130).

For wildlife and wildlife habitat, cumulative impacts are discussed in greater detail in their representative sections of the 2010 EIS (e.g., Key Line of Inquiry: Caribou [De Beers 2010, Section 7], Subjects of Note: Carnivore Mortality [De Beers 2010, Section 11.10], Other Ungulates [De Beers 2010, Section 11.11], and Species at Risk and Birds [De Beers 2010, Section 11.12]), and summarized again in Cumulative Effects (De Beers 2010, Section 13). All primary pathways (which consider cumulative impacts) for wildlife were classifed as being medium to long-term in duration and reversible, with the exception of the impacts from physical footprints that will be permanent and irreversible.

Reference

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, N.W.T.

Information Request Number: DKFN_2

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.1 Introduction

Preamble:

Under subsection 10.1.3 Study Area; in an area of such an amazing frequency of rivers and lakes is the hydrological connectivity always completely limited to the obvious and surface visible connections via rivers or can subsurface connections via the aquifer also exist?

Request

If yes, is the LSA correctly defined?

Response

The local study area (LSA) presented in Subsection 10.1-3, Figure 10.1-3 of the 2011 EIS Update (De Beers 2011) defines the surface water aquatics disciplines, but not the hydrogeology and groundwater LSA, which is shown in Figure 11.6-2, Subject of Note: 11.6 Permafrost, Hydrogeology and Groundwater, and Figure G2.3-1 in Annex G: Hydrogeology Baseline of the 2010 EIS (De Beers 2010).

The aquatics LSA incorporates the local drainage network from Kennady Lake to the outlet of Kirk Lake, which lies within an appropriate boundary to assess all of the expected direct and indirect Project effects to fish and fish habitat.

The hydrogeology and groundwater LSA forms an irregular polygon approximately 17 by 17 kilometres (km) in size; Kennady Lake and the site of the proposed Project are located in the central part of the hydrogeology and groundwater LSA, which covers an area of some 222 square kilometres (km^2). Major local lakes are thought to act as the controlling features of the deep groundwater flow system. The elevation of the Lake N16 in the northwest corner of the LSA is 423 metres above sea level (masl), while unnamed lakes along the eastern limits of the LSA are located at elevations of 385 masl. Kennady Lake and several lakes immediately to the west of the Project have higher elevations (421 to 423 masl) than most lakes within the LSA (385 to 420 masl).

During construction and operations, the dewatering of Kennady Lake will increase the hydraulic gradient in the shallow groundwater regime within the active layer around Kennady Lake. The thickness of this layer may extend 1 to 5 metres (m) below the ground surface of the Kennady Lake watershed depending on the topography. Groundwater inflows from this shallow layer to the dewatered Kennady Lake will occur concurrently with the drawdown. The volume of groundwater ingress was assumed to be negligible with quality that had a slightly higher total dissolved solids concentration than lake water.

During operations, the development of the mined-out pits will induce deeper groundwater ingress to the pits from all directions. The reduced groundwater pressure in the deep groundwater flow system will cause a small volume of water to flow from Lakes X4 and X6 in the Hoarfrost watershed, two lakes near the Project boundary immediately south of the hydrogeology and groundwater LSA, to flow towards the mined-out pits. Due to their close proximity to the mined-out pits and the presence of through taliks beneath these lakes, they are the most hydraulically connected to the groundwater below Kennady Lake and changes are predicted to be greatest at these two lakes. The small lakes in the upper watershed of Kennady Lake are not considered of sufficient surface area to have talik penetration to the deep groundwater regime (generally limited to lakes that have a surface area of at least 1 km^2, although there are exceptions for some long and narrow lakes). The extent of influence of groundwater flow to the open pits is very small, with the decrease in water volume in these two lakes being 0.4 percent (%) of their annual precipitation volume for the period that the deep pits are available (approximately 15 years). Therefore climatic variability likely overwhelms any potential for lake volume, and water level, change during the period the pits are available; measureable changes in water level are not expected in these lakes.

At closure and beyond closure, groundwater flow in the LSA is expected to be generally in a southeast direction as discussed in Appendix 11.6.II of the 2010 EIS (De Beers 2010). At closure, with the refilled Kennady Lake, there will be a minor flow to Lakes X4 and X6, with the flux to these lake from the Kennady Lake at closure estimated to be on the order of 10 cubic metres per day (m^3/d) and the travel time is on the order of 500 years to Lake X6 and 800 years to Lake X4. This flow accounts for only 0.1% and 0.05% of the total yield from Lakes X4 (2,480,000 cubic metres per year [m^3/y]) and X6 (6,470,000 m^3/yr), respectively, indicating Kennady Lake has limited connectivity with these lakes.

The selection of the groundwater and hydrogeology LSA is appropriate for the assessment of effects of the Project to surface and deep groundwater regimes. Similalry, the selection of the aquatics LSA as the Kirk Lake watershed is appropriate because of the the negligible effect of altered groundwater regime during all phases of the Project to fish and fish habitat in lakes within the Hoarfrost River watershed.

Reference

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

Information Request Number: DKFN_3

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.1 Introduction

Terms of Reference Section:

Preamble:

Under subsection 10.1.4 Content; the title “Cumulative Impact Assessment to the Lockhart River System” is missing.

Request

Has a real cumulative impact assessment been carried out? Please provide details.

Response

A cumulative effects assessment has been carried out in the EIS. As described in Section 6.6.2, Approach to Cumulative Effects, in the 2010 EIS (De Beers 2010), not every valued component (VC) requires an analysis of cumulative effects. The key is to determine if the effects from the Project and one or more additional developments/activities overlap (or interact) in time and space.

Within the EIS, a comprehensive cumulative effects analysis was completed for the terrestrial component, particularly to wildlife species that have large home ranges (i.e., caribou, grizzly bear, wolverine, wolves), which have the capacity to interact with other current and foreseeable developments. However, as there is no potential for cumulative effects to fish and water quality from the Project and additional developments, a comprehensive cumulative effects analysis for the aquatic environment was not completed.

For the aquatics assessment, the local study area (LSA) is defined by watersheds of the lakes and streams that may be directly affected by the proposed Project, and includes Kennady Lake to the outlet of Kirk Lake. The database of previous and existing developments indicated that there are no prior or existing developments within the LSA. The only reasonably foreseeable future development is the proposed Taltson Hydroelectric Expansion Project (THEP), in which a proposed transmission line route crosses the Kennady Lake, Kirk Lake, and N watersheds within the LSA.

The results from the impact assessment for the THEP indicated that impacts to the aquatic environment would be limited to the construction of a transmission line through the LSA, and would not be environmentally significant in terms of the entire Kennady Lake watershed and downstream watersheds. Incremental effects during the construction phase of the THEP are not anticipated to result in measurable changes to water quantity and quality, or fish habitat, abundance, and health. In their report of assessment, the Mackenzie Valley Environmental Impact Review Board (MVEIRB 2010) did not raise any new concerns regarding the possible effect of the transmission line on aquatic systems. Thus, the effects from development of the THEP transmission line and the Project are not anticipated to be different than incremental effects of the Project predicted for the LSA.

There is also no opportunity for impacts from existing and planned developments in the Lockhart River System beyond the LSA to interact with those of this Project since no effects from the Project are predicted downstream to Kirk Lake, the limit of the LSA. As a consequence, there is no potential for cumulative effects to fish and water quality downstream of Kennady Lake, and therefore a comprehensive cumulative effects analysis for the Lockhart River watershed is not required.

A more details related to cumulative effects analysis to valued components of the aquatic environment is provided in Section 13.6 of the EIS (De Beers 2010). Summary information addressing cumulative effects to the aquatics environment for each of the aquatics key lines of inquiry is provided in Sections 8.5.6, 9.5.4 and 10.10.1 of the 2011 EIS Update (De Beers 2011).

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2010. *Report of the Environmental Assessment and Reasons for Decision: EA0708-007:Dezé Energy Corporation Ltd. Taltson Hydroelectric Expansion Project.* August 6, 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_4

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Preamble:

Under Closure and Reclamation Plan (p. 10-12); the reclamation program includes 'construct additional fish habitat enhancement structures'.

Request

Provide details on the site locations and design of these structures.

Response

Information on the fish habitat compensation options that have been identified for the Project are outlined in Section 3.II.7.2 of the Conceptual Compensation Plan (CCP, Appendix 3.II) of the Gahcho Kué Project EIS (De Beers 2010). The habitat enhancement structures are still considered proposed options at this stage of compensation planning. Finalization of options will be part of the development of the detailed compensation plan, which will occur through discussions with Fisheries and Oceans Canada (DFO) and with input from local communities. Once options are finalized, a more detailed design phase will be initiated to refine site locations, detailed design, and timing.

The in-lake habitat enhancement features that have been included in the proposed compensation plan include Options 3 and 4 (construction of habitat enhancement features in Areas 6, 7, and 8 of Kennady Lake), Option 8 (the Dyke B habitat structure), and Option 10 (widening the top bench of mine pits where they extend onto land).

Reference

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

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GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_5

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Preamble:

Under Existing Environment (p. 10-12); “groundwater or subsurface water quality” is missing as a component from this section.

Request

Is “groundwater or subsurface water quality” just missing as a component of the existing environment here or throughout the EIS?

Response

The existing environment or baseline data associated with groundwater quality and quantity is not provided in Section 10: Key Line of Enquiry: Long-term Biophysical Effects, Closure and Reclamation of the 2010 Environmental Impact Statement (EIS) (De Beers 2010). This information is provided in detail in Section 11.6: Subject of Note: Permafrost, Groundwater and Hydrogeology, within sub-sections 11.6.2.2.3 (Hydrogeology), 11.6.2.2.4 (Water Quality), and 11.6.2.2.5 (Groundwater Flow) of the 2010 EIS (De Beers 2010). Additionally, summary groundwater quality and quantity is provided in sub-section 8.3.4, Section 8: Key Line of Inquiry: Water Quality and Fish in Kennady Lake.

Reference

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_6

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Preamble:

Under Long-term Effects to Water Quality (p. 10-14); seepage from materials in the mine rock pile, coarse PK pile and fine PKC facility is expected to enter surrounding water bodies.

Request

Have attempts been made to quantify this seepage through modeling? If not, how can this seepage be stopped or the seepage water be treated to a quality that conforms with CCME Water Quality Guidelines? Section 3 – Project Description on page 3-4 states ”The only outflow from the controlled area will be licensed discharges that are monitored”. Will the aforementioned seepage be licensed and monitored?

Response

The quantity, and the quality, of runoff and seepage drainage from the Mine Rock Piles, the Coarse Processed Kimberlite (PK) Pile and the Fine Processed Kimberlite Containment (PKC) Facility were modelled in the 2011 EIS Update (De Beers 2011). The quality was assessed by assigning a unit volume a mass for each material (i.e. coarse PK, mine rock, etc.) determined from humidity cell testing and scaling it to the simulated volumes of water expected to occur under ambient conditions (EBA 2011). In the context of the Mine Rock and Coarse PK Piles, seepage and runoff are expected to be in contact with materials that will result in a similar drainage water quality. As such, the total volume of water originating from these facilities (seepage and runoff) was assigned the same water drainage water quality, which was subsequently evaluated in Kennady Lake against the CCME Guidelines (1999) for the Protection of Freshwater Aquatic Life. Details of the water quality modeling assessment are provided in Appendix 8.II of the 2012 EIS Supplement (De Beers 2012).

For these facilities, this approach is considered prudent for the water quality assessment because the final surface area of the mine rock piles will be graded to promote runoff as precipitation, rather than seepage penetrating into the piles. Additionally, the placement of both the Coarse PK Pile adjacent to Kennady Lake will promote a seepage gradient towards the lake, rather than into the underlying taliks. Therefore, significant seepage from mine rock piles that could result in changes to groundwater quality is not expected. As stated in Section 11.6 of the 2010 EIS (De Beers 2010):

> *“Seepage rates into the underlying groundwater system are expected to be small, with no measureable effect beyond the boundaries of the facilities themselves.”*

It is also important to note that the development of permafrost was not considered in the water quality assessment. This approach was selected to provide a conservative estimate of the water quality in Kennady Lake. However, the development of permafrost is expected to occur in the Mine Rock and Coarse PK piles which would promote runoff to Kennady Lake and provide an impermeable pathway into the underlying groundwater.

A detailed seepage analysis was conducted for the Fine PKC Facility (EBA 2012). At closure, this facility will be composed of a lower layer of Fine PK, overlain by a two meter cover consisting of mine rock or a combination of mine rock and coarse PK. Based on the results of geochemical testing (Appendix 8.III, De Beers 2012), these materials are expected to have distinct chemical signatures. As a result, to evaluate the water quality in Kennady Lake, it was necessary to evaluate the volumes of water that would be flowing through each of the cover materials.

The surface of this facility will be graded to promote precipitation as runoff and the placement of this facility adjacent to open water within Area 2 will promote a seepage gradient towards the open water, rather than into the underlying groundwater system. The seepage analysis of the Fine PKC Facility (EBA 2012) indicates all seepage from the facility will drain into Kennady Lake.

Water quality in Kennady Lake in closure and post-closure was derived using a flow and mass-balance water quality model, developed in GoldSim™, for a range of water chemistry parameters. Updated water quality modelling provided in the 2012 EIS Supplement (De Beers 2012) is based on the updated mine plan that reduces the size of the Fine PKC Facility and the results of on-going geochemical testing results of mine rock and PK material as described above. The water quality model input values for Kennady Lake during closure and post closure assume that:

- runoff and seepage from mine rock piles and PK facilities occur in the absence of permafrost (i.e., completely thawed conditions); and
- more conservative higher-end (higher concentration) geochemistry test results have been applied to the water quality model to determine chemical loads from the storage facilities and in-pit disposal.

The water quality model, which accounts for these drainage inputs, indicates that the Kennady Lake water quality will be suitable for discharge following refilling (i.e., removal of Dyke A and reconnection of Kennady Lake to downstream waters). Similarly, as referenced in the Request, dewatering discharge and operational discharge of Areas 3 and 5 in Kennady Lake during the construction phase and early operations years, will be pumped to Lake N11. The water quality model indicates that the water quality will be suitable for discharge an assessment concluded that potential changes to water quality in downstream lakes are not expected to result in adverse effects on aquatic health.

While conservative assumptions were used in the assessment to provide confidence that changes to water quality will not be worse than projected in Kennady Lake, they use an upper bound in the source terms in order to develop adequate mitigation. In addition, operational conditions are such that permafrost is expected to aggrade into the piles and decrease contact and reactivity with air and water, thereby providing natural mitigation to potential geochemical loading to Kennady Lake.

Predicted water quality is based on several inputs (i.e., surface flows, groundwater flows and seepage, background water quality, and geochemical characterization), all of which have inherent variability and uncertainty. As such, it is suggested that water quality predictions should not be used to predict absolute concentrations, but rather as a planning tool and to develop monitoring plans (Appendix 8.II.5; De Beers 2011). It is anticipated that runoff and seepage from the reclaimed facilities will be monitored during operations to compare to EIS predictions. If it is identified that the quality of runoff or seepage is worse than predictions, adaptive management strategies will be triggered to address the problem.

Although the development of water quality discharge criteria for the Project was not a requirement of the Terms of Reference (Gahcho Reference Kué Panel 2007), De Beers acknowledges the importance and benefit of setting water quality benchmarks, which will be used for the effects evaluation for the receiving aquatic environment. This level process is typically addressed as part of the Water License Application and Approval Process, but there is also added benefit to undergo this process early in the Project review phase, and De Beers is currently developing these benchmarks, which will incorporate inputs from the waste rock storage facilities, for Kennady Lake (i.e., operations, closure and post-closure) and downstream lakes during operations (e.g., Lake N11) and closure (e.g., Lake 410). It is planned that an initial iteration of proposed benchmarks and rationale will be prepared as a technical memorandum to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in 2012, which will form the basis for detailed consultation with government agencies and communities.

References

CCME (Canadian Council of Ministers of the Environment. 1999. Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life. In: Canadian Environmental Quality Guidelines Canadian Environmental Quality Guidelines with updates to 2011. Canadian Council of Ministers of the Environment. Winnipeg, MB.

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

EBA. 2011. Updated Summary of Water Management and Balance during Mine Operation, Gahcho Kué, NWT (for updated fine PK disposal plan – Option 2). EBA File: E14101143.

EBA. 2012. Seepage Analysis for Fine PK in Area 2 (Updated Fine PK Management Plan – Option 2) Gahcho Kué Diamond Project. EBA File: E14101143.Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, N.W.T.

Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, N.W.T.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. December 2009.

Information Request Number: DKFN_7

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Preamble:

No preamble provided.

Request

Provide a detailed analysis comparing expected under-ice O_2 winter concentrations with O_2 demands of all present fish species to assess potential mortality rates for all species and the overall changes to the species composition. In addition to an analysis for all fish species, this analysis should include the effects to invertebrates and aquatic vegetation.

Response

As described in Section 8.10.4.4.1 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), during post-closure, under-ice dissolved oxygen levels in the refilled Kennady Lake are predicted to be suitable to support all fish species currently in the lake.

Section 10.2 of the 2011 Update (De Beers 2011) is a summary section. It summarizes the assessments completed for the long-term (i.e., post-closure) for the following Key Lines of Inquiry: Kennady Lake and Watershed (Section 8) and Downstream Water Effects (Section 9). The full discussion relating to winter dissolved oxygen is provided in Section 8.10.4.4.1 of the 2011 EIS Update under the *Effects of Changes in Nutrient Levels* pathway (De Beers 2011).

The full assessment of the potential effects of changes to the dissolved oxygen regime on fish and fish habitat is located in the Changes to Fish and Fish Habitat, Habitat Changes, Dissolved Oxygen, subsection of Section 8.10.4.4.1 (De Beers 2011). This subsection references the predictions made by the water quality component and assesses potential effects on fish species, as well as potential changes to the fish community of the refilled Kennady Lake. Potential effects of lower dissolved oxygen on lower trophic levels are addressed in the Changes to

Lower Trophic Communities subsection of Section 8.10.4.4.1 (De Beers 2011). As described in this subsection, lower late winter dissolved oxygen concentration than that under baseline conditions may also alter community composition by eliminating sensitive taxa, thereby favouring certain species of chironomids and aquatic worms, which are tolerant of low dissolved oxygen concentrations. The effect of increased nutrients on aquatic vegetation is described on page 8-417 in the Changes to Fish and Fish Habitat, Spawning Habitat subsection of Section 8.10.4.4.1 (De Beers 2011). As described in this subsection, aquatic vegetation in Kennady Lake is currently limited by physical factors, such as rocky substrates and wave action. Existing macrophyte beds in sheltered areas may benefit from the increased nutrient concentrations, which would be reflected in increased plant abundance and productivity. Most of the aquatic vegetation in Kennady Lake is along the immediate shoreline and at tributary mouths (De Beers 2010, Annex J, Section J.4.1.1). As this 0 to 2 m zone would freeze to the substrate during winter, no effects on macrophytes would be expected from changes in winter dissolved oxygen conditions.

However, with the supplemental mitigation associated with the Fine PKC Facility, nutrient levels in the refilled Kennady Lake will be lower than predicted in the 2011 EIS Update (De Beers 2011). Therefore, changes to winter dissolved oxygen are expected to be less than described in the 2011 EIS Update, and as a result, subsequently reduced effects on fish and fish habitat. See the 2012 EIS Supplement (De Beers 2012) for more details.

Reference

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_8

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Preamble:

No preamble provided.

Request

Please provide a detailed analysis comparing expected post-closure year-round concentrations of chromium, iron, cadmium and copper and compare with toxicity of the metals for all present fish species throughout the life history stages for fish species using Kennady Lake. Please assess potential mortality rates for all species and the overall changes to the species composition. In addition to an analysis for all fish species, this analysis should include the effects to invertebrates and aquatic vegetation.

Response

The full discussion relating to Effects to Aquatic Health was provided in Section 8.9 of the 2011 Environmental Impact Assessment (EIS) Update (De Beers 2011). This section assessed potential effects to aquatic health in Kennady Lake for closure and post-closure based on the predicted changes in water quality presented in Section 8.8.

Of the substances listed in the Request above, maximum concentrations of total cadmium and chromium were predicted to remain below the Chronic Effects Benchmark (CEB) identified for each substance (see De Beers 2011, Section 8.9.3.2.1); as a result, the predicted increases in the concentrations of these substances were expected to have a negligible effect on aquatic health in Kennady Lake under closure and post-closure conditions. Maximum concentrations of total copper and iron were projected to be above their respective benchmarks at one or more points during closure and post-closure. However, based on a review of the CEBs and the concentrations predicted, the potential for adverse effects to aquatic life (i.e., aquatic vegetation, aquatic invertebrates, and fish) in Kennady Lake from copper or iron was considered to be low.

The potential for effects on fish populations or communities resulting from changes in aquatic health was assessed in Section 8.10.4.4.2 of the 2011 EIS Update (De Beers 2011). Based on the aquatic health assessment described above and presented in Section 8.9, changes to concentrations of substances considered were predicted relative to baseline conditions, but the residual effects to fish tissue quality and, by association, aquatic health in Kennady Lake were considered to be negligible. As a result, effects to fish populations or communities were not expected to occur from changes in aquatic health. Therefore, mortality of fish, or changes to species composition, related to changes to the chemical constituents of the water was not expected.

However, based on the supplemental mitigation associated with the Fine PKC Facility, the water quality model was revised. The results of the revised water quality modelling were used to update the aquatic health assessment of the 2012 EIS Supplement (De Beers 2012). The results of this revised assessment are summarized below.

Based on comparisons to baseline concentrations and federal water quality guidelines for the protection of aquatic life, 12 substances of potential concern (SOPCs) were selected to further evaluate the potential for aquatic health effects due to direct waterborne exposure. Maximum water concentrations of total antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, strontium, vanadium, fluoride, and total dissolved solids are predicted to remain below the CEB identified for each substance. Thus, the predicted increases in the concentrations of these 11 SOPCs are expected to have a negligible effect on aquatic health in Kennady Lake under closure and post-closure conditions. The maximum concentration of total copper is projected to be above respective CEBs at one or more points during closure and post-closure. However, based on a review of the CEBs and the concentrations predicted, the potential for adverse effects to aquatic organisms in Kennady Lake from copper is considered to be low, and residual effects to aquatic communities are expected to be negligible; follow-up monitoring will be undertaken to confirm this evaluation.

Predicted metal concentrations in fish tissue are predicted to be above tissue-based toxicological benchmarks for aluminum, nickel, and silver under closure conditions, and silver under post-closure conditions in Kennady Lake. However, based on a review of the benchmarks and the concentrations predicted, the potential for adverse effects to fish tissue quality is predicted to be low; follow-up monitoring will be undertaken to confirm this evaluation.

Based on the aquatic health assessment in the EIS Supplement (De Beers 2012), as summarized above, no effects to fish populations or communities would be expected in the post-closure Kennady Lake from changes in aquatic health. Therefore, mortality of fish, or changes to species composition, related to changes to the chemical constituents of the water would not be expected.

References

De Beers (De Beers Canada Inc.) . 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_9

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble:

No Preamble provided.

Request

Please provide the analysis suggested for Kennady Lake in the last two requests for Area 8 as well.

Response

The assessment of under-ice dissolved oxygen (DO) concentrations in Area 8 during operations is provided in Section 8.6.2.3 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011) under the secondary pathway of *Reduction in upper watershed flow to Area 8 may change surface water levels, and affect surface water quality, fish habitat and fish*. As described in this section, Area 8 is isolated from the L watershed in winter, with the outlet channel completely frozen during ice-covered months. Following the construction of Dyke A and the close-circuiting of the Kennady Lake watershed, the reduction in inflows to Area 8 during the operations and closure phases of the Project will result in an estimated decrease of 0.10 metre (m) in under-ice water levels in Area 8 relative to baseline, even under dry conditions.

As the average depth of Area 8 is approximately 3 m, with a maximum depth of up to 8 m, the reduction in water level due to the Project is considered minor. The minor change in depth is not expected to alter water quality in Area 8. Consistent with other areas in Kennady Lake, under-ice DO concentrations decrease with depth. These characteristics are expected to remain consistent during the operation of the Project.

As a result, changes to water quality, including under-ice DO concentrations, are expected to be negligible relative to baseline conditions; as a consequence, residual effects to fish and fish habitat (including the availability of overwintering habitat in Area 8 and lower trophic levels) are predicted to be negligible.

The full discussion relating to Effects to Aquatic Health for Area 8 is provided in Section 8.9 of the 2011 EIS Update (De Beers 2011). This section assessed potential effects to aquatic health in Area 8 for post-closure, following the reconnection of Kennady Lake after refilling, based on the predicted changes in water quality presented in Section 8.8.

Of the substances listed in the previous Request (DKFN #8), maximum concentrations of total cadmium, chromium, and iron were predicted to remain below the Chronic Effects Benchmark (CEB) identified for each substance (De Beers 2011, Section 8.9.3.2.1); as a result, the predicted increases in the concentrations of these substances are expected to have a negligible effect on aquatic health in Area 8 under post-closure conditions. Maximum concentration of total copper was projected to be above its respective benchmark during post-closure. However, based on a review of the CEB and the concentration predicted, the potential for adverse effects to aquatic life (i.e., aquatic vegetation, aquatic invertebrates, and fish) in Area 8 from copper was considered to be low.

The potential for effects on fish populations or communities in Kennady Lake, including Area 8, resulting from changes in aquatic health was assessed in Section 8.10.4.4.2 (De Beers 2011). However, based on the aquatic health assessment described above and presented in Section 8.9, changes to concentrations of all substances considered relative to baseline conditions are predicted, but residual effects to fish tissue quality and, by association, aquatic health in Kennady Lake, are considered to be negligible. As a result, effects to fish populations or communities are not expected to occur from changes in aquatic health. Therefore, mortality of fish, or changes to species composition, related to changes to the chemical constituents of the water would not be expected.

However, based on the supplemental mitigation associated with the Fine PKC Facility, the water quality model was revised. The results of the revised water quality modelling were used in the aquatic health assessment and the results are provided in the 2012 EIS Supplement (De Beers 2012). The results of this revised assessment are summarized below.

Based on comparisons to baseline concentrations and federal water quality guidelines for the protection of aquatic life, 10 substances of potential concern (SOPCs) were selected to further evaluate the potential for aquatic health effects due to direct waterborne exposure. Maximum water concentrations of total antimony, barium, beryllium, cadmium, cobalt, manganese, strontium, vanadium, and total dissolved solids are predicted to remain below the CEB identified for each substance. Thus, the predicted increases in the concentrations of these nine SOPCs are expected to have a negligible effect on aquatic health in Area 8 under post-closure conditions. Maximum concentration of total copper is projected to be above its respective CEB during post-closure. However, based on a review of the CEB and the concentration predicted, the potential for adverse effects to aquatic organisms in Area 8 from copper is considered to be low and residual effects to aquatic communities are expected to be negligible; follow-up monitoring will be undertaken to confirm this evaluation.

Predicted metal concentrations in fish tissue are predicted to be above tissue-based toxicological benchmarks for silver under post-closure conditions in Area 8. However, based on a review of the benchmark and the concentration predicted, the potential for adverse effects to fish tissue quality is predicted to be low; follow-up monitoring will be undertaken to confirm this evaluation.

Based on the aquatic health assessment in the EIS Supplement (De Beers 2012), as summarized above, no effects to fish populations or communities would be expected in Area 8 at post-closure from changes in aquatic health. Therefore, mortality of fish, or changes to species composition, related to changes to the chemical constituents of the water would not be expected.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_10

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Under Long-term Effects to Fish and Fish Habitat (p. 10-16); the statement "The project is expected to have low or negligible effects on aquatic health in Kennady Lake…therefore, no effects to fish populations or communities are expected to occur…" is in stark contrast with the statement "…due to the change in trophic status to mesotrophic, overwintering habitat in Kennady Lake at post-closure may become more limited for cold water fish species, such as lake trout and round whitefish, than under baseline conditions".

Request

We recommend deleting the misleading first statement and leaving the truthful second statement. We further recommend to look into wind powered aeration as a mitigative measure to avoid winter kill of fish under the ice.

Response

The statement that is referred to in the Preamble, will not be deleted. It is a concluding paragraph to a summary of long-term effects to fish and fish habitat in Section 10.2 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), which is a summary section of the Key Line of Inquiry: Long-term Biophysical Effects, Reclamation and Closure (Section 10). It summarizes the assessments completed for the long-term (i.e., post-closure) for the following Key Lines of Inquiry: Kennady Lake and Watershed (De Beers 2011, Section 8) and Downstream Water Effects (De Beers 2011, Section 9).

The referred statement relating to the prediction of no effects to fish populations or communities from changes in aquatic health:

"The Project is expected to have low or negligible effects on aquatic health in Kennady Lake from changes in the chemical constituents of water quality; therefore, no effects to fish populations or communities are expected to occur from changes in aquatic health"

is not misleading; however, as the statement is presented in a summary section, additional information to put the statement into context can be found in other sections of the Conformity Response Update. The full discussion relating this pathway is provided in Section 8.10.4.4.2, *Effects of Changes to Aquatic Health*. This conclusion is based on the aquatic health assessment (De Beers 2011, Section 8.9), where predicted changes to concentrations of all substances considered were projected to result in negligible effects to fish tissue quality and, by association, aquatic health in Kennady Lake; as a result, no effects to fish populations or communities would occur from changes in aquatic health.

Similarly, the full discussion relating to the effects of nutrient enrichment on Kennady Lake is included in Section 8.10.4.4.1 of the 2011 EIS Update under the *Effects of Changes in Nutrient Levels* pathway (De Beers 2011). This section assesses the effects to fish and fish habitat in the refilled Kennady Lake from potential changes to nutrient concentrations. However, based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L); this level is less than that presented in the 2011 EIS Update (De Beers 2011). The dissolved oxygen modelling associated with the updated phosphorus projection, conducted as part of the 2012 EIS Supplement (De Beers 2012), predicts that overwintering habitat conditions will be suitable to support fish populations of cold-water fish species, such as lake trout and round whitefish. As a result, under-ice mitigation measures, such as wind-powered aeration, are not proposed.

The updated water quality projections, and effects to fish and fish habitat will be provided in the EIS Supplement, which will be submitted to the MVEIRB in 2012.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_11

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Under Long-term Effects to Fish and Fish Habitat (p. 10-17); the reestablishment of a fish community post closure in Kennady Lake re-filling could be helped along with a compensatory measure in form of a stocking project with fish from surrounding lakes.

Request

Consider a stocking project during the post-closure period of the project.

Response

De Beers will consider a restocking program for Kennady Lake. A discussion of restocking is located in Section 8.11.1.3.3 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011). Any stocking program proposed for Kennady Lake would require acceptance and input from federal and territorial agencies, including Fisheries and Oceans Canada (DFO), as well as from local Aboriginal communities.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

Information Request Number: DKFN_12

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Under Long-term Effects to Fish and Fish Habitat (p. 10-18); the fish species composition or the increase in grazeable plankton following re-colonization is speculative. The added nutrients may lead to the establishment of a phytoplankton community that is less grazeable, contribute less to the trophic chain and ultimately lead to less fish in the lake.

Request

In consideration of above, provide an updated assessment of this section.

Response

Nutrient increases can lead to less edible and toxic forms of phytoplankton (chlorophytes – large inedible forms, and cyanobacteria), which may be considered inedible to zooplankton and thus may ultimately affect food availability to fish. However, this is associated with eutrophic and hyper-eutrophic systems, where the inedible fraction of the phytoplankton community exhibits significant, nonlinear growth with increasing phosphorus concentration (Watson *et al*. 1997).

Updated water quality modelling provided in the 2012 EIS Supplement (De Beers 2012) based on the updated mine plan predicts nutrient concentrations that are lower than those in the 2011 EIS Update. Concentration of total phosphorus in downstream waterbodies, and the predicted long-term steady state phosphorus concentration in Kennady Lake, are expected to remain within the oligotrophic range of less than 10 micrograms/litre (µg/L). Therefore, minor effects are expected on the trophic status of lakes, mostly in the form of increased biomass with minor shifts in phytoplankton community composition, resulting in a negligible effect on the edibility of plankton.

References

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Watson, S.B., McCauley, E., and Downing, J.A. 1997. Patterns in phytoplankton taxonomic composition across temperate lakes of differing nutrient status. Limnology and Oceanography 42: 487-495.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_13

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Under Long-term Effects to Downstream Watersheds, Long-term Effects to Water Quality (p. 10-19); the predicted increase of Phosphorus and trophic status from oligo- to meso-trophic in Lakes M3 and M4 will apparently "remain sufficient to support aquatic life". Certain species that are part of "Aquatic life" can persevere without any oxygen at all.

Request

Please state what the anticipated effects are of the decreased under-ice O_2 levels on fish, zooplankton and phytoplankton in Lakes M3 and M4.

Response

Updated water quality modelling for Kennady Lake predicted under-ice dissolved oxygen (DO) concentrations above 5.0 milligrams per litre (mg/L) for the majority of depths that zooplankton and phytoplankton use (estimated as the upper 6 to 8 metre (m) based on light penetration) (De Beers 2012). These DO predictions were based on the updated predictions for nutrient concentrations in Kennady Lake, which indicate that the lake would remain oligotrophic over the long term.

DO conditions were not modelled in downstream lakes M3 and M4. Based on the updated water quality modelling provided in the 2012 EIS Supplement (De Beers 2012), downstream lakes are expected to have lower total phosphorus concentrations than Kennady Lake, with concentrations remaining within the oligotrophic range. Based on this prediction, DO concentrations are expected to be less affected by nutrients in downstream lakes than in Kennady Lake, and declines in DO concentrations that would influence aquatic life are not expected. Therefore, DO concentrations are expected remain in ranges suitable to support aquatic life in Lakes M3 and M4, and measurable effects on aquatic life due to an altered DO regime are not expected.

References

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_14

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

No preamble provided.

Request

Have the small lakes in the L watershed been investigated for under-ice fish presence? It is recommended that the assumption of no fish in these lakes be validated.

Response

Investigation of small lakes in the L watershed indicated a low likelihood for the presence of fish in under-ice conditions. As described in Section 9.3.5.2.1 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), lakes in the L watershed are generally small (i.e., < 13 Hectares [ha]) and shallow (< 4 metres [m]). Lake L18 is larger, but still considered a relatively small lake, with a surface area of 14.2 ha and a maximum depth of 5.5 m; however, Lake L18, is not on the flow path between Kennady Lake and Lake 410. Depths and areas for the L watershed lakes are shown in Table 9.3-28 of Section 9.3.5.2.1 (De Beers 2011).

Lakes less than 3 m deep within the study area are considered unlikely to provide overwintering habitat for fish because the annual ice depth is typically about 2 m thick and each of the lakes between Kennady Lake and Lake 410 become isolated once ice freezes solid to the bottom of streams. No under-ice fish sampling has been conducted in the L watershed lakes; however, late winter sampling in April 2011 for under-ice dissolved oxygen found considerable oxygen depletion in Lakes L1b and L2, indicating that overwintering habitat was very limited. See the 2011 Water and Sediment Quality Supplemental Monitoring Report (Golder 2012).

In the L watershed lakes along the flow path from Kennady Lake to Lake 410, there may be limited overwintering habitat available for small-bodied fish that are more tolerant of low dissolved oxygen levels; however, no suitable overwintering habitat for large-bodied species is expected to be present. Large-bodied fish likely move to larger, deeper lakes in the area for overwintering, such as Kennady Lake, Lake M4, Lake I1, and Lake 410. However, as fish have been captured in the L watershed lakes during spring and summer, and are connected during the open-water season, these lakes are considered fish-bearing (De Beers 2010, Section J4.9.3.3 of Annex J, Section JJ4.4.2.3 of Addendum JJ).

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

Golder 2012. 2011 Water and Sediment Quality Supplemental Monitoring Report. Submitted to Mackenzie Valley Environmental Impact Review Board. March 2012

Information Request Number: DKFN_15

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Even if the trophic status of Lake 410 will not change from oligo- to mesotrophic, a small increase in primary productivity can lead to under-ice O_2 depletion and winter fish kill.

Request

Provide more detail with regards to the anticipated effects of increased nutrients on Lake 411. Please also state whether the current oligo-trophic classification is based on a Phosphorus or a Nitrogen limitation.

Response

In Section 9 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), De Beers committed to incorporating additional mitigation associated with the deposition of fine processed kimberlite (PK) to achieve a long-term steady-state total phosphorus concentration of 0.018 milligrams per litre (mg/L) in Kennady Lake. Concentrations of total phosphorus were projected to increase in Lake 410 from a background concentration of 0.005 mg/L to a peak of 0.007 mg/L (refer to De Beers 2011, Figure 9.8-13).

Within the 2011 EIS Update (De Beers 2011), the anticipated effects of increased nutrients effects in Lake 410 were predicted to be small changes in the productivity of lower trophic communities. Increased productivity was anticipated at all lower trophic levels, likely reflected in increases in biomass of phytoplankton, zooplankton, and benthic invertebrates. Large shifts in the composition of plankton and benthic invertebrate communities were not anticipated, but some shifts in relative abundances of different plankton and benthic invertebrate groups may occur, as communities adjust to the greater nutrient and food supply.

Since the submission of the 2011 EIS Update (De Beers 2011), the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK. This change has resulted in a lower volume of fine PK that will be deposited to Area 2 and a higher volume of fine PK that will be deposited to the 5034 and Hearne pits (see the updated Project Decsription, Section 3 of the 2012 EIS Supplement [De Beers 2012]). As a result, the Fine PKC Facility's footprint has been reduced by omitting Area 1, which included Lakes A1 and A2 in the 2010 EIS (De Beers 2010). This reduction in size reduces the long-term phosphorus loadings from the facility to Kennady Lake. This strategy would reduce the Fine PK surface area by approximately half, effectively reducing the phosphorus loadings from the facility to Kennady Lake and downstream waters, including Lake 410.

On-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update. Phosphorus loading was determined from a limited set of PK material, which has been supplemented by additional PK material sourced from drill cores for the site. Geochemical testing of this material has been undertaken since 2011, and the results of this testing along with the original testing results have been used to update the loading from the updated Fine PKC Facility. The updated source term inputs have been used in the water quality modeling to predict long-term steady state water chemistry in Kennady Lake and downstream waters.

Using supplemental geochemical testing data of fine PK that, and the reduced footprint of the Fine Processed Kimberlite Containment (PKC) Facility (Area 1 has been omitted), water quality modelling results for the long-term steady-state total phosphorus concentrations in Kennady Lake is now 0.009 mg/L. This is approximately half of the commitment made in 2011. As a result, the slight increase in primary productivity originally projected for Lake 410 is anticipated to be smaller than reported in the 2011 EIS Update (De Beers 2011). It is anticipated that this small change will have a negligible influence on the existing winter dissolved oxygen regime in Lake 410, and as a result winter fish kill events would not be expected.

The updated Project Description (Section 3) and water quality modelling of downstream lakes (Section 9.7) will be presented in the 2012 EIS Supplement (De Beers 2012), which will be submitted to the Board in 2012.

The trophic classification was based on total phosphorus concentrations according to OECD (1982) and EC (2004). Productivity in Kennady Lake and downstream lakes within the local study area (LSA) is primarily limited by phosphorus.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers (De Beers Canada Inc.). 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Environment Canada. 2004. Canadian guidance framework for the management of phosphorous in freshwater systems. Ecosystem Health: Science-based Solutions Report No. 1-8. National Guidelines and Standards Office, Water Policy and Coordination Directorate, Environment Canada, pp. 114.

OECD. 1982. Eutrophication of Waters, Monitoring, Assessment and Control. Organization for Economic Co-operation and Development (OECD), Paris. 154 pp.

Information Request Number: DKFN_16

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Under Long-term Effects to Downstream Watersheds, Long-term Effects to Fish and Fish Habitat (p. 10-20); as pointed out before, the sentence "…no effects to fish populations or communities are expected to occur from changes in aquatic health" is preceded by the statements " … although there may be reduced suitability and availability of spawning habitat immediately downstream of Kennady Lake due to increased benthic algal growth on streambed substrates" and "… there may be reductions in overwintering habitat availability or suitability…".

Request

The latter statements contradict the "no effects to fish" statement and we therefore recommend to delete the "no effects to fish" statement and instead provide more detail about the fish species that will likely be affected and suggest mitigative or compensatory measures.

Response

In the *Long-Term Effects to Fish and Fish Habitat* subsection on Page 10-20 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), the statements regarding the potential for reduced suitability and availability of spawning and overwintering habitat do not contradict the statement that no effects to fish populations or communities are expected to occur from changes in aquatic health. Section 10.2 of the 2011 EIS Update is a summary section. It summarizes the assessments completed for the long-term (i.e., post-closure) for the following Key Lines of Inquiry: Kennady Lake and Watershed (Section 8) and Downstream Water Effects (Section 9) of the 2011 EIS Update (De Beers 2011).

The full discussion relating to the prediction of no effects to fish populations or communities from changes in aquatic health is provided in Section 9.10.4.4 of the 2011 EIS Update (De Beers 2011), under the *Effects from Changes to Aquatic Health on Fish and Fish Habitat Downstream of Kennady Lake* pathway. This conclusion is based on the aquatic health assessment (Section 9.9), where predicted changes to concentrations of all substances considered in waterbodies downstream of Kennady Lake (i.e., Lake N11 and Lake 410) are projected to result in negligible effects to fish tissue quality and, by association, aquatic health; as a result, no effects to fish populations or communities would occur from changes in aquatic health.

The full discussion relating to the effects of nutrient enrichment on the downstream watershed is included in Section 9.10.4.3 of the EIS Update under the *Effects of Increased Nutrients on Fish and Fish Habitat* pathway (De Beers 2011). This section assesses the effects to lake and stream habitat from potential changes to nutrient concentrations. However, based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 EIS Supplement (De Beers 2012), nutrient levels are less than those predicted in the 2011 EIS Update. As a result, effects to fish habitat would be also be less than described in the 2011 EIS Update.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_17

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.2 Summary

Terms of Reference Section:

Preamble

Under Residual Impact Classification (p. 10-22); the statement "The projected long-term impacts of the Project on the suitability of water to support a viable and self-sustaining aquatic ecosystem are considered to be not environmentally significant for the Kennady Lake watershed, and its downstream watershed" is not supported by earlier statements about the potential for under-ice winter kills due to higher phosphorus and primary productivity levels causing increased bacterial breakdown that will reduce the O_2 levels under the ice. In addition to the loss of lacustrine fish, winter fish kills cause large changes to aquatic ecosystems based on the cascading trophic interactions hypothesis as shown by Vanni et al. (1990). Large increases in phytoplankton grazing due to less predation on zooplankton may completely change the limnology of Kennady Lake.

Request

We recommend that De Beers carry out a more detailed analysis and modeling exercise of the anticipated winter fish kills and suggest mitigative and compensatory measures such as aeration, combined with the introduction of highly efficient zooplankton grazers such as cisco.

Response

As described in the Response to IR DKFN #18, additional under-ice dissolved oxygen modelling and analysis have been conducted. A three-dimensional hydrodynamic model has been developed using the Generalized Environmental Modelling System for Surfacewaters (GEMSS®) to predict under-ice dissolved oxygen concentrations in Kennady Lake after refilling as a result of projected total phosphorus (TP) concentrations.

Based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 Environmental Impact Statement (EIS) Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L); this level is less than that presented in the 2011 EIS Update (De Beers 2011).

The dissolved oxygen modelling associated with the updated phosphorus projection, conducted as part of the 2012 EIS Supplement (De Beers 2012), predicts that overwintering habitat conditions will be suitable to support fish populations of cold-water fish species, such as lake trout and round whitefish. As a result, mitigation or compensation for under-ice winter fish kills is not required. As discussed in the Response to DKFN #33, De Beers does not plan on stocking Kennady Lake with fish species that do not currently occur within the system, such as cisco.

The updated water quality projections, and effects to fish and fish habitat will be provided in the 2012 EIS Supplement (De Beers 2012, Section 8), which will be submitted to the MVEIRB in 2012.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_18

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.3 Existing Environment

Terms of Reference Section:

Preamble

Subsection 10.3.2.1 Temperature and Dissolved Oxygen; figures 10.3-4 show that in addition to low oxygen concentrations in deeper water, fish located directly under the ice would find hyperoxic conditions with oxygen saturation levels of more than 150%. In this scenario, the range of suitable oxygen saturation depths would be between 2-6 m in some basins of Kennady Lake and between 2-12 m in others. The expected post-closure increase in bacterial oxygen consumption to facilitate the phosphorus mediated increase in breakdown of organic matter will further reduce oxygen concentrations. This may result in a very small range of depths suitable for overwintering of fish.

Request

More modeling and examples from other studies are needed to assess whether the anticipated oxygen reduction will render Kennady Lake uninhabitable for fish under the ice.

Response

In the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), water quality baseline data, modelled nutrient concentrations and published literature were used to develop empirical models to predict post-closure dissolved oxygen (DO) concentrations in Kennady Lake (Section 8.8 and Appendix 8.V [De Beers 2011]). Considering the limitations of the empirical models, a three-dimensional (3-D) hydrodynamic model was developed following the submission of the 2011 EIS Update using Generalized Environmental Modelling System for Surface waters (GEMSS®). GEMSS is in the public domain and has been used for similar studies throughout North America and elsewhere in the world, including a 3-D water quality model that was developed for the De Beers Canada Inc. Snap Lake Mine (Golder 2011). While the empirical models estimated average DO concentrations in three specific depth zones of Kennady Lake, which did not include the open regions of Hearne and Tuzo pits, the GEMSS model was used to project DO concentrations at a larger spatial array throughout Kennady Lake, including the pits (Tuzo and Hearne pits were modelled to a depth of 40 m).

A "Modified WASP5" module was adapted to fit within the GEMSS framework to simulate water quality, primarily nutrients and other oxygen-related constituents, in Kennady Lake. The Modified WASP5 module is comprised mainly of formulae from the United States Environmental Protection Agency's (U.S. EPA's) Water Quality Analysis Simulation Program (WASP) model (Ambrose et al. 1993). The detailed methods and model results are described in Appendix 8.V in the 2012 EIS Supplement (De Beers 2012).

While total phosphorus (TP) concentrations were the primary indicator parameter to predict the winter oxygen depletion rates in the empirical model assessment and hence late winter DO profiles (De Beers 2011), all known input variables, anticipated point and non-point source inflows to the lake, and associated chemistries were included as inputs to the GEMSS model. These included the following:

- meteorological data inputs (i.e., sourced from observed data from the meteorological station at Snap Lake, NWT, and data from the Environment Canada station at the Yellowknife Airport);
- hydrological inflows and outflows (i.e., associated with the GoldSim© watershed model outputs associated with the mine site water balance); and
- chemistry, including baseline water and modelled water quality projections developed for the assessment.

All available water quality parameters and modifiers that may influence DO concentrations were incorporated in the DO modelling, including nitrogen, phosphorus, phytoplankton, sediment oxygen demand (SOD), biochemical oxygen demand (BOD), re-aeration rates, decay rates, and temperature correction factors. Many of these parameters are measured parameters, whilst some rely on reaction rates and other applicable coefficient factors that are sourced from literature and observations from other similar lake environment conditions.

The focus of the DO modelling was to predict late winter DO concentrations as a result of changes to the modelled nutrient concentrations in Kennady Lake after refilling, in order to predict effects to fish overwintering habitat conditions. In the 2011 EIS Update, De Beers committed to incorporate additional mitigation associated with the deposition of fine Processed Kimberlite (PK) to achieve a long-term steady-state total phosphorus (TP) concentration of 0.018 milligrams per litre (mg/L) in Kennady Lake.

Since the submission of the 2011 EIS Update (De Beers 2011), the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK to reduce potential loading of phosphorus. This change has resulted in a lower volume of fine PK that will be deposited to the Fine PKC Facility. Therefore, the Fine PKC Facility's footprint has been limited to Area 2, which reduces the Fine PK surface area by approximately half as it no longer includes Area 1. This reduction in size alters the projected long-term loading of phosphorus to Kennady Lake. In addition, on-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update (De Beers 2011). Updated water quality modelling based on revised source term inputs of TP projected the long-term steady state TP concentrations to be 0.009 mg/L in Kennady Lake. The updated water quality data were used in the GEMSS DO modelling.

There is often a high degree of uncertainty in developing a numerical model to represent an aquatic ecosystem. This uncertainty is based upon model parameters and coefficients that are not always available from baseline or measured data for use in the model. As a consequence, assumptions are often made that are applied to the model to address any gaps, and then the model calibrated with available baseline data to reduce some of the uncertainty. To further reduce uncertainties encountered during the baseline calibration phase of the model development, and because water quality conditions in Kennady Lake during the post-closure time period are anticipated to be different, sensitivity analyses are completed.

The sensitivity analysis for this model included modifying input parameters that could directly or indirectly affect DO concentrations, one parameter variable per simulation, and analyzing the response of the model to that change. The volume of Kennady Lake that met or exceeded DO threshold concentrations was the primary indicator in the sensitivity analysis:

- the average volume of Kennady Lake in post-closure with a DO concentration greater than 5 mg/L at the end of the ice-covered season; and
- the average volume of Kennady Lake in post-closure with a DO concentration greater than or equal to 6.5 mg/L at the end of the ice-covered season.

Of the 17 parameters, rates and coefficients tested in the sensitivity analysis, only sediment oxygen demand (SOD) was identified as having the most substantial effect on DO concentrations. Therefore, three SOD scenarios were used to predict a range of potential DO in late winter periods:

1) Post-closure SOD Scenario 1: a SOD rate of -0.25 grams of oxygen per square metre per day (g DO/m^2/d) was used; In the calibration time period, an SOD value of -0.25 g DO/m^2/d was found to be appropriate for simulating DO, especially under ice (Figure DKFN_18-1);

2) Post-closure SOD Scenario 2: a 50% increase in SOD (-0.375 g DO/m^2/day) was assumed at post-closure compared to the calibration time period; and

3) Post-Closure SOD Scenario 3: a 100% increase in SOD (-0.5 g DO/m^2/day) was assumed at post-closure compared to the calibration time period.

These SOD rates used in the sensitivity analyses (-0.25 to -0.50 g DO/m^2/d) are very conservative compared to reported literature values. Mathias and Barica (1980) reported SOD levels of -0.23 g DO/m^2/d in eutrophic lakes estimated from four sets of Canadian lakes, prairie, southeastern Ontario, Arctic and the Experimental Lake Area (ELA). In addition, White et al. (2008) reported an SOD level of -0.10 g DO/m^2/d in a small arctic gravel pit lake (depth 10.7 metres [m], area 13,355 m^2), and Matisoff and Neeson (2005) reported a summer SOD level in central Lake Eire of -0.164 g $DO/m^2/d$.

For the post-closure SOD Scenario 1, predicted DO profiles indicate the following:

- The littoral zone of Kennady Lake (down to a depth of 4 m) is anticipated to possess DO concentrations greater than 6.5 mg/L at the end of the ice-covered season (Figure DKFN_18-2a).
- The pelagic zone of Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 8 m and DO concentrations greater than 6.5 mg/L at depths above 7 m at the end of the ice-covered season (Figure DKFN_18-2b).
- The pits in Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 38 m and DO concentrations greater than 6.5 mg/L at depths above 36 m at the end of the ice-covered season (Figure DKFN_18-2c).

The post-closure water volume of Kennady Lake including the Tuzo and Hearne pits modelled to a depth of 40 m is 55.6 million cubic meters (Mm^3). For the post-closure SOD Scenario 1, the average volumes of Kennady Lake with a DO concentration greater than 5 mg/L and 6.5 mg/L at the end of under-ice conditions (i.e. just prior to ice melt) are predicted to be approximately 51.4 Mm^3 (92% of the total volume) and 49.2 Mm^3 (89% of the total volume), respectively. Therefore, 89% of the volume of Kennady Lake in post-closure is predicted to have a DO concentration higher than the CCME guideline of 6.5 mg/L.

For the post-closure SOD Scenario 2, predicted DO profiles indicate the following:

- The littoral zone of Kennady Lake is anticipated to possess DO concentrations greater than 6.5 mg/L at the end of the ice-covered season (Figure DKFN_18-3a);
- The pelagic zone of Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 7 m and DO

concentrations greater than 6.5 mg/L at depths above 6 m at the end of the ice-covered season (Figure DKFN_18-3b); and

- The pit lakes in Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 35 m and DO concentrations greater than 6.5 mg/L at depths above 27 m at the end of the ice-covered season (Figure DKFN_18-3c).

For the post-closure SOD Scenario 2, the average volumes of Kennady Lake with a DO concentration greater than 5 mg/L and 6.5 mg/L at the end of winter are predicted to be approximately 47.2 Mm^3 (85% of the total volume) and 44.4 Mm^3 (80% of the total volume), respectively (Figure DKFN_18-3c). Therefore, 80% of the volume of post-closure Kennady Lake is predicted to have a DO concentration higher than the CCME water quality guideline of 6.5 mg/L. This represents a 17% increase in volume additional to the actual volume of Kennady Lake that will have a DO greater than 6.5 mg/L, which is a measure of additional overwintering habitat for fish.

For the post-closure SOD Scenario 3, predicted DO profiles indicate the following:

- The littoral zone of Kennady Lake is anticipated to possess DO concentrations greater than 6.5 mg/L at the end of the ice-covered season (Figure DKFN_18-4a);
- The pelagic zone of Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 6 m and DO concentrations greater than 6.5 mg/L at depths above 5 m at the end of the ice-covered season (Figure DKFN_18-4b); and
- The pit lakes in Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 19 m and DO concentrations greater than 6.5 mg/L at depths above 17 m at the end of the ice-covered season (Figure DKFN_18-4c).

For the post-closure SOD Scenario 3, the average volumes of Kennady Lake with a DO concentration greater than 5 mg/L and 6.5 mg/L at the end of winter are predicted to be approximately 41.2 Mm^3 (74% of the total volume) and 28.6 Mm^3 (51% of the total volume), respectively (Figure DKFN_18-4c). Therefore, 51% of the volume of post-closure Kennady Lake is predicted to have a DO concentration higher than the CCME water quality guideline of 6.5 mg/L.

The results of the updated DO modelling are consistent with the conclusions outlined in the 2011 EIS Update (De Beers 2011) based on empirical DO modelling. For the broad range of empirical approaches (i.e., Babin and Prepas 1985, Mathias and Barica 1980, Vollenweider 1979) and based on a 0.018 mg/L TP in post-closure and under-ice baseline DO data, the surface zone of Kennady Lake (i.e., under ice to 6 m) was predicted to maintain sufficient DO concentrations to support cold-water aquatic life (greater than 6.5 mg/L). However, the empirical modeling did not separate shallow littoral zones and or include the volume of water available in the pit lakes, which are included in the GEMSS model.

With the updated predictions of TP in Kennady Lake in post-closure, and the supplemental DO modelling using GEMSS, it is anticipated that 74 to 92% of the total volume of Kennady Lake will have a DO concentration above 5 mg/L, which represents the acute guideline for the protection of cold water species excluding the larval stages (AENV 1999), and 51 to 89% of the total volume of Kennady Lake possessing a DO concentration above 6.5 mg/L, which represents the chronic guideline for the protection of aquatic life for cold water species excluding the larval stages (CCME 1999). Even the shallow littoral zones are anticipated to have sufficient DO concentrations which might be related to the considerable portion of cobble/boulder substrate in the littoral zone. Therefore, it is anticipated that Kennady Lake during the post-closure phase of the Project will be habitable by the fish assemblage that currently exists in the lake.

It is anticipated that water column profiles in Kennady Lake will be monitored during closure and following reconnection with Area 8 to compare measured DO concentrations to EIS predictions. If it is identified that water column DO concentrations, particularly in the surface 6 m depth zone, are worse than predictions, adaptive management strategies will be triggered to address the problem.

References

AENV (Alberta Environment) 1999. Surface Water Quality Guidelines for Use in Alberta. November 1999. Environmental Service, Environmental Sciences Division. Edmonton, AB, Canada.

Ambrose, R.B., T.A. Wool and J.L. Martin. 1993. The Water Quality Analysis Simulation Program WASP5, Part A: Model Documentation, Version 5.10. US Environmental Protection Agency, Environmental Research Laboratory. Athens, GA, USA.

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De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

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Matisoff, G., and T.M. Neeson. 2005. Oxygen concentration and demand in Lake Erie sediments. J. Great Lakes Res. 31 (Suppl. 2): 284-295.

Vollenweider, R.A. 1979. Das Nährstoffbelastungskonzept als Grundlage für den externen Eingriff in den Eutrophierungsprozess stehender Gewässer und Talsperren. Z. Wasser-u. Abwasser-Forschung 12: 46-56.

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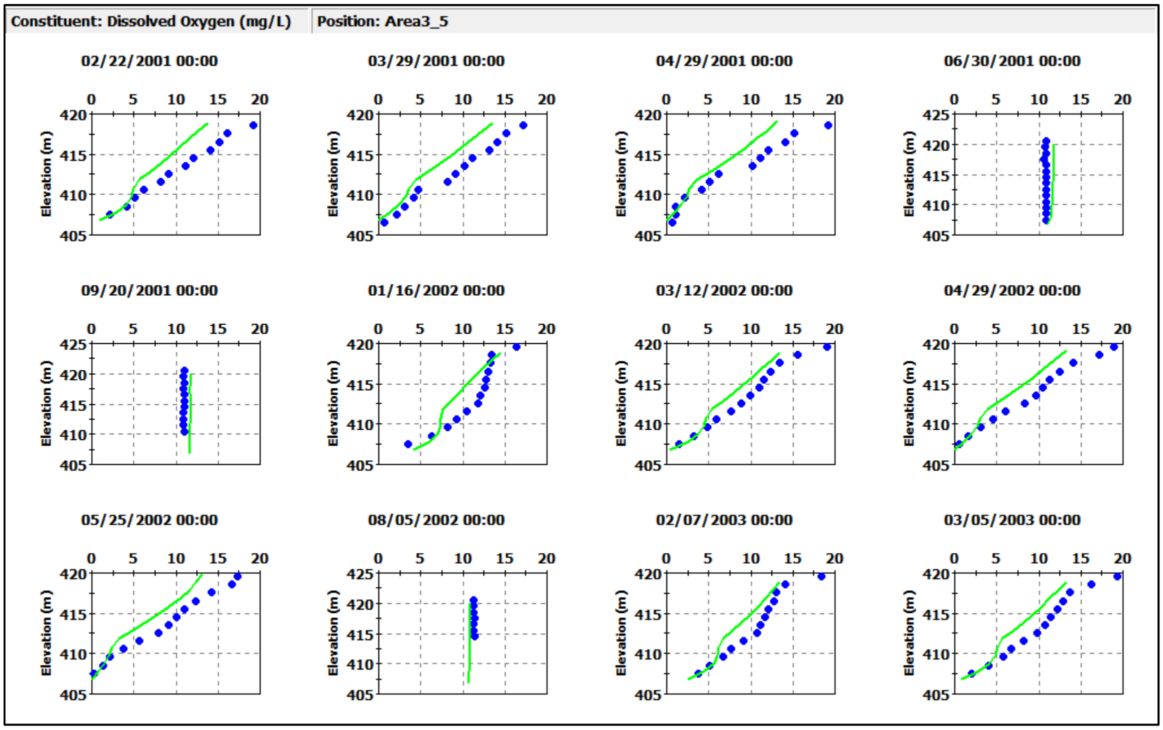
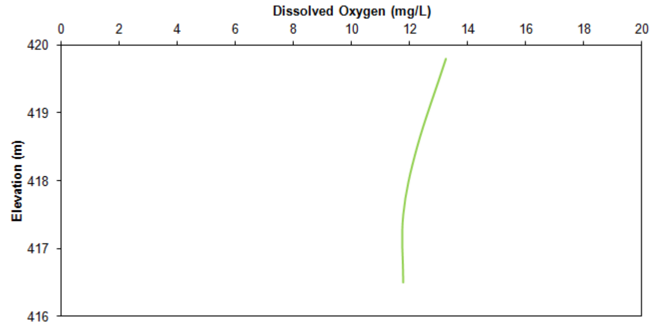
Figure DKFN_18-1 Vertical Profile Calibration Plots for Dissolved Oxygen

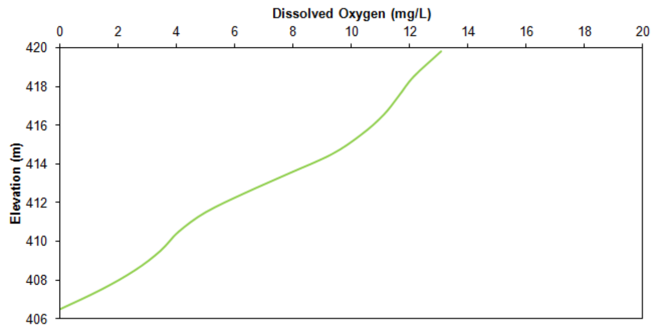


Note: Solid line represents model predictions; dots represent measured data.

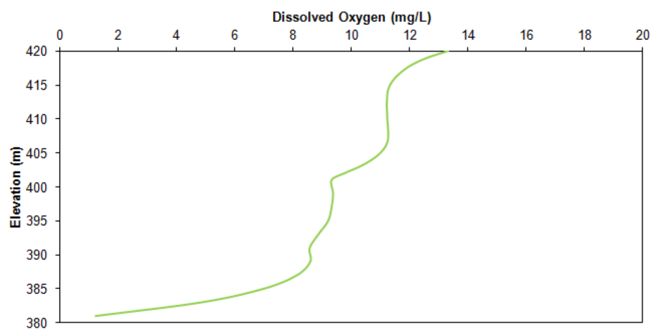
Figure DKFN_18-2 End-of-Winter Dissolved Oxygen Profiles in (a) the Littoral Zone, (b) Pelagic Zone, and (c) the Hearne Pit of Kennady Lake in Post-closure with a Sediment Oxygen Demand of -0.250 g DO/m^2/day



(a)

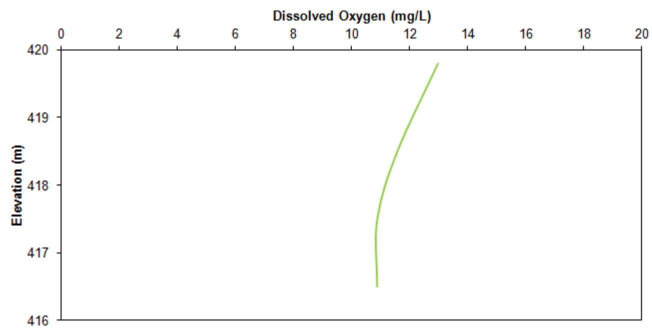


(b)

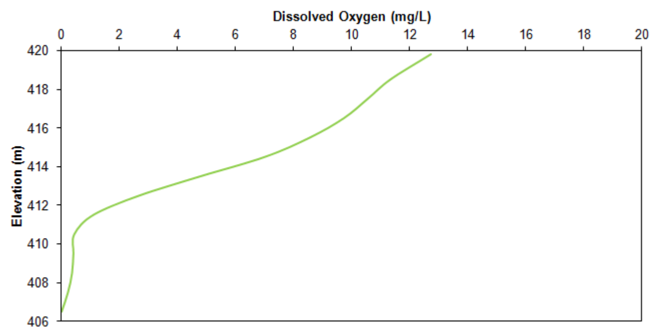


(c)

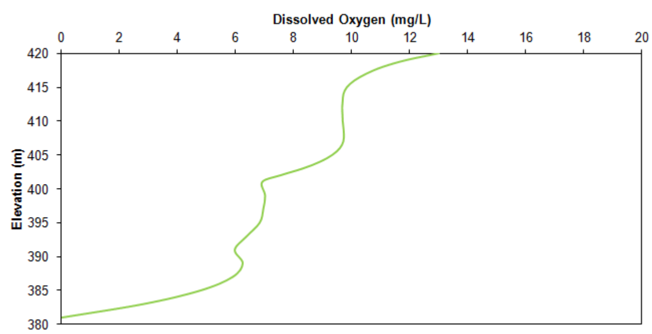
Figure DKFN_18-3 End-of-Winter Dissolved Oxygen Profiles in (a) the Littoral Zone, (b) Pelagic Zone, and (c) the Hearne Pit of Kennady Lake in Post-closure with a Sediment Oxygen Demand of -0.375 g DO/m^2/day



(a)

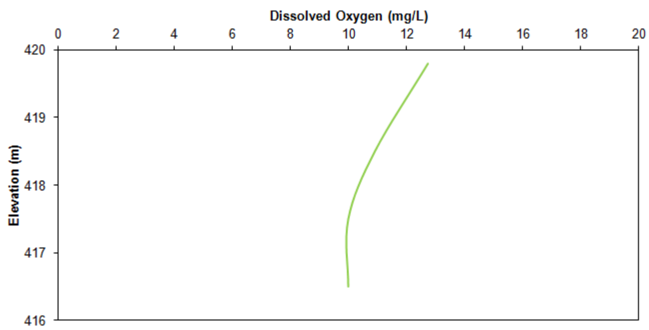


(b)

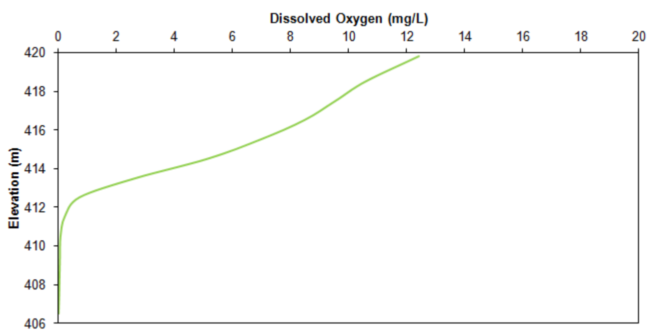


(c)

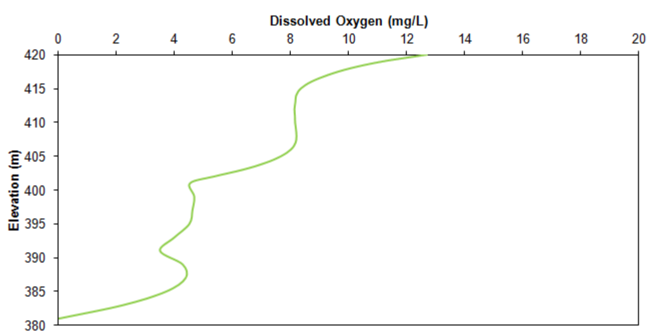
Figure DKFN_18-4 End-of-Winter Dissolved Oxygen Profiles in (a) the Littoral Zone, (b) Pelagic Zone, and (c) the Hearne Pit of Kennady Lake in Post-closure with a Sediment Oxygen Demand of -0.500 g DO/m²/day



(a)



(b)



(c)

Information Request Number: DKFN_19

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.3 Existing Environment

Preamble

Subsection 10.3.2.4 Metals; it is certainly a fact that metal concentrations in excess of CCME levels are often found in uncompromised watersheds but it is also true that for any additional discharge of metals into those waters, site specific water quality objectives have to be developed.

Request

Have site specific water quality objectives been developed?

Response

The development of water quality objectives for the Gahcho Kué Project was not a requirement of the Terms of Reference (Gahcho Kué Panel 2007), and is typically addressed as part of the Water License Application and Approval Process. However, De Beers acknowledges the importance and benefit of setting water quality benchmarks, which will be used for the effects level evaluation for the receiving aquatic environment. There is also added benefit to undergo this process early in the Project review phase, and De Beers is currently developing these benchmarks for Kennady Lake and downstream lakes (e.g., Lake N11, Area 8 and Lake 410) during dewatering, operations, closure and post-closure periods. It is planned that an initial iteration of proposed benchmarks and rationale will be prepared as part of the Project Monitoring and Adaptive Management Framework for the Project that is being developed and which will form the basis for detailed consultation with government agencies and communities.

References

Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, N.W.T.

Information Request Number: DKFN_20

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.3 Existing Environment

Preamble

Subsection 10.3.3 Lower Trophic Levels; in Figure 10.3-6 Relative Biomass of Major Phytoplankton; the very high and most likely statistically significant variability in phytoplankton composition between years demonstrates the unpredictability of effects potentially caused by the anticipated phosphorus fertilization. Especially since higher primary and secondary productivity also influences pH stability which in turn will influence the composition of the phytoplankton community. In summary, effects of the added phosphorus to Kennady Lake are completely unpredictable but will certainly be seen. All statements predicting no significant negative change to the Kennady Lake and downstream lakes are completely speculative and come with a high degree of uncertainty.

Request

Given that a precautionary approach should be taken, we would recommend that DeBeers admits to this unpredictability and set aside a compensation trust fund for the potential loss of Kennady Lake as a fish rearing lake. As part of this compensation trust fund DeBeers could suggest compensatory measures and use them as measures to build good local relationships.

Response

Due to the implementation of a precautionary approach for the assessment, the conservatism within the water quality modelling, and the development of a detailed compensation plan to achieve no net loss of fish habitat, De Beers does not plan on setting aside a compensation trust fund.

Uncertainty associated with the water chemistry in Kennady Lake after refilling is described in Section 8.15.3 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011); this section also describes the conservative approach that was taken in the development of the water quality model and in the empirical dissolved oxygen modelling. However, as described in the Response to IR

DKFN #18, additional under-ice dissolved oxygen modelling and analysis have been conducted. Based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment Facility presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L); this level is less than that presented in the 2011 EIS Update (De Beers 2011).

The water quality and dissolved oxygen modelling conducted as part of the 2012 EIS Supplement (De Beers 2012), predicts that conditions will be suitable to support fish populations throughout the year for all fish species currently in the lake. Similar to the Conformity Response Update (De Beers 2011), the water quality and dissolved oxygen modeling conducted for the 2012 EIS Supplement (De Beers 2012) has inherent conservatism built into the model; as a result, effects should not be greater than predicted.

Currently, De Beers is working on the development of the detailed fish habitat compensation plan to achieve no net loss of fish habitat for the Gahcho Kué Project (Project), through discussions with Fisheries and Oceans Canada (DFO). As part of this development, compensation options and ratios will be finalized; the compensation plan will take into account uncertainty associated with the construction and fish use of the compensation habitats. As described in Section 3.II.7.4 of the Conceptual Compensation Plan in the 2010 EIS (De Beers 2010), habitat created or enhanced to compensate for the loss of fish habitat will be monitored to assess effectiveness of compensation and to confirm that the no net loss objective has been achieved.

Furthermore, the Aquatics Effects Monitoring Program (AEMP) for the Project is currently being developed, which will be designed to monitor changes relative to the impact predictions. Any unexpected adverse impacts to the aquatic ecosystem identified through the AEMP would be addressed through adaptive management (i.e., implementation of additional mitigation or compensation as required). The monitoring programs for the Project will also help with reducing uncertainty for future projects in the north. The AEMP will be developed with regulatory and stakeholder input.

Reference

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_21

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.3 Existing Environment

Terms of Reference Section:

Preamble

In Figure 10.3-7 Relative Abundance of Major Zooplankton Taxa in Kennady Lake, the very high and most likely statistically significant variability in phytoplankton and zooplankton composition between years is justification for more sampling. Through the addition of samples taken throughout one year and over more years, DeBeers may be able to better explain the high variability and make assumptions about future effects of phosphorus addition.

Request

This should be a consideration for the aquatic effects monitoring program.

Response

The recommendation will be considered during ongoing supplemental plankton monitoring and in the development the detailed design of the Aquatic Effects Monitoring Program (AEMP).

De Beers is currently developing a Environmental Monitoring Framework for the Project, which will include the AEMP. The framework provides a conceptual structure for site-specific monitoring and mitigation plans, and the approach and criteria for monitoring the aquatic disciplines, including hydrology, water quality, lower trophic organisms (e.g., plankton). The initial phase of the Framework is to provide the basis for De Beers to engage and elicit feedback from government and communities, which will be an important element of completing the Framework, and developing the AEMP during the licensing phase of the Project.

Information Request Number: DKFN_22

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.3 Existing Environment

Preamble

Under Subsection 10.3.4.1 Aquatic Habitat, Streams; the rare gravel substrates in the streams downstream of Kennady Lake will be used by arctic grayling for spawning and should therefore be identified in detail.

Request

This site should be used as a monitoring site of the effects of increased primary productivity expected post-closure and for changes in hydrology during mine operations.

If negative effects are identified, mitigative (such as gravel cleaning) or compensatory measures (such as creation of added spawning gravel) should be considered.

Response

Monitoring stations will be selected during the detailed design phase of the Aquatic Effects Monitoring Program (AEMP), and will consider the type and magnitude of predicted effects and sensitivity of the affected habitat. Results of the AEMP will be used to evaluate the necessity for mitigation as part of adaptive management.

De Beers is currently developing a Project Monitoring and Adaptive Management Framework for the Project, which will include the conceptual structure and approach of site-specific monitoring and mitigation plans associated with aquatics effects monitoring. One of the objectives of the Framework is to define the criteria for AEMP monitoring. The initial phase of the Framework is to provide the basis for De Beers to engage and elicit feedback from government and communities, which will be an important element of completing the Framework, and developing the AEMP during the licensing phase of the Project.

Information Request Number: DKFN_23

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.4 Closure and Reclamation

Terms of Reference Section:

Preamble

Subsection 10.4.1.3 Mine Rock Piles; the approach taken by De Beers to structure the mine rock piles in a way that keeps the PAG rock in a permanently frozen state is fine as long as all PAG rock will be stored under water at closure. Climate change has already thawed permafrost areas and a permanent storage of PAG rock neutralized by freezing may therefore pose the risk of thawing and acid rock drainage and subsequent metal leaching.

Request

Provide an assessment of storing all PAG rock under water at closure.

Response

There is no change to the assessment at closure regardless of weather the rock is stored above or below the water table. Some additional related discussion is provided below.

The water quality assessment is based on the deposition plan as stated in the Project Description in Section 3 of the 2012 Environmental Impact Statement (EIS) Supplement (De Beers 2012), which stores mine waste below the water table and above the water table. The assessment, does not rely on, or account for, the freezing of potentially acid generating (PAG) materials. Instead, the mine plan calls for the portion of PAG materials that are to be above the water table to be placed below a layer of till materiall or coarse processed kimberlite (PK), and encapsulated with a suitable thickness (greater than 10 metres [m]) of mine rock. The use of fine material such as till to encapsulate the PAG cells not only limits water infiltration, but more importantly limits oxygen availability to the PAG rock. The use of alternate cover/encapsulation materials to inhibit oxidation, such as coarse PK, which is planned to be placed in the mine rock piles, will also form part of the ARD control program. Coarse PK not only would limit oxygen availability to the PAG rock but also exhibits an excess of neutralizing potential.

It is technically feasible to place all the PAG mine rock below the restored Kennady Lake water elevation of 420.7 metres above sea leve (masl) post-closure. However, this would require double-handling of a portion (4.5 million tonnes [Mt]) of the PAG mine rock mined before the completion of the 5034 Pit, i.e. firstly placing the rock in a temporary stockpile and then re-handling back to the mined-out pits. Considering the overall low acid generation risk of the relatively small portion of the mine rock and high cost associated with re-handling mine rock, the option to place all the PAG mine rock below the restored post-closure Kennady Lake water elevation of 420.7 masl was not proposed.

The geochemical properties of mine rock, including the static and kinetic geochemical test results, are presented in Section 8.II.4.3, Section 8 of the 2012 EIS Supplement (De Beers 2012). This section also describes the metal leaching and acid/alkaline rock drainage characteristics of mine rock likely to be encountered in the Project. The major findings of the tests are as follows:

- The acid potential of a sample is generally a function of sulphide mineral content. In comparison to other diamond mining projects in the North, mine rock from the Project has very low sulphur content (average 0.04%). The Project granitic kinetic leaching results are most similar to the mine rock from the Ekati Diamond Mine and low sulphur granites from the Snap Lake Mine (e.g., with low amounts of metavolcanic).

- The typical screening level sulphur criterion for classifying PAG rock at mine sites is 0.3%. Approximately 1.5% of the mine rock samples in the geochemistry dataset have total sulphur concentrations greater than 0.3 wt%.

- Most samples of granite, granodiorite and gneissic granite have total sulphur concentrations less than 0.1%. Granite will be the dominant mine rock lithology at the Project, comprising at least 95% of all mine rock.

- A small fraction (less than 1.5%) of the mine rock has some limited potential to generate acidity, however the likelihood of significant amounts of acidic water to be released from the Project is low.

These findings suggest that the potential geochemical loadings from the PAG mine rock will be relatively low. The implications of these loadings based on the amount of PAG rock potentially exposed are considered within the context of mine rock seepage source inputs to the water quality predictive model used to determine Project effects to Kennady Lake and downstream waterbodies (Appendix 8.I, Section 8 of the 2012 EIS Supplement [De Beers 2012]). As stated in the 2012 EIS Supplement, projections of water quality in Kennady Lake did not include the development and persistence of permafrost conditions within the mine rock piles, the Coarse PK Pile, and the Fine PKC Facility.

Even though less than 1.5% of the mine rock has some limited potential to generate acidity, it was conservatively assumed in the 2012 EIS Supplement (De Beers 2012) that less than 6% of mine rock extracted through open pit mining will have to be managed as being PAG with metal leaching potential as a precaution, even at very low levels of sulphur.

In the current mine waste management plan the following measures will be adopted to limit the risks of potential oxidation and acid generation of the PAG mine rock:

- Place PAG mine rock below an elevation of 418.7 masl in the basins of both the South and West Mine rock piles to the extent practical, such that the portion of the mine rock will be completely submerged under water with a minimum of 2.0 m water cover when the original lake elevation of 420.7 masl is restored after final mine site closure.

- Place PAG mine rock in the mined-out 5034 Pit, where the mine rock pile will be limited to a top elevation of 418.0 masl and be completely submerged with a water cover of about 2.7 m after the final mine site closure.

- In the case that a small portion of the PAG mine rock cannot be placed either below the elevation of 418.7 masl in the base of the South and West Mine rock piles, or in the mined-out 5034 Pit, the excess portion of the PAG mine rock can be placed in inside of either the South or West Mine rock piles.

Under the assumption that 6% of mine rock would be managed as PAG, the estimated total tonnage of the PAG would be around 13.6 Mt. Any PAG mine rock that is excavated after 5034 Pit is completely mined (Year 5) can be directly placed in the mined-out 5034 Pit. The estimated total tonnage of this portion of the PAG mine rock is approximately 7.1 Mt. The remaining portion of 6.5 Mt of the PAG mine rock will be placed in the South or West Mine Rock Piles. The estimated total tonnage of the PAG mine rock that can be placed below the elevation of 418.7 masl in the two mine rock piles is approximately 2 Mt. Therefore, the maximum tonnage of the PAG mine rock to be placed above the restored Kennady Lake water elevation of 420.7 masl in the two mine rock piles would be 4.5 Mt. This value is about 3% of the total mine rock to be stored in the two mine rock piles.

References

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_24

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.4 Closure and Reclamation

Terms of Reference Section:

Preamble

Subsection 10.4.1.7.1 General Demolition and Disposal Procedures, mentions the disposal of inert solid materials.

Request

Provide a map showing where the inert solid landfill is located.

Response

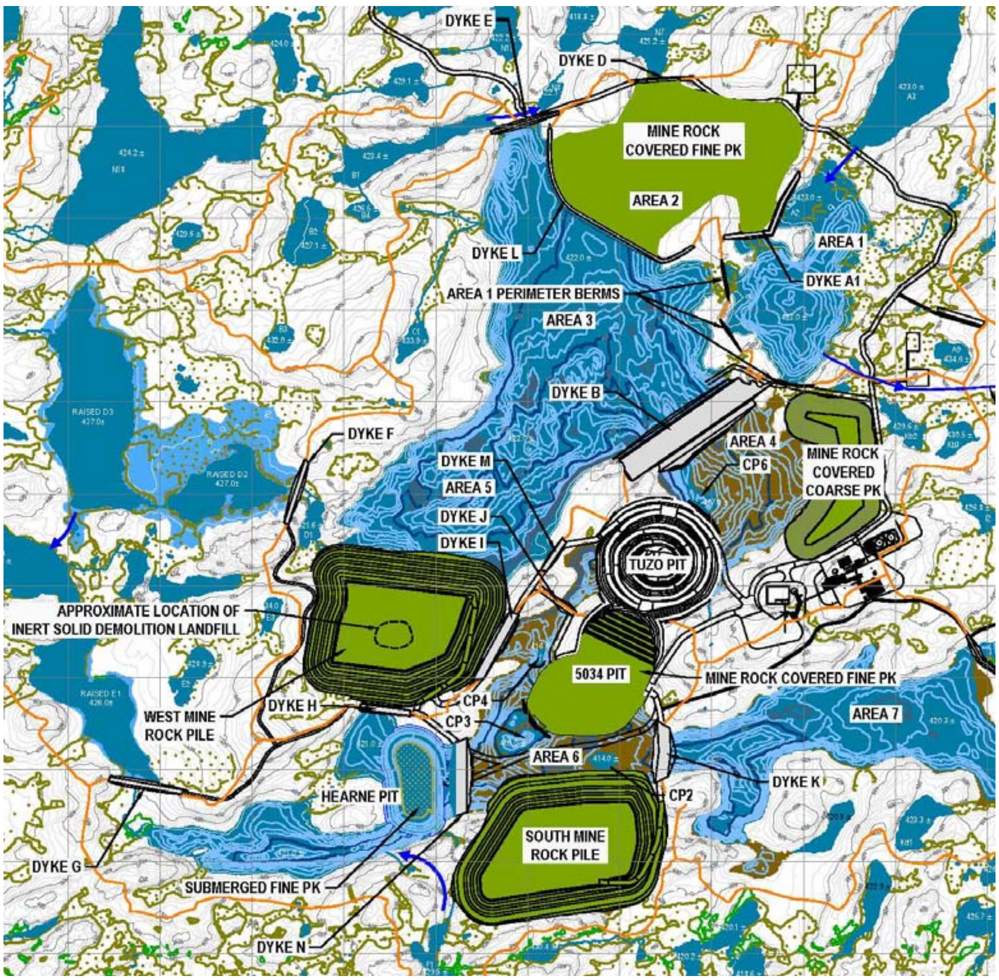
The landfill for inert solid demolition materials at closure would be located within the West Mine Rock Pile as described in Section 3.12.7.1.2 of the 2010 Environmental Impact Statement (EIS) (DeBeers 2010). The approximate location of the landfill is shown in the figure below.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES



Approximate Location of Inert Solid Demolition Landfill

Information Request Number: DKFN_25

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.4 Closure and Reclamation

Preamble

Subsection 10.4.1.7.9 Conceptual Fish Habitat Compensation Plan, in Table 10.4-2, raising lakes A3, D2, D3, E1 and N14 are proposed as compensation measures. The potential effects of raising these lakes relative to methyl mercury generation, increased shoreline erosion, and increased turbidity are not specified.

Request

Provide an assessment of these potential effects, as well as the potential effects from increased turbidity on phytoplankton development, fish feeding, gill abrasion and egg survival rates. Also, provide an assessment of how the presence of permafrost on the shoreline may exacerbate erosion and turbidity effects, and may prolong the period until the shoreline (and effects) stabilizes.

Response

An assessment of the effects of flooding soils and vegetation around the diversion lakes associated with the Gahcho Kué Project operations is included in Section 8.6.2.3 of the 2010 Environmental Impact Statement (EIS) (De Beers 2010) under the secondary pathway of *Release or generation of nutrients, mercury, or other substances into Lakes A3, D2, D3 and E1 from flooded sediments and vegetation may change water quality, and affect aquatic health and fish*. This pathway has been updated in the 2012 EIS Supplement (De Beers 2012) to exclude Lake A3 as a lake that will be raised because the updated Fine Processed Kimberlite Containment (PKC) Facility will be limited to Area 2 as a result of mitigation associated with the deposition of fine processed kimberlite (PK).

As described in Section 8.7.3.3 of the 2010 EIS (De Beers 2010), raising of the water levels in the diversion lakes will create new shorelines at higher elevations than the existing shorelines; this will expose new soils, often on steeper slopes than the existing shorelines, to wave erosion and potential instability due to permafrost disturbance. As described in this section, increases in total suspended solids (TSS) concentrations in the raised lakes are expected to be low due to the armouring action of morainal materials and the rapid settling of its coarse fractions from the water column, along with the location of organic soils in low-gradient locations.

Additional field studies were conducted in 2011 to identify areas susceptible to shoreline erosion and mitigation to minimize effects of shoreline erosion; this is discussed in the Shoreline and Channel Erosion Assessment report (Golder 2012). This report presents a detailed assessment/analysis of erosion potential at the lakes with increase in water levels and for the lake outlet channels with modified flows. To estimate the shoreline erosion potential, a number of parameters were used to produce a five-class classification system, ranking from Very Low to Very High.

The parameters considered in the lake shoreline analysis included three categories: bank and shoreline features (bank height, bank vegetation, bank stability, shoreline geometry), exposure characteristics (shore orientation and wind direction, fetch length, water depth at 6 metres [m] and 30 m from shore) and attenuation characteristics (aquatic vegetation, bank composition, bank slope). The results show that most of the surveyed areas (including but not limited to lakeshores and outlet channels of Lakes D2, D3, E1 and N14) fall within the Low and Very Low erosion susceptibility classes. For areas associated with high erosion susceptibility classes, mitigation measures were proposed that included structural measures (the shoreline will be protected such that the wave action will have minimum impact on the new shoreline) and non-structural measures (the shoreline will be protected on a pro-active basis for the sensitive areas where TSS evolution is possible, following the water level rise).

For the lakes that will be raised, the rate of increase will be based on natural inflows from snow melt and rainfall. Because the bulk of the flow is generated by snow melt, the highest rate of water level increase will occur during the cold season, followed by a slower rate during the open water season. Based on baseline natural flows, it was estimated that Lakes D2 and D3 would fill up to an elevation of 427.0 m within three years (from an approximate baseline elevation of 424.2 m and 425.4 m), and Lake E1 would fill up to an elevation of 426.0 m within one year (from an approximate baseline elevation of 425.2 m). Combining the rate of increase with the local low slopes topography will minimize erosion potential during the period of water level increase. However, it should be noted that the raised elevations of 427.0 m and 426.0 m are based on the application case presented in the 2010 EIS, and that these lakes may be raised up to 429.0 m as a proposed option in the fish habitat compensation plan (De Beers 2010).

Outlet channels were also surveyed to collect data on the existing conditions, including bed and bank materials, bank vegetation, active erosion or depositional areas if present, slope measurements, and cross-sectional profiles. The data were then used to recommend mitigation measures for the channels with increased flows, as well as for the new channels that will result from flow diversions.

The assessment of the effects of shoreline erosion, resuspension of sediments and sedimentation on fish and fish habitat (including lower trophic levels) in the diversion lakes is provided in Section 8.10.3.3 of the 2010 EIS (De Beers 2010). As the increases in TSS concentrations in the raised lakes are expected to be low due to the stability of the shorelines and the implementation of mitigation measures where required, negligible effects on fish and fish habitat are expected from shoreline erosion, resuspension of sediments, and sedimentation.

Changes in water levels and lake areas in the diversion lakes are expected to increase habitat area available for plankton and benthic invertebrates, once new lake areas are fully colonized. This will result in overall increased total biomass of plankton and benthic invertebrates in these lakes, after a period of adjustment to the new water levels. Production of plankton and benthic invertebrate communities in these watersheds is not expected to be negatively affected with the raising of the lake levels, but will require a period of adjustment to the new water level. As explained above, diversions are not expected to substantially increase TSS concentrations in the water column or appreciably alter other water quality parameters upon which invertebrate production is dependent (i.e., phosphorus, nitrogen, carbon). However, some initial changes in water quality are expected after flooding of the new areas, as fine sediments are redistributed and any residual organic material is used by bacteria. These changes are anticipated to be small after the first year of elevated lake levels; the monitoring program described above has also identified areas where mitigation may be implemented to minimize sources of suspended sediments. Taking this into account, negligible effects would be expected on fish feeding from the raising of the lake levels in the diversion lakes.

It is also expected that any increases in TSS concentrations due to shoreline erosion would occur during spring freshet or storm events, and fish would tolerate the levels in the short-term. Fish would also show a behavioural response, moving away from any shoreline areas with a high sediment load. Therefore, as TSS levels are expected to be low, and fish will be able to move away from shoreline areas with higher levels, negligible effects to fish health would be expected (including the potential for gill abrasion). Similarly, as the TSS levels are expected to be low, and spawning areas would continue to be kept clean by wind and wave action, negligible effects would be expected on egg survival. The diversion lakes would continue to support self-sustaining populations of fish species, such as Arctic grayling, northern pike, burbot, slimy sculpin, and ninespine stickleback.

The results of the permafrost assessment were also reviewed and considered. The effects on permafrost related to the raising of lake levels was assessed in Section 11.6.3.2 of the 2010 EIS (De Beers 2010) under the secondary pathway of *Expansion of Open Water Areas in Raised Lakes Adjacent to Kennady Lake Could Result in the Expansion of the Taliks Present Under Those Lakes*. As described in this section, depending on water depth, permafrost will thaw beneath the inundated terrain, resulting in expansions of the existing taliks that are located beneath the lakes. Although these expansions represent a change to pre-development permafrost conditions, they have little relevance to the assessment of effects to valued components, because this change would not be expected to directly affect surface water quality or fish. As a result, changes to permafrost from the raising of lake levels would not be expected to increase shoreline erosion and TSS levels in these lakes, or increase the time for the shorelines to stabilize.

The potential for increases in mercury specifically related to compensation lakes was not included in the EIS, as the raising of lake levels for compensation was included in the EIS as a potential compensation option only. The finalization of compensation options will as part of the development of the detailed fish habitat compensation plan, which will be developed through ongoing discussions with Fisheries and Oceans Canada (DFO), and with input from local communities. However, the effects associated with the raising of lakes for fish habitat compensation would be as described in Section 8.6.2.3 of the 2010 EIS (De Beers 2010) under the secondary pathway: *Release or generation of nutrients, mercury, or other substances into Lakes A3, D2, D3 and E1 from flooded sediments and vegetation may change water quality, and affect aquatic health and fish*, and summarized below. This pathway has been updated in the 2012 EIS Supplement (De Beers 2012) to exclude Lake A3 as a lake that will be raised because the updated Fine PKC Facility will be limited to Area 2 as a result of mitigation associated with the deposition of fine PK.

Mercury concentrations in fish in the raised compensation lakes would not be expected to increase high enough to impair the health of the fish or any wildlife that may eat these fish because of the following:

- The raised lakes are located in the headwaters of the Kennady Lake watershed, which limits the input of mercury from upstream sources.
- The vegetation in the areas to be inundated is generally low lying tundra lying over a cobble and boulder substrate with limited soil. Prior to inundation, the area will be surveyed, and where necessary, some preparation of the area through removal of vegetation assemblages other than tundra (e.g., shrubs) may be considered to reduce the amount of potentially available organic material.
- The number of piscivorous fish (i.e., lake trout, burbot, and northern pike) initially expected to be present in the raised lakes is low and these

higher trophic level fish have the greatest potential to accumulate mercury into their tissue.

- Arctic grayling, slimy sculpin, and ninespine stickleback, (i.e., the fish species most likely to initially inhabit the diverted watersheds) are planktivores or benthivores and, therefore, are low on the food chain which lowers the potential for mercury accumulation in their tissues.
- Mercury concentrations in non-piscivorous fish typically peak in 4 to 5 years and then return to pre-impoundment concentrations usually within 10 to 15 years after flooding (Schetagne et al. 1997, cited in Legault et al. 2004; Bodaly et al. 1997).
- The area flooded in relation to the lake size is small which will limit the potential for impact over the whole lake.

While the possibility for increased mercury methylation rates exists, given the modifying factors mentioned above, any potential for increased mercury concentrations is likely minimal. Furthermore, naturally low nutrient levels in the surface soils and cold temperatures throughout the year would limit bacterial production, resulting in much lower rates of processes such as decomposition (e.g., releasing nutrients) and methylation compared to warmer waterbodies where large increases in nutrient releases to the water column and mercury accumulation in fish have been documented. Monitoring of fish tissues will be incorporated into the monitoring programs for the Project to confirm this prediction.

References

Bodaly, R.A., V.L. St. Louis, M.J. Paterson, R.J.P. Fudge, B.D. Hall, D.M. Rosenberg and J.W.M. Rudd. 1997. Bioaccumulation of Mercury in the Aquatic Food Chain in Newly Flooded Areas. In A. Sigel and H. Sigel (eds.) Metal Ions in Biological Systems. Vol. 34. Mercury and Its Effects on Environmental Biology. Marcel Dekker, Inc. pp. 259-287.

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Golder (Golder Associates Ltd.) 2012 In Preparation. 2011 Shoreline and Channel Erosion Assessment Report. Information Submission for the Gahcho Kué Project.

Schetagne, R., J.-F. Doyon and R. Verdon. 1997. Summary Report: Evolution of Fish Mercury Levels at La Grande Complex, Québec (1978-1994), Joint Report of the Direction principale communication et Environnement, Hydro-Québec, and Groupe-conseil Génivar Inc. cited in Legault, M., J. Benoit and R. Berube. 2004. Impact of Reservoirs. In: Boreal Shield Ecosystems: Lake Trout Ecosystems in a Changing Environment. J.M. Gunn, R.J. Steedman, and R.A. Ryder eds. Lewis Publishers, Boca Raton, FL.

Information Request Number: DKFN_26

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.4 Closure and Reclamation

Terms of Reference Section:

Preamble

Subsection 10.4.3 Consideration of Public Feedback and Traditional Knowledge in Developing the Plan; it needs to be mentioned that the increased primary productivity poses the very real risk of winter fish kills under the ice due to low oxygen saturation (hypoxia) conditions.

Request

Please update this section accordingly.

Response

The Closure and Reclamation Plan included in Section 10.4 of the 2011 EIS Update (De Beers 2011) is conceptual. Section 10.4.3 of the conceptual plan outlines how additional community, and public feedback, as well as traditional knowledge, was initially solicited, what information was obtained, and how this information was used or how it influenced the design of the Closure and Reclamation Plan.

As described in Section 10.4.3.2 of the EIS Update, based on the feedback received during the open houses and the traditional knowledge available through secondary sources, one of the key community desires for restoration included restoring Kennady Lake so that the refilled lake can support fish. As described in this section, water quality in the refilled lake is expected to return to conditions suitable to support aquatic life and it is expected that a fish community will become re-established in Kennady Lake after closure. De Beers understands the importance of a sustainable fish community in Kennady Lake and is committed to do additional work to reduce the uncertainty around future conditions in the lake.

As described in the Response to IR DKFN #18, additional under-ice dissolved oxygen modelling and analysis have been conducted. A three-dimensional hydrodynamic model has been developed using the Generalized Environmental Modelling System for Surfacewaters (GEMSS®) to predict under-ice dissolved oxygen concentrations in Kennady Lake after refilling as a result of projected total phosphorus (TP) concentrations.

Based on the supplemental mitigation associated with the Fine PKC Facility, and additional geochemical testing, presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 mg/L, which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L); this level is less than that presented in the 2011 EIS Update.

The dissolved oxygen modelling and analysis associated with the updated phosphorus projection, conducted as part of the 2012 EIS Supplement, predicts that overwintering habitat conditions will be suitable to support fish populations of cold-water fish species, such as lake trout and round whitefish. As a result, under-ice winter fish kills due to mine effects in Kennady Lake are not expected.

Additional community input will be gathered by De Beers on the Closure and Reclamation Plan as part of the ongoing engagement for the Project.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_27

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.4 Closure and Reclamation

Terms of Reference Section:

Preamble

On page 10-87, Protect the Quality of Water.

Request

Please explain the statement "Supplemental mitigation considered for the Fine PKC Facility will reduce loading of geochemical constituents (e.g. phosphorus) associated with seepage that comes into contact with fine PK ". Page 10-80, 10.4.2.2 did not give us any more clues about the planned supplemental mitigation.

Response

The supplemental mitigation considered for the Fine Processed Kimberlite Containment (PKC) Facility involves a modification to the waste management plan associated with deposition of fine processed kimberlite (PK). The basis of this mitigation is an increase in the volume of fine PK that will be deposited to the mined out 5034 and Hearne pits instead of the Fine PKC Facility, which reduces the size of the Fine PKC Facility footprint by 83 hectares (ha). The reduction in the size of the facility footprint thereby reduces amount of infiltration and drainage through the facility that comes into contact with the deposited fine PK material.

In the 2010 Environmental Impact Statement (EIS) (De Beers 2010), approximately 5.5 million tones (Mt) of fine PK was planned for deposition in the Fine PKC Facility, with 3.31 Mt planned for deposition to the Hearne pit; in the mitigation case, approximately 3.32 Mt of fine PK material is planned for deposition to the Fine PKC Facility. Of the remaining 4.51 Mt of fine PK, 1.5 Mt is planned to be deposited in 5034 pit and 3.01 Mt in Hearne pit.

The 2010 plan for the Fine PKC Facility involved storage of fine PK in both Area 1 and Area 2 of the Kennady Lake watershed. The supplemental mitigation has resulted in the Fine PKC Facility's footprint being limited to Area 2 so that it omits Area 1, which included Lakes A1 and A2. As a result, the size of the Project footprint has decreased by about 83 ha compared to the footprint associated with the 2010 facility.

Concentrations of phosphorus are projected to increase in Kennady Lake in post-closure, with the main source of total phosphorus loadings being the Fine PKC Facility. The supplemental mitigation associated with the deposition of fine PK will reduce loading of geochemical constituents, such as phosphorus, to Kennady Lake.

Additional detail of the supplemental mitigation associated with the Fine PKC Facility will be provided in the updated Project Description (Section 3) in the EIS Supplement (De Beers 2012), which will be submitted to the MVEIRB in 2012.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2012. *Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project*. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_28

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.4 Closure and Reclamation

Terms of Reference Section:

Preamble

Subsection 10.4.3.3.4 Reclaimed Processed Kimberlite Facilities Not Attractive to Caribou, mentions that these facilities will not be attractive to caribou therefore no effects to caribou are expected. However, there is no mention of other wildlife species (e.g., small mammals) using these facilities post-closure. Small mammals are vital prey species for other wildlife species (e.g., wolverine, grizzly bears, foxes) that are top level predators.

Request

Provide an assessment of the health risk to these predators when they prey upon small mammal species that inhabit the processed kimberlite facilities during the postclosure phase of the Project.

Response

An assessment of the potential health risk to caribou and predators, which prey upon small mammal species that may inhabit the processed kimberlite facilities during the post-closure phase of the Project will be evaluated as part of the Wildlife Risk Assessment. The existing Wildlife Risk Assessment is currently being updated using information recently collected by the Air Quality Team as part of a monitoring program of road dust during summer and winter conditions at an operating mine that is similar to the Project. The Wildlife Risk Assessment will be updated with the revised air quality information and is anticipated to be available in August 2012, but this timeline is dependent upon receipt of revised air quality data.

A summary of the available information is provided below.

As described in Subject of Note: Mine Rock and Processed Kimberlite (PK) Storage of the 2010 Environmental Impact Statement (EIS) (De Beers 2010, Section 11.5), the mine rock and PK will be placed in mine rock piles. The Fine Processed Kimberlite Containment (PKC) Facility and Coarse Processed Kimberlite (PK) Pile will be placed in areas that are subject to permafrost over the long term. The quantity of mine rock and PK that will be placed at surface has been reduced by placement of these materials in the mined-out pits which will allow for the reduction of environmental effects of the Project by allowing the permanent storage of groundwater inflows to the active mine pits within the backfilled mine pits and also facilitate progressive closure and reclamation of the mine rock piles and PK storage areas prior to the end of operations. The mine rock piles will not be vegetated at closure to prevent the facilities from becoming attractive to wildlife in response to local concerns about this issue.

The Fine PKC Facility will be covered with 1 to 2 metres (m) of non-acid generating rock and the Coarse PK Pile will be covered with a layer of approximately 1 m of mine rock to prevent erosion. Direct contact with contaminants of potential concern present in the mine rock or PK storage areas by small mammals or larger predators is not expected to occur as the result of the placement of non-acid generating rock on these materials and also through the placement of materials in areas which will be subject to long-term permafrost.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_29

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Nutrients (p. 10-91), three mitigation strategies are being considered for the Fine PKC Facility.

Request

Describe potential contingency measures that could be undertaken post-closure, to reduce phosphorous loadings to Kennady Lake should the mitigation strategies not perform as anticipated.

Response

Contingency measures are not considered necessary in post-closure conditions to reduce phosphorus loadings to Kennady Lake.

Concentrations of phosphorus are projected to increase in Kennady Lake in post-closure, with the main source of total phosphorus loadings being the Fine Processed Kimberlite Containment (PKC) Facility. Since the submission of the 2011 Environmental Impact Assessment EIS Update (De Beers 2011), the mine plan has been updated to reflect supplemental mitigation of the deposition of fine processed kimberlite (PK). As a result, the Fine PKC Facility's footprint has been reduced by 83 hectares (ha) through limiting the extension of the facility into Area 1, which included Lakes A1 and A2. This reduction in size allowed for a reduction in the long-term phosphorus loadings from the facility. This strategy would reduce the surface area of fine PK in the facility by approximately half, effectively reducing the potential for phosphorus loadings from the facility by an equivalent amount.

On-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update (De Beers 2011). Phosphorus loading was determined from a limited set of PK material, which has been supplemented by additional PK material sourced from drill cores for the site. Geochemical testing of this material has been undertaken since 2011, and the results of this testing along with the original testing results have been used to update the loading from the updated Fine PKC Facility. The updated source term inputs have been used in the water quality modeling to predict long-term steady state water chemistry in Kennady Lake and downstream waters.

The supplemental water quality modeling incorporating the updated Fine PKC Facility footprint and the most recent geochemical test results indicate the expected long-term steady state total phosphorous concentrations will be approximately 0.009 milligrams per litre (mg/L). This means that predicted changes of phosphorus in Kennady Lake will not result in a trophic change.

The most recent water quality predictions indicate that no additional mitigation is required and the water quality in Kennady Lake at refilling is expected to be suitable for reconnection with Area 8, and downstream waters. However, De Beers are committed to monitor the site water quality in Areas 3 and 5 during operations, which will receive the loading from the Fine PKC Facility, closure (i.e. the refilling period) and post-closure. In the event that monitored water quality during operations and closure indicates a shift from EIS projections or identifies a potential water quality issue, contingencies during operations and closure (refilling) through adaptive management processes may be considered. These include flexibility in the water management plan to isolate and sequester water that is not acceptable for discharge in Hearne and Tuzo pits (operations and early refilling) or reduce refilling time (refilling) to allow time to address and manage any issue.

The updated Project description (Section 3) and water quality modelling of Kennady Lake (Section 8.7) will be presented in the 2012 EIS Supplement (De Beers 2012), which will be submitted to the MVEIRB in 2012.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. *Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project*. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_30

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Nutrients (p. 10-91), the modeled elevation of the trophic status from oligo- to eutrophic would likely lead to large winter fish kills. Therefore it will be crucial to implement the well thought out supplemental mitigation measures.

Request

Please clarify the model that was used to reach the conclusion that the top 6 m of the water column would stay suitable as overwintering habitat despite higher nutrient loadings given that only the top 6 m of the water throughout the lake are suitable for overwintering before increased primary productivity. Please also consider the current O_2 super-saturation found right below the ice to further reduce fish overwintering habitat. Please quote examples out of the peer-reviewed literature to prove that the model assumptions are correct and that the predicted model outcome will be likely.

Response

The results of three empirical dissolved oxygen (DO) models (i.e., Babin and Prepas 1985, Mathias and Barica 1980, Vollenweider 1979), based on a long-term steady state total phosphorus (TP) concentration of 0.018 milligrams per litre (mg/L) in Kennady Lake estimated that the upper 6 metre (m) depths in late winter (under ice) would have higher than 6.5 mg /L (the CCME [1999] water quality guidelines for cold water species excluding larval stages). The modelling indicated that the depth-averaged DO concentrations in the upper 6 m depths in baseline conditions (11.6 mg/L) would be reduced to between 7.7 and 10.3 mg/L in the post-closure phase depending on modelling approach used. Similarly, in the middle and bottom depths zones, the depth averaged DO concentrations were 4.5 and 1.4 mg/L in baseline conditions, respectively, whereas they approached anoxia in post-closure (Table 8.V-6 in Appendix 8.V of the 2011 Environmental Impact Statement [EIS] Update [De Beers 2011]).

Considering the limitations of the empirical models, a three-dimensional (3-D) hydrodynamic model was developed following the submission of the 2011 EIS Update using Generalized Environmental Modelling System for Surface waters (GEMSS®). GEMSS is in the public domain and has been used for similar studies throughout North America and elsewhere in the world, including a 3-D water quality model that was developed for the De Beers Canada Inc. Snap Lake Mine (Golder 2011). While the empirical models estimated depth averaged DO concentrations in three specific depth zones of Kennady Lake, which did not include the open regions of Hearne and Tuzo pits, the GEMSS model was used to project DO concentrations at a larger spatial array throughout Kennady Lake, including the pits (Tuzo and Hearne pits were modelled to a depth of 40 m).

A "Modified WASP5" module was also adapted to fit within the GEMSS framework to simulate water quality, primarily nutrients and other oxygen-related constituents, in Kennady Lake. The Modified WASP5 module is comprised mainly of formulae from the United States Environmental Protection Agency's (U.S. EPA's) Water Quality Analysis Simulation Program (WASP) model (Ambrose et al. 1993). The detailed methods and model results are described in the 2012 EIS Supplement (De Beers 2012), with summary details provided in similar responses provided to DKFN_18, DKFN_42, and DKFN_45.

While TP concentrations were the primary indicator parameter to predict the winter oxygen depletion rates in the empirical model assessment, and hence, late winter DO (De Beers 2011), all known input variables, including nitrogen, phytoplankton, sediment oxygen demand (SOD), biochemical oxygen demand (BOD), re-aeration rates, decay rates, and temperature correction factors, anticipated point and non-point source inflows to the lake, and associated chemistries were included as inputs to the GEMSS model.

Since the submission of the 2011 EIS Update (De Beers 2011), the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK to reduce potential loading of phosphorus. This change has resulted in a lower volume of fine PK that will be deposited to the Fine PKC Facility. This reduction in size alters the projected long-term loading of phosphorus to Kennady Lake. In addition, on-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update. Updated water quality modelling based on revised source term inputs of TP projected the long-term steady state TP concentrations to be 0.009 mg/L in Kennady Lake.

The DO modelling results using the updated TP concentrations are consistent with the general conclusions outlined in the 2011 EIS Update that were estimated by the empirical modelling (De Beers 2011). By incorporating a series of conservative oxygen demand scenarios and available pit volumes into the GEMSS modelling, it is anticipated that 74 to 92% of the total volume of Kennady Lake will have a DO concentration above 5 mg/L, which represents the acute guideline for the protection of cold water species excluding the larval stages (AENV 1999), and 51 to 89% of the total volume of Kennady Lake possessing a DO concentration above 6.5 mg/L, which represents the chronic guideline for the protection of aquatic life for cold water species excluding the larval stages (CCME 1999). Even the shallow littoral zones are anticipated to have sufficient DO concentrations which might be related to the considerable portion of cobble/boulder substrate in the littoral zone. Therefore, it is anticipated that Kennady Lake during the post-closure phase of the Project will be habitable by the fish assemblage that currently exists in the lake; winter fish kills related to Project effects are not expected.

It is anticipated that water column profiles in Kennady Lake will be monitored during closure and following reconnection with Area 8 to compare measured DO concentrations to EIS predictions. If it is identified that water column DO concentrations, particularly in the surface 6 m depth zone, are worse than predictions, adaptive management strategies will be triggered to address the problem.

The Request references super-saturated dissolved oxygen conditions measured in lakes within the local study area (LSA) during winter monitoring programs (i.e., under ice) in the 2011 EIS Update. Based on the baseline water quality data in Section 8.3.6.2.1 of the 2011 EIS Update (De Beers 2011), some of the winter dissolved oxygen measurements in Kennady Lake show naturally-occurring dissolved oxygen supersaturated conditions immediately under the ice. This occurrence is not uncommon in lakes during ice cover conditions in late winter and has been attributed to increased diurnal plankton photosynthesis in the surface water zone immediately under the ice (e.g., Phillips and Fawley 2002), or by the diffusion of dissolved oxygen from the ice to the surface water layer at the lake/water interface (e.g., Craig et al. 1992). However, there is also a possibility that some of the measured supersaturated dissolved oxygen concentrations at the ice-water interface could be a result of the turbulence caused by auguring through the ice to access the lake for water quality field measurements and sampling. Efforts are taken to reduce this possibility; however, the period of stabilization may not be sufficient to result in surface water dissolved oxygen concentrations to stabilize. It is notable that the modelling did not suggest the development of supersaturated conditions under the ice.

It is anticipated that future monitoring during under ice-conditions will include sampling for phytoplankton just below the ice-water interface where super-saturated DO conditions are measured.

References

AENV (Alberta Environment) 1999. Surface Water Quality Guidelines for Use in Alberta. November 1999. Environmental Service, Environmental Sciences Division. Edmonton, AB, Canada.

Ambrose, R.B., Wool, T.A. and J.L. Martin. 1993. The Water Quality Analysis Simulation Program WASP5, Part A: Model Documentation, Version 5.10. US Environmental Protection Agency, Environmental Research Laboratory. Athens, GA, USA.

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April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_31

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Nutrients (p. 10-91), an in-depth discussion of low O_2 concentrations on benthic invertebrates is missing. Lowell et al. (1999) are reporting that benthic invertebrates show reduced feeding and change their behaviour in search of higher O_2 concentrations. Similar changes have been observed by other authors. These kinds of changes can lead to sweeping changes in the food base for fishes and the whole lake ecosystem and should be considered.

Request

Please provide an assessment of low O_2 concentrations on benthic invertebrates.

Response

The assessment of the changes to benthic invertebrates and lower trophic levels in Kennady Lake was presented in Section 8.10.4.4.1 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011a). A brief update is provided below.

The benthic communities in the project area consist mostly of tolerant invertebrate taxa that are adapted to periodic low dissolved oxygen (DO) conditions (e.g., midges and oligochaete worms). Small decreases in winter DO concentration are predicted by increased nutrient concentrations, based on updated nutrient modelling results presented by De Beers in the 2012 EIS Supplement (De Beers 2012). These small changes are not expected to affect the deep water benthic communities, which are already adapted to periods of reduced DO concentration.

Effects in other unproductive sub-Arctic lakes undergoing nutrient enrichment related to operating diamond mines, such as Snap Lake and Lac de Gras, also provide an indication of expected benthic community changes in Kennady Lake resulting from nutrient enrichment. In both Snap Lake and Lac de Gras, total phosphorus concentration has increased slightly and remains below 10 micrograms per litre (µg/L), and total nitrogen concentration has increased moderately during the first decade of operations. This resulted in increases in total invertebrate density and densities of fingernail clams (Pisidiidae), snails (*Valvata*) and a number of chironomid genera (Snap Lake: *Microtendipes*, *Corynocera*, *Procladius*; Lac de Gras: *Procladius*, *Heterotrissocladius*, *Micropsectra*) in affected areas, with only occasionally measurable changes in densities of other invertebrates and other benthic community variables (e.g., richness, diversity, dominance, evenness) (DDMI 2011; De Beers 2011b).

Updated nutrient predictions for Kennady Lake and downstream waterbodies (De Beers 2012) are lower than those predicted in the 2011 EIS Update (De Beers 2011a), indicating oligotrophic conditions over the long term. Therefore, limited changes to the benthic invertebrate community of Kennady Lake are predicted, consisting mostly of increased abundances of certain taxa and minior shifts in community structure as the community adjusts to the increased food base. A measurable change in benthic community structure due to changes in DO regime is not expected.

References

De Beers. 2011a. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2011b. 2010 Annual Report, Aquatic Effects Monitoring Program, Type A Water License MV2001L2-0002. Prepared by Golder Associates Ltd. Submitted to the Mackenzie Valley Land and Water Board. April 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Diavik Diamond Mines Inc. (DDMI). 2011. 2010 AEMP Annual Report for the Diavik Diamond Mine, NWT. Submitted to the Wek’èezhii Land and Water Board. Yellowknife, NWT.

Information Request Number: DKFN_32

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Preamble

Under Subsection 10.5.4 Long-term Effects to Aquatic Health; Chromium, Iron, Cadmium and Copper concentrations will exceed water quality guidelines. Therefore site specific water quality guidelines must be developed for evaluation by DFO. The detailed rationale required to develop site specific water quality guidelines will give De Beers the opportunity to mention all mitigative circumstances.

Request

Identify site specific water quality objectives for the project.

Response

As stated in De Beers' response to DKFN_19, the development of water quality objectives for the Project was not a requirement of the Terms of Reference (Gahcho Kué Panel 2007), and is typically addressed as part of the Water License Application and Approval Process. However, De Beers acknowledges the importance and benefit of setting water quality benchmarks, which will be used for the effects level evaluation for the receiving aquatic environment. There is also added benefit to undergo this process early in the Project review phase, and De Beers is currently developing these benchmarks for Kennady Lake and downstream lakes (e.g., Lake N11, Area 8 and Lake 410) during dewatering, operations, closure and post-closure periods. It is planned that an initial iteration of the proposed benchmarks and rationale will be prepared as part of the Project Monitoring and Adaptive Management Framework for the Project that is being developed and which will form the basis for detailed consultation with government agencies and communities.

References

Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, N.W.T.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_33

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Under subsection 10.5.5 Long-Term Effects to Fish and Fish Habitat (p. 10-95), the authors state: 'The predicted change in the trophic status of Kennady Lake is expected to result in an increase in summer phytoplankton biomass… increased secondary productivity and biomass of the zooplankton community'.

Request

Although not suggested in the report, please discuss the feasibility and rationale of introducing the planktivorous cisco (native to Lake N16, Lake 410 and Kirk Lake) into Kennady Lake. Please discuss relative to the increased zooplankton populations and relative to potential effects on overwinter dissolved oxygen concentrations.

Response

As described in Section 8.11.1.3.3 of the 2011 Environmental Impact Assessment (EIS) Update (De Beers 2011), the possibility exists for species not currently residing in the lake, including cisco, to become established in the refilled lake. However, De Beers does not plan on stocking Kennady Lake with fish species not currently within the system, such as cisco.

Cisco are present in Lake 410 and Lake M4, which are located downstream of Kennady Lake, and in Lake N16 in the adjacent N watershed. Cisco from N16 could enter the D and E lakes during operations and then move into the refilled Kennady Lake after the connection is restored. As described in Section 8.11.1.3.3 of the 2011 EIS Update, habitat conditions and food availability in Kennady Lake are considered to be suitable for cisco (De Beers 2011).

However, based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L). As this level is less than that presented in the 2011 EIS Update, effects on plankton communities and under-ice dissolved oxygen conditions will be less than presented in the 2011 EIS Update (De Beers 2011). The updated water quality projections, and effects to fish and fish habitat will be provided in the EIS Supplement (De Beers 2012, Section 8), which will be submitted to the MVEIRB in 2012.

References

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_34

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Under subsection 10.5.5 Long-Term Effects to Fish and Fish Habitat; the anticipated chain of events following the anticipated increase in primary productivity is well described but the decrease in suitability for overwintering may not only apply to Lake Trout and Round Whitefish if the current O_2 supersaturation is considered.

Request

A more detailed explanation is needed. In addition, the local First Nations groups may consider what kind of measures they would expect to compensate for the potential loss of at least lake trout and round whitefish.

Response

Although fish will not be able to use Areas 2 to 7 of Kennady Lake during operations and closure (the refilling of Kennady Lake), all fish species currently present in the lake, including lake trout and round whitefish, will re-establish in the refilled Kennady Lake. As a result, it will not be necessary to compensate for the loss of the lake trout and round whitefish populations, as referred to in the Request. All fish habitat compensation required for the Project will be incorporated into the development of the fish habitat compensation plan; this plan will be developed through discussions with Fisheries and Oceans Canada (DFO) and input from Aboriginal communities.

The detailed discussion regarding the effects of changes in nutrient levels on fish and fish habitat was provided in Section 8.10.4.4.1 of the 2011 Environmental

Impact Statement (EIS) Update (De Beers 2011). A detailed discussion of the effects of changes to winter under-ice dissolved oxygen depletion on fish and fish habitat was included, which took into account the results from the water quality assessment (De Beers 2011, Section 8.8.4.1.1 and Appendix 8.V).

However, based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L); this level is less than that presented in the 2011 EIS Update (De Beers 2011). The dissolved oxygen modelling associated with the updated phosphorus projection, conducted as part of the 2012 EIS Supplement (De Beers 2012), predicts that overwintering habitat conditions will be suitable to support fish populations of cold-water fish species, such as lake trout and round whitefish post closure.

In the Preamble, there is a reference to dissolved oxygen supersaturation conditions measured in lakes within the local study area (LSA) during winter monitoring programs (i.e., under ice) in the 2011 EIS Update (De Beers 2011). Based on the baseline water quality data in Section 8.3.6.2.1 of the 2011 EIS Update (De Beers 2011), some of the winter dissolved oxygen measurements in Kennady Lake show naturally-occurring dissolved oxygen supersaturated conditions immediately under the ice. This occurrence is not uncommon in lakes during ice cover conditions in late winter and has been attributed to increased diurnal plankton photosynthesis in the surface water zone immediately under the ice (e.g., Philips and Fawley 2002), or by the diffusion of dissolved oxygen from the ice to the surface water layer at the lake/water interface (e.g., Craig et al. 1992). It is anticipated that future monitoring during under ice-conditions will include sampling for phytoplankton just below the ice-water interface where dissolved oxygen supersaturation is measured.

However, there is also a possibility that some of the measured supersaturated dissolved oxygen concentrations at the ice-water interface could be a result of the turbulence caused by auguring through the ice to access the lake. Efforts are taken to reduce this possibility, as it is standard practice for field crews to allow a short period of time for the surface water to stabilize following auguring as it is common for the surface water to become highly aerated during the auguring process; however, the period of stabilization may not be sufficient to result in surface water dissolved oxygen concentrations to stabilize. To help reduce or eliminate the potential effects of this, the initial dissolved oxygen readings were taken at a depth of a minimum of 1.0 metre (m) from the ice surface (i.e., near the under ice/water interface). This assists by avoiding the potentially aerated water that would be present in the augured hole near the surface.

In response to the preamble, studies have shown that, for the most part, fish will still exist in total gas supersaturated conditions, but that they will often move deeper as a normal response to stress and to avoid adverse effects (i.e., gas bubble trauma) (CCME 1999; Fidler and Miller 1994; Shrimpton et al. 1990a and b). It should also be noted that the under-ice measurements were for dissolved oxygen, and not for total dissolved gas levels (or total gas pressure). Dissolved gas supersaturation occurs when the partial pressures of atmospheric gases exceed their respective partial pressures in the atmosphere; however, individual atmospheric dissolved gases (i.e., oxygen, nitrogen, and trace gases, such as, argon and carbon dioxide) can often be supersaturated without adverse effects on aquatic organisms (CCME 1999). For example, although oxygen alone can produce gas bubble trauma, studies have shown deleterious effects on fish only at high concentrations of dissolved oxygen (i.e., 300% saturation or higher) (Weitkamp and Katz 1980). Furthermore, in natural conditions, fish do not remain at a fixed depth; the depths that fish naturally occupy would provide hydrostatic compensation that either avoids the effects of total dissolved gas supersaturation, or mitigates their exposure during the time they spend in shallower water (Weitkamp 2008).

As a result, it is expected that suitable overwintering conditions would be available in the refilled lake for the re-establishment of all fish species currently present in the lake, including lake trout and round whitefish.

References

CCME (Canadian Council of Ministers of the Environment). 1999. *Canadian Water Quality Guidelines for the Protection of Aquatic Life: Dissolved Gas Supersaturation*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment.

Craig, H., R.A. Wharton Jr. and C.P. McKay. 1992. *Oxygen Saturation in Ice-Covered Lakes: Biological Versus Physical Contributions*. Science 5042:318-321.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Fidler, L.E. and S.B. Miller. 1994. *British Columbia Water Quality Guidelines for Dissolved Gas Supersaturation*. Prepared for BC Ministry of Environment. Canada Department of Fisheries and Oceans. Environment Canada

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Weitkamp, D.E. 2008. *Total Dissolved Gas Supersaturation Biological Effects, Review of Literature 1980-2007*. Draft. Prepared by Parametrix, Bellevue, Washington, June 2008.

Weitkamp, D.E. and M. Katz. 1980. *A Review of Dissolved Gas Supersaturation Literature*. Transactions of the American Fisheries Society 109:659-702.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_35

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

The aquatic habitat figures on pages 10-50 and 10-51 show a limited distribution of cobble/gravel substrates in Kennady Lake.

Request

Provide an assessment of the importance of these areas as potential fish spawning habitats, and the post-closure implications on Kennady Lake fish populations of locating 5034 Pit and Tuzo Pit on or immediately adjacent to these substrates. Similarly, provide an assessment of the post-closure implications on potential fish spawning of siting the South Mine Rock Pile on boulder/cobble substrate in Area 6.

Response

As described in Section J4.1.1 of the Fisheries and Aquatic Resources Baseline (Annex J) of the 2010 Environmental Impact Assessment (EIS) (De Beers 2010), cobble/gravel substrates are not limited in Kennady Lake. The figures referenced in the Preamble are Figure 10.3-16 (Aquatic Habitat in Areas 2, 3, 4, and 5 of Kennady Lake) and Figure 10.3-17 (Aquatic Habitat in Area 6 of Kennady Lake). These figures and additional information regarding Kennady Lake habitat can be found in Section J4.1.1 of Annex J.

As described in Section J4.1.1 of Annex J, clean boulder/cobble and boulder substrates are the most abundant substrate types found in the nearshore area of Kennady Lake, and together comprise almost half (47%) of all nearshore habitat. These types of habitat are generally found along exposed shorelines where wind and wave actions keep substrates free of silt. As a result, nearshore cobble/gravel substrate is not limiting in Kennady Lake. However, it is recognized in Section 3.II.2.1.3 of the Conceptual Compensation Plan (CCP) (De Beers 2010, Appendix 3.II) that "habitat with the potential to support spawning lake trout exists in areas proposed for the Fine PKC Facility, the West and South Mine Rock piles, Hearne, Tuzo, and 5034 pits, Dykes B, I, K, and L, and the road through Area 6".

Fish species that use boulder/cobble shoreline habitat include lake trout and round whitefish, both of which are fall spawning species. The results of fall spawning surveys are presented in Section J4.4.7 of Annex J. As described in this section, the nearshore area of the northern half of the island separating Areas 3 and 4 is the primary spawning location for lake trout in Kennady Lake. This area of the island is one of the only locations in Kennady Lake that has all of the characteristics considered optimal for lake trout spawning, including cobble, rubble, and large gravel substrates, depths less than 5 metre (m) near steep drop-offs, and areas kept clean by wind-generated wave action. Like most of Kennady Lake, the island has clean/boulder substrates; however, the island is directly adjacent to deep (> 10 m) areas on both sides and is exposed to the largest fetch (> 1.5 km) in the lake. Fall spawning studies suggest that the number of other spawning sites currently used by lake trout in Kennady Lake is relatively small. Other nearshore areas with suitable habitat for lake trout spawning have also been identified in all basins of Kennady Lake, including the shorelines of Areas 3, 4, and 5. Round whitefish spawning habitat (i.e., nearshore areas with clean, wave-washed cobble/gravel substrates) was also present along the shorelines of the lake, including Areas 3, 4, and 6. Both of these fish species spawn at depths greater than 2 m to avoid freezing of eggs and ice scour damage.

The primary area used for lake trout spawning (i.e., the island separating Areas 3 and 4) will not be affected by the placement of the pits or mine rock piles; as a result, this habitat will be suitable for lake trout spawning during post-closure. The losses of habitat areas associated with the mine pits and mine rock piles are addressed in the CCP. The areas associated with the mine rock piles are considered permanent losses (De Beers 2010, Section 3.II.5.1), whereas the mine pits are considered physically altered and re-submerged areas (De Beers 2010, Section 3.II.5.2).

Fish habitat compensation will be constructed to offset the losses associated with the Project. The compensation options that have been considered are described in Section 3.II.7.2 of the CCP (De Beers 2010). As described in this section, several of the identified compensation options focus on the construction of habitat enhancement structures within specific areas of Kennady Lake. The in-lake habitat enhancement features that have been included in the proposed compensation plan include Options 3 and 4 (construction of habitat enhancement features in Areas 6, 7, and 8 of Kennady Lake), Option 8 (the Dyke B habitat structure), and Option 10 (widening the top bench of mine pits where they extend onto land). These compensation features will be permanent structures designed to provide spawning, rearing, and foraging habitat for the fish community that will be re-established in the Kennady Lake watershed after closure, including lake trout and round whitefish. Compensation habitat structures will therefore be designed and constructed to maximize the amount of habitat created in the 0 to 4 m depth range, as this is where the majority of the high quality fish habitat in the lake currently exists.

As a result of the availability of unaltered shoreline habitat, in combination with habitat enhancement features, it is expected that sufficient shoreline spawning habitat will be available for the lake trout and round whitefish populations in the refilled Kennady Lake. The finalization of habitat compensation options will be completed as part of the development of the detailed compensation plan for the Project, through discussions with Fisheries and Oceans Canada (DFO) and with input from Aboriginal communities.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Information Request Number: DKFN_36

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Under Subsection 10.5.6 Recovery of Kennedy Lake; in general, De Beers has followed the proper approach to the prediction of the recovery time but based on the assessment, the majority of examples chosen to compare the Kennady Lake conditions are based on conditions found in more temperate areas. Obviously, more limnological research has been carried in lower latitudes and more temperate climates and therefore examples from sub-arctic areas are sparse. Therefore, it is impossible to determine the exact outcome of the increased primary productivity.

Request

De Beers should therefore err on the side of caution and assume that under-ice winter fish kills will happen and suggest how to best mediate them or, in the worst case scenario, compensate for them. One idea for compensation of the use of Kennady Lake during operations of the mine could be the establishment of a cold water fish hatchery and grow-out operation. Fed by a pump, the hatchery could produce edible size fish of one or two of the species preferred by local First Nations.

Response

Overwintering conditions within the refilled Kennady Lake will be suitable to support fish populations of all species of fish currently found in the lake, including sensitive, cold-water species, such as lake trout and round whitefish. Based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility presented in the 2012 Environmental Impact Statement (EIS) Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., less than 0.010 mg/L); this level is less than that presented in the 2011 EIS Update (De Beers 2011). The dissolved oxygen modelling associated with the updated phosphorus projection, conducted as part of the 2012 EIS Supplement (Section 8, De Beers 2012), predicts that overwintering habitat conditions will be suitable to support fish populations of cold-water fish species, such as lake trout and round whitefish. As a result, mitigation or compensation for under-ice winter fish kills is not required.

The proposed fish habitat compensation options include the following: Options 1b and 1c (raising the water level in lakes to the west of Kennady Lake); Option 10 (widening the top bench of mine pits where they extend onto land); Options 3 and 4 (construction of habitat enhancement features in Areas 6, 7 and 8); and Option 8 (the Dyke B habitat structure); these options are described in Section 3.II.7.4 of the Conceptual Compensation Plan (Appendix 3.II of the 2010 EIS [De Beers 2010]). Development of the detailed compensation plan, including finalization of options, will occur through discussions with Fisheries and Oceans Canada with input from local communities. However, a cold-water fish hatchery is not expected to be one of the options considered.

Reference

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_37

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble:

Under Subsection 10.5.6 Recovery of Kennedy Lake; based on local low organic carbon content of the soils, the likelihood of microbial methyl mercury production and release from flooded organic matter is low.

Request

a) Due to the high toxicity of methyl mercury, the monitoring of mercury levels in all lakes with flooded shores should be conducted often (weekly or monthly) and lime could be added only if needed as a short-term measure. The release of methyl mercury from flooded soils is time limited and therefore a temporary measure may be all that is needed until the soils stop to release methyl mercury.

Response

The potential for increased methyl mercury production does exist when flooding areas containing high concentrations of organic material and mercury. However, the areas to be flooded around Kennady Lake do not contain elevated concentrations of organic matter and there is no reason to expect them to have elevated mercury levels, there is currently no primary source other than long-range atmospheric deposition. The shores of the lake consist largely of low-lying tundra lying over a cobble and boulder substrate with limited soil. Prior to inundation, the area will be surveyed, and where necessary, some preparation of the area through removal of vegetation assemblages other than tundra (e.g., shrubs) may be considered to reduce the amount of organic material potentially available. Monitoring of water quality, sediment quality and fish tissue will be incorporated into the monitoring programs for the Project.

Monitoring of mercury concentrations in edible fish tissue will be conducted prior to and following flooding using non-invasive techniques, to determine whether there is a potential issue. If, despite expectations to the contrary, mercury concentrations (adjusted for fish age, which is a major modifying factor) do show a significant upward trend following flooding, management options will be considered. The actual management option(s) that may be employed in this unlikely scenario could include liming but could also include fish barriers, fish consumption advisories, or selenium additions. Specific management options would be determined if and when necessary in consultation with regulatory agencies and communities.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_38

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Preamble

Under Subsection 10.5.6 Recovery of Kennedy Lake; we agree with the general statements that the post-closure and recovered fish community will likely still be composed of the same species as found before Kennady Lake was de-watered and that the increased primary production may favour northern pike over lake trout as the top predator.

Preamble only no request.

Response

De Beers acknowledges the statement provided in the preamble and have confirmed with DKFN that a response is not required.

Information Request Number: DKFN_39

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.5 Effect of Project Activities on the Long-term Recovery of Kennedy Lake

Terms of Reference Section:

Preamble

Predicted Recovery of Kennady Lake (p. 10-103), the authors state: 'Mesotrophic conditions (in Kennady Lake) are likely to be more favourable to northern pike…'

Request

Although not suggested as a potential compensation measure in the report, please discuss the feasibility and rationale of creating/enhancing shallow water habitat for northern pike.

Response

De Beers has considered the option of developing compensation habitat for northern pike in Kennady Lake; however, due to existing habitat conditions in the lake, developing compensation habitat for northern pike (i.e., establishment of additional aquatic vegetation communities) would be difficult to achieve. As described in Section 8.11.1.3.3 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011), Kennady Lake currently does not support a substantial aquatic plant community due to physical factors and climate.

Vegetation in Kennady Lake is rare, related to the availability of suitable habitat for the growth of vegetation (i.e., the lack of fine sediment around the periphery of the lake). As described in Section 8.3.8.2.1 of the 2010 EIS and Section J.4.1.1 of Annex J (De Beers 2010), the nearshore habitats of Kennady Lake are primarily composed of clean cobble and boulder substrates; these substrates are generally found along exposed shorelines where wind and wave actions function to reduce silt accumulation. Aquatic vegetation in Kennady Lake is extremely limited and is typically restricted to a narrow fringe of sedges in protected embayments and at tributary mouths where sediments have accumulated. A narrow band of shoreline vegetation is typically inundated in spring when water levels in the lake rise, but this habitat usually exists for only two to three weeks during the peak spring freshet.

As a result of the increased nutrients in the refilled lake, there may be an increase in aquatic macrophyte growth, which would improve the availability of suitable spawning and rearing habitats for northern pike in Kennady Lake; however, as the substrate is the limiting factor in the distribution of aquatic vegetation in Kennady Lake, it is unlikely that a substantial increase in macrophytes will occur during post-closure. It should also be noted that based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady state phosphorus concentration is projected to be 0.009 milligrams per litre (mg/L), which indicates that long-term trophic status in Kennady Lake will remain oligotrophic, not mesotrophic as presented in the 2011 EIS Update (De Beers 2011). Efforts to increase aquatic vegetation (i.e., transplants) within the lake are considered unlikely to be successful, due to the substrate limitations.

The proposed fish habitat compensation options include Options 1b and 1c (raising the water level in lakes to the west of Kennady Lake), which would provide additional habitat area for northern pike in the D-E-N watershed; these options are described in Section 3.II.7.2 of the Conceptual Compensation Pan (Appendix 3.II of the 2010 EIS [De Beers 2010]). Development of the detailed compensation plan, including finalization of options, will occur through discussions with Fisheries and Oceans Canada (DFO) and input from Aboriginal communities.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DKFN_40

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.6 Long-term Effects to Downstream Aquatic Ecosystems

Preamble

In general, all issues that are summarized in this section have been discussed before and the main potential threats to fish and invertebrates and their habitat are the increased primary productivity and the potential for winter fish kill that goes along with it. Heavy metal concentrations that are predicted to be exceeding water quality guidelines benefit from solution once they have reached downstream aquatic ecosystems and are modeled to be within water quality guidelines.

Preamble only no request!

Response

De Beers acknowledges the statement provided in the preamble and have confirmed with DKFN that a response is not required.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_41

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.7 Long-term Effects to Wildlife and Human Use

Terms of Reference Section:

Preamble

Subsection 10.7.2.1.3 Long-term effects of a decrease in open water area to wildlife habitat, it is stated that long term residual effects to water birds and shorebirds are anticipated to be negligible in magnitude.

Request

How was this determined especially since "the classification of residual effects for wildlife has not been presented" (page 10-114 par 2 line 3)?

Response

With regards to the approach to the assessment and classification of impacts in Section 10, please see Section 10.8 (Residual Impact Classification), Page 10-109, second paragraph of the 2010 Environmental Impact assessment (EIS) (De Beers 2010). Here, it is stated that given that long-term effects to wildlife were not predicted as a result of the Project, the classification of residual effects for wildlife has not been presented. Wildlife includes water birds and shorebirds. Instead, a summary of the effects to wildlife is presented in Section 10.7.2 (De Beers 2010), which is based on the Key Line of Inquiry and Subjects of Note for wildlife and vegetation, including Species at Risk and Birds and Vegetation.

The statement in Section 10.8 is based on the Summary of Residual Effects to wildlife provided in Sections 10.7.2 (De Beers 2010). The summary in Section 10.7.2.1.3 (Long-term Effects of a Decrease in Open Water Area to Widlife Habitat) states that the decrease in the surface area of open water in the Kennady Lake watershed beyond closure will primarily affect habitat for water birds (e.g., waterfowl, loons, and grebes) and shore birds whose important habitats include vegetation communities with a wetter moisture regime including shallow and deep water, sedge wetlands, and riparian habitats. Long-term residual effects from the Project on water birds and shore birds are anticipated to be negligible in magnitude. This prediction is based on the permanent changes in wetland and water habitats from the Project at the population (regional) level, which is less than 1% (negligible magnitude) (see Table 11.7-18; Section 11.7.4.1.2, De Beers 2010). This information should have been provided to support the summary in Section 10.7.2.

Section 10 presents a summary of the long-term biophysical effects, and closure and reclamation, to wildlife and terrestrial habitat, and human health. The summary of residual effects is based on assessments presented in other sections of the EIS (e.g., Key Line of Inquiry: Caribou [Section 7], Subjects of Note: Carnivore Mortality [Section 11.10], Other Ungulates [Section 11.11], and Species at Risk and Birds [Section 11.12]), and summarized again in Cumulative Effects (Section 13) (De Beers 2010). For example, Section 10 includes:

- a summary of the analysis that has been completed to evaluate how long-term changes to Kennady Lake may affect wildlife; and
- a summary of the residual impact classification that has been completed, with a focus on the aquatic ecosystem in Kennady Lake and downstream systems.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Information Request Number: DKFN_42

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.8 Impact Classification

Terms of Reference Section:

Preamble

Subsection 10.8.2 Results, Annex I, Water Quality Baseline states on page I4-2 "In general, DO concentrations at depths greater than 8 m in deeper basins and at depth below 4-6 m in shallow basins were below the CWQG for the protection of cold-water life (9.5 mg/L for early life stages and 6.5 mg/L for other life stages)". It is important to remember that these values are valid for a pre-mine condition. In addition you have an average of 2 m ice thickness and in combination a thin layer from 2 m to 4-6 m of depth is suitable for the protection of cold water life under ice. The Residual Impact Classification does not use the conditions stated in Annex I as the basis for the evaluation of impact and no modeling or literature based prediction of the changes in O_2 concentrations in the thin layer of suitable overwintering habitat is given. Therefore residual impact cannot be classified as is.

Request

Please give a modeled or literature based likelihood of winter fish kills in post-mine closure Kennady Lake.

Response

"Winter-kill of fish" is a common phenomenon in most freshwater lakes of higher latitudes of the temperate regions (Greenbank 1945, Tonn et al. 1990). Winter brings about a set of conditions which differ sharply from those which prevail during the rest of the year. "*The appearance of piles of dead fish along the shores of a lake at the break up of the ice is dramatic evidence of the harshness and suddenness with which the forces of nature can act*" (Greenbank 1945). The key causal factor of fish-kill is the lack of dissolved oxygen (DO) in the water column during under ice conditions due to oxygen demand processes primarily attributed to the decomposition of organic matter and respiration of aquatic life, associated with limited or no atmospheric re-aeration, and low rates of *in situ* oxygen production from phytoplankton or aquatic macrophytes because of ice cover and snow blanket on the water surface and limited light availability.

In the 2011 EIS Update (De Beers 2011), water quality baseline data, modelled nutrient concentrations and published literature were used to develop empirical models to predict post-closure DO concentrations in Kennady Lake (Section 8.8 and Appendix 8.V [De Beers 2011]). Considering the limitations of the empirical models, a three-dimensional (3D) hydrodynamic model was developed following the submission of the 2011 EIS Update using Generalized Environmental Modelling System for Surface waters (GEMSS®). GEMSS is in the public domain and has been used for similar studies throughout North America and elsewhere in the world, including a 3-D water quality model that was developed for the De Beers Canada Inc. Snap Lake Mine (Golder 2011). While the empirical models estimated average DO concentrations in three specific depth zones of Kennady Lake, which did not include the open regions of Hearne and Tuzo pits, the GEMSS model was used to project DO concentrations at a larger spatial array throughout Kennady Lake, including the pits (Tuzo and Hearne pits were modelled to a depth of 40 metres [m]).

A “Modified WASP5” module was adapted to fit within the GEMSS framework to simulate water quality, primarily nutrients and other oxygen-related constituents, in Kennady Lake. The Modified WASP5 module is comprised mainly of formulae from the United States Environmental Protection Agency’s (U.S. EPA) Water Quality Analysis Simulation Program (WASP) model (Ambrose et al. 1993). The detailed methods and model results are described in the 2012 EIS Supplement (De Beers 2012).

While total phosphorus (TP) concentrations were the primary indicator parameter to predict the winter oxygen depletion rates in the empirical model assessment and hence late winter DO (De Beers 2011), all known input variables, anticipated point and non-point source inflows to the lake, and associated chemistries were included as inputs to the GEMSS model. These included the following:

- meteorological data inputs (i.e., sourced from observed data from the meteorological station at Snap Lake, Northwest Territories (NWT), and data from the Environment Canada station at the Yellowknife Airport),
- hydrological inflows and outflows (i.e., associated with the GoldSim© watershed model outputs associated with the mine site water balance); and
- chemistry, including baseline water and modelled water quality projections developed for the assessment.

The water quality parameters and modifiers that were included in the DO modelling included those that would influence DO concentrations in Kennady Lake. These parameters included nitrogen, phosphorus, phytoplankton, sediment oxygen demand (SOD), biochemical oxygen demand (BOD), re-aeration rates, decay rates, and temperature correction factors. Many of these parameters are measured parameters, whilst some rely on reaction rates and other applicable coefficient factors that are sourced from literature and observations from other similar lake environment conditions.

The focus of the DO model was to predict late winter DO concentrations as a result of changes to the modelled nutrient concentrations in Kennady Lake following refilling (post closure), in order to predict effects to fish overwintering habitat conditions. In the 2011 EIS Update, De Beers committed to incorporate additional mitigation associated with the deposition of fine Processed Kimberlite (PK) to achieve a long-term steady-state total phosphorus (TP) concentration of 0.018 milligrams per litre (mg/L) in Kennady Lake (De Beers 2011).

Since the submission of the 2011 EIS Update, the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK to reduce potential loading of phosphorus (De Beers 2011). This change has resulted in a lower volume of fine PK that will be deposited to the Fine Processed Kimberlite Containment (PKC) Facility. Therefore, the Fine PKC Facility's footprint has been limited to Area 2, which reduces the Fine PK surface area by approximately half as it no longer includes Area 1. This reduction in size alters the projected long-term loading of phosphorus to Kennady Lake. In addition, on-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update (De Beers 2011). Updated water quality modelling based on revised source term inputs of TP projected the long-term steady state TP concentrations to be 0.009 mg/L in Kennady Lake. Additionally, the updated water quality data were used in the GEMSS DO modelling.

There is often a high degree of uncertainty in developing a numerical model to represent an aquatic ecosystem. This uncertainty is based upon model parameters and coefficients that are not always available from baseline or measured data for use in the model. As a consequence, assumptions are often made that are applied to the model to address any gaps, and then the model calibrated with available baseline data to reduce some of the uncertainty. To further reduce uncertainties encountered during the baseline calibration phase of the model development, and because water quality conditions in Kennady Lake during the post-closure time period are anticipated to be different, sensitivity analyses are completed.

The sensitivity analysis for this model included modifying input parameters that could directly or indirectly affect DO concentrations, one parameter variable per simulation, and analyzing the response of the model to that change. The volume of Kennady Lake that met or exceeded DO threshold concentrations was the primary indicator in the sensitivity analysis:

- the average volume of Kennady Lake in post-closure with a DO concentration greater than 5 mg/L at the end of the ice-covered season[1]; and

[1] A DO concentration greater than 5 mg/L was selected because it represents the acute guideline for the protection of aquatic life for cold water species excluding the larval stages (AENV 1999)

- the average volume of Kennady Lake in post-closure with a DO concentration greater than or equal to 6.5 mg/L at the end of the ice-covered season[2].

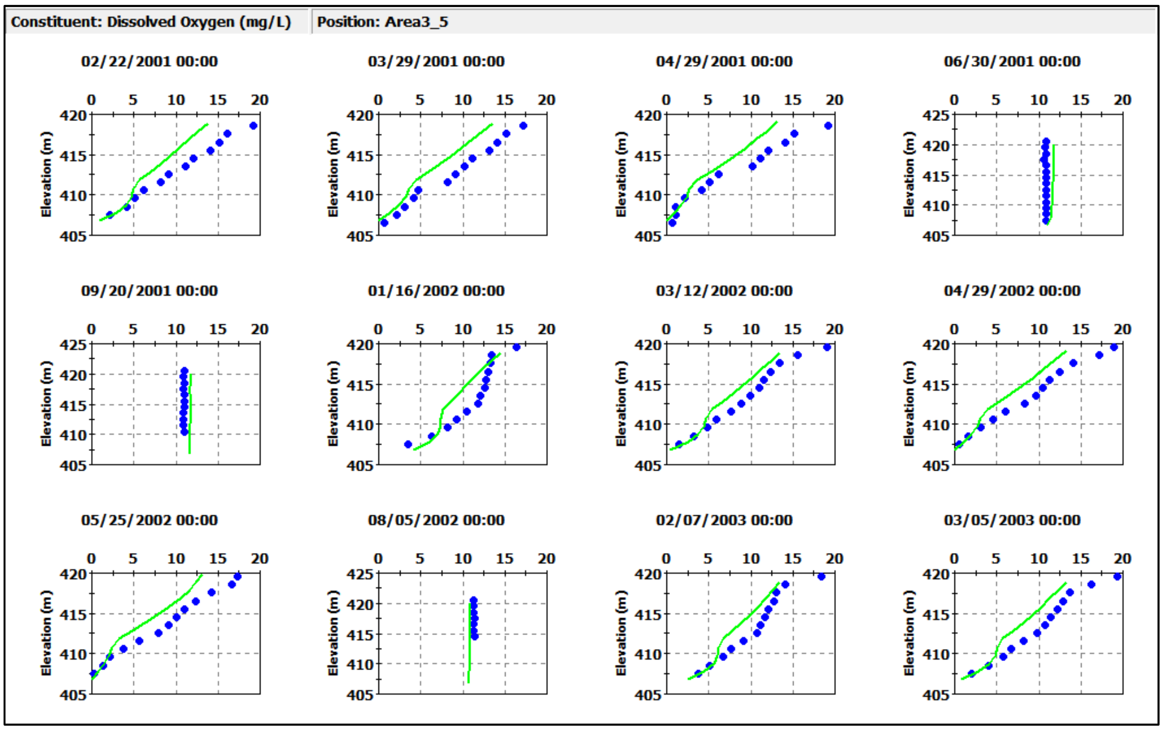
Of the 17 parameters, rates and coefficients tested in the sensitivity analysis, only SOD was identified as having the most substantial effect on DO concentrations. Therefore, three SOD scenarios were used to predict a range of potential DO in late winter periods:

- Post-closure SOD Scenario 1: a SOD rate of -0.25 grams of oxygen per square metre per day (g DO/m^2/d) was used; In the calibration time period, an SOD value of -0.25 g DO/m^2/d was found to be appropriate for simulating DO, especially under ice (Figure DKFN_42-1).
- Post-closure SOD Scenario 2: a 50% increase in SOD (-0.375 g DO/m^2/d) was assumed at post-closure compared to the calibration time period; and
- Post-Closure SOD Scenario 3: a 100% increase in SOD (-0.5 g DO/m^2/d) was assumed at post-closure compared to the calibration time period.

These SOD rates used in the sensitivity analyses (-0.25 to -0.50 g DO/m^2/d) are very conservative compared to reported literature values. Mathias and Barica (1980) reported SOD levels of -0.23 g DO/m^2/d in eutrophic lakes estimated from four sets of Canadian lakes, prairie, southeastern Ontario, Arctic and the Experimental Lake Area (ELA). In addition, White et al. (2008) reported an SOD level of -0.10 g DO/m^2/d in a small arctic gravel pit lake (depth 10.7 m, area 13,355 square metres [m^2]), and Matisoff and Neeson (2005) reported a summer SOD level in central Lake Eire of -0.164 g DO/m^2/d.

[2] A DO concentration greater than or equal to 6.5 mg/L was selected because it represents the chronic guideline for the protection of aquatic life for cold water species excluding the larval stages (CCME 1999). A DO threshold for larval stages was not considered necessary because the lake is predicted to be well oxygenated at all times during the open water season.

Figure DKFN_42-1 Vertical Profile Calibration Plots for Dissolved Oxygen

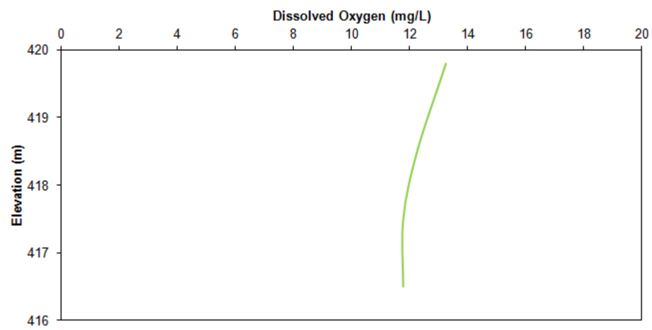


Note: Solid line represents model predictions; dots represent measured data.

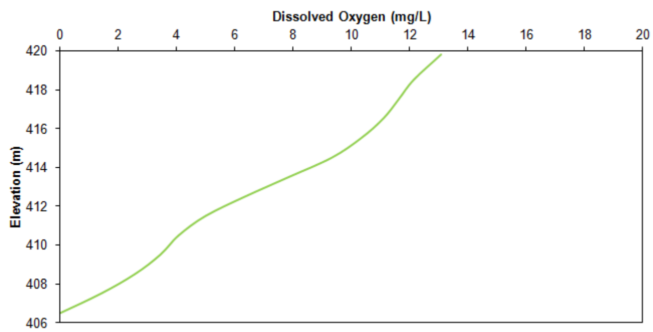
For the post-closure SOD Scenario 1, predicted DO concentration profiles indicated the following:

- The littoral zone of Kennady Lake (down to a depth of 4 m) is anticipated to possess DO concentrations greater than 6.5 mg/L at the end of the ice-covered season (Figure DKFN_42-2a);
- The pelagic zone of Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 8 m and DO concentrations greater than 6.5 mg/L at depths above 7 m at the end of the ice-covered season (Figure DKFN_42-2b); and
- The pits in Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 38 m and DO concentrations greater than 6.5 mg/L at depths above 36 m at the end of the ice-covered season (Figure DKFN_42-2c).

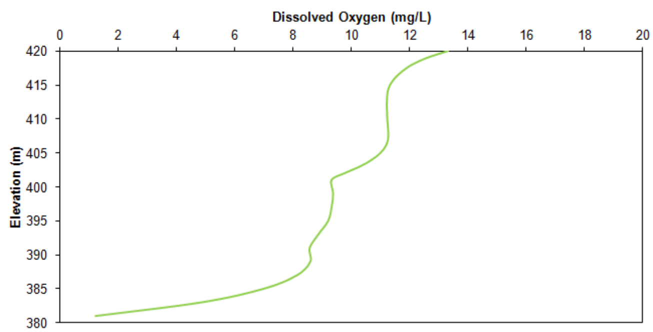
Figure DKFN_42-2a-c End-of-Winter Dissolved Oxygen Profiles in (a) the Littoral Zone, (b) the Pelagic Zone and (c) the Hearne Pit of Kennady Lake in Post-closure with a Sediment Oxygen Demand of -0.250 g DO/m^2/d



(a)



(b)



(c)

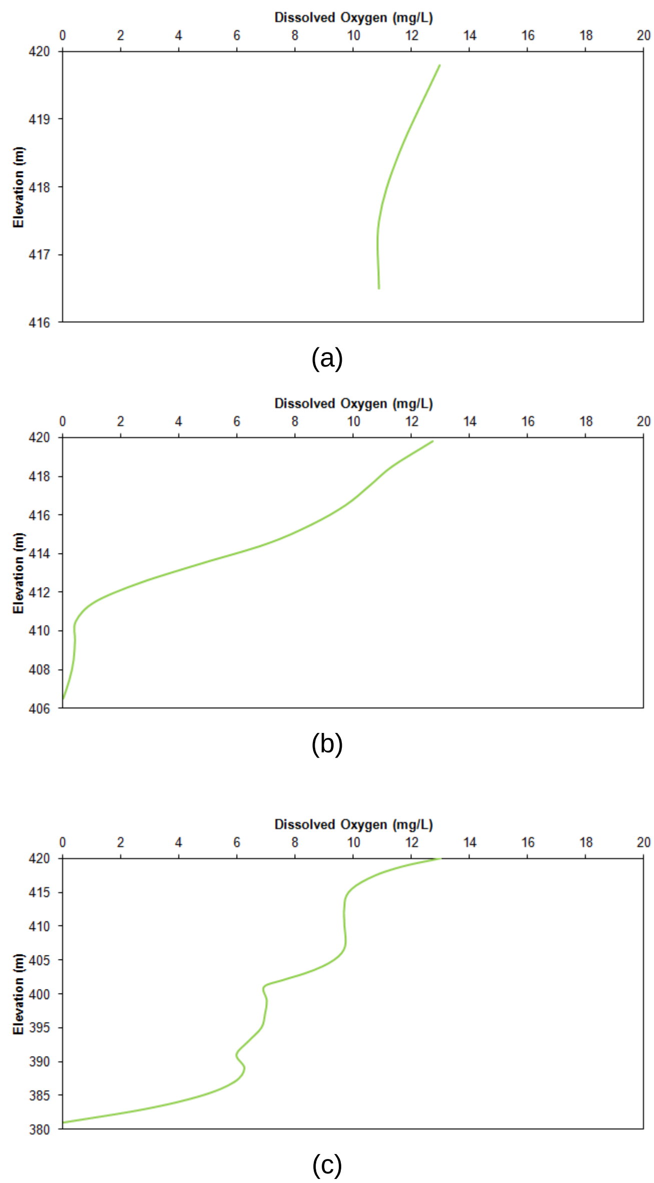
The post-closure water volume of Kennady Lake including the Tuzo and Hearne pits modelled to a depth of 40 m is 55.6 million cubic meters (Mm^3). For the post-closure SOD Scenario 1, the average volume of Kennady Lake with a DO concentration greater than 5 mg/L and 6.5 mg/L at the end of under-ice conditions (i.e. just prior to ice melt) are predicted to be approximately 51.4 Mm^3 (92% of the total volume) and 49.2 Mm^3 (89% of the total volume), respectively. Therefore, 89% of the volume of Kennady Lake in post-closure is predicted to have a DO concentration higher than the CCME guideline of 6.5 mg/L (Figure DKFN_42-2c).

For the post-closure SOD Scenario 2, predicted DO concentration profiles indicate the following:

- The littoral zone of Kennady Lake is anticipated to possess DO concentrations greater than 6.5 mg/L at the end of the ice-covered season (Figure DKFN_42-3a);
- The open water zone of Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 7 m and DO concentrations greater than 6.5 mg/L at depths above 6 m at the end of the ice-covered season (Figure DKFN_42-3b); and
- The pit lakes in Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 35 m and DO concentrations greater than 6.5 mg/L at depths above 27 m at the end of the ice-covered season (Figure DKFN_42-3c).

For the post-closure SOD Scenario 2, the average volume of Kennady Lake with a DO concentration greater than 5 mg/L and 6.5 mg/L at the end of winter is predicted to be approximately 47.2 Mm^3 (85% of the total volume) and 44.4 Mm^3 (80% of the total volume), respectively (Figure DKFN_42-3c). Therefore, 80% of the volume of post-closure Kennady Lake is predicted to have a DO concentration higher than the CCME water quality guideline of 6.5 mg/L. This represents a 17% increase in volume additional to the actual volume of Kennady Lake that will have a DO greater than 6.5 mg/L, which is a measure of additional overwintering habitat for fish.

Figure DKFN_42-3a-c End-of-Winter Dissolved Oxygen Profiles in (a) the Littoral Zone, (b) the Pelagic Zone and (c) the Hearne Pit of Kennady Lake in Post-closure with a Sediment Oxygen Demand of -0.375 g $DO/m^2/d$



For the post-closure SOD Scenario 3, predicted DO concentrations profiles indicate the following:

- The littoral zone of Kennady Lake is anticipated to possess DO concentrations greater than 6.5 mg/L at the end of the ice-covered season (Figure DKFN_42-4a);
- The open water zone of Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 6 m and DO concentrations greater than 6.5 mg/L at depths above 5 m at the end of the ice-covered season (Figure DKFN_42-4b); and
- The pit lakes in Kennady Lake is anticipated to possess DO concentrations greater than 5 mg/L at depths above 19 m and DO concentrations greater than 6.5 mg/L at depths above 17 m at the end of the ice-covered season (Figure DKFN_42-4c).

For the post-closure SOD Scenario 3, the average volume of Kennady Lake with a DO concentration greater than 5 mg/L and 6.5 mg/L at the end of winter are predicted to be approximately 41.2 Mm^3 (74% of the total volume) and 28.6 Mm^3 (51% of the total volume), respectively (Figure DKFN_42-4c). Therefore, 51% of the volume of post-closure Kennady Lake is predicted to have a DO concentration higher than the CCME water quality guideline of 6.5 mg/L.

The results of the updated DO modelling are consistent with the conclusions outlined in the 2011 EIS Update (De Beers 2011) based on empirical DO modelling. For the broad range of empirical approaches (i.e., Babin and Prepas 1985, Mathias and Barica 1980, Vollenweider 1979) and based on a 0.018 mg/L TP at post-closure and under-ice baseline DO data, the surface zone of Kennady Lake (i.e., under ice to 6 m) was predicted to maintain sufficient DO concentrations to support cold-water aquatic life (greater than 6.5 mg/L). However, the empirical modeling did not separate shallow littoral zones and or include the volume of water available in the pit lakes, which are included in the GEMSS model.

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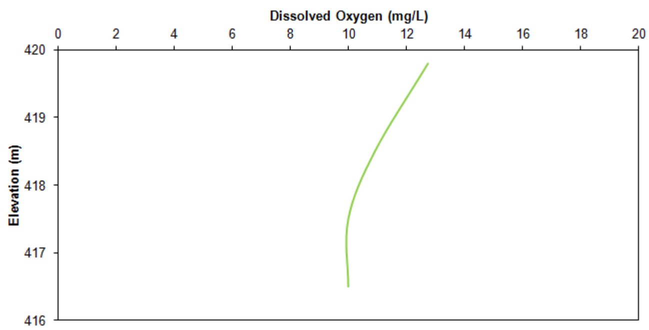
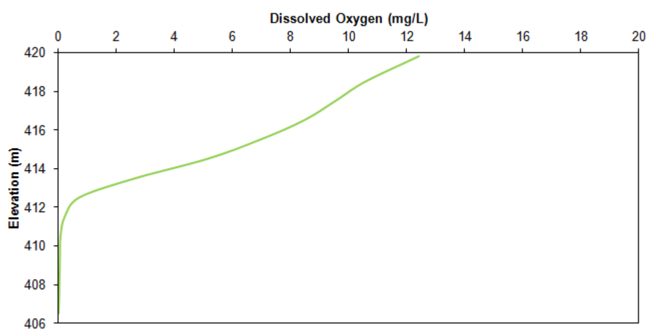
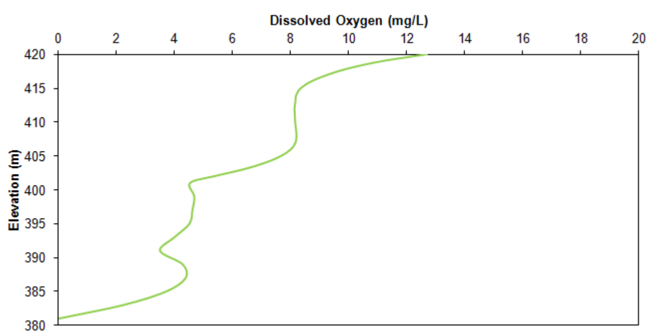
Figure DKFN_42-4a-c End-of-Winter Dissolved Oxygen Profiles in (a) the Littoral Zone, (b) the Pelagic Zone and (c) the Hearne Pit of Kennady Lake in Post-closure with a Sediment Oxygen Demand of -0.500 g DO/m^2/d



(a)



(b)



(c)

With the updated predictions of TP in Kennady Lake in post-closure, and the supplemental DO modelling using GEMSS, it is anticipated that 74% to 92% of the total volume of Kennady Lake will have a DO concentration above 5 mg/L, which represents the acute guideline for the protection of cold water species excluding the larval stages (AENV 1999), and 51% to 89% of the total volume of Kennady Lake possessing a DO concentration above 6.5 mg/L, which represents the chronic guideline for the protection of aquatic life for cold water species excluding the larval stages (CCME 1999). Even the shallow littoral zones are anticipated to have sufficient DO concentrations which might be related to the considerable portion of cobble/boulder substrate in the littoral zone. Therefore, winter fish kill events in Kennady Lake during the post-closure phase of the Project are not expected.

It is anticipated that water column profiles in Kennady Lake will be monitored during closure and following reconnection with Area 8 to compare measured DO concentrations to EIS predictions. If it is identified that water column DO concentrations, particularly in the surface 6 m depth zone, are worse than predictions, adaptive management strategies will be triggered to address the problem.

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GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_43

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.8 Impact Classification

Terms of Reference Section:

Preamble

Subsection 10.8.2 Results, Annex I, to classify residual impacts on arctic grayling, the previously mentioned potential for fish winter kill or reduction in spawning habitat at the outlet of Kennady Lake due to nutrient enrichment needs to be taken into consideration.

Request

Please include the two factors into the residual impact classification and reassess all assumptions made.

Response

The two factors described in the Preamble above were included in the residual impact classification in the 2011 Environmental Impact Assessment (EIS) Update (De Beers 2011), so there is no need to reassess. The classification of residual impacts in Sections 8.14.3, 9.13.3, and 10.8.2 of the 2011 EIS Update (De Beers 2011) takes into account the potential effects of nutrients on Kennady Lake and downstream waters on the Valued Components, including reduced under-ice dissolved oxygen levels in the refilled Kennady Lake and changes to spawning habitat downstream.

Annex I (Water Quality Baseline in the EIS [De Beers 2010]) is a baseline report that summarizes the results of water and sediment quality programs in the study area; this baseline report does not include assessment results. However, additional information regarding dissolved oxygen modelling and results can be found in Section 8.8.2.2 and Appendix 8.V of the 2011 EIS Update (De Beers 2011).

The residual impact classification for Chapter 10 (Section 10.8.2) in the 2011 EIS Update (De Beers 2011) focused on long-term effects (i.e., during post-closure) to be consistent with the scope of the key line of inquiry for Chapter 10 (KLOI: Long-Term Biophysical Effects, Closure, and Reclamation). The residual impact classification section provides a summary of the residual impacts; however, more details regarding the assessment of effects relating to nutrients can be found in Section 8.10.4.4.1 for Kennady Lake and Section 9.10.4.3 for the Downstream Watershed (De Beers 2011). These sections include literature review and review of modelling results presented in the Water Quality sections.

However, as a result of the supplemental mitigation associated with the Fine PKC facility proposed in the 2012 EIS Supplement (De Beers 2012), the long-term nutrient levels projected for Kennady Lake and downstream are less than those presented in the 2011 EIS Update (De Beers 2011).

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

DE BEERS CANADA

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_44

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.8 Impact Classification

Terms of Reference Section:

Preamble

Subsection 10.8.2 Results, Annex I, as previously mentioned the potential for under-ice winter fish kills (arctic grayling or lake trout) and the reduction of spawning habitat for (arctic grayling) are hardly mentioned.

Request

We believe that these factors can significantly effect VCs and therefore ask DeBeers to re-assess the significance of effects to these factors based on existing data, better modeling and scientific literature.

Response

As described in the response to IR DKFN #43, the classification of residual impacts in Section 10.8.2 of the 2010 Environmental Impact Statement (EIS) (De Beers 2010) does take into account the potential effects of nutrients on Kennady Lake and downstream waters on the Valued Components (including reduced under-ice dissolved oxygen levels in the refilled Kennady Lake and changes to spawning habitat downstream).

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_45

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.9 Uncertainty

Terms of Reference Section:

Preamble

Subsection 10.9.1 Project Site Water Balance and Hydrology; the uncertainty in the water quality modeling is much higher than stated. Based on the thorough analysis of Appendix 8.V, page 8.V-11 (Table 8.V-6), the model outcome of the level of oxygen depletion based on phosphorus enrichment is not clearly described throughout Section 10. Winter O_2 concentrations are calculated to become anoxic or close to anoxic below 6 m and to be between 7.7 mg/L and 10.34 mg/L from 0-6 m depth. Since the O_2 concentration values certainly do not decrease from 8.88 mg/L to 0 mg/L within a few centimeters, De Beers should calculate all values from right under the ice to 6 m depth to inform the reader at which depth the O_2 concentrations fall to anoxic levels and below the CCME guidelines for aquatic life. Based on our quick and rough graphic estimation for an interpolation between the two given values, only the top 1 m of the water column would have sufficient O_2 levels for overwintering lake trout and the top 1-3 m would have overwintering O_2 levels for arctic grayling and northern pike.

Request

Please re-calculate the predicted O_2 concentrations under added phosphorus load for the whole depth profile from 0-6 m and re-evaluate all previous statements about significance of residual effects based on this re-calculation.

Response

A three-dimensional (3D) hydrodynamic model to simulate long-term dissolved oxygen (DO) conditions in Kennady Lake in post-closure was developed following the submission of the EIS Update using Generalized Environmental Modelling System for Surface waters (GEMSS®). The detailed methods and model results for this updated modelling are described in the 2012 EIS

Supplement (De Beers 2012), with summary details provided in similar responses provided to DKFN_18, and DKFN_42. The GEMSS modelling, which incorporated a "Modified WASP5" module within the GEMSS framework to simulate water quality in Kennady Lake, supersedes the empirical modelling presented in the 2011 EIS Update (De Beers 2011).

In the 2011 EIS Update, De Beers committed to incorporate additional mitigation associated with the deposition of fine processed kimberlite (PK) to achieve a long-term steady-state total phosphorus (TP) concentration of 0.018 milligrams per litre (mg/L) in Kennady Lake. Since the submission of the 2011 EIS Update, the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK to reduce potential loading of phosphorus. This change has resulted in a lower volume of fine PK that will be deposited to the Fine PKC Facility. This reduction in size alters the projected long-term loading of phosphorus to Kennady Lake. In addition, on-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the July 2011 EIS Update (De Beers 2011). Updated mass-balance water quality modelling based on revised source term inputs of TP projected the long-term steady state TP concentrations to be 0.009 mg/L in Kennady Lake.

The focus of the DO modelling was to predict late winter DO concentrations through the water column in Kennady Lake as a result of changes to the modelled nutrient concentrations in Kennady Lake following refilling, in order to predict the potential for effects to fish overwintering habitat conditions. For the GEMSS modelling, the updated nutrient concentrations presented in the 2012 EIS Supplement (De Beers 2012) were used.

A comprehensive description of the updated DO modelling is provided in Appendix 8.V in Section 8 of the 2012 EIS Supplement (De Beers 2012). The updated DO modelling supports the conclusions made in the 2011 EIS Update (De Beers 2011). For the broad range of empirical approaches used in the 2011 EIS Update (i.e., Babin and Prepas 1985, Mathias and Barica 1980, Vollenweider 1979), and based on a 0.018 mg/L TP in post-closure and under-ice baseline DO data, the surface zone of Kennady Lake (i.e., under ice to 6 m) was predicted to maintain sufficient dissolved oxygen concentrations to support cold-water aquatic life (greater than 6.5 mg/L). However, the empirical modeling did not separate shallow littoral zones and or include the volume of water available in the pit lakes, which are included in the GEMSS model.

With the updated predictions of TP in Kennady Lake in post-closure, and the supplemental DO modelling using GEMSS, it is anticipated that 74 to 92 percent (%) of the total volume of Kennady Lake (which include the Hearne and Tuzo pit voids to a depth of 40 metres [m]) will have a DO concentration above 5 mg/L, which represents the acute guideline for the protection of cold water species excluding the larval stages (AENV 1999), and 51 to 89% of the total volume of Kennady Lake possessing a DO concentration above 6.5 mg/L, which represents the chronic guideline for the protection of aquatic life for cold water species excluding the larval stages (CCME 1999). Even the shallow littoral zones are anticipated to have sufficient DO concentrations which might be related to the considerable portion of cobble/boulder substrate in the littoral zone.

Section 8 and 9 in the 2011 EIS Update (De Beers 2011) concluded that with an increased long-term steady state TP concentration (0.018 mg/L) in Kennady Lake, late winter under-ice DO concentrations in the upper 6 m would likely be sufficient for overwintering fish habitat (DO > 6.5 mg/L), although concentrations would be less than available in pre-development conditions; beyond this depth DO would fall below 6.5 mg/L and tend towards anoxia. With the revised water quality and DO modelling, the conclusions regarding the significance of effects presented in the 2011 EIS Update have not changed; GEMSS DO modelling of the lower TP concentrations predicted in Kennady Lake indicate a higher proportion of available overwintering habitat to fish than presented in the 2011 EIS Update (De Beers 2011). An update of the residual effects assessment is presented in the 2012 EIS Supplement (De Beers 2012).

It is anticipated that water column profiles in Kennady Lake will be monitored during closure and following reconnection with Area 8 to compare to EIS predictions. If it is identified that water column DO concentrations, particularly in the surface 6 m depth zone, are worse than predictions, adaptive management strategies will be triggered to address the problem.

References

AENV (Alberta Environment) 1999. Surface Water Quality Guidelines for Use in Alberta. November 1999. Environmental Service, Environmental Sciences Division. Edmonton, AB, Canada.

Babin, J., and E.E. Prepas. 1985. Modelling winter oxygen depletion rates in ice-covered temperate zone lakes in Canada. Can. J. Fish. Aquat. Sci. 42: 239-249.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment. Winnipeg, MB, Canada.

De Beers (De Beers Canada Inc.). 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2.* Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. *Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project*. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Mathias, J., and J. Barica. 1980. Factors controlling oxygen depletion in ice-covered lakes. Can. J. Fish. Aquat. Sci. 37: 185-194.

Vollenweider, R.A. 1979. Das Nährstoffbelastungskonzept als Grundlage für den externen Eingriff in den Eutrophierungsprozess stehender Gewässer und Talsperren. Z. Wasser-u. Abwasser-Forschung 12: 46-56.

Information Request Number: DKFN_46

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: Section 10.9 Uncertainty

Terms of Reference Section:

Preamble

Subsection 10.9.4 Understanding of Ecosystems in the Region of the Project, there is no discussion about the understanding of long-term impacts to terrestrial ecosystems. It has been identified under several components that sedge wetlands are the most effected ecosystem in the Project area. These wetland also support the largest species composition (i.e., biodiversity) in the area.

Request

Provide additional information regarding the impacts to these important ecosystems and the resultant effects on the biodiversity in the project area.

Response

Section 10 of the 2010 Environmental Impact Statement (EIS) (De Beers 2010) presents a summary of the long-term biophysical effects, and closure and reclamation, to wildlife and terrestrial habitat, and human health. The summary is based on comprehensive assessments presented in other sections of the 2010 EIS (e.g., Key Line of Inquiry: Caribou [Section 7], Subjects of Note: Carnivore Mortality [Section 11.10], and Species at Risk and Birds [Section 11.12]), and Vegetation [Section 11.7]) (De Beers 2010).

Detailed analysis of effects to vegetation ecosystems can be found in Section 11.7.4.1.2 of the 2010 EIS, which includes direct physical disturbance from the Gahcho Kué Project (Project) footprint (i.e., infrastructure) and changes to vegetation communities and plants from the dewatering and refilling of Kennady Lake. In addition, a fragmentation analysis was completed at the landscape scale to determine effects to regional-scale biodiversity, sensitive vegetation communities, and listed and traditional use plants (De Beers 2010, Section 11.7.4.1.3).

At the local scale, the Project is predicted to disturb about 18 percent (%) (8.7 hectares [ha]) of the Water Sedge – Narrow-leaved Cottongrass Fen ecosystem type, which is due to the restricted distribution of this ecosystem type in the local study area (De Beers 2010, Section 11.7.4.1.2). However, sedge wetlands and peat bogs (which are comprised of this ecotype) are abundant in the regional study area (RSA). For example, sedge wetlands and peat bogs constitute 9.9% (56,199 ha) and 8.5% (48,334 ha) of the RSA (De Beers 2010, Table 11.7-18). Other wetland communities include tussock-hummock, birch seep, and tall shrub vegetation types, which constitute 4.8% to 9.1% of the terrestrial environment in the RSA.

The predicted incremental loss to these wetland communities from the Project ranges from 0.10% for peat bog to 0.24% for sedge wetlands (De Beers 2010, Table 11.7-21). Application of the Project and other reasonably foreseeable projects changed the number and distance between similar patches on the landscape by less than 0.5%. For example, the increase in mean distance to nearest neighbour is 0.1 metres for tussock-hummock and sedge wetland habitats. Most changes from the Project should result in local-scale impacts to plants. Overall, the weight of evidence predicts that the Project should not result in significant adverse impacts to the vegetation ecosystems and listed and traditional use plant species.

Reference

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_47

Source: Long-term Biophysical Effects, Closure and Reclamation

Subject:10.10 Monitoring and Follow-up

EIS Section:

Terms of Reference Section:

Preamble

All water quality requirements for De Beers during operations and post-closure will be determined through the regulatory agencies.

Request

We recommend that De Beers develop a monitoring plan together with the local First Nation and include First Nations in the execution of water monitoring throughout the project operational and post-closure period. In this context De Beers may also consider an offer to train First Nations technicians in water quality monitoring methods.

Response

De Beers carried out community meetings in February 2012, which included discussion on the involvement of Community Monitors in both water and terrestrial monitoring programs that will be developed for the project. De Beers currently includes Community Monitors in the baseline monitoring programs undertaken at site, including water monitoring. De Beers is committed to the continued involvement of Community Monitors. It is anticipated, based on the De Beers community visits, that Community Monitors are available. However, if qualified persons are not identified for future programs, De Beers will consider the need for training.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_48

Source: LGL Limited

Subject: Long-term Biophysical Effects, Closure and Reclamation

EIS Section: 10.10 Monitoring and Follow-up

Terms of Reference Section:

Preamble

Subsection 10.10.2 Potential Monitoring Activities, long-term monitoring activities are focused on water quality, fish and fish habitat.

Request

Clarify if long-term monitoring for terrestrial biophysical components (e.g., caribou) will occur.

Response

De Beers will evaluate the requirement for long-term monitoring for terrestrial biophysical components as the Project proceeds through development and as the Closure and Reclamation Plan is refined.

Information Request Number: DKFN_49

Source: LGL Limited

Subject: Carnivore Mortality

EIS Section: 11.10.1 Introduction

Terms of Reference Section:

Preamble

Subsection 11.10.1.3.4 Wolverine Study Area, this area is identified as the Slave Geological Province; however, on subsequent sections and figures in the chapter the potential effects to wolverine are discussed in the context of the RSA (Regional Study Area).

Request

Clarify what the assessment area is for wolverine.

Response

Subsection 11.10.1.3.4 of the 2010 Environmental Impact Statement (EIS) is correct in that the assessment of primary pathways for wolverine was based on a spatial extent of the Slave Geological Province (SGP) (De Beers 2010). Use of the SGP as the effects study area for the wolverine assessment is also discussed in Section 11.10.4.2.1 of the 2010 EIS, where effects to habitat quantity and configuration were assessed, and again in Section 11.10.4.3.2 of the 2010 EIS, where effects to preferred habitats were assessed. Further, the SGP was the basis for the population viability modelling (De Beers 2010, Section 11.10.4.4.1). For example, all simulations started with 1,298 individuals, which was calculated using the mean density of wolverine at Daring Lake, Ekati, Diavik, and Kennady Lake (Boulanger and Mulders 2007) and the SGP study area (ca. 190,000 square kilometres [km^2]).

However, in some locations of Section 11 of the 2010 EIS, smaller spatial scales are discussed either for providing context and/or summarizing baseline collections. Baseline surveys were executed at the local and regional scales which is where on-going monitoring is expected to continue into the future. The spatial extent of the regional study area (RSA) is intended to capture both direct and indirect effects of the Gahcho Kué Project (Project), such as changes in the movement and behaviour of individuals from sensory disturbances (e.g., noise, lights). In contrast, the spatial extent of the SGP is intended to capture incremental and cumulative effects (both direct and indirect) to a more meaningful demographic unit (i.e., the population).

Use of the SGP represents an appropriate approach for meeting the Terms of Reference and completing the assessment. For example, this area (and portion of the population) has experienced the largest rate and spatial extent of development in the Northwest Territories and Nunavut, and therefore represents the most conservative (i.e., maximum effects) and appropriate spatial boundary for assessing cumulative effects on the population. Also, a habitat selection model (resource selection function) for wolverine has been generated for the SGP (Johnson et al. 2005).

Although local changes to the availability of habitat types at smaller spatial scales were discussed in the effects analysis (e.g., De Beers 2010, Section 11.10.4.2.2; bottom of page 11.10-105), the classification of impacts to abundance and distribution of wolverine was based on the assessment of primary pathways in the context of the population within the SGP. On page 11.10-170 of Residual Impacts to Carnivores (De Beers 2010, Section 11.10.7.2), it is concluded that cumulative impacts related to direct habitat loss and fragmentation from the Project and other developments are beyond regional in geographic extent, as the impacts occurred throughout the spatial boundaries of the population. Also, on page 11.10-174 (De Beers 2010, Section 11.10.7.2), it is noted that although the combined direct and indirect changes from the Project on habitat are local-to-regional in geographic extent, the impacts extend to the population (because animals interact with the Project and other developments during their seasonal movements).

References

Boulanger, J. and R. Mulders. 2007. *Analysis of 2005 and 2006 Wolverine DNA Mark-recapture Sampling at Daring Lake, Ekati, Diavik, and Kennady Lake, Northwest Territories.* Draft Report prepared for Environment and Natural Resources, Government of the Northwest Territories by Integrated Ecological Research.

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Johnson, C.J., M.S. Boyce, R.L. Case, H.D. Cluff, R.J. Gau, A. Gunn, and R. Mulders. 2005. *Cumulative Effects of Human Developments on Arctic Wildlife.* Wildlife Monographs 160:1-36.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_50

Source: LGL Limited

Subject: Carnivore Mortality

EIS Section: 11.10.3 Pathway Analysis

Terms of Reference Section:

Preamble

Subsection 11.10.3.2.2 Primary Pathways, this section analyzes and classifies the primary pathways in the effects assessment including: changes to habitat quantity and fragmentation; changes to habitat quality, movement and behavior, and changes to survival and reproduction. The linkage between these effect pathways and the predominant cause of mortality at mine sites (i.e., attractants to site) is not clear.

Request

Demonstrate how the effect pathways are (or are not) linked to the predominate causes of carnivore mortality at the Project.

Response

A general description of the approach to the carnivore assessment is located in Section 11.10.4.1 of the 2010 Environmental Impact Statement (EIS) (De Beers 2010). The assessment is based on effects analyses that capture all primary pathways that may result in changes to the abundance and distribution of carnivores, after implementing environmental design features and mitigation (i.e., residual effects).

The five primary pathways for the carnivore assessment are summarized on page 11.10-96 of Section 11.10.3.2.4 (De Beers 2010). Four of these pathways are not linked to direct-mine related mortality but are related to changes in habitat quantity and quality through physical and sensory disturbance. These changes can influence movement and behaviour of individuals, and carrying capacity of the landscape, which can produce effects on the abundance and distribution of carnivore populations.

Of the five primary pathways for the carnivore assessment, only one makes the linkage to direct mine-related mortality (survival): effects from changes in survival and reproduction from negative interactions with projects due to site attractants (food waste, shelter). This pathway was quantitatively evaluated under Section 11.10.4.4 (Effects on Population Viability) (De Beers 2010). Here, local and regional effects from the Project and other developments on habitat quantity and quality, direct mine-related mortality, other human-conflict kills, and harvest rates were incorporated into model simulations.

To understand potential effects from changes in survival, long-term data on direct-mine related mortality (1996 to 2009) were summarized (See Table 11.10-4, De Beers 2010). For example, for grizzly bear, there were four reported deaths over 54 mining years (construction and operation). In other words, annual direct mine-related mortality is very low: approximately 0.074 bears per mine per year. If there are four operating mines on the 2010 landscape, then the estimated total annual direct mine-related mortality is 0.3 bears per year.

Assuming that the highest levels of activity at the Project are anticipated to occur during construction through initial closure (15 years), which is the period of the highest risk of carnivore-Project interactions, it is predicted that one grizzly bear may be removed from the population due to the Project (which during any given year may be well over 800 animals). This prediction is a conservative estimate given that the Project will implement waste management and wildlife mitigation procedures similar to that used at the Snap Lake mine where no grizzly bears (and only 1 wolverine) have been killed during the 12-year period from construction to operations (1999 to 2010) (also see page 11.10-137, De Beers 2010).

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Information Request Number: DKFN_51

Source: LGL Limited

Subject: Carnivore Mortality

EIS Section: 11.10.4 Effects on Population Size and Distribution of Grizzly Bear and Wolverine

Terms of Reference Section:

Preamble

Subsection 11.10.4.3.2 Effects Beyond the Regional Scale of the Project, Table 11.10-18 (p. 11.10-120) identifies a negative balance for preferred (high and good) habitats for all seasons for grizzly bear (decrease of 12.4%). A similar trend is presented for wolverine (decrease of 9.5%).

Request

Demonstrate the link between this expected decrease in preferred habitat and the predominate cause of carnivore mortality at mine sites. Provide an assessment of how this expected decrease in preferred habitat in the future and cumulative scenario is related to the long-term biophysical effects.

Response

As stated in response to DKFN_50, the primary pathways for the carnivore assessment are summarized on page 11.10-96 of Section 11.10.3.2.4 of the 2010 Environmental Impact Statement (De Beers 2010). There are five primary pathways. Four of these pathways are not linked to direct-mine related mortality but are related to changes in habitat quantity and quality through physical and sensory disturbance. These pathways are not linked to direct-mine related mortality of carnivores at the Project. Although the habitat pathways describe changes that may influence movement and behaviour of individuals, and the carrying capacity of the landscape, a key conclusion of the assessment was that the incremental decrease of preferred habitat (for either grizzly bear or wolverine) due to the Project was less than 1% of the effects study area.

Of the five primary pathways on page 11.10-96 (De Beers 2010), only one makes the direct linkage to direct mine-related mortality: effects from changes in survival and reproduction from negative interactions with development due to site attractants (e.g., food waste, shelter). This pathway was quantitatively evaluated under Section 11.10.4.4 (Effects on Population Viability) (De Beers 2010). Here, local and regional effects from the Project and other developments on habitat quantity and quality, direct mine-related mortality, other human-conflict kills, and harvest rates were incorporated into demographic model simulations. The long-term biophysical effects from this change on the abundance and distribution of carnivores are predicted to be reversed within 5 to 10 years after Project closure (Section 11.10.6.2; page 11.10-160, De Beers 2010).

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_52

Source: LGL Limited

Subject: Carnivore Mortality

EIS Section: 11.10.4 Effects on Population Size and Distribution of Grizzly Bear and Wolverine

Terms of Reference Section:

Preamble

Subsection 11.10.4.5 Effects from Changes in Prey Availability, cumulative effects of development were predicted to have a moderate effect on caribou abundance, which may change the encounter rate between grizzly bears and caribou. If prey availability rates change around the Project, scavenging predators may be attracted to other food sources.

Request

Provide an assessment of the changes to prey availability and the relationship to the predominate causes of potential carnivore mortality at the Project. Include a discussion of the long-term effects.

Response

Changes to prey availability and related influences on carnivore attraction to the Project (and then mortality rate) were assessed with the following analyses, and focussed on caribou as the primary food source for carnivores (Mulders 2000; Gau et al. 2002). The Project is expected to have a negligible effect on caribou abundance from direct mine-related mortality (De Beers 2010, Section 7.4.2.2.3). The combined direct and indirect change to habitat from the Project is less than 1.4% of caribou seasonal ranges (De Beers 2010, Section 7.5.3.2.1). Caribou are predicted to change their distribution and reduce habitat use within 15 kilometres (km) from the Project. However, there are natural environmental factors that operate over large scales of space and time (e.g., fire, snowfall, food abundance, and quality) that will have greater influences on local distributions of caribou relative to effects from the Project. Overall, it was determined that the addition of the Project to the existing landscape had no statistical effect on the modelled caribou population projections (De Beers 2010, Section 7.5.4.2).

In addition, the effect from changes in survival of grizzly bear and wolverine from negative interactions with projects due to site attractants (food waste, shelter) was quantitatively evaluated using population viability analyses (De Beers 2010, Section 11.10.4.4). Projections were made over 30-year periods where direct mine-related mortality was assumed to be constant even though the greatest potential for Project interaction with carnivores will be about half that duration (i.e., construction and operation is expected to be about 15 years). Even with this conservatism, the models showed that the Project will not statistically influence the final projected abundance for grizzly bear and wolverine.

The recent decline in the Bathurst caribou population has likely been associated with a decrease in the availability of caribou for grizzly bear and wolf, as well as decreased scavenging opportunities for all carnivores. But the Project is not expected to result in seasonal range shifts to caribou distribution, and thus, should not affect prey distribution for grizzly bear and wolverine in a manner (either over the short-term or long-term) that will lead to increased attraction and mortality at the Project. Furthermore, it is anticipated that direct mine-related carnivore mortality will be negligible given that the successful waste management program being used at the Snap Lake Mine will be implemented at the Gahcho Kué Project.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Gau, R.J., R. Case, D.F. Penner and P.D. McLoughlin. 2002. *Feeding Patterns Barren-ground Grizzly Bears in the Central Canadian Arctic*. Arctic 55:339-344.

Mulders, R. 2000. *Wolverine Ecology, Distribution and Productivity in the Slave Geological Province*. Final Report. Submitted to the West Kitikmeot/Slave Study Society.

Information Request Number: DKFN_53

Source: LGL Limited

Subject: Other Ungulates

EIS Section: 11.11.2 Existing Environment

Terms of Reference Section:

Preamble

Subsection 11.11.2.3 Muskoxen, a description of habitat use, behaviour and distribution, population characteristics, and traditional and non-traditional use is provided.

Request

Provide a description of the status and trend of the local population of muskoxen in the Project area, particularly during the winter season. Provide an assessment of the proportion of the local population that is expected to be affected by the Project. Further, in the context of long-term trends and potential impacts, provide an assessment of whether increased occurrences of muskoxen are expected in the Project area.

Response

Aerial surveys for muskoxen completed by the Department of Environment and Natural Resources (ENR) of areas overlapping and adjacent to regional study area for the Gahcho Kué Project in 1989 (March), 1991 (July) and 1998 (July) are likely out-dated (Section 11.11.2.3.1; page 11.11-16, De Beers 2010). More recently, an aerial survey for muskoxen was completed by ENR in March 2010. The western boundary of this survey passed through the regional study area, and will provide more information on the occurrence of muskoxen near the Project during late winter. As the survey report has not yet been published, no further information is available at this time (J. Williams, personal communication).

Muskoxen surveys were defined by the Gahcho Kué regional study area and muskoxen management units, and not by local population units. Actual population units (ranges) are unknown, and it is possible that a meta-population exists across the mainland of the Northwest Territories and Nunavut. Providing an estimate of the actual proportion of the local population that may be affected by the Project is not possible with the state of current knowledge. However, long-term monitoring studies at the Ekati and Snap Lake mines have detected no to little interaction between muskoxen and mineral developments. Although, muskoxen were not observed during initial baseline studies at Snap Lake, records of muskoxen have shown periods of increased frequency during further baseline and monitoring studies.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Williams, Judy. 2012. Wildlife Technician, Environment and Natural Resources. Email communication on 14 March 2012. Personal Communication.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_54

Source: LGL Limited

Subject: Other Ungulates

EIS Section: 11.11.4 Effects on the Population Size and Distribution of Muskoxen

Terms of Reference Section:

Preamble

Subsection 11.11.4.1.2 Results, Table 11.11-6 (p. 11.11-65) identifies change in area and configuration of habitat types in the spring to autumn period.

Request

Explain how these changes in habitat types will effect the availability of wintering habitat for muskoxen in the Project area.

Response

The Project is predicted to result in a 2.6 percent (%) decrease in habitat availability for muskoxen in the study area for both winter and spring to autumn (non-winter) periods. During winter, an additional 0.05% decrease in available esker habitat was associated with the Winter Access Road during baseline conditions (page 11.11-66) (De Beers 2010). Changes in area and configuration of habitat types from developments (for baseline, application and future conditions) were assessed for muskoxen for the spring to autumn period in Table 11.11-6 (De Beers 2010). The change in habitat types from developments for the winter period is presented in Table 11.11-7, which are relevant for muskoxen. Most of the difference in habitat availability between winter and non-winter periods is associated with the temporary disturbance of frozen lakes (shallow and deep water) from the Winter Access Road during baseline conditions (page 11.11-66) (De Beers 2010).

We would like to clarify that the same development layers were applied to habitat types in the study area for both seasonal periods, with the exception that winter road footprints did not influence water (shallow and deep lakes) for the summer period. All of the developments used in the assessment are illustrated in Figure 11.11-8, and the results from the effects analyses for the winter period are summarized on page 11.11-66.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_55

Source: LGL Limited

Subject: Effects on Population Size and Distribution of Muskoxen

EIS Section: 11.11.6

Terms of Reference Section:

Preamble

A discussion of the effects on populations and distributions is not included.

Request

Identify what the population and density of muskoxen and moose is in the RSA. Identify what the frequency of occurrence for these species is in the RSA. Clarify if there are impacts to any key habitat features (e.g., mineral licks) in the vicinity of the project that would result in a direct effect on these species.

Response

Muskoxen and moose observations were recorded during aerial surveys for caribou. From 1995 to 2003, eight groups of muskoxen were recorded within the regional study area (RSA, approximately 5,700 square kilometres [km^2]) during unbounded and non-systematic aerial surveys for caribou. Group size ranged from one to 47 individuals. In 2004 and 2005, 15 group observations were recorded within the RSA during systematic aerial surveys. Group size ranged from 1 to 92 individuals in 2004 and 2005 (De Beers 2010, Section 11.11.2.3.1, page 11.11-16). From 1996 through 2005, 14 moose were recorded within the RSA, 13 of which have been recorded since 1999 (De Beers 2010, Section 11.11.2.3.2, page 11.11-23).

Because survey methods included unbounded reconnaissance surveys and systematic surveys, and the total number (and occurrence) of observed animals was low, population densities were not calculated in the 2010 Environmental Impact Statement (EIS) (De Beers 2010). Based on the maximum number of observations during May 2004 (n = 133), the density of muskoxen is estimated to be 0.02 animals per km^2 in the RSA. However, the number of individuals counted more than once during the surveys is not known. There are also seasonal movements (occurrence) of moose into the study area during the spring and summer months, and a return back to the forest during autumn and winter.

Although no mineral licks were identified within the RSA, Section 11.11.4.2 of the 2010 EIS categorizes available habitat types by their preference for muskoxen (Table 11.11.8, De Beers 2010). The predicted change in the amount of different quality habitats was estimated from the Gahcho Kué Project (Project) and other developments relative to undisturbed reference conditions. Similar analyses are presented for moose in the 2010 EIS, Section 11.11.5.2. Table 11.11-7 of the 2010 EIS also presents the amount of direct disturbance to the various habitat types in the RSA from the Project (De Beers 2010).

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_56

Source: LGL Limited

Subject: Species at Risk and Birds

EIS Section: 11.12.4 Effects on Population Size and Distribution of Upland Breeding Birds

Terms of Reference Section:

Preamble

Subsection 11.12.4.2.1 Methods, p. 11.12-102 3rd paragraph states that during baseline studies, 500 m x 500 m plots were surveyed. It was previously stated that 100 m x 500 m plots were surveyed.

Request

Clarify the methods used for the baseline studies for upland breeding birds.

Response

All sampling plots for upland breeding birds in the heath tundra, sedge wetland, and riparian habitat types were 500 metres (m) x 500 m, or 0.25 square kilometres (km^2) in size (Annex F; Section F3.2.8) (Section 11.12.2.2.1, page 11.12-15) (De Beers 2010). Each plot was sampled using the same method of having two experienced bird biologists and a local assistant from Łutselk'e Dene First Nation (LKDFN) walk five, 100-m wide by 500-m long transects over a minimum period of 2.5 hours (Section 11.12.2.2.1, top of page 11.12-17) (De Beers 2010). Surveyors walked side by side covering an equal proportion of each transect. The surveyor on the outside line of the previous transect adopted the inside line of the adjacent transect to minimize double-counting of birds located on the edge of the previous transect. This sampling protocol resulted in 100% coverage of each plot. There was no spatial overlap among plots, so each plot was an individual sampling unit for analyses.

This response is also captured, in part, in the reply to Information Request EC_1.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Information Request Number: DKFN_57

Source: LGL Limited

Subject: Species at Risk and Birds

EIS Section: 11.12.4 Effects on Population Size and Distribution of Upland Breeding Birds

Terms of Reference Section:

Preamble

Subsection 11.12.4.2.2 Results, it is stated that direct habitat loss is expected to decrease bird abundance.

Request

Provide an assessment of this impact on the bird species affected and effects to their local populations.

Response

Estimates of bird abundance for upland and wetland vegetation communities (which were comprised of habitat types classified in the regional study area [Table 11.12-17]) in the 2010 Environmental Impact Statement (EIS) included individual species densities observed during baseline studies (De Beers 2010, Section 11.12, Table 11.12-3). Thus, the relative habitat-specific changes to species abundance (local populations) are expected to be similar to values described for total upland breeding birds (see Table DKFN_57-1 below). For example, incremental decreases from the Project in the abundance of willow ptarmigan (or any bird species recorded in the regional study area) from indirect effects (e.g., sensory disturbances) and direct effects (i.e., the physical footprint) will be approximately 0.46%; whereas cumulative changes from all developments (previous, existing and future) will be about 2.0% (see Table DKFN_57-1 below). These small changes in the availability of habitat are expected to have a negligible demographic consequence (reproduction and survival) on the local populations of upland breeding birds.

Similarly, habitat fragmentation effects (e.g., changes in movement between nesting and foraging areas, nest predation, and effective dispersal) from the Project and other developments on the abundance and distribution of local bird populations are expected to be difficult to detect relative to reference conditions (De Beers 2010, Section 11.12.7.1). For example, distance to similar habitat patches increased marginally (0.01 to 0.03%) from reference to 2010 baseline conditions (De Beers 2010). With the addition of the Project, the distance between similar patches of highly suitable habitat (i.e., spruce forest, birch seep, tussock/hummock, heath tundra, tall shrub, and sedge wetland) increased by less than 0.1% (less than 1 metre). Similarly, the distance between similar patches from future potential projects is expected to increase from 0.01% to 0.02% for birch seep and spruce forest habitats, respectively, while no change is expected for tussock-hummock habitat. Mean distances to nearest neighbour are expected to decrease by 0.01% to 0.04% for tall shrub and sedge wetland habitat.

Overall, the results predicted that the incremental and cumulative impacts from the Project and other developments should not significantly influence the abundance and distribution of upland bird populations in the region (see De Beers 2010, Section 11.12, Table 11.12-27 and Section 11.12.9.2).

Table DKFN_57-1 Relative Changes in the Abundance of Upland Breeding Birds in the Regional Study Area from Reference to Reasonably Foreseeable Projects (based on Table 11.12-19 in the 2010 EIS [De Beers 2010])

Effects / Habitat Type	% Change Reference to 2010 Baseline	% Incremental Change 2010 Baseline to Application	% Cumulative Change Reference to Future
Direct Effects			
Wetland	-0.10	-0.24	-0.40
Upland	-0.08	-0.15	-0.28
Total	**-0.09**	**-0.20**	**-0.35**
Indirect Effects			
Wetland	-0.12	-0.26	-1.70
Upland	-0.09	-0.25	-1.65
Total	**-0.10**	**-0.26**	**-1.68**
Direct + Indirect			
Wetland	-0.22	-0.50	-2.1
Upland	-0.17	-0.40	-1.93
Total	**-0.19**	**-0.46**	**-2.03**

Notes: Direct effects are due to physical disturbance from development footprints while indirect effects are related to sensory disturbance (i.e., zone of influence).

Reference conditions = baseline conditions prior to any development in the study area.

2010 Baseline Case = previous and existing developments in the regional study area up to 2010.

Application Case = Gahcho Kué Project plus 2010 baseline conditions.

Future = Taltson Hydroelectric Expansion Project plus application case.

ha = hectares; % = percent.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DKFN_58

Source: LGL Limited

Subject: Species at Risk and Birds

EIS Section: 11.12.5 Effects on Population Size and Distribution of Water Birds

Terms of Reference Section:

Preamble

Subsection 11.12.5.1.2 Results, it is stated that the lake surface area in the LSA will be decreased by 2.2%. It is presumed that the majority of this decrease will result from the loss of Kennady Lake as usable habitat during the operations of the project.

Request

Provide an assessment of the effects to the species composition and population levels of water birds directly affected by the loss of habitat in Kennady Lake.

Response

Baseline surveys suggest that the decrease in surface water from the dewatering of Kennady Lake should have a negligible effect on the water bird populations and species composition in the region. Aerial surveys for water birds along the ice-free shoreline of Kennady Lake on June 20, 2004, observed 30 individuals or 0.64 birds per kilometre of shoreline (De Beers 2010, Section 11.12.2.3.2). Using similar methods, the presence of water birds along the ice-free shoreline of Kennady Lake was determined by aerial survey on June 28, 2010 and June 10, 2011. The surveys were completed by helicopter at 50 metres above ground level and at a speed of 80 kilometres per hour. Results in 2010 and 2011 produced an estimated 14 to 15 birds observed or 0.32 birds per kilometre of shoreline (Table DKFN_58-1).

Table DKFN_58-1 Number of Water Birds Observed on Kennady Lake in Spring 2010 and 2011

Species	2010	2011
Common merganser	10	5
Red-breasted merganser	0	4
Common loon	2	2
Yellow-billed loon	0	3
Canada goose	3	0
Herring gull	0	1

The dewatering of Kennady Lake will result in decreasing the lake surface area in the local study area by 2.2 percent (%) during construction and operations, which may reduce habitat for 14 to 30 birds at the local scale. However, at the population level, the calculated incremental loss of any habitat type from the Project relative to 2010 baseline conditions is less than or equal to 0.5% of the regional study area (RSA). Development of the Gahcho Kué Project (Project) is expected to directly decrease highly suitable habitat (i.e., deep water, shallow water and sedge wetland habitats) for water birds in the RSA by 1.2%, relative to 2010 baseline conditions.

In addition, application of the Project changed the number and distance between patches of water bird habitat on the landscape by less than 0.5% (De Beers 2010, Table 11.12-16). The increase in mean distance to nearest neighbour is about 0.3 metres for shallow water habitat (De Beers 2010, Section 11.12.5.1.2). These localized changes in the availability and connectivity of habitat from dewatering Kennady Lake are expected to have a negligible demographic consequence (reproduction and survival) on the populations of water birds in the region. Overall, the results predict that the incremental impacts from the Project should not significantly influence the abundance and distribution (or the species composition) of water bird populations in the region (De Beers 2010, Table 11.12-27 and Section 11.12.9.2).

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.