DE BEERS
CANADA
GAHCHO KUÉ PROJECT

File: L020

July 13, 2011

Robert Jenkins
Head, Water Resources Division
Aboriginal Affairs and Northern Development
4914 - 50th St., Yellowknife, NT
X1A 2R3

By: email (Robert.jenkins@inac-ainc.gc.ca)

Re: Gahcho Kué Project Description and EIS Overview meeting follow-up.

Dear Mr. Jenkins,

De Beers Canada Inc. (DBCI) appreciated the opportunity, on May 19, 2011, to engage with the Aboriginal Affairs and Northern Development (AAND) Water Resources Division and provide an overview of the Gahcho Kué Diamond Project (Project) and applicable sections of the Environmental Impact Statement. We trust that the meeting was helpful in clarifying water related aspects of the Project Description as well as the content and structure of the EIS.

As follow-up to the meeting, please find attached a copy of the meeting notes. Electronic copies of presentation materials have been forwarded to your office. Also, as promised, DBCI will provide a written response to the technical subject notes provided by Mr. Dave Huebert. The response is anticipated to be available on August 5, 2011.

DBCI looks forward to working with AAND during the Environmental Impact Review process. Should you have any questions please feel free to contact me.

Sincerely,

Paul Cobban

Paul Cobban
Permitting Manager

Attached: May 19, 2011 Meeting Notes.

A DIVISION OF DE BEERS CANADA INC.
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Record of Meeting

Date/Time	19 May 2011	**File no.**	11-1365-0001 Phase 3030
Between	Marie Adams; Robert Jenkins; Dave Huebert (Stantec)	**of:**	Aboriginal Affairs and Northern Development (AANDC) Water Resources Division (WRD)
And	Paul Cobban – Permitting Manager; Stephen Lines – Environmental Assessment & Permitting Coordinator John Faithful – Technical Director (Golder Associates); Lisa Hurley – Engagement Coordinator (Golder Associates)	**of:**	De Beers Canada Inc.
Subject	Project Description Update and EIS Overview (Aquatics)		
Distribution	AANDC –WRD; De Beers; Golder Associates		

Project Description Overview

- De Beers provided a PowerPoint presentation, with supporting figures and summary information from the EIS document, outlining the proposed Gahcho Kué Project.
- Presentation focused on mining method, water and waste management aspects of the Project, including an overview of the alternatives considered in reaching the proposed Project description.
- Discussion points presented on the Project description:
  - The Project description represents a balance between environment, economics and social considerations
  - Project approach is to minimize the size of disturbance footprint
  - All operations are managed within a sub-basin of the Kennady Lake watershed (the controlled area)
  - The controlled area is established to maintain segregation of non-contact water away from the site and manage contact water within the site
- Discussion included questions and answers related to the Project design, Project sequencing and water management.

EIS – Overview: Aquatics

- Presentation of the aquatics environmental setting for the Project and EIS conclusions
  - Structure of the EIS and importance of the influence of the TOR on the structure of the document
  - Aquatics Environmental Setting; review of the study areas, aquatic components studied, data types collected
  - Assessment Approach – review of assessment approach flow diagram; approach to selecting VC's; assessment and measurement endpoint examples; pathways analysis
- Discussion of the aquatic aspects of the EIS work included:
  - Water management associated with the Project
  - Groundwater chemistry
  - Reference lake(s)
  - Land surface that will be flooded

Discussion – AANDC - WRD Comments

- AANDC - WRD draft comments were provided in advance of the meeting. These comments were discussed at a high level and De Beers committed to responding to these comments in writing.
- Some of the comments were related to the structure of the document and where information was located. De Beers committed to providing an overview of the structure of the document.
- De Beers encourages on-going discussions between regulators and the consultants. It was requested that if AANDC - WRD identifies a particular area of technical interest they would like to discuss at a future meeting, it is appreciated if they advise De Beers in advance so they can prepare and coordinate consultants necessary to ensure productive discussion.

Follow-up

- AANDC - WRD noted that they are continuing to review the document and the comments provided are starting the initial engagement with De Beers. The comments provided on May 2, 2011 provided in advance of the field season, in the event that supplemental baseline programs could be was planned to collect additional background aquatics-related information.
- A follow-up meeting with individuals that reviewed the document on behalf of AANDC – WRD would be beneficial. These individuals include, in addition to Dave Huebert who attended this meeting and reviewed the Water Quality, John Brodie who reviewed the engineering and geotechnical aspects of the Water Management Plan (i.e., dykes), and Chris Burn who reviewed the permafrost-related issues.
- There was a discussion about the coordination between two federal departments if both have an interest in the same topic (e.g., permafrost; AANDC and Natural Resources Canada [NRCan]).

AANDC - WRD noted that there is some coordination that occurs in the form of meetings and discussions prior to the issuances of Information Requests (IRs).

- AANDC - WRD noted that the involvement of NRCan has not yet been defined. It is anticipated they will be involved with respect to explosives and maybe permafrost.

Information from AANDC – WRD

- De Beers asked two questions:
  - Is there anything that we should know about AANDC – WRD as we proceed through the Environmental Impact Review?
  - Guidance on what De Beers can do to help clarify and resolve any of the AANDC – WRD information needs?
- AANDC - WRD identified the following in response to these questions:
  - Aquatic Effects Monitoring Program (AEMP) Guidelines
    - AANDC has been working on these guidelines for a number of years; AANDC generally requests that each proponent follows these to the extent possible; include incorporation of Traditional Knowledge into the programs; and anticipate that AANDC - WRD will recommend these guidelines be followed
  - Developing protocol for collecting data for consistency between mining operations
    - AANDC noted that each project/operation is unique and typically has a different receiving environment. It was noted that some of the mines have been in operation for 10 years and the methods around monitoring have changed, authorizations have changed and labs changed with respect to their analytical precision; so difficult to draw conclusions on a consistent or standardized approach
    - Work by Monique Dubé in the area of aquatics effects monitoring was discussed *(Note: the references provided below were identified after the meeting by Golder Associates):*
      - Dubé, M. Aquatic Effects Monitoring Final Plan, Canadian Zinc. June 2, 2011. Found at: http://www.reviewboard.ca/upload/project_document/1276102835_Aquatic_Effects_Monitoring_Plan_for_the_Prairie_Creek_Mine_-_Addendum_to_Canadian_Zinc_Corporation_s_Developer_s_Assessment_Report.PDF. (accessed June 27, 2011)
      - Dubé, M., and Scrimgeour G., Development and application of methods to monitor the ecological health of the South Nahanni Watershed. March 31, 2008. Found at: http://www.nwtcimp.ca/documents/cimpProjects/0708/UOS_SouthNahanniWatershed_07_08.pdf. (accessed June 27, 2011)
  - Municipal Waste Water and Effluent Regulations

- AANDC noted that the regulations have not come into force in the NWT. There is a 5 year window for the north to conduct research and collect technical information in regards to the setting of appropriate standards in the Territory

▪ Guidelines for Mine Site Reclamation (2009)

- AANDC recommends that Proponents think about reclamation early in the process; AANDC encourages proponents to consider the key environmental characteristics in any area (terrestrial environment) before buildings are constructed.

- AANDC has a mandate for closure related to reclamation security (security deposit) posted for the Project. They will be reviewing the closure options through the process and providing input. AANDC is open to considering a phased approach to reclamation security whereby the security amount increases as Project infrastructure is put in place over time (i.e., similar to Snap Lake Mine)).

- AANDC is working with the Mackenzie Valley Land and Water Board (MVLWB) to update the Guidelines for Mine Site Reclamation previously issued by AANDC as an alternative to having separate guidelines.

▪ Effluent Quality Criteria

- AANDC mentioned that work is underway on these.

▪ Water Strategy

- AANDC mentioned that work is underway on this. AANDC identified the need for community involvement and understanding what the communities want for water as part of implementing the water strategy. They noted a need to consider community involvement in a technical sense (e.g., monitoring)

Action Item / Commitment	Responsible	Date
Provide a digital copy of the materials used in the meeting.	De Beers / Golder	July 2011
Provide written response to AANDC – WRD on the comments provided from Dave Huebert (Stantec) in advance of the May 19, 2011 meeting.	Golder	July/August 2011
Provide an overview of the EIS document structure.	Golder (Lisa Hurley)	July 2011
Work with AANDC - WRD to identify timing for meeting with individuals that reviewed the document on behalf of AANDC – WRD. These individuals include, in addition to Dave Huebert who attended this meeting and reviewed the Water Quality, John Brodie who reviewed the engineering and geotechnical aspects of the Water Management Plan (i.e., dykes), and Chris Burn who reviewed the permafrost-related issues	De Beers (Stephen Lines)	July 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation
- Key Facts and Figures

The following figures which were also handed out during the meeting can be found in the EIS and due to size limitations are not attached to these meeting notes.

- Figures:
  - 8.1-2: Kennady Lake Study Area
  - 3.9-1: Water Management Areas, Dykes, Collection Ponds, and Lakes Associated with the Project
  - 2.3-1: Location of 5035, Hearne, and Tuzo Kimberlite Pipes
  - 2.3-2: Alternative 1 – Conceptual Plan for Dewatering Areas 4 and 6 (2000)
  - 2.3-3: Alternative 2 – Conceptual Plan for Dewatering Areas 4, 6 and 7 (2002)
  - 2.3-4: Alternative 3 – Conceptual Plan for Dewatering Areas 2 through 7 (2005)
  - 2.3-5: Alternative 4 – Conceptual Plan for Dewatering Kennady Lake (2010)
  - 2.3-6: Diversion of Surface Water from Kennady Lake
  - 2.3-7: Alternative 1 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2000)
  - 2.3-8: Alternative 2 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2002)
  - 2.3-9: Alternative 3 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2005)
  - 9.1-3: Downstream Water Effects Regional Study Area
  - H5.3-1: Local Study Area Watersheds
  - 3.5-5: Mining Operations Years 9 to 11 (2023 to 2025)
  - 3.12-1: Final Reclamation
  - 8.3-14: Surface Water Quality Sampling Locations in the Kennady Lake Watershed
  - 6.5-1: Flow Diagram for the Assessment Approach

DRAFT Meeting Agenda

De Beers Canada
Gahcho Kué Project

MEETING	De Beers Canada and Indian and Northern Affairs Canada – Water Resource Division Gahcho Kué Project Discussion	**DATE:**	May 19, 2011
INVITED	De Beers Canada Inc. Indian and Northern Affairs Canada – Water Resources Divsion Golder Associates Ltd.		
LOCATION	De Beers Canada Boardroom Suite 300, 5102 -50th Ave Yellowknife, Northwest Territories		

Agenda Item/Discussion	**Timing**
Introduction ■ Health and Safety ■ Review of Agenda	9:00 – 9:15
Project Description ■ Overview of the major elements of the Project Description, focusing on aquatic environment interactions ▪ Mining methods, water management, waste management fundamentals ▪ Project sequencing and timeline of activities	9:15 – 10:30
Break	10:30 – 10:45
EIS – Overview ■ Presentation of environmental setting for the Project and EIS conclusions	10:45 – noon
Lunch	Noon – 12:30
Discussion ■ Discussion on areas of interest	12:30 – 1:30
Path Forward ■ Next steps for meeting information needs	1:30 – 2:00

Gahcho Kué Project

INAC – Water Resources Division

May 2011

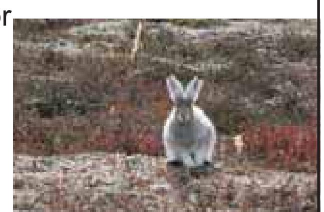
Introductions

De Beers Canada Inc.

- **Paul Cobban** Permitting Manager – De Beers Canada Inc.
- **Stephen Lines** Environmental Assessment and Permitting Coordinator - Gahcho Kué Project

Golder Associates Ltd.

- **John Faithful** Technical Director
- **Lisa Hurley** Engagement Coordinator



Agenda

- **Project Description**
  - Overview of the major elements of the Project Description, focusing on aquatic environment
  - High level discussion of alternatives
- **Overview of EIS**
  - Presentation of aquatic environment setting, overview of the EIS and conclusions.
- **Discussion of INAC comments**
- **Path Forward**

Project Overview and Description

Project Overview

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- The current Project Description represents a balance between environment, economics and social considerations
- Project approach is to minimize the size of disturbance footprint
- All operations are managed within a sub-basin of the Kennady Lake watershed
- Controlled area established to maintain segregation of clean water away from the site and managed water within the site
  - Facilitated by a comprehensive water management plan
- Project description designed to minimize refilling time for Kennady Lake, and therefore aquatic ecosystem recovery

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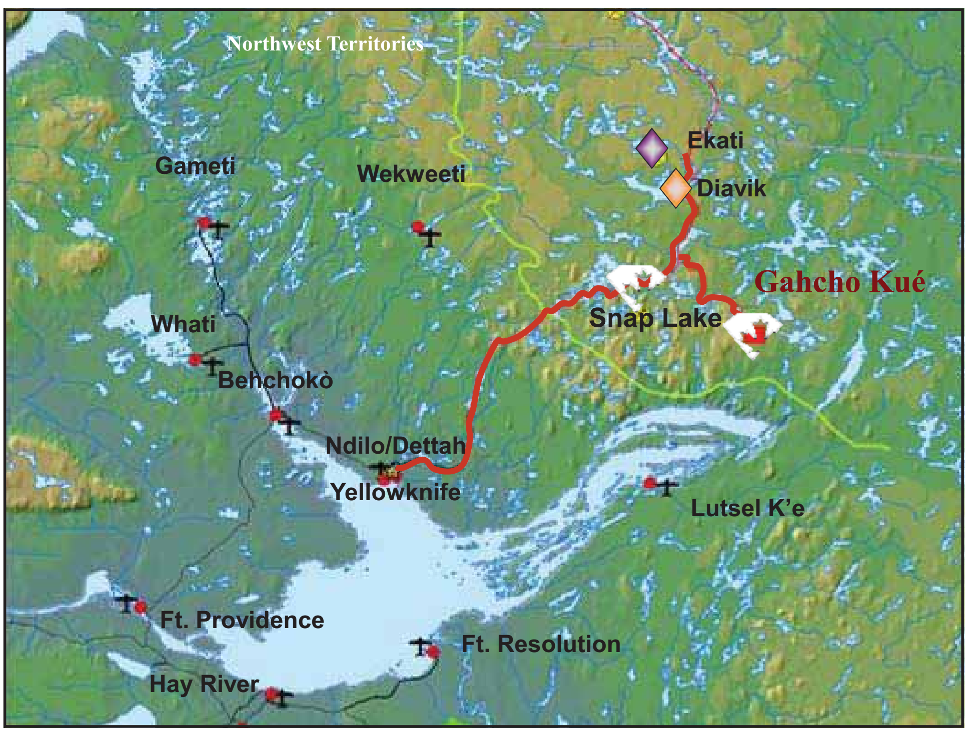
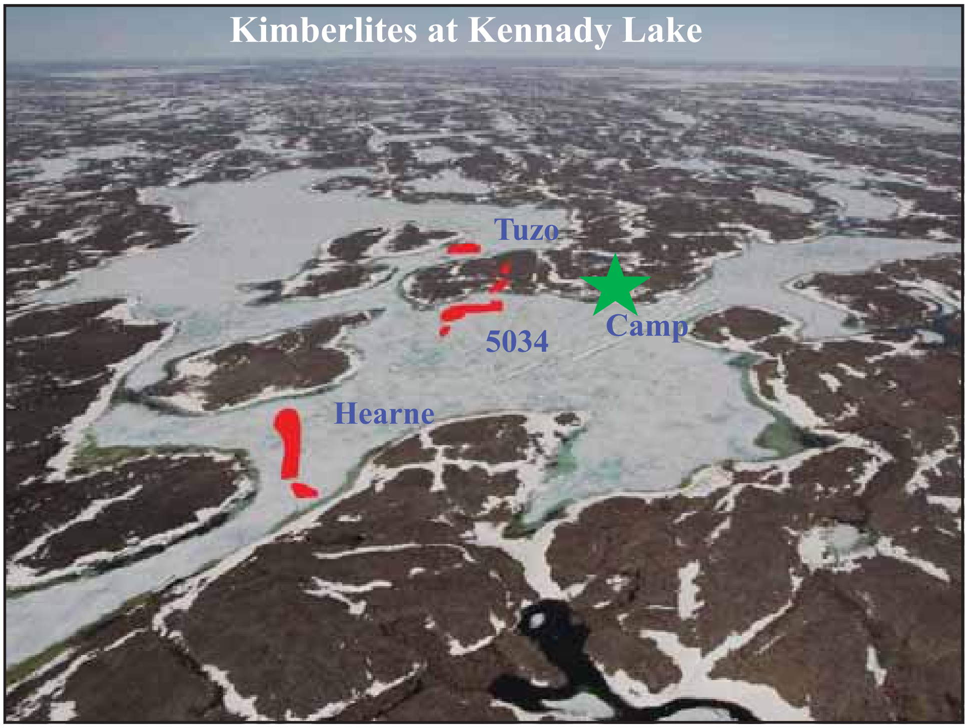
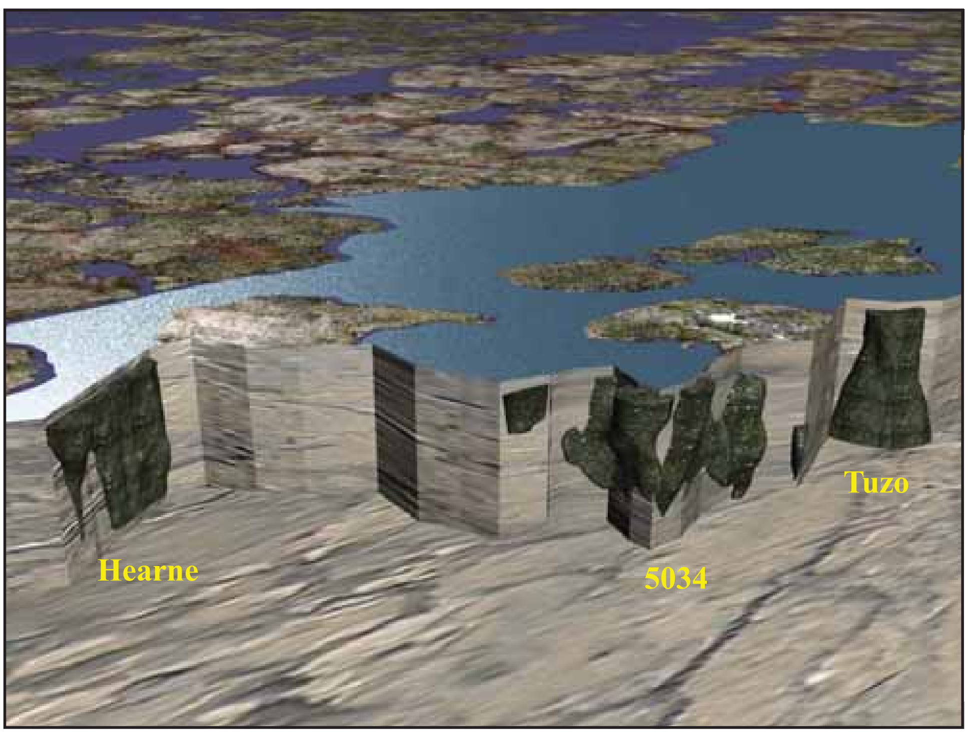



Kimberlites at Kennady Lake
Tuzo
Camp
5034
Hearne


Tuzo
Hearne
5034

Project Description – Order of Discussion

- Major Elements of the Project Description
  - Mining methods, mining sequence, Project timeline
  - Surface footprint requirements and approach
  - Water management
    - Dewatering – establishing the controlled area
    - Operations – accessing the ore, managing mine and process water
    - Closure – dyke decommissioning and re-filling
  - Waste management
    - mine rock
    - coarse PK
    - fine PK

Mining Method

- The ore bodies Kennady Lake will be mined using open pit mining methods
- The alternative (underground mining) was considered but not selected
  - Diamond-bearing kimberlite pipes are vertically aligned
  - Technically challenging (maintain sufficient layer of competent, water-tight rock between mine workings and overlying lake)
  - Safety concerns
  - Economically less favourable (capital and operating costs, ore sterilization)
  - Management of groundwater inflow to mine would have impacts on surface water quality

Mining Sequence and Extraction Rates

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- Kimberlite pipes will be mined in sequence (5034, Hearne, Tuzo)
  - Order based on economics, and management of mine rock and PK
- Parallel mining considered but not selected
  - More complex operation
  - Larger footprint (mine pits not available for storage)
  - Economically less favourable (capital and operating costs)
- The maximum sustainable extraction rate of 3.0 Mt/y selected
  - most ideal alternative from a financial, as well as environmental and technical perspective (reduce amount of groundwater to be managed)
- Other extraction rates tested but not selected
  - Faster rate would result in no pits available for backfilling
  - Slower rate uneconomic

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Project Timeline

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- Once EA approval, permits, and licences obtained, construction will take 2 years (Yr -2 to Yr -1)
  - Installation of infrastructure, dewatering to reduce water level in all of Kennady Lake (upstream of Dyke A)
  - After water above ore bodies drained, pre-stripping of first open pit (5034) and initial production mining will begin

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Project Timeline

- Operational period (Yr 1 to 11): kimberlite mining and processing
  - 5034 ore body first to be mined, followed by Hearne in Yr 4, and Tuzo in Yr 5
  - Processing plant operating by beginning of Yr 1 – PK storage required by this point
  - 5034 backfilled with mine rock starting in Yr 5; Hearne backfilled with fine PK starting in Yr 8
  - Where possible, progressive decommissioning and reclamation (e.g., contouring mine rock and PK storage) as mining advances

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Project Timeline

- Interim closure within 2 yrs after mining completed (end of Yr 13)
  - Removal of most site infrastructure and disposal of materials on site or off site as appropriate

- Lake refilling and reclamation monitoring from Yr 14 onward until remaining areas of Kennady Lake refilled
  - Flooding pits and returning Kennady Lake to original level by restoring natural drainage and pumping from Lake N11 (~8-16 yrs)
  - Removing all remaining site infrastructure (e.g., airstrip and camp)
  - Monitoring until Project site and Kennady Lake meet regulatory conditions

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Operating Life - Existing Diamond Mines

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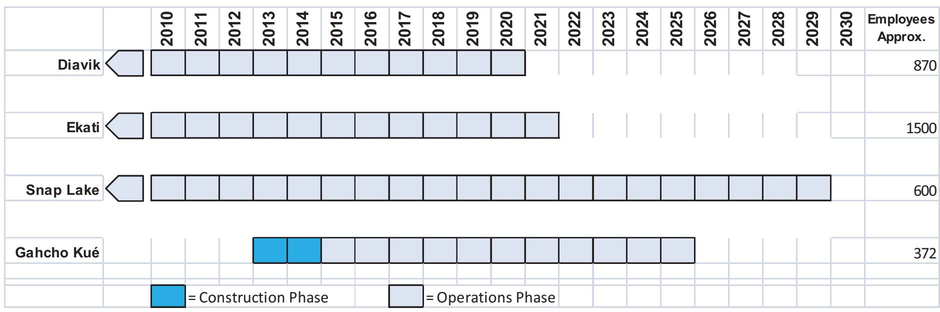

- New mines such as the Gahcho Kué Project and the Jericho Mine in Nunavut that is planning to open will be needed to maintain the economic well being of the areas that they operate in

Surface Footprint

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- Overall environmental and operational objective of minimizing project footprint
- Maintain project disturbance areas to one basin

Surface Footprint

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- Mining infrastructure established at site in parallel with start of mining
  - e.g., plant site; accommodations complex and administrative offices, maintenance complex and warehouse, storage for oil, fuel, glycol, and explosives, winter access road, site roads, airstrip, etc.
- Kennady Lake Watershed
  - Mine pits and associated infrastructure in dewatered Kennady Lake
  - Water Management Pond (WMP) to control site water
  - Entire lake dewatered (or partially dewatered) required for the construction and operation of the mine – discussed under *Water Management*
  - Dykes, diversion channels, etc. required for diversions
  - Placement of mine rock, PK – discussed under *Mine Waste Management*

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Full Extent of Operations

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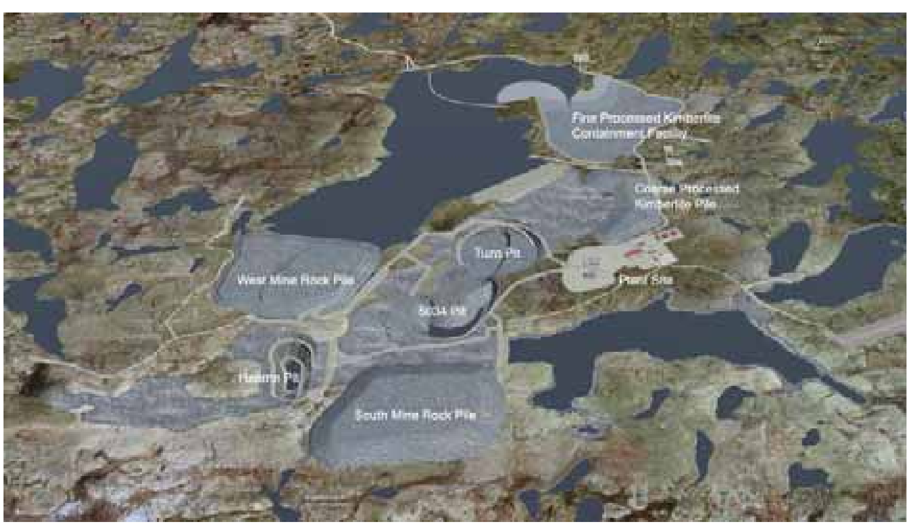

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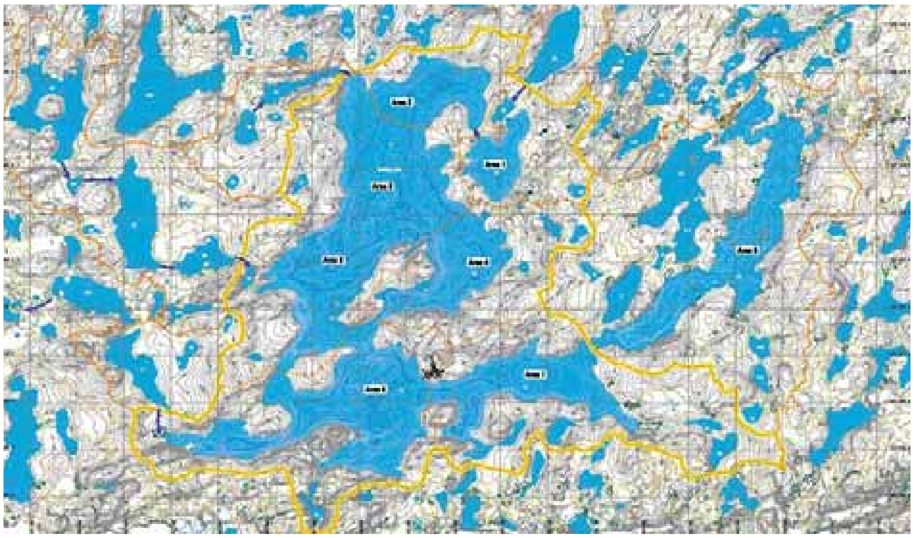
Alternatives Considered

- As identified in Section 2 of the EIS

Water Management

- Manage water within one basin
- Keep clean water out of controlled area

Water Management – Controlled Area



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Water Management

- Key water-related activity is dewatering of Kennady Lake and Lake A1, and subsequent re-filling of Kennady Lake
- Key to the Water Management Plan is creating controlled system isolated from surrounding watersheds except for licensed discharges (i.e., diverting inflows and damming outflows)
- The selected Water Management Plan will isolate 8 major sub-watershed areas within the controlled area boundary
  - Area 1 is located northeast of Kennady Lake (Lake A1 and A2)
  - Areas 2 to 8 within Kennady Lake
- Alternative options considered for water management (including maintaining some portion of Kennady Lake) not selected
  - More technically challenging (longer and higher dykes, maintaining fish passage), economically less favourable (capital and operating costs), greater risk of leakage

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Water Management

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- Dewatering of Kennady Lake
  - Prior to dewatering, dykes built to divert runoff water from Kennady Lake and retain Project-affected water within controlled area
    - Dyke A constructed at narrows separating Areas 7 and 8
  - Diversion of A, B, D, and E watersheds to adjacent N watershed
    - Fish passage maintained; fish sustained in these watersheds
  - Partial dewatering of Areas 2 through 7 to neighbouring lakes
  - After initial dewatering is complete, Areas 6 and 7 isolated and drained completely, with water being pumped into Areas 2 to 5
    - Flocculant will be added to reduce suspended lake sediment entering the WMP in Area 5

Water Management Areas – Dykes and Other Infrastructure

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Gahcho Kué Project Location

Google Earth Image of Kennady Lake

- **Located in headwaters of the Lockhart River**
- **One of many small lakes in the region**

Downstream Flow Paths and N Watershed

Water Management – Dewatering

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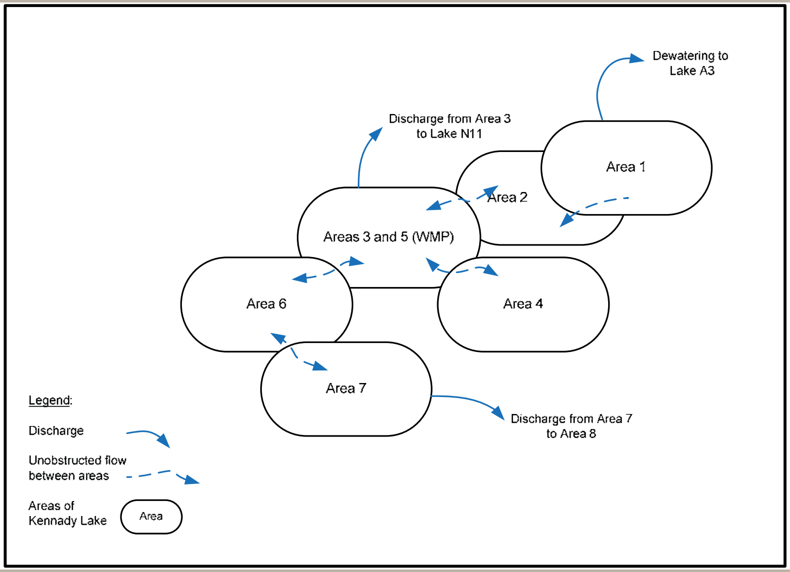

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Water Management

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- Operational Water Management
  - Water Management Pond (WMP) created in Areas 3 and 5 to store site water and manage mine water quality
    - e.g., drainage through filter dyke from Fine PKC Facility; runoff and seepage from mine rock pikes, Coarse PK Pile; open pit inflows; treated effluent discharge from sewage treatment plant; process water; and disturbed and undisturbed site runoff
    - Should water within the WMP meet discharge criteria, excess water will be pumped to Lake N11
    - Source of process make-up water for mine (Yrs 1-8, supplementing Tuzo Pit water Yrs 8-11)

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Water Management – Operations

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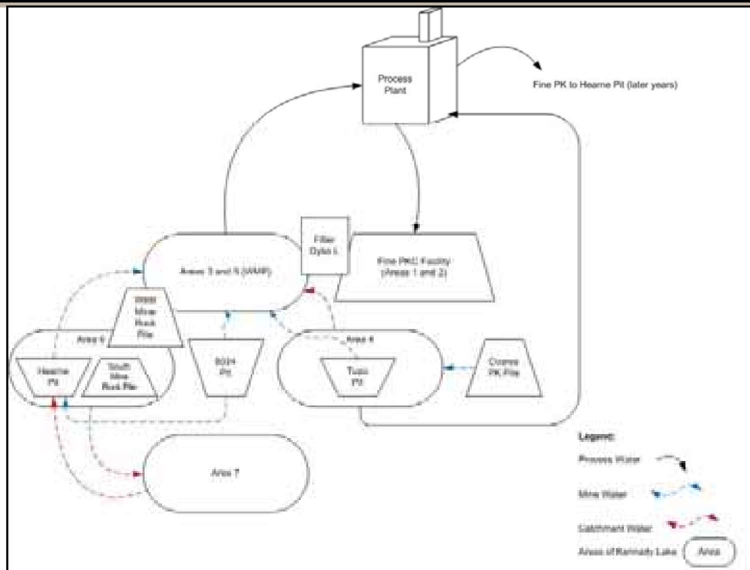

Mine Waste Management

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- Short haul distances
- Maximize use of the pits
- Keep waste management infrastructure all in the same basin

Mine Waste Management

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- Recovery of diamonds from ore bodies will generate mine rock, coarse PK, and fine PK that will require on-site disposal
- Mine rock stored in mine rock piles in and adjacent to Area 5 (West Mine Rock Pile) and Area 6 (South Mine Rock Pile), and mined-out 5034 Pit
- Alternatives considered for mine rock piles (including on-land options) not selected
  - Larger footprint, extending into adjacent watersheds requires systems to capture and control runoff, increased truck haulage, less economically favourable (capital and operating costs)
- Coarse PK Pile on land beside process facility (Area 4)

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Mine Waste Management (Years 1-3)

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Mine Waste Management

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- Preferred Alternative - Fine PK disposed of in the Fine PKC Facility (Areas 1 and 2) and mined-out Hearne pit
  - PK storage area required for first 8 years of mining before pits are available
  - Lakes A1 and A2 partially dewatered prior to PK storage
- Alternatives considered for fine PK storage (including on-land or entirely within Kennady Lake options) not selected
  - More complex construction (e.g., higher dykes or impervious dykes, leakage detection systems, topographical challenges), increased maintenance and inspection (e.g., active operation of seepage and runoff control), higher risk of loss of containment, larger footprint, cost prohibitive (capital and operating costs)

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Closure and Reclamation

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- At completion of mine operations
  - Hearne Pit partially backfilled with fine PK, 5034 Pit partially backfilled with mine rock, Tuzo Pit open and empty
  - Areas 1 and 2 filled with fine PK and reclaimed with coarse PK and mine rock cover
  - Construction of compensation habitats and decommissioning of roads, diversion channels, and pipelines within Kennady Lake
  - Transfer of water from WMP to Tuzo Pit
- Temporary diversion dykes breached and removed
  - Natural runoff from upper watersheds (B, D, E) and supplemental pumping from Lake N11 used to refill Kennady Lake (~8 years)
  - Alternative of not pumping considered but not selected (delays ecosystem recovery)
- Dyke A removed when water quality considered suitable

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Water Management - Closure

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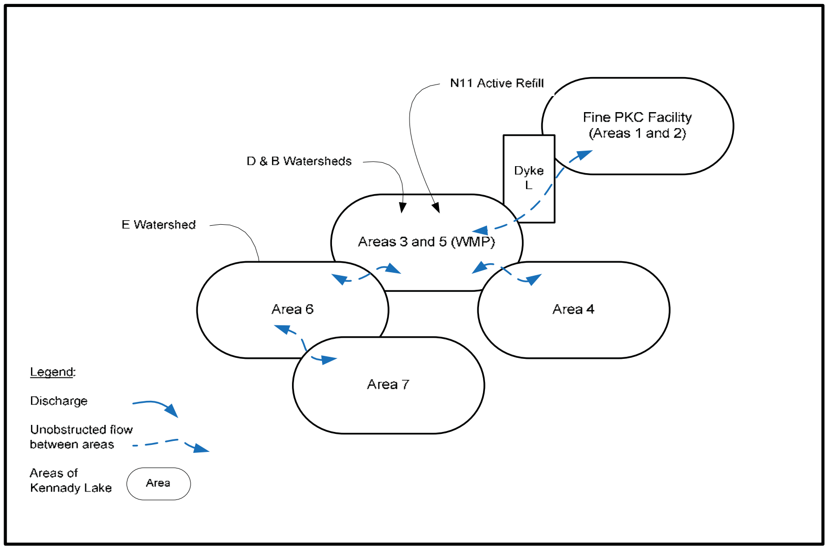

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Final Reclamation

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Aquatic Environment

- There will be no change in water quantity downstream of Lake 410
- During dewatering the flows will not exceed the 1 in 2 year flood flows
- During operations water that comes in contact with the mine site flows into one sub-basin of Kennady Lake
  - Operational discharges to Lake N11
- Possible augmentation of flows downstream of Kennady Lake to maintain fish passage and habitat
- At final reclamation the flow is re-established to Kennady Lake and the watersheds that flow into Lake 410

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Aquatic Environment – Ongoing Work

- Ongoing Technical Work Related to the EIS
  - Commitments for ongoing assessment work in the EIS
    - Nutrient (phosphorus) levels in refilled Kennady Lake
      - This will be addressed in the response to question 1 from the conformity check
    - Flows downstream of Area 8 during operations

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Phosphorus Levels in Refilled Lake

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- Potential for increases in phosphorus in refilled Kennady Lake from seepage associated with infiltration contact with PK and mine rock
  - Nutrients have the potential to affect fish and fish habitat (e.g., higher growth and productivity, changes to habitat suitability and availability, etc.)
- Due to uncertainty in prediction of P loadings, the effects on fish and fish habitat were not assessed in the EIS
- Additional work to be completed
  - Supplemental geochemistry work to refine inputs
  - Refinement of modelling to predict P loading
  - Completion of assessment for fish and fish habitat

Downstream Flows

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- Assessment completed under a scenario of no additional flow augmentation downstream of Area 8 to mitigate for reduced flows during operations and closure
  - Reduced flows from Area 8 to Lake 410 may not be sufficient to maintain spawning and rearing habitat for Arctic grayling
  - Commitment in EIS to mitigate downstream flow impacts to avoid habitat compensation resulting from flow reduction
- Additional work to be completed
  - Additional field data to be collected in spring and summer 2011
  - Flow mitigation plan will be developed that considers habitat availability and suitability, in consultation with DFO
  - Assessment findings will be updated using the mitigation flow regimes for operations and refilling

Summary

- The current Project Description represents a balance between environment, economics and social considerations
- Project approach is to minimize the size of disturbance footprint
- All operations are managed within sub-basins of the Kennady Lake watershed
- Controlled area established to maintain segregation of clean water away from the site and managed water within the site

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Overview of the EIS
Aquatics Focus

Purpose

- Provide an overview of the aquatic environmental setting and assessment within the EIS. This presentation was prepared for INAC – Water Resources Division

- Obtain feedback from INAC – Water Resources Division

Outline

- Structure of the EIS
- Aquatic Environmental Setting
- Assessment Approach – Aquatics Focus
- Summary of Residual Effects Analysis and Impact Classification
- EIS Conclusions

Structure of the EIS

Structure of the EIS

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- The Terms of Reference issued by the Gahcho Kué Panel required that the assessment of the Key Lines of Inquiry and Subjects of Note “be comprehensive stand-alone analyses which require only minimal cross-referencing with other parts of the EIS”.
- The result was a document organized by Key Lines of Inquiry and Subjects of Note, with baseline reports for each aquatics discipline included as annexes to the EIS.
- To be responsive to the Terms of Reference, only the information needed for the effects assessment within each Key Line Of Inquiry and Subject of Note was presented.

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EIS Sections Relevant to Water

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Section Number	Section Title
2	Project Alternatives
3	Project Description
8	Key Line of Inquiry: Water Quality and Fish in Kennady Lake
9	Key Line of Inquiry: Downstream Water Effects
10	Key Line of Inquiry: Long-term Biophysical Effects, Closure, and Reclamation
11.2	Subject of Note: Impacts on Great Slave Lake
11.6	Subject of Note: Permafrost, Groundwater, and Hydrogeology
13	Cumulative Effects Assessment
14	Summary and Conclusions
Annex G	Hydrogeology Baseline
Annex H	Hydrology Baseline
Annex I	Water Quality Baseline
Annex F	Fish and Fish Habitat Baseline

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Aquatic Environmental Setting

Aquatic Environmental Setting

Components relevant to the Aquatic Environmental Setting for the EIS include:

- Hydrogeology
- Hydrology
- Water Quality
- Fish and Aquatic Resources
  - Plankton and benthic invertebrates
  - Aquatic habitat
  - Fish

Where available, historic data were reviewed and summarized, with multi-year and seasonal baseline sampling programs conducted

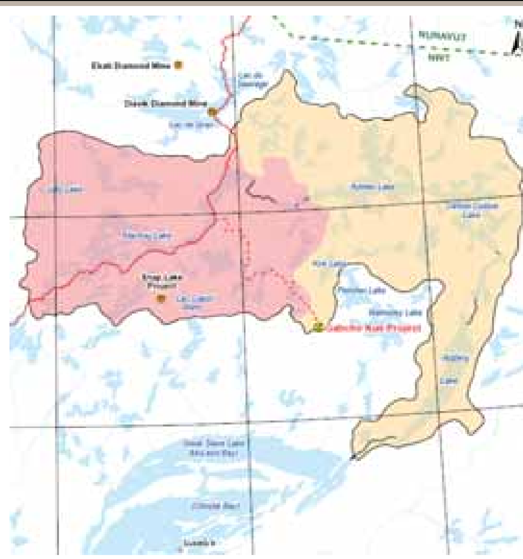
Gahcho Kué Project Location

Google Earth Image of Kennady Lake

- **Located in headwaters of the Lockhart River**
- **One of many small lakes in the region**

Aquatic Resources – Regional Study Area

- The Project is located in the watershed of Kennady Lake, a small headwater lake within the Lockhart River system
- The Lockhart River drains into the east arm of Great Slave lake
- This area constitutes the aquatics regional study area



Aquatic Resources – LSA

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- The drainage direction from Kennady Lake is northward, and passes through a number of small watersheds before entering Aylmer Lake
- The drainage area to the outlet of Kirk Lake constitutes the aquatics local study area
- The downstream LSA extends from the outlet of Kennady Lake at Area 8 downstream to the outlet of Kirk Lake, and includes all the associated watersheds
- The drainage from the adjacent N watershed joins the natural drainage from Kennady Lake at Lake 410
- The combined drainage then flows out of Lake 410 through the P watershed to Kirk Lake, and then to Aylmer Lake.

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Aquatic Resources – Kennady Lake Study Area

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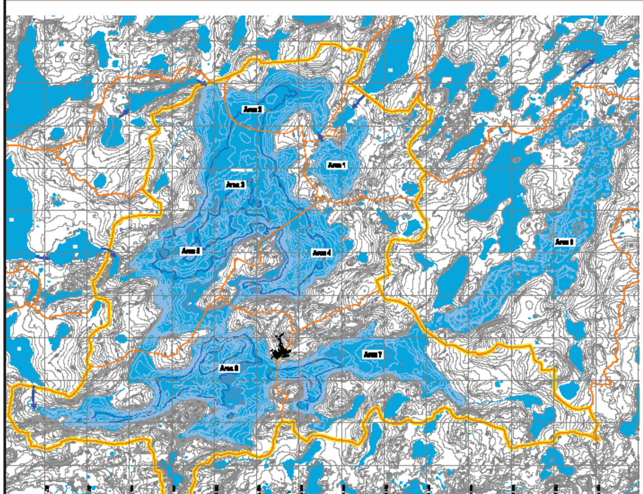

- This study area includes the seven areas of Kennady Lake (Areas 1, 2, 3 and 5, 4, 6, 7, and 8, and the Kennady Lake watershed
- The Kennady Lake watershed is 32.5 square kilometres (km^2)
- The downstream limit of the study area is the Kennady Lake outflow in Area 8 (i.e., Stream K5).

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Hydrogeology

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- The baseline setting is defined from available published work and recent seasonal surveys and investigations.
- Hydrogeology baseline studies in the Kennady Lake area:
  - Packer testing studies – 1996, 2004, 2005
  - Pressure profiling study – 2005
  - Geotechnical studies – 2004, 2005
  - Geothermal/permafrost study – 2004
  - Groundwater quality studies – 2004, 2005, **2011**

Hydrogeology Sampling Locations

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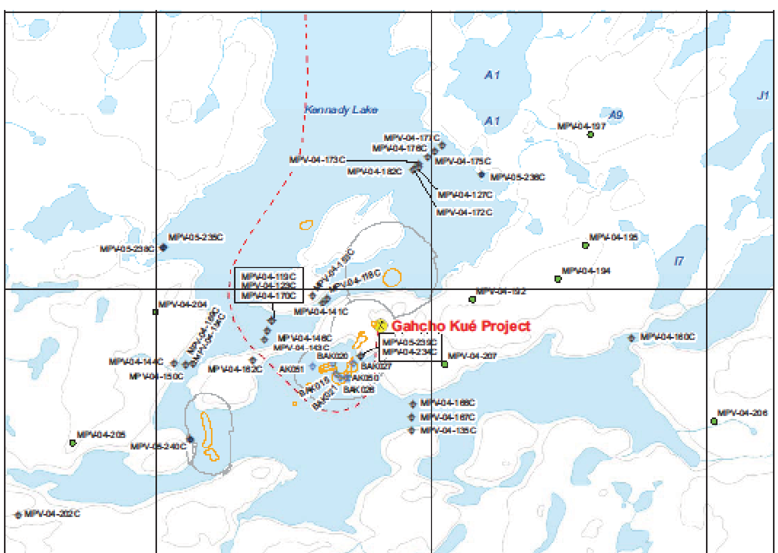

Hydrogeology – Groundwater Regimes

- Shallow groundwater
  - a shallow groundwater flow, which occurs seasonally within the active layer above the permafrost; the active layer is up to 4 m thick
  - Shallow groundwater flows towards the nearest lakes, at rate of a few cm/day
  - Shallow groundwater has low salinity in the active zone and in unconsolidated deposits
- Deep groundwater
  - A deep groundwater regime is laterally continuous and found in bedrock below the permafrost at approximately 300 m below ground surface
  - It is anticipated that there is generally little to no hydraulic connection between the two flow regimes because of the thick, low permeability permafrost

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Hydrogeology - Groundwater Flows

- Shallow groundwater flows are controlled by local topography, and usually extend only to the nearest pond, lake, or stream.
- In the Project area, deep groundwater generally flows in an easterly direction

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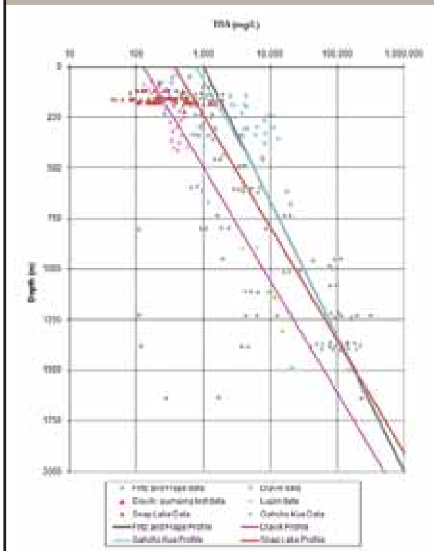
Hydrogeology – Groundwater Quality

- The shallow groundwater system is only active in the summer season, and receives water mainly from summer precipitation, with possibly a minor contribution from snowmelt
- Groundwater samples in the active layer had TDS concentrations ranging from 44 to 544 mg/L, which is classified as fresh water
- The chemistry of shallow groundwater is expected to be similar over most of the LSA.

Hydrogeology – Groundwater Quality



- The deep groundwater system was characterized by TDS that are generally consistent with the TDS of groundwater observed at other sites in the Canadian Shield.
- Groundwater below the permafrost is dominated by chloride and calcium, with sodium, magnesium and sulphate levels increasing in step with increasing TDS levels.

Hydrogeology – Groundwater Quality

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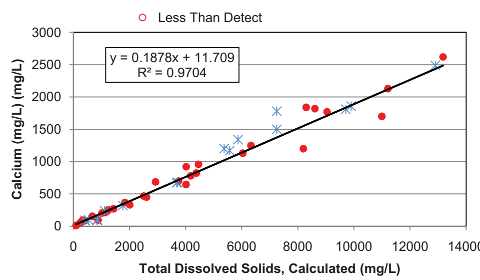
Parameter (mg/L)	Non-correlated	
Major Ions	**Median**	**Max**
Fluoride	0.51	1.49
Nutrients		
Nitrate	<0.05	1.6
Nitrite	<0.005	0.009
total ammonia	0.4	2.2
total Kjeldahl nitrogen	0.4	2.2
total phosphorus	<0.02	0.221
phosphorus, dissolved	<0.005	0.04
Dissolved Metals		
Aluminum	0.0083	0.15
Antimony	0.0003	0.002
Barium	0.06	0.41
Beryllium	<0.0005	0.004
Cadmium	<0.0001	0.001
Chromium	<0.0006	0.0012
Cobalt	0.0005	0.0022
Iron	0.5	5.7
Lead	<0.0005	0.002
Manganese	0.15	0.42
Mercury	<0.00005	0.01
Molybdenum	0.0077	0.083
Selenium	<0.0004	0.0004
Silver	<0.00025	0.002
Thallium	<0.00003	0.002
Uranium	0.00086	0.0315
Vanadium	0.00045	0.01
Zinc	<0.016	0.142

- Data: combined pit (2004, 2005, 2011)
- Groundwater quality is characterized by constituents that do not change with depth and those that do change with depth (*c.f.,* TDS)
- The latter include Ca, Cl, Mg, K, Na, SO_4, As, B, Cu, and Ni



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Hydrology

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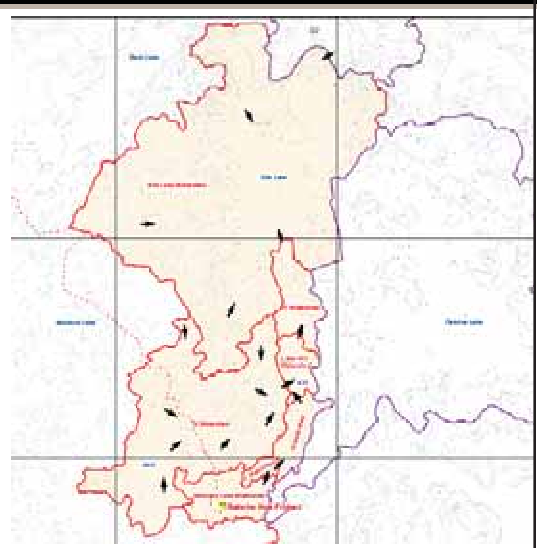
- Section 8 (KLOI: Water Quality and Fish in Kennady Lake) focused on the streamflow at lake outlets in the Kennady Lake watershed
- Section 9 (KLOI: Downstream Water Effects) focused on streamflow at lake outlets downstream of the Kennady Lake watershed
- The baseline report (Annex H) examined local and regional data to develop estimates for the following:
  - long-term mean values of discharge and annual water yield
  - ranges of natural variability
  - dry and wet year values
  - peak discharges
  - low flows

Hydrology

- Within the Kennady Lake watershed, lakes comprise more than 35% of the landscape
- Lakes are typically connected by short outlet channels that are steep relative to overall land slopes
- Channels are typically only slightly entrenched, have high bankfull width-to-depth ratios (>12) and are moderately sinuous (i.e., curving).

Hydrology

- Lakes comprise greater than 25% of the landscape within the LSA
- Lakes are typically connected by short outlet channels that are steep relative to overall land slopes
- Channels are typically only slightly entrenched, have high bankfull width-to-depth ratios (>12) and are moderately sinuous (i.e., curving).
- Sinuosity is greater than 1.2.



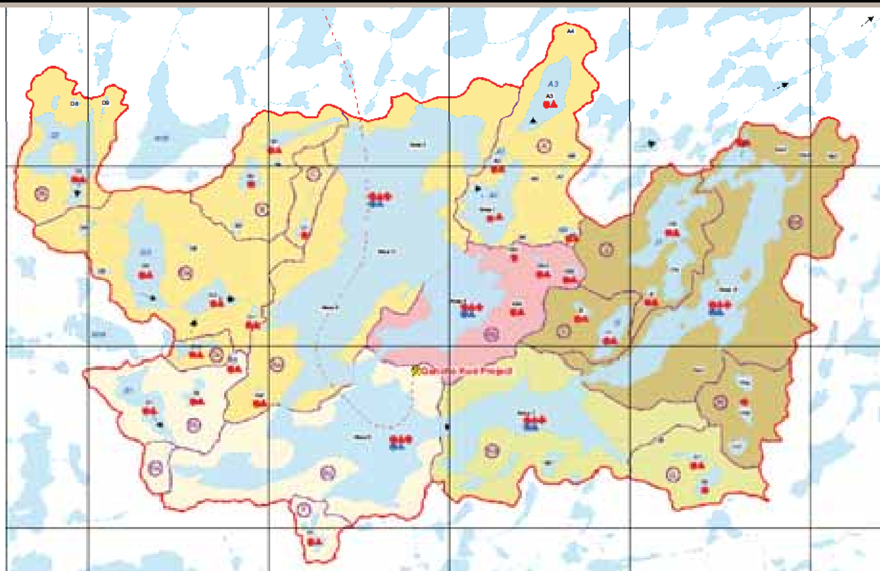
Hydrology

- Hydrology baseline data sources:
  - 1996 hydrometric study in the Local Study Area
  - continuous discharge monitoring from 1999 through 2005
  - Water Survey of Canada network of hydrometric stations (6 stations)
  - site surveys in 2004 and 2005, and 2010
- During winter, ice thickness in lakes is about 1.7 to 1.8 m and lake outlets are frozen to the bottom
- Lake levels follow a predictable seasonal cycle:
  - rapid spring rise which appears to occur before there is any loss of ice cover and before the onset of discharge at the lake outlet
  - subsequent decline to lowest water levels typically in late August
  - increase in water levels from late August into September, due to an increase in rainfall during late summer and early fall

Water Quality

- Water quality data sources:
  - 21 water quality sampling programs between 1995 and 2005, and in 2010
  - Water quality profile data collected in Kennady Lake and Lake N16 in 1996, 1998, 1999, 2004, 2005 and 2010
  - Annual summer baseline programs in Kennady Lake between 2000 and 2005, and 2010
  - Winter baseline study in Kennady Lake 1998 and annually between 2001 and 2004
  - Baseline programs in waterbodies surrounding Kennady Lake in 2002 and 2003, and 2010
- Sediment quality surveys in Kennady lake in 2004 and 2005, and 2010

Water Quality Sampling Locations – Kennady Lake Watershed



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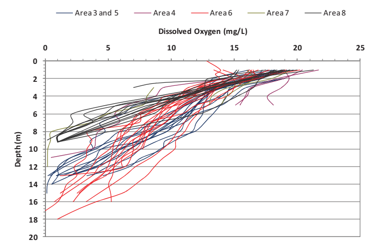
Water Quality Sampling Locations – Local Study Area

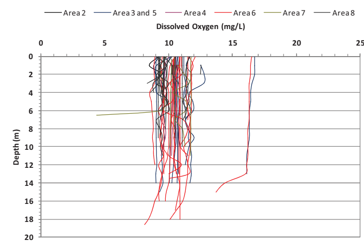
Water Quality

Physico-chemical conditions

- Shallow lakes within the Kennady Lake watershed and adjacent watersheds are usually well mixed during open-water conditions
- Deeper lakes may stratify in summer, but dissolved oxygen concentrations remain high throughout the water column
- Lakes are typically inversely stratified in winter, with colder water near the surface; dissolved oxygen concentration may decrease with depth



DO Under-ice / Open water



Water Quality

- Water quality is similar throughout Kennady Lake and other lakes in the LSA; seasonal variability is minor
- Most lakes have low concentrations of total dissolved solids, alkalinity and hardness, and total suspended solids
- The lakes can be characterized as oligotrophic, and phosphorus limited
- The lakes have low total organic carbon and dissolved organic carbon, but possess some colour
- Metal concentrations are generally low, but some metals (e.g., aluminum, copper and iron) commonly have concentrations above aquatic life guidelines

Sediment Quality

- Kennady Lake sediments are mainly composed of sand, with variable organic carbon content (5 to 13%)
- Sediment-P levels ranged from 1.3 to 2.4 mg/g
  - available P concentrations ranged from 7 to 37 µg/g, and nitrate concentrations ranged from non-detect to 0.7 µg/g
- Sediment-TPH content ranged from 7 to 2,450 µg/g
- Concentrations of most metals in Kennady Lake bed sediments are below sediment quality guidelines, but cadmium, arsenic, copper and zinc are commonly above guidelines

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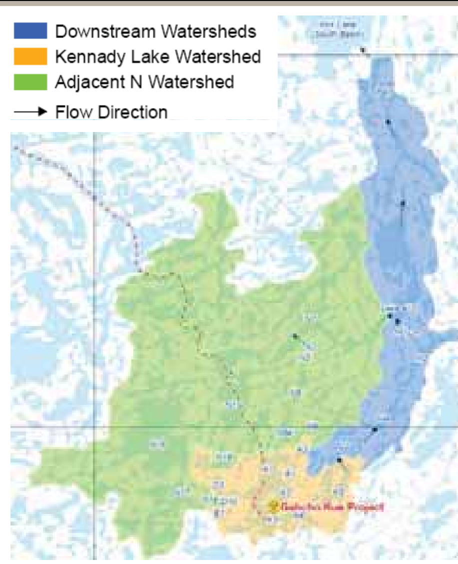
Fisheries and Aquatic Resources

- Baseline studies focused on Kennady Lake, adjacent watersheds and downstream watersheds
  - Lower trophic levels included Phytoplankton and zooplankton, benthic invertebrates
  - Fish surveys included fish habitat, fish inventory, fish population estimates, spawning surveys, overwintering, migrations, stream utilization, and tissue chemistry



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Fisheries and Aquatic Resources

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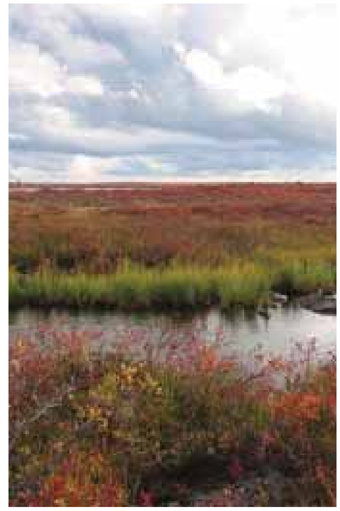
- Plankton and benthic invertebrates were sampled at various times between 1996 and 2007 in Kennady Lake, Lake N16, Kirk Lake, Lake 410 and small streams
- Baseline fisheries studies in Kennady Lake and surrounding area initiated in 1996, continued from 1999 to 2005, and also 2007 and 2010
  - Fish sampling conducted in >60 lakes and >50 streams
  - Fish habitat evaluated in >70 lakes and >50 streams



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Fisheries and Aquatic Resources

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- Plankton
  - Low phytoplankton and zooplankton abundances, typical of sub-Arctic lakes
  - Diverse phytoplankton communities (many different types of algae)
  - Less diverse zooplankton communities, dominated by copepods
  - Similar plankton communities in all sampled lakes (Kennady Lake, Lake N16, Kirk Lake, Lake 410)
- Benthic invertebrates
  - Low to moderate invertebrate density overall, typical of sub-Arctic lakes, with denser and more diverse communities in shallow near-shore areas compared to deep waters
  - Lakes dominated by midge (small fly) larvae, worms, and fingernail clams
  - Streams dominated by midges larvae, hydras, mites, and blackfly larvae

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Fisheries and Aquatic Resources

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- Kennady Lake consists of five interconnected basins within Areas 2 to 8
  - mean depth ~5 m, max depth 20 m
- Aquatic habitat in Kennady Lake
  - shallow ice-scoured nearshore zone (ice depth to 2 m)
  - nearshore (<4 m), low gradient, wave-washed zone, with primarily cobble/boulder substrate
  - deep-water offshore zone (>4 m) with primarily loose fine sediments
  - aquatic vegetation limited to narrow fringe of sedges along some shorelines and at tributary mouths

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Fisheries and Aquatic Resources

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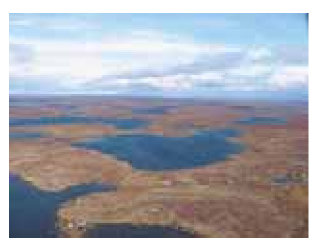
- Lakes sampled in area ranged in size and depth
  - many small lakes (< 3 m in depth) freeze to bottom in winter and do not provide overwintering habitat
  - about half of sampled lakes were considered non fish-bearing
  - in fish-bearing lakes, fish abundance was low, species captured included sport and forage fish



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Fisheries and Aquatic Resources

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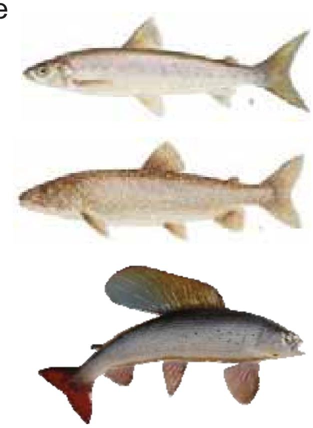
- Eight fish species present in Kennady Lake
  - Round whitefish and lake trout most abundant; Arctic grayling, northern pike, burbot present in lower numbers
  - Forage fish include lake chub, ninespine stickleback and slimy sculpin
  - Arctic grayling and northern pike make spawning migrations into streams in spring
  - Other large lakes in area found to have similar fish communities



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Fisheries and Aquatic Resources

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- Streams typically shallow, low gradient with boulder/cobble substrates
  - small streams typically flow only in spring, restricting fish passage
  - habitat suitable for spawning and rearing of Arctic grayling and other stream-dwelling fish present in larger streams
  - Arctic grayling was the most abundant species captured in streams
  - other sport and forage fish captured
  - young-of-the-year Arctic grayling captured in streams downstream of Kennady Lake in summer

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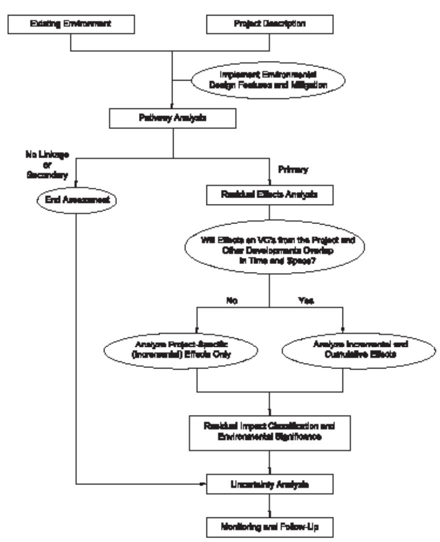
Assessment Approach
Aquatics Focus

Assessment Approach



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What is Environmental Assessment?

- A process that identifies and assesses the environmental effects of the Project and provides a determination of the significance of effects.
- Assesses effects to the air, land, water, and people
  - Air & Land includes air quality, noise, soil, vegetation and wildlife
  - Water includes water quality and quantity, fish and other aquatic life
  - People includes social, economic and cultural considerations
- Process is iterative, where assessment results may lead to changes in the project and identification of mitigation measures to reduce environmental effects

Overview of Environmental Assessment Approach

1. Describe the Project and alternatives considered
2. Identify Key Issues and Valued Components (VCs)
3. Define endpoints to measure and assess effects to VCs
4. Define the boundaries for assessment in time and space
5. Identify pathways through which the Project can affect the Environment
6. Undertake a preliminary evaluation of pathways to focus the assessment on primary pathways; those that could lead to significant adverse effects
7. Undertake impact analyses for all primary pathways
8. Use results of impact analyses to classify impacts and determine significance, using common criteria such as magnitude, geographic extent and duration

Identify Key Issues and Potential Environmental Effects

- The Project Description and preliminary knowledge of existing environment
  - scoping of Project effects pathways (i.e., interactions between Project and biophysical and socio-economic environments)
- Engagement with the Public, First Nations and Métis, and Government
- Scientific knowledge and experience with other northern mines
- Issues identified in the Terms of Reference for the Gahcho Kué Project

Identify Valued Components and Endpoints

- Valued Components (VCs)
  - physical, biological, cultural, social, and economic properties of the biophysical and human environments that are considered important to society
- Assessment Endpoints
  - key properties of VCs that should be protected for use by future human generations (incorporates *sustainability*)
  - used to assess significance of impacts on VCs
- Measurement Endpoints
  - quantifiable (measurable) expressions of assessment endpoints (chemical concentrations, rates, area, abundance, family income)
  - used for testing impact predictions in monitoring and follow-up programs

Identify Valued Components and Endpoints

Valued Component	Assessment Endpoint	Measurement Endpoints
Water Quality	suitability of water quality to support a viable and self-sustaining aquatic ecosystem	• water chemistry • physical properties (pH, TDS, TSS) • water levels and flow • aquatic health
Lake Trout	abundance and persistence of desired population(s) of lake trout	• habitat availability • fish number, movement and behavior • fish survival and reproduction • fish reproductive condition and health
Northern Pike	abundance and persistence of desired population(s) of northern pike	
Arctic Grayling	abundance and persistence of desired population(s) of Arctic grayling	

Spatial Boundaries

- Specific to VCs
  - study areas capture scale-dependent factors that influence geographic distribution and movement patterns specific to each VC
  - implies using a range of spatial scales to describe baseline conditions, and analyze and predict effects
- Local study area
  - direct effects from the Project (geology, soil and habitat loss, water quantity and quality, individual animal mortality)
  - small-scale indirect effects on environment (changes to soil and vegetation from dust deposition)
- Regional study area
  - mostly larger-scale indirect effects from project activities on VCs (noise, dust and air emissions on animal movement and behaviour)
  - captures the maximum predicted extent of the combined direct and indirect effects from the Project on VCs

Temporal Boundaries

- Development phases of the Project
  - construction
  - operation
  - closure (and post-closure)
- Predicted duration of effects on VCs from Project
  - duration = amount of time between start and end of Project activity or stressor (related to Project phases) plus time required for the effect to be reversible
- Incorporates sustainability
  - links duration of Project effects on VC to the amount of time that human use of ecological resources may be influenced

Aquatic Assessment Conclusions

Residual impacts were classified for two time periods:

- Initiation of the Project to 100 years, and
- future conditions after 100 years

The first 100 years incorporates the construction and operations, and closure phases of the Project, and the expected recovery period in which the aquatic ecosystem would be in a stable and productive state

- The recovery period was conservatively based on the amount of time that northern pike will re-establish to a stable, self-sustaining population in Kennady Lake following the complete refilling of Kennady Lake.
- Northern pike are expected to require a long time to re-establish (i.e., 50 to 60 years).
- Once suitable habitat conditions develop for lake trout in the refilled lake, it is expected that this species would also require a long time to re-establish a stable, self-sustaining population (i.e., approximately 60 to 75 years following the complete refilling of Kennady Lake).

The second period focuses on future conditions after 100 years from Project initiation, in which the affected ecosystems has recovered to a steady state.

Pathway Analysis

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- A screening step that uses environmental design features (mitigation), proven experience, logic, and science to distinguish no linkage, secondary, and primary pathways
- Consider all potential linkages between the Project and VCs
- Apply environmental design features to remove the pathway or limit effects to VCs
  - Project designs, environmental best practices, management policies and procedures, and social programs
  - iterative process between Project engineers and environmental scientists

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Pathway Analysis

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- No Linkage – pathway is removed by environmental design features so that the Project results in no detectable environmental change and residual effects to a VC relative to baseline or guideline values;
- Secondary - pathway could result in a minor environmental change, but would have a negligible residual effect on a VC relative to baseline or guideline values; or
- Primary - pathway is likely to result in a measurable environmental change that could contribute to residual effects on a VC relative to baseline or guideline values.

Environmental effects of secondary pathways are evaluated as part of the pathway analysis, and primary pathways are carried through a more detailed effects analysis

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Pathway Analysis (Example)

Dewatering of Kennady Lake

- Dewatering of Kennady lake may cause mortality and spoiling of fish
- Impingement and entrainment of fish in intake pumps during dewatering may cause injury and mortality to fish
- Release of sediment to Area 8 during the construction of Dyke A may change water and sediment quality, and effect fish and fish habitat
- Erosion of lake bottom sediments in Area 8 near the outfall may cause changes to water and sediment quality and affect fish and fish habitat
- Alteration of groundwater flows from the dewatering of Kennady Lake may change surface water levels in nearby lakes, and affect water quality and quantity, fish and fish habitat
- Dewatering of Area 7 to Area 8 may changes flows, water levels, and channel/bank stability in Area 8
- Dewatering of Area 7 and pumping to Area 8 may change water quality and affect aquatic health and fish
- Reduction in upper watershed flow to Area 8 may change surface water levels, and affect water quality, fish and fish habitat

Effects Analysis

- Examines all primary pathways that result in expected changes to VCs, after implementing environmental design features (i.e., residual effects)
- Measurement endpoints are used to analyze residual effects to VCs for each major pathway
- Analyses are quantitative and qualitative
  - Baseline studies and guideline values
  - Modelling and statistical analysis
  - Scientific literature
  - Government publications
  - Traditional knowledge
- Includes both Project-specific and cumulative effects (where applicable)

Effects Analysis - Tools and Methods

- Methods and tools used to analyse effects include the following:
  - Aquatic Environment
    - 3-D Groundwater Modelling
    - Geochemical modelling
    - Regional hydrological analysis and water balance development
    - Surface water quality modelling
    - Aquatic health analysis using a risk assessment methodology
    - Fish and Fish Habitat analysis using habitat area determination, habitat suitability determination, and calculation of habitat units
  - Air
    - Calpuff air dispersion modelling

Residual Impact Classification

- The purpose of the residual impact classification is to describe the residual effects from the Project using a scale of common words
- The classification of residual impacts on primary pathways provides the foundation for determining environmental significance from the Project on assessment endpoints
- Magnitude, geographic extent, and duration (which includes reversibility) are the principal criteria used to predict significance
- Only completed for those VCs that have assessment endpoints

Residual Impact Classification

- Completed for each primary pathway
- For VCs with cumulative effects, incremental and cumulative effects are classified for magnitude and geographic extent
- The following criteria are used to assess residual impacts for pathways
  - Direction
  - Magnitude
  - Geographic extent
  - Duration
  - Reversibility
  - Frequency
  - Likelihood
  - Ecological context

Environmental Significance

- Represents the overall impact on VCs after considering
  - Direction
  - Magnitude
  - Geographic extent
  - Duration (which includes reversibility)
- Completed for assessment endpoints
  - Based on results from residual impact classification of all primary pathways
  - Application of professional judgment and ecological principles (resilience) to predict duration and reversibility
- For the aquatics assessment endpoints, impacts were classified for two time periods:
  - Initiation of the Project to 100 years, and
  - future conditions after 100 years

Environmental Significance

For WQ:

Not significant, if impacts are measureable at the local scale, and may be strong enough to be detectable at the regional scale.

- **Significant**, if impacts are measurable at the regional scale and are irreversible. A number of high magnitude and irreversible effects (i.e., pathways) at the regional scale would be significant.

For VC fish populations:

- **Not significant**, if impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population persistence.
- **Significant**, if impacts are measurable at the population level and likely to decrease resilience and increase the risk to population persistence. A high magnitude and irreversible impact at the population level would be significant.

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Uncertainty

- Provide key sources of uncertainty in effects analysis and impact classification
  - adequacy of baseline data for understanding current conditions and future changes not related to the Project (extent of future developments, climate change)
  - understanding of Project-related effects on complex ecosystems
  - knowledge of effectiveness of mitigation for limiting effects
- Discuss how uncertainty was addressed to increase level of confidence that effects will not be worse than predicted
  - using results from several models to reduce bias and increase confidence
  - implementing conservative approach so that impacts are typically overestimated

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Monitoring and Follow-Up

- Used to deal with uncertainties associated with impact predictions and effectiveness of Project environmental design features
  - Compliance inspection – monitoring to make sure De Beers is meeting conditions of approval and commitments
  - Environmental monitoring – monitoring to track conditions or issues during Project lifespan, and implementation of adaptive management
  - Follow-up – programs designed to test accuracy of impact predictions, reduce uncertainty, and determine effectiveness of mitigation

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Summary of Aquatics Residual Effects Analysis and Impact Classification

Overview

- The following slides represent a summary of the residual effects identified for aquatics components that were considered in the impact classification:
  - Hydrology
  - Water quality
  - Aquatic health
- The impact classification tables are also provided for:
  - Section 8 KLOI: Water Quality and Fish in Kennady Lake
  - Section 9 KLOI: Downstream Water Effects

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Residual Effects – Hydrology

- During operations and closure, there will be changes to flows, water levels and mean annual yields in the downstream watershed and in the N watershed
  - channel bank stability and integrity is expected to be maintained, although the exposed bed may be subject to some erosion.
- Following closure, the hydrology of the reconnected Kennady Lake system is expected to be similar to existing conditions once Dyke A separating most of Kennady Lake from Area 8 is removed and pumping from Lake N11 ceases.
- The natural drainage of most small watersheds to Kennady Lake will be restored; however, in the A watershed, Lake A3 will continue to flow to the N watershed.
- Beyond closure, a reduction in surface area of Kennady Lake will result in a small increase in annual water yield and a slight increase in flood peak discharges, but effects to the N lake and downstream watersheds of Kennady Lake are similar to baseline conditions.

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Residual Effects - Water Quality

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- Influences to WQ include:
  - air emissions from the Project (e.g., fugitive dust, vehicle emissions)
  - isolation of Areas 2 and 7 from Area 8
  - drainage in the controlled area that comes into contact with the Fine PKC Facility, mine rock piles and the Coarse PK Pile
  - Hearne and Tuzo open pits

- WQ simulations for Kennady Lake and adjacent/downstream watersheds completed using a mass balance model developed in GoldSim
  - The WQM incorporated the water balance models for each key watershed

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Residual effects - Water Quality

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- Air emissions evaluated for lakes within the Kennady Lake watershed
  - TSS and some metals in lakes in close proximity to the mine piles and haul roads will exceed baseline concentrations by >100%
  - localized and expected to be seasonal, during and after the freshet
  - high degree of conservatism associated with summer (55%) and winter (0%, no natural mitigation considered) mitigation, and aerial deposition modelling based on most productive mine years

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Residual Effects – Water Quality

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- – Pumped discharge to Area 8 and Lake N11 will not be a source of TSS
- – TDS and major ions will increase in Kennady Lake during operations due to the WMP (i.e., natural runoff, process water cycling, groundwater inflows) and decrease in closure with the refilling and reconnection with the L and M lakes
  - Within Area 8, the isolation of the upper watershed will result in an increase in TDS and major ions until after dyke A is removed
  - Within Lake N11, concentrations will increase as a result of WMP discharges (during dewatering, concentrations will be similar)
  - Relative attenuation of TDS and major ion concentrations will occur in further downstream lakes
  - Potassium will be sourced from geochemical inputs and may increase to a steady state concentration in Kennady Lake over time
  - Concentrations will remain above baseline, but below aquatic health guidelines

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Residual Effects – Water Quality

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- Nitrogen and phosphorus (P) is predicted to increase within Kennady Lake, lake N11, and downstream lakes due to blasting residuals and geochemistry inputs
  - – Nitrogen (nitrate and ammonia) within Kennady Lake, Lake N11 (during operations through pumping from the WMP) and downstream watersheds following closure is expected to be at, or below guidelines, at closure, and continue to decline to near background levels
  - – A peak will occur in Area 8 and downstream lakes following the removal of dyke A before returning to background concentrations
  - – There is potential for P to increase in Kennady Lake as a result of runoff from the reclaimed mine site
    - Infiltration through the external PK storage facilities may mobilize P with saturated fine PK the largest potential source
    - The amount of P that may be released is the subject of further work, with consideration of environmental design features and other mitigation

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Residual Effects – Water Quality

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- Trace metals concentrations are predicted to increase in Kennady Lake, Lake N11, and downstream lakes
- Three patterns are predicted based on the source of the metals:
  - Increase in operations and decrease during post-closure (Cr, Co, Fe, Pb, Mn, Hg, Se, Ag, Tl, U, and Zn)
  - Increase in operations, rise or fall in closure, and remain at steady state in post-closure (Al, Sb, As, Cd, Cu, Ni, and V)
  - Continue to increase following closure and reach a steady state in post-closure (Ba, Be, B, Mo, and Sr)
- WQ guideline exceedances (Protection of Aquatic Life) are expected in Kennady Lake following closure for Cd, Cr, Cu, and Fe; Cd, Cr and Fe in Area 8; Cr and Cd in Lake N11 early in operations

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Residual Effects – Water Quality

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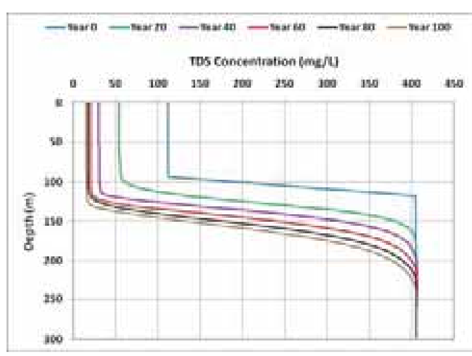
- Meromixis in Tuzo pit
  - Meromixis will develop in Tuzo pit as a consequence of the density gradient differential between the saline bottom waters in the pit and the overlying low TDS waters
  - Water above the pit will be determined by the upper 20 m of lake water above Tuzo pit, which will be subject to natural temperature and wind-driven summer seasonal stratification patterns
  - Stratification will strengthen over time



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Residual Effects – Aquatic Health

Kennady Lake

- During construction and operations, maximum solids and some metals concentrations from air emissions will exceed guidelines
- During closure and post-closure, predicted max concentrations of most substances of potential concern (SOPCs) are lower than chronic effects benchmarks (CEBs), with the exception of Cu, Fe and Sr
  - Despite exceedances, the potential for adverse effects to aquatic life was considered low
- For the indirect exposure pathway, predicted fish tissue concentrations are below toxicological benchmarks, except Ag
  - The increase is modest, and slightly above the available no-effect concentration; potential for effects to fish is low
- WQ changes are predicted to result in negligible effects to aquatic health, fish populations and communities

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Residual Effects – Kennady Lake

Recovery of Kennady Lake

- An aquatic ecosystem will develop within Kennady Lake after refilling and reconnection with Area 8; however, the re-established communities may differ from pre-development communities
- Estimated time frame for recovery is as follows:
  - phytoplankton community ~ 5 years after refilling is complete
  - zooplankton community development ~ 5 to10 years after refilling
  - benthic invertebrate community expected to be slower than plankton, i.e., about ten years after refilling is complete
  - re-establishment and speed of fish community development will depend on ability of fish to re-colonize, habitat conditions, and how succession takes place after the lake has been fully connected to the surrounding environment (~ 50 to 60 years, or more)
- Fish community expected to become re-established; however, the community may be different than what exists currently

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Residual Effects – Downstream of Kennady Lake

- Dewatering will result in augmented flows in N, L and M watersheds during open-water period; most pumping occur after peak of spring freshet, and peak discharges remain similar to baseline conditions
  - water levels in downstream lakes remain near spring freshet levels longer into summer compared to baseline conditions
- During operations, flow reductions in the L and M watersheds during operations will result in a reduction of available habitat
  - flows in June substantially reduced in streams between Kennady Lake and Lake 410
  - however, assessment completed under scenario of no additional flow augmentation downstream of Area 8 to mitigate for reduced flows
    - pumping plan is being developed as mitigation

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Residual Effects – Downstream of Kennady Lake

- At closure, flow regime in N watershed returns to near baseline conditions, with small seasonal reductions for Kennady Lake refilling
- During post-closure, flows return to near baseline conditions throughout the N, L, and M watersheds and effects to fish habitat considered to be negligible

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Cumulative Effects

- Existing and planned projects in the NWT are located outside of the LSA (i.e., Kennady Lake watershed or in downstream areas potentially affected by the Project)
- As such, there is no opportunity for the releases of those projects to interact with those of the Project within the Kennady Lake watershed downstream to Kirk Lake
- Consequently, there is no potential for cumulative effects to fish or water quality in Kennady Lake or small lakes and streams in the Kennady Lake watershed, or downstream of Kennady Lake to Kirk Lake

Residual Impact Classification Table
KLOI: Water Quality and Fish in Kennady Lake

Assessment Endpoint	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Ecological Context
Suitability of water within the Kennady Lake watershed to support a viable and self-sustaining aquatic ecosystem								
Construction to 100 years from Project start	negative	moderate	local	long-term	continuous	reversible	likely	high
Beyond 100 years from Project start	negative	low	local	long-term	continuous	not reversible	likely	high
Abundance and persistence of Arctic grayling within the Kennady Lake watershed								
Construction to 100 years from Project start	negative	high	local	long-term	continuous	reversible/	likely	high
Beyond 100 years from Project start	negative	low	local	long-term	continuous	not reversible	likely	high
Abundance and persistence of lake trout within the Kennady Lake watershed								
Construction to 100 years from Project start	negative	high	local	long-term	continuous	reversible/not reversible	likely	high
Beyond 100 years from Project start	negative	moderate	local	long-term	continuous	not reversible	likely	high
Abundance and persistence of northern pike within the Kennady Lake watershed								
Construction to 100 years from Project start	negative	high	local	long-term	continuous	reversible	likely	high
Beyond 100 years from Project start	neutral	negligible	-	-	-	-	-	-

Residual Impact Classification Table
KLOI: Downstream Water Effects

Assessment Endpoint	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Ecological Context
Suitability of water in downstream waterbodies to support a viable and self-sustaining aquatic ecosystem								
Construction to 100 years from Project start	negative	negligible	-	-	-	-	-	-
Beyond 100 years from Project start	negative	negligible	-	-	-	-	-	-
Abundance and persistence of Arctic grayling in downstream waterbodies								
Construction to 100 years from Project start	negative	moderate[(a)]	local	medium-term	periodic	reversible	likely	high
Beyond 100 years from Project start	negative	negligible	-	-	-	-	-	-
Abundance and persistence of lake trout in downstream waterbodies								
Construction to 100 years from Project start	negative	low	local	medium-term	periodic	reversible	likely	high
Beyond 100 years from Project start	negative	negligible	-	-	-	-	-	-
Abundance and persistence of Northern pike in downstream waterbodies								
Construction to 100 years from Project start	negative	low	local	medium-term	periodic	reversible	likely	high
Beyond 100 years from Project start	neutral	negligible	-	-	-	-	-	-

EIS Conclusions

Aquatic Assessment Conclusions

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- The following slides represent the determination of significance for the assessment endpoints in:
  - Section 8 KLOI: Water Quality and Fish in Kennady Lake
  - Section 9 KLOI: Downstream Water Effects
  - Section 10 KLOI: Long-term Biophysical Effects, Closure, and Reclamation

- **The impacts of the Project to these endpoints are considered to be not environmentally significant**

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Aquatic Assessment Conclusions

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The impacts of the Project on the suitability of water quality to support a viable and self-sustaining aquatic ecosystem are considered to be not environmentally significant for both time periods.

- Water quality is predicted to change in Kennady Lake and downstream of Kennady Lake, but is expected to result in negligible effects to aquatic health

- The potential effects of changes to nutrient levels have not been presented.
  - They are the subject of continuing evaluation and are therefore not included at this time in the determination of environmental significance for any aquatic environment assessment endpoints.
  - Once the continued analysis is complete, the significance determination will be updated as appropriate and required

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Aquatic Assessment Conclusions

The impacts on the abundance and persistence of Arctic grayling, lake trout, and northern pike are considered to be not environmentally significant for both time periods.

- It is expected that self-sustaining populations of these fish species will become established in the refilled Kennady Lake.
  - Arctic grayling and northern pike will be affected by the loss of habitat during operations and closure, but will persist in Area 8 and the diverted watersheds
- Potential effects of changes to nutrient levels will be addressed as part of the conformity response.

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Aquatic Assessment Conclusions

In downstream waters, the impacts on the abundance and persistence of Arctic grayling, lake trout, and northern pike are considered to be not environmentally significant for both time periods.

- In the first 100 year time period, reduced flows and lake levels downstream of Area 8 during operations and closure may affect habitat availability, suitability and movement of VC fish between Area 8 and Lake 410
- All three VC species are expected to persist in the watersheds downstream of Kennady Lake during construction, operations, closure and post-closure

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Wrap Up

Field Work in 2011

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Overview of baseline field work being conducted in 2011

- ***Hydrology***
  - collection of meteorological, hydrometric and bathymetric data
  - one snow survey trip in April, four hydrology trips in May, June, August, and September, and one bathymetry trip in July
- ***Shoreline Survey***
  - a site reconnaissance evaluate erosion potential and preparation of conceptual mitigation designs
- ***Water Quality***
  - A winter program (March/April), spring freshet sampling program (May) and summer program (July/August)
  - Includes a new reference lake

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Field Work in 2011

- ***Fish and Aquatic Resources***
  - collect baseline fish and fish habitat information for Lake N11 and a reference lake
  - undertake additional lower trophic level sampling for the L and M lakes downstream of Kennady Lake
  - undertake sampling for the presence of northern pike in the N watershed
  - determine appropriate mitigation flow requirements for downstream of Area 8

- The work outlined above will occur in a late spring/early summer program and a late summer program.

Summary

- Provided an overview of the:
  - Structure of the EIS
  - Aquatic Environmental Setting
  - Assessment Approach – Aquatics Focus
  - Summary of Residual Effects Analysis and Impact Classification
  - EIS Conclusions
  - Field work being completed in 2011

INAC Draft Comments on the EIS

Path Forward

- Is there anything that we should know about your INAC – Water Resources Division as we proceed through the Environmental Impact Review?
- Guidance on what De Beers can do to help clarify and resolve any of INAC – Water Resources Division information needs.

Path Forward

- Gahcho Kué Panel completed conformity check of the EIS in March 2011, identified 5 deficiencies to be addressed
  - 3 items related to SEIA (response submitted to Panel on May 3, 2011)
  - 2 items related to waste rock/PK storage and effects of phosphorus (De Beers expecting to submit response in July 2011)
- Gahcho Kué Panel has released a draft work plan which identifies the next step in the EIR Process is the EIS Analysis
  - Presentation of EIS by De Beers followed by workshop for all parties to the EIR
    - discuss EIS, identify information gaps, and potentially resolve issues

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Project Location	• Longitude 63° 26' North and Latitude 109° 12' West. • 140 km northeast of Łutselk'e and 280 km northeast of Yellowknife, 84 km east of Snap Lake Mine. • Project is accessed in winter by a 120 km long winter road which extends from the Tibbitt-to-Contwoyto Winter Road at MacKay Lake to Kennady Lake.
Project Elevation	• Project site is at approximately 420 masl.
Watershed Area	• Kennady Lake watershed is 32.5 km^2. The controlled area watershed is 17.3 km^2. • The Kennady Lake watershed comprises approximately 0.14 % of the 27,500 km^2 Lockhart River watershed.
Kennady Lake Information	• Surface area of Kennady Lake is 815 ha (8.15 km^2). • Mean depth of Kennady Lake is 5 m and maximum depth is 18 m; average depth of Area 8 is < 4 m. The location of maximum depth is in Area 6. • Kennady Lake drains northeast to north for about 70 km through Kirk Lake and into Aylmer Lake. Aylmer Lake is located on the mainstem of the Lockhart River, approximately halfway between the Kennady Lake watershed and Great Slave Lake. Lake 410 is ~ 10 km downstream of Kennady Lake, and Kirk Lake is ~ 25 km downstream of Kennady Lake and is the most downstream reference lake for the Project.
Kimberlite Deposits	• The diamond-bearing kimberlite deposits are vertical pipes generally located beneath Kennady Lake and contain an indicated resource of about 30 million tonnes (Mt) of kimberlite rock in three economic ore bodies (5034, Hearne, and Tuzo). • The ore extends from near the bottom of Kennady Lake down to more than 300 m below the lake. The ore bodies are covered by water ranging from approximately 7 to 16 m in depth, except for part of the 5034 ore body, which is about 45 m below the surface of the main peninsula.
Project Timeline	• Construction will take two years (Year -2 to Year -1). • The operational period will be 11 years (Year 1 to 11). • Interim closure will occur within 2 years after completion of mining (by the end of Year 13). • Lake refilling and reclamation monitoring will continue from Year 14 onward. Refilling is expected to take approximately 8-16 years after the end of operations. • Remaining site infrastructure will be removed after the water level in the planned reclamation areas of Kennady Lake is restored. Monitoring of the Project site will continue after lake refilling until it is shown that the Project site and Kennady Lake meet all regulatory conditions.

Water Management - Dewatering	• The objective of the dewatering program will be to drain Areas 2 to 7 of Kennady Lake to at least 50% of capacity by initial discharge of clean water to designated receiving points. • Dyke A will be constructed at the narrows separating Area 7 and Area 8. • Initially, the water from Kennady Lake will be discharged without water treatment. It is anticipated that more than half the water in Kennady Lake (~ 17 Mm^3) can be pumped out without water treatment. • During the first phase of dewatering, the surface water would be pumped via pipeline at the maximum rates to Area 8 of Kennady Lake, and Lake N11 in the N watershed. The projected maximum water flow to Area 8 will be 114,000 m^3/d and 500,000 m^3/d to Lake N11. This will result in small increases in water levels during the open water season, as water levels will remain at near spring freshet levels longer into the summer and early fall. In Area 8, the estimated increase is 30 cm (< 1% change in surface area). In Lakes N11 and Lake 410 (where discharge from both routes join), the increases in lake level are projected to be < 20 cm (< 2% change in surface area). Discharge flow rates to Area 8 and Lake N11 will be restricted to one-in-two year flood levels, except at outlets where there is sufficient protection. • During the second phase, the excess capacity of the partially dewatered northern portion of Kennady Lake (Areas 2 to 5) will be used to settle and/or store water unsuitable for release directly to the natural watershed. Flocculent may be added to Area 5 as required to reduce TSS in the Water Management Pond (WMP) so that pumping can continue to Lake N11.
Water Management - Diversions	• The B, D, and E watersheds on the west side of Kennady Lake will be diverted, so that the runoff from these watersheds is directed away from Kennady Lake. Due to the placement of the Fine Processed Kimberlite Containment (PKC) Facility in Areas 1 and 2, Lake A3 will be isolated from Lakes A1 and A2, and the Lake A3 outlet will be permanently diverted into Lake N9. • Fourteen dykes will be built to achieve the controlled area boundary for the Project site; additional dykes may be constructed as part of the fish habitat compensation plan (i.e., creation of additional flooded areas).
Mining Sequence	• The ore bodies will be mined in sequence, beginning with 5034, followed by Hearne and then Tuzo. • When mining operations in the 5034 and Hearne pits are completed, the pits will be used to store mine rock and PK.
Mine Plan	• The current mine plan includes mining of approximately 31.3 Mt of ore, 226.4 Mt of mine rock, and 7.3 Mt of overburden from the three pits during 2013 to 2025 (Year -1 to Year 11). • The ore will be processed at an annual rate of 3 Mt beginning in 2015 (Year 1) and extending to 2025 (Year 11). • The pits will produce about 8 tonnes (t) of mine rock for every tonne of diamondiferous kimberlite.
Ore Processing	• The ore processing system will concentrate and recover diamonds in the size range of 28 to 1.0 mm.
Mine Rock	• Most of the mine rock from the excavation of the open pits will be stored in mine rock piles in and adjacent to Area 5 (West Mine Rock Pile) and Area 6 (South Mine Rock Pile); and the mined-out 5034 Pit. Granite will comprise more than 95% of all mine rock.

Processed Kimberlite	• The processed kimberlite will be divided into two streams based on particle size: 1) coarse (including grits) and 2) fines. Coarse and grits are between 0.25 mm and 6 mm, while fines are less than 0.25 mm. • During the first four years of operation (Years 1 to 4), fine PK will be stored in the Area 1 side of the Fine PKC Facility, located adjacent to the northeast margin of Kennady Lake. During Year 6, fine PK will be deposited in the Area 2 side of the Fine PKC Facility. During the course of Year 8 until the end of the mine life, fine PK will be placed in the mined-out Hearne open pit. • Coarse PK will be placed on the Coarse PK Pile. In later years, coarse PK will be used for reclamation of the Fine PKC Facility, and co-disposed with mine rock in the 5034 Pit. • All PK will be contained within the controlled area of Kennady Lake.
Lake Refilling	• Lake refilling is anticipated to continue for ~ 8 years to restore Kennady Lake to its original lake level, although the actual refilling time will vary between 8 and 16 years. Natural drainage from the watershed will be augmented by using water from Lake N11. Refilling time could potentially be less than 8 years under unusually wet hydrological conditions. • The total annual diversion from Lake N11 will be in the order of 3.7 Mm^3/y, which represents no more than 20% of the normal annual flow to Lake N11. Based on a six-week pumping period, the average daily pumping rate will be 88,100 m^3/d. It is anticipated that more water will be withdrawn during wetter years (i.e., up to a maximum of 175,200 Mm^3/d). In drier years, less water will be withdrawn. Decreases in lake levels in Lake N11 are estimated to be < 10 cm (<1% change in lake area).
Water Management – Water Management Pond (WMP)	• During construction and operations, a WMP will be developed in Areas 3 and 5 with a maximum storage capacity of 18.8 Mm^3. The WMP will be the primary reservoir for storage of site water. Should water within the WMP meet discharge criteria, excess water in the WMP, including seasonal melt water, will be pumped to Lake N11.

Golder Associates

TECHNICAL MEMORANDUM

DATE August 18, 2011 **PROJECT No.** 11-1365-0001/DCN-020

TO Stephen Lines
De Beers Canada Inc.

CC Amy Langhorne

FROM John Faithful, Kristine Mason, Zsolt Kovats, Ekram Azim and Julien Lacrampe **EMAIL** John_Faithful@golder.com

RESPONSE TO THE DRAFT AQUATICS COMMENTS PROVIDED BY ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA

Introduction

The memorandum has been prepared to provide responses to the draft aquatics-related comments provided to De Beers Canada Inc. (De Beers) by the Government of Canada – Aboriginal Affairs and Northern Development Canada (AANDC) in May 2011. Golder understands that AANDC provided these comments so they could be used as a basis for discussions between AANDC and De Beers.

Response to Comments

Comment No. 1

Section 8.3.4.3: "Groundwater Quality" (p. 8-56)

There are almost no groundwater chemistry data provided within this section. Based on modeling work found in several different locations (e.g., Appendix 8.1, p 8.1-19/20), it is clear that groundwater data have been collected and are available. The groundwater section would benefit from a table summarizing, or Piper Plot illustrating, basic groundwater chemistry, and a short descriptive paragraph of the quality of groundwater within the project area.

Response

Baseline groundwater chemistry data are detailed and described in the hydrogeology baseline annex (Annex G; Section G6), which is a separate section of the Environmental Impact Statement (EIS). To minimize the level of baseline information in the Key Lines of Inquiry (KLOI), i.e., Section 8: Kennady Lake Water Quality and Fish, the authors provided brief summaries of the baseline information and directly referenced the appropriate annex(es).

Additionally, the section of the EIS for the Gahcho Kué Project (the Project) that focuses solely on effects to groundwater and hydrogeology is Subject of Note (SON) 11.6 - Permafrost, Groundwater and Hydrogeology. Information specific to the baseline studies conducted to characterize groundwater are provided in that SON.

A supplemental groundwater sampling program was conducted in March 2011. Additional chemistry data were collected for targeted Westbay wells, which will be incorporated into assessment updates as needed.

Comment No. 2 (part 1)

Section 8.3.5: "Surface Water Quantity" (p. 8-62)

Within this section, there is no information for Kennady Lake or the other lakes in the study area describing lake volume, residence time, outflow rates and volumes, or inflow rates and volumes.

The lack of these data makes it impossible to evaluate the potential effectiveness of the Water Management Plan. However, it is likely that at least a portion of the required data do exist, just not in this subsection. In particular, Sections 8.4, 8.7, 8.8 and 8.10 contain considerable amounts of information that should be reorganized and moved into Section 8.3.5. Failing that, and at the very least, Section 8.3.5 should contain extensive cross-references to relevant sections characterizing water quantity (including the Appendices, Annexes and Addenda).

Response

As described in the response to Comment 1, comprehensive baseline information for the EIS is provided in annexes and addenda to the EIS. Baseline hydrological information for the EIS is provided in Annex H (baseline data for 1996 to 2007) and Addendum HH (baseline data for 2010). As key lines of inquiry separate the study areas of the EIS to the Kennady Lake watershed (Section 8) and adjacent and downstream watersheds (Section 9), baseline information specific to these KLOI are summarized therein (i.e., Sections 8.3.5 and 9.3.2).

Flow regime data for lakes other than Kennady Lake are provided in Annex H and Addendum HH. These lakes include Lakes L3, L2, L1, M4, M3, M2, M1, N18, N17, N16, N12, N11, N9, N6, N5, N3, N2, N1, 410, P8, P6, P5, P4, P3, and Kirk Lake. These lakes were selected to quantify progressive effects downstream of Kennady Lake from the L and N watersheds to the Kirk Lake watershed. Flow regime data exist for lakes within the watershed (i.e., Lakes A3, A1, B1, D7, D3, D2, D1, E1, G1, H1, I1 and J1), as these lakes are incorporated into the watershed hydrological model; however, the data are not provided in Annex H.

Residence time data are not presented for the majority of the lakes within the Kennady Lake watershed, and adjacent and downstream watersheds. However, an estimate of the residence time for Kennady Lake is provided in Annex H, based on a stage-storage curve developed for Kennady Lake that was developed from bathymetry contours (Figure H5.9-1). Additionally, bathymetric mapping was completed for 21 lakes during two separate field trips (i.e., July and August) during the 2010 open water season so that lake volumes could be calculated for these lakes. The data presented in Table HH3-14 can be used to estimate residence times. Ongoing bathymetric information is being collected, with 13 additional lakes being surveyed during the 2011 open water season.

Comment No. 2 (part 2)

The reviewer also indicated that water quantity has apparently been estimated through the use of water-balance models (Tables 8.3-19, 8.3-20; 9.3.2). There are, however, no input parameters presented and no sensitivity analyses summarized, so it is not possible to fully evaluate the validity of the presented data. It is likely that these data do exist in separate reports (e.g., Appendices in Section 8, Annex H and Addendum HH), but there should be additional data summarized from these reports and placed in this section so that the model output could be evaluated. At the very least, cross-references are required so that the data can be readily accessed.

Response

Details on model calibration and validation are presented in Annex H.

Comment No. 3 (part 1)

Section 8.3.6.2.1: "Water Quality" (p. 8-75) and Section 9.3.3: "Surface Water and Sediment Quality" (p. 9-40)

A short summary table of water chemistry data would be useful. Table 8.1-3 in Appendix 8.1 is an excellent example, and could be placed in the section on water quality.

Response

Table 8.1-3 in Appendix 8.1 lists the background water chemistry input data for the water quality modelling tasks; these specific background water chemistry data are provided in a separate column in Tables 8.8-13 and 8.8.14 (Kennady Lake), Table 8.3-23 (other lakes in the Kennady Lake watershed), Table 9.8-4 (lakes in the N watershed), and Table 9.8-5 (Lake 410). It was deemed appropriate to provide a more comprehensive list of water quality parameters, including physico-chemical field parameters, major ions, nutrients, total metals, and dissolved metals, under two seasonal conditions where available (i.e., open water and under-ice conditions). Summary statistics for the parameters were also provided in the existing environment sections of each KLOI, i.e., Table 8.3-21 (Kennady Lake), Table 8.3-23 (other lakes in the Kennady Lake watershed), Table 9.3-19 (the Interlakes: i.e., the L and M lakes watershed), Table 9.3-21 (the N lakes watershed), and Table 9.3-24 (Lake 410 and Kirk Lake).

These water chemistry data, including additional descriptive detail, are also provided in Annex I and Addendum II for lakes in the Kennady Lake watershed, and adjacent and downstream watersheds, which include under-ice and open water chemistry data, method detection limits, and CCME guideline data.

Comment No. 3 (part 2)

It would be useful if the consultant had developed a Trophic State Index (TSI) (Carlson and Simpson 1996) for Kennady Lake and other lakes in the region. The TSI would have provided a simple numerical description of the productivity of the lakes within the study area. The TSI could have been based on any or all of all the data for chlorophyll 'a,' TN, TP, and/or secchi-disc depth (if available). Understanding the current and future trophic state of the waterbodies within the study area is particularly important for complete and credible assessment of impacts, given the large projected increases in phosphorus and nitrogen and the resultant risk of eutrophication.

Response

There are several ways of expressing the trophic state of a waterbody; TSI, or trophic status indicator, as proposed by Carlson (1977, 1996) is one of them. While total phosphorus (TP), Secchi depth and chlorophyll *a* (Chl *a*) levels can be used to directly indicate the trophic state of a waterbody (OECD 1982; Nunberg 1996; EC 2004) and are well-accepted by water quality specialists and limnologists, manipulating these parameters to calculate the TSI is not considered necessary. TP, Secchi depth and Chl *a* data have been collected during baseline studies, although not always consistently, as baseline programs were completed at different times by different companies, and were designed in response to different mine plans. The data are reported for waterbodies in the Kennady Lake watershed in Sections 8.3.6.2.1 and 8.3.7.2.1 of the Kennady Lake KLOI. The range of baseline values for these parameters (i.e., TP = <1 to 10 µg/L, Secchi depth = up to 8 m in the deeper basins, and Chl *a* = <0.2 to 1.5 µg/L) indicate that the Kennady Lake is an ultra-oligotrophic/oligotrophic lake (OECD 1982, EC 2004). The calculation of TSI using the available baseline data (i.e., ~25 for Chl *a*; ~25 for TP; and ~30 for Secchi depth) also indicate oligotrophy.

Comment No. 3 (part 3)

Recognition and discussion of the dystrophic character of the lakes should have been included in the water-quality section. The amount of colour and DOC within a water body can profoundly affect aquatic ecosystems and should at least have been mentioned.

Response

The dystrophic character of Kennady Lake was not discussed in the existing environment section of the EIS. Dystrophic lakes are characterized by low nitrogen and phosphorus concentrations, but moderate to high coloured humic organic content (Thienemann 1925, cited in Kalff 2002) and typically associated with bog or 'brown-water' lakes (Wetzel 2001). On the basis of nutrient and chlorophyll data, Kennady Lake can be considered oligotrophic; however, as the reviewer correctly points out, the amount of colour and DOC within a water body can profoundly affect aquatic ecosystems, through more pronounced light attenuation and enhanced respiration associated with dissolved organic matter within the water column. Dystrophic lakes can also possess a substantial underlying lower trophic productivity than indicated by typical trophic state indicators (e.g., TP, Chl *a* and Secchi depth).

Colour data are presented in Table I4.1-1 (Annex I) and Table 8.3-21 (Section 8.3.6.2.1); however, data are limited (n = 25) and it is unknown if the data reflect true or apparent colour measurements. The range of colour values reported is below detection (<1 TCU) to 30 TCU, with a median value of 10 TCU. Supplemental information is required to determine the extent of any seasonality to the colour regime (e.g., reduction in colour following the ice-cover and freshet inflows); this parameter will be included in on-going baseline programs.

Comment No. 3 (part 4)

The use of Piper Plots would have been useful in visualizing and comparing the water quality of the lakes found within the study area. The plots would have allowed for an improved understanding of the differences in water chemistry amongst the various lakes and streams within the study area. They would also have provided a simple, graphical understanding of any expected effects of the project on water quality.

Response

Consideration of the use of piper plots is a good suggestion to determine whether any differences in ionic proportion are present within the lakes surveyed in the baseline programs. Specifically, they may be developed for use in presentations as part of the regulatory process and in future baseline updates. It is noted, however, that these plots are typically limited to the presentation of major ion data.

Comment No. 3 (part 5)

There is a complete lack of data on water transparency. Either Secchi-disc depth measurements should have been collected, or a light probe should have been used to calculate extinction coefficients. In addition, turbidity data (expressed as NTU) should have been collected, and should be collected by De Beers moving forward. Considering that sediment resuspension is potentially a major effect of the project on water quality, water transparency is a characteristic of Kennady Lake and Lake N11 that requires competent understanding. Monitoring water transparency of downstream lakes would also be useful. Understanding light penetration is particularly important given the remarkably low productivity and TSS within the oligotrophic lakes found in the study area. It is likely that the biological communities within the study area would be extremely sensitive to alterations in water clarity associated with changes in the level of TSS.

Response

Secchi depth data exist for lakes within the Kennady Lake watershed, and adjacent and downstream watersheds. These data are presented and discussed within the context of the limnological characterization of fisheries habitat, and not within the water quality baseline reporting. Annex J (Fisheries and Aquatic Resources Baseline) and Addendum JJ (Additional Fish and Aquatic Resources Baseline Information) provide a summary of Secchi depth data that encompasses the historic data period (1996 to 2003) and baseline survey periods (2004, 2005 and 2010).

In general, Secchi depth measurements ranged from greater than 5 m to less than 9 m in the deeper basins of lakes within the Kennady Lake watershed (Section J.4.2 of Annex J and Section JJ.4.2 of Addendum JJ). These deep Secchi depths indicate high water transparency (good clarity), low suspended solids concentrations and turbidity, and low suspended algal (phytoplankton) biomass in the water column. Secchi depths were slightly lower in shallower basins or lake areas, which may reflect higher productivity or increased turbidity as a result of the stronger influence of wave action, compared to deeper basins.

Turbidity and total suspended solids (TSS) data are also available for lakes within the Kennady Lake watershed, and adjacent and downstream watersheds. The majority of the turbidity data is laboratory-derived (i.e., minimal field-measured turbidity data were recorded), and summary data are presented in the water quality baseline reports (Annex I and Addendum II; Tables I4.1-1 (Kennady Lake), I4.1-4 (lakes within the Kennady Lake watershed), I4.1-6 (lakes downstream of Kennady Lake upstream of Lake 410), I4.1-8 (lakes in the N watershed), I4.1-11 (Lake 410), I4.1-12 (Kirk Lake), I4.2-1 (lakes in the Upper Lockhart River watershed), I4.2-3 (lakes in the Lower Lockhart River watershed), II.4-1 (lakes in the Kennady Lake watershed), II.4-2 (lakes downstream of the Kennady Lake watershed and in the N watershed).

Supplemental baseline monitoring of TSS and turbidity during the freshet at selected lakes within the Kennady lake watershed was completed in 2011.

Measurement of light attenuation profiles is a good suggestion, but considering that the lakes have a high degree of clarity, it is considered sufficient to maintain the Secchi disc, turbidity and TSS measurements to characterize water clarity.

Comment No. 4 (part 1)

Table 8.3-22: "Sediment Quality Summary for Kennady Lake, 1995 to 2010" (p. 8-79), and "Sediment Quality Summaries for Downstream Lakes" (s.9.3.3)

It appears from the data that the only sediments that were sampled were coarse sediments consisting primarily of sand. For Section 8, this is a major data gap in the description of the existing environment, because the deeper areas (>4m) of over half of Kennady Lake (~420 ha) contain a fine flocculent sediment (p. 8-109). The section on Sediment Quality (p. 8-79), therefore, contains no information on flocculent-sediment chemistry, or any estimate of the amount of flocculent sediment within the lake. These data are of critical importance because it will be the flocculent sediment that is mobilized into the water column when dewatering commences. It would be useful if older reports were examined for sediment chemistry and sediment core data. If found, the data could be usefully included within the appropriate sections.

Response

Baseline sediment quality was characterized from samples collected in lakes within the Kennady Lake watershed, the N watershed, and Lake 410 and Kirk Lake by AMEC (2004 and 2005) and Golder (2010 and 2011). Sediment samples for the baseline reports were collected using an Eckman grab. Baseline sediment data for lakes in various locations within the upper and lower Lockhart River watershed were obtained from the Department of Indian and Northern Affairs Canada (INAC), representing 1993 and 1994 (Puznicki 1996, 1997), and 1999 (Blais 2005, pers. comm.). The sediment data characterized in the water quality baseline annex (Annex I) and addendum (Addendum II) comprised composited surface sediment layer Eckman grab samples from each sampling location.

The surface sediments of Kennady Lake within the deeper regions are described as being predominantly a veneer *gyttja,* characteristic of high-latitude soft-water systems, underlain by clay-rich post-glacial sediments (EBA 2000). These systems are associated with extremely low sediment accumulation rates; Canamera (1996) indicated that organic sediment layer thicknesses in Kennady Lake do not exceed one metre before undergoing transition to post-glacial clays. As a low net sedimentation rate is assumed (i.e., on the order of only 0.1 mm per year), grab samples that typically extract up to approximately 15 cm of sediment used in the baseline studies should represent more than 100 years of sediment accumulation; therefore, the results of the sediment analyses should sufficiently characterize the baseline surface sediment quality. It is noted that for much of the shallow substrate to within 4 m depth is coarse and has limited sediment; it typically is cobble dominated.

The aquatic habitat in Kennady Lake was classified by substrate, depth, and gradient characteristics (Section J3.2.2.2 of Annex J). The characterization of the aquatic habitat in the deeper offshore habitat (i.e., greater than 4 m) (Section 8.3.8.2.1 of the EIS, Section J.4.1.1 of Annex J) described the substrate as consisting of a uniform layer of loose, thick organic material and fine sediment. As per Table J.3.2-1 of Annex J, the category for fines/organics consisted of substrates predominantly composed of fines, organics or sand. It is suggested that this characterization is consistent with the laboratory characterization of approximately 70% sand and 25% silt.

As per the reviewer’s comments, supplemental sediment data exist for Kennady Lake that were not included in the baseline reporting; these are provided in Canamera (1996) and EBA (2000). Their sediment data obtained from core sampling programs, includes carbon (total and total organic carbon), grain size distribution, and trace metals concentrations. Canamera (1996) also reports sediment nitrogen and phosphorus concentrations. An outline of their findings related to sediment particle size distribution is provided below.

Canamera (1996) characterized baseline sediment conditions from sediment samples collected in the north and south basins of Kennady Lake at sampling stations established for the water monitoring program and three additional locations. A depression corer was used to collect samples in July and August 1996, due to its capacity to collect long sediment cores, which would include the organic sediment layer and lacustrine sediments; sediment thicknesses ranged from 0.25 to 0.88 m and consistently included the base (postglacial) clay. Each sediment core was sectioned and analyzed for the listed parameters to determine trends with sediment depth. Only select samples (composites) were analyzed for particle size distribution.

EBA (2000) obtained sediment core samples from sites at various depths in each of the three main basins of Kennady Lake (i.e., Areas 3, 6, and 8), and Lake N16, to characterize the sediment quality. The cores were collected using a modified KB core sampler, with acrylic core tubes. Sediment cores (typically 30 cm or more in length) were sectioned in the field at 1 cm intervals (typically through the interval 0 to 10 cm depth of the core), or at 5 cm intervals (to the maximum penetration depth of the core) to provide information on recent and historic trends in sediment quality.

In Canamera (1996), sediments from Kennady Lake were considered to be dominated by silt (26.8% to 65% by weight) and clay (21.7 to 72.7%) fractions (i.e., grey clay), with relatively little sand present (0.5 to 12.5%). In contrast, EBA (2000) results indicated that, in general, the sediments contained greater than 50% sand-sized particles, with lesser amounts of silt (25-30%) and clay (<13%), which is consistent with the sediment data reported in the baseline studies (Annex I; Table 14.1-2). Some differences were noted between shallow and deeper basins, with the shallow stations possessing more sand and less clay than sediment from deeper stations, as would be expected for a site more exposed to water movements arising from wind and wave action. Although differences in apparent grain size reported between Canamera and EBA were considered to be a consequence of local site-specific conditions or by differences in laboratory procedures (see below), they were more likely to be due to the influence of the deeper basal glacial clay material as a consequence of the longer length of cores. The EBA cores, on the other hand, and the grab samples collected for the baseline characterization studies, are representative of surficial sediment samples; samples for the baseline reports were collected with an Eckman grab which will penetrate to a maximum of 15 cm into the surface sediment layers.

Comment No. 4 (part 2)

There has also been no modeling of sediment resuspension dynamics, so that there is currently no understanding of the conditions under which sediments will be re-suspended, or any estimates of the amount of sediment that will be re-suspended. A clear statement regarding the minimal elevation of Areas 3 and 5 would be useful. There is a suggestion in Appendix 8.1 that the WMP would be drawn down to a minimum of 417 masl (Appendix 8.1, Section 8.1.4.1.1). What this means for sediment resuspension in the WMP should be clearly stated. This information is of critical importance in developing a comprehensive understanding of the environmental effects associated with dewatering Kennady Lake.

Response

No modelling of suspended sediment dynamics has been considered because during the dewatering and refilling of the Kennady Lake, Areas 2 to 7 will be within a controlled area; water within the controlled area boundary will be isolated from the remainder of the Kennady Lake watershed and managed. The Water Management Plan (see Section 3.9 of the EIS) consists of processes and mitigation that will reduce the potential for sediment resuspension and erosion concerns. These measures include isolating Kennady Lake (Areas 2 to 7), controlling water levels during dewatering to facilitate clean water discharge, utilizing water treatment as required (e.g., flocculation) to reduce TSS potential in the WMP during operations, and not reconnecting the refilled Kennady Lake to Area 8 until water quality criteria are met. Mitigation, such as flocculation, will be used to manage elevated turbidity in water to be pumped to the WMP from areas within Kennady Lake that are being drained (e.g., Areas 6 and 7).

Comment No. 4 (part 3)

There are four reasons why an understanding of the chemistry and resuspension of flocculent sediments is required. First, the sediment appears to be toxic (8.3.7.2.3), such that resuspension may result in toxic effects from metals or other constituents of the sediment on fish. This determination of toxicity is uncertain, however, because there is no indication what type of sediment was tested. Second, the sediment itself will likely cause mortality. This is because Kennady Lake and surrounding lakes naturally contain very low concentrations of TSS (p. 8-75), and fish species that are naturally sensitive to TSS (particularly salmonids and sculpin) are present. Kennady Lake and the downstream ecosystems are therefore extremely sensitive to increases in turbidity caused by TSS. Any increase in TSS will therefore likely result in some extent of fish mortality. Third, once the sediment settles again, it will result in habitat loss downstream, particularly for sensitive species such as Slimy Sculpin. These small, generally stream-dwelling fish, are an important component of the food web, and are extremely sensitive to environmental degradation in part because of their very small home ranges (i.e., do not move far away from localized stress). Finally, potentially major resuspension of sediment may result in a significant release of nitrogen and phosphorus into the water column, such that algal productivity may increase dramatically, contributing to other adverse effects on aquatic biota or habitats.

To address this data gap, it is recommended that:

- Samples of deep, fine textured sediment should be collected throughout Kennady Lake for determination of sediment chemistry. If these samples have already been collected and analyzed, then the data should be included in the report in a separate table, identified as such, and their significance to potential downstream effects should be stated.

Response

On-going baseline work has increased the extent and number of sampling areas for sediment characterization within Kennady Lake. These supplemental sampling locations include shallow and deep habitat zones.

We agree with the reviewer that it is important to understand the texture and elemental composition of sediment to determine the potential impacts of disturbance due to dewatering and refilling Kennady Lake. The lake system within the Kennady Lake watershed is characterized as a low depositional environment, and in the deeper depositional zones, an organic sediment layer of approximately 1 m overlies a glacial clay layer and bedrock. As described above (response Comment No. 4 [part 1]), reference data from the baseline studies (Annex J and Addendum JJ) and supplemental data from Canamera (1996) and EBA (2000) suggest that the organic layer comprises approximately 60 to 70% sand-sized material, and approximately 20 to 30% silt-sized material; it is considered that these data, and ongoing baseline monitoring data will be used to describe the physical and chemical characteristics of the sediment within Kennady Lake.

Comment No. 4 (part 4)

- Estimates of the volume of flocculent sediment should be developed through collection of sediment cores within the basins of Kennady Lake. Again, if these samples have already been collected and analyzed, then the data should be included in the report in a separate table, identified as such.

Response

As stated above, core data collected and reported by Canamera (1996) and EBA (2000) are available; this data will be included in updates to the baseline sediment quality characterization, as appropriate. Planned on-going baseline and monitoring data will be used to continue to describe the physical and chemical characteristics of the sediment within Kennady Lake.

Comment No. 4 (part 5)

- A sediment-resuspension model should be developed so that there is some understanding of environmental conditions that will cause the resuspension of sediment, and some understanding of the amount of sediment that will be re-suspended (see p. 8.1-28).

Response

As indicated above (response Comment No. 4 [part 2]), there is no current need for the development of a sediment-resuspension model as suggested.

Comment No. 4 (part 6)

- Acceptable TSS criteria should be developed for determining when it would be allowable to release water into downstream habitat. These criteria should be developed before lake dewatering commences.

Response

- It is expected that criteria for TSS will be developed as part of the on-going environmental impact review and permitting (i.e., water licensing) process, well in advance the lake dewatering.

Comment No. 4 (part 7)

Failure to address this key data gap will result in a significant gap in the Section 8 effects analysis. It would also be of interest to characterize the deep sediments of lakes downstream (i.e., Section 9), though this information is not as critical because sediment resuspension is not expected to be a significant problem downstream of the project (though resuspension may also occur at EOP in Lake N11 and Area 8).

The reviewer stated that it appeared that the proponent has considered and dismissed the likelihood of sediment resuspension in Kennady Lake (Appendix 8.1) though a thorough rationale and discussion would be helpful. Currently, it is difficult to determine exactly what the risk and prevalence of sediment resuspension might be within the context of project construction and operations.

Response

The Water Management Plan (see Section 3.9 of the EIS) has been developed to reduce the potential for suspended sediment effects to lakes receiving discharge from the dewatering of Kennady Lake, and through the refilling of Kennady Lake at closure. During the construction, operations, and refilling phases, Kennady Lake water inflows and outflows (Areas 2 to 7) will be controlled. Water management for the controlled area is summarized below.

The objective of the dewatering program prior to operations will be to drain Areas 2 to 7 of Kennady Lake to at least 50% of capacity by initial discharge of clean water to designated receiving points. It is anticipated that more than half the water in Kennady Lake (about 17 Mm^3) will meet discharge water quality criteria (e.g., turbidity) and be pumped out the Lake N11 and Area 8 (water from Areas 6 and 7 will be pumped out to Area 8). Previous experience at Diavik Diamond Mine and Ekati Diamond Mine has shown that water from the upper portion of the lake will meet regulatory requirements for the total suspended solids (TSS) concentration in the discharged water.

Dewatering will occur in a two-phase approach:

- During the first phase of dewatering, the surface water would be pumped via pipeline at the maximum rates simultaneously to Area 8 of Kennady Lake, which is the natural outlet for Kennady Lake; and Lake N11 in the N watershed (see Figure 3.9-1, Section 3.9 – Water Management, Project Description). The projected maximum water flow to Area 8 and Lake N11 will be restricted to one-in-two year flood levels, except at outlets where there is sufficient protection, and account natural discharge levels in any given year. This process will limit the potential for erosion concerns and associated effects on fisheries. Additionally, the potential for erosion of lake-bottom sediments in Area 8 and Lake N11 will be reduced during dewatering pumping with the use of diffusers on the discharge pipe outlets, which will be located in deep regions of Area 8 and Lake N11 and placed close to the lake surface at the discharge points to increase the distance between the outfall and the bottom sediments. Although some sediment may be mobilized despite these measures, the extent of any effect is expected to be limited with proposed mitigation strategies.

The dewatering of Kennady Lake will continue from Area 7 to Area 8 and from Area 6 into the water management pond (WMP, i.e., Areas 3 and 5) and then into Lake N11 until TSS in the Kennady Lake water increases to a level that no longer meets the regulatory requirement for the discharge quality. As water levels decrease, sediment from the lake bottom may become suspended in the water. Once a threshold TSS concentration is reached, discharge from Area 7 to Area 8 will no longer be possible. After this initial dewatering, Areas 6 and 7 will be isolated and drained completely into Areas 2 to 5.

- During the second phase, the excess capacity of the WMP (i.e., 422.5 masl *c.f.* 420.7 masl under baseline conditions) will be used to settle and/or store water unsuitable for release directly to the natural watershed. Flocculant may be added as required to reduce occurrences of elevated TSS concentrations. More specifically, the water transferred to the south end of the WMP (i.e., Area 5) from Areas 6 and 7 will have in-line flocculation to promote settling of suspended solids in Area 5 that will eventually be covered by the West Mine Rock Pile. In-line flocculation is expected to allow for continued discharge of water from Area 2 to the environment. It is expected that water from Area 2 will contain sufficiently low levels of TSS that pumping to Lake N11 can continue until the area above the 5034 and Hearne ore bodies in Area 6 and 7 is dry and available for mining.

  Sediment from the lake bottom can also become suspended due to wave action on the exposed shorelines as the water level in Kennady Lake is lowered. Areas 2, 3, and 5 will be dewatered to the maximum extent possible; however, for planning purposes, it is estimated that, at a minimum, a 2 m drawdown can be achieved before suspension of lake-bottom sediments would result in TSS levels in Areas 2, 3, and 5 that are too high to discharge to Lake N11. If possible, the water level will be drawn down further.

Fifty percent capacity in Kennady Lake represents a 3 m reduction in water level (i.e., 417.5 masl) from the baseline water level for Kennady Lake; as a consequence, the substrate likely to be exposed during this drawdown will typically comprise predominantly coarser grained material. It is expected that areas that possess a higher proportion of fine grained material will not be exposed during dewatering, with the exception of those areas that will be drained to allow for pit development. As necessary, water will be treated in-line as it is pumped to the WMP for flocculation and settling in the WMP. Should TSS levels within Kennady Lake reach levels assigned as discharge water quality criteria, dewatering will cease.

During operations, water that may come in contact with the disturbed area of the Project site will be isolated by diverting inflows and damming outflows to create a controlled system that is isolated from the surrounding watersheds (with the exception of licensed discharges) (see the Water Management Plan, Section 3.9). Discharges from the WMP to Lake N11 will only be completed if discharge water quality criteria are met.

At closure, in-lake dykes will be breached to the elevation 417 masl to allow flooding of the Tuzo Pit area. This activity will lower each of these dyke structures to a level below the expected restored lake level (420.7 masl). The major reason for limiting the drawdown water levels to 417.0 masl in the Water Management Plan is to reduce the risk of disturbing a large proportion of the lakebed and thereby increasing turbidity in the lake water during mine closure. At the same time, temporary upstream watershed diversion dykes will be breached and removed to allow the upper watersheds to resume their flow into Kennady Lake. Natural runoff from these upper watersheds and supplemental pumping from Lake N11 will be used to refill Kennady Lake.

During the construction and operations, and closure phases (including dewatering and refilling activities), observations along exposed shoreline of Kennady Lake will be conducted to monitor the effects of dewatering and spring thaw runoff.

On-going baseline work includes further sediment characterization for substrates in Kennady Lake, as well as lakes within the Kennady Lake watershed and adjacent lakes. When the aquatic effects monitoring program is developed for the water license, TSS concentrations in the Area 8 and Lake N11 during dewatering and pumped discharge events will be targeted, as well as TSS concentrations in the WMP.

Comment No. 5

Section 8.3.7.2.1 (p. 8.89) and Section 9.3.4 (p. 9-70): "Plankton Communities"

Plankton samples were collected in 2004, 2005 and 2007, though the dates were variable for each lake. Apparently, however, both phytoplankton and zooplankton were sampled only once for each year in any given lake. This intensity of sampling is completely inadequate because of the short life cycle of plankton and the presence of multiple generations within any given year.

Failure to characterize shifts in community structure through a season results in a serious data gap that precludes understanding the effects of the project on plankton communities, or the effectiveness of remediation efforts at the end of the project. The plankton data would benefit considerably from weekly/biweekly sampling through at least one ice-free season. This would allow for the understanding of:

- Seasonal plankton community dynamics, including any bloom formation
- Annual productivity estimates
- Increased understanding of Trophic Status

It is expected that activities associated with the Water Management Plan will potentially result in substantial alteration of the nutrient and trophic status of Kennady Lake and surrounding lakes. This, in turn, may profoundly alter plankton community dynamics. Currently, however, there is simply not enough baseline data to determine if/when these alterations might occur. This data gap is important, because the plankton are the base of the food chain, and if the planktonic communities are altered, the fish community may be as well, potentially able to cause other impacts.

Response

The objective of the plankton baseline surveys was to collect representative data from lakes in the area of the Project. Combined with baseline water quality data, the plankton baseline data indicate that surface waters in the Project area have low nutrient concentrations and plankton biomass, and are classified as oligotrophic.

Water quality predictions indicate that the key effect of the Project will be nutrient (P and N) enrichment caused by contact of surface waters with processed kimberlite and explosives residues. The effects of nutrient enrichment on lake productivity and plankton communities have been extensively studied, as reviewed in the EIS. In addition, similar effects are being documented in unproductive tundra lakes affected by diamond mine discharges at three operating diamond mines in the Northwest Territories (i.e., Ekati, Diavik, and Snap Lake mines). Hence, understanding the Project effects on plankton communities is unlikely to be limited by the available baseline data. In addition, timing of effects will be related to the timing of nutrient inputs rather than the availability of baseline data.

As the reviewer points out, understanding the effectiveness of remediation efforts at the end of the Project requires baseline data; however, reference lake data collected at the time of mine closure and during an appropriately designed Aquatic Effects Monitoring Program (AEMP) are also useful to achieve this if baseline data are limited. In addition, De Beers is committed to developing an AEMP that will employ a sampling design appropriate to evaluate effects based on the mine plan, using currently accepted statistical design principles (e.g., based on those used in Environmental Effects Monitoring). Baseline aquatic surveys are continuing and provide the opportunity to collect additional pre-development data for use in designing the AEMP and in future comparisons with monitoring data.

Comment No. 6

Section 8.3.7.2.2 (p. 8-97) and Section 9.3.4.2.2 (p. 9-75): "Benthic Invertebrate Community"

The methods and the monitoring design used to collect benthic invertebrate samples within Kennady Lake are deficient. Due to these deficiencies, the data do not provide an adequate understanding of the baseline benthic invertebrate community within Kennady Lake, and cannot be used for effects assessment or determination of the effectiveness of remediation. This is a major data gap in the analysis of the existing environment.

The methods and the monitoring design used to collect benthic invertebrate samples downstream of Kennady Lake are also likely deficient, though for these data it is hard to tell because there are almost no details of the sample-collection methods provided. It is unlikely, therefore, that the data provide an adequate understanding of the baseline benthic invertebrate community downstream of Kennady Lake, and it is unlikely the data can be used for effects assessment or determination of the effectiveness of remediation. This is a major data gap in the analysis of the existing environment.

When sampling benthic invertebrates, it is critically important that sampling methods are entirely consistent throughout the surveillance period. The reason is that benthic invertebrate communities are highly variable, both spatially and temporally, and unless these two factors are addressed in experimental design, there is little likelihood that the resultant information would be useful. Unfortunately, the use of consistent sampling protocols has not occurred within this project.

Inconsistencies between sampling events include differences in:

- Sampling locations (including depth)
- Mesh sizes
- Taxonomic effort
- Sampling dates

The lack of rigour in the sampling and analytical methods has seriously compromised the data, and currently precludes their use in temporal or spatial comparison. Moving forward, the following are required:

- Use GPS to locate sample sites and to return to the same location for each sampling event

- Characterize each sample site for depth, sediment particle size, sediment organic carbon, and sediment chemistry (*c.f.* Environment Canada 2002)
- Locate multiple, comparable, sample sites for each habitat type
- Use the same number of site replicates
- Use the same equipment for every sampling event, particularly the mesh size
- Use an accredited benthic invertebrate taxonomist (preferably the same one every time)
- Follow the methods found in Section 5 of the metal mines Environmental Effects Monitoring (EEM) Program guidance document (Environment Canada, 2002) with improvements (Huebert et al. 2011), and analyze for the following parameters:
  - Invertebrate density
  - Invertebrate richness
  - Diversity and Evenness
  - Bray Curtis Index
  - EPT Index

It is also inexplicable that apparently no benthic invertebrate samples were taken in the streams within the Kennady Lake study area, though there is a data set from downstream habitats (p. 9-79). Riffle-stream habitat is productive habitat of considerable importance in the spawning and rearing of a variety of indigenous fish species. There should be a series of sample sites established in the area streams for both monitoring of fish and benthic invertebrates. Lack of this information again reduces the rigour of the subsequent effects analysis. A monitoring program should be established that follows one of the following well-established guidance documents;

- Rapid bio-assessment of wadeable streams, as outlined in Barbour et al. (1999). This is a performance-based evaluation that has been used extensively in the United States, and occasionally in Canada.
- The metal mines EEM protocol as outlined by Environment Canada (2002). This is an effects-based evaluation required for all operating metal mines in Canada, which provides an excellent benchmark for sample design.
- The Canadian Aquatic Biomonitoring Network (CABIN) protocol as outlined at *http://www.ec.gc.ca/rcba-cabin/default.asp?lang=En&n=72AD8D96-1*. This is a qualitative approach to monitoring benthic invertebrates that is increasingly being used across Canada to develop regional reference data.

There can be no justification for not using one of the well-established and comprehensive guidance documents now available for monitoring benthic invertebrates in aquatic environments. Use of these documents will produce a dataset comparable over time and will allow for the development of a comprehensive understanding of the study area reference condition. The EEM, in particular, has become a standard for environmental monitoring in the Canadian pulp and paper industry and the metal mining industry, and will soon be mandated for wastewater systems in many parts of Canada. Though there are recognized methodological problems with the EEM (e.g., Huebert *et al.* 2011), it is still an excellent benchmark for designing monitoring programs.

Response

Baseline programs in the Project area were done at different times by different companies, and were designed in response to evolving mine plans (sample collection methods are provided in Annex J and Addendum JJ). This has resulted in a baseline data set that is not internally consistent in terms of methods and spatial coverage, which is typical of mining developments in general. However, as indicated in the response to Comment No. 5, the effects of nutrient enrichment on aquatic communities are well understood and ongoing monitoring of unproductive tundra lakes at operating diamond mines in the NWT continue to provide valuable information on the biological effects of nutrient enrichment. Hence, baseline data availability is not an issue regarding the prediction of effects due to nutrient enrichment.

As the reviewer points out, baseline data availability can be a potential issue regarding assessment of the effectiveness of remediation. To address this, De Beers is committed to developing an Aquatic Effects Monitoring Program that will employ a sampling design appropriate to evaluate effects based on the mine plan, using currently accepted sampling methods and statistical design principles (e.g., based on those used in Environmental Effects Monitoring). To this end, baseline aquatic surveys are continuing and provide the opportunity to collect additional pre-development data for use in designing the AEMP and in future comparisons with monitoring data. In 2011, additional benthic invertebrate data are being collected at nine lakes during the open water season.

Comment No. 7 (part 1)

Section 8.3.8.2.2 (p. 8-115) and Section 9.3.5.2.2 (p. 9-96): "Large-bodied Fish Community"

This section contains information of central importance to the effects assessment, is well organized, and well written. There are a few sections that are out of place, but not enough to confuse the reader. The various tables summarizing fish habitat quality are substantive and provide useful information. Examination of spawning activity and stream habitat utilization is of importance and is well presented.

One piece of information that is missing, however, is a species list for Kennady Lake, and a species list and life-history table for the larger study area. It would be useful to include this within the opening paragraphs of both Section 8 and 9 (e.g., Table 9.3-44). Cross-referencing with other pertinent sections would also be helpful. It is inexplicable, as well, that neither the aquatic habitat (Table 9.3-28) nor the fish community (Section 9.3.5.2.2) in Lake N11 has been described. Lake N11 is apparently the primary receptor of water from Lake Kennady during the dewatering phase, and will also receive water from Area 3 and 5 during operations. Considering that the water from the project site will likely contain suspended sediments, groundwater, nutrients, and/or water from acidic drainage, this is a significant omission.

Response

The fish species of Kennady Lake is described in Section 8.3.8.2.2. A list of fish species in Kennady Lake and other large lakes (i.e., Lake N16, Lake 410, and Kirk Lake) is in Table 10.3.5. Additional information on fish species in Kennady Lake and other waterbodies sampled in the study area is provided in Annex J and Addendum JJ.

Lake N11 was not initially selected for sampling as previous alternatives of the mine plan did not affect this lake. However, with the change in project design, with water being pumped to Lake N11, it is recognized that fish and fish habitat baseline data will need to be collected. As a result, a fish and fish habitat baseline sampling program is being conducted on Lake N11 during the summer of 2011, including fish habitat, fish inventory, and lower trophic level sampling.

Comment No. 7 (part 2)

Table 8.3-30: "Mean Length, Weight, and Condition Factor for Fish Captured in Standardized Experimental Gill-Nets in Kennady Lake."

- Condition factor is apparently calculated incorrectly. It should be calculated as follows:

  Condition Factor (k) = 10_n(weight,g)/(fork length, mm)$_3$, where 10_n = a correction factor to bring the value close to unity. The formula in the footnote omits the cube function.

- Calculation of a Condition Factor is, however, not the best use of the existing fish data. It is preferable to graph individual variables (e.g., Length and Weight) rather than calculate ratios, because ratios assume a relationship between variables that may not exist, and because they have unusual and undesirable statistical properties (Environment Canada 2002). The Condition Factor is also species and site specific. Graphing length against weight, in contrast, allows eventual development of Standard Weight estimates (e.g., Bister *et al.* 2000), and comparison of fish condition within a species from different locations, and even between species.

Response

The Condition Factor was calculated correctly, using the following formula:

$$K = [\text{weight (g)} \times 10^5] / \text{fork length}^3 \text{ (mm)}$$

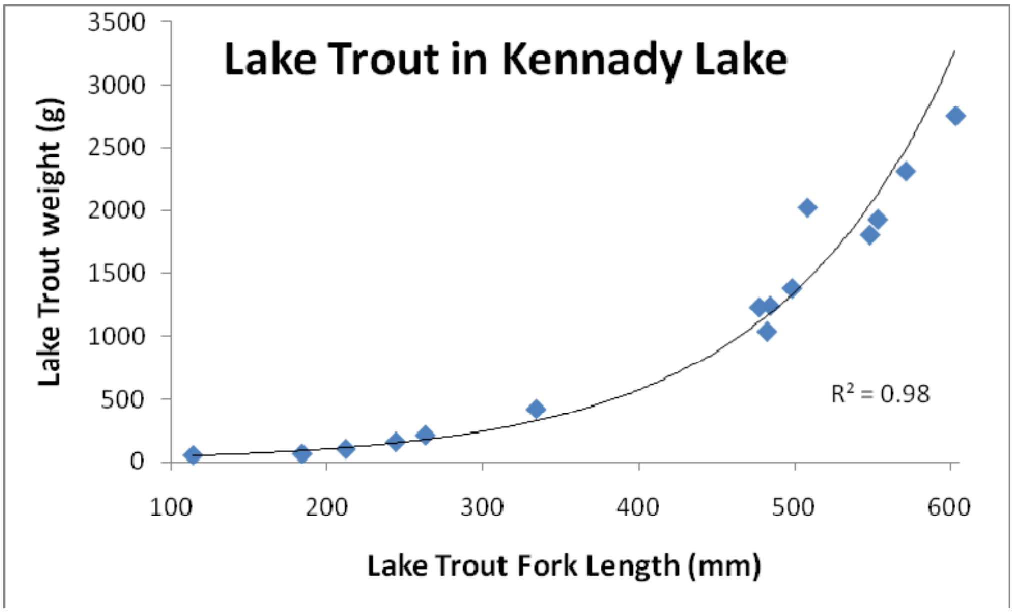
The generic definition of condition factor provided in the footnote in Section 8.3.8.2.2 does not explicitly state the formula used in the calculation.

Although not presented graphically, length-weight relationships for several fish species captured in Kennady Lake, Lake 401 and Lake N16 are provided in Annex J (Appendix J.I, Table J.I-82).

Comment No. 7 (part 3)

To optimize the existing data, it is recommended that:

- Length/weight relationship graphs should be developed for all species for which there are data.
- The graphs should be continually updated as fish are captured. The fish-salvage project is an excellent opportunity to develop a strong database of length/weight information.
- The length/weight database should be used to determine fish-species condition during the remediation phase of the project, and should be considered a key performance indicator (once fish have been re-introduced) during the remediation process (see Figure 4-1 below prepared by Stantec from the data in the EIS).



Response

As the project moves from baseline data collection towards monitoring, the above mentioned points will be considered during program design.

Comment No. 7 (part 4)

Fish Condition Factor data are completely missing from Section 9, though the data required for developing an understanding of fish condition have obviously been collected and have been summarized in Tables 9.3-33 and 9.3-34. It would be useful if length/weight relationships were developed from these data, as described for Section 8 above.

Response

Although not presented in the summary, Condition Factor was also calculated for downstream watershed (see Annex J). Length-weight relationships for fish species captured in Lake 401 and Lake N16 are provided in Appendix J.I, Table J.I-82.

Comment No. 8

P. 8-118

Lake trout is not the 'top predator' in Kennady Lake or in downstream lakes. In fact, there are three apex predators found in the area, and they include Lake Trout, Northern Pike and Burbot. Though Lake Trout is apparently the dominant species, the existence of the other two apex predators cannot be discounted in the effects assessment.

Response

In Kennady Lake, lake trout were referred to as the "top predator", as they are the most abundant of the predatory species. As indicated in Section J4.3.3.1 of Annex J, lake trout were consistently the second most abundant species (after round whitefish) in summer gillnetting surveys, comprising approximately 20% of the large-bodied fish community in Kennady Lake each year. In Kennady Lake, the population of northern pike and burbot are small (i.e., less than 2%). However, it is recognized that both species are important predators within the lake and the area, and were not discounted in the effects assessment.

Comment No. 9

Despite the apparent use of short net sets, the long-term use of gill nets is of concern. The reviewer suggested that it may be beneficial to develop a monitoring program using electro-fishing and non-destructive sampling methods, especially for determining the presence or absence of non-pelagic species, and those with short home ranges. Slimy Sculpin were identified as an excellent sentinel species and could be adopted for such a program (Tetr*ES* Consultants 2009).

Response

As described in Annex J, gillnetting surveys were used to describe the large-bodied fish communities in lakes. For the most part, short sets were used to minimize mortalities. Other lake sampling methods included shoreline electrofishing and minnow trapping, as well as angling in some cases. However, for lake sampling, the large-bodied fish community was characterized primarily through the gill net surveys.

When the monitoring program is developed, the appropriate methods for continued sampling will be developed, which will likely include a combination of sampling methods. The use of a sentinel species will also be discussed, taking into account locations and abundance of fish species in representative watersheds. A field program targeted the collection of slimy sculpin in 2007 for metals testing. The crew was unable to collect sufficient numbers of sculpin from lake sites, although they were able to supplement from downstream stream sites.

Comment No. 10

Section 8.5.2.2.3 (p. 8-181) and 9.5.1.4 (p. 9-131): "Fish Species Selected as Valued Components"

All fish species are valued components according to the federal *Fisheries Act*. Slimy Sculpin, for instance, is an excellent metal-sensitive sentinel species (Tetr*ES* Consultants 2009), widespread in its distribution and sensitive to alterations in water quality and habitat. Currently, there is a considerable amount of information regarding the biology of the species. It would be an outstanding monitoring tool for determining downstream effects using electrofishing and non-destructive sampling (eg. Spencer et al. 2008). Failure to monitor populations of Slimy Sculpin will reduce the reliability of the effects assessment, and will reduce the reliability of remediation monitoring.

Response

As described in Section 6.3.1 (Assessment Approach), valued components were selected to focus the EIS on the key issues and to represent physical, biological, cultural, social, and economic properties that society considers to be important. Valued components were not selected in order to be carried through as sentinel species to monitoring programs.

It is recognized that slimy sculpin could be useful as a sentinel species; however, although fairly widespread, they have been captured at low numbers at some sites. As a result, there may be challenges with the use of this fish species as the sentinel species. When the monitoring program is developed, the use of a sentinel species will be discussed, taking into account locations and abundance of fish species in representative watersheds.

Comment No. 11 (part 1)

Table 8.6-1 (p. 8-199) and Table 9.6-1 (p. 9-152) Potential Pathways for Effects to Water Quality and Fish in Kennady Lake and Downstream of Kennady Lake during Construction and Operations

These two tables are comprehensive and almost complete. It is recommended, however, that increased emphasis on sediment control should be added to Table 8.6-1, as follows:

- Effects Pathway: Erosion and entrainment of lake sediments in Area 3 and 5 due to continual alterations in water elevation may cause deleterious changes to water and sediment quality, and affect fish and fish habitat.
- Environmental Design Features and Mitigation: Release of water from the Water
  - Management Pond will not occur unless compliant with discharge criteria for turbidity and other identified water-quality parameters.

Response

The table does not explicitly state that sediment entrainment may occur within the WMP (i.e., Areas 3 and 5) during operations. However, although there may be sediment entrainment in the WMP during mine operations, the WMP is a closed system, i.e., it is part of the controlled area of the Project from a water management perspective, and would not be suitable for fish (as described on Page 8-209 of the EIS). As the WMP is within the controlled area, no water will be discharged to the environment unless it meets the discharge criteria specified in the water licence.

Comment No. 11 (part 2)

It is recommended that increased emphasis on water quality should be added to Table 9.6-1, as follows:

- Effects Pathway: Alteration of groundwater regime with pit development may change surface water levels and water quantity and quality in downstream lakes, and affect fish habitat.

Response

This is discussed in the secondary pathway: Alteration of the groundwater regime from groundwater flows to the mined out pits may change water quality and water quantity in other lakes in the watershed. As per page 8-226 of the EIS, altered groundwater flow directions and intercepts are anticipated in the Local Study Area (LSA) surrounding the pit development, but no measureable effects are expected in reducing lake volumes, and therefore water levels, in the small lakes within the Kennady Lake watershed. This would be expected to have a negligible residual effect on water quality and fish.

Comment No. 11 (part 3)

Project Component/Activity: Development of waste rock piles

- Effects Pathway: Development of acid rock drainage may change water quality (pH, metals) within Area 3 and 5 and affect downstream lakes and fish habitat.

Response

Acid rock drainage (ARD) is discussed under the no linkage pathway: Seepage and runoff from the mine rock piles, Coarse PK Pile, and Fine PKC Facility may change water quality in the Kennady Lake watershed, and affect aquatic health and fish. The mitigation is listed in Table 8.6-1: during reclamation, only non-reactive mine rock will be placed on the upper and outer surfaces of the mine rock pile. The thickness of the cover layer is predicted to be sufficient so that the active freeze-thaw layer remains within the non-acid generating (NAG) mine rock with the development of permafrost.

Due to this mitigation, seepage and runoff from the mine rock piles are not expected to result in changes to water quality in downstream waters in the Kennady Lake watershed. Consequently, this pathway was determined to have no linkage to effects to fish.

The geochemical characterization study of the mine rock from the Project site is summarized in the EIS (see Appendix 8.II, Section 8, and Section 3.7). The mine rock has a low sulphur content, with only 1.4% of the samples for the Acid/Base Accounting (ABA) having a total sulphur concentration greater than 0.3 percent by weight (wt%) (0.3 wt% is generally considered the minimum sulphur concentration for potential acid generation). One-hundred and sixteen of 1,274 samples (9.1%) have a Neutralization Potential/Acid Potential (NP/AP) ratio less than one, and are considered to be potentially acid generating (PAG). Therefore, the PAG rock comprises only a small proportion of the overall mine rock tonnage that will be sourced from the operation.

While permafrost will enhance the performance of the mine rock piles in terms of seepage control, other mitigation features are associated with the design of the mine rock piles with respect to PAG mine rock. These include:

- PAG mine rock will be placed below an elevation of 418.7 m in the basins of both the South and West Mine Rock Piles, 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 m is restored after final mine site closure;
- PAG mine rock will be placed in the mined-out 5034 and Hearne Pits, where the mine rock pile will be limited to a top elevation of 418.0 m and be completely submerged with a water cover of about 2.7 m after the final mine site closure; and
- In the case that a small portion of the PAG mine rock cannot be placed below the elevation of 418.7 m in the basins of both the South and West Mine Rock piles or in the mined-out 5034/Hearne Pits, the excess portion of PAG mine rock would be encapsulated in the interior portions of either the South or West Mine Rock piles. The PAG mine rock would be placed in an interior zone at least 20 m from the outer surfaces of the mine rock pile and the restored lake surfaces. The PAG mine rock within the mine rock piles will be enclosed with a minimum of 2 m thick till overburden fill to limit the potential for infiltration into, and through, the encapsulated PAG rock areas.

Comment No. 11 (part 4)

- Effects Pathway: Release of nitrogen and phosphorus may increase algal productivity within Areas 3 and 5 and affect downstream lakes and fish habitat.

Response

Similar to above for operations, this is included in the no linkage pathway: Seepage and runoff from the mine rock piles, Coarse PK Pile, and Fine PKC Facility may change water quality in the Kennady Lake watershed, and affect aquatic health and fish. During operations, seepage and runoff from these facilities will be managed within the WMP; as a result, no effects would occur downstream. At closure, this was considered a primary pathway and carried through into the assessment.

Comment No. 12 (part 1)

Table 8.6-3 (p. 8-230) and Table 9.6-3 (p. 9-160) Effects Statements for Water Quality and Fish during Construction and Operations

These two tables (in Section 8) are comprehensive and almost complete. It is recommended, however, that increased emphasis on dewatering should be added to Table 8.6-3, as follows:

- Effects pathway: Dewatering of Kennady Lake.
- Pathway: Dewatering of Areas 1, 2, 4, 6 and 7 will result in changes to shoreline erosion, resuspension of sediments, and direct loss of fish habitat in these areas and in downstream receiving environments.

Response

In Table 8.6-3, the pathway for Dewatering of Kennady Lake listed under Fish and Fish Habitat is: Dewatering of Kennady Lake and other small lakes may cause mortality and spoiling of fish, temporary loss in productive capacity, and the alteration of flows, water levels, and channel/bank stability in Area 8.

As Areas 2 through 7 are within the controlled area, any changes in shoreline erosion and/or sediment entrainment would not have any effects on fish and fish habitat during operations, including downstream environments. No water will be discharged to the environment unless it meets the discharge criteria specified in the water licence.

The loss of habitat was carried as a primary pathway into the Fish and Fish Habitat assessment, primarily under the Effects of Changes to Fish Habitat from Project Footprint pathway (Section 8.10.3.1). The temporary loss of habitat from dewatering was also discussed on Page 8-379.

Comment No. 12 (part 2)

- Effects Pathway: Water Management Pond (Areas 3 and 5):
- Pathway: Continual elevation changes and input of contaminated water into Areas 3 and 5, and output of water from Areas 3 and 5, will result in resuspension of sediment, shoreline erosion, and direct loss of fish habitat in these areas and in downstream receiving environments.

Response

As previously described, there were no linkages to fish and fish habitat from changes in water levels in the WMP during operations, other than the controlled discharges.

Comment No. 12 (part 3)

- Effects Pathway: Water Quality: This pathway requires a considerable expansion to be inclusive. Section 8.8 contains discussion of several pathways not listed in Table 8.6-3.

Response

It is recognized that there are a few pathways that are carried into the assessment that are not specifically included in Table 8.6-3. These include:

- Effect of Project footprint (dykes, mine pits, mine rock and Coarse PK piles, Fine PKC Facility, access roads, mine plant and airstrip) on Flows, Water Levels and Channel/Bank Stability in Streams and Smaller Lakes in the Kennady Lake Watershed
- Effects of Dewatering of Kennady Lake to Flows, Water Levels and Channel/Bank Stability in Area 8
- Effect of Watershed Diversion in Watersheds A, B, D and E on Flows, Water Levels and Channel/Bank Stability in Streams and Smaller Lakes in the Kennady Lake Watershed

Comment No. 12 (part 4 and part 5)

Additions are also required as follows:

- Pathway: Continual elevation changes and input of contaminated water into Areas 3 and 5, and output of water from Areas 3 and 5, will result in resuspension of sediment, shoreline erosion, and a potential reduction in water quality in both the upstream and downstream affected aquatic habitats.
- Pathway: Continual elevation changes and input of contaminated water into Areas 8, and output of water from Areas 8, will result in resuspension of sediment, shoreline erosion, and a potential reduction in water quality in both the upstream and downstream affected aquatic habitats.

Response

The water quality in the WMP was included in the Water Quality Model. However, during operations, the assessment focused on potential receiving environments (i.e., Area 8 and downstream environments in Chapter 9). As a result, changes in water levels and sediment entrainment would not affect water quality or fish habitat, except for licensed discharges. At closure, the main basins of Kennady Lake were included in the assessment.

Comment No. 12 (part 6)

The two tables (in Section 9) are comprehensive and almost complete. It is recommended, however, that increased emphasis on groundwater, nutrients and ARD should be added to Table 9.6-3, as follows;

- Project Activity: Development of mine pits:
- Pathway: groundwater removal from mine pits may change flows and water quality (salinity, hardness) in downstream waterbodies.

Response

This is discussed in the alteration of groundwater regime with pit development may change surface water levels and water quantity in downstream lakes, and affect fish habitat pathway (secondary pathway). As per Page

9-157 of the EIS, altered groundwater flows are anticipated in large lakes within the LSA surrounding the pit development in the Kennady Lake watershed, but measureable changes to water quantity and water levels in these lakes are expected to be minor. This would be expected to have a negligible residual effect on water quality and fish.

Comment No. 12 (part 7)

- Project Activity: Development of waste-rock piles:
- Pathway: development of ARD may change water quality (pH, metals) in downstream water bodies.

Response

Acid rock drainage (ARD) is included in Section 8 (Kennady Lake and watershed) under the pathway: Seepage and runoff from the mine rock piles, Coarse PK Pile, and Fine PKC Facility may change water quality in the Kennady Lake watershed, and affect aquatic health and fish. This was considered a no linkage pathway due to mitigation as listed in Table 8.6-1. As there would be no potential linkage to downstream effects, this pathway was not included in Section 9.

Comment No. 13 (part 1)

Table 8.7.1 (p. 8-249) and Table 9.7.1 (p. 9-167) Valid Pathways for Effects to Water Quantity in the Kennady Lake Watershed during Construction and Operation

The reviewer noted that the title wasn't changed in Section 9

Suggested alterations/additions include:

- Project Activity: Dewatering of Areas 1, 2, 4, 6 and 7 in Kennady Lake:
- Pathway: Dewatering of these areas will changes flows, water levels and channel bank stability in these areas, in upper watersheds, and in receiving environments.

Response

Section 9 only includes downstream environments (i.e., downstream of Area 8). The potential changes to flows and bank stability in the dewatered areas (and upper watershed, if it were to be potentially affected) is covered in Section 8. The receiving environments (i.e., downstream and N watershed) are covered under the *Effects of dewatering Kennady Lake to flows, water levels and channel/bank stability in downstream waters*, is covered in Section 9.

It is also acknowledged that 'dewatering of Kennady Lake' implies dewatering of Areas 2, 3 and 5, 4, 6, and 7 in Kennady Lake.

Additionally, as pointed out by the reviewer, the title of EIS Table 9.7-1 (and Table 9.7-2) should read "…in the lakes and streams downstream of the Kennady Lake Watershed…".

Comment No. 13 (part 2)

- Project Activity: Project development in the Kennady Lake watershed:
- Pathway: Groundwater seepage and removal of groundwater from pit areas may change flows, water levels, and channel/bank stability in streams and lakes in downstream watersheds.

Response

The alteration of groundwater regime with pit development was considered a secondary pathway and discussed on pages 9-156 and 9-157. As a result, this pathway was not carried into the hydrology assessment (Section 9.7).

Comment No. 14 (part 1)

Sections 8.8 and 9.8, Effects to Surface Water Quality, are not complete. Table 8.8-1(derived from Table 8.6-3) and Table 9.8-1

These sections do not adequately describe the range of potential effects discussed within the section, and omit at least one important project effect on water quality (sediment resuspension). Construction and operation activity must include effects of the Water Management Plan on water quality as follows:

- Pathway: Sediment resuspension and shoreline erosion caused by continual alterations in water elevation in Areas 3 and 5 and in Area 8 will result in the degradation of water quality within these areas and within downstream receiving environments.
- Effects Statement: Effects of turbidity, nutrient release, and release of Hg on water quality.

Response

This pathway was not included in the pathway analysis of the two key KLOIs (Sections 8.6 and 9.6); however, the modelling and water quality assessment indirectly included implications to water quality within Kennady Lake and the downstream and adjacent lakes. TSS levels were projected to remain within background levels; where required, turbidity and TSS concentrations within the WMP during the Project will be mitigated (i.e., through the use of flocculants).

It is important to note that during the construction, operations, and closure phases of the Project, Kennady Lake will be isolated from Area 8 and the N watershed (i.e., downstream and adjacent watersheds), with the exception that during the dewatering phase, water meeting discharge criteria will be pumped to Lake N11 and Area 8. During operations, water will be pumped to Lake N11, if water within the WMP meets discharge criteria.

Discussion of turbidity and the water management plan within Areas 3 and 5 (WMP) has been detailed above, and is presented in more detail in Section 3.9 (Water Management). Regarding nutrient and metals, water quality modelling (see Section 8.7 and Appendix 8.I) provided projections of nutrient and metals concentrations through each phase of the Project; however, the effects assessment focused primarily on the post-closure period, i.e., after Kennady Lake has been refilled and is reconnected with Area 8. These projections indicated that nutrients and metals would remain within concentrations that would allow water to be discharged to Lake N11 during operations.

Comment No. 14 (part 2)

- Pathway; Continual input of process water, acid rock drainage (ARD), and groundwater into Areas 3 and 5 will result in the degradation of water quality within these areas and within downstream receiving environments.
- Effects Statement; Effects of salinity, pH, hardness, metals on water quality.

Response

This pathway was incorporated into the following operation and closure pathways*:*

- Section 8 - seepage and runoff from the mine rock piles, Coarse PK Pile and the Fine PKC Facility, may change water quality in the Kennady Lake watershed, and affect aquatic health and fish (p 8-197) and seepage from the mine rock and coarse PK piles may change water quality, and affect aquatic health and fish (p 8-234); and
- Section 9 - dewatering of Kennady Lake to Lake N11 may change water quality (i.e., suspended sediments, major ions, metals, and nutrients concentrations) in downstream waterbodies, and affect aquatic health, and fish habitat and fish (p 9-152) and seepage from mine rock and PK storage repositories, and the open Tuzo Pit may change water quality in Kennady Lake, and affect water quality in downstream waterbodies, aquatic health, and fish habitat and fish (p 9-161).

All pathways, with the exception of the initial construction and operations pathway for Kennady Lake, were primary pathways and incorporated in the water quality effects assessment. As Kennady Lake is isolated as a controlled area during construction and operations, a no linkage pathway was assigned. However, effects to water quality in Lake N11 and Area 8 as a result of dewatering and pumped discharges during construction and operations were assessed in Section 9.8.

Modelled hardness and metals concentrations are provided for each of the assessment nodes and phases in the tables provided in Sections 8.7 and 9.7. Temporal plots are provided for metals, but not hardness, although projected calcium and magnesium concentrations are included in the plots, which can be used to estimate temporal changes to hardness over time. pH was not included in the modelling; however, as geochemical characteristics (Appendix 8.II) and acidification assessment of local waterbodies (Section 8.8.1.2) indicated negligible potential to affect Kennady Lake and lakes adjacent to the controlled area of the Project, it was assumed that there would be no change in the range of measured baseline pH for these lakes.

Comment No. 15

Sections 8.10 and 9.10, Effects to Fish and Fish Habitat

These sections are not complete. There is no mention of the effects of alteration of water quality (pH, sediment, nutrients, hardness, metals) in Kennady Lake, or in downstream receiving environments.

Response

Sections 8.9 and 9.9 assess the potential for health effects to aquatic life resulting from the modelled changes in water quality. These results were carried through to Section 8.10 and 8.11 under the *Effects of Changes to Aquatic Health* pathway.

Sediment through the dust deposition pathway was included in Section 8.10 and 8.11. Other sediment pathways were considered to be secondary pathways and discussed in Sections 8.6 and 9.6.

It is recognized that the nutrients pathway was incomplete in the EIS. This was identified as a deficiency by the Panel (letter dated March 17, 2011). However, Sections 8, 9 and 10 have been updated to address nutrients, particularly phosphorus, and these were submitted to the Panel in July 2011.

References

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DE BEERS
CANADA
GAHCHO KUÉ PROJECT

File: L020

July 13, 2011

Gavin More
Manager, Environmental Assessment
Government of the Northwest Territories
PO Box 1320
Yellowknife, NT, X1A 2L9

By: email (gavin_more@gov.nt.ca)

Re: Gahcho Kué Project Description and EIS Overview meeting follow-up.

Dear Mr. More,

De Beers Canada Inc. (DBCI) appreciated the opportunity, on May 25, 2011, to meet with the Government of the Northwest Territories (GNWT) and provide an overview of the Gahcho Kué Diamond Project (Project) and applicable sections of the Environmental Impact Statement. We trust that the meeting was helpful in clarifying aspects of the Project Description related to the terrestrial environment, socio-economics and the general content and structure of the EIS.

As follow-up to the meeting, please find attached a copy of the meeting notes. Electronic copies of presentation materials have been forwarded to your office. Also, as promised, DBCI will provide a written response to the technical subject notes on caribou provided by the GNWT Department of Environment and Natural Resources biologists. The response is anticipated to be available on July 22, 2011.

DBCI looks forward to working with the GNWT during the Environmental Impact Review process and to our next meeting scheduled for July 26 and 27, 2011. Should you have any questions please feel free to contact me.

Sincerely,

Paul Cobban

Paul Cobban
Permitting Manager

c.c. Nicole McCutchen, GNWT Manager Wildlife Research and Management.

Attached: May 25, 2011 Meeting Notes.

Record of Meeting

Date/Time	25 May 2011	**File no.**	11-1365-0001 Phase 3030
Between	Gavin More, Robert Mulders, Dean Cluff, Bruno Croft, Nicole McCutchen, Jan Adamczewski, Kimberly Balsillie, Sarah True, Loretta Ransom, Terry Bugg, Jessica Budgell, Murray Cutten	**of:**	Government of the Northwest Territories (GNWT)
And	Paul Cobban – Permitting Manager; Stephen Lines – Environmental Assessment & Permitting Coordinator Amy Langhorne – Project Manager (Golder Associates); John Virgl – Terrestrial Lead (Golder Associates); Cameron Stevens – Terrestrial Team (Golder Associates); Damian Panayi – Terrestrial Team (Golder Associates); Graeme Clinton – Economics Lead (Impact Economics)	**of:**	De Beers Canada Inc.
Subject	Project Description Update and EIS Overview (Terrestrial)		
Distribution	GNWT; De Beers; Golder Associates		

Project Description Overview

- De Beers provided a PowerPoint presentation, with supporting figures and summary information from the EIS document, outlining the proposed Gahcho Kué Project.
- Presentation focused on mining method, water and waste management aspects of the Project, including an overview of the alternatives considered in reaching the proposed Project description.
- Discussion Points Presented on the Project description:
  - The Project description represents a balance between environment, economics and social considerations
  - Project approach is to minimize the size of disturbance footprint
  - All operations are managed within a sub-basin of the Kennady Lake watershed (the controlled area)

  - The controlled area is established to maintain segregation of non-contact water away from the site and manage contact water within the site

- Discussion also included questions and answers related to the Project design, Project sequencing and timeline.

EIS – Overview: Economics

- Presentation of economics associated with the Project
  - Background info – study area, baseline methods, existing GNWT conditions for gross domestic product (GDP), potential future projects, population growth in the NWT
  - Economic impact assessment methods
  - Conclusions of the economic impact assessment for both the construction and operations phases in the following categories:
    - the gross output
    - the labour income occurring in the NWT
    - the percentage of predicted employment
    - indirect tax on production less subsidies
    - the effect of the Project on the population of the NWT
  - The induced impacts for the NWT from the operations phase were identified as:
    - induced gross domestic product:
      - total : $35,159,000
      - annual average: $3,196,000
    - induced employment:
      - total: 289 (full time equivalents)
      - annual average: 26 (full time equivalents)
    - induced labour income:
      - total: $12,929,000
    - annual average: $1,175,000

EIS – Overview: Wildlife

- Presentation of environmental setting for the Project and EIS conclusions
  - Structure of the EIS and importance of the influence of the terms of reference (TOR) on the structure of the document
  - Terrestrial Environmental Setting; review of the study areas, terrestrial components studied, data types collected
  - Assessment Approach – review of assessment approach flow diagram; approach to selecting VC's; assessment and measurement endpoint examples; pathways analysis
- Discussion of the wildlife aspects of the EIS work included:
  - Discussion of the study area selected for various species
  - The approach to selecting and using remote sensing data for the landscape classification
  - Baseline surveys
  - Monitoring protocols.

Follow-up

- Golder will develop written responses to the draft questions provided by ENR.
- ENR, DBCI and Golder agreed to a follow-up meeting to discuss wildlife only. Likely require ½ day to discuss caribou, ½ day for other wildlife issues. June 29 and 30 was proposed. *(Note: A two-day meeting has been set for July 26th and 27th; it is anticipated that one day will be spent discussing caribou, and one day will be spent discussing carnivores).*
- De Beers encourages on-going discussions between regulators and the consultants. It was requested that if the GNWT identifies a particular area of technical interest they would like to discuss at a future meeting, it is appreciated if they advise De Beers in advance so they can prepare and coordinate consultants necessary to ensure productive discussion.

Action Item / Commitment	Responsible	Date
Provide a digital copy of the materials used in the meeting.	De Beers / Golder	July 2011
Provide written response to GNWT – ENR questions	Golder	July/August 2011
Set date for follow-up meeting to discuss wildlife	De Beers (Stephen Lines)	July 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation
- Visualization Posters
- Figures:
  - 7.5-1: Previous, Existing, and Reasonably Foreseeable Future Developments in the Effects Study Area for the Bathurst Caribou Herd
  - 7.1-2: Bathurst Caribou Herd Study Area
  - 11.10-21: Previous, Existing, and Reasonably Foreseeable Future Developments in the Study Areas
  - 11.10-1: Grizzly Bear and Wolverine Study Area
  - 2.3-1: Location of 5035, Hearne, and Tuzo Kimberlite Pipes
  - 2.3-2: Alternative 1 – Conceptual Plan for Dewatering Areas 4 and 6 (2000)
  - 2.3-3: Alternative 2 – Conceptual Plan for Dewatering Areas 4, 6 and 7 (2002)
  - 2.3-4: Alternative 3 – Conceptual Plan for Dewatering Areas 2 through 7 (2005)
  - 2.3-5: Alternative 4 – Conceptual Plan for Dewatering Kennady Lake (2010)
  - 2.3-6: Diversion of Surface Water from Kennady Lake
  - 2.3-7: Alternative 1 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2000)
  - 2.3-8: Alternative 2 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2002)
  - 2.3-9: Alternative 3 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2005)

File: L020

July 13, 2011

Sarah Olivier
Environmental Assessment Analyst
Fisheries and Oceans Canada
5204- 50th Avenue, Suite 301
Yellowknife, NT
X1A1E2

By: email (sarah.olivier@dfo-mpo.gc.ca)

Re: Gahcho Kué Project Description and EIS Overview meeting follow-up.

Dear Ms. Olivier,

De Beers Canada Inc. (DBCI) appreciated the opportunity, on May 26, 2011, to meet with the Fisheries and Oceans Canada (DFO) and provide an overview of the Gahcho Kué Diamond Project (Project) and applicable sections of the Environmental Impact Statement. We trust that the meeting was helpful in clarifying aspects of the Project Description related to the aquatic environment as well as the content and structure of the EIS.

As follow-up to the meeting, please find attached a copy of the meeting notes. Electronic copies of presentation materials have been forwarded to your office.

DBCI looks forward to working with DFO during the Environmental Impact Review process. Should you have any questions please feel free to contact me.

Sincerely,

Paul Cobban

Paul Cobban
Permitting Manager

Attached: May 26, 2011 Meeting Notes.

DE BEERS CANADA

Record of Meeting

Date/Time	26 May 2011	**File no.**	11-1365-0001 Phase 3030
Between	Sarah Olivier – Environmental Assessment Analyst; Pete Cott - Fish Habitat Biologist; Bruce Hanna - Fish Habitat Biologist; Corrine Gibson – Acting Habitat Team Leader; Lorraine Sawdon – Habitat Biologist	**of:**	Fisheries and Oceans Canada (DFO)
And	Paul Cobban – Permitting Manager; Stephen Lines – Environmental Assessment & Permitting Coordinator Amy Langhorne – Project Manager (Golder Associates); Kristine Mason – Senior Fisheries Biologist (Golder Associates); Gordon Walder – Senior Fisheries Scientist (Golder Associates)	**of:**	De Beers Canada Inc.
Subject	Project Description Update and EIS Overview (Fish and Fish Habitat)		
Distribution	DFO; De Beers; Golder Associates		

Project Description Overview

- De Beers provided a PowerPoint presentation, supporting figures, and summary information from the EIS document, outlining the proposed Gahcho Kué Project.
- Presentation focused on mining method, water and waste management aspects of the Project, including an overview of the alternatives considered in reaching the proposed Project description.
- Discussion Points presented on the Project description:
  - The Project description represents a balance between environment, economics and social considerations
  - Project approach is to minimize the size of disturbance footprint
  - All operations are managed within a sub-basin of the Kennady Lake watershed (the controlled area)
  - The controlled area is established to maintain segregation of non-contact water away from the site and manage contact water within the site
- Discussion also included questions and answers related to Project design specifics, Project

sequencing and timeline.

- Specific areas of question included:
  - Fish passage
  - Approach to de-watering plans
  - Acid Rock Drainage / Metal Leaching (ARD/ML) potential from mine rock and processed kimberlite and associated EIS findings.
  - The alternatives considered for the Project including water and waste management strategies.

EIS – Fish and Fish Habitat

- Discussion Points presented on the Fish and Fish Habitat:
  - Overview of ongoing work
  - Downstream flow mitigation
    - As there are certain periods during the life of the mine where water discharges downstream a preliminary flow mitigation plan has been developed in accordance with the commitment made in the EIS. The engineering team is looking at where the water will come from; field work this spring/summer; work is ongoing.
    - DFO requested that De Beers make sure there are considerations for where flow is coming from and going to, and associated infrastructure needs (i.e., intakes draw-downs, water quality considerations, TSS)
  - Fish Habitat Compensation Approach
    - Review of areas of lost, altered and temporarily disturbed habitats
    - Review of approach to compensation works including:
      - flooding of adjacent small lakes to increase habitat area,
      - focus of compensation on areas that will have some disturbance directly related to the project,
      - habitat enhancements in areas of Kennady lake
  - Overview of what will be included in the application De Beers will submit as per Section 35(2) of the *Fisheries Act*
- Initial questions associated with the fish and fish habitat assessment work included:
  - Lake recovery timing and considerations for various trophic levels
  - Information on the dyke structures, design approach for any that will be long-term, walk away

structures

- Approach and considerations for the use of HSI's, weighting factors, selection of target species and life stages, temporal losses

Path Forward

- DFO is starting EIS review – will be dividing up aspects among various people to work through and provide comments
  - Willing to work through questions with De Beers on an ongoing basis, outside of Information Requests (IRs)
- Discussions/follow-up meetings with DFO:
  - Baseline data collection program – a meeting was proposed by De Beers that would preferably occur before the 2011 field season so that if the opportunity is available, 2011 field programs can be adjusted (same participants as in today's meeting would be appropriate).
  - Meeting to discuss the extent of the fish habitat loss and alterations and the approach to calculations
  - Meeting to discuss approach to Habitat Suitability Index (HSI) value determination, weightings, and species assemblages
- Sarah Olivier is main point of contact for DFO

Follow-up

- Make arrangements for next meetings
- Forward information as discussed during the meeting
- De Beers encourages on-going discussions between regulators and the consultants. It was requested that if the DFO identifies a particular area of technical interest they would like to discuss at a future meeting, it is appreciated if they advise De Beers in advance so they can prepare and coordinate consultants necessary to ensure productive discussion.

Action Item / Commitment	Responsible	Date
Provide a digital copy of the materials used in the meeting.	De Beers / Golder	July 2011
Work with DFO to identify timing for meetings: - Baseline Data Collection Program - Extent of fish habitat loss and alterations, and the approach to calculations - Habitat Suitability Index (HSI) value determination, weightings, and species assemblages	De Beers (Stephen Lines)	July 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation
- Visualization Posters
- Meeting Material Binder:
  - Key Facts and Figures
  - Gahcho Kué Project Description Reference TOC
  - Fish and Fish Habitat Summary for the Gahcho Kué Project Environmental Impact Statement
  - Figures:
    - 2.3-2: Alternative 1 – Conceptual Plan for Dewatering Areas 4 and 6 (2000)
    - 2.3-3: Alternative 2 – Conceptual Plan for Dewatering Areas 4, 6 and 7 (2002)
    - 2.3-4: Alternative 3 – Conceptual Plan for Dewatering Areas 2 through 7 (2005)
    - 2.3-7: Alternative 1 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2000)
    - 2.3-8: Alternative 2 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2002)
    - 2.3-9: Alternative 3 – Locations of Mine Rock Piles and the Processed Kimberlite Containment Facility (2005)
    - 3.12-1: Final Reclamation
    - 3.II-1: Kennady Lake Sub-watersheds and Controlled Area Boundary
    - 3.II-3: Permanently Lost or Altered Fish Habitat Areas
    - 3.II-5: Project Footprint at End of Operations (Years 9 to 11) Showing Compensation Options 1b and 2
    - 3.II-6: Final Reclamation Showing Compensation Options 1c and 2
    - 3.II-7: Potential Compensation Habitat With Options 1c, 2 and 3 After Closure
    - 8.3-41: Fish-Bearing Status of Small lakes in the Kennady Lake Watershed
    - 8.4-2: Watershed Management Areas and Infrastructure Associated with the Project
    - 8.4-3: Surface Water Diversions Associated with the Project – Mining Operations Years 1 to 3 (2015 - 2017)
    - 9.17-7: Kennady Lake Watershed Project Watershed Alterations
    - 9.3-2: Local Study Area Watersheds
    - 9.7-1: Downstream Watersheds and Flow Paths from Kennady Lake to Lake 410

DE BEERS
CANADA
GAHCHO KUÉ PROJECT

Via Email (nicole_mccutchen@gov.nt.ca)

August 12, 2011 File: S110

Nicole McCutchen, PhD
Manager
Wildlife Research and Management
Government of the Northwest Territories
PO Box 1320
Yellowknife, NT X1A 2L9

Dear Ms. McCutchen,

Re: **Gahcho Kué Project Carnivore Meeting**

De Beers Canada Inc. (DBCI) appreciated the opportunity, on July 27, 2011, to meet with the Government of the Northwest Territories Department of Environment and Natural Resources (ENR) to discuss the assessment of effects on carnivores. We trust that the meeting was helpful in clarifying aspects of the study methods and assessment approach.

As follow-up to the meeting, please find attached a copy of the meeting notes, meeting presentation, as well as written responses to the draft technical comments provided to DBCI on July 1, 2011.

DBCI looks forward to working with ENR during the Environmental Impact Review process and to our next meeting scheduled for October 4, 2011 to discuss the Key Line of Inquiry: Caribou. Should you have any questions please feel free to contact me.

Sincerely,

Stephen Lines
Environmental Assessment & Permitting Coordinator

cc: Gavin More, GNWT Manager Environmental Assessment
Paul Cobban, DBCI Permitting Manager

attached: meeting notes; presentation; responses to draft technical comments

THE DE BEERS GROUP OF COMPANIES 1888

DE BEERS CANADA

Record of Meeting

Date/Time	27 July 2011	**File no.**	11-1365-0001 Phase 3030
Between	Nicole McCutchen – Manager, Wildlife Research and Management; Robert Mulders – Wildlife Biologist, Carnivores/Furbearers	**of:**	Government of the Northwest Territories (GNWT)
And	Paul Cobban – Permitting Manager; Stephen Lines – Environmental Assessment & Permitting Coordinator John Virgl – Terrestrial Lead (Golder Associates); Cameron Stevens – Terrestrial Team (Golder Associates); Dan Coulton – Terrestrial Team (Golder Associates); Lisa Hurley – Engagement Coordinator (Golder Associates)	**of:**	De Beers Canada Inc.
Purpose	The purpose of the meeting was to discuss the comments provided by ENR on July 1, 2011 regarding the carnivore effects assessment		
Distribution	GNWT; De Beers; Golder Associates		

Introduction

- Roundtable of introductions.
- ENR requested that meeting notes be prepared and distributed
  - Paul Cobban (PC) noted that this would be done.
- De Beers stated that a written response to the carnivore comments would be provided.

Terms of Reference Overview

- John Virgl (JV) provided an overview of the Terms of Reference (TOR) for the Subject of Note: Carnivore Mortality and touched on the following topics:
  - detail about the study areas used in the carnivores assessment (i.e., Grizzly Bear, Wolverine, and Wolf study areas); and
  - conceptual assessment approach diagram (included in the presentation).

Carnivore Comments provided by (ENR)

- De Beers and Golder provided a presentation (attached) focused on ENR comments in order to guide discussion of the following topics.
  - Effects of the Winter Road
  - Availability of Wildlife Mortality Data
  - Estimates of Mine-related Mortality of Wolverine
  - Uncertainty in Local Wolverine Activity
  - Grizzly Bear Surveys
  - Other Comments
    - Wolverine Density Calculations
    - Waste Management Plan
    - Reasonably Foreseeable Developments
    - Noise results, effects and guidelines
    - Dust results, effects and monitoring

Discussion: Comment 1 – Effects of the Winter Road

- Robert Mulders (RM) identified the need to consider the proximity of the Gahcho Kué Project being closer to the treeline which is wintering habitat for the Bathurst Herd.
  - JV acknowledged this.
- Nicole McCutchen (NM) asked about the possibility of running worst case scenarios to see what might result
  - JV noted that it is difficult to predict (or model) numerically with no parameter value for harvest along access roads.
- RM noted there appears to be carnivore harvest data that De Beers/Golder has not used in the modelling (e.g., could be provided by the North Slave Region office [Bruno Croft and Fred Mandeville] and from the Kitikmeot [Mathieu Dumond]).
  - It was acknowledged that there might be additional data that could be included and that requests have been made by Golder to obtain this data. It is difficult to respond this item without access to the data. .
  - PC made a formal request that all relevant data that is available be provided. It was noted, that if these data are not provided, then De Beers may issue an Information Request (IR) to obtain this data through the EIR Process.
  - RM noted that the majority of the data are provided by regional offices and there is a need to deal directly with the sources of this data.

- NM identified that she would like to understand from RM what is missing so she can help coordinate obtaining the information from the regional offices.
- NM identified that she could become the point person for information required from ENR.

Discussion: Comment 2 – Mortality Data Availability

- In the comments provided by ENR there was mention of some Border A and Border B data. RM clarified that these are referenced in Saskatchewan Reports published by Dean Cluff.
  - Reference was made to Rennie Lake, and its proximity to the effects study area for wolf.
- There was discussion about the assessment considering direct mine-related mortality. To date this has been negligible.
- Wolf harvesting was discussed, and the question was raised by JV about how the number of wolves being harvested near Rennie Lake would contribute to the impact predictions.
  - RM noted this issue because the baseline harvest numbers are not consistent with ENR's harvest information (wanted to identify gaps). There was agreement that the information would not likely change the impact assessment as mine-related mortality is limited.
    - There was agreement around the table that some information may not be captured in the assessment. It was noted that this information is more relevant to refining the baseline and not the assessment predictions.

Discussion: Information that GNWT Can Provide

- The GNWT provide a summary of the information that can be provided to De Beers and Golder:
  - Wolverine Information
    - Hardcopy of information provided at the meeting; includes data to 2009 – digital copies of this information can also be provided.
    - It was noted there should be additional information since 2009; this would have to be obtained from the North Slave Office – ENR looking into obtaining internally and then providing to De Beers/Golder.
  - Grizzly Bear Information
    - It was noted there have been one or two mortalities in the North Slave Area; three south of the Gahcho Kué Project (one at Hoarfrost River and one at Reliance).
    - RM noted this data is not reflected in the EIS and is also not available on the ENR website.
    - Dan Coulton (DC) noted he had requested the Kitikmeot information but had not

received. There was discussion about the contact in Nunavut and NM indicated she could provide a contact if required. (DC noted he had a contact for Nunavut).

- Fur Harvest
  - There was discussion about different data sets for different furbearers.
  - NM indicated she could provide a contact so a query could be done of the North Slave for various species.
  - RM noted that a wolverine carcass collection program has been underway for five to six years and the data can be compared to fur auction data.
    - RM identified Francois Rossouw (ITI: Fur Marketing/ Traditional Economy) as someone who has been collecting data regarding fur auctions.
    - There is some sensitivity around the data (e.g., identifying the trapper) and it was noted that De Beers does not want to be provided data that might be confidential/sensitive as they cannot use it. RM noted they would not provide the confidential/sensitive data.

Discussion: Assessment Approach (Population Level)

- To provide context for the assessment completed in the EIS, JV provided an overview of the population level assessment using grizzly bear as the example. He noted that the team used land classification and looked at developments over time, putting these on the landscape to see what area is lost and the cumulative changes to grizzly bear habitat quality.
  - JV explained some of the assumptions used for the conservative approach:
    - e.g., exploration footprints were given a 500 m radius, it was assumed that all exploration projects were in operation for the entire duration of their permits; it was assumed that loss of habitat within all development footprints was permanent throughout the assessment.
    - it was assumed that mine-related mortality would be 4-5 wolverine over 22 year life of Project although the highest risk to wolverine (and grizzly bears) is expected to occur over 15 years (i.e., construction through operations).
    - It was noted that in the response to ENR's draft caribou comments (memo submitted to ENR July 22, 2011) there is a table describing the ecological conservatisms included in the impact assessment.
  - PC noted the importance of ENR having a comfortable understanding of the assessment approach used, and if necessary a follow up meeting could be held to review this in additional detail.
- There was discussion around the harvesting of grizzly bear, what is considered a sustainable harvest, and the numbers being harvested.

- It was noted that sustainable harvest was identified to be between 14 to 16 bears across the entire Slave Geological Province (including portions of the Kitikmeot and North Slave regions), and that by 2005 the mean annual harvest was approaching 18 bears, with 31 bear mortalities in 2004..

- There was discussion about what is contributing to the number of bears being harvested (i.e., Nunavut commercial harvest, and exploration related mortality).

- The modelling completed for the EIS was reviewed.

  – Cam Stevens (CS) explained that 18 bears per year was used in the population models for harvest levels (not mine-related)

  – It was noted that the modelling was focussed on the Slave Geological Province (SGP). There was discussion around whether this is the most relevant area to use, and if the Churchill Geological Province (CGP) should be included.

  – JV explained that the intent was to look at the maximum cumulative effects. It was noted that if a larger area was used (e.g., including CGP [or portion of] where the ratio of development to undisturbed land area is much less) then this would actually dilute the cumulative effects that are currently included in the assessment.

  – RM noted he understood the value of what has been done, but indicated there might be an impact in drawing in grizzly bears from other areas/home ranges. The baseline used for the EIS looks at the SGP, but noted that any grizzly bear mortalities from the Project might be to bears that do not have their home ranges in the SGP.

    - There was discussion about differences among baseline data for the RSA, data used in the impact assessment, and monitoring data.

- PC noted that it is important that ENR understand that the impact assessment was done at the population level, because of the smaller range used the effect on grizzly bears has not been underestimated, but the area from which they come from is a separate issue more relevant to monitoring.

  – It was recommended that ENR review the assessment and provide feedback about whether they agree with the approach.

■ There was discussion about wildlife management in the NWT and the role of the GNWT versus the role of industry.

- It was noted that De Beers will continue with an assessment within the bounds of what is an appropriate approach for impact assessment in accordance with the TOR.

■ There was discussion about monitoring.

- It was noted that the focus of monitoring for De Beers is why grizzly bears are being attracted to the Project, which when understood results in a change of practices to eliminate the attractant (i.e., the focus of monitoring would not be where they are coming from to the Project site, but why they are coming to the Project site).

  - There was further discussion about wolverine and grizzly bear hair snagging, and it was identified that a written plan from ENR, outlining the approach and goals of the wildlife monitoring program is required in order to consider this further (i.e., the need for a systematic approach across all monitoring programs at mine sites).

Discussion: Comment 3 – Mine-related Mortality of Wolverine

- RM noted the discussion in the EIS takes a limited view of where wolverine are killed and should include the relocations as mortalities
  - JV acknowledged that relocations were not pulled out of the data
  - A preliminary analysis using relocations as mortalities was completed for the meeting and the results included in the presentation.
  - RM indicated that the North Slave Region office needs to confirm the number of relocations.
- There was discussion about the wolverines seen at Snap Lake and it was acknowledged that Snap Lake has only seen wolverines at site but they have not been causing safety or property damage.

Discussion: Comment 4 – Uncertainty in Local Wolverine Activity

- RM noted that snow track data does not allow for comparison of abundance; there were some contradictory statements in the EIS
  - This was acknowledged, and clarification provided in the presentation and will be included in the written response.
- NM indicated that if occupancy can be used to understand abundance, then it can be used as a monitoring tool.
  - It was identified that it depends on the study design. CS noted that a correlation between track counts and hair snagging is outlined in a Diavik report (DDMI 2007) that shows the potential for wolverine snow tracking surveys to provide a reliable index of relative activity levels from year-to-year and distance from the mine.
  - RM noted he has been happy to see Diavik continue to use both methods (i.e., hair snagging with DNA analysis and track counts) to help understand the correlation. He noted he was happy to see hair snagging used as part of the baseline for the Project and would like to see hair snagging with DNA analysis conducted at a set 2 year monitoring interval.
- The presentation included a graph showing the Annual Fluctuations in Total Number of Tracks Observed at Diavik Mine which was discussed.

- RM noted that there may be differences in the make-up of wolverine populations in December compared to April (i.e., the number of younger individuals surviving until April may be lower, reflecting a seasonal difference in population demography).
- JV appreciates the comments regarding the track counts study method, and the limitations are recognized. JV pointed out that the method is effective in providing useful information on wolverine activity in a study area.

Discussion: Comment 5 – Grizzly Bear Surveys

- JV provided an overview of why eskers were investigated for grizzly bear denning. In summary, a previous iteration of the Project description included the use of glacialfluvial (esker) material to build parts of the Project so it was important to understand if/where dens were located on eskers. The current version of the Project description does not use this esker material.
- There was discussion about grizzly bears denning habitat, and whether the survey efforts conducted to date would have provided adequate coverage or measure of relative abundance. The primary focus on esker habitat may have excluded other types of potential bear denning habitat, that might have also been surveyed.
- PC asked what ENR is currently doing to understand the abundance of grizzly bears in the NWT.
  - RM noted that they have used telemetry data to collect density (1 bear per 300 km^2). They are looking at new techniques identified by Mathieu Dumond.
  - ENR noted that in the next five years the focus is on caribou but looking at grizzly bear monitoring as a future priority.

Discussion: Other Comments

Wolverine Density

- RM noted a wolverine management plan is under development, which could include more protection for wolverines in mid-winter by shortening the harvest season (e.g., Yukon has shortened to February and is currently considering January; the NWT currently has April). It is expected this will be available in approximately a year.

Waste Management

- There was discussion around the location of the mine's incinerator.
- PC requested that ENR have discussions with air quality representative(s) from ENR (Aileen Stevens) and Environment Canada (Dave Fox) so that if possible, a consistent direction regarding the location of the incinerator is provided to De Beers.

Reasonably Foreseeable Developments

- JV provided an overview of the criteria used to identify reasonably foreseeable developments included in the EIS.

- The rationale for not including the Bathurst Inlet Port and Road (BIPR) was identified as there being currently no financial support for the Project, and its regulatory application being long out dated.
  - RM acknowledged this but expects that it might be a project within the next 10 to 20 years.
- RM asked about the proposed East Arm National Park
  - JV confirmed this was included in the assessment qualitatively (i.e., included in the uncertainty section of the assessment) and the boundaries for the proposed area of interest provided by Parks Canada were used.

Noise Results, Effects and Guidelines

- CS explained that the distance to which noise levels returned to background were considered in the assessment.
- JV agreed with RM's statement that animals are more sensitive to noise than humans, but the intent of the assessment was to show where the noise levels approached background levels and to confirm that the zones of influence applied was appropriately scaled.

Dust Results, Effects and Monitoring

- JV explained that the monitoring program will be developed.

Discussion: Path Forward

- ENR appreciates the effort to address comments in the presentation and the written response that will be provided.
- De Beers noted they welcome ENR's providing the additional data discussed.
- It was agreed that NM and Stephen Lines (SL) will work to identify a date for the caribou meeting.
- It was agreed that a note would be submitted to the Gahcho Kué Panel by ENR and De Beers summarizing the discussions taken place in advance of the EIS analysis session planned for November (plan submission to Gahcho Kué Panel mid-October).
  - There is a template for this note available from the Mackenzie Valley Environmental Impact Review Board (MVEIRB).
  - It is expected that De Beers will draft the note for review by ENR; the purpose of which is to provide an overview of what was discussed and where agreement was reached. It was noted that it would be beneficial to others to see what questions had been asked and responses provided in the event that they have the same questions.

Action Item / Commitment	**Responsible**	**Date**
De Beers circulate meeting notes.	De Beers / Golder	Aug 2011
De Beers provide written response to carnivore comments from ENR	Golder	Aug 2011
ENR provide additional wolverine information (specifically updates to hard copy information to 2009 provided at the meeting)	ENR	Aug / Sep 2011
ENR provide additional grizzly bear information.	ENR	TBD
Golder to contact Nicole McCutchen (ENR) if Nunavut contact required. *(Note: Golder has identified they had a contact, but would touch base with Nicole McCutchen if required.)*	Golder	If necessary.
ENR review assessment approach and identify if additional discussion or follow up meeting is required.	ENR	Sep / Oct 2011
ENR confirm the number of wolverine relocations.	ENR	Aug / Sep 2011
De Beers/Golder obtain a copy of the wolverine management plan when prepared (expected approximately August 2012).	De Beers / Golder	Aug 2012
Set date for follow-up meeting to discuss caribou	De Beers / ENR	Aug 2011
De Beers prepare a summary note of discussions for the Gahcho Kué Panel registry which will be reviewed/confirmed by ENR prior to submission.	De Beers	Oct 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation

DRAFT Meeting Agenda

De Beers Canada
Gahcho Kué Project

MEETING	De Beers Canada and GNWT – Environment and Natural Resources Carnivores Discussion	**DATE:** July 27, 2011
INVITED	De Beers Canada Inc. GNWT – Environment and Natural Resources Golder Associates Ltd.	
LOCATION	De Beers Canada Boardroom Suite 300, 5102 -50th Ave Yellowknife, Northwest Territories	

Agenda Item/Discussion	Timing
Introduction ▪ Health and Safety ▪ Review of Agenda	9:00 – 9:15
Overview of the Terms of Reference ▪ Overview of the Terms of Reference for the Subject of Note: Carnivore Mortality	9:15 – 9:30
Carnivore Comments from the GNWT ▪ Review of the comments received from the GNWT	9:30 – noon
Lunch	Noon – 1:00
Discussion ▪ Continued discussion on the carnivore comments received from the GNWT and general discussion	1:00 – 2:30
Path Forward ▪ Review of next steps in communications	2:30 – 3:00

Gahcho Kué Project

Government of the Northwest Territories
Discussion of Carnivore Comments

July 2011

Introductions

De Beers Canada Inc.

- **Paul Cobban** Permitting Manager – De Beers Canada Inc.
- **Stephen Lines** Environmental Assessment and Permitting Coordinator - Gahcho Kué Project

Golder Associates Ltd.

- **John Virgl** Technical Lead – Terrestrial
- **Cam Stevens** Terrestrial Team
- **Dan Coulton** Terrestrial Team
- **Lisa Hurley** Engagement Coordinator

Purpose

- Meeting with Government of the Northwest Territories, Department of Environment and Natural Resources (ENR) to discuss carnivore comments.
  - Follow-up to a meeting held on May 26, 2011
  - Comments on Subject of Note: Carnivore Mortality provided by ENR in July 2011

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Outline

- Terms of Reference for Subject of Note: Carnivore Mortality
- Comments provided by ENR
- Discussion

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Structure of the EIS

- The Terms of Reference issued by the Gahcho Kué Panel required that the assessment of the Key Lines of Inquiry and Subjects of Note "be comprehensive stand-alone analyses which require only minimal cross-referencing with other parts of the EIS".
- The result was a document organized by Key Lines of Inquiry and Subjects of Note, with Baseline reports for each terrestrial discipline included as annexes to the EIS.
- To be responsive to the Terms of Reference, only the information needed for the effects assessment within each Key Line Of Inquiry and Subject of Note was presented.

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EIS Sections Relevant to Terrestrial

Section Number	Section Title
2	Project Alternatives
3	Project Description
7	Key Line of Inquiry: Caribou
11.7	Subject of Note: Vegetation
11.7.I	Geology, Soils and Terrain Appendix
11.9	Subject of Note: Waste Management and Wildlife
11.10	**Subject of Note: Carnivore Mortality**
11.11	Subject of Note: Other Ungulates
11.12	Subject of Note: Species at Risk and Birds
13	Cumulative Effects Assessment
14	Summary and Conclusions
Annex D	Geology, Soils and Terrain Baseline
Annex E	Vegetation Baseline
Annex F	Wildlife Baseline

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Subject of Note: Carnivore Mortality

- The EIS must evaluate the experiences with carnivore mortality and related mitigation measures at the existing and developing diamond mines.
  - In addition to an evaluation of the mitigation measures prescribed in earlier assessments, as well as any adaptive management activities, the EIS must provide improvements over the methods applied at existing developments.
- The EIS must address any differences in impact predictions resulting from the proposed development's proximity to the tree line.

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Subject of Note: Carnivore Mortality (continued)

- The geographical scope for this Subject of Note includes the development area and all related access routes. In the cumulative context for species with larger ranges, this must include evaluations of the impacts in consideration of the full range used by each species.
- Specific information needs identified include:
  - potential attraction to wolves, foxes, bear, and wolverines to attractants such as garbage, the creation of habitat in the camp, waste rock storage, etc;
  - development components that may cause a sensory disturbance to wolves, foxes, bear, and wolverines effects on movement

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Subject of Note: Carnivore Mortality (continued)

- effects on movement and hunting success from linear development components, such as the ice road;
- increased carnivore mortality resulting from creating access into a previously largely inaccessible area;
- impacts on prey species such as small mammals;
- effective habitat loss; and
- measures that may be taken to avoid or reduce these impacts.

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Grizzly Bear and Wolverine Study Area

10

Wolf Study Area

11

Conceptual Approach to Assessment

Project (plus Existing Environment)

Direct habitat loss and fragmentation

Habitat quality

Direct mine-related mortality

Effects to population persistence

12

ENR Comments: Carnivores

1. ENR – Effects of Winter Access Road

- Comments:
  - The effects of improved access on wolf harvest too easily dismissed
  - De Beers does not account for public use of winter road
  - Increased public access and resulting harvest is a major concern
  - Cumulative impacts assessment does not consider the primary Tibbitt-to-Contwoyto Road
  - Increased access could potentially have significant impacts on caribou, wolves, and wolverine
  - There is a need for a broader discussion of practical options for regulating harvest
  - The proximity of the spur road to the treeline has significant implications for caribou (and carnivores)

1. Reply – Effects of Winter Access Road

- The prediction that harvests will not noticeably increase with the Winter Access Road is based on the following principal reasons:
  - De Beers (2008) has detected no evidence of harvesting on Snap Lake Winter Access Road which occurs at kilometre 228 of the Tibbitt-to-Contwoyto Winter Road.
  - Ziemann (2007) reported only 3 wolverines harvested on Tibbitt-to-Contwoyto Winter Road from 2004-2006 (& no wolf harvests).
  - The Winter Access Road for the Project will begin at kilometre 271 of the Tibbitt-to-Contwoyto Winter Road
  - Harvesting along the Winter Access Road is expected to be limited and similar to the Snap Lake Winter Access Road

1. Reply – Effects of Winter Access Road (continued)

- The spatial extent of the effect on populations should be limited to the local area around the Winter Access Road and not extend beyond Kennady Lake or below the treeline.
- The duration of the effect is expected to continue until the end of final closure (i.e., 5 to 10 years after stopping the use of road), and the frequency is limited to approximately 12 weeks each year.
- Overall, the minor, local increase in harvest mortality from the Winter Access Road should not have a significant adverse effect on carnivore populations.

2. ENR – Incomplete Mortality Data (e.g., harvest, incidental)

- Incomplete data on wolverine harvest rates; critical of use of wolverine tags as an index
- Resident (YK) harvest data insufficient to estimate wolf harvest; should include Border License A hunt
- Harvest data lacking for Kitikmeot and North Slave regions.
- Data on Border A and B harvests (from southeastern NWT) should be considered.
- Data missing on mortalities of wolverine at exploration camps and winter road camps

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2. Reply – Incomplete Mortality Data

- Substantial efforts were made during the preparation of the EIS to obtain mortality data information from a number of people in various organizations. We incorporated the information received into the EIS when submitted.
- The number of tags appears to be best available data for estimating regulated harvests.
  - But we are interested in obtaining new information that would help to understand the cumulative impacts on carnivore populations.
- We considered regulated and non-regulated harvest numbers. As a conservative approach, approximately 10% of the modelled wolverine population was affected:
  - Regulated: 20
  - Non-regulated:120
- Recent efforts have been made to obtain the information from ENR, ENR-North Slave Office, Nunavut Government Department of Environment and Bearwise.

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3. ENR – Estimates of Mine-related Mortality of Wolverine

- Need to refer specifically to effects of relocation on incidents at the diamond mines (e.g., 128 incidents in 2005 to 23 in 2006 at BHP).
- Relocations should be categorized as (potential) mortalities
  - 10 problem wolverine have been removed from BHP's study area
- Does not include estimates from exploration camps and winter road camps

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3. Reply – Estimates of Mine-related Mortality of Wolverine

- For the EIS, **incidents** are defined to include all interactions between mine and wolverine and require some action. Incidents are logged by environment staff on-site.
- Recent efforts have been made to acquire additional harvest and mortality data, and will be examined for the potential to further assess the impact of removing animals from the population.
- Unlikely that a re-analysis will change overall impact classification.
  - the incremental effect should remain 'low' and the cumulative effects should remain 'moderate' in magnitude
  - However, we are willing to re-examine mortality rates

For example:

- With relocations as mortality, a revised calculated annual mortality rate equals 0.38 wolverine per mine per year (vs. 0.20 reported in EIS).

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3. Reply – Estimates of Mine-related Mortality of Wolverine (continued)

- Thus, over 22-yr period, it is predicted that about 8 to 9 wolverine may be removed from the population due to the Project (vs. 4-5 reported in EIS)
- However, exposure period of 22 yrs (in EIS) is conservative
  - over-estimates the effect given that the construction, operation, and closure of the mine is expected to be 15 years
  - A revised prediction using a rate of 0.38 wolverine per mine and year, and a 15-yr exposure period is about 5-6 wolverine killed
- This prediction is still conservative
  - the Project will implement waste management and wildlife mitigation procedures similar to that at the Snap Lake Mine
  - where only 1 wolverine has been killed during a 12-yr period (1999 to 2010; annual rate = 0.08 wolverine for Snap Lake Mine per year).

4. ENR – Uncertainty in Local Wolverine Activity

- Critical of monitoring tracks in snow
- Snow tracking does not provide reliable measure of activity given variable survey conditions and inability to distinguish individuals.
- Clarification needed on how track counts intend to contribute to understanding of wolverine abundance
- Too difficult to distinguish real differences in annual relative abundance (e.g., 0.01 vs. 0.12)
- Apparent cyclical patterns in wolverine activity at mines likely due to relocations (e.g., drop in incidents at Ekati in 2006 after 5 removals in 2005).

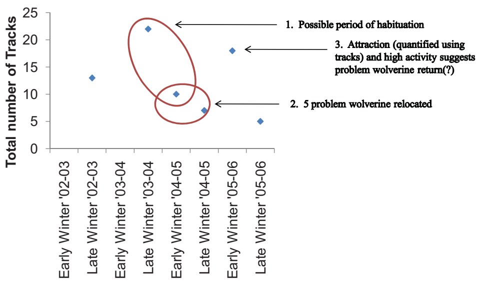
4. Reply – Uncertainty in Local Wolverine Activity

- Winter track surveys, DNA hair sampling, and incidental observations provided an index of relative active, distribution, and abundance of wolverine in the local and regional study areas.
- Importantly, the EIS does not solely rely on the results from winter track surveys and DNA hair sampling to analyze and predict Project-specific and cumulative effects on wolverine.
- To meet the Terms of Reference, the EIS uses multiple approaches:
  - Changes in habitat quantity and fragmentation
  - Changes in abundance of different quality habitats (using resource selection functions)
  - Long-term data on direct mine-related mortality
  - Population viability analysis
  - Integrates uncertainty and ecological conservatisms
- The approach was appropriate for meeting the Terms of Reference and providing confident and ecologically relevant impact predictions.

4. Reply – Uncertainty in Local Wolverine Activity

- Yes, we agree that observed cyclical trends are probably a result of both removals/mortalities, and natural fluctuations in prey
- A study of snow-tracking and hair-snagging DNA methods (DDMI 2007) showed:
  - annual density of wolverine estimated from hair samples were correlated with snow tracks.
  - track data appears to better quantify effects of mining developments on the spatial distribution of local wolverine activity.
    - attraction was quantified using snow tracks during 2005 (the time of high incidents and removals)

Annual Fluctuations in Total Number of Tracks Observed at Diavik Mine (DDMI 2007)



5. ENR – Grizzly Bear Surveys

- Grizzly bear den surveys were biased because focused on esker habitat
- Inadequate effort to-date in identifying dens
- Although selection for eskers, bears often den in tundra.
  - Many dens reported in McLoughlin (2002) were in tundra
- Critical of bear sign surveys and inherent uncertainty of its data
  - How many bears contribute to a bear observation/sign?
  - What is the detectability of bear sign?

5. Reply – Grizzly Bear Surveys

- Bear sign surveys, den surveys, and incidental observations provided an index of relative active, distribution of grizzly bears in the local and regional study areas.
- Effects assessment did not solely rely on results from bear sign surveys, den surveys, and incidental animal observations.
- To meet the Terms of Reference, the EIS uses multiple approaches:
  - Changes in habitat quantity and fragmentation
  - Changes in abundance of different quality habitats (using resource selection functions)
  - Long-term data on direct mine-related mortality
  - Population viability analysis
  - Integrates uncertainty and ecological conservatisms

5. Reply – Grizzly Bear Surveys (continued)

- Habitat selection studies of collared animals show a general affinity for eskers across seasons (e.g., Johnson et al. 2005)
- McLoughlin et al. (2002) showed selection for eskers for denning.
  - Statistical selection for eskers based on availability whereas heath tundra was used in proportion to availability.
- Given large area of heath tundra on landscape, surveys for dens in tundra would be challenging (without collared bears)
  - one den may have been missed in LSA based on reported densities in McLoughlin et al. (2002).
- The approach was appropriate for meeting the Terms of Reference and providing confident and ecologically relevant impact predictions.

5. Reply – Grizzly Bear Surveys (continued)

- Limitations of bear sign surveys are noted (De Beers 2008);
  - Relations between bear sign activity and environment have been difficult to quantify
- Pilot studies of hair-snagging methods have been initiated through discussions with ENR and mining companies.

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6. ENR – Grizzly Bear Study Area

- Statement that grizzly bear do not travel below treeline is false
- Critical of focus on Slave Geological Province (SGP); broader coverage is necessary.

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6. Reply – Grizzly Bear Study Area

- EIS states that grizzly bears “typically do not travel below the treeline” (page 11.10-6), which is intended to indicate that the population is at the southern extent of their range, and the probability of bears located below the treeline is low.
- We agree that the range of barren ground grizzly bear population is broader than examined (i.e., into Churchill Geological Province [CGP]); however, the EIS approach was appropriate because:
  - Study area where RSFs have been developed
  - Area where known population parameters have been calculated
  - Area has highest development rate and so represents a conservative assessment approach

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McLoughlin et al. (2002)

Population delineation of grizzly bears • McLoughlin et al. 729

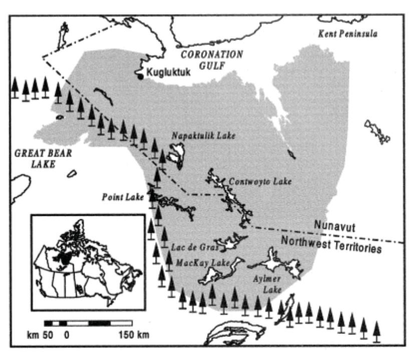

Figure 1. General area of the central Canadian Arctic, western Nunavut and the Northwest Territories, and the bounds of the study area (shaded region). The treeline indicates the northernmost extent of coniferous forest in the study area.

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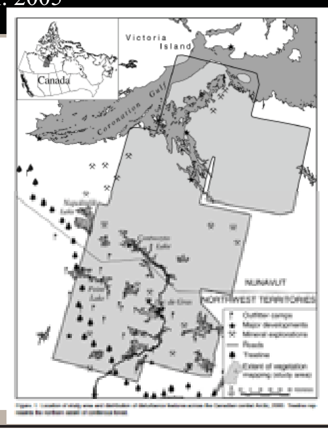
Johnson et al. 2005



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Reasonably Forseeable Developments in Caribou Study Area

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Other Comments

- Wolverine density calculations
- Waste management plan
- Foreseeable developments (e.g., Bathurst Inlet Port and Road [BIPR])
- Noise results, effects and guidelines
- Dust results, effects and monitoring

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Follow-up

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TECHNICAL MEMORANDUM

DATE August 10, 2011 **PROJECT No.** 11-1365-0001 (DCN 019)

TO Stephen Lines
De Beers Canada Inc.

CC Amy Langhorne

FROM John Virgl and Cameron Stevens **EMAIL** John_Virgl@golder.com

RESPONSE TO THE DRAFT CARNIVORE COMMENTS PROVIDED BY THE GOVERNMENT OF THE NORTHWEST TERRITORIES - DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Introduction

Golder Associates Ltd. (Golder) has prepared responses to the draft carnivore comments provided to De Beers Canada Inc. (DBC) by the Government of the Northwest Territories – Department of Environment and Natural Resources (ENR) on July 1, 2011. Golder understands that ENR provided these comments so they could be used as a basis for discussions between ENR and De Beers,

Two sets of comments were provided, one set by the ENR Wildlife Division, and the other by the ENR – North Slave Region. There are two attachments in this memorandum that address both sets of comments received. Golder has added numbers to the comments received so they can be easily referenced going forward.

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Attachment 1: Responses to ENR – Wildlife Division General Questions

GAHCHO KUÉ PROJECT
ENVIRONMENTAL IMPACT STATEMENT

SECTION 11.10
SUBJECT OF NOTE: CARNIVORE MORTALITY

ENR Wildlife Division – General Questions

Comment #1 (ENR – Wildlife)

Winter Access Road Area (page 11.10-6)

"The spatial area included for this study area was the 120 km winter access from the existing Tibbitt-to-Contwoyto Winter Road, to the Project site at Kennady Lake."

In fact, this project would be using the entire length of winter road from Tibbitt Lake to Kennady Lake. However, analysis in the EIS only focuses on the additional spur (from the turn-off at the Tibbitt – Contwoyto Winter Road to Kennady Lake). Is the cumulative impact of additional truck traffic (25 trucks per day) to pre-existing volumes on the primary Tibbitt to Contwoyto winter road, also being addressed? In other words, it would seem reasonable to expect there may be cumulative impacts in terms of the level of additional volume of vehicle traffic, and the potential for increased disturbance and harvest pressure on wildlife, that should be considered – beyond the geographic scope of the proponent's study area.

Response

Cumulative impacts were addressed in several locations in the EIS for the Gahcho Kué Project (Project). For example, at the scale of the population range (which includes the Tibbitt-to-Contwoyto Winter Road), cumulative effects from changes in winter habitat loss and fragmentation were analyzed (Sections 11.10.4.2 and 11.10.5.1). Similarly, cumulative changes in the quality of winter habitat from sensory disturbances were quantified for wolverine and wolves using resource selection functions (Sections 11.10.4.3.2 and 11.10.5.2.2). Sensory disturbance includes vehicle traffic along the winter roads. The pathway for effects to carnivore populations from vehicle collisions was assessed in the EIS (see page 11.10-92), and included mitigation for limiting vehicle mortality along the entire Tibbitt-to-Contwoyto Winter Road (Tibbitt-to-Contwoyto Winter Road Joint Venture 2000) and the Winter Access Road (e.g., wildlife have right-of-way and enforcing speed limits).

The reviewer also comments that increased hunting pressure along the Winter Access Road for the Project may contribute to cumulative effects on carnivore populations. The assessment considers the incremental increase in potential harvesting of carnivores from the Winter Access Road and current harvest along the Tibbitt-to-Contwoyto Winter Road (Sections 11.10.4.6 and 11.10.5.4). Similar to the response to the effects from increased access on caribou, the following provides additional information for the assessment of increased access on carnivores.

De Beers (2008) has detected no evidence of harvesting/hunting activity on the Snap Lake Winter Access Road, which occurs at kilometre 228 of the Tibbitt-to-Contwoyto Winter Road, and is closer to Tibbitt Lake than the Project Winter Access Road. Ziemann (2007) reported three wolverines harvested along the Tibbitt-to-Contwoyto Winter Road from 2004 to 2006 (no wolves were reported to be harvested). The Winter Access Road for the Project will begin at kilometre 271 of the Tibbitt-to-Contwoyto Winter Road. Therefore, harvesting along the Winter Access Road is expected to be limited, which has been the case along the Snap Lake Winter Access Road.

Snow machines can access areas through existing trails and along winter roads before they are open and after they close to vehicle traffic. In the assessment, it was assumed that the Winter Access Road will provide improved access with the potential to result in an increase in the harvest of carnivores. However, the spatial extent of the effect on the populations should be limited to the local area around the Winter Access Road and not extend well below the treeline. The duration of the effect is expected to continue until the end of final closure (i.e., 5 to 10 years after stopping the use of the Winter Access Road), but the frequency is limited to approximately 12 weeks each year. Overall, the marginal and local increase in harvest mortality from the Winter Access Road is not anticipated to have a significant adverse effect on the persistence of carnivore populations.

Comment #2 (ENR – Wildlife)

11.10.1.3.3 Grizzly Bear Study Area

"Like wolves, the life history and annual home range of grizzly bears in this area are closely tied to the Bathurst caribou herd. However, unlike wolves, these grizzly bears typically do not travel below the treeline."

In fact, ENR believes that grizzly bears in the Gahcho Kue area use an area that receives overlap use by both Bathurst caribou and Ahiak & Beverly caribou, although there is annual variability in caribou use of this range.

The statement that grizzly bears do not travel below the tree-line is inaccurate. Grizzly bears do travel below tree-line and have been sighted and harvested to the south and east of Kennady Lake and the RSA.

Response

The EIS states that grizzly bears "typically do not travel below the treeline" (page 11.10-6), which is intended to indicate that the population is at the southern extent of their range, and the probability of bears located below the treeline is low. The statement is not intended to imply that barren-ground grizzly bears would never be observed below the treeline, but likely would include little forested habitat within their home range relative to tundra habitats.

Comment #3 (ENR – Wildlife)

Figure 11.10-1

The EIS has focused its analysis on previous research and mine activity within the Slave Geological Province (SGP). However, the geographic scope of the current analysis seems to have overlooked the importance of the transition area near tree-line, and the vast area of grizzly bear habitat to the east of Gahcho Kue within the adjacent Churchill Geological Province (CGP), its boundary is on the eastern shore of Artillery Lake. The proponent's primary focus within the SGP, appears to be at the expense or exclusion of important grizzly bear habitat to the east and south of the RSA. The proposed study area for grizzly bears (Figure 11.10-1) appears to be based on satellite image boundaries, rather than adequately representing grizzly bear range in this region. Broader coverage, primarily to east and south of Gahcho Kue may be necessary in order to provide a more complete assessment of the potential impacts on this important and wide ranging species.

Response

The reviewer is correct that the Project is on the southern and eastern boundaries of the effects study area (SGP) for grizzly bear (and wolverine), and that there is more grizzly bear range within the CGP. However, the effects study area used in the EIS represents an appropriate approach for meeting the Terms of Reference and completing the assessment for the following reasons.

- The area (and portion of the population) has experienced the largest rate and spatial extent of development in the NWT and Nunavut, and therefore represents the most conservative (i.e., maximum effects) and appropriate spatial boundary for assessing cumulative effects on the population.
- Habitat selection and resource selection functions have been determined for the area (McLoughlin et al. 2002a; Johnson et al. 2005).
- The area includes most of the study area used to determine grizzly bear abundance and demographic rates (McLoughlin et al. 2003).

Using a larger area would have captured more natural ecological land cover types in the analysis, but would have also diluted the effects assessment because of the much lower ratio of human development to non-disturbed landscape outside of the SGP. We believe that the study area used in the assessment was appropriate to meet the Terms of Reference, and provides the most confident and ecologically relevant impact predictions.

Comment #4 (ENR – Wildlife)

Page 11.10-20

"In July 1999, all mapped and unmapped eskers within a 30-km radius of Kennady Lake were flown to locate grizzly bear and carnivore den sites." Although it's generally accepted that wolves select eskers for denning, there is increasing evidence that grizzly bears do not select esker habitat for denning as frequently, as previously thought (McLoughlin 2002). Using unbiased collar data to locate grizzly bear dens (Journal of Mammalogy, 83(1): 188-198p 2002), McLoughlin found that only 7 of 35 dens (20%) were situated on or near eskers. Heath tundra was found to provide important denning habitat (23 of 35 dens) for grizzly bears. Despite these findings, it seems that the much of the proponent's grizzly bear survey have focused on searching esker habitat. This raises further uncertainty as to whether the survey efforts to date have been adequate in terms of locating a reasonable portion of the grizzly bear dens within the RSA.

Response

The information on grizzly bear dens was presented as baseline data, but was not the primary focus of the effects assessment, and is not anticipated to be a component of the monitoring program. Based on results of monitoring at operating diamond mines, den occupancy has been determined to not be an efficient measure of mine-related effects. The detection of den sites in habitats other than eskers is logistically difficult, and the number of den sites in the study areas is not large enough to separate the effects from mine-related and natural factors on den occupancy.

The reviewer states correctly that eskers are not the only important habitat for bear dens. McLoughlin et al. (2002b) found that eskers were statistically preferred relative to their availability in the study area, and heath tundra was selected for den sites in proportion to availability (see Annex F, Section F4.2 for a more comprehensive presentation of baseline conditions). Approximately 40% (23 of 56) of all dens were located in heath tundra habitat (McLoughlin et al. 2002b). Other studies have shown that grizzly bears select seasonal ranges that include eskers (McLoughlin et al. 2002a, Johnson et al. 2005). Given the large area of heath tundra, surveys for dens in heath tundra is logistically difficult without the use of collared bears. In addition, the initial Project designs included the use of glaciofluvial material for construction material, and searches for den sites in this limited and statistically preferred habitat were necessary to determine potential impacts. The Project design in the submitted EIS does not include the use of esker material.

McLoughlin et al. (2003) estimated 800 bears in their study area (235,000 km^2), or approximately 1 bear per 300 km^2. Given that the local study area is about 200 km^2, it is predicted that one (perhaps two) bear den(s) may be directly influenced by Project activities in some years, which has a negligible affect on the impact predictions in the EIS.

Comment #5 (ENR – Wildlife)

Page 11.10-21

The stated objectives of the baseline study were to **"document the natural variation in the presence and relative activity levels of wolverine in the RSA and LSA".** Given the variability in environmental conditions, timing of surveys, inability to distinguish individual wolverines, and variability between individuals in terms of travel patterns, it would seem somewhat questionable whether track count surveys can actually provide a useful or reliable measure of assessing relative activity levels. Given the uncertainty in what track count surveys actually represent, one might expect a corresponding low level of confidence in the results and impact predictions for this species.

Response

The assessment approach does not solely rely on one method to predict Project-specific and cumulative effects on wolverine. Winter track count surveys, DNA hair sampling, and incidental observations were all used to provide an index of the relative activity, distribution, and abundance of wolverine in the local and regional study areas.

To meet the Terms of Reference and assess incremental and cumulative effects on the wolverine population(s), the EIS uses multiple approaches for making impact predictions by analyzing seasonal changes in habitat quantity and fragmentation and the abundance of quality habitats (with resource selection functions [Johnson et al. 2005]), and completing population viability analysis. In addition, the EIS has integrated uncertainty and ecological conservatisms throughout the assessment (see detailed response for caribou for conservatisms that were also part of the wolverine assessment). Thus, the impact predictions have a moderate to high level of confidence as they are based on the results from long-term monitoring programs at operating diamond mines (e.g., direct mine-related mortality and incidents), regional collaborative government-industry research studies (i.e., DNA hair sampling in the Lac de Gras and Kennady Lake regions), and habitat selection coefficients and demographic estimates from the peer-reviewed scientific literature.

Comment #6 (ENR – Wildlife)

Page 11.10-23

The proponent states that **the track density index (TKD) is used to determine the relative abundance of wolverines in the LSA for each survey period**. Yet, on the following page, the report states that "**It is important to acknowledge that the snow track method is not designed to estimate the annual changes in abundance of wolverines in a study area**". Can the proponent clarify how snow track counts surveys are in fact intended to contribute to our understanding of wolverine relative abundance. Based on the evidence to date, the use of snow track data to establish patterns of use or relative abundance seem be rather inconclusive.

Response

The reviewer has detected an inconsistency in the terminology used in the text. Relative abundance refers to the change in activity levels from year to year, as opposed to the number of individuals in the study area. Snow track surveys were not intended to determine the abundance of wolverine in the study area. However, studies have documented the ability of winter track count surveys to detect annual variation in relative activity levels, and changes in the probability of occurrence of wolverine tracks as a function of distance from operating mines (DDMI 2007; De Beers 2008; Golder 2011). As stated in the response above to Comment #5 (ENR-Wildlife), the impact predictions to wolverine were not solely based on winter track surveys, but were determined from a number of analyses that used robust and quantitative measurement endpoints in accordance with the Terms of Reference (e.g., changes to habitat quantity, fragmentation, and quality).

Comment #7 (ENR – Wildlife)

Page 11.10-31

Without knowing how many individual bears contribute to bear sign in the sedge wetland and riparian plots, it's unclear what the detected variability in bear sign actually represents in terms of annual use. Uncertainty in the sampling data, would introduce uncertainty in the assessment.

Response

Bear sign surveys, den surveys, and incidental observations were used to provide an index of the relative activity and distribution of grizzly bear in the local and regional study areas. The EIS does not solely rely on the results from the bear sign surveys and incidental animal observations in the regional study area to analyze and predict Project-specific and cumulative effects on grizzly bear. To meet the Terms of Reference and assess incremental and cumulative effects on the grizzly bear population, the EIS uses multiple approaches for making impact predictions by analyzing seasonal changes in habitat quantity and fragmentation and the abundance of quality habitats (with resource selection functions [Johnson et al. 2005]), and completing population viability analysis. In addition, the EIS has integrated uncertainty and ecological conservatisms throughout the assessment (see detailed response for caribou for conservatisms that were also part of the grizzly bear assessment). Thus, the impact predictions have a moderate to high level of confidence as they are based on the results from monitoring programs at operating diamond mines (e.g., direct mine-related mortality and incidents), and habitat selection coefficients and demographic estimates from collaborative academic-government research studies, which have been published in the peer-reviewed scientific literature.

The limitations of the bear sign surveys for monitoring effects from mining activities on grizzly bears has been identified (De Beers 2008), and De Beers is currently completing pilot studies using hair-snagging methods to monitor annual and spatial changes in the relative activity and distribution of grizzly bears in the regional study area. The hair-snagging approach for monitoring grizzly bear has been recommended by ENR, particularly if it is carried out using similar study designs and sampling methods at other mine sites.

Comment #8 (ENR – Wildlife)

11.10-32

Unless there is some means of distinguishing individual bears, or correcting for effort per incidental sighting, it's unclear what comparisons can be made with these incidental observations. For example, what can be concluded from the observation at Snap Lake there were 13 incidental observations of grizzly bears over a seven year period - from 1999 through 2006. At the Ekati Diamond mine there were 76 incidental observations in 2005. Unless this data is put into context, and corrected for sightability bias, this data seem to be somewhat anecdotal.

Response

The reviewer is correct that incidental observations are anecdotal and simply reflect the relative activity of bears in an area, and a biased index of bear density. The information is intended to provide a relative index of the activity levels (and abundance) of barren-ground grizzly bears within different geographic areas (i.e., near Lac de Gras and south of MacKay Lake) of the population range. As stated in the response above to Comment #7 (ENR - Wildlife), the impact predictions to the grizzly bear population were not solely based on incidental observations, but were determined from a number of analyses that used robust and quantitative measurement endpoints in accordance with the Terms of Reference (e.g., changes to habitat quantity, fragmentation, and quality).

Comment #9 (ENR – Wildlife)

Page 11.10-34

The discussion on the removal of problem bears from the Slave Geological Province is unclear and contains incomplete harvest data. The SGP is distributed over the Kitikmeot region of Nunavut and the North Slave region of the NWT. The proponent should work with these jurisdictions to obtain more recent harvest data. Updated harvest data would provide a more solid basis from which to discuss regional patterns of mortality.

"The hunting of grizzly bears in the SGP is not permitted". Again, the proponent should be careful in describing patterns of hunting across a vast geological formation (SGP). This statement is incorrect.

Response

ENR is correct, and the text should be revised to state that no tags are issued for grizzly bears in the NWT region of the SGP. However, there is a harvest of grizzly bears in the Nunavut region of the SGP. Importantly, substantial effort was taken to obtain as much relevant and up-to-date harvest information as possible during the completion of the EIS. More recent efforts have been made to acquire additional harvest data for grizzly bears from the different jurisdictions in the NWT and Nunavut. Once received, the data will provide additional baseline information on regional patterns of mortality in the grizzly bear population.

Comment #10 (ENR – Wildlife)

Page 11.10-35

The report makes reference to "satellite" collared wolverine studies on the central Canadian Arctic barrens. To date, the GNWT has only deployed VHF radio collars on wolverines.

Although density estimates have been calculated from across four study areas (Boulanger and Mulders, 2007), it may be a bit simplistic to extrapolate these densities to generate a regional population estimate. To date, no density estimate has been obtained for the Snap Lake project. Considering the significant decline in caribou abundance in recent years, one might expect additional uncertainty in estimating wolverine population size.

Response

The text referring to "satellite" collared wolverines is incorrect. We agree that the density estimates may be biased, but represent an appropriate approach for predicting effects to barren-ground wolverine populations, as opposed to using estimates from other regions or ecosystems in North America and Europe. We have used the best information available for the effects study area. The approach was appropriate for meeting the Terms of Reference and providing confident and ecologically relevant impact predictions. For example, the assessment included both habitat fragmentation analysis and the use of habitat quality models, which together limit the bias and imprecision in predictions. In addition, many ecological conservatisms were incorporated into the assessment so that the impacts would not be worse than predicted (e.g., footprint area for exploration sites was 500 m radius (78.5 ha), a 5 km zone of influence was applied to all active exploration sites for the entire five year permit period and the entire year, and a 15 km zone of influence was applied to all active mine sites (including the Project) regardless of the size and level of activity of each mine).

Comment #11 (ENR – Wildlife)

Page 11.10-37

"There were 23 incidental observations of wolverine reported at the Ekati Diamond Mine in 2006, which decreased from 128 observations in 2005 (BHPB 2007)". An obvious explanation for this annual variation (reduction) might involve the removal of 5 problem wolverines from BHP's regional study area in January 2005. Removing 5 individuals from this study area would provide a reasonable explanation for subsequent decline in incidental observations.

Response

We agree that most of variation in the number of incidental observations was likely due to the removal of animals from the study area.

Comment #12 (ENR – Wildlife)

Page 11.10-38

Given the poor weather conditions, and the confounding environmental factors involved in the collection of snow track data (an acknowledged limitation of this survey technique) it would seem difficult to distinguish any real differences or changes in relative abundance (i.e. 0.01 vs. 0.12 TKD) with this dataset. This uncertainty would suggest there might also be low confidence in the conclusions being made.

Response

Potential variability in relative abundance has been reduced by adjusting track densities for weather conditions and by completing them when conditions permit. There is currently no consensus in the literature that track surveys can not be used to monitor the relative activity of wolverine across time and space (see DDMI 2007). As stated in the response above to Page 11.10-21 (Comment #5 [ENR-Wildlife]), the impact predictions to wolverine were not solely based on winter track surveys, but were determined from a number of analyses that used robust and quantitative measurement endpoints (e.g., changes to habitat quantity, fragmentation, and quality). The approach and methods provides confident and ecologically relevant impact predictions.

Comment #13 (ENR – Wildlife)

Page 11.10-41

Technically, the 2004 Daring Lake wolverine results (53 wolverines) is not directly comparable with the 2005 survey (38 wolverines) or 2006 survey (33 wolverines) results. The 2004 survey involved four 10 day sessions, which is twice the sampling effort of the subsequent surveys involving two 10 day sessions.

It may be true that none of the individuals identified in the Lac de Gras area (based on DNA microsatellites), were subsequently detected in the Gahcho Kue Project study area. However, it's worthwhile noting the documented southward movement of Lac de Gras wolverines; VHF collar data did document the long-range southern movement of 3 individuals (Mulders, 2000). As well, a number of wolverines in the Lac de Gras area were subsequently harvested below tree-line (near Reliance and Lutsel ke).

Response

The point is noted and it is understood that the results from the two areas may not be directly comparable, and that there has been long-distance movements made by VHF collared animals. We also appreciate the information provided about the individuals harvested below the treeline, which provides more information on the effective dispersal distance in barren-ground wolverine populations. The intent of our analysis of these data was only to provide an indication of the extent of population areas that are mostly influenced by reproduction and mortality, and are spatially separated (Berryman 2002).

Comment #14 (ENR – Wildlife)

Page 11.10-44

Yes, ENR permits a low level of wolverine harvest by sport hunters. Given the low rate of encounter, the number of wolverines harvested on an annual basis by sport hunters is typically a small fraction (2-4%) of the tags issued. As per terms of their Environmental Agreements, established mines have made a commitment to minimize any wolverine mortality during the duration of their mining operations.

In addition to the "intentional" wolverine mortalities that occur at mine sites, the proponent should also consider the potential cumulative mortalities that likely occur as a result of relocating wolverines as well. ALL removals (intentional mortalities as well as relocated wolverines) from a regional study area should be considered when conducting regional analysis. Table 11.10-4 (on page 11.10-62) combines deterrent, relocation, and report of damage under the heading of "incidents" and as independent from intentional mortalities. Since there were no documented cases of marked "relocated" wolverines returning to regional study areas, classification of relocated wolverines as mere "incidents" likely understates the significance of these removals on the local population. For example, in addition to 5 “intentional” wolverine mortalities at Ekati, there were 5 additional wolverines that were captured (as habituated problem wolverines) and relocated; removed from the Ekati study area. From a biological perspective, it would seem more appropriate for the proponent to conduct analysis on the potential significance of having 10 wolverines removed from Ekati over a 6 year period. In addition to considering mortalities at established mines, inclusion of all wolverine mortalities at exploration camps and winter road camps would provide a more comprehensive review of the impact of mining activity on the regional wolverine population. The current analysis likely understates the actual significance of these removals. A re-analysis, with more complete records, would seem warranted.

Response

Substantial effort was taken to obtain as much relevant and up-to-date harvest information as possible during the completion of the EIS. More recent efforts have been made to acquire additional harvest and mortality data for wolverines from the different jurisdictions in the NWT and Nunavut. Once received, the data will provide additional baseline information on regional patterns of mortality in the wolverine population(s). However, considering the general harvest levels and relocations reported in the EIS, it seems unlikely that a re-analysis will change the overall conclusions. In other words, the incremental effect from the Project should remain ‘low’ and the cumulative effects from the Project and other developments are expected to remain ‘moderate’ in magnitude (See Table 11.10-37).

If we assume that all relocations result in death, then there have been approximately 21 wolverine mine-related mortalities since 1996 (a 54-yr period [represents sum of construction and operating years for Ekati, Diavik, Snap Lake, and Jericho mines]). This is equal to an annual mortality rate equal to 0.389 wolverine per mine (versus 0.204 wolverine per mine reported in the EIS). Thus, based on the length of time from construction to the end of closure (22 years), it is predicted that 8-9 wolverine may be removed from the population due to the Project (which during any given year may be well over 1,000 animals) (for comparison see the results presented in the EIS on page 11.10-137). 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 only 1 wolverine has been killed during the 12-year period from construction to operations (1999 to 2010) (also see page 11.10-137). In addition, 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 wolverine-Project interactions.

Comment #15 (ENR – Wildlife)

Page 11.10-52

The estimated wolf harvest levels for Yellowknife hunters (Carrierre 2007 in Berens 2007, internet site) does not include all reported wolf mortalities for the southeast portion of the NWT. Inclusion of the Border A and Border B harvest (on caribou winter range), in the southeast portion of the NWT, would reflect higher levels of wolf harvest that should probably be considered.

Response

Substantial effort was taken to obtain as much relevant and up-to-date harvest information as possible during the completion of the EIS. We will inquire about collecting additional harvest data for wolves in the area of Border A and Border B, and upon receipt, the data will provide additional baseline information on regional patterns of harvest levels in the wolf population.

Comment #16 (ENR – Wildlife)

Pages 11.10-57 – 11.10-61

The report lists regional single year harvest levels for red fox, marten (in 2005/2006) and lynx in 2006/2007. A multi-year summary of harvest levels would provide a measure of annual variability in harvest. This variation would not only reflect annual differences in hunting and trapping effort, but would also serve to reflect some of the annual fluctuation in relative abundance that typically occurs in furbearer populations. Documenting variability in baseline conditions would likely be useful when subsequently considering potential residual effects.

Response

Substantial effort was taken to obtain as much relevant and up-to-date harvest information as possible during the completion of the EIS. More recent efforts have been made to acquire additional harvest data for carnivores from the different jurisdictions in the NWT and Nunavut. Once received and evaluated, the data may provide additional baseline information on the annual variation in harvest levels in furbearer populations.

Comment #17 (ENR – Wildlife)

Page 11.10-64

"The report states that the frequency of incidents grizzly bear, wolverine and fox appear cyclic (i.e. periods associated with a high number of incidents interspersed with fewer incidents. This may be indicative of cycles in populations of carnivores or their prey." From an ENR perspective, there is another possible explanation. The habituation of wolverine and foxes to local areas is often directly related to either a weakness in camp design and/or problem with following waste management practices. When a state of emergency is declared due to ongoing property damage or concern over human safety, ENR staff may be asked to either kill or relocate problem animals. Once habituated individuals are removed, and deficiencies in the waste management policies (i.e. food, waste, odours, shelter) are addressed, the situation typically settles down. The subsequent decline in relative abundance of wolverine and fox, could be a direct consequence of removing individuals from the RSA. Note the significant drop in incident wolverine sightings at Ekati in 2006, after 5 wolverines were removed from the RSA. The removal of multiple individuals (fox and wolverine) effectively creates a vacuum (lower numbers) within the RSA, and may be contributing to the perceived cyclical pattern.

Response

It is agreed that the majority of decrease in the number of incidental observations during 2006 was likely due to the removal of animals from the study area in January 2005. The low values for late-winter (March-April) 2005 wolverine track data collected at Diavik supports the reviewer's comment (Figure 1). Alternately, the increase in the number of tracks in December 2005 is not explained by the removal of animals in January, and additional factors appear to be producing the patterns observed from the winter track count surveys.

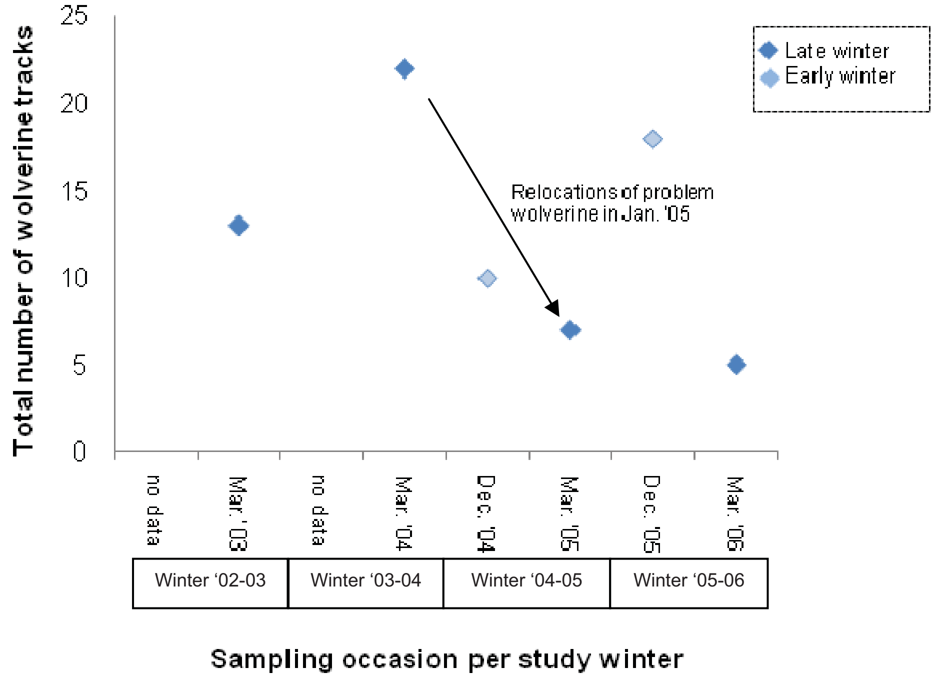

Figure 1. Total tracks observered from 23 transects (148 km total length) surveyed during early winter (December) and late winter (March/April) at the Diavik mine, NWT; surveys were not completed in December 2002 or December 2003.

Comment #18 (ENR – Wildlife)

Page 11.10-94

The Waste Management Plan will be an important strategy to minimize potential carnivore incidents and mortality levels. Reference to food waste being stored in sealed plastic bags, bags being stored in sealed wildlife-resistant containers, transport to fenced incinerator storage areas, and subsequent transport of ash to the landfill – seems cumbersome. Each step in this complicated, multi-stage process is prone to human error, and will not eliminate odors. An efficient, properly maintained incinerator operated adjacent to the kitchen provides a direct solution, might be more cost effective and minimize unnecessary handling and storage. Two meter high partially buried fencing, with not prevent wolverines from climbing fences and accessing waste transfer areas. (note the Diavik experience).

Response

This suggestion is noted and will be considered as part of the final Project design. It is important to mention that the location of the incinerator proposed by ENR to mitigate attraction of wildlife may not exactly correlate with the location suggested by Environment Canada to limit air quality issues respectively. However, efforts will be made to arrive at a suitable arrangement.

Comment #19 (ENR – Wildlife)

Page 11.10-96

Increased access to the Winter Access Road by residents, non-residents, and aboriginal harvesters could potentially have a significant impact on harvest pressure on caribou, wolves and wolverine. Although the road may only be open for 8-12 weeks per year, the potential for increased harvest along a new seasonal linear development, adjacent to caribou winter range, could be quite significant. In addition to measures offered by the proponent to monitor potential impacts, there is a need for broader discussion and involvement of governments and stake holders to explore practical options for regulating harvest along winter roads.

Response

See response above to comment concerning Winter Access Road page 11.10-6 (Comment #1 [ENR – Wildlife]). Also, please see the response concerning caribou on the same subject (Memo submitted to ENR July 22, 2011; Caribou – Comment #1).

Comment #20 (ENR – Wildlife)

Page 11.10-104

Other projects - A major foreseeable development that would affect wildlife on a regional scale involves the Bathurst Inlet Road and Port, with its associated mine developments. This is expected to start within the lifetime of the Gahcho Kue operation, and would be a significant component of any region cumulative effects assessment. Why has the proponent not included the BIRAP in this analysis?

Response

The Bathurst Inlet Port and Road (BIPR) was not included in the list of reasonably foreseeable future developments because at the time of the assessment it did not satisfy the criteria for inclusion, which included projects that met the following criteria:

- have been proposed and scoped to a reasonable level of detail;
- may be induced by the Project, and
- have the potential to change the Project and the Project-specific impact predictions.

The uncertainty regarding the development of the Bathurst Inlet Road and Port has been recently clarified by the proponent[1], who has indicated to the Nunavut Impact Review Board that it does not plan to continue with the review of the project proposal. Therefore, we feel it would not be appropriate to consider it as part of the assessment.

[1] Letter dated July 7, 2011, from Grant Pearson BIPAR, to Ryan Barry, NIRB.

Comment #21 (ENR – Wildlife)

Page 11.10-110

The report suggests there are no noise guidelines for wildlife. Is it appropriate to use human guidelines to make predictions of potential effects on carnivores? It would seem reasonable to assume that there might be significant differences in tolerance and noise detection levels for humans and for wildlife. Given the fairly significant finding that caribou may be influenced by a 15 km Zone of Influence around mining developments, a more conservative approach to assessing various forms of sensory disturbance might be warranted.

In considering the impacts of aircraft noise, has the proponent also considered the impact of cumulative sources of aircraft noise within the RSA associated with anticipated increases in exploration activity, and aerial monitoring flights involving helicopter use? Have the impact predictions made by other mines, about the anticipated volume and potential impacts of aircraft traffic, been considered in this EIS?

Response

With no knowledge of threshold noise levels for carnivores (and other wildlife), the assessment used guidelines for humans to provide some indication of the local changes in noise levels from the Project. In addition, noise modeling predicted the distance from the Project when the noise from different sources would reach background levels (Section 11.10.4.3.1; Table 11.10-14), which was used to help estimate zones of influence for the analysis. For example, noise from mining operations is predicted to reach background levels at 3.5 km from the Project.

The reviewer is likely correct that the sensitivity of carnivores to Project-related noise is greater than humans. This is why the analysis was not limited to predicting local-scale noise effects to carnivores through a comparison to human noise assessment guidelines. The analysis also quantified changes in habitat quality, which included noise and other sensory disturbances, from the Project and other developments using varying disturbance coefficients within zones of influence up to a maximum of 15 km for operation mines and the Project (Section 11.10.4.3.2; Table 11.10-17). For example, habitat quality was reduced by 95% and 50% within 1 km and 1 to 5 km of the footprint for the Project and other operational mine sites within the seasonal ranges of carnivores. Zones of influence and disturbance coefficients also were applied to all other developments (e.g., exploration camps, roads, and outfitting camps) within the carnivore population areas. This analysis was intended to more accurately predict the effects from noise levels and other sensory disturbances on carnivore habitat, behaviour, and movement, and the persistence of populations. We believe that a 15 km zone of influence is conservative as the general thinking in the literature is that spatial extent of disturbance around human developments usually extends no more than 5 km (e.g., Vistnes and Nelleman 2008, Benitez-Lopez et al. 2010). The assessment approach and methods were appropriate for meeting the Terms of Reference, and provided confident and ecological relevant impact predictions.

Comment #22 (ENR – Wildlife)

Page 11.10-111

The report states that the major effects of dust deposition occurs within 5 to 50 meters of a road (Meininger and Spatt, 1988), with less obvious effects observed between 50 and 500 m from the road. This may be true, but there is increasing evidence that the impacts of dust deposition on wildlife are not well known and may be significant beyond 500 m. If caribou appear to be influenced by a 15 km Zone of Influence (ZOI) around mining developments, a more conservative approach to assessing various forms of sensory disturbance would seem warranted. Although this behavioral response has been demonstrated for caribou, there are obvious implications for carnivores that prey and scavenge on caribou. The current analysis does not fully consider the potentially significant impacts of low levels of dust deposition (beyond 500 m) on wildlife behavior and habitat use. Dust may also influence the rate and timing of snow melt, which would have direct implications on the timing of green-up, which could potentially serve to attract ungulates. Clearly, the influence of dust deposition is poorly understood and potentially quite significant. Future research and monitoring attention should perhaps be directed at assessing the influence and mechanism of dust deposition in contributing to the observed 15 km ZOI for caribou.

Response

Please see responses concerning caribou on the same subjects. In addition, an ecological risk assessment was completed to evaluate the potential for adverse effects on individual animal health associated with exposure to chemicals through fugitive dust, air emissions, and surface water pathways (Section 11.10.3.2, page 11.10-81). The result of the assessment was that no impacts are predicted for the health of carnivores.

Comment #23 (ENR – Wildlife)

Page 11.10-113

The proposed winter access road is an additional extension to the existing network of winter roads. This additional spur is located just above tree-line and has the potential to influence the movement of caribou associated with the Bathurst herd, and/or the Ahiak/Beverly herds in late winter. Given the close proximity of this spur to caribou winter range, it would seem that the potential impacts of this new stretch of winter road may have significant implications for caribou.

Response

Please see the response concerning caribou on the same subject (Memo submitted to ENR July 22, 2011; Caribou Comment #1).

Comment #24 (ENR – Wildlife)

Page 11.10-34

The discussion on the removal of problem bears from the Slave Geological Province contains incomplete harvest information. The SGP is positioned over a portion of the Kitikmeot region of Nunavut and a portion of the North Slave region of the NWT. The proponent should approach each jurisdiction and obtain more recent harvest data. Updated harvest data would provide a more solid basis from which to discuss regional patterns of mortality across this region (geological formation).

"The hunting of grizzly bears in the SGP is not permitted". Again, the proponent should be careful in describing patterns of hunting across a vast geological formation (SGP). This statement is incorrect.

Response

See response above to comment concerning page 11.10-34 (Comment #9 [ENR – Wildlife]).

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Attachment 2: Responses to ENR – North Slave Region Comments

GAHCHO KUÉ PROJECT
ENVIRONMENTAL IMPACT STATEMENT

SECTION 11.10
SUBJECT OF NOTE: CARNIVORE MORTALITY

SECTION 11.8
SUBJECT OF NOTE: TRAFFIC AND ROAD ISSUES

ENR NORTH SLAVE REGION (NSR)

Wolverine

Comment #1 (ENR – NSR)

Page 11.10-23 & 24

Why continue with monitoring tracks in snow for wolverine? Why not just adopt the hair snagging/DNA method, especially since it has become a “best practices” technique? There is merit to compare techniques, so doing both is good, if De Beers so chooses. However, if only one method is adopted it needs to be the hair-snagging technique.

Response

The assessment approach does not solely rely on one method to predict Project-specific and cumulative effects on wolverine. Winter track count surveys, DNA hair sampling, and incidental observations were all used to provide an index of the relative activity, distribution, and abundance of wolverine in the local and regional study areas.

To meet the Terms of Reference, and assess incremental and cumulative effects of the Project on the wolverine population(s), the EIS uses multiple approaches for making impact predictions by analyzing seasonal changes in habitat quantity and fragmentation and the abundance of quality habitats (with resource selection functions [Johnson et al. 2005]), and completing population viability analysis.

Studies have documented the ability of winter track count surveys to detect annual variation in relative activity levels, and changes in the probability of occurrence of wolverine tracks as a function of distance from operating mines (DDMI 2007; De Beers 2008; Golder 2011). A study comparing snow-track and hair snagging DNA methods was completed by Diavik Diamond Mines and demonstrated that the annual density of wolverine hair samples and snow tracks were spatially correlated (DDMI 2007). The study concluded that track data appears to better quantify effects of mining developments on the spatial distribution of wolverine activity (i.e., attraction to the mine).

The report also concludes that mark-recapture techniques would be informative if direct mine-related mortality occurs frequently during mining operations (DDMI 2007). However, it has been demonstrated at De Beers’ Snap Lake Mine, that existing mitigation and waste management practices for limiting direct mine-related mortality to wolverines have been successful (i.e., one wolverine has been killed during the 12-year period from construction to operations (1999 to 2010)). The same designs, policies, and procedures will be implemented by the Project.

Winter track surveys are therefore an appropriate design for monitoring Project-related effects on wolverines in the Kennady Lake study area; and also to verify the effectiveness of mitigation to provide the necessary feedback for adaptive management during operations.

Comment #2 (ENR – NSR)

Page 11-10-35

As Robert [Mulders; Wildlife Biologist, Carnivore/Furbearers, ENR] pointed out, the home range estimate of wolverine came from VHF-only collars. Very few satellite collars were deployed. I believe there was 2, one didn't work right away and one failed very soon after deployment.

Response

The information is appreciated, and we acknowledge that the text referring to "satellite" collared wolverines is incorrect.

Comment #3 (ENR – NSR)

Page 11-10-35

128 wolverine incidence in 2005 down to 23 in 2006 (Ekati). One needs to refer to trapping and relocation of wolverine for that time period.

Response

It is agreed that the removal (individuals relocated or destroyed) of five wolverines during the winter of 2005 along Misery Road likely contributed to the decrease in incidental observations during 2006. We will include this information in the Carnivore Incident/Mortality database, and have provided an explanation of how this additional information would influence the impact predictions (see response to Comment #14 [ENR – Wildlife]).

Comment #4 (ENR – NSR)

Page 11.10-44

wolverine tags issued to sports hunters.

- this is not an indication of harvest kill rates, as hunting practices changed

Page 11.8-35

- an issued tag is not a "killed" tag

Response

It is agreed that the number of animals harvested is likely less than the number of tags issued. This is a relative measure of how much harvest ENR believes is allowable, which is greater than the reported removals from developments. The number of tags represented the best available information for estimating harvests (to the knowledge of the authors of the EIS). More recent efforts have been made to acquire additional harvest data for wolverines (and other carnivores) from the different jurisdictions in the NWT and Nunavut. Once received, the data will provide additional baseline information on regional patterns of mortality in the wolverine population(s).

Wolf

Comment #5 (ENR – NSR)

Page 11.10-26

-ground surveys along eskers as a follow-up to aerial surveys

1) were additional dens found?

2) were these sites check aerially the following year?

- if so, which ones/how many were active again?

Response

Baseline searches for wolf dens occurred in 1999 to 2001, 2004, and 2007 and included both aerial and ground searches of eskers during late May and early June for inactive and active dens (Annex F, Section F3.2.3). Follow-up surveys were completed on the ground where wolf sign, such as prey bones or scat, occurred. A total of 25 dens were identified in the regional study area as part of baseline monitoring activities. Surveys of these dens continued during 2010 (Addendum FF). Dens deemed active were surveyed a second time in late July and August for the presence of young. Since 1999, nine wolf dens have been active including two that have been active in multiple years. Additional results of baseline wolf den surveys are reported in Annex F, Section F4.3.2.

Comment #6 (ENR – NSR)

Page 11.10-26

- [ground] inspection of dens by helicopter

- exactly what did this entail? When were the inspections done?

Response

Inspections included more thorough searches for wolf sign such as prey bones, scat, or animal presence. In addition, measurements of den openings were recorded at three dens. As noted in the comment above regarding baseline wolf den methods, surveys were completed between late May and August. Additional details of baseline methods are reported in Annex F, Section F3.2.3.

Comment #7 (ENR – NSR)

Page 11.10-52

- wolf harvest by Yellowknife hunters; resident harvest data is not sufficient to estimate overall wolf harvest.

- given the large study area adopted for assessment of cumulative effects, harvest records should include the “Rennie Lake” or Border Licence A wolf hunt.

Response

Substantial effort was taken to obtain as much relevant and up-to-date information as possible during the completion of the EIS. We will inquire about collecting additional harvest data for wolves in the area of Border License A, and upon receipt, the data will provide additional baseline information on regional patterns of harvest levels in the wolf population.

Comment #8 (ENR – NSR)

Page 11.10-65

- wolf found dead at Ekati in 2006; could also state that a necropsy was done on this animal too

- stomach contents – largely empty except for pieces of wire and wire coatings

Response

We appreciate the additional information and will add it to the Carnivore Incident/Mortality database.

Comment #9 (ENR – NSR)

Page 11.10-150

-when discussing wolves at Ekati, should also mention the active wolf den near the airport in 2004.

Response

We appreciate the additional information.

Comment #10 (ENR – NSR)

Page 11.10-156

"It is predicted that the number of wolf harvested in the region from improved access due to the Winter Access Road for the Project will not be detectable from baseline conditions."

-- this concern is too easily dismissed, and needs further explanation.

Response

The prediction that the wolf harvest will not noticeably increase during operation of the Winter Access Road is based on the following principal reasons, which are generally applicable to all wildlife and are also expanded on in our responses concerning caribou on the same subject.

De Beers (2008) has detected no evidence of harvesting/hunting activity on the Snap Lake Winter Access Road, which occurs at kilometre 228 of the Tibbitt-to-Contwoyto Winter Road, and is closer to Tibbitt Lake than the Project Winter Access Road. Ziemann (2007) reported three wolverines harvested along the Tibbitt-to-Contwoyto Winter Road from 2004 to 2006 (but no wolf harvests were reported). The Winter Access Road for the Project will begin, at kilometre 271 of the Tibbitt-to-Contwoyto Winter Road. Therefore harvesting along the Winter Access Road is expected to be limited, which has been the case along the Snap Lake Winter Access Road.

Snow machines can access areas through existing trails and along winter roads before they are open and after they close to vehicle traffic. In the assessment, it was assumed that the Winter Access Road for the Project will provide improved access over the existing winter roads, and has the potential to result in an increase in the harvest of carnivores. However, the spatial extent of the effect on the populations should be limited to the local area around the Winter Access Road and not extend well below the treeline. The duration of the effect is expected to continue until the end of final closure (i.e., 5 to 10 years after stopping the use of the Winter Access Road), but the frequency is limited to approximately 12 weeks each year. Overall, the marginal and local increase in harvest mortality from the Winter Access Road is not anticipated to have a significant adverse effect on the persistence of carnivore populations.

Comment #11 (ENR – NSR)

"... Artillery Lake Adventures has a camp ...., and should not be influenced by the Project."

-- this needs to be expanded to explain the rationale behind this conclusion.

Response

Artillery Lake is located approximately 80 km southeast of the Project, which is well beyond the predicted spatial extent of effects from the Project on wolf habitat quality, behaviour, and movement (i.e., maximum zone of influence for the Project is predicted to be 15 km, and does not overlap the camp at Artillery Lake).

Grizzly Bear

Comment #12 (ENR – NSR)

Page 11.10-28

- how were grizzly bear dens identified?, i.e., what criteria were used?

- sounds like only eskers were flown, if so, this is likely biased (see McLoughlin et al. 2002, J. Mammalogy)

- bear sign per plot – too variable for use as a technique

Page 11.8-34

No mention of the scientific analysis of grizzly bear dens and that eskers are used less often than thought. This should be included whether or not it conflicts with TK.

Response

Grizzly bear dens were identified by the presence of bear sign such as tracks, scat, and digs, during both helicopter and ground surveys as part of a larger program to locate dens of carnivores in the regional study area (Annex F, Section F3.2.2.2). Surveys for grizzly bear dens on foot occurred in 1998, 1999, 2004, and 2007 and were completed by experienced biologists and First Nation assistants.

The information on grizzly bear dens was presented as baseline data, but was not the primary focus of the effects assessment, and is not anticipated to be a component of the monitoring program. Based on results of monitoring at operating diamond mines, den occupancy has been determined to not be an efficient measure of mine-related effects. The detection of den sites in habitats other than eskers is logistically difficult, and the number of den sites in the study areas is not large enough to separate the effects from mine-related and natural factors on den occupancy.

The reviewer states correctly that eskers are not the only important habitat for bear dens. McLoughlin et al. (2002a) found that eskers were statistically preferred relative to their availability in the study area, and heath tundra was selected for den sites in proportion to availability (see Annex F, Section F4.2 for a more comprehensive presentation of baseline conditions). Approximately 40% (23 of 56) of all dens were located in heath tundra habitat (McLoughlin et al. 2002a). Other studies have shown that glaciofluvial deposits represent important denning habitat, and grizzly bears select seasonal ranges that include eskers (Mueller 1995; Banci and Moore 1997; McLoughlin et al. 2002b; Johnson et al. 2005). Given the large area of heath tundra, surveys for dens in heath tundra is logistically difficult without the use of collared bears. In addition, the initial Project designs included the use of glaciofluvial material for construction material, and searches for den sites in this limited and statistically preferred habitat were necessary to determine potential impacts. The Project design in the submitted EIS does not include the use of esker material.

McLoughlin et al. (2003) estimated 800 bears in their study area (235,000 km^2), or approximately 1 bear per 300 km^2. Given that the local study area is about 200 km^2, it is anticipated that one (perhaps two) bear den(s) may be directly influenced by Project activities in some years, which has a negligible affect on the impact predictions in the EIS.

Arctic Fox

Comment #13 (ENR – NSR)

Page 11.10-56

- there have been sightings of arctic fox in Yellowknife some winters, and this area is considered as part of the species' range.

- "Voight" is spelled "Voigt"

Response

The information on Arctic fox is appreciated and the spelling of "Voigt" will be corrected.

Comment #14 (ENR – NSR)

Page 11.8-37

Re: decline of arctic fox numbers

- competition from red fox is a leading theory that is not mentioned

Response

Annex F, Section F4.4.1 provides a more comprehensive presentation of baseline conditions, which includes a reference to the current theory that interspecific competition between Arctic and red fox has shifted the abundance and distribution of Arctic fox.

Carnivores, in general

Comment #15 (ENR – NSR)

Section 11.10.2.4 Table 11.10-4

- because relocations are relatively rare but akin to a mortality (usually intended to remove an individual from an area), perhaps best to separate this out from "incidents" and either have its own column or at least enumerate these in footnotes or use another table (latter option preferred)

- it's not clear from the table or the accompanying text if the grizzly bear [ENR killed] at Ekati on 05 August is included. There should be a sentence or two on this incident as the bear was starving and weak but shot because it was on the mine site where many people were around.

Response

We appreciate these suggestions and will update the Carnivore Incident/Mortality database.

Comment #16 (ENR – NSR)

Page 11.10-162

Winter Access Road – last paragraph

-- De Beers conclusion of no impact does not account for public use of the winter road.

Response

Public use of the road was included in the effects analysis (see Section 11.10.4.6; page 11.10-139). For example, the EIS provides information on the decline in the vehicles travelling for hunting from 2004 to 2006, and suggests the decrease may be due to the increase in mine-related vehicles. The paragraph on page 11.10-162 that the reviewer is referring to represents a summary of the effects analysis (i.e., Residual Effects Summary [Section 11.10.6]) and does not provide the details presented in the effects analysis sections.

Comment #17 (ENR – NSR)

Pathway Analysis: Page 11.10-68 Table 11.10-5

- will the airstrip really be scarified.

- usually airstrip in remote areas such as this are requested to be kept intact for limited subsequent use.

Response

The comment is appreciated. The airstrip will be decommissioned as described in Section 3.12.7.6 of the EIS, which includes scarification.

Comment #18 (ENR – NSR)

Page 11.10-74 Winter Access Road

- increased public access & resulting harvest of (esp. Subsistence) is a major concern

- issue is not addressed adequately and remains a potential impact

- impact mainly on caribou but some wolf and wolverine harvesting impact too.

Response

Please see response above to comment concerning page 11.10-156 (Comment #10 [ENR – NSR]).

Comment #19 (ENR – NSR)

Page 11.8-44

- the main reason for slow speed and spacing on the ice roads is for ice maintenance

- a table showing all the years with spills would be good

- information provided seems focused on incidents by ownership interval

Response

We will inquire about obtaining this information.

General comments:

Figures in the PDF version online were unreadable in the resolution provided.

Some references in the text not listed in the Literature Cited section

Response

We appreciate your editorial comments. On March 7, 2011 the Department of Environmental and Natural Resources requested 15 copies of the Environmental Impact Statement on DVD from De Beers. The high resolution versions of the document were provided on March 18, 2011. An additional copy of the Environmental Impact Statement is included with this response. Please contact Stephen Lines (Stephen.lines@debeerscanada.com or 867-766-7352) if you would like additional copies of the document on DVD. .

References

Banci, V. and S. Moore. 1997. BHP Billiton Diamonds Inc. Lac de Gras, NWT, 1996 Wildlife Studies. Report prepared by Rescan Environmental Services Ltd.

DDMI (Diavik Diamond Mines Inc.). 2007. A Comparison of Methods for Monitoring Abundance and Distribution of Wolverine at the Diavik Diamond Mine. Prepared by Golder Associates Ltd. for Diavik Diamond Mines Inc. Yellowknife, NWT.

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McLoughlin, P.D., R.L. Case, R.J. Gau, H.D. Cluff, R. Mulders, and F. Messier. 2002b. Hierarchical habitat selection of barren-ground grizzly bears in the central Canadian Arctic. Oecologia 132:102-108.

Mueller, F.P. 1995. Tundra Esker Systems and Denning by Grizzly Bears, Wolves, Foxes, and Ground Squirrels in the Central Arctic, Northwest Territories. Department of Renewable Resources. Government of the Northwest Territories, Yellowknife, N.W.T. File Report No. 115.

De Beers Canada

GAHCHO KUÉ PROJECT

October 21, 2011 File: S110

Sarah Olivier
Environmental Assessment Analyst
Fisheries and Oceans Canada
5204- 50th Avenue, Suite 301
Yellowknife NT X1A 1E2

Email: sarah.olivier@dfo-mpo.gc.ca

Dear Ms. Olivier:

Re: Gahcho Kué Project: Site Visit, Water Management Plan and Fish Habitat Compensation Meeting Follow-up

De Beers Canada Inc. (De Beers) appreciated the opportunity on September 15th and 16th, 2011 to meet with Fisheries and Oceans Canada (DFO) for a site visit and follow up meeting. The purpose of the meeting was to provide an overview of the Water Management Plan and Fish Habitat Compensation for the Gahcho Kué Diamond Project (Project). We trust that the site visit provided an understanding of the Project setting, and that the meeting was helpful in identifying key areas for further discussion.

As follow-up to the meeting, please find attached a copy of the meeting notes and materials, including the agenda and presentation.

De Beers looks forward to continuing to work with DFO during the Environmental Impact Review process. Should you have any questions, please feel free to contact me.

Yours truly,

Stephen Lines
Environmental Assessment & Permitting Coordinator.

Attachment: 1

Record of Meeting

Date/Time	16 September 2011	**File no.**	De Beers: S110 Golder: 11-1365-0001 Phase 3030
Between	Beverly Ross (BR) - Regional Manager, Environmental Assessment for Major Projects; Corrine Gibson (CG) – Habitat Biologist; Sarah Olivier (SO) - Environmental Assessment Analyst; Peter Cott (PC) – Fish Habitat Biologist; Bruce Hanna (BH) – Fish Habitat Biologist; Michael Rennie (MR) – Research Scientist; and Matthew Guzzo (MG)	**of:**	Fisheries and Oceans Canada (DFO)
And	Stephen Lines – Environmental Assessment & Permitting Coordinator John Faithful (JF) – Technical Director (Golder Associates); Kristine Mason (KM) – Fish and Fish Habitat Component Lead (Golder Associates); Gary Ash (GA) – Senior Fisheries Biologist (Golder Associates); Lisa Hurley (LH) – Engagement Coordinator (Golder Associates)	**of:**	De Beers Canada Inc.

Purpose The purpose of the meeting was to provide an update on the Project, provide additional details on the Water Management Plan for the Project, and an overview of the habitat compensation proposed.

Distribution DFO; De Beers; Golder Associates

Site Visit – September 15, 2011

- On September 15, 2011 De Beers hosted Fisheries and Oceans Canada (DFO) for a site visit at the Gahcho Kué Project site. The purpose of this site visit was to provide DFO a tour of the proposed Project area.
- Attendees from DFO for the site visit included:

- Beverly Ross (BR) - Regional Manager, Environmental Assessment for Major Projects;
- Corrine Gibson (CG) – Habitat Biologist;
- Sarah Olivier (SO) - Environmental Assessment Analyst;
- Michael Rennie (MR) – Research Scientist; and
- Matthew Guzzo (MG)

Meeting – September 16, 2011

Introduction

- Roundtable of introductions.
- Stephen Lines (SL) provided DFO (via Sarah Olivier; SO) with three copies of the DVDs that contain the entire EIS including conformity responses.

Project Update

- De Beers provided an update on the Gahcho Kué Project.
- It was noted that De Beers is working towards finalizing the Fine PKC Facility alternatives analysis report, and aiming to complete a draft by end of 2011 for review. It is expected that it will be provided to Fisheries and Oceans Canada (DFO) for review prior to submission to the Gahcho Kué Panel and posting on the public registry.

Water Management Plan

<u>Construction and Dewatering</u>

De Beers presented an overview of the Water Management Plan for the Project during construction and dewatering phase of the Project. Questions and discussion with DFO covered the following topics:

- dewatering and infrastructure development sequence;
- whether water will be treated prior to being discharged to the Water Management Pond;
- the lake levels to which the dewatering in the different areas of Kennady Lake will occur; and
- fish salvage plan.

De Beers noted that they would like to obtain feedback and input on the Water Management Plan as we move forward through the process. The current Water Management Plan has been developed as the most effective way to manage water around the site.

De Beers is seeking a HADD for Areas 2 to 7 of Kennady Lake. It is expected that additional discussion will be required on this. Additional discussions will likely also be required regarding the potential for fish to remain in Areas 2, 3, 4, and 5 of Kennady Lake after initial dewatering.

Operations

De Beers presented a summary of the Water Management Plan for the operations phase of the Project. Questions and discussion with DFO covered the following topics:

- levels to which the various pits will be backfilled; and
- whether there is an opportunity for a land-based or location in the completely dewatered areas of Kennady Lake (i.e., Areas 6 and 7) for deposition of the PK.

Closure

De Beers presented a summary of the Water Management Plan for the closure phase of the Project. Questions and discussion with DFO was primarily focused on the depths of the pits at closure and how they would be used to store material and water.

DFO noted that their understanding is that when Tuzo Pit is mined, waste will be deposited into the 5034 Pit. The area above Tuzo Pit will be dewatered, and the lake bottom scraped off. DFO recommended that the material from the 5034 Pit that is scraped off be stockpiled/saved for placement on top of the 5034 pit after being backfilled to lake level. It is expected this would help with the reclamation and recovery of the lake.

Fish Habitat Compensation

De Beers presented an overview of the options that have been investigated to compensate for the HADD associated with the Project. Questions and discussion with DFO covered the following topics:

- review of losses associated with the Project;
- review of compensation options identified;
- what is included in the calculations for the compensation plan;
- concerns about mercury (potential for methyl mercury generation) in the flooding of large areas;
- types of species for which habitat will be created;
- ratio for compensation; and
- the of detail that the compensation plan should include prior to DFO confirming to the Gahcho Kué Panel that agreement has been reached with De Beers.

De Beers indicated they would welcome feedback from DFO on the option of engineered flooding of selected areas in order to create additional fish habitat. De Beers noted that it has been challenging to come up with options for compensation in the Gahcho Kué Project area. DFO indicated a willingness to further explore the approach to compensation for the Project. It was suggested by DFO that De Beers look at what habitat is limiting fish production in the system and provide additional habitat enhancements in the flooded areas. It was also noted that starting to develop compensation earlier in the Project is favoured from DFO’s perspective.

DFO noted that the compensation plan should also include a rigorous assessment of how the options worked. The assessment should be published in a scientific manner and be available for review and consideration for upcoming projects. It was noted that there is limited information on the success of compensation projects, especially in the north.

DFO noted that compensation ratios are higher if there is uncertainty around a proposed compensation project. More detail can help reduce uncertainty and help reduce the compensation ratio. De Beers expressed a willingness to explore further at a future meeting with DFO dealing specifically with habitat compensation.

DFO noted that habitat suitability should be determined using northern information so that comparable information is being used. They noted there are documents that outline the habitat suitable for the Northwest Territories and DFO can provide if required.

DFO noted that an assessment is being done on the artificial reefs constructed at Snap Lake and a report is being prepared by John Fitzsimons from DFO. They noted that temperature loggers have just been removed from the water, and the data will be incorporated into the report and released.

There was some discussion on how advanced DFO would like to see the compensation plan prior to the hearing. DFO noted it would be ideal to go before the Panel and state that an agreement has been reached between DFO and De Beers and that no-net-loss can be achieved and significant environmental effects mitigated.

- The final details of the plan (e.g., exact amount of rock to be placed where) are not required, but how much habitat will be provided and an understanding that what is proposed is feasible is necessary.
- De Beers noted they would like to work with DFO during the advancement of the plan, so there is agreement as compensation is refined.

Path Forward

- It was proposed that the next meeting could be scheduled for January 2012. Topics at this meeting could include the alternatives analysis, and discussion of the calculations for losses and gains associated with the Project.
  - SO and SL to work together on the schedule for the next meeting and the topics to discuss.
- SO noted it might be beneficial to have a meeting with DFO, EC and De Beers to review the mine plan and have a discussion about regulatory issues associated with authorizing the Project.
  - SL noted that EC is going to the Gahcho Kué Project site on September 19, 2011 for a site tour and a meeting was planned for September 20, 2011 with a focus on the Project description and water management plan.
- De Beers noted that correspondence and communication directly with consultants is encouraged but asked that SL be copied on emails.
- De Beers noted they will provide a summary of the discussion and a copy of the presentation from the meeting.

Action Item / Commitment	Responsible	Date
De Beers to provide a copy of the draft alternatives analysis report to EC for review when completed.	De Beers	End 2011 / Early 2012
DFO and De Beers set date for January 2012 meeting.	De Beers (SL) / DFO (SO)	November 2011
De Beers provide notes and presentation from meeting.	De Beers	October 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation
- A binder with figures from the EIS was handed out during site visit September 15, 2011.

Three (3) copies the entire Environmental Impact Statement (EIS) with Conformity Responses were provided on DVD to Sarah Olivier at the meeting.

Meeting Agenda

DE BEERS CANADA
GAHCHO KUÉ PROJECT

MEETING	De Beers Canada and Fisheries and Oceans Canada Gahcho Kué Project Discussion	**DATE:** September 16, 2011	
INVITED	De Beers Canada Inc. Fisheries and Oceans Canada Golder Associates Ltd.		
LOCATION	De Beers Canada Boardroom Suite 300, 5102 -50th Ave Yellowknife, Northwest Territories		

Agenda Item/Discussion	Timing
Introduction ▪ Health and Safety ▪ Review of Agenda	9:00 – 9:15
Project Update ▪ Update on the Project, including conformity and alternatives analysis	9:15 – 9:30
Project Description ▪ Overview of the Water Management Plan ▪ Project sequencing and timeline of activities	9:30 – 10:55
Break	10:55 – 11:00
HADD and Compensation ▪ HADD overview, project footprint ▪ Compensation options and proposed habitat compensation plan	11:00 – 11:45
Path Forward ▪ Review of next steps	11:45 – 12:00
Lunch	12:00 – 12:30

Gahcho Kué Project

DFO Yellowknife Presentation

September 16, 2011

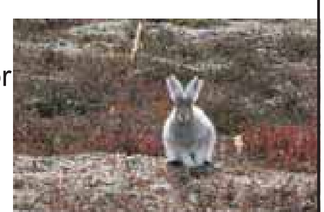
Introductions

De Beers Canada Inc.

- **Stephen Lines** Environmental Assessment and Permitting Coordinator - Gahcho Kué Project

Golder Associates Ltd.

- **Kristine Mason** Fish and Fish Habitat Component Lead
- **Gary Ash** Senior Fisheries Biologist
- **John Faithful** Technical Director
- **Lisa Hurley** Engagement Coordinator



Agenda

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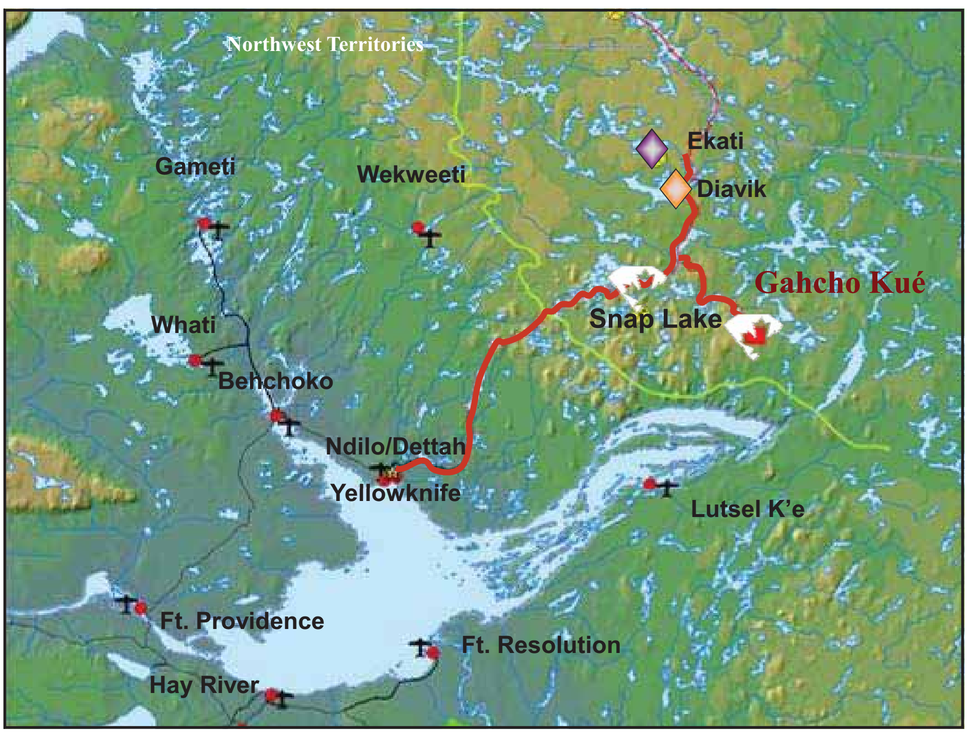
- **Project Update**
  - Conformity
  - Brief overview of change to project footprint and associated ongoing work
- **Water Management Plan**
  - Overview of the Water Management Plan
- **Compensation**
  - Compensation plan development and options
- **Path Forward**

3



Gahcho Kué Project Location

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Google Earth Image of Kennady Lake

- **Located in headwaters of the Lockhart River**
- **One of many small lakes in the region**

Project Update

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- **Conformity Response**
  - On July 15th, conformity responses to phosphorus and permafrost was submitted to the Gahcho Kué Panel
    - Chapters 8, 9 and 10 resubmitted with assessment of the effects of nutrients completed
    - Takes into account supplemental mitigation for the Fine PKC Facility
    - No other updated information included
  - On July 26th, the Panel determined that the EIS met conformity with the Terms of Reference
- **Alternatives Analysis**
  - Reduction in the footprint of the Fine PKC Facility has the benefit of reducing phosphorus loading to Kennady lake, and will remove the use of Lakes A1 and A2 for the deposition of PK

Project Update

- **Alternatives Analysis**
  - Viable alternatives to the base case for deposition of PK were identified
  - Alternatives scored on technical, environmental, and economic accounts
  - The alternative that rated the best from the multiple accounts analysis only involved a minor change to the Project footprint
    - ➢ More fine PK will be placed in the pits (5034 and Hearne)
    - ➢ Fine PK will still be stored in Area 2 of Kennady Lake; however, no fine PK in Area 1 (Lakes A1 and A2)
  - Ongoing work includes:
    - Detailed engineering design
    - Water balance update and seepage modelling
    - Alternatives analysis reporting

Water Management Plan

- Major elements of the Project Description include:
  - Mining, Processing, Mine Waste Management, Water Management, Site Infrastructure, Human Resources, Closure and Reclamation
    - Project Description is Section 3 of the EIS
- Today - focus on the key aspects of water management
  - Construction and Dewatering – establishing the controlled area, dewatering Kennady Lake
  - Operations – managing mine and process water while accessing the ore
  - Closure – dyke decommissioning and re-filling Kennady Lake
- Water Management Plan is detailed in Section 3.9, summaries in Sections 8.4 and 9.4

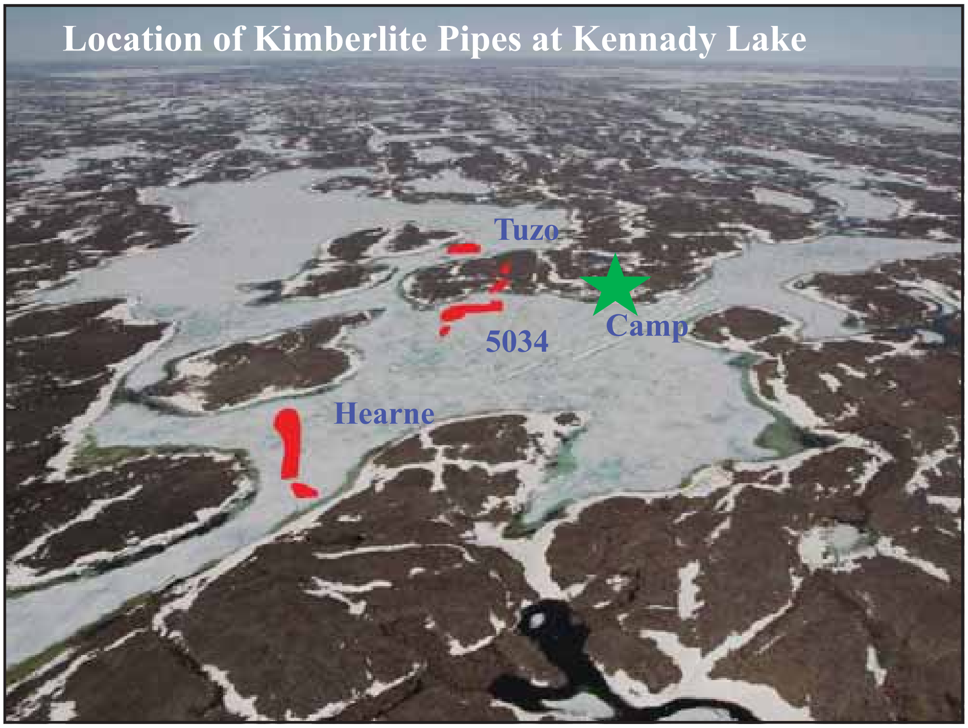
Water Management Plan

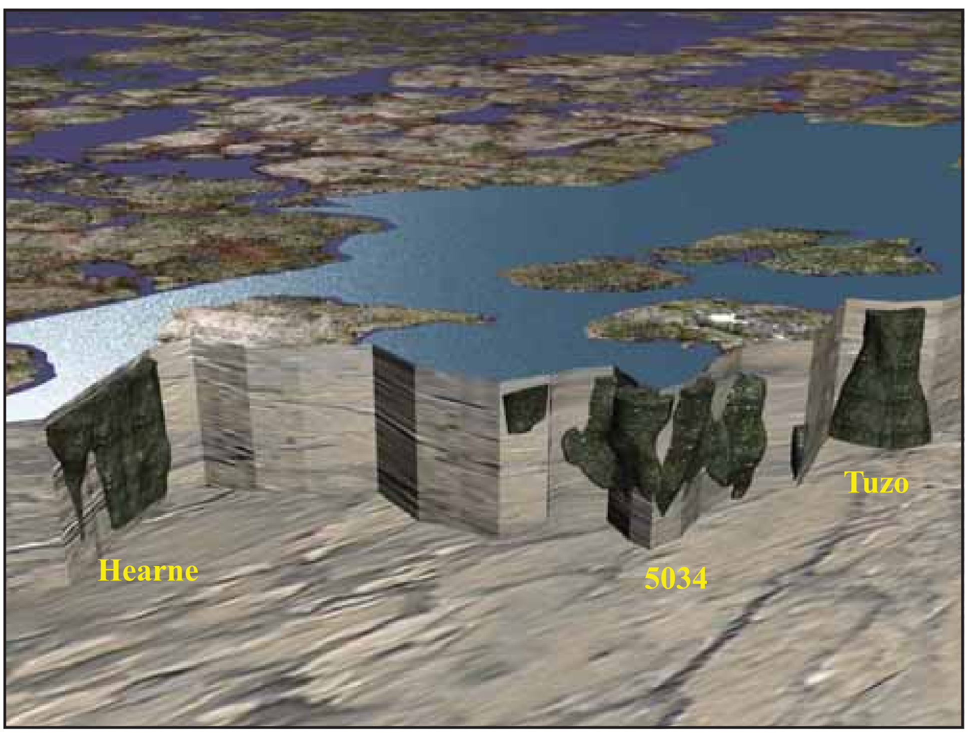
- Key objectives of the Water Management Plan are:
  - Minimize the amount of water requiring discharge from the controlled area to downstream and adjacent watersheds
  - Manage mine water to minimize potential WQ effects within the Water Management Pond (WMP) during and after refilling (closure and post-closure)
  - Reconnect Kennady Lake with the downstream watershed following refilling

Water Management Plan

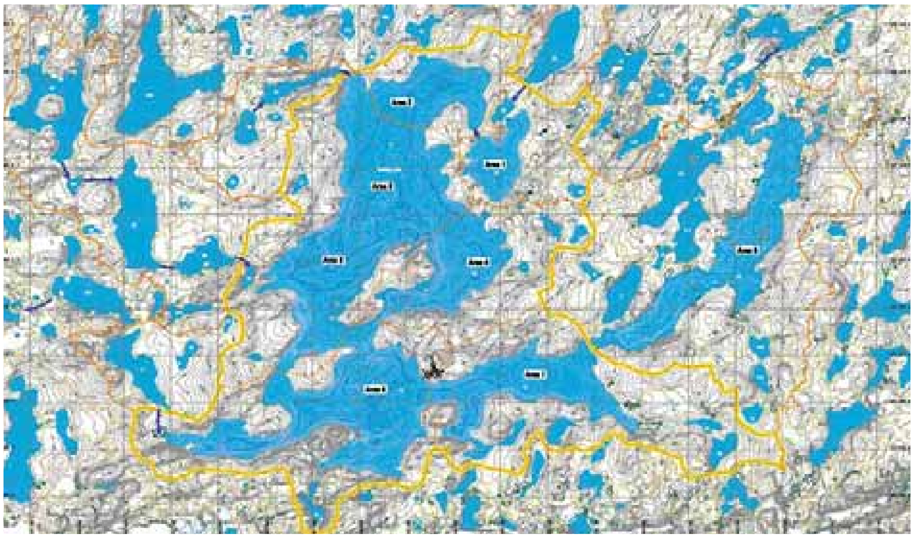
- Key elements of the Water Management Plan:
  - A controlled area boundary around the mine
  - Dykes and diversion channels
  - Dewatering Kennady Lake for the construction and operation of the mine
  - Establishing a WMP to manage mine and process water
  - Infrastructure to transfer water between basins, pits and the WMP
  - Refilling Kennady Lake as quickly as possible

- Note that maps and figures still show the EIS Project footprint, as changes to A watershed are not yet reflected


Location of Kimberlite Pipes at Kennady Lake
Tuzo
Camp
5034
Hearne


Tuzo
Hearne
5034

Water Management – Controlled Area



Note: map to be revised

Water Management Plan

Key Project Phases:

- Construction – Years -2 to -1
  - Dewatering
  - Establishment of the Controlled Area
- Operations – Years 1 to 11
  - Establishment of WMP
  - Operational discharge
  - Water management within the Controlled Area
- Closure (refilling) – Years 12 to 20
  - Refilling Kennady Lake – natural and supplemental inflows
- Closure (post-closure) – Years 20+
  - Recovery of Kennady Lake
  - Reconnection with downstream lakes

Water Management – Construction

Key Components:

- Construction of Dyke A at the narrows separating Areas 7 and 8
  - Isolates the main body of Kennady Lake (i.e., Areas 2 to 7) from Area 8
- Construction of dykes to divert upper watershed runoff water away from Kennady Lake
  - Establishes the Controlled Area
- Fish salvage
- Dewatering of Kennady Lake (Areas 2 to 7)
  - Commences following completion of Dyke A
  - Water discharged to Lake N11 and Area 8
  - Habitat in Areas 2 to 7 not available for fish during the life of the mine

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Water Management Areas – Dykes and Other Infrastructure

Note: map to be revised

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Water Management – Construction

- As water levels decrease, sills will be exposed and internal water retention dyke construction will start (Year -2)
  - i.e., Dykes H and I (between Areas 5 and 6), M (on Tuzo Island), K (between Areas 6 and 7), and J (between Areas 4 and 6)
- Diversion dykes and internal water retention dykes will be constructed:
  - Temporary diversion dykes will be placed across outlets of D and E watersheds (Dykes F, G)
  - *Permanent dyke for diversion of A watershed (Dyke A1) (date TBD)*
  - Internal water retention Dyke K (between Areas 6 and 7) will start
  - Construction of Filter Dyke L (between Areas 2 and 3)

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Water Management – Construction

- Areas 6 and 7 will be drained completely to allow safe and effective mining of the ore bodies
  - Water will be pumped to Area 5
- Collection ponds will be established within the basins in dewatered Areas 6 and 7 to collect runoff and pumped pit groundwater inflows, which will be pumped to the WMP
- Water transfers within the Controlled Area
  - Open pit dewatering system installed within 5034 Pit to manage groundwater inflows
  - Inflows to 5034 Pit and runoff water from collection ponds in Areas 6 and 7 pumped to WMP

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Water Management – Operations

Key Components:

- Water Management Pond (WMP) (Areas 3 and 5) to store mine water and be a source of process water
  - Inputs:
    - Open pit groundwater inflows; site runoff; seepage through filter Dyke L from Fine PKC Facility; runoff and seepage from mine rock piles, and the Coarse PK Pile; and process water
  - Outputs:
    - Should water within the WMP meet discharge criteria, water will be pumped to Lake N11
- Water transfers within the Controlled Area
  - Transfers between the WMP, mine pits, Areas 4, 6 and 7

Water Management – Operations

- Years 1 to 3
  - Pumped discharge from WMP to Lake N11
  - Areas 6 and 7 dewatered
  - Mining of 5034 Pit
  - Dyke E completed to divert B watershed
  - Filter Dyke L completed to allow deposition of fine PK in Area 2
  - Reclaim water pumped from WMP to process plant
- Year 4
  - Pumped discharge from WMP to Lake N11
  - Mining of both 5034 and Hearne pits
  - Pit water from 5034 and Hearne pits pumped to WMP
  - Dyke N construction starts (between Areas 6 and 7)
  - Runoff water from Area 6 and 7 collection ponds pumped to WMP
  - Construction of Dyke B started to separate Area 4 from WMP

Water Management – Operations

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- Year 5 and 6
  - Dyke B completed to allow Area 4 to be dewatered to access Tuzo Pit
  - Mining of 5034, Hearne, and Tuzo pits
  - Backfilling of 5034 Pit
  - Siphon water in Area 4 to 5034 pit
  - Pit water from Hearne and Tuzo pits pumped to WMP
  - Completion of Dyke K between Areas 6 and 7
  - Refilling of Area 7 starts from natural runoff and water in collection ponds in Area 6 (until mining completed in Hearne Pit)
- Years 7 and 8
  - Mining of Hearne and Tuzo pits
  - Runoff water from Area 4 collection pond pumped to WMP
  - Pit water from Hearne and Tuzo pits pumped to WMP

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Water Management – Operations

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- Years 9 to 11
  - Mining of Tuzo Pit
  - Process water sourced primarily from Tuzo pit
  - Fine PK slurry pumped to Hearne Pit
  - Excess water in refilled Area 7 pumped to the mined-out Hearne pit
  - Dyke N completed allowing the southwest portion of Area 6 containing partially backfilled Hearne Pit to be refilled (provides increased water storage capacity)
  - Excess water in WMP can be pumped to Hearne and 5034 pits, or to southwest arm of Area 6 (if required)

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Water Management - Closure and Reclamation

- At completion of operations (Year 11):
  - The WMP (Areas 3 and 5) and Area 7 will contain water, Area 4 (adjacent to Tuzo pit) will be dewatered and Area 6 will be partially refilled (southwest arm)
- 5034 is backfilled with mine rock *(and fine PK)*
- Hearne Pit is partially backfilled with mine rock and fine PK
- Tuzo Pit is not backfilled
- Area 2 is filled with fine PK, and reclaimed with coarse PK and mine rock cover layers

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Water Management - Closure and Reclamation

- Years 12 and 13 (interim closure)
  - Water will be siphoned from Areas 3 and 5, west of Area 6, and Area 7 to mined-out Tuzo pit
  - In-lake and temporary diversion dykes and berms will be lowered or submerged
  - Construction of in-lake compensation habitats and decommissioning of roads, diversion channels, and pipelines within Kennady Lake
  - Lake refilling will be achieved by:
    - Natural runoff from upper *A,* B, D, E watersheds
    - Supplemental pumping from Lake N11 to speed refilling and recovery

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Closure and Reclamation

- Years 14 to 19
  - Kennady Lake refilling continues
- Once Areas 3 to 7 are refilled to same elevation as Area 8, and water quality within refilled lake is considered suitable for fish, Dyke A will be removed, and Areas 3 to 7 will be reconnected to Area 8

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Water Management Plan - Summary

- Construction
  - Dewater Kennady Lake
  - Divert upper watersheds and construct Dyke A
  - Establishment of the Controlled Area
  - Construct internal dykes to segregate basins around kimberlite pipes
- Operations
  - Complete internal dykes
  - Establish WMP
  - Mine 5034, Hearne and Tuzo pits
  - Operational discharge
  - Water management within the Controlled Area
- Closure (refilling)
  - Refill Kennady Lake – natural and supplemental inflows
- Closure (post-closure) – Years 20+
  - Recovery of Kennady Lake and reconnection with downstream lakes

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Kennady Lake - Pre-development

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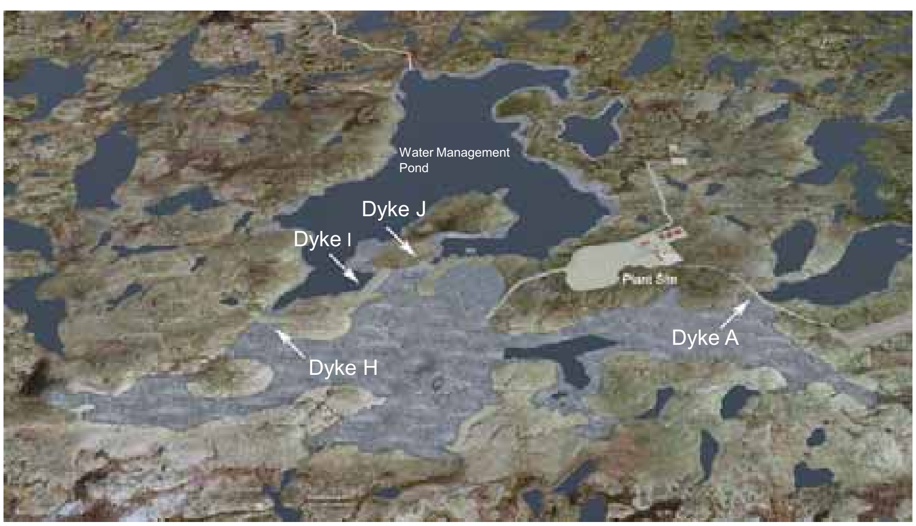
Construction



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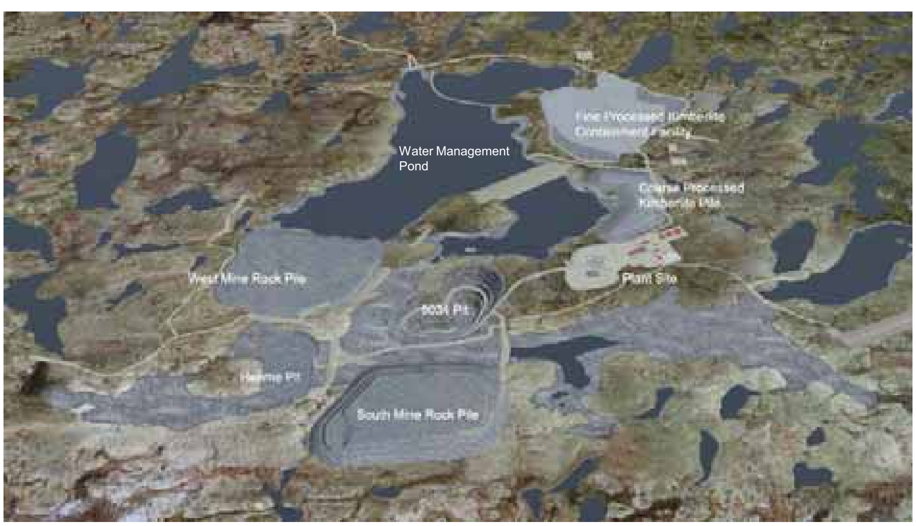
Operations – Years 1 to 3

Note : Fine PKC Facility to be revised

Operations – Year 4



Note : Fine PKC Facility to be revised

Operations – Years 5 and 6

DE BEERS CANADA

Note : Fine PKC Facility to be revised

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Full Extent of Operations – Year 7

DE BEERS CANADA

Note : Fine PKC Facility to be revised

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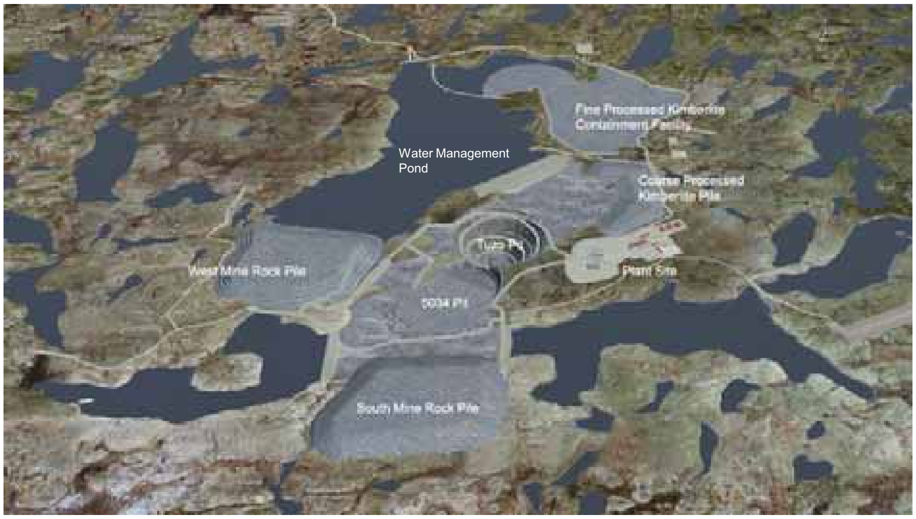
End of Mining – Years 9 to 11



Note : Fine PKC facility to be revised

Closure

Note : Fine PKC Facility to be revised

Final Reclamation

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Note: map to be revised

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HADD and Compensation

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- Compensation Plan to offset permanent losses and alterations
- Compensation works completed progressively during operations
- Development of the detailed plan will require input from local and regional DFO staff

- Ongoing work required to complete the final compensation plan
  - Finalization of HADD calculations based on revised project footprint
  - Calculation of Habitat Units (HUs)
  - Finalization of options

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HADD and Compensation

- Construction and operation of the Project will cause a HADD of fish habitat in the entire main basin of Kennady Lake (i.e., Areas 2 to 7) and parts of the Kennady Lake watershed

- Classified into three types of losses:
  - Permanent Losses
  - Physically Altered and Re-submerged Areas
  - Dewatered and Re-submerged Areas

- Preliminary calculations of losses (based on surface area) for revised footprint of Fine PKC Facility are included in subsequent slides, but numbers will be refined when alternative finalized

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HADD and Compensation

- Permanent Losses:
  - West Mine Rock Pile (Area 5 and Lake Ka1); South Mine Rock Pile (Area 6); Fine PKC Facility (Area 2); Dykes *A1*, D, H, I and L; culvert under the airstrip
    - Permanent loss of about *158.4* ha in lake area and *0.3* ha in watercourse area
    - Majority of losses will occur in Kennady Lake (*156.3* ha), representing about 19% of total pre-development Kennady Lake area of 813.6 ha

  - These permanently lost habitat areas will be compensated for by fish habitat compensation works

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HADD and Compensation

- Physically Altered and Re-submerged Areas
  - Part of Area 3 (affected by Dyke B); Part of Area 4 (affected by Tuzo Pit, Dyke B, Dyke J, and CP6 Berm); Part of Area 6 (affected by Hearne Pit, 5034 Pit, Dyke K, Dyke N, Road between Hearne Pit and Dyke K, CP3 Berm, CP4 Berm, and CP5 Berm); and Part of Area 7 (affected by Dyke A and Dyke K)
    - Project will result in about 83.3 ha of lake area being physically altered and re-submerged at closure
    - All of this area located in Kennady Lake, representing about 10% of total pre-mine Kennady Lake area of 813.6 ha
  - These physically altered and re-submerged areas will be compensated for by the fish habitat compensation works

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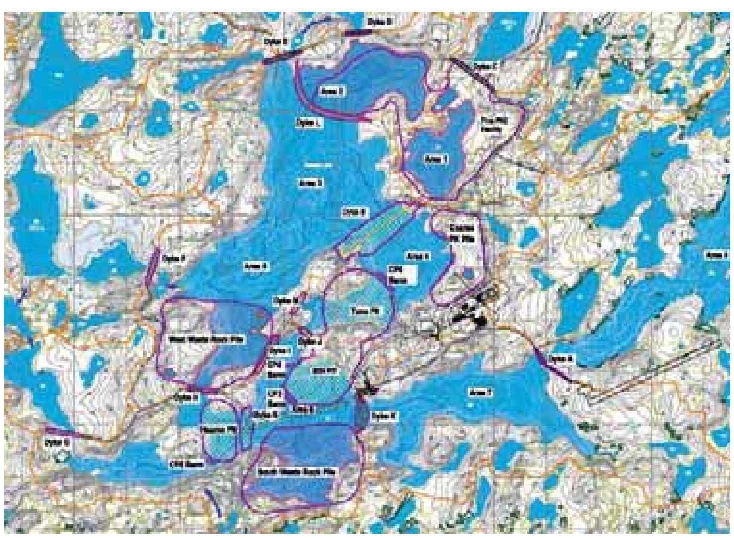
Permanently Lost or Altered Habitat Areas



Note: map to be revised

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HADD and Compensation

- Dewatered and Re-submerged Areas
  - Portions of Kennady Lake Areas 3 through 7 (parts that are not either permanently lost or physically altered); Lake D1; and Streams D1, D2, and E1
    - Project will result in about *433.0* ha of lake area being dewatered and re-submerged at closure but that will remain otherwise unaltered
    - Includes *431.2* ha in Kennady Lake, which represents about 53% of total pre-mine Kennady Lake area, and 1.9 ha in Lake D1
  - Dewatered, but otherwise physically unaltered areas that will be re-submerged, will provide habitats after closure with same physical characteristics as these areas had prior to Project development
  - Proposed compensation works not intended to compensate for these areas

HADD and Compensation

- Several compensation options focus on construction of habitat structures within specific areas of Kennady Lake; others focus on opportunities for habitat compensation in adjacent areas

- The options for compensation currently include the following:
  - Construction of impounding dykes to raise lake levels
    - Additional flooding to increase lake depth and surface area
    - Connections to formerly non-fish-bearing waters
  - Construction of finger reefs in Kennady Lake
  - Construction of habitat structures on the decommissioned mine pits/dykes
  - Widening the top bench of pits to create shelf areas where they extend onto land

Proposed Habitat Compensation Plan

- Proposed fish habitat compensation plan consists of combination of options
- Preferred options include:
  - Options 1b and 1c (raising water level in lakes west of Kennady Lake)
  - Option 10 (widening top bench of mine pits where extend onto land)
- Also included in proposed compensation plan are:
  - Options 3 and 4 (enhancement features in Areas 6, 7 and 8)
  - Option 8 (Dyke B habitat structure)
- Option 2 (additional flooding of Lake A3) no longer an option with revised Project footprint

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Proposed Habitat Compensation Plan

- Option 1b
  - Raise water level of some lakes west of Kennady Lake (in D, E, N watersheds) to level greater than required only for the Project
    - Construction of impounding dykes to raise Lakes D2, D3, E1, and N14 during operations
    - Increase maximum depths: Lake D2 by 3.8 m (from 1.0 to 4.8 m), Lake D3 by 2.6 m (2.5 to 5.1 m), Lake E1 by 2.8 m (3.4 to 6.2 m), Lake N14 by 2.7 m (2.8 to 5.5 m)
    - Total compensation habitat provided by this option is 149.7 ha
      - 143.5 ha of newly flooded area and 6.2 ha of three non-fish-bearing lakes which will become connected to fish-bearing waters

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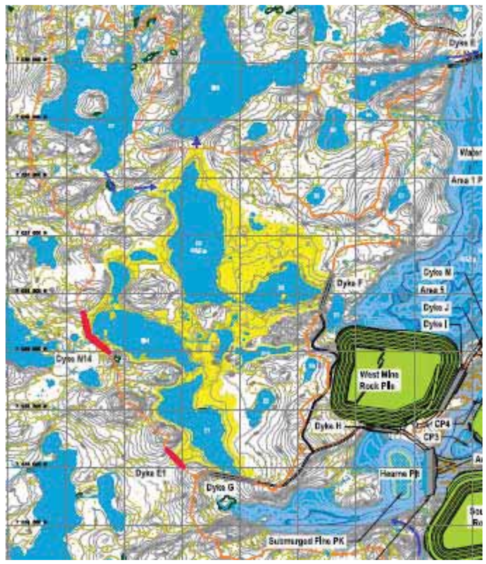
Proposed Habitat Compensation Plan

- Option 1b



Proposed Habitat Compensation Plan

- Option 1c
  - Additional raising, after mine closure, of water level in flooded area created by Option 1b
    - Further increase in water level in Lakes D2, D3, E1, and N14, and surrounding area at closure
    - Reconnect flooded area to Kennady Lake through Lake D1
      - Source of spawning and rearing habitat for re-established fish populations in Kennedy Lake at closure
    - Total compensation habitat provided by this option is 195.9 ha
      - 186.7 ha of newly flooded area and 9.2 ha of four non-fish-bearing lakes which will be connected to fish-bearing waters

Proposed Habitat Compensation Plan

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- Option 1c

Proposed Habitat Compensation Plan

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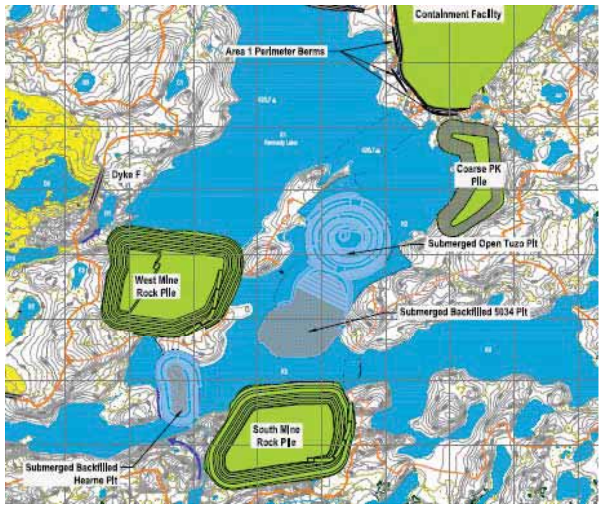
- Option 10
  - Widening top bench of Tuzo and 5034 pits to create shelf areas where they extend onto land
    - Alterations to southeast edge of Tuzo/5034 joined pit edge, north end of Tuzo Pit and northwest edge of 5034 Pit
    - Provide an additional 13.7 ha of lake area

Proposed Habitat Compensation Plan

- Option 10



Proposed Habitat Compensation Plan

- Option 3
  - Construction of finger reefs in Areas 6 and 7 during dewatered period
    - Appropriately-sized mine rock placed to create finger reefs
    - Reefs would extend to within 2 m of normal refilled lake level, be aligned to maximize exposure to wind-generated waves, and be designed to provide rocky reef habitats suitable for fish species expected to inhabit refilled Kennady Lake
- Option 4
  - Habitat enhancement structures in Area 8 (i.e., rocky reef habitats similar to Option 2)

Proposed Habitat Compensation Plan

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- Option 8
  - Development of a Dyke B habitat structure within Kennady Lake during closure
    - Placement of boulder and cobble mine rock to maximize suitability as rocky reef habitat suitable for fish species expected to inhabit refilled Kennady Lake
    - After operations, Dyke B will be lowered to level below expected restored lake level
    - Reef area provided by this option is 16.0 ha

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Proposed Habitat Compensation Plan

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Summary of Fish Habitat Compensation Achieved with Proposed Conceptual Compensation Plan

Compensation Description	Compensation Habitat Area (ha)	
	Operations	After Closure
Newly Created Habitat		
Option 1b – Construction of dykes west of Kennady Lake to raise Lakes D2, D3, E1 and N14 to 428 masl elevation	149.7	–
Option 1c – After closure, further raise water level to 429 masl and reconnect flooded area to Kennady Lake through Lake D1	–	195.9
Option 10 – Widening top bench of pits where they extend onto land	–	13.7
Altered Areas Reclaimed and Submerged at Closure		
Hearne Pit	–	16.0
5034 Pit	–	35.0
Tuzo Pit	–	35.2
Dykes A, B, J, K and N	–	23.8
Road in Area 6	–	4.0
Water Collection Pond Berms CP3, CP4, CP5 and CP6	–	1.3
Mine rock areas	–	25.3
Total	**149.7**	**350.2**
Compensation Ratios (gains:losses) [c]	**0.6**	**1.5**

[c] Calculated based on total area of permanently lost habitat and physically altered and re-submerged habitat (242.0 ha)

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HADD and Compensation

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- Detailed compensation plan to be developed in consultation with DFO Regional staff
    - Finalization of preferred compensation options
    - Fish species present, habitat suitabilities, compensation ratio
  - Refinement of Habitat Evaluation Procedure (HEP) analysis, including analysis of habitat gains
    - Quantification of habitat gains in terms of HUs
    - Determination of compensation ratios based on HUs
  - Detailed hydrologic and water quality modelling (as required)
  - Details of proposed monitoring program
    - Physical and biological characteristics
    - Validate habitat loss predictions
    - Confirm no net loss achieved

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Summary

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- Alternatives analysis report will be provided

- The Water Management Plan is detailed and allows for safe and effective mining of the three ore bodies
  - All operations managed within sub-basin of Kennady Lake watershed
  - Controlled area established to maintain segregation of clean water away from the site and managed water within the site

- Detailed Compensation Plan to be developed
  - Allows for compensation works to be completed progressively during operations
  - Will require input from local and regional DFO staff

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Path Forward

- Gahcho Kué Panel has released draft work plan, which identifies next step in the EIS Analysis
  - Presentation of EIS by De Beers followed by workshop for all parties to the EIR
- Finalization of alternatives analysis work
  - Detailed engineering, modelling etc.
  - Update HADD calculations

Path Forward

- In advance of the EIS Analysis session planned by the Panel, De Beers is hosting an EIS Overview Workshop on October 26 and 27 to present the
  - Project description
  - assessment approach
  - existing environment
  - key assessment findings

Path Forward

- Would like continued discussions with DFO related to
  - Development of a final compensation plan
  - Review of EIS results and clarifications of any outstanding questions or technical issues
- In consultation with DFO, develop a schedule of follow-up meetings and discussion topics

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Follow-up

Permitting and Assessment Contact:
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Stephen.lines@debeerscanada.com
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Technical Team Contact:
Golder Associates
John Faithful
John_Faithful@golder.com
(403) 513-3529
Lisa Hurley
Lisa_Hurley@golder.com
(403) 513-3538

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CANADA
GAHCHO KUÉ PROJECT

October 21, 2011 File: S110

Lisa Lowman
Senior EA Coordinator
Environment Canada
PO Box 2310
Yellowknife NT XIA 2P7

Email: lisa.lowman@ec.gc.ca

Dear Ms. Lowman:

Re: Gahcho Kué Project: Site Visit, Project Description and Water Management Plan Meeting Follow up

De Beers Canada Inc. (De Beers) appreciated the opportunity on September 19th and 20th, 2011 to meet with Environment Canada (EC) for a site visit and follow up meeting. The purpose of the meeting was to provide an overview of the Project Description and Water Management Plan for the Gahcho Kué Diamond Project (Project). We trust that the site visit provided an understanding of the Project setting, and that the meeting was helpful in identifying key areas for further discussion.

As follow-up to the meeting, please find attached a copy of the meeting notes and materials, including the agenda and presentation.

De Beers looks forward to continuing to work with EC during the Environmental Impact Review process. Should you have any questions, please feel free to contact me.

Yours truly,

Stephen Lines
Environmental Assessment & Permitting Coordinator.

Attachment: 1

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Record of Meeting

Date/Time	20 September 2011	**File no.**	De Beers: S110 Golder: 11-1365-0001 Phase 3030
Between	In person: Lisa Lowman (LL) – Senior Environmental Assessment Coordinator; Jane Fitzgerald (JaF) – Environmental Assessment Coordinator (alternate for Lisa Lowman). Phone: Paul Rochon (PR) – Technical Engineer, Mining and Processing (Ottawa office)	**of:**	Environment Canada (EC)
And	Stephen Lines – Environmental Assessment & Permitting Coordinator John Faithful (JF) – Technical Director (Golder Associates); Lisa Hurley (LH) – Engagement Coordinator (Golder Associates)	**of:**	De Beers Canada Inc.

Purpose The purpose of the meeting was to provide an update on the Project, provide details on the Water Management Plan for the Project, and an overview of the baseline aquatic environment and assessment.

Distribution EC; De Beers; Golder Associates

Site Visit – September 19, 2011

- On September 19, 2011 De Beers hosted Lisa Lowman of Environment Canada (EC) for a site visit at the Gahcho Kué Project site. The purpose of this site visit was to provide EC a tour of the proposed Project area.

Meeting – September 20, 2011

Introduction

- Roundtable of introductions.
- De Beers noted that correspondence and communication directly with consultants is encouraged but asked that SL be copied on emails and kept informed of discussions.
- Health and Safety: acknowledgement of Environment Canada's (EC) practices for travel in helicopters.

Project Update

- De Beers provided an update on the Gahcho Kué Project, which focused primarily on the reduced Project footprint resulting from no longer depositing fine PK in lakes A1 and A2.
- It was noted that De Beers is working towards finalizing the Fine PKC Facility alternatives analysis report, and aiming to complete a draft by end of 2011 for review. It is expected that it will be provided to EC and Fisheries and Oceans Canada (DFO) for review prior to submission to the Gahcho Kué Panel and posting on the public registry.

Project Description Overview

- De Beers provided an overview of the proposed Gahcho Kué Project description.
- The presentation focused on mining method, water and waste management aspects of the Project.
- Discussion points presented on the Project description:
  - The Project description represents a balance between environmental considerations, economics and feasibility
  - Project approach is to minimize the size of disturbance footprint
  - All operations are managed within a sub-basin of the Kennady Lake watershed (the controlled area)
  - The controlled area is established to maintain segregation of non-contact water away from the site and manage contact water within the site
- There was discussion about the development of an AEMP for the Project and it was agreed that it would be beneficial to have a meeting to discuss aquatic baseline data, and the AEMP, before the baseline program is finalized for 2012 so that input can be obtained from EC.

Water Management Plan

De Beers presented the water management plan for the Project during construction and dewatering, operations and closure phases of the Project. Questions and discussion with EC covered the following topics:

- the areas of Kennady Lake;
- dewatering sequence;

- approximate lake levels to which the dewatering in the different areas of Kennady Lake can occur;
- whether water will be treated prior to being discharged to the Water Management Pond; and
- fish salvage plan.

De Beers noted that they would like to include both DFO and EC in the same discussions so that communication on the issue is ongoing and consistent. It was clarified that DFO is responsible for Section 35 of the *Fisheries Act*, and EC is responsible for Section 36(3) of the *Fisheries Act.*

De Beers noted that they would like to obtain feedback and input as the Project moves forward through the review process. The current water management plan has been developed as the best way to move water around the site.

EIS Structure

A brief overview of the EIS structure was provided, with a summary of what sections should be referred to for information related to water quality and the aquatic environment.

EIS Overview – Aquatics

The intent had been to provide EC with an overview of the EIS from an aquatics perspective. However, due to the length of discussion on the Project description and water management plan there was insufficient time remaining to address aquatics.

The slides from this portion of the presentation will be provided to EC for information and it is anticipated this will be discussed at an upcoming meeting.

Path Forward

- De Beers noted they will provide a summary of the discussion and a copy of the presentation from the meeting.
- De Beers provided EC (via Lisa Lowman) with three copies of the DVDs that contain the entire EIS including conformity responses.
- De Beers noted that they would be happy to provide responses to any written questions that EC might prepare.

Action Item / Commitment	Responsible	Date
EC to provide the task hazards they prepared for helicopter and fixed wing travel	Environment Canada (LL)	November 2011
De Beers to provide a copy of the draft alternatives analysis report to EC for review when completed.	De Beers	End-2011 / Early 2012
De Beers (SL) and EC (LL) discuss appropriate time to have preliminary AEMP discussion which includes discussion of baseline data.	De Beers (SL) / EC (LL)	November 2011
De Beers (SL) and EC (LL) to discuss the timing for the next meeting and topics to be discussed.	De Beers (SL) / EC (LL)	November 2011

De Beers to provide meeting notes and presentation from meeting.	De Beers	October 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation

Three (3) copies the entire Environmental Impact Statement (EIS) with Conformity Responses were provided on DVD to Lisa Lowman at the meeting.

Meeting Agenda

De Beers Canada
Gahcho Kué Project

MEETING	De Beers Canada and Environment Canada Gahcho Kué Project Discussion	**DATE:** September 20, 2011
INVITED	De Beers Canada Inc. Environment Canada Golder Associates Ltd.	
LOCATION	De Beers Canada Boardroom Suite 300, 5102 -50th Ave Yellowknife, Northwest Territories	

Agenda Item/Discussion	Timing
Introduction ▪ Health and Safety ▪ Review of Agenda	9:00 – 9:15

Project Description
▪ Overview of the key elements of the Project Description
  ▪ Mining methods, infrastructure, water and waste management, economics, closure
  ▪ Project sequencing and timeline of activities
	9:15 – 10:15

Break	10:15 – 10:30
Water Management Plan – Overview ▪ Presentation of an overview of the water management plan	10:30 – 11:15
Water Quality – Overview ▪ Presentation of environmental setting for the Project, assessment and findings	11:15 – 11:45
Path Forward ▪ Next steps for meeting information needs	11:45 – noon
Lunch	Noon – 12:30

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Gahcho Kué Project

Project Description

Environment Canada
September 20, 2011

Introductions

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De Beers Canada Inc.

- **Stephen Lines** Environmental Assessment and Permitting Coordinator - Gahcho Kué Project

Golder Associates Ltd.

- **John Faithful** Technical Director
- **Lisa Hurley** Engagement Coordinator

Agenda

- Project Update
- Project Description
  - Employment, Mining methods, Infrastructure, Water and Waste management, Closure.
- Presentation of Water Management Plan
- Water quality environment setting including overview of the EIS and conclusions.
- Path Forward

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Project Update

Project Update

De Beers Canada

- **Conformity Response**
  - On July 15th, conformity responses to phosphorus and permafrost was submitted to the Gahcho Kué Panel
    - Chapters 8, 9 and 10 resubmitted with assessment of the effects of nutrients completed
    - Takes into account supplemental mitigation for the Fine PKC Facility
    - No other updated information included
  - On July 26th, the Panel determined that the EIS met conformity with the Terms of Reference
- **Alternatives Analysis**
  - Reduction in the footprint of the Fine PKC Facility has the benefit of reducing phosphorus loading to Kennady lake, and will remove the use of Lakes A1 and A2 for the deposition of PK

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Project Update

De Beers Canada

- **Alternatives Analysis**
  - Viable alternatives to the base case for deposition of PK were identified
  - Alternatives scored on technical, environmental, and economic accounts
  - The alternative that rated the best from the multiple accounts analysis only involved a minor change to the Project footprint
    - ➢ More fine PK will be placed in the pits (5034 and Hearne)
    - ➢ Fine PK will still be stored in Area 2 of Kennady Lake; however, no fine PK in Area 1 (Lakes A1 and A2)
  - Ongoing work includes:
    - Detailed engineering design
    - Water balance update and seepage modelling
    - Alternatives analysis reporting

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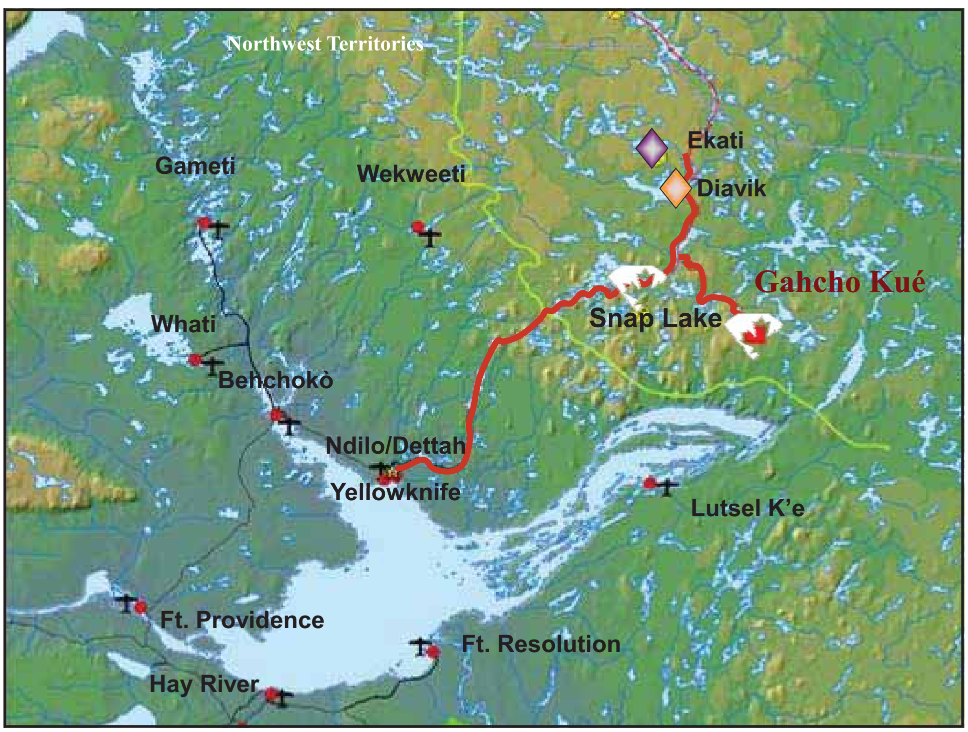
Project Description



Gahcho Kué Project Location

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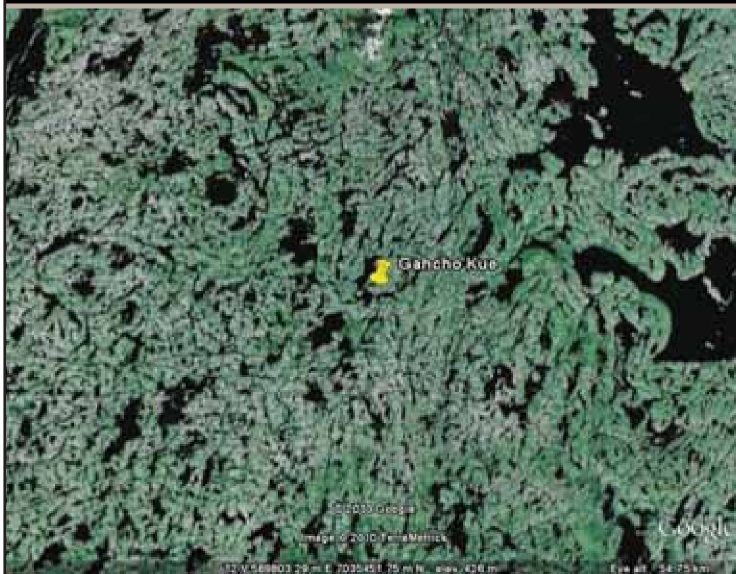

Google Earth Image of Kennady Lake

- Located in headwaters of the Lockhart River
- One of many small lakes in the region

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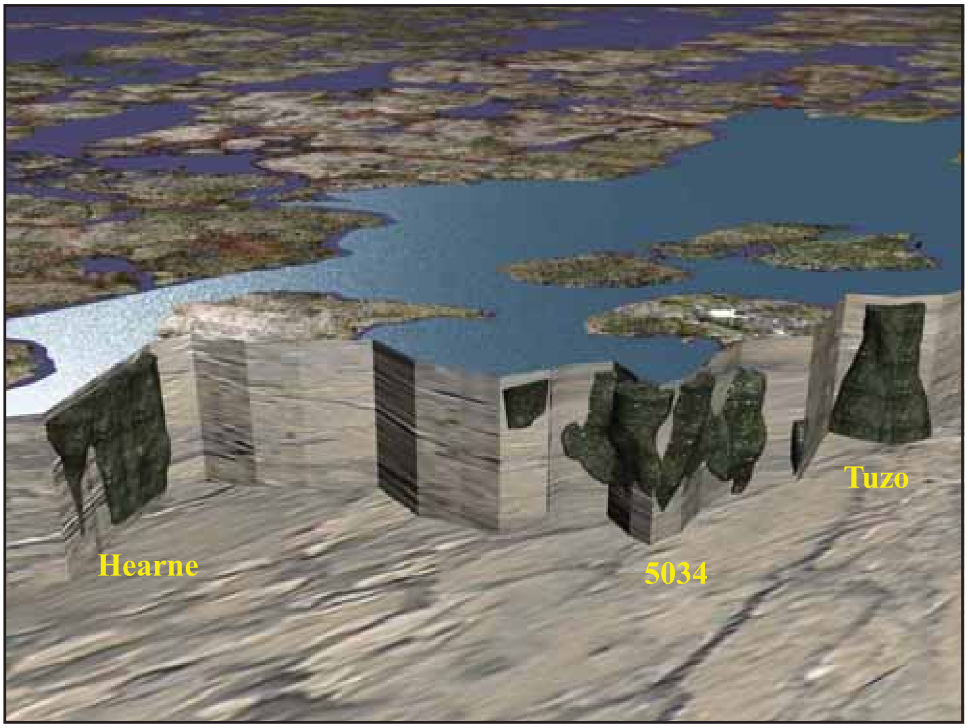
Kimberlites at Kennady Lake



Project Overview

De Beers Canada

- The current Project Description represents a balance between environmental considerations, feasibility and economics
- Project approach is to minimize the size of disturbance footprint
- All operations are managed within the Kennady Lake watershed
- Controlled Area established to maintain segregation of clean water away from the site and managed water within the site
- Project is designed to minimize refilling time for Kennady Lake, and therefore aquatic ecosystem recovery

Project Description – Order of Discussion

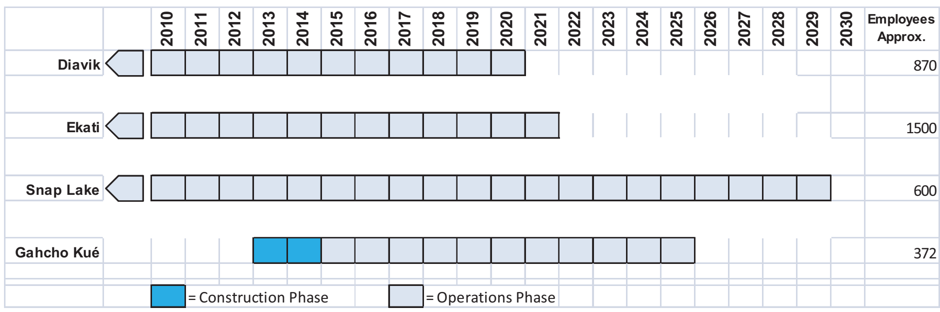
- Major Elements of the Project Description
  - Employment
  - Mining methods, mining sequence, Project timeline
  - Infrastructure, Surface footprint
  - Water management
  - Waste management
  - Closure

Employment

- Peak of 700 Full Time Equivalents during construction
  - Includes on-site and off-site employees
  - Camp capacity of 432 persons
- 372 during operations (11 years)
- 100 or less during closure & reclamation
- Gahcho Kué Diamond Mine will be small relative to the Ekati and Diavik Diamond mines, but an important project for the territory’s economic growth

*one FTE is the number of hours worked that add up to one full-time employee.

Operating Life - Existing Diamond Mines



- New mines such as the Gahcho Kué Project will be needed to maintain the economic well being of the areas that they operate in

Mining Method

- The three ore bodies in Kennady Lake will be mined using open pit mining methods
- The alternative of underground mining was considered but not selected
  - Diamond-bearing kimberlite pipes are vertically aligned
  - Technically challenging (maintain sufficient layer of competent, water-tight rock between mine workings and overlying lake)
  - Safety concerns
  - Economically less favourable (capital and operating costs, ore sterilization)
  - Management of groundwater inflow to mine would have impacts on surface water quality

Mining Sequence and Extraction Rates

- Kimberlite pipes will be mined in sequence (5034, Hearne, Tuzo)
- Parallel mining considered but not selected
  - More complex operation
  - Larger footprint (mine pits not available for storage)
  - Economically less favourable (capital and operating costs)
- The maximum sustainable extraction rate of 3.0 Mt/y selected
  - most ideal alternative from a financial, as well as environmental and technical perspective (reduce amount of groundwater to be managed)
- Other extraction rates tested but not selected
  - Faster rate would result in no pits available for backfilling
  - Slower rate uneconomic

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Project Timeline

- Once EA approval, permits, and licences obtained, construction will take 2 years (Yr -2 to Yr -1)
  - Installation of infrastructure, dewatering to reduce water level in all of Kennady Lake (upstream of Dyke A)
  - After water above ore bodies drained, pre-stripping of first open pit (5034) and initial production mining will begin

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Project Timeline

- Operational period (Yr 1 to 11): kimberlite mining and processing
  - 5034 ore body first to be mined, followed by Hearne in Yr 4, and Tuzo in Yr 5
  - Processing plant operating by beginning of Yr 1 – PK storage required by this point
  - 5034 backfilled with mine rock starting in Yr 5; Hearne backfilled with fine PK starting in Yr 8
  - Where possible, progressive decommissioning and reclamation (e.g., contouring mine rock and PK storage) as mining advances

Project Timeline

- Interim closure within 2 yrs after mining completed (end of Yr 13)
  - Removal of most site infrastructure and disposal of materials on site or off site as appropriate

- Lake refilling and reclamation monitoring until remaining areas of Kennady Lake refilled
  - Flooding pits and returning Kennady Lake to original level by restoring natural drainage and pumping from Lake N11 (~8-16 yrs)
  - Removing all remaining site infrastructure (e.g., airstrip and camp)
  - Monitoring until Project site and Kennady Lake meet regulatory conditions

Surface Footprint

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- Overall environmental and operational objective of minimizing project footprint
- Maintain project disturbance areas to Controlled Area
- Kennady Lake Watershed
  - Mine pits and associated infrastructure in dewatered Kennady Lake
  - Water Management Pond (WMP) located within Controlled Area.
  - Entire lake dewatered (or partially dewatered) required for the construction and operation of the mine – discussed under *Water Management*
  - Dykes, diversion channels, etc. required for diversions
  - Placement of mine rock, PK – discussed under *Mine Waste Management*

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Controlled Area

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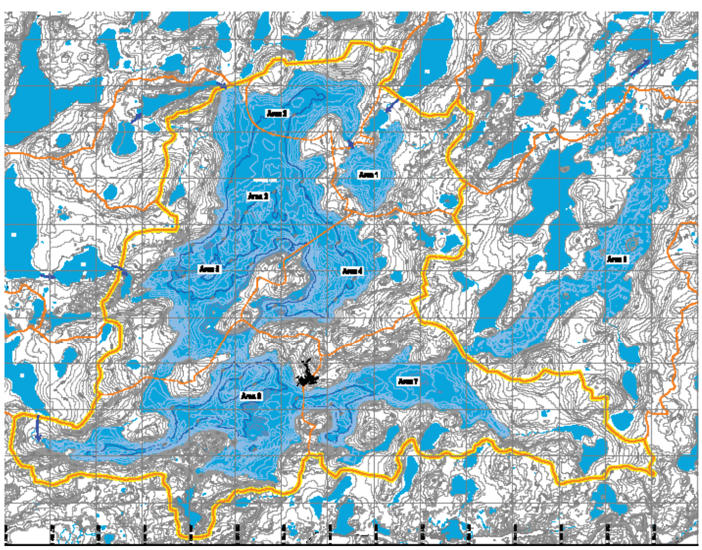

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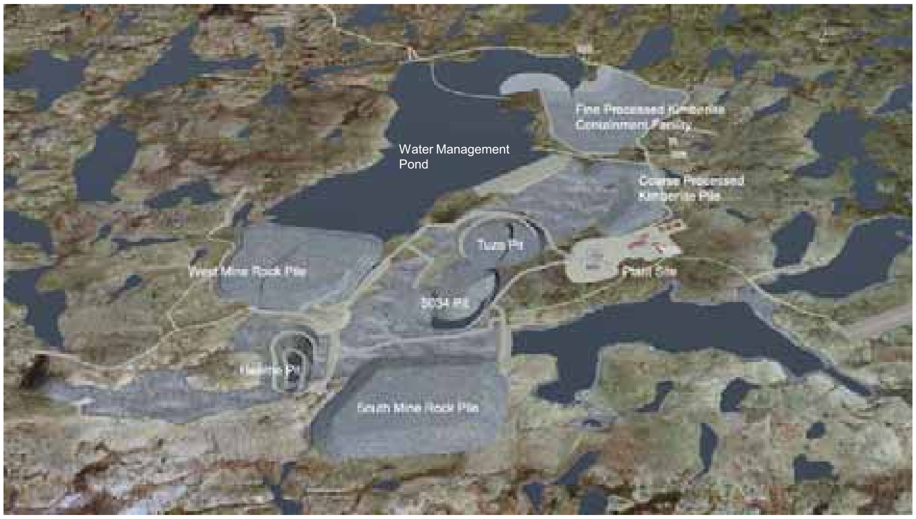
Full Extent of Operations – Year 7



Note : Fine PKC Facility to be revised

Infrastructure

- Power generation (5 x 2,825 kilowatt (kW(e)) diesel-powered electric generator units)
- Processing plant
- Fuel storage (8 x 500,000 L tanks and 2 x 18 million L tanks)
- Accommodations complex (216 double occupancy rooms)
- Water Intake (Area 8)
- Airstrip (45m x 1620m)
- Winter access road (120 km starting at km 271 of the Tibbitt-to-Contwoyto road)
- Sewage treatment plant (effluent to the WMP and fine PK, sludge to the landfill)

Water Management Plan

- Project Description is Section 3 of the EIS
- Water Management Plan is detailed in Section 3.9, summaries in Sections 8.4 and 9.4
- Key objectives of the Water Management Plan are:
  - Minimize the amount of water requiring discharge from the Controlled Area to downstream and adjacent watersheds
  - Manage mine water to minimize potential WQ effects within the Water Management Pond (WMP) during and after refilling (closure and post-closure)
  - Reconnect Kennady Lake with the downstream watershed following refilling

Water Management Plan

Key Project Phases:

- Construction – Years -2 to -1
  - Dewatering
  - Establishment of the Controlled Area
  - Infrastructure to transfer water between basins, pits and the WMP
- Operations – Years 1 to 11
  - Establishment of WMP
  - Operational discharge
  - Water management within the Controlled Area
- Closure (refilling) – Years 12 to 20
  - Refilling Kennady Lake – natural and supplemental inflows
- Closure (post-closure) – Years 20+
  - Recovery of Kennady Lake
  - Reconnection with downstream lakes

Mine Waste Management

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- Recovery of diamonds from ore bodies will generate mine rock, coarse PK, and fine PK that will require on-site disposal
- Mine rock stored in mine rock piles in and adjacent to Area 5 (West Mine Rock Pile) and Area 6 (South Mine Rock Pile), and mined-out 5034 Pit
- Alternatives considered for mine rock piles (including on-land options) not selected
  - Larger footprint, extending into adjacent watersheds requires systems to capture and control runoff, increased truck haulage, less economically favourable (capital and operating costs)
- Coarse PK Pile on land beside process facility (Area 4)

Mine Waste Management

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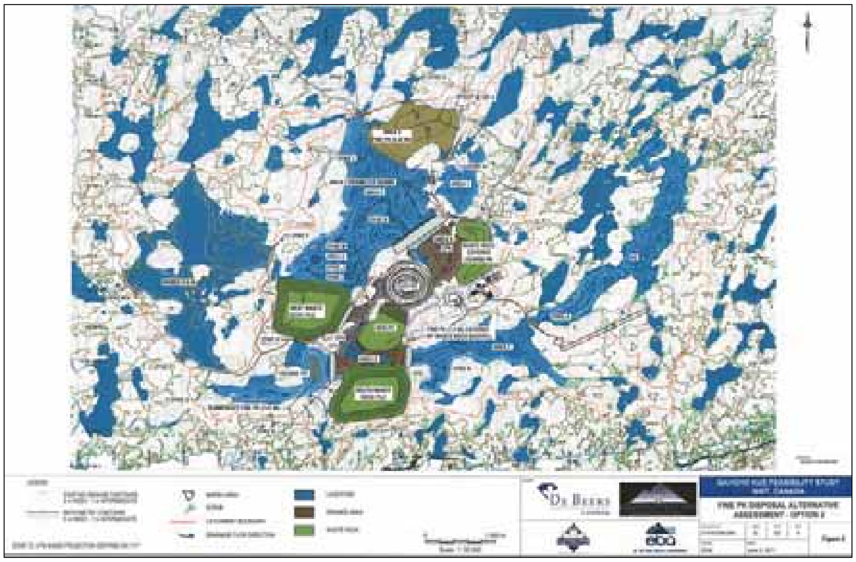
- Fine PK - disposed of in the Fine PKC Facility (Area 2) and mined-out 5034 and Hearne pit
- Alternatives considered for fine PK storage (including on-land or entirely within Kennady Lake options) not selected
  - More complex construction (e.g., higher dykes or impervious dykes, leakage detection systems, topographical challenges), increased maintenance and inspection (e.g., active operation of seepage and runoff control), higher risk of loss of containment, larger footprint, cost prohibitive (capital and operating costs)

Mine Waste Storage Facilities



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Waste Management

- On-site waste management areas will be used to contain and store wastes:
  - a landfill for inert solid wastes;
  - a landfarm for petroleum-contaminated soils (constructed as required);
  - incinerators for combustible waste and waste oil; and
  - a sewage treatment plant.

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Closure and Reclamation

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- At completion of mine operations
  - Hearne Pit partially backfilled with fine PK, 5034 Pit backfilled with mine rock, Tuzo Pit open and empty
  - Area 2 filled with fine PK and reclaimed with coarse PK and mine rock cover
  - Construction of compensation habitats and decommissioning of roads, diversion channels, and pipelines within Kennady Lake
  - Transfer of water from WMP to Tuzo Pit
- Temporary diversion dykes breached and removed
  - Natural runoff from upper watersheds (B, D, E) and supplemental pumping from Lake N11 used to refill Kennady Lake (~8 years)
  - Alternative of not pumping considered but not selected (delays ecosystem recovery)
- Dyke A removed when water quality considered suitable

Closure

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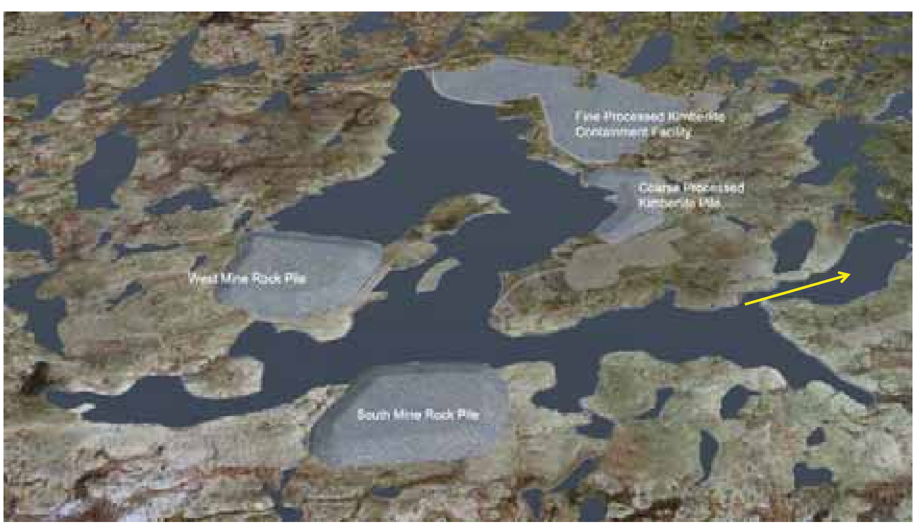

Note : Fine PKC Facility to be revised

Final Reclamation

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Note: map to be revised

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Summary

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- The current Project Description represents a balance between environmental considerations, feasibility and economics
- Project approach is to minimize the size of disturbance footprint
- All operations are managed within the Kennady Lake watershed
- Controlled Area established to maintain segregation of clean water away from the site and managed water within the site
- Project is designed to minimize refilling time for Kennady Lake, and therefore aquatic ecosystem recovery

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Water Management Plan

Water Management Plan

- Major elements of the Project Description include:
  - Mining, Processing, Mine Waste Management, Water Management, Site Infrastructure, Human Resources, Closure and Reclamation
    - Project Description is Section 3 of the EIS
- Today - focus on the key aspects of water management
  - Construction and Dewatering – establishing the controlled area, dewatering Kennady Lake
  - Operations – managing mine and process water while accessing the ore
  - Closure – dyke decommissioning and re-filling Kennady Lake
- Water Management Plan is detailed in Section 3.9, summaries in Sections 8.4 and 9.4

Water Management Plan

- Key objectives of the Water Management Plan are:
  - Minimize the amount of water requiring discharge from the controlled area to downstream and adjacent watersheds
  - Manage mine water to minimize potential WQ effects within the Water Management Pond (WMP) during and after refilling (closure and post-closure)
  - Reconnect Kennady Lake with the downstream watershed following refilling

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Water Management Plan

- Key elements of the Water Management Plan:
  - A controlled area boundary around the mine
  - Dykes and diversion channels
  - Dewatering Kennady Lake for the construction and operation of the mine
  - Establishing a WMP to manage mine and process water
  - Infrastructure to transfer water between basins, pits and the WMP
  - Refilling Kennady Lake as quickly as possible

- Note that maps and figures still show the EIS Project footprint, as changes to A watershed are not yet reflected

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Water Management – Controlled Area

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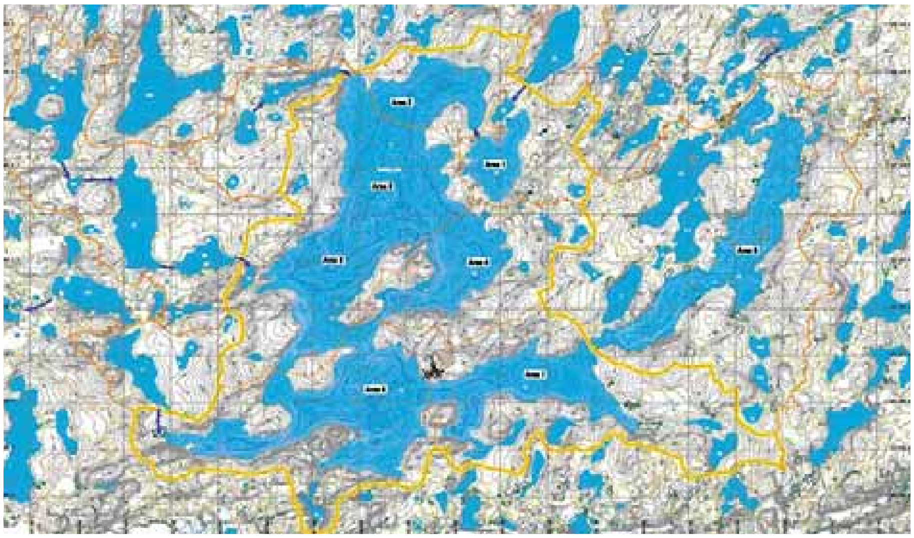

Note: map to be revised

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Water Management Plan

De Beers Canada

Key Project Phases:

- Construction – Years -2 to -1
  - Dewatering
  - Establishment of the Controlled Area
- Operations – Years 1 to 11
  - Establishment of WMP
  - Operational discharge
  - Water management within the Controlled Area
- Closure (refilling) – Years 12 to 20
  - Refilling Kennady Lake – natural and supplemental inflows
- Closure (post-closure) – Years 20+
  - Recovery of Kennady Lake
  - Reconnection with downstream lakes

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Water Management – Construction

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Key Components:

- Construction of Dyke A at the narrows separating Areas 7 and 8
  - Isolates the main body of Kennady Lake (i.e., Areas 2 to 7) from Area 8
- Construction of dykes to divert upper watershed runoff water away from Kennady Lake
  - Establishes the Controlled Area
- Fish salvage
- Dewatering of Kennady Lake (Areas 2 to 7)
  - Commences following completion of Dyke A
  - Water discharged to Lake N11 and Area 8
  - Habitat in Areas 2 to 7 not available for fish during the life of the mine

Water Management Areas – Dykes and Other Infrastructure

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Note: map to be revised

Water Management – Construction

- As water levels decrease, sills will be exposed and internal water retention dyke construction will start (Year -2)
  - i.e., Dykes H and I (between Areas 5 and 6), M (on Tuzo Island), K (between Areas 6 and 7), and J (between Areas 4 and 6)

- Diversion dykes and internal water retention dykes will be constructed:
  - Temporary diversion dykes will be placed across outlets of D and E watersheds (Dykes F, G)
  - *Permanent dyke for diversion of A watershed (Dyke A1) (date TBD)*
  - Internal water retention Dyke K (between Areas 6 and 7) will start
  - Construction of Filter Dyke L (between Areas 2 and 3)

Water Management – Construction

- Areas 6 and 7 will be drained completely to allow safe and effective mining of the ore bodies
  - Water will be pumped to Area 5

- Collection ponds will be established within the basins in dewatered Areas 6 and 7 to collect runoff and pumped pit groundwater inflows, which will be pumped to the WMP

- Water transfers within the Controlled Area
  - Open pit dewatering system installed within 5034 Pit to manage groundwater inflows
  - Inflows to 5034 Pit and runoff water from collection ponds in Areas 6 and 7 pumped to WMP

Water Management – Operations

Key Components:

- Water Management Pond (WMP) (Areas 3 and 5) to store mine water and be a source of process water
  - Inputs:
    - Open pit groundwater inflows; site runoff; seepage through filter Dyke L from Fine PKC Facility; runoff and seepage from mine rock piles, and the Coarse PK Pile; and process water
  - Outputs:
    - Should water within the WMP meet discharge criteria, water will be pumped to Lake N11
- Water transfers within the Controlled Area
  - Transfers between the WMP, mine pits, Areas 4, 6 and 7

Water Management – Operations Years 1 to 3

- Pumped discharge from WMP to Lake N11
- Areas 6 and 7 dewatered
- Mining of 5034 Pit
- Dyke E completed to divert B watershed
- Filter Dyke L completed to allow deposition of fine PK in Area 2
- Reclaim water pumped from WMP to process plant

Note: map to be revised

Water Management – Operations Years 4

Note: map to be revised

- Pumped discharge from WMP to Lake N11
- Mining of both 5034 and Hearne pits
- Pit water from 5034 and Hearne pits pumped to WMP
- Dyke N construction starts (between Areas 6 and 7)
- Runoff water from Area 6 and 7 collection ponds pumped to WMP
- Construction of Dyke B started to separate Area 4 from WMP

Water Management – Operations Years 5 and 6

Note: map to be revised

- Dyke B completed to allow Area 4 to be dewatered to access Tuzo Pit
- Mining of 5034, Hearne, and Tuzo pits
- Backfilling of 5034 Pit
- Siphon water in Area 4 to 5034 pit
- Pit water from Hearne and Tuzo pits pumped to WMP
- Completion of Dyke K between Areas 6 and 7
- Refilling of Area 7 starts from natural runoff and water in collection ponds in Area 6 (until mining completed in Hearne Pit)

Water Management – Operations Years 7 and 8

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Note: map to be revised

- Mining of Hearne and Tuzo pits
- Runoff water from Area 4 collection pond pumped to WMP
- Pit water from Hearne and Tuzo pits pumped to WMP

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Water Management – Operations Years 9 to 11

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Note: map to be revised

- Mining of Tuzo Pit
- Process water sourced primarily from Tuzo pit
- Fine PK slurry pumped to Hearne Pit
- Excess water in refilled Area 7 pumped to the mined-out Hearne pit
- Dyke N completed allowing the southwest portion of Area 6 containing partially backfilled Hearne Pit to be refilled (provides increased water storage capacity)
- Excess water in WMP can be pumped to Hearne and 5034 pits, or to southwest arm of Area 6 (if required)

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Water Management - Closure and Reclamation

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- Years 12 and 13 (interim closure)
  - Water will be siphoned from Areas 3 and 5, west of Area 6, and Area 7 to mined-out Tuzo pit
  - In-lake and temporary diversion dykes and berms will be lowered or submerged
  - Construction of in-lake compensation habitats and decommissioning of roads, diversion channels, and pipelines within Kennady Lake
  - Lake refilling will be achieved by:
    - Natural runoff from upper *A,* B, D, E watersheds
    - Supplemental pumping from Lake N11 to speed refilling and recovery
- Years 14 to 19
  - Kennady Lake refilling continues

Once Areas 3 to 7 are refilled to same elevation as Area 8, and water quality within refilled lake is considered suitable for fish, Dyke A will be removed, and Areas 3 to 7 will be reconnected to Area 8

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Final Reclamation

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Note: map to be revised

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Water Management Plan - Summary

- Construction
  - Dewater Kennady Lake
  - Divert upper watersheds and construct Dyke A
  - Establishment of the Controlled Area
  - Construct internal dykes to segregate basins around kimberlite pipes
- Operations
  - Complete internal dykes
  - Establish WMP
  - Mine 5034, Hearne and Tuzo pits
  - Operational discharge
  - Water management within the Controlled Area
- Closure (refilling)
  - Refill Kennady Lake – natural and supplemental inflows
- Closure (post-closure) – Years 20+
  - Recovery of Kennady Lake and reconnection with downstream lakes

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Kennady Lake - Pre-development

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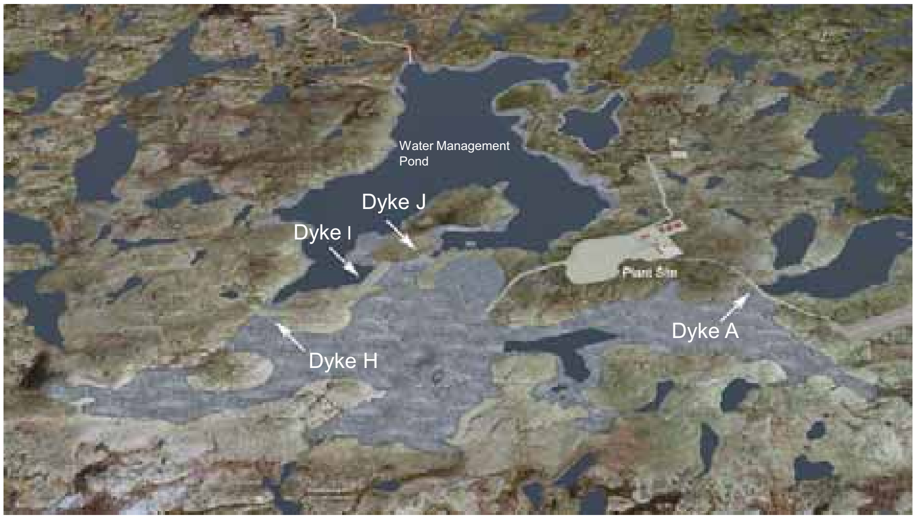
Construction



Operations – Years 1 to 3

Note : Fine PKC Facility to be revised

Operations – Year 4

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Note : Fine PKC Facility to be revised

Operations – Years 5 and 6

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Note : Fine PKC Facility to be revised

Full Extent of Operations – Year 7

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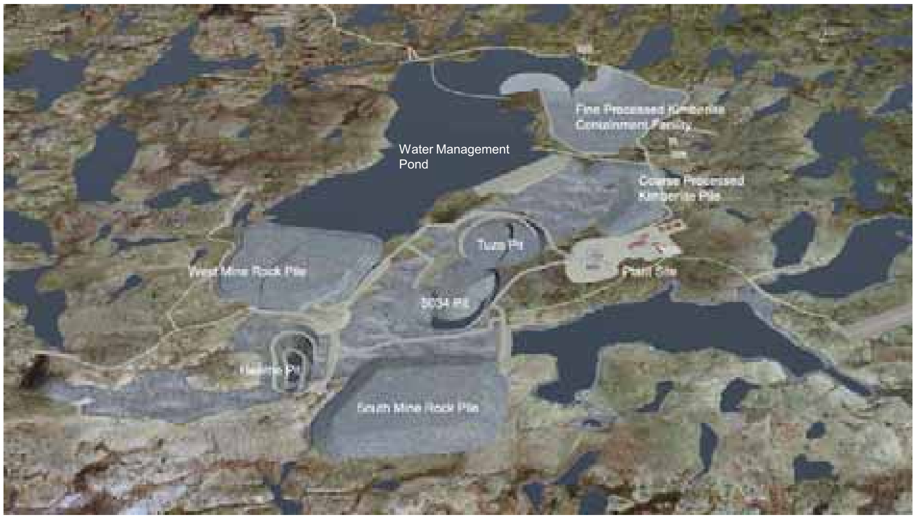

Note : Fine PKC Facility to be revised

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End of Mining – Years 9 to 11

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Note : Fine PKC facility to be revised

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Closure

Note : Fine PKC Facility to be revised

Structure of the EIS

Structure of the EIS

- The Terms of Reference issued by the Gahcho Kué Panel required that the assessment of the Key Lines of Inquiry and Subjects of Note "be comprehensive stand-alone analyses which require only minimal cross-referencing with other parts of the EIS".
- The result was a document organized by Key Lines of Inquiry and Subjects of Note, with Baseline reports for each aquatics discipline included as annexes to the EIS.
- To be responsive to the Terms of Reference, only the information needed for the effects assessment within each Key Line Of Inquiry and Subject of Note was presented.

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EIS Sections Relevant to Water

Section Number	Section Title
2	Project Alternatives
3	Project Description
8	Key Line of Inquiry: Water Quality and Fish in Kennady Lake
9	Key Line of Inquiry: Downstream Water Effects
10	Key Line of Inquiry: Long-term Biophysical Effects, Closure, and Reclamation
11.2	Subject of Note: Impacts on Great Slave Lake
11.6	Subject of Note: Permafrost, Groundwater, and Hydrogeology
13	Cumulative Effects Assessment
14	Summary and Conclusions
Annex G	Hydrogeology Baseline
Annex H	Hydrology Baseline
Annex I	Water Quality Baseline
Annex J	Fish and Fish Habitat Baseline

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Overview of the EIS
Water Quality Focus

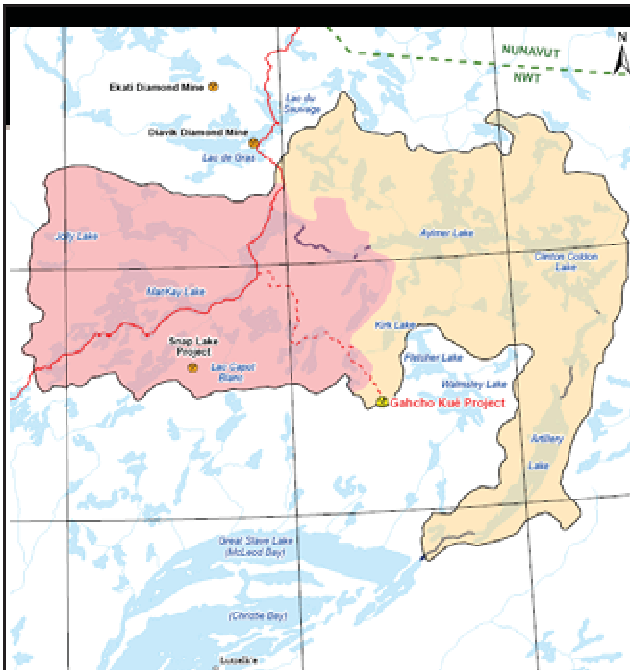
Purpose

- Provide an overview of the water quality environmental setting and assessment within the EIS.
- Obtain feedback from Environment Canada

Outline

- Aquatic Environmental Setting – Water Quality
- Assessment – Water Quality Effects
- Summary of Residual Effects

Environmental Setting
Water Quality



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- The Project is located in the watershed of Kennady Lake, a small headwater lake within the Lockhart River system
- The Lockhart River drains into the east arm of Great Slave Lake
- This area constitutes the **aquatics regional study area**

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Local Study Area

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- The drainage direction from Kennady Lake is northward, and passes through a number of small watersheds before entering Aylmer Lake
- The drainage area to the outlet of Kirk Lake constitutes the **aquatics *local study area***

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Kennady Lake Study Area

Water Quality

- More than 20 water quality sampling programs completed between 1995 and 2005, and 2010 and 2011
  - Focus on Kennady Lake and Lake N16 (Control Lake)
  - Other lakes and streams within and outside of the Kennady Lake watershed
    - ➢ Summer and winter programs
    - ➢ Water chemistry
    - ➢ Water column profiles
  - ➢ Provided a comprehensive understanding of baseline conditions

- Sediment chemistry surveys in Kennady Lake in 2004, 2005, 2010, and 2011
  - More frequent sampling in recent years

Water Quality Sampling Locations – Kennady Lake Watershed

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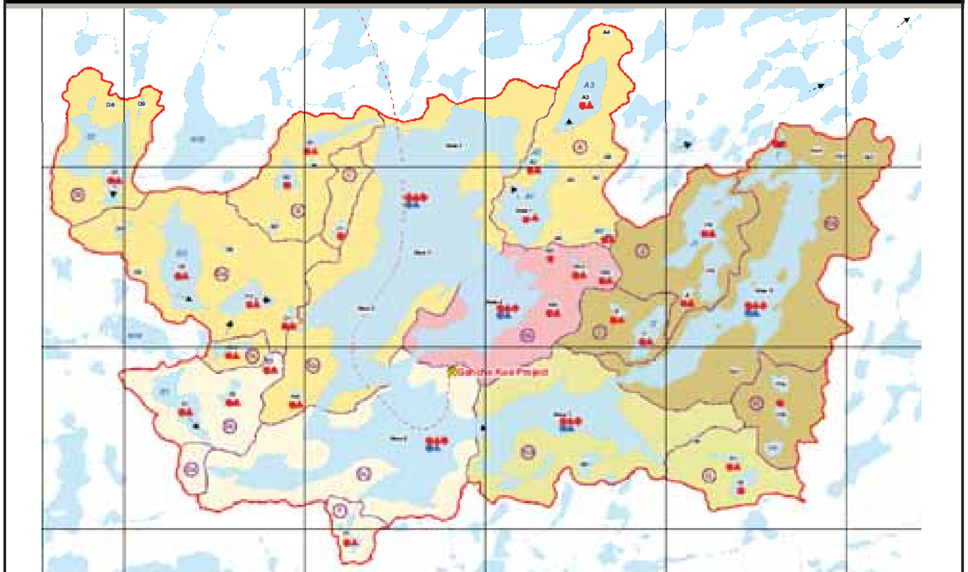

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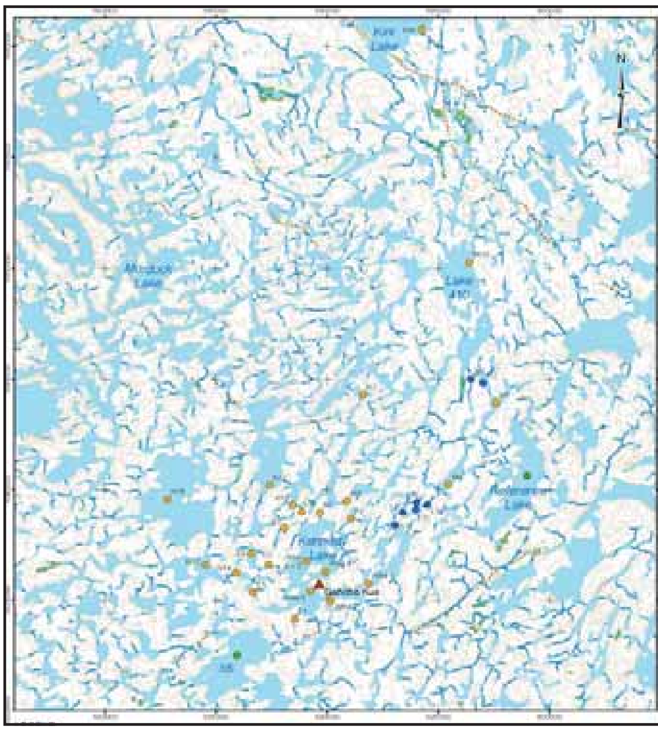
De Beers CANADA



Local Study Area Sampling Locations (Winter)

- Kennady Lake Watershed
- Land M Lakes
- Lake 410
- N Lakes
- Kirk Lake

Water Quality

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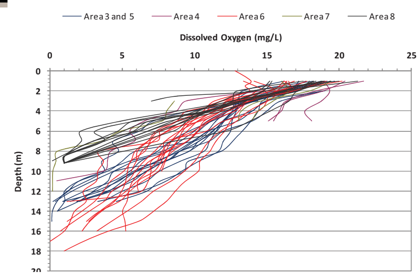
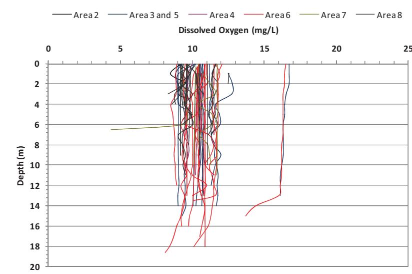
Physico-chemical conditions

- Lakes are typically inversely stratified in winter, with colder water near the surface; dissolved oxygen concentration decreases with depth
- Shallow lakes within the Kennady Lake watershed and adjacent watersheds are usually well mixed during open-water conditions
- Deeper lakes may stratify in summer, but dissolved oxygen concentrations remain high throughout the water column





DO Under-ice / Open water

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Water Quality

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- Water chemistry is similar throughout Kennady Lake and other lakes in the LSA; seasonal variability is minor
- Most lakes have low concentrations of total dissolved solids, alkalinity and hardness, and total suspended solids
- The lakes can be characterized as oligotrophic, and phosphorus-limited
- The lakes have low to moderate total and dissolved organic carbon, with some colour in fall
- Metal concentrations are generally low, but some metals (e.g., aluminum, cadmium, copper, iron, and zinc) measured in concentrations above PAL guidelines

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Sediment Quality

- Deep sediments are mainly composed of sand (~75%), with silt (~25%) and clay (<2%)
- Organic carbon content low to moderate (5 to 13%)
- Concentrations of most metals in Kennady Lake bed sediments are below sediment quality guidelines, but cadmium, arsenic, copper and zinc have been measured above ISQG guidelines
- Sediment chemistry data generally consistent among lakes within the LSA

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2011 Baseline Program

- Continued seasonal sampling baseline programs in winter and summer
  - Additional sampling stations since 2010
  - Higher resolution detection limits especially for nutrients and metals
  - Chlorophyll a
- Freshet Monitoring
  - Physico/chemical characteristics
  - In situ turbidity
- Reference Lake Program
- Aquatics Monitoring
  - Lake N11, Area 8, Reference Lake

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Summary of Residual Effects Analysis Water Quality

Overview

The effects analysis results reported in:

- Section 8 KLOI: Water Quality and Fish in Kennady Lake
  - Air Quality - Operations
    - Lakes in the Kennady Lake watershed
  - Water chemistry – Closure
    - Kennady Lake - Areas 3 to 7
    - Area 8
- Section 9 KLOI: Downstream Water Effects
  - Water chemistry – Construction, Operations and Closure
    - Lake N11, and Lake 410
- Section 10 KLOI: Long-term Biophysical Effects, Closure and Reclamation

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Residual Effects - Water Quality

Influences to WQ include:

- Altered hydrology
  - Construction, operations and closure (refilling)
- Air emissions from the Project (e.g., fugitive dust, vehicle emissions)
  - Operations
- Water chemistry (e.g., drainage and seepage from site facilities, groundwater inflows, open pits after refilling)
  - Operations and closure

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Residual Effects - Water Quality

- Air emissions modelled by Calpuff dispersion modelling
  - Acidifying emissions
  - TSP (dust) and metals
- WQ projections for Kennady Lake and adjacent/downstream watersheds completed using a mass balance model developed in GoldSim and a hydrodynamic model developed in GEMMS
  - Site water balance for the controlled area
  - Hydrological model for each key watershed to Kirk Lake
  - Background water chemistry
  - Geochemical source terms
  - Nitrogen blast residuals
  - Recycling of plant process water (WMP and Tuzo pit)

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Residual Effects - Water Quality

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Air emissions
- Evaluated for small lakes within the Kennady Lake watershed
  - Acidifying emissions projected to be negligible
    - net PAI values and annual N deposition rates below the lake acidification criteria
  - TSS and some metals in lakes in close proximity to the mine rock piles and haul roads will exceed baseline concentrations by >100%
  - localized and seasonal influence,
    - during and after the freshet
  - high degree of conservatism associated with summer (55%) and winter (0%, no natural mitigation considered) mitigation, and aerial deposition modelling based on most productive mine years

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Residual Effects – Water Quality

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Total Suspended Solids
- Pumped discharge to Area 8 and Lake N11 will not be a source of TSS
- Water transfers within the Controlled Area will be mitigated to reduce TSS loading to the WMP

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Residual Effects – Water Quality

TDS and Major Ions

- TDS and major ions will increase in Kennady Lake during operations due to the WMP (i.e., natural runoff, process water cycling, groundwater inflows) and decrease in closure with the refilling and reconnection with the L and M lakes
- Within Area 8, TDS and major ions concentrations increase after the removal of dyke A
- Within Lake N11, concentrations increase as a result of operational discharges (during dewatering, concentrations will be similar)
- Relative attenuation of TDS and major ion concentrations will occur in downstream lakes
- Increases linked to groundwater influence, but some major ions (e.g., potassium) also sourced from geochemical inputs
  - ➢ Results in a steady state concentration in Kennady Lake over time

Concentrations will remain above baseline, but below aquatic health guidelines

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Residual Effects – Water Quality

Nutrients

- N projected to increase within Kennady Lake, Lake N11, and downstream lakes due to blasting residuals
  - – Nitrate and ammonia within Kennady Lake, Lake N11 (during operations through pumping from the WMP) and downstream watersheds following closure are expected to be at, or below guidelines, at closure, and continue to decline to near background levels
  - – Finite source
- P projected to increase in Kennady Lake primarily as a result of seepage and drainage from the reclaimed mine site
  - – Infiltration through the external Fine PK Facility may mobilize P with saturated fine PK the largest potential source

- Concentrations will remain above baseline, but below aquatic health guidelines

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Residual Effects – Water Quality

Trace Metals

- During operations and closure there will be increases to trace metals concentrations in Kennady Lake, Area 8, Lake N11, and downstream lakes
- Majority of metals will be below PAL WQ guidelines
  - Exceptions: Cd and Cr in Lake N11 during operational discharges; in Kennady Lake following closure for Cd, Cr, Cu, and Fe; and Cd, Cr and Fe in Area 8
  - Aquatic health effects negligible
- Three patterns are predicted based on the source of the metals in Kennady Lake:
  - Increase in operations and decrease during post-closure (i.e., Cr, Co, Fe, Pb, Mn, Hg, Se, Ag, Tl, U, and Zn)
  - Increase steadily during operations, rise or fall in closure, and remain in steady state in post-closure (i.e., Al, Sb, As, Cd, Cu, Ni, and V)
  - Increase after closure and reach a steady state early in post-closure (i.e., Ba, Be, B, Mo, and Sr)

Residual Effects – Water Quality

Stability of Tuzo Pit

- Deep saline (high TDS) layer will remain stable and not overturn
  - Stability increases over time
- The water chemistry of Kennady Lake above Tuzo Pit will be primarily determined by the upper 20 m of fresh water

Winter Oxygen Demand

- Increases of phosphorus in Kennady Lake will increase primary productivity and therefore organic carbon accumulation
- WODR will increase resulting in lower DO in deeper water zones during under ice conditions, with the exception of Hearne and Tuzo pits
- Surface water column layers of Kennady Lake are expected to retain sufficient DO levels to sustain aquatic life
  - lower sediment oxygen demand in shallow lake zones

Cumulative Effects

- Existing and planned projects in the NWT are located outside of the LSA (i.e., Kennady Lake watershed or in downstream areas potentially affected by the Project)
- As such, there is no opportunity for the releases of those projects to interact with those of the Project within the Kennady Lake watershed downstream to Kirk Lake
- Consequently, there is no potential for cumulative effects to water quality in Kennady Lake or small lakes and streams in the Kennady Lake watershed, or downstream of Kennady Lake to Kirk Lake

Aquatic Assessment Conclusions

Water quality specific assessment endpoint:

The impacts of the Project on the suitability of water quality to support a viable and self-sustaining aquatic ecosystem are considered to be not environmentally significant

- Water quality is predicted to change in Kennady Lake and downstream of Kennady Lake, but is expected to result in negligible effects to aquatic health

Path Forward

Path Forward

- Gahcho Kué Panel has released a work plan, which identifies next step in the EIS Analysis
  - Presentation of EIS by De Beers followed by workshop for all parties to the EIR
- In advance of the EIS Analysis session planned by the Panel, De Beers is hosting an EIS Overview Workshop on October 26 and 27 to present the
  - Project description
  - assessment approach
  - existing environment
  - key assessment findings

Follow-up

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Lisa Hurley
Lisa_Hurley@golder.com
(403) 513-3538

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DE BEERS
CANADA
GAHCHO KUÉ PROJECT

November 23, 2011

File: S110

Sophia Garrick
Environmental Officer
Transport Canada
344 Edmonton Street
Winnipeg, MB R3B 2L4

Dear Ms. Garrick,

Re: Gahcho Kué Project Site Visit

Thank you for accepting our invitation to visit the Gahcho Kué Project site on September 19th of this year. We were pleased to have the opportunity to show you the site, explain the Project to date, as well as the planned future development. I trust you found it helpful, from Transport Canada's perspective, towards understanding the proposed mine site and the scope of the development.

Should you have any questions, now or in the future, please do not hesitate to contact me at stephen.lines@debeerscanada.com or 867-766-7352.

Sincerely,

Stephen Lines
Environmental Assessment & Permitting Coordinator

DE BEERS
CANADA
GAHCHO KUÉ PROJECT

October 21, 2011 File: S110

Mr. Gavin More
Manager, Environmental Assessment
Government of the Northwest Territories
PO Box 1320
Yellowknife NT X1A 2L9

Email: gavin_more@gov.nt.ca

Dear Mr. More:

Re: Gahcho Kué Project: Caribou Meeting Follow-up

De Beers Canada Inc. (De Beers) appreciated the opportunity on October 4, 2011 to meet with the Government of the Northwest Territories Department of Environment and Natural Resources (ENR) to discuss the assessment of effects on caribou. We trust that the meeting was helpful in clarifying aspects of the study methods and assessment approach.

As follow-up to the meeting, please find attached a copy of the meeting notes, agenda and meeting presentation.

De Beers looks forward to working with ENR as we advance through the Environmental Impact Review process. Should you have any questions, please feel free to contact me.

Yours truly,

Stephen Lines
Environmental Assessment & Permitting Coordinator

Attachment: 1

Record of Meeting

Date/Time	04 October 2011	**File no.**	De Beers: S110 Golder: 11-1365-0001 Phase 3030
Between	Bruno Croft (BC) – Manager; Research and Monitoring, Fred Mandeville (FM) – Regional Superintendent; North Slave Region, Gavin More (GM) Manager; Environmental Assessment, Jan Adamczewski (JA) –Wildlife Biologist; Ungulates Loretta Ransom (LR) – Analyst; Environmental Assessment, Sara True (ST) – Regional Assessment Coordinator; North Slave Region,	**of:**	Environment Canada (EC)
And	Stephen Lines – Environmental Assessment & Permitting Coordinator John Faithful (JF) – Technical Director (Golder Associates); John Virgl (JV) – Technical Lead – Terrestrial (Golder Associates); Cameron Stevens (CS) – Terrestrial Team (Golder Associates); Dan Coulton (DC) – Terrestrial Team (Golder Associates); Lisa Hurley (LH) – Engagement Coordinator	**of:**	De Beers Canada Inc.
Purpose	The purpose of the meeting was to discuss the comments provided by ENR in May 2011 regarding the caribou effects assessment		
Distribution	GNWT; De Beers; Golder Associates		

Introduction

- Roundtable of introductions.
- Gavin More (GM) confirmed he is the primary contact for the GNWT.

- Gavin More (GM) noted he had received the invitation to the Environmental Impact Statement (EIS) Overview workshop scheduled for October 26 and 27th. They anticipate there would be between eight (8) and ten (10) people from the GNWT attending. The wildlife team indicated they might not attend because they were having these separate meetings to help address comments.
- There was discussion about the process for providing the Panel with a summary of the discussions/resolutions between De Beers and ENR.

Project Update

- De Beers provided an update on the Gahcho Kué Project, which focused primarily on the reduction in Project footprint associated with supplemental mitigation for Fine PKC Facility.
- It was noted that De Beers is working on the Fine PKC Facility alternatives analysis report, and aiming to complete a draft by end of 2011.

Terms of Reference Overview

- John Virgl (JV) provided an overview of the Terms of Reference (TOR) for the Key Line of Inquiry: Caribou, and touched on the following topics:
  - detail about the study areas used in the caribou assessment (i.e., Bathurst, Ahiak and Beverly herds); and
  - conceptual assessment approach diagram (included in the presentation).

The following provides a summary of the specific topics discussed with the GNWT:

- There was some discussion about the caribou collar data that was used in the assessment and whether it was from the GNWT. It was confirmed that the information was obtained from ENR.
- There was agreement around the table with the approach used to develop the study areas for the herds; and that using the 1996 to 2007 data is conservative for the Bathurst Herd (i.e., provides maximum number of developments in home range). It was noted that there is some difficulty separating the Beverly and Ahiak herds. It was noted that there were collars on Bathurst caribou that appeared southeast of Lutsel k'e one year (thought to be 2006), but they haven't been there since. The locations the caribou and use of winter range can change year to year depending on many factors.
- There was discussion about the pathways that were assessed; it was noted that twenty-nine (29) pathways were considered in the assessment, and five (5) were identified as primary. JV explained that access was not one of the primary pathways, but the presentation at this meeting, and memo prepared (submitted to GNWT on July 22, 2011) provide a response to comments from the GNWT about this pathway.
- The GNWT noted some reservations about the population viability analysis (PVA); ENR commented that the PVA aims to ask whether the Project will reduce the population to zero.
  - JV and CS noted this was not the intent, but acknowledged there may be a need to redefine the intent of the PVA. The intent was to roll up all the work that had been done in the assessment and complete a PVA whose purpose was to provide an indication or measure of

the relative contribution of different human-related and natural factors (both natural and development related) on caribou population size.. *(note: further discussion about the PVA comments provided is outlined below).*

Caribou Comments provided by (ENR)

- De Beers and Golder provided a presentation (attached) focused on ENR comments in order to guide discussion of the following topics.
  - Effects of the Winter Access Road
  - Non-linear Additive Effects
  - Use of Population Viability Analysis (PVA)
  - Energetic Model
  - Progressive Reclamation
  - NO_2 Deposition
  - Land Cover Datasets
  - Other Comments
    - Caribou Study Area
    - Road Mitigation
    - Effects from Downstream Changes
    - Spill Response
    - Dust Monitoring
    - Noise Level Thresholds

Discussion: Comment 1 – Effects of the Winter Access Road

- Jan Adamczewski (JA) noted that it is almost unpredictable what might happen to herds with increased access. In some years the herd might not show up near a road, but then another year they might and people will have easy access to hunt there. Models cannot predict this but we should be aware that a non-effect for a number of years could become an issue depending on where the caribou are located with respect to distance from winter roads.
  - JV agreed that the effect of hunting is larger when the population is small (i.e., lower number animals, higher proportion taken). It is agreed that currently, the population is small. SL noted that winter road access in the project area is not currently an issue but monitoring might address the concern. . JV noted that since 2006, the core winter range has contracted with decreased population size, and animals are north and west of the Winter Access Road for the Project.
  - JA noted there is year-to-year variation; this is a potential issue rather than one that we can assign numbers to. It is not just an issue when the population of caribou is small.
- The GNWT noted that the EIS assumes that hunting is limited by where people have snowmobile access and how many caribou can be hunted and brought back by snowmobile. It was noted that

communities are taking planes or driving snowmobiles out in trucks and bringing animals back that way. This could increase the number of animals taken during these hunts.

- There was discussion around how De Beers would assist with monitoring activity on the winter road. No agreement was reached, but there might be an opportunity for further discussion on this topic.
- The GNWT noted they have been working with the message that careful harvesting of the herds is required. There is some concern because there are no restrictions for the Beverly/Ahiak herds. ENR's work to date has involved check stations on the winter roads.
- De Beers noted that the issue about increase access from the winter road is not a comment on the assessment approach but an issue of harvesting and how to manage it. SL noted having found no evidence of hunting activity on the winter road in previous years. However, it was noted that there could be an opportunity for discussions between De Beers and the GNWT regarding monitoring.
- The GNWT noted that there are monitoring check stations on Tibbitt-to-Contwoyto road which the GNWT operates through a joint venture with the Yellowknives Dene. Some of the funding for this is provided by the Tibbitt-to-Contwoyto joint venture.
  - JV acknowledged what the GNWT is saying and there is unpredictability with the caribou and their travel in the area. However, to meet the Terms of Reference, an assessment of this pathway must still be completed, which we did to the best of knowledge and ability with the information we had at that time.
  - Bruno Croft (BC) noted that there might be different scenarios to assess. The data from the monitoring check stations and caribou monitors might help. Because of the restrictions on hunting the Bathurst herd, people are travelling to hunt the other herds.
  - GM noted there is an opportunity to work together between the GNWT and De Beers regarding the access issue. It was noted that communities are developing plans and looking and how to manage hunting.
    - De Beers indicated they are open to hear suggestions from the GNWT on how to monitor the access road to the Gahcho Kué Project.
- Fred Mandeville (FM) provided a brief overview of the monitoring that is currently done at other locations. This includes:
  - wildlife monitors meeting with hunters when they return to the communities to obtain information from them regarding the health of the caribou. Hunters report on the number of, sex, age and location of caribou caught,
  - voluntary monitoring check points the main winter roads, and
  - cabins at different locations where people stay 24-hours a day.
- The GNWT noted that annual reports are prepared with the information collected by the monitors and are available for review.

Discussion: Comment 2 – Non-linear Additive Effects

JV provided an overview of the conservatism around the duration of effects predicted in the assessment. He noted that duration is a source of uncertainty in the assessment as we do not currently have an example of a mine closing to see how long it affects caribou.

- There was discussion around the zones of influence (ZOIs) allocated in the assessment to various types of developments on the landscapes (e.g., communities, roads, exploration projects). It was noted that conservatism was applied in an effort to make sure that changes were not underestimated (e.g., assumed a 500 m radius for exploration projects all year, every year until the permit is inactive; and if two ZOIs overlapped, the maximum disturbance coefficient was used).
- The GNWT indicated that caribou can do things that are unexpected. If we follow the linear additive then we might assume we could build a number in mines to the area and there might not appear to be a big effect, but there could be a point where caribou leave the area and we may not have any indicator identifying that this will happen. The GNWT noted they are not in disagreement or looking for additional analysis of this, but want acknowledgement of this issue.
  - JV provided an additional rationale of ZOIs. The ZOIs do not represent areas where there are no caribou, it is a probability distribution. In some years caribou appear to avoid mine sites in the Lac de Gras region, but analysis has also shown that in some years caribou are closer to the mine sites.
  - BC noted he agrees, but we need to be clear about this when presenting ZOIs. There will be additional questions about cumulative effects, but believes that assessment completed was done well.
  - De Beers noted they would give some thought to how to present this information at public meetings so that is clear what ZOIs are and how they were used in the assessment.

Discussion: Comment 3 – Use of Population Viability Analysis (PVA)

- The GNWT noted that they understand the purpose of the PVA was not to assess the possibility of the herd disappearing as a result of the Gahcho Kué Project.
  - JV acknowledged that there has been confusion about the PVA objective and will be working to help avoid misunderstandings as we go forward.

Discussion: Comment 4 – Energetic Model

- The GNWT asked if the insect harassment part of the model was extended through to October?
  - JV and CS confirmed that yes, it was extended into October, but it is expected that there will be no insects in October.
  - There was a discussion about the energetic model that was built for the assessment. The GNWT acknowledged that what was done was the best that could be done with the information that was available.
  - SL noted that future additional academic research would be required to advance energetic modelling.

- There was discussion about the models that Don Russell has developed. JV noted they had attempted to contact him and obtain these models but weren't provided with the actual model and platform for running the model. Don Russell did provide some preliminary and incomplete draft reports on the model inputs.
- There was discussion about what are the specific potential issues the GNWT has with the energetics model. The GNWT noted that those at this meeting did not have the specialization to comment on the model but thought there might be aspects of the end product that could be addressed.
  - Response: It was noted that Golder did not build this model, it was based on a model built by C.J.A Bradshaw. Initial model inputs were also taken the scientific literature (*see references below*)
- There was discussion about whether it might be worthwhile to have a targeted meeting on the energetic model. It was agreed this could be revisited at a later date, but was not deemed necessary at this time.

Discussion: Comment 5 – Progressive Reclamation

- It was noted that Section 10 Key Line of Inquiry: Long-term Biophysical Effects, Closure and Reclamation includes information about progressive reclamation.

Discussion: Comment 6 – NO_2 Deposition

- JV provided an overview of how the assessment was completed in the EIS.

Discussion: Comment 7 – Land Cover Datasets

- The GNWT noted that data are available at a 25 metre resolution for a portion of the range.
  - CS clarified that the intent was to use a dataset for the assessment that covered the entire area so that the effects from all known developments in the Bathurst herd range would be included in the assessment (i.e., provide maximum predicted effects), and meet the Terms of Reference. It is not anticipated that this finer resolution data would change the assessment (i.e., expect that the similar relative changes in the habitat quality results would be obtained if we used higher resolution information than was used in the assessment).

Discussion: Other Comments

Caribou Study Area

- JV noted that the comments were covered during the EIS Overview and Comment 7 – Land Cover Datasets discussions earlier in the meeting.

Site Road Mitigation

- It was noted that the site roads associated with the Project are very localized and would be built using best practices to facilitate the movement of wildlife through the mine site and will be decommissioned when no longer required.

Effects from Downstream Changes

- It was explained that information from hydrology was provided to the soils and vegetation disciplines which then provided information to wildlife.
  - The downstream flows associated with the Project will be maintained within one to two year flood events, because of this we are not expecting to see changes to soils/vegetation, therefore no changes to wildlife habitat.

Spill Response

- An Emergency Response Plan and Spill Contingency Plan will be developed similar to what is done for other mines.

Noise

- It was noted this was covered during discussions earlier (e.g., NO_2 emissions and zones of influence).

Dust

- The monitoring for air quality will be linked with soils, vegetation and wildlife monitoring and will use a gradient-based design looking at deposition at various distances from mine footprint.
- De Beers provided an overview of the dust monitoring that has been initiated. BC asked if there would be a controls set up away from the mine?
  - JV indicated that yes, monitors would be set up in a gradient manner extending away from roads.

Path Forward

- De Beers noted they will provide a summary of the discussion and a copy of the presentation from the meeting.
- De Beers provided GNWT (via Gavin More) with four copies of the DVDs that contain the entire EIS including conformity responses.

Action Item / Commitment	Responsible	Date
GNWT – ENR to confirm participants in the October 26th and 27th workshop.	GNWT (GM)	October 2011
GNWT (FM) provide annual reports prepared as part of the caribou monitoring.	GNWT (FM)	December 2011
De Beers provide notes and presentation from meeting.	De Beers	October 2011

Note: the material listed below is attached to these meeting minutes; this is consistent with the information that was presented during the meeting:

- Meeting Agenda
- Presentation

Four (4) copies the entire Environmental Impact Statement (EIS) with Conformity Responses were provided on DVD to Gavin More at the meeting.

References:

Cameron, R.D. and J.M. Ver Hoef. 1994. *Predicting Parturition Rate of Caribou from Autumn Body Mass*. Journal of Wildlife Management 58:674-679.

Bradshaw, C.J.A., S. Boutin, and D.M. Hebert. 1998. *Energetic Implications of Disturbance Caused by Exploration to Woodland Caribou*. Canadian Journal of Zoology 76: 1319-1324.

Weladji, R.B., O. Holand, and T. Almoy. 2003. *Use of Climatic Data to Assess the Effect of Insect Harassment on the Autumn Weight of Reindeer (Rangifer tarandus) calves*. Journal of Zoology 260:79-85.

Meeting Agenda

De Beers Canada
Gahcho Kué Project

MEETING	De Beers Canada and GNWT – Environment and Natural Resources Caribou Discussion	DATE:	October 4, 2011
INVITED	De Beers Canada Inc. GNWT – Environment and Natural Resources Golder Associates Ltd.		
LOCATION	De Beers Canada Boardroom Suite 300, 5102 -50th Ave Yellowknife, Northwest Territories		

Agenda Item/Discussion	Timing
Introduction ■ Health and Safety ■ Review of Agenda	9:00 – 9:15
Overview of the Terms of Reference ■ Overview of the Terms of Reference for the Key Line of Inquiry: Caribou	9:15 – 9:30
Caribou Comments from the GNWT ■ Review of the comments received from the GNWT and discussion ▪ Topics to include: effects of winter access road, non-linear additive effects, use of population viability analysis, energetic model, progressive reclamation, NO_2 deposition, and land cover datasets.	9:30 – noon
Lunch	Noon – 1:00
Path Forward ■ Review of next steps in communications	1:00 – 1:30

Gahcho Kué Project

Government of the Northwest Territories
Discussion of Caribou Comments

October 4, 2011

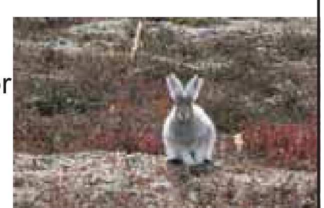
Introductions

De Beers Canada Inc.

- **Stephen Lines** Environmental Assessment and Permitting Coordinator - Gahcho Kué Project

Golder Associates Ltd.

- **John Virgl** Technical Lead – Terrestrial
- **Cam Stevens** Terrestrial Team
- **Dan Coulton** Terrestrial Team
- **John Faithful** Technical Director
- **Lisa Hurley** Engagement Coordinator



Purpose

Meeting with Government of the Northwest Territories, Department of Environment and Natural Resources (ENR) to discuss caribou comments:

– Comments on Key Line of Inquiry: Caribou provided by ENR in May 2011

Outline

- Project Update
- Terms of Reference for Key Line of Inquiry: Caribou
- Comments provided by ENR
- Discussion

Project Update

Project Update

- **Conformity Response**
  - On May 3rd, conformity responses to socio-economic questions were submitted to the Gahcho Kué Panel
  - On July 15th, conformity responses to phosphorus and permafrost was submitted to the Gahcho Kué Panel
  - On July 26th, the Panel determined that the EIS met conformity with the Terms of Reference
- **Engagement with ENR**
  - May 25th: Project and EIS Overview Meeting
  - July 27th: Carnivores Meeting
    - Responses to comments provided August 12th
  - October 4th: Caribou Meeting
    - Responses to caribou comments provided July 22nd

Structure of the EIS

Structure of the EIS

- The Terms of Reference issued by the Gahcho Kué Panel required that the assessment of the Key Lines of Inquiry and Subjects of Note "be comprehensive stand-alone analyses which require only minimal cross-referencing with other parts of the EIS".
- The result was a document organized by Key Lines of Inquiry and Subjects of Note, with Baseline reports for each terrestrial discipline included as annexes to the EIS.
- To be responsive to the Terms of Reference, only the information needed for the effects assessment within each Key Line Of Inquiry and Subject of Note was presented.

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EIS Sections Relevant to Terrestrial

Section Number	Section Title
2	Project Alternatives
3	Project Description
7	**Key Line of Inquiry: Caribou**
11.7	Subject of Note: Vegetation
11.7.I	Geology, Soils and Terrain Appendix
11.9	Subject of Note: Waste Management and Wildlife
11.10	Subject of Note: Carnivore Mortality
11.11	Subject of Note: Other Ungulates
11.12	Subject of Note: Species at Risk and Birds
13	Cumulative Effects Assessment
14	Summary and Conclusions
Annex D	Geology, Soils and Terrain Baseline
Annex E	Vegetation Baseline
Annex F	Wildlife Baseline

Key Line of Inquiry: Caribou

- Within this Key Line of Inquiry the EIS must detail any effects on caribou, as well as their significance and likelihood in accordance with the instructions in Sections 3.2 on assessment methods and Section 7 on wildlife issues.
- The EIS must address how changes to abundance, health, distribution, and behaviour of caribou may affect the social, cultural, and economic well being of residents of the Mackenzie Valley, particularly Aboriginal communities in the regional study area.

Key Line of Inquiry: Caribou (continued)

DE BEERS CANADA

- The developer is required to include a summary of caribou research and caribou related monitoring activities and their results for the potentially affected herds since the first diamond mine was permitted, to the extent that relevant information is publicly available.
- The EIS must outline management options for dealing with impacts on caribou and related socio-economic impacts. For situations where the proposed development is predicted to be only one of many sources of impacts, direct or indirect, that combine in a cumulative manner, the EIS should outline what contributions this development can make to addressing a cumulative problem.

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Key Line of Inquiry: Caribou (continued)

DE BEERS CANADA

- For potential impacts on caribou, the geographical scope includes the potentially affected portion of the range of any herd that may be affected, including but not restricted to the vicinity of the mine site, the access road from MacKay Lake, and the Tibbitt-to-Contwoyto Road up to the start of the access road at MacKay Lake.
- Observations from existing diamond mines must be used to establish how far from a mine site caribou show behavioural changes.
- Research and monitoring activities must be included for the Tibbitt-to-Contwoyto winter road corridor.

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Key Line of Inquiry: Caribou (continued)

DE BEERS CANADA

The following specific information needs were identified and must be included in the caribou-specific impact analysis:

- Information on all caribou herds with ranges that include the area of the proposed development, as well as the Tibbitt-to-Contwoyto winter road
- Description of any life stages during which each herd may interact with the proposed development
- Estimate of the amount (absolute and relative) of habitat loss, change, degradation, or effective habitat loss for each potentially affected herd for various life stages resulting from the development
- Estimate of the existing habitat fragmentation at the landscape (seasonal range) and local (site) scale, the expected increase, and its possible effects on each caribou herd for various life stages

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Key Line of Inquiry: Caribou (continued)

DE BEERS CANADA

- Analysis of ways the development may influence the energy balance of caribou under different seasonal conditions and to what extent this may affect birth rates, and calf survival
- Identification of all possible sources for increased caribou mortality
- Identification of all hazards to caribou within the development area and access routes
- Identification of all possible pathways for caribou exposure to contaminants
- Identification of all potential changes to the predator-prey relationship of any potentially affected herd and how this may affect the herds

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Key Line of Inquiry: Caribou (continued)

DE BEERS CANADA

- Description of any methods used to distinguish between impacts from development and natural variations in caribou numbers, health or behaviour
- Identification of all cumulative effects of other past, current, or reasonably foreseeable future developments within the range of each potentially affected caribou herd in combination with individual components or activities of the proposed development and its effects on other environmental components such as predators as well as the overall effect of the proposed development

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Key Line of Inquiry: Caribou (continued)

DE BEERS CANADA

- Outline of any potential measures or actions to minimize impacts, (e.g. various road bed designs)
- Explanation of how any proposed mitigation measures, including plans for progressive reclamation, will contribute to the sustainability of the Bathurst caribou herd as well as other potentially affected herds
- Outline of any adaptive management strategies (i.e. what management response will occur if adverse effects on caribou are detected) for any of the items listed above, as well as any plans for monitoring effects on caribou

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Caribou Study Areas – Bathurst Herd

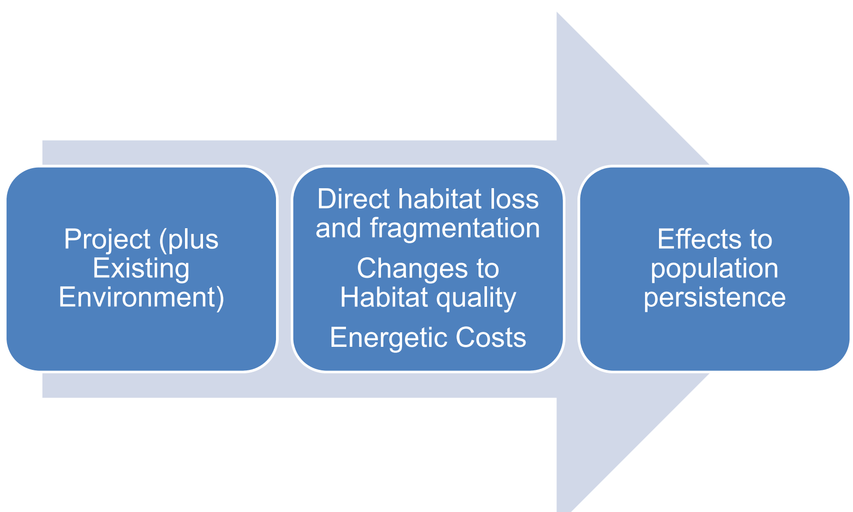
De Beers Canada

Caribou Study Areas – Ahiak Herd

De Beers Canada

Caribou Study Areas – Beverly Herd

Conceptual Approach to Assessment



Approach to Meet Terms of Reference

To meet the Terms of Reference and assess incremental and cumulative effects on caribou, the EIS used multiple approaches for making impact predictions by analyzing the following:

- changes in habitat quantity and fragmentation per season
- changes in the abundance of quality (preferred) habitats per season (with RSFs [Johnson et al. 2005])
- encounter rates with zones of influence and changes in behaviour and energetics
- population viability analysis that compared scenarios describing natural and human-related factors (insects, weather-related events, development, and hunting)

The EIS integrated uncertainty and ecological conservatisms throughout the assessment so the impacts would not be worse than predicted.

Conservative Modelling Assumptions in EIS

EIS Section(s)	Assessment Step	Assumption Description
7.5.2.1	Development Database	A spatial bias of footprint (area of direct habitat disturbance) for all exploration sites; footprints assumed to be a 500-m radius (78.5 ha)
7.5.2.1	Development Database	A spatial bias of linear footprints; all linear footprints (e.g., winter roads) were assumed to be of a 200-m corridor.
7.5.3.2.1	Development Database	Spatial and temporal biases included a 5-km ZOI for active exploration permits for the entire length of permit (i.e., 5-yr period)
7.5.3.2.1	Development Database	Spatial and temporal biases included a 15-km ZOI for all active mines regardless of mine footprint or level of activity for each mine
7.5.3.2.1	Resource Selection Function	Disturbance coefficients (modifier that reduced habitat quality in ZOI) with greatest effect were applied in cases where ZOIs overlapped
Table 7.5-15	Movement Analysis and Energy Model	Residency time (versus encounter rates) was used to estimate number of disturbance events in energetic models
7.5.3.2.2; Fig 7.5-4	Energy Model	When an animal responds to a sensory disturbance event, it's response is to run, become excited and lose body weight
7.5.3.2.2; Fig 7.5-4	Energy Model	Energetic model included a cost of excitement and assumed that animals are excited for a 12-hr period following a sensory disturbance event
7.5.3.2.2; Fig 7.5-4	Energy Model	Animals do not habituate to repeated encounters of similar sensory disturbances
7.5.3.2.2; Fig 7.5-4	Energy Model	No compensatory mechanisms to offset energetic costs from sensory disturbances and insect harassment; predicted weight loss was permanent
7.5.3.2.2; Fig 7.5-4	Energy Model	IHI-autumn weight relationship was based on calf responses of reindeer in Norway
Table 7.5-15 & 18	Energy Model and PVA	Assessment of incremental effects combined Project and Taltson
7.5.4.1.1	PVA	Large variances in parameters (e.g., CV of 0.2 for K) were used in the population model to account for uncertainty in estimates

ENR Comments: Caribou

1. ENR – Effects of Winter Access Road

Comments:

Concerned that winter road access will lead to increased harvest

- Potential effects to small herd size
- Regional data shows significant number harvested (2006-2009) from pick-ups
- Winter road part of core winter range
- Hunting access may increase for Bathurst, Beverly & Ahiak herds
- Previous work shown that regulating hunting on roads is difficult (e.g., Dempster Road)
- Harvest management is challenging

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1. Reply – Effects of Winter Access Road

De Beers Canada

- The pathway was considered secondary for the following reasons:
  - Access associated with the winter roads is limited to 8 to 12 weeks / yr
  - Caribou harvest for residents and non-residents is regulated
  - De Beers staff will be prohibited from hunting while on site
  - Winter access road extends above treeline and outside core winter range
    - The existing core winter range 2006 to 2010 is west/northwest of the Project
    - The existing core winter range 2006 to 2010 is smaller than the previous range 1996 to 2005
    - Minor and local increase in harvest mortality risk from hunters along Winter Access Road

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1. Reply – Effects of Winter Access Road (continued)

De Beers Canada

- Additional consideration on the changes to caribou mortality from increased access and hunter harvest includes:
  - No evidence of harvest along Snap Lake Winter Access Road (kilometre 228)
    - It has been in operation since 2006.
  - The Winter Access Road for the Project (kilometre 271) is 40 km further along of the Tibbitt-to-Contwoyto Winter Road
    - It has been permitted for ten years, and in operation in 2001, 2002 and 2006
  - Harvesting along the Winter Access Road is expected to be limited and similar to the Snap Lake Winter Access Road

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1. Reply – Effects of Winter Access Road (continued)

- The spatial extent of the effect on populations should be limited to the local area around the Winter Access Road and not extend beyond Kennady Lake or below the treeline
- The duration of the effect is expected to continue until the end of final closure (i.e., 5 to 10 years after stopping the use of road), and the frequency is limited to approximately 12 weeks each year
- Overall, the low and local increase in harvest mortality from the Winter Access Road will not have a significant adverse effect on the persistence of caribou populations

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2. ENR – Non-linear Additive Effects

Comments:

- Although modelling outcomes consistent with work by ENR, effects may have been misdiagnosed because the assessment assumed linear versus non-linear responses by caribou to each development
- Some evidence in Norway that responses to each new infrastructure not necessarily (linearly) additive; there may be tipping points (provoking non-linear responses) (e.g., Nelleman 2001)
- Responses or effects may be longer lived than predicted

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2. Reply – Non-linear Additive Effects

De Beers Canada

- Assumed linear effects based on the following:
  - Cumulative direct disturbance less than 1.7% in seasonal ranges and maximum proportion of annual range covered by cumulative zones of influence was 6% in 2006
  - These changes are well below 40% threshold (and 20% target level for high magnitude effect in EIS) of habitat loss generally resulting in non-linear changes to population processes
  - Conservative input values used so that actual effect size should be less than that reported in the EIS
  - Unlikely that Bathurst caribou avoid mine developments because of association with hunting as found in Norway (no hunting policy at mine sites)
  - In the EIS, the duration of impacts is predicted to occur over 27 to 32 year period (includes 5 to 10 years for effects to be reversed)

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3. ENR – Use of Population Viability Analysis (PVA)

De Beers Canada

Comments:

Questions the use of PVA in the assessment

- PVA inputs and relationships questioned with respect to current emperical knowledge of caribou population dynamics
- Use of density dependence and carrying capacity inputs

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3. Reply – Use of PVA

DE BEERS CANADA

- PVA is commonly used and well-accepted scientific approach for evaluating relative changes to population viability
  - >200 PVA articles in peer-reviewed literature since 2008
  - Robust tool for predicting effects
    - functions for model sensitivity analysis and ranking of population viability across management scenarios
  - Sensitivity results of Bathurst caribou PVA are consistent with other modelling approaches
  - Incorporating density dependence in the model is ecologically relevant and appropriate (even despite low effect in model)
- K based on densities in Bergerud et al. (2008), and reported herd sizes for Bathurst
- The approach was appropriate for meeting the Terms of Reference and providing confident and ecologically relevant impact predictions

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3. Reply – Use of PVA (continued)

DE BEERS CANADA

- To demonstrate the robustness of our approach (i.e., use of relative changes in comparison scenarios), new effects tests were completed for reference and cumulative effect scenarios using:
  - a substantially different carrying capacity of 145,000 females (rather than 290,000 females)
  - contest-type (Beverton-Holt) density dependence (rather than ceiling-type density dependence), which assumes that populations grow 5% to 10% when N is low and that there is no growth at N = K (Lopez 2004)

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3. Reply – Use of PVA (continued)

Simulation	Projected Final Abundance	% Change in Final Abundance	Max Difference in Prob of Threshold Abundance between Risk Curves (D)	Kolmogorov-Smirnov P-value
1) Cumulative Effects Tests (original; ref K = 290,000, ceiling-type density dependence)				
Null model = reference baseline (no development, low insect harassment)	35,556	n/a	n/a	n/a
Application-future #1 (low insect harassment) versus reference	31,703	-12.15	0.166	<0.0001
2) Cumulative Effects Tests (ref K = 145,000; ceiling-type density dependence)				
Alternative Null model #1 = reference baseline (no development, low insect)	35,111	n/a	n/a	n/a
Application-future #1 (low insect harassment) versus reference	31,224	-11.07	0.170	<0.0001
3) Cumulative Effects Tests (ref K = 290,000; contest-type density dependence)				
Alternative Null model #2 = reference baseline (no development, low insect)	115,415	n/a	n/a	n/a
Alternative Application-future #1 (low insect harassment) versus reference	111,419	**-3.46**	0.077	0.0053

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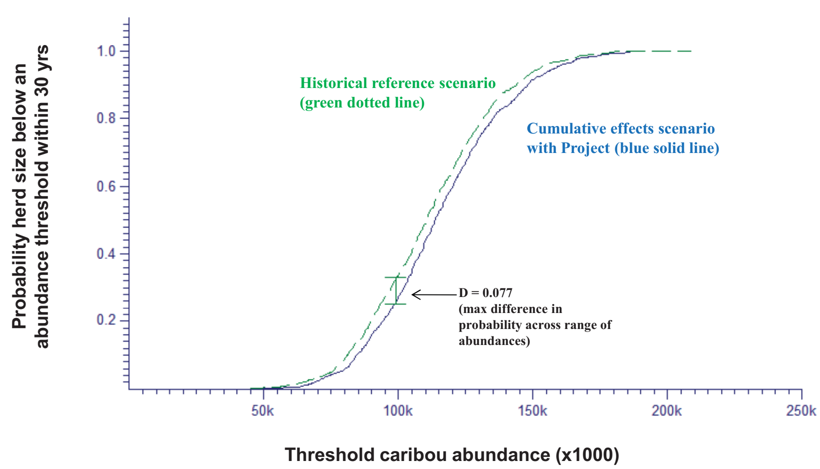
3. PVA risk curves for cumulative effects test (contest density dependence)



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4. ENR – Energetic Model

Comments:

Questioned energetic model used, assumptions, and uncertainty

- Energetic model is untested and too simple
- Underestimated effects of insect activity
- IHI-autumn weight relationship for calves introduced bias
- Percent body fat is a better predictor of parturition
- No foraging inputs in model
- Underestimated number of disturbance events using residency time

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4. Reply – Energetic Model

- The energetic model used was based on the following elements:
  - Conservative approach (to avoid underestimating effects)
  - Inputs were based on data and relationships from peer-reviewed literature
  - Simpler models can be more transparent and have fewer assumptions
  - Agree that insects have strong influence on weight loss, but outcome of EIS will not change if 'threshold' of 14 IHI is removed from model (see top of page 7-116)
    - relative effects from natural factors will still be higher than effects from development
  - IHI-weight loss formula for calves could overestimate weight losses for cows (if calves more susceptible to disturbance)

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4. Reply – Energetic Model (continued)

- Use of body weight as a correlate of parturition rate is supported by scientific literature
- Assumed weight loss was permanent, no compensatory mechanisms with respect to amount and quality of forage consumed after disturbance
- For each day in a ZOI, an animal was assumed to be exposed to one disturbance event independent of proximity to development/activity

- The approach was appropriate for meeting the Terms of Reference and providing confident and ecologically relevant impact predictions

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5. ENR – Progressive Reclamation

Comment:

Provide examples of progressive reclamation

Reply:

Progressive reclamation prior to final closure. Examples of progressive reclamation include:

- Salvage and stockpile soil, overburden, lakebed sediments from disturbed areas (for reclamation)
- Create new and/or expanded fish habitat during operations
- Reclamation of completed portions of Fine PKC Facility
- Reclamation of completed portions of South and West Mine Rock Piles

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6. ENR – NO_2 Deposition

Comment:

NO_2 deposition and changes to habitat quality

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6. Reply – NO_2 Deposition

- EIS applied conservative air quality modelling assumptions for emission and deposition rates:
  - Maximum emission rates used, although equipment not likely to continuously operate at maximum capacity
- Potential Acid Input (PAI, includes NO_2 and SO_2) expected to be localized to 169 ha around the Project site (within 500 m of Project)
- PAI predicted to have negligible effect on soil and plant communities
- NO_2 expected to be localized to South Mine Rock Pile and haul roads
- Risk assessment predicted no impacts to caribou health
- Overall, predict minor and local influences on forage quality and negligible effect on persistence of caribou
- Predictions will be tested by linking Air Quality to Vegetation and Wildlife Effects monitoring programs

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7. ENR – Land Cover Datasets

Comment:

Clarification on land cover datasets used in EIS

7. Reply – Land Cover Datasets

- Relative change between development scenarios (baseline, application, future) was assessed so use of different landscape classification should have little influence on impact classification and determination of significance (precision versus accuracy)
- Land Cover of Canada (LCOC) covers entire caribou ranges that may be influenced by developments (meets Terms of Reference and provides confident and ecologically relevant impact predictions)
- Agree LCOC not precise at pixel scale but good representation of vegetation distribution at scale of caribou ranges
- A winter RSF was unavailable but cumulative changes to habitat quantity and configuration within the winter ranges were included in assessment

Other Comments

- Caribou study area
- Road mitigation
- Effects from downstream changes
- Spill response
- Dust monitoring
- Noise level thresholds

De Beers Canada

Path Forward

Path Forward

De Beers CANADA

- Gahcho Kué Panel has released a work plan, which identifies next step in the EIS Analysis
  - Presentation of EIS by De Beers followed by workshop for all parties to the EIR
- In advance of the EIS Analysis session planned by the Panel, De Beers is hosting an EIS Overview Workshop on October 26 and 27 to present the
  - Project description
  - assessment approach
  - existing environment
  - key assessment findings
- Would like continued discussions with GNWT – ENR

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Follow-up

De Beers CANADA

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TECHNICAL MEMORANDUM

DATE July 22, 2011 **PROJECT No.** 11-1365-0001/DCN-016

TO Paul Cobban and Stephen Lines
De Beers Canada Inc.

CC Amy Langhorne

FROM John Virgl and Cameron Stevens **EMAIL** John_Virgl@golder.com

RESPONSE TO THE DRAFT CARIBOU COMMENTS PROVIDED BY THE GOVERNMENT OF THE NORTHWEST TERRITORIES - DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Introduction

The memorandum has been prepared to provide responses to the draft caribou comments provided to De Beers Canada Inc. (DBC) by the Government of the Northwest Territories – Department of Environment and Natural Resources (ENR) in May 2011.

Comprehensive Comments

Caribou - Comment #1

Issue

The reviewer states that new winter access to the Gahcho Kué Project (Project) could lead to increased harvest and resulting caribou mortality. Roads allow greater access and harvest than snow machine alone. Further, this particular road could provide access to Beverly/Ahiak caribou as well as Bathurst, and during the winter season. Efforts to regulate harvest from roads (such as no-hunting corridors) have not been very successful in the Yukon.

Response

This issue was assessed in the EIS under the pathway "Increased access for traditional and non-traditional harvesting may alter caribou movement and behaviour, which can affect survival and reproduction" (Section 7.4.2.2.3). This pathway was considered a secondary pathway for the following principal reasons:

- the increase in access to the region associated with the winter roads is limited to 8 to 12 weeks each year;
- the caribou harvest for residents and non-residents is regulated; and
- De Beers staff will be prohibited from hunting while on site.

Given the current low population size of most caribou herds, ENR raised an appropriate concern that the proximity of the Project to the treeline may provide new access to caribou wintering grounds. The following additional consideration of the changes to caribou mortality from increased access and hunter harvest, and the persistence of caribou populations is provided.

De Beers (2008) has detected no evidence of harvesting/hunting activity on the Snap Lake winter access road (i.e., private traffic is rarely observed on the winter access road), which occurs at kilometre 228 of the Tibbitt-to-Contwoyto Winter Road. Harvest data reported along the Tibbitt-to-Contwoyto Winter Road also suggest that hunting activity should be limited on the Gahcho Kué Winter Access Road. Ziemann (2007) reported data from the Dome Lake checkpoint on the Tibbitt-to-Contwoyto Winter Road. Here, the reported caribou harvest was 583, 494, and 255 caribou in 2004, 2005 and 2006 (including both General Hunting License (GHL) and Resident hunters; Ziemann 2007). However, it was anticipated that most of this harvest occurs within the first 100 km of the road before the treeline. The Winter Access Road for the Project will begin at kilometre 271 of the Tibbitt-to-Contwoyto Winter Road, and harvesting along the Winter Access Road is expected to be limited and similar to Snap Lake.

Considering that the caribou hunting season is between 15 August and 30 April in the NWT, construction of the Winter Access Road could provide increased access over existing winter roads with regards to access for harvesting caribou. Under most circumstances (except for the current non-hunting zone that overlaps the Project) resident and aboriginal hunters are permitted to hunt from the Tibbitt-to-Contwoyto Winter Road, or use it to gain access to hunting areas. It is possible to use trucks and snow machines on the Tibbitt-to-Contwoyto Winter Road to gain access to areas such as Cook Lake or Artillery Lake, where groups of individuals of the Bathurst caribou have previously over-wintered. Snow machines can access the winter range through existing trails and along winter roads before they are open and after they close to vehicle traffic. However, the number of caribou efficiently harvested with the use of snow machines is much less relative to vehicles, such as pick-up trucks.

The Winter Access Road for the Project will provide improved access over the existing winter roads, and has the potential to result in an increase in the harvest of caribou. Subsequently, the number of caribou harvested in the winter range from improved access due to the Winter Access Road is predicted to be within or approach the upper limits of baseline values (in the absence of additional mitigation or management to be determined through discussions with ENR). However, the spatial extent of the effect on the population should be limited to the local area around the Winter Access Road and not extend into the winter range well below the treeline. The duration of the effect is expected to continue until the end of final closure (i.e., 5 to 10 years after stopping the use of the Winter Access Road), but the frequency is limited to approximately 12 weeks each year. Overall, the moderate and local increase in harvest mortality to caribou from the Winter Access Road should not have a significant adverse effect on the persistence of caribou populations.

Caribou - Comment #2

Issue

The reviewer states that the modelling outcomes for caribou in the EIS are consistent with the zone of influence (ZOI) of 15 to 30 kilometres that has been accepted for diamond mines in the Bathurst range. The reviewer notes that the modelling projections for the Project and additional mines assumes an essentially linear response by caribou to each additional mine. That is, there will be another ZOI, caribou will tend to avoid the new mine, the net effects are in direct proportion to the additive effects of these mines.

The reviewer cites studies of reindeer in Norway that suggest the response by reindeer to each additional transmission line, road, or to other infrastructure is not necessarily additive. They note that there may be a tipping point beyond which reindeer essentially stop using a disturbed area.

The reviewer identifies that the projections in the EIS make an attempt to account for possible additional mines and roads, but the modelling assumes that the avoidance and disturbance effects end or become much reduced when the mines are less active or closed. The reviewer indicates that at some point the response by caribou may have a tipping point beyond which caribou essentially cease to use an area, or stop crossing roads or linear corridors.

The reviewer states that it is possible that the Project may have effects as modelled and predicted in the EIS, but they also note, that the effects may also not be as predicted, and may last longer than predicted. The reviewer indicates it would be appropriate to acknowledge this kind of uncertainty in the model predictions.

Response

The reviewer is correct in that the assessment assumed linear (additive) responses by caribou to each additional development. The rationale is partly related to the observed low levels of disturbance cover in the seasonal ranges. For the Bathurst and Ahiak herds, the cumulative direct disturbance to each seasonal range from the Project and other previous, existing and future developments is predicted to be less than or equal to 1.7% (see bottom paragraph of page 7-91 in EIS). In addition, the maximum proportion of the annual range of the Bathurst herd covered by cumulative zones of influence (indirect effects to habitat quality) from development was 6% in 2006 (Figure 7.5-3 in EIS). This level of development is well below the 40% threshold where habitat loss and disturbances generally result in non-linear changes to population processes (i.e., when effects of habitat loss and fragmentation are observed on population parameters). In other words, the present landscape is not close to any reasonably ecological tipping point beyond which changes to caribou behaviour have demographic implications for the herd.

What is interesting about the reindeer herd in south-central Norway is that the population has been characterized as being stable at about 30,000 animals, despite apparent fragmentation from high levels of human activity and disturbance within their home range. For example, in the Nodrfjella wild reindeer region where a sub-population of reindeer reside, there is an extensive network or roads, railway lines, and power lines dating back almost 100 years (e.g., Vistnes et al. 2001). Some of the longer term changes in caribou distribution are related to avoidance of roads (adjacent to power lines) that are associated with sensory disturbance effects and hunting, which caribou likely perceive as predation risk.

Although Christian Nellemann's (Nellemann et al. 2001, 2003) research is good quality work and relevant to the effects analysis section, the conclusions may not be directly applicable to the environmental setting in the Bathurst and Ahiak caribou ranges. For example, avoidance of powerlines by the non-migratory herd in Norway does not necessarily imply that Bathurst caribou will not cross a powerline or winter road within their range. Nellemann proposes that caribou associate powerlines with traffic and hunting; hence, avoidance is most likely related to reducing exposure to stress/hunting and part of a spacing-out strategy. This association has not been confirmed for Bathurst caribou, and is likely to be weak given the low level of human disturbance in the seasonal ranges. In addition, hunting is prohibited at or around exploration camps and mining operations in the NWT. Furthermore, the approach in the EIS used conservative values for uncertain variables so that the actual effect sizes are not worse than predicted.

The reviewer states that effects to caribou from development may be longer-lived than predicted and the EIS should acknowledge this kind of uncertainty. The reviewer's comments are based on Nellemann's research (Nellemann et al. 2001; Nellemann et al. 2003), which show that sensory disturbance effects during construction/operation phases may continue after closure. The reasoning is that animals develop an association of stress with human development during construction/operation and avoid these areas even when sites are closed and sensory disturbances stop. Specifically, if a one-year old caribou is disturbed along a winter road, then the individual may avoid similar developments for the next 15 years (approximate life span of caribou).

In the EIS, the duration of impacts included the period of activity of the stressor (i.e., construction, operation, and closure), and the anticipated length of time to reverse the effect on the population (Section 7.7.1.3). The number of caribou life spans associated with the duration of the effects is also provided. The expected life of the Project from construction to the end of initial closure is 16 years, which is the period of time when the highest levels of activity will occur on site. After initial closure (which involves decommissioning of most site infrastructure) the level of activity for the remaining 6 years until final closure (complete re-filling of Kennady Lake) will be limited to care and maintenance. In the EIS, the duration of indirect impacts to caribou distribution from changes in preferred habitat is predicted to occur over a 27 to 32 year period (page 7-162). This estimate includes the 16 years of construction, operation, and decommissioning activities, 6 years of care and maintenance activity, and 5 to 10 years for the effects to be reversed. Thus, the EIS predicts that the period of the maximum level of activities and associated effects to caribou behaviour and distribution is followed by an equivalent period of time before the effects are reversed on the population (two caribou life spans). We agree that the duration of effects is a primary component in the uncertainty of predictions on environmental significance and is discussed in the EIS (page 7-171).

Caribou - Comment #3

Issue

The reviewer criticized the use and value of population viability analysis (PVA) in the EIS. Inputs and relationships in the models were also questioned with respect to the uncertainties in caribou population dynamics.

Response

Population viability analysis is a commonly used and well-accepted approach for evaluating the relative changes to population sizes under a suite of varying intrinsic and extrinsic factors that influence demographic rates. For example, a recent search of the phrase "Population Viability Analysis" in Web of Science® yielded 190 articles since 2008.

In brief, PVA provides a quantitative modelling and assessment framework that explicitly incorporates stochasiticty and uncertainty in factors that are predicted to influence population size and extinction probabilities (Akcakaya et al. 2004). The strength of PVA lies in the use of model sensitivity analysis and ranking (or comparison) of extinction risks across varying land use and population management scenarios. Population viability analysis models are best used for estimating the relative population changes and risks from varying influences of human and natural factors (stochastic and deterministic) on survival and reproduction rates (e.g., Reed et al. 2002; Curtis and Vincent 2008; Roger et al. 2011). This approach was used in the EIS and is emphasized at various locations in the assessment (e.g., see Section 7.5.4 and page 7-135). It is important to note that the assessment did not rely solely on results from a single model. Doing so could potentially generate imprecise and inaccurate results affected by model structure, study duration, and other uncontrolled factors.

Although the reviewer critizices the use of inputs and relationships that are not well established, the results from the sensitivity analyses are consistent with other modelling attempts (as the reviewer states), which lends support to the conclusion that the base structure of the model is reliable and grounded in reality. The reviewer is correct that the nature and frequency of density dependence, and carrying capacity are not well established in migratory tundra caribou. Even though the frequency and strength of density dependence can vary spatially and temporally in populations, environmental selection on density-dependent mortality factors must exist for populations to persist long enough for the evolution of life history strategies (Murdoch 1994; Turchin 1995). Incoporating density dependence in the population model was ecologically relevant and appropriate. Interestingly, the frequency of strong density dependence affecting the caribou population in the model was low, which is similar to the results from empirical studies (Messier et al. 1988; Ferguson and Messier 2000). For example, parturition rates for the George River herd (and other migratory herds) appear be unaffected by summer densities (reviewed in Bergerud et al. 2008). A density-dependent component in fecundity occurs only at extreme densities.

To demonstrate the robustness of the assessment approach (i.e., the use of relative risk and abundance), two new comparisons (i.e., effects tests; Table 1) were completed for reference and application scenarios using:

- a substantially different carrying capacity of 145,000 females (rather than 290,000 females); and
- contest-type density dependence (rather than ceiling-type density dependence), which assumes that populations grow 5% to 10% when N is low and that there is no growth at N = K (Lopez 2004). Maximum annual growth rate (lambda) was assumed to be 1.117 (see Table 7.5-17 in EIS). This type of density dependence (Beverton-Holt) has been previously used for modelling populations of Florida Key deer and the effects of urban development (Lopez 2004).

The results from the new comparisons (or effects tests) showed that cumulative effects were similar when assuming a much smaller carry capacity (Table 2). The new percent change in final population size was -11%; whereas the original percent change was -12%. If models assume contest-type density dependence, then the anticipated cumulative effect is smaller than the original prediction. The 3rd cumulative effects test in Table 2 shows that the percent change in final abundance was -3.5%.

Table 1 Table 1: Simulation Scenarios for Population Viability Analysis of Bathurst Caribou Herd (also see Table 7.5-18 in EIS)

Simulation	Input Parameters	Condition of Modifier Variable
Reference baseline (null model) - low insect harassment - no development	survival fecundity carrying capacity (K) initial abundance weather event management action	no change from stage matrix no change from stage matrix 290,000 (with ceiling model density dependence) 23,000 50% decrease in abundance of calves and 14 and 15 year old individuals every 10 years 4% harvest rate
Alternative Null #1 - low insect harassment - no development	survival fecundity carrying capacity (K) initial abundance weather event management action	no change from stage matrix no change from stage matrix 145,000 (with ceiling model density dependence) 23,000 50% decrease in abundance of calves and 14 and 15 year old individuals every 10 years 4% harvest rate
Alternative Null #2 - low insect harassment - no development	survival fecundity carrying capacity (K) initial abundance weather event management action	no change from stage matrix no change from stage matrix 290,000 (with contest-type model density dependence) 23,000 50% decrease in abundance of calves and 14 and 15 year old individuals every 10 years 4% harvest rate
Application-future #1 - includes the Project and the Taltson Hydroelectric Expansion Project - low insect harassment	survival fecundity carrying capacity (K) initial abundance weather event management action	no change from stage matrix decrease by 3.1% decrease by 7.3%(with ceiling model density dependence) 23,000 50% decrease in abundance of calves and 14 and 15 year old individuals every 10 years 4% harvest rate
Alternative Application-Future #1 - includes the Project and the Taltson Hydroelectric Expansion Project - low insect harassment	survival fecundity carrying capacity (K) initial abundance weather event management action	no change from stage matrix decrease by 3.1% decrease by 7.3% (with contest-type model density dependence) 23,000 50% decrease in abundance of calves and 14 and 15 year old individuals every 10 years 4% harvest rate

Note: words highlighted in yellow are of parameters under question that have been modified for additional 'effects tests'; cells highlighted in grey represent original inputs of models presented in the EIS.

Table 2: Sensitivity Analyses of Parameter Inputs and Effects Analyses of Various Landscape Scenarios and Insect Harassment Levels for the Bathrust Herd Population Viability Analysis (also see Table 7.5-19 in EIS)

Simulation	Projected Final Abundance	% Change in Final Abundance	Maximum Difference in Probability of Threshold Abundance between Risk Curves (D)	Kolmogorov-Smirnov P-value[(a)]
1) Cumulative Effects Tests (reference model assumed 290,000 carrying capacity; both models assumed ceiling-type density dependence)				
Null model = reference baseline (no development, low insect harassment)	35,556	n/a	n/a	n/a
Application-future #1 (low insect harassment) versus reference	31,703	-12.15	0.166	<0.0001
2) Cumulative Effects Tests (reference model assumed 145,000 carrying capacity; both models assumed ceiling-type density dependence)				
Alternative Null model #1 = reference baseline (no development, low insect harassment)	35,111	n/a	n/a	n/a
Application-future #1 (low insect harassment) versus reference	31,224	-11.07	0.170	<0.0001
3) Cumulative Effects Tests (reference model assumed 290,000 carrying capacity; both models assumed contest-type density dependence) [(b)]				
Alternative Null model #2 = reference baseline (no development, low insect harassment)	115,415	n/a	n/a	n/a
Alternative Application-future #1 (low insect harassment) versus reference	111,419	-3.46	0.077	0.0053

Note: Reference baseline = no development, low insect levels, and a harvest rate of 4%. Current (2010) baseline = previous and existing developments (1996 to 2010). Application-future = previous and existing developments plus the Project and the Taltson Hydroelectric Expansion Project.

(a) statistical significance accepted at an alpha level of 0.05.

(b) contest-type density dependence (Beverton-Holt) assumes that populations grew 5% to 10% when N was low and that there was no growth at N = K (Lopez 2004). Maximum growth rate was assumed to be 1.117 per year (see Table 7.5-17 in EIS).

Other Ungulates - Comment #4

Issue

The reviewer notes that direct impacts on moose and muskoxen are likely to be limited. It is unlikely that the new winter road to the Project would immediately mean increased harvest pressure on muskoxen, but their vulnerability to hunter harvest should be recognized.

Response

The authors acknowledge that muskoxen are susceptible to over harvest pressure, particularly since they are currently at low population size in the NWT. The assessment of increased access on mortality and persistence of muskoxen populations was predicted to be a secondary pathway for the following principal reasons:

- the Project is not within a current hunting zone for muskoxen; although hunting area ‘U/MX/01’ lies just east of the Project.
- the increase in access to the region associated with the winter roads is limited to 8 to 12 weeks each year and as previously mentioned, no hunting increase has been documented as a result of Snap Lake.

Specific Comments

Comment 7.1.3.3 Caribou study area

Issue

The reviewer is seeking clarification on why the entire database of satellite collar data up to 2010 was not used to derive home ranges for the three herds.

Response

The reviewer is correct that annual and seasonal ranges were calculated using data from 1996 to 2007. This period used data from 167 animals and included the period of maximum population size during the past 15 years, which also includes the largest annual range sizes. These shapefiles were developed for the first iteration of the assessment in early 2008, and in the interest of being efficient the estimated ranges were used for the submitted EIS beginning in early 2010. Including the locations of animals for 2008 and 2009 would likely result in negligible changes to annual and seasonal ranges considering that the herd size was much smaller than in the mid to late 1990s.

Comment 7.4 Pathway Analysis

Issue

The reviewer agreed that the Bathurst herd is the most likely to be impacted by the development, but noted that the Ahiak and Beverly herd can potentially be just as impacted during winter months.

Response

See response to Comprehensive Comment; Caribou – Comment #1.

Comment 7.4.1 Potential Pathways for Effects to Caribou

"Road Escarpments and Injury"

Issue

The reviewer asked how roads at the Project will be built to mitigate the concern of road escarpments at mining sites being too steep and causing injury.

Response

Bathurst caribou travel over 1,000 km each year. During this time, they encounter many natural hazards and obstacles, including rivers, thin ice, cliffs, escarpments, boulder fields, hills and eskers. Caribou are familiar with these hazards and obstacles, and are well equipped to avoid or negotiate them. All roads will be within the Project footprint with other mine activities, and will be designed foremost for safety and to meet engineering standards.

The implementation of environmental design features (Table 7.4-1) and the Wildlife Effects Mitigation and Monitoring Plan (Appendix 7.I) are expected to decrease the risk to animals from physical hazards on-site. Ditches along roads will be contoured where appropriate to facilitate movement of caribou and other wildlife across roads. Roads will be constructed at a low-profile and construction will follow proven best practices for winter road construction. At closure, the entire site area will be re-contoured to reduce hazards to wildlife. Past experience has shown that the frequency of direct mine-related mortality on caribou is extremely low. For example, the Snap Lake Mine has had no incidents with caribou (injury or mortality) during the 10-year period from advanced exploration through construction (De Beers 2010).

Importantly, wildlife monitoring by site environmental technicians will determine the efficacy of the proposed mitigation and adaptive management plan. Regular surveys for caribou presence around the Project site and constant communication with all staff will provide early-warning of wildlife presence on-site, and the opportunity to manage and mitigate situations as they develop to prevent incidents. This will include regular inspections of the landfill, waste storage and transfer areas, asking site staff about wildlife observations, and walking inspections of the Project site to record wildlife and wildlife sign. In this way, environmental staff on-site may correct problems if they arise. There will also be review and updates as required through the results of the Wildlife Effects Monitoring Program, and regular review and updates to the Operating Procedures, if necessary.

"Unavoidable Sensory Disturbances"

Issue

The reviewer asked for an explanation of why or when it would not be possible to maintain a 200-m distance to avoid disturbing caribou.

Response

The statement of a 200-m distance is incorrect as the intent of the wildlife mitigation policies and procedures is to avoid any disturbance and harassment to caribou (and other wildlife), and is not dependent on distance from animals.

“Removing caribou”

Issue

The reviewer asked what safe and effective methods will be used to remove caribou form the airstrip before take-off or landings.

Response

Caribou will only be herded away from roads or the airstrip in specific circumstances, such as when there are incoming flights or an emergency. Typically, this is done by driving a truck down the length of the airstrip. Electric fencing, flagging, and inukshuks have had limited success at deterring caribou from airstrips and other mine facilities. However, caribou have become entangled in electric fences.

“Progressive Reclamation”

Issue

The reviewer asked for examples of progressive reclamation.

Response

Progressive reclamation takes place prior to permanent closure, reclaiming components and/or decommissioned facilities that no longer serve the objectives of the exploration program (MVLWB 2009). The reclamation activities can be initiated during exploration activities to reduce future reclamation costs, to minimize the duration of environmental exposure and enhance environmental protection. Progressive reclamation may shorten the time for achieving reclamation objectives. Importantly, progressive reclamation may provide valuable experience (e.g., new ecological knowledge) on the effectiveness of certain measures which can then be implemented during permanent closure (MVLWB 2009).

A ‘Conceptual Closure and Reclamation Plan’ has been developed for the Project (Section 10.4.1 of the EIS). Closure and reclamation were considered during the selection of design alternatives. As such, closure and reclamation planning has been considered in all Project phases. Progressive reclamation during operations and closure and reclamation phases will be consistent with the objectives outlined by INAC in the Mine Site Reclamation Guidelines for the NWT (INAC 2007).

The overall goal of the reclamation plan is to minimize the lasting environmental impacts of operations to the extent practical and allow disturbed areas to return to productive fish and wildlife habitat as quickly as possible.

Examples of progressive reclamation proposed for the Project include the following:

- Salvage and stockpile soil, overburden, and lakebed sediments, to the extent practical, from areas of disturbance.
- Create new and/or expanded fish habitat areas during construction and operations phases.
- Progressively reclaim the Fine PKC Facility.
- Progressively reclaim portions of the South Mine Rock Pile.
- Progressively reclaim portions of the West Mine Rock Pile.

For further details, please refer to Section 10 (Long-Term Biophysical Effects, Closure, And Reclamation) and Section 11.7 (Vegetation) of the EIS.

"Classification of Increased Access Pathway"

Issue

The reviewer recommended that the pathway for increased access to traditional and non-traditional harvesting be changed to primary from secondary, and that the Project explore ways of working with ENR to minimize chances of overharvesting caribou in the winter in the proximity of the winter road.

Response

See response to Comprehensive Comment; Caribou – Comment #1.

"Effects from Downstream Changes"

Issue

The reviewer asked what mitigation measures will address the concern of changes in downstream flows and water levels from the refilling of Kennady Lake affecting the quantity of riparian habitat which could alter caribou movement and behaviour.

Response

Any potential changes to downstream riparian vegetation are anticipated to be minor and localized to the drainage areas adjacent to the Project, which would be difficult to detect at the scale of the seasonal range of the caribou herds. Downstream flows will be managed primarily to reduce impacts to fish habitat, and to provide continued fish passage. Consequently, water pumping or diversion will not increase discharges above the baseline 2-year flood levels in downstream lakes and channels. Lake N11 has a natural capacity to accept the increased flow and there is no expected erosion to downstream water courses. These minor and localized changes to riparian habitat are not predicted to affect caribou movements and behaviour.

Comment Page 7-62 "Spills"

Issue

The reviewer asked what additional mitigation measures, and contingency plans, would be applied to limit changes to the existing environment outside of the Project footprint as a result of non-desired material being released into the natural drainage system.

Response

The following are mitigation policies and procedures to decrease the risks of wildlife encountering or ingesting potentially toxic substances from spills during all phases of activity on the Project site (also see Section 7.4.2.1.2).

- Adhere to and regularly update the Emergency Response and Contingency Plan.
- Follow the procedures outlined in the Hazardous Material Management Plan.
- Designate and train a spill response team consisting of on-site personnel.

- Provide spill containment supplies at fuel transfer and storage areas.
- Immediately isolate, clean and report any spills.
- Keep spill response equipment readily available and maintained.
- Maintain vehicles and equipment.
- Store fuel in lined and bermed containment areas.

Comment Page 7-66 “Dust extent”

Issue

The reviewer asked about the monitoring that will be implemented for dust deposition.

Response

The Project will implement dust deposition and vegetation monitoring programs to test predictions made in the EIS (Section 10.7.10.2). The study designs and sampling protocols for these programs will likely use a gradient approach to determine the spatial extent of dust deposition and effects on vegetation. For example, sampling locations would be located at increasing distances from the Project footprint (range of dust deposition zones extending up to 30 km from the footprint) and consider prevailing wind directions. The results from these studies would be linked to the Wildlife Effects Monitoring Program.

Comment Page 7-71 “NO_2 concentrations”

Issue

The reviewer requested clarification about the NO_2 deposition and the predicted changes to habitat quality.

Response

Air emission and deposition rates are based on conservative assumptions in the air quality models so that estimated effects are not worse than predicted. For example, modelling used maximum emission rates from the Project even though most equipment will not operate at maximum capacity on a continuous basis. This assumption likely resulted in overestimation of the potential Project impacts for the longer averaging periods (24-hour and annual) (Section 11.14.8). Potential acid input (PAI) (which includes SO_2 and NO_2 deposition) is expected to be localized near the Project site and influence 169 ha of habitat extending up to 500 m from the Project development area boundary. The increase in PAI is predicted to have a negligible effect on soil chemistry and plant communities (Section 11.7). Similarly, peak concentrations of NO_2 are predicted to exceed the guideline value (60 $\mu g/m^3$) by 4.3 $\mu g/m^3$ and be localized to the South Mine Rock Pile and haul roads along the south side of the Project footprint. These negligible and localized changes in soil quality and plant communities are anticipated to have minor influences on caribou foraging habitat relative to baseline conditions and should have a negligible effect on the population persistence of caribou. These predictions will be tested by implementing an Air Quality Monitoring Program that will be linked to the Vegetation Monitoring Program and Wildlife Effects Monitoring Program.

Comment Page 7-78 “increased access”

Issue

The reviewer stated that eight to 12 weeks of winter road operation is enough to allow for a substantial increase in the harvest when caribou are within half a day of travel by snow machine and the winter road operation should be treated as a potential negative major influence on the harvest.

Response

See response to Comprehensive Comment; Caribou – Comment #1.

Comment Page 7-83 “Landcover datasets”

Issue

The reviewer asked for clarification on the landcover datasets used.

Response

The Land Cover of Canada was used because it provided full coverage of all caribou ranges, and provides the most comprehensive and appropriate approach for assessing the cumulative effects from all previous, existing, and future developments on caribou. In addition, the important information in the assessment is the relative difference between development scenarios (i.e., baseline, application, and future cases), and the use of a different landscape classification should have little influence on the impact classification and determination of significance.

It is unclear what the reviewer means by stating that the Land Cover data was not perfectly ground-truthed. For example, classification accuracy for the SGP dataset ranges from 51-82% among cover types (Matthews et al. 2001) (see Section 7.5.2). Although the Land Cover of Canada map was generally not precise on a single-pixel basis (because most pixels contain several land cover types), it does give a representative picture of land cover distribution over larger areas such as the caribou seasonal home ranges. Quantitatively, it has been found to be accurate for area by vegetation class (For more information, see http://geodiscover.cgdi.ca/).

Regarding the comment related to resource selection models on page 7-103, the text is incorrect and should have stated that a winter resource selection function was unavailable for caribou at the time of the assessment. Importantly, the assessment included an analysis of the cumulative changes to the abundance and fragmentation of caribou habitat from previous, existing, and future developments within the winter range (see Section 7.5.2.2).

Comment Page 7-98 “Sensory Disturbances”

Issue

The reviewer asked for clarification on why human noise level guidelines were used.

Response

With no knowledge of threshold noise levels for caribou (and other wildlife), the assessment used guidelines for humans to provide some indication of the local changes in noise levels from the Project.

The reviewer is likely correct that the sensitivity of caribou to Project-related noise is greater than humans. This is why the analysis was not limited to predicting noise-related effects to caribou through a comparison to human noise assessment guidelines. The analysis also quantified changes in habitat quality, which included noise and other sensory disturbances, from the Project and other developments using varying disturbance coefficients within zones of influence (Section 7.5.3.2.1; Table 7.5-9). For example, habitat quality was reduced by 95% and 50% within 1 km and 1 to 5 km of the footprint for the Project and other operational mine sites within the spring to autumn ranges of the Bathurst and Ahiak caribou herds. This analysis was intended to more accurately predict the effects from noise levels and other sensory disturbances on caribou habitat, behaviour, and movement.

Comment Section 7.5.3.2.2 "Effect on Behaviour, Energy Balance, and Calf Production"

Issue

The reviewer raised questions about the energetic model used in the EIS and the assumptions and uncertainty associated with it.

Response

The reviewer is correct that the energetic model used in the EIS is untested. To the knowledge of the authors of this assessment, a tested (or validated) model is currently unavailable for applications similar to that required for the EIS. However, a clear advantage of our model is its simplicity. Most ecologists would argue that less detail is better when using mathematical descriptions of ecological phenomena. In addition, we have based the model on a suite of supporting peer-reviewed literature. The general approach in calculating energetic costs was consistent with a well-cited study on caribou in Alberta (Bradshaw et al. 1998). Similarly, the energetics model followed the best-available information on metabolic rates in the peer-reviewed literature (for example, see Boertje 1985; Blaxter 1962; McEwan 1970; Fancy and White 1987).

- The EIS reported that during an average insect harassment index (IHI) year females may lose as much as 1.33 kg. This may be an underestimate as the reviewer points out. The reviewers comment confirms the strong influence of natural factors (versus human-related factors) on caribou energetics. The reviewer is suggesting that the relative influence of insect harassment is stronger than we described. However, the overall outcome of the caribou assessment will likely not change even if the IHI formula is modified, which could include the removal of the IHI threshold that caribou tolerate insect activity [creating a formula of autumn body weight = 80 kg – (IHI) x 0.148] (see Figure 7.5-4).

- The reviewer is critical of the use of the IHI-autumn weight relationship (which was based on a study of calves) for estimating effects on parturition rates. This approach is potentially ecologically conservative given that calves may be more susceptible to the effects of insect activity levels given their small size (Table 3). Young and old animals in a population generally exhibit the highest mortalities and are most susceptible to the effects of disease and adverse climate conditions. Thus, based on the approach in the EIS and the reviewer's comments, the assessment likely overestimated the effects of insect activity levels on parturition rates. However, if this is true, the proposed conservative relationship may have offset the assumption that caribou can tolerate low levels of insect harassment.

- With regards to the comment of premature weaning, late winter/spring conditions appear to be the primary driver of calf survival (e.g., see Boertje 1985; Adams et al. 1995; Helle and Kojola 2008). The reviewers comment confirms the strong influence of natural factors (versus human-related factors) on caribou energetics. Indeed, the reviewer is suggesting that the relative influence of natural factors is stronger than described in the EIS, and the authors acknowledge that this may be true. The dynamics of caribou populations are incredibly complex and modelling every known interaction between caribou and their natural environment is beyond the scope of the Terms of Reference and this assessment. The challenge (which the EIS has met) was to develop a model that not only best captured the dynamics of a population, but was scientifically defensible, transparent, and allows the methods to be repeatable. There are potentially more biases in a model characterized by more parameters.

- The reviewer comments that percent body fat (versus percent body weight) is a better predictor of parturition, but did not provide a reference for this statement. The EIS provides multiple references for percent body weight (e.g., Bradshaw et al. 1998; Cameron et al. 1993; Cameron and Ver Hoef 1994). The approach in the EIS was consistent with the peer-reviewed literature.
- The authors agree, in part, with the reviewer on having foraging inputs in an energetic model. However, the approach used in the assessment was consistent with Bradshaw et al. (1998). Further, the approach is ecologically conservative in that animals are assumed to not compensate for energetic costs from sensory disturbances. Animals could, in theory, increase foraging intake following a disturbance event to offset energy costs (i.e., weight losses). Consideration of compensatory mechanisms would have produced a more liberal assessment. Rather, the assessment assumed that the predicted weight loss was permanent (Table 3).
- The reviewer asked for clarification on the calculation of the IHI. The IHI (i.e., potential harassment days; PHDs, which is based on wind speed and termperature) was calculated using previously collected climate data at Snap Lake and Diavik, and was summarized for the 138-day exposure period. If there were potential harassment days (PHDs) in October (which there wasn't for obvious reasons), then those numbers would have been summarized in Figure 7.5-5 and included in the energetic modelling.
- On page 7-113 it is stated that it was assumed that for each day in a ZOI an animal was exposed to one disturbance event regardless of how close it was to the development footprint or activity. This assumption was thought to best estimate the actual number of disturbance events given that: a) caribou generally move at a rate of 7 to 8 km/day during the summer to autumn period; and b) potential sensory disturbances are anticipated to be within 5 km of the Project footprint (e.g., see Table 7.5-7). The comment that 'one disturbance event per day in a ZOI is vastly underestimated' is not supported. There are many occasions where the assessment has used ecological conservatism (e.g., applied weight loss and reduced parturition rates to all females in the population) as a means to reduce uncertainty in the underestimation of impacts (also see Table 3).
- With the regards to the paragraph on page 7-127 (last paragraph of Section 7.5.3), the assessment is referring to sensory disturbance events only.

Comment 7.5.4.2

Issue

The reviewer requested clarification about the population of females used in the model.

Response

The reviewer is critical of the initial population size input of 23,000 females for the PVAs, and argues that 16,000 females should have been used. The estimate of 16,000 refers to breeding females only in Adamczewski et al. (2009). The assessment used 23,000 animals because that was the reported number of females (both breeding and non-breeding) reported in Adamczewski et al. (2009), and was used to complete the stage matrix of the PVA (see page 7-132).

Issue

The reviewer asked what could be done to reduce the predicted cumulative impacts to caribou to a lower level.

Response

With regards to the comment on predicted cumulative impacts to caribou, the impact predictions may be excessively overestimated given the number of ecological conservatisms that were used throughout various analyses of the assessment (Table 3). To reduce the predicted cumulative impact of 12.2% to a lower level, some of the conservative assumptions could be eliminated or modified and the PVA models re-run after discussions with ENR.

Comment 7.5.5.1 "Access to caribou"

Issue

The reviewer asked if De Beers would be willing to assist in monitoring harvest in the vicinity of the Project.

Response

See response to Comprehensive Comment; Caribou – Comment #1.

Comment 7.6.2.2.2 "Behaviour, Energy Balance, and Calf Production

Issue

The reviewer noted that additional work and research is required on the energetic model used in the EIS.

Response

See response to Comment Section 7.5.3.2.2. Yes, more research is needed, but for the purposes of the EIS and meeting the requirements in the Terms of Reference, the energetic model is adequate enough to substantiate the cumulative effects on productivity of caribou. It is important to note that the assessment has likely overestimated the cumulative effects to energetic costs, parturition rates, and population viability (see Table 3).

Table 3: Modelling assumptions in the caribou assessment that were based on ecological conservatism (i.e., good EA practices).

EIS Section(s)	Assessment Step	Assumption Description	Potential Implications
7.5.2.1	Development Database	A spatial bias of footprint (area of direct habitat disturbance) for all exploration sites; footprints assumed to be a 500-m radius (78.5 ha)	Predicted changes in availability of habitat types and good quality habitat were overestimated
7.5.2.1	Development Database	A spatial bias of linear footprints; all linear footprints (e.g., winter roads) were assumed to be of a 200-m corridor.	Predicted changes in availability of habitat types and good quality habitat were overestimated, particularly for assessments of winter habitat
7.5.3.2.1	Development Database	Spatial and temporal biases included a 5-km ZOI for active exploration permits for the entire length of permit (i.e., 5-yr period)	Predicted changes in the availability of good-quality habitat were overestimated; encounter rates and residency times were also overestimated
7.5.3.2.1	Development Database	Spatial and temporal biases included a 15-km ZOI for all active mines regardless of mine footprint or level of activity for each mine	Predicted changes in the availability of good-quality habitat were overestimated; encounter rates and residency times were also overestimated
7.5.3.2.1	Resource Selection Function	Disturbance coefficients (modifier that reduced habitat quality in zones of influence) with greatest effect were applied in cases where ZOIs overlapped	Predicted changes in the availability of good-quality habitat were overestimated
Table 7.5-15	Movement Analysis and Energetic Modelling	Residency time (versus encounter rates) was used to estimate number of disturbance events in energetic models	Estimated number of sensory disturbance events and total energetic costs were overestimated
7.5.3.2.2; Figure 7.5-4	Energetic Modelling	When an animal responds to a sensory disturbance event, it's response is to run, become excited and lose body weight	Estimated energetic cost per disturbance event, as well as total energetic costs accumulated during migration were overestimated
7.5.3.2.2; Figure 7.5-4	Energetic Modelling	Energetic model included a cost of excitement and assumed that animals are excited for a 12-hr period	Estimated energetic cost per disturbance event, as well as total energetic costs accumulated during migration were

EIS Section(s)	Assessment Step	Assumption Description	Potential Implications
		following a sensory disturbance event	overestimated
7.5.3.2.2; Figure 7.5-4	Energetic Modelling	Animals do not habituate to repeated encounters with similar types of sensory disturbances	Predicted total energetic costs from sensory disturbance events and related effects on parturition rates were overestimated
7.5.3.2.2; Figure 7.5-4	Energetic Modelling	No compensatory mechanisms to offset energetic costs from sensory disturbances and insect harassment; predicted weight loss was permanent	Predicted weight losses from disturbance events and related effects on parturition rates were overestimated
7.5.3.2.2; Figure 7.5-4	Energetic Modelling	IHI-autumn weight relationship was based on calf responses of reindeer in Norway	Predicted weight losses from insect harassment and related cumulative effects on parturition rates were overestimated
Table 7.5-15; Table 7.5-18	Energetic Modelling and Population Viability Analyses	Assessment of incremental effects combined the Project and Taltson Hydroelectric Expansion Project	Predicted incremental effects on parturition rate, abundance at year 30, and risk curves were overestimated
7.5.4.1.1	Population Viability Analyses	Large variances in parameters (e.g., CV of 0.2 for K) were used in the population model to account for uncertainty in estimates	Either population growth was underestimated or population decline was overestimated; however, the assessment outcome should not be affected (i.e., results should be similar with or without large variances)

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TECHNICAL MEMORANDUM

DATE November 23, 2011 **PROJECT No.** 11-1365-0001 (DCN-043)

TO Veronica Chisholm
De Beers Canada Inc.

CC Stephen Lines and Andrew Williams (De Beers Canada Inc.)

FROM Lisa Hurley and John Faithful **EMAIL** john_faithful@golder.com

RE: RESPONSES TO FOLLOW-UP ITEMS IDENTIFIED FROM THE GAHCHO KUÉ PROJECT EIS OVERVIEW WORKSHOP (OCTOBER 25 AND 27TH, 2011)

The purpose of this memorandum is to provide you with the compiled responses to the items identified for follow-up from the Gahcho Kué Project Environmental Impact Statement (EIS) Overview Workshop held with communities and regulators on October 26th and 27th, 2011. On October 25th, 2011 a session was held only with community representatives, Golder is not aware of any items that need to be followed up from the meeting held that date.

Attached to this memo is the tracking sheet that is being used to record the status of these items for easy reference. This memo is organized by department/individuals so that De Beers can take excerpts from this memo and draft individual memos as appropriate. This memo only includes the Information Requested for which Golder, JDS or EBA was responsible for providing.

Aboriginal Affairs and Northern Development Canada

Nathan Richea, Julian Kanigan, Aboriginal Affairs and Northern Development Canada (AANDC) and Dave Huebert (Stantec; consultant to AANDC), requested the following information.

Information Requested (EIS Overview – 003): What is the size of Kennady Lake after it is refilled?

Response: Section 8.7.4.4.2 of the EIS describes the residual effects of the project on the Kennady Lake watershed. It states that the water surface area of Kennady Lake will be reduced from 8.15 km^2 to 7.19 km^2 as the net result of infill less land area removed during pit excavation. The volume of Kennady Lake will have a corresponding increase from 38.3 Mm^3 to 66.7 Mm^3.

Information Requested (EIS Overview – 005): Provide additional information regarding the placement of material from the dykes after they are breached.

Response: An initial response was provided during the EIS Overview Workshop. Additional information is being sought from JDS and EBA regarding this question to provide a more complete response to AANDC. We are proposing that a response to AANDC could be prepared for December 9, 2011.

Information Requested (EIS Overview – 006): Additional detail regarding roads and transmission lines (i.e., linear features) included in terrestrial assessment.

Response: Section 7.5.2.1 of the EIS provides an overview of the previous and existing developments in the study area, features which were used to estimate changes in the landscape between pre-disturbance and existing conditions. The available information indicated 326.8 km of transmission lines, 1,926.8 km of winter roads, 75.7 km of all-season roads, and 161.6 km of highway within the range of the Bathurst herd. These values do not include municipal infrastructure. For the purposes of estimating landscape disturbance, all roads and transmission line right-of-ways were conservatively assumed to be 20 metres wide.

Information Requested (EIS Overview – 007): The change in disturbance on the landscape if some development had been assumed in the reference case.

Response: Two landscape classifications were used in the EIS, depending on the geographic scale of assessment. CESA: For the cumulative effects study area for caribou and carnivores, we used the 2000 Land Cover of Canada classification [which is largely a product of Earth Observation for Sustainable Development (EOSD) project]. Prior to analyses we qualitatively validated the classification by overlaying the Land Cover with a classification by Matthews et al. (2001). A visual assessment confirmed that two classifications were in alignment. One advantage of going forward with the Land Cover was that it streamlined the analyses by reducing computational demands associated with the geographic scale of the assessment to meet the Terms of Reference. The Land Cover uses 1 km pixel resolution. The coarse resolution of this dataset would detect only larger developments such as human settlements and communities and would have classified this cover as non-vegetated. However, communities were included in the pre-development scenario by superimposing the community area on the Land Cover of Canada classification.

For Bathurst and Ahiak herds, the cumulative direct disturbance to each seasonal range from the Project and other previous, existing and foreseeable developments is predicted to be less than 1.7%. This statistic should be highlighted as it is independent of the “quality” of the land cover database that was used. This statistic is similar to that describing disturbance for the Slave Geological Province (for the carnivore assessment).

RSA: Within the Regional Study Area we used a classification by Matthews et al. (2001) captured at a 25-m pixel resolution. Although this resolution could potentially detect developments on the landscape, there is no cover type in the classification database that directly measures developments or disturbance (Matthews et al. 2001). The classification has a total of 22 land and water cover types, including bare ground and gravel as potential indicators or correlates of disturbance on the landscape. However, there is no bare ground or gravel cover in the RSA suggesting that the RSA database that was applied in the EIS accurately reflects a pre-disturbance landscape (see Table 11.7-18 or Table 11.11-6 in the EIS). Although Matthews et al. reports that the database may contain some inaccuracies, they believe it is an artefact of overlap between classes, for example heath tundra and heath bedrock are ecologically similar. Image analysis for this classification was carried out at the NWT Centre for Remote Sensing in Yellowknife from 1997 to 2001. The lack of disturbance cover captured in the classification database may be (partly) a result of the dates of the analysis (in other words, the dates precede the majority of exploration activity in NWT). Again, it is important to highlight the fact that with the application of the Project less than 0.5% of the RSA is classified as disturbance cover. This statistic is independent of the “quality” of the land cover database that was used in the EIS.

Environment Canada

James Hodson (Canadian Wildlife Service (CWS) and Jane Fitzgerald Environment Canada (EC) requested information on the following:

Information Requested (EIS Overview – 008): Confirm that footprint used for terrestrial assessment included raised water levels post closure?

Response: Yes, the footprint used for the terrestrial assessment did include changes to upland and wetland habitats from the mine infrastructure and alterations to water levels from some lakes. (*Note: this response was provided to James Hodson via email on October 31, 2011).*

Information Requested (EIS Overview – 009 and 010): Where are the TDS levels that were included in the hydrogeology and hydrology modelling that show the inflow rates for the Pits.

Response: Concentrations of TDS were not included in the hydrology modelling.

Information relevant to the hydrogeological modeling is located in Section 11.6. Subject of Note: Permafrost, Groundwater and Hydrogeology. TDS concentrations are based on a groundwater profile developed for the Gahcho Kue project. This profile can be found in Figure 11.6-11. Other relevant information includes:

- The figure showing Total Dissolved Solids in Groundwater versus Depth is located in Section 11.6.2.2.4 of the EIS on Page 11.6-32.
- Predicted groundwater quantities and associated TDS concentrations are provided in Table 11.6-5.
- The table showing Predicted Groundwater Inflow Quantity and Quality During Mining, is located on on Page 11.6-57 of Section 11.6.4.1.2 of the EIS.

Information Requested (EIS Overview – 011): Provide additional detail about understanding the influence of permafrost in Kennady Lake area.

Response: Information relevant to the description of permafrost in the Kennady Lake area is located in Section 11.6. Subject of Note: Permafrost, Groundwater and Hydrogeology. In particular, this information is provided in Section 11.6.2.1, Existing Environment, Permafrost.

Information Requested (EIS Overview – 014): Residence time for Kennady Lake (Pre-development and Post closure)

Response: The baseline volume of Kennady Lake is 38.3 Mm^3 and baseline mean annual outflow is 4.76 Mm^3/year (Volume 3a, Section 8.7.4.2), yielding a baseline residence time of 8.0 years. The post-closure volume of Kennady Lake is 66.7 Mm^3 and the post-closure mean annual outflow is 5.03 m^3/year, yielding a post-closure residence time of 13.3 years. The latter includes the deep Tuzo Pit, which is not expected to fully mix with the remainder of the lake, so the residence time of the mixed volume would be somewhat smaller.

Information Requested (EIS Overview – 015): Did the model assess landslides within the pits and affects on water Quality?

Response: Overturning of the pit lake is not accounted for in the hydrodynamic model.

It is understood from Gammons et al. (2009); the slope stability of an open pit after refilling is subject to the influence from a number of factors (e.g., steep-sided and fractured bedrock walls, groundwater pressure) that may increase the potential for a landslide to occur. A landslide event could induce a turnover event due to resultant turbulent mixing associated with substantial rock falls within the pit. However, if a landslide were to result in complete mixing of the Tuzo pit water, it is not expected to significantly influence the TDS concentrations in Kennady Lake. For example, the initial meromixis results in TDS concentrations of approximately 410 mg/L below the pycnocline (i.e., the defined boundary between high and low TDS waters), and approximately 110 mg/L above the pycnocline. The total volume of the pit is approximately 41 Mm^3. Of this total, only 16 Mm^3 is attributed to higher TDS water. If a landslide were to result in overturning at this point, conservative mixing of the upper and lower portions of the pit would result in a concentration of approximately 230 mg/L, which is still considered to be representative of freshwater.

The hydrodynamic model used to define the stability of the meromixis in Tuzo Pit indicates that the pycnocline progressively migrates downwards, which will result in a reduction in the volume of high TDS water approximating 9 Mm^3 after a period of 100 years. If a landslide, resulting in complete mixing of the Tuzo pit, were to occur, conservative mixing of the high and low TDS waters is predicted to result in a pit lake TDS concentration of approximately 170 mg/L.

It is important to note that the deeper groundwater will become enriched in TDS as a result of moving to a steady state with the high TDS deep regime groundwater over time, which will increase the stability of the meromixis state. However, as indicated in Figure 8.8-24 Modelled Water Column Distribution of Total Dissolved Solids Concentration in the Tuzo Pit Projected Over Time (Section 8.8.4.2.2), the Tuzo pit requires greater than 1000 years before a significant change in TDS concentrations is expected. After 1,000 years, concentrations below the pycnocline increase to approximately 1,000 mg/L. Assuming this water completely mixes with the overlying lower TDS water (100 mg/L), conservative mixing results in a total pit TDS concentration of approximately 300 mg/L, which is still considered representative of freshwater.

It is also noteworthy to point out that as the pit density gradient is strengthened (i.e. >1000 years), rock falls down the submerged pits wall, depending on their magnitude, may likely result in an internal seiche (a wave-induced disruption through the water column) in the Tuzo pit and not necessarily a complete turnover.

Information Requested (EIS Overview 016): Additional detail regarding what was included in the model regarding mixing in the pit.

Response: The details of the hydrodynamic model are provided in Volume 3b, Appendix 8.I, Section 8.I.4 of the EIS. Hydrodynamic model results are provided in Section 8.8.4.2 of the EIS. *(Note: Discussion was had with Jane Fitzgerald during one of the breaks in response to her question; the information above provides the reference to the EIS for information on this topic.)*

Government of the Northwest Territories

The individual from the Loretta Ransom Government of the Northwest Territories (GNWT) requested the following information:

Information Requested (EIS Overview – 017): Confirmation that emissions from Snap Lake Mine do not reach the Gahcho Kué Project.

Response: The dispersion modelling indicated that negligible level of gaseous compounds (i.e., SO_2 and NO_2) emitted from the Snap Lake Mine may reach the Gahcho Kué Project under specific meteorological conditions. Particulate matter (i.e., $PM_{2.5}$ and TSP) and dust emitted from the Snap Lake Mine will unlikely reach the Gahcho Kué Project. A summary of Snap Lake Mine's contributions to the Baseline Case SO_2, NO_2, $PM_{2.5}$ and TSP predicted concentrations at the Gahcho Kué Project presented in Subject of Note Section 11.4 in the EIS is listed in Table 1.

Table 1: Summary of Snap Lake Mine's contributions to the Baseline Case SO_2, NO_2, $PM_{2.5}$ and TSP predicted concentrations at the Gahcho Kué Project

Parameter		Predicted Concentration
SO_2		
	Maximum 1-hour SO_2 in the LSA	3.4 µg/m³
	Snap Lake Mine's contribution	0.8 µg/m³
	NWT Air Quality Standard for 1-hour SO_2	450 µg/m³
	Maximum 24-hour SO_2 in the LSA	2.8 µg/m³
	Snap Lake Mine's contribution	0.2 µg/m³
	NWT Air Quality Standard for 24-hour SO_2	150 µg/m³
	Maximum annual SO_2 in the LSA	2.6 µg/m³
	Snap Lake Mine's contribution	0 µg/m³
	NWT Air Quality Standard for annual SO_2	30 µg/m³
NO_2		
	Maximum 1-hour NO_2 in the LSA	17.9 µg/m³
	Snap Lake Mine's contribution	12.2 µg/m³
	National Air Quality Objective for 1-hour NO_2	400 µg/m³
	Maximum 24-hour NO_2 in the LSA	8.6 µg/m³
	Snap Lake Mine's contribution	2.9 µg/m³
	National Air Quality Objective for 24-hour NO_2	200 µg/m³
	Maximum annual NO2 in the LSA	5.8 µg/m³
	Snap Lake Mine's contribution	0.1 µg/m³
	National Air Quality Objective for annual NO_2	30 µg/m³
$PM_{2.5}$		
	Maximum 24-hour $PM_{2.5}$ in the LSA	2.2 µg/m³
	Snap Lake Mine's contribution	0 µg/m³
	NWT Air Quality Standard for 24-hour $PM_{2.5}$	30 µg/m³
TSP		

Table 1: Summary of Snap Lake Mine's contributions to the Baseline Case SO_2, NO_2, $PM_{2.5}$ and TSP predicted concentrations at the Gahcho Kué Project (continued)

Parameter		Predicted Concentration
	Maximum 24-hour TSP in the LSA	7.1 µg/m³
	Snap Lake Mine's contribution	0 µg/m³
	NWT Air Quality Standard for 24-hour TSP	120 µg/m³
	Maximum annual TSP in the LSA	7.1 µg/m³
	Snap Lake Mine's contribution	0 µg/m³
	NWT Air Quality Standard for annual TSP	60 µg/m³

Yellowknives Dene First Nations

Todd Slack, Yellowknives Dene First Nation (YKDFN), requested the following information.

Information Requested (EIS Overview – 002): The capacity of areas 6 and 7.

Response: The baseline water storage capacity of Area 6 is approximately 8.6 Mm^3 (Volume 3a, Section 8.3, Table 8.3-1). Under the water management plan described in the EIS, the west portion of Area 6 including the mined-out Hearne Pit is used to store the site contact water during the late stage of mine operation after Hearne Pit is mined out. The total storage capacity of the area including the mined-out Hearne Pit is approximately 15.7 Mm^3 at a water elevation of 421.3 m.

The baseline water storage capacity of Area 7 is approximately 3.3 Mm^3 (Volume 3a, Section 8.3, Table 8.3-1). Based on the water management plan described in the EIS, Area 7 will be gradually refilled with natural runoff water to a level close to its original lake water elevation during the late stage of mine operation. The total storage capacity in Area 7 (from El. 414.5 m to El. 420.7 m) is approximately 3.2 Mm^3.

Closure

We trust that this memo provides you with the information to respond to those organizations with outstanding information requests. Should you have any questions please do not hesitate to contact the undersigned at 403-299-5600.

Sincerely,

GOLDER ASSOCIATES

Lisa Hurley
Engagement Coordinator

John Faithful
Technical Director

LH/JF/lh

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Reference:

Gammons, C. H., Harris, L.N., Castro J.M., Cott, P.A., and Hanna, B.W. 2009. Creating lakes from open pit mines: processes and considerations - with emphasis on northern environments. Can. Tech. Rep. Fish. Aquat. Sci. 2826: ix + 106 p.