Gahcho Kué Project
Air Quality

November 30, 2011

De Beers Canada

Air Quality Assessment Presentation

Outline:

- Introduction
  - ToR Requirements
  - Location in EIS
  - Findings
- Environmental Setting
  - Air Quality Characterization
  - Ambient Air Quality and Emission Criteria
- Air Quality Assessment
  - Emissions Estimation and Dispersion Modelling
  - Findings
  - Follow-up Actions
- Summary

2

Introduction – Air Quality Terms of Reference

Key Terms of Reference Requirements:

- The EIS must address the issue of emissions from the Gahcho Kué Project adding to pre-existing emissions
- The EIS must provide air quality modelling for construction and operational phases including worst case scenarios
- The EIS must further identify proven available technologies and best management practices to be used
- The EIS must include an assessment of risk to human health

3

Introduction

Location in the EIS:

- Baseline – Annex B
- Assessment –Subject of Note (SON) Section 11.4

Air quality assessment data were provided to other disciplines for addressing effects to wildlife, vegetation, water quality and human health

4

Introduction – Air Quality Findings

Assessment Findings:

- Project emissions were determined to not have significant adverse effects to air quality, although there will be temporary changes to air quality
- Predictions were based on conservative emission assumptions

5

Air Quality - Environmental Setting

Baseline Meteorological and Air Quality Monitoring Data Sources:

- On-site meteorological data collected between 1998 and 2005.
- Background PM, SO_2 and NO_2 data obtained from regional monitoring stations

Air Quality Characterization:

- Existing sources of emissions in the Project area are primarily forest fires and wind-blown dust
- Closest source of other emissions is the De Beers Snap Lake Project, located approximately 80 km northwest of the Project

6

Applicable Ambient Air Quality and Emissions Criteria

- Air Quality Criteria considered:
  - Northwest Territories Air Quality Standards
  - Canada-Wide Standards
  - National Ambient Air Quality Objectives
- Emission Criteria considered:
  - Low Sulphur Diesel Regulations
  - Non-road Diesel Engine Emission Standards
  - Canadian Council of Ministers of Environment (CCME) Emission Guidelines for Industrial Boilers and Heaters
  - Canada-Wide Standards for Dioxins and Furans from Waste Incineration

7

AQ Assessment - Emissions Estimation

- Sources of Emissions at the Project (Construction and Operation Phases):
  - Stationary point sources including diesel power generators, waste incinerator, auxiliary boiler and crusher
  - Mobile combustion equipment including diesel haul trucks and other earth-moving equipment
  - Mining and material handling activities
  - Exposed Kennady Lake bed and other exposed surfaces
  - Winter access road traffic
- Other Non-Project Emission Sources:
  - De Beers Snap Lake Mine

8

AQ Assessment - Emissions Estimation

- Estimation Methods
  - Mass Balance (i.e., mine rock, kimberlite, process kimberlite and fuel mass balance)
  - Engineering Estimates (e.g., design specifications for equipment)
  - Published Emission Factors
- Assessed Compounds
  - SO_2, NO_2, CO, $PM_{2.5}$, PM_{10}, TSP, VOCs, PAHs, metals, dioxins and furans

9

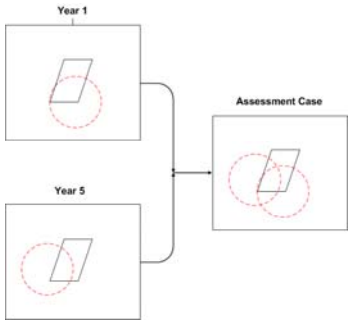
AQ Assessment – Conservatisms in Emission Estimation

- Estimated project emissions are based on conservative assumptions:
  - Considered all emission sources occurring at the same time, which would result in maximum aerial extent of effects
  - The extent of natural winter mitigation (i.e., precipitation and snow accumulation on the haul road surface) on road dust emissions was unknown, a conservative approach of assuming no natural mitigation effects on road dust emission during winter (resulting in higher emissions) was used
- Actual Particulate Matter (PM) concentrations and deposition rates are expected to be much lower than predicted

10

AQ Assessment – Conservatisms in Emissions Estimation

- Conservative case emissions will occur in Year 8 based on mine production rates
- Conservative case locations will occur in Year 1 and Year 5



11

AQ Assessment - Dispersion Modelling

- Dispersion model provides both ground-level concentrations and deposition rates
  - CALPUFF Version 6
  - Predicted ground-level concentrations for SO_2, NO_2, CO, $PM_{2.5}$, PM_{10}, TSP, VOCs, PAHs, metals, dioxins and furans
  - Predicted deposition rates for $PM_{2.5}$, PM_{10}, TSP, PAHs, metals, and Potential Acid Input (PAI)
  - All modelling results were used to assess effects on human health and wildlife
  - TSP, metal deposition and PAI results were used in the water quality assessment
  - NO_2 concentrations and PAI data were used in the vegetation assessment

12

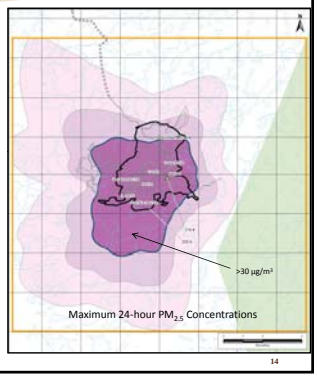
AQ Assessment Results – CO, SO_2 and NO_2 Concentrations

- CO concentrations – all predictions are well below applicable ambient air quality criteria
- SO_2 concentrations – all predictions are well below applicable ambient air quality criteria
- NO_2 concentrations – some predicted concentrations marginally exceed NWT air quality standards immediately outside Project Development Area

13

AQ Assessment Results – $PM_{2.5}$ Concentrations

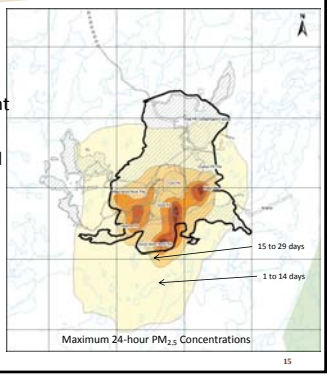
- $PM_{2.5}$ concentrations – some predicted $PM_{2.5}$ concentrations immediately outside the Project Development Area are above the NWT air quality standard
- A conservative approach was undertaken in the fugitive PM emission estimates
  - contributes to conservative estimates of $PM_{2.5}$ concentrations



14

AQ Assessment Results – Number of Days above $PM_{2.5}$ Standard

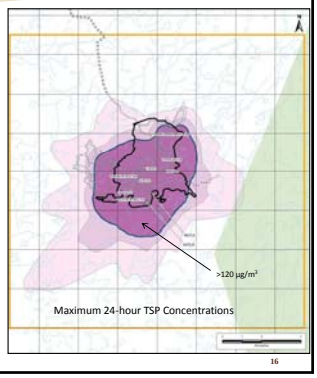
- No concentration above NWT air quality standard predicted beyond 3 km from development area boundary
- Majority of area with predicted concentrations above standard may experience 1 to 14 days of values over the standard in a year.
- Only area adjacent to emission sources may experience more than 14 days of concentrations above standard.



15

AQ Assessment Results – TSP Concentrations

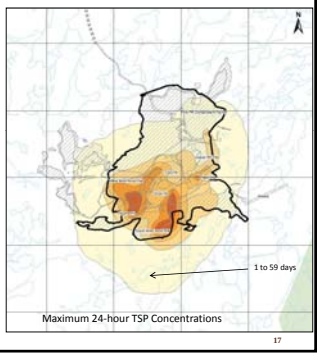
- TSP concentrations – some predicted TSP concentrations immediately outside the development area are above the NWT air quality standard
- A conservative approach was undertaken in the fugitive PM emission estimates
  - contributes to conservative estimates of TSP concentrations



16

AQ Assessment Results – Number of Days above TSP Standard

- No concentration above NWT air quality standard predicted beyond 2 km from development area boundary
- Majority of area with predicted concentrations above standard may experience 1 to 59 days of values over the standard in a year
- Only area adjacent to emission sources may experience more than 59 days of concentrations above standard



17

AQ Assessment Results – Follow-up Actions

- Continue on-going work to better understand the level of fugitive PM emissions to validate assessment results and to reduce the uncertainty in the assessment
- Develop an air quality management plan for the Project
- Design and implement a monitoring program to validate the predictions in the assessment
- Adopt proven management practices to minimize emissions and be protective of the environment

18

AQ Assessment - Summary

- Project emissions were determined to not have significant adverse effects to air quality, although there will be temporary changes to air quality
  - SO_2 and CO concentrations less than NWT Air Quality Standards
  - NO_2 concentrations are near guideline levels immediately outside the Project development area
  - $PM_{2.5}$ and TSP concentrations are above NWT air quality standards immediately outside the Project Development Area
- Predictions are conservative
  - Predictions based on worst case emissions from worst case locations
  - Assuming no natural mitigation on road dust in winter
  - On-going review of emissions and mitigation
- An Air Quality and Emissions Management Plan will be developed for the Project

19

Questions

Gahcho Kué Project
Terrestrial

November 30, 2011

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

2

Environmental Impact Statement

- Impacts from the Project will not have a significant negative influence on the persistence of terrestrial Valued Components
  - Including vegetation, caribou, other ungulates, carnivores, species at-risk
  - Based on weight of evidence from analysis of primary pathways
- The EIS was based on multiple assessment approaches and endpoints per species
  - To meet Terms of Reference
  - Was critical in reducing uncertainty in predictions
- The EIS considered a suite of ecological conservatisms throughout the assessment
  - Impacts should not be worse than predicted.

3

Mitigation Examples (Appendix 7.1)

- Promote natural re-vegetation and practice progressive reclamation as mine develops
- Regularly apply water to roads, and airstrip to limit fugitive dust
- Enforce speed limits to reduce fugitive dust and collisions with wildlife
- Suspend blasting if caribou within danger zone
- Stop traffic if caribou are crossing Project roads (i.e., caribou have right-of-way).
- Use low-profile roads to facilitate movements of caribou
- Manage water seepage and effluent from the site to control release of nutrients and contaminants
- Incinerate food waste (attractants) frequently and regularly to reduce holding time and odours.

4

Terrestrial Presentation Outline

- Overview of Assessment and Key Concepts
- SON: Vegetation
- KLOI: Caribou
  - Baseline environment
  - Habitat, energetics, and population modeling
  - Effects of Winter Access Road
  - Assessment conclusion
- SON: Carnivore Mortality
  - Baseline environment
  - Habitat and mortality analysis
- SON: Other Ungulates
- SON: Species at-risk and Birds

5

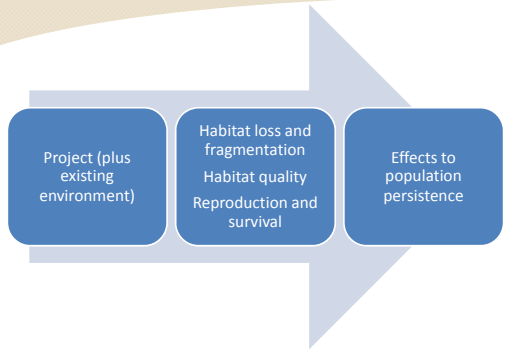
General Setting

Valued Components

- Vegetation (Section 11.7)
  - Ecosystem types, traditional-use plants, rare plants
- Caribou (Section 7)
  - Ahiak, Beverly and Bathurst herds
- Carnivores (Section 11.10)
  - Wolverine, grizzly bear, and wolf
- Other Ungulates (Section 11.11)
  - Moose and muskoxen
- Species at-Risk and Birds (Section 11.12)
  - Upland birds, water birds, and raptors

7

Conceptual Approach to Assessment



8

Study Area – Local and Regional

- Local Study Area (LSA)
  - 200 km^2
  - Baseline field work
  - Effects study area:
    - Vegetation, soils
  - Includes winter Access Road (120 km)
- Regional Study Area (RSA)
  - 5,700 km^2
  - Baseline field work
  - Effects study area:
    - Muskoxen, birds

9

Study Area – Cumulative Effects

- Wolverine / Grizzly Bear
  - Slave Geological Province (SGP)
    - 200,000 km^2
    - best met the Terms of Reference
  - Study region used in Johnson et al. (2005)
  - Emphasizes region of human development

10

Study Area – Cumulative Effects

- Migratory Tundra Caribou
  - Study areas delineated for summer, northern migration, rut and winter range
  - Based on GNWT collared caribou locations
  - Kennady Lake within range of Bathurst, Beverly and Ahiak herds
  - Largest overlap with Bathurst herd

11

Methods Overview – Development Database

- Key part of assessment
  - All previous, existing & foreseeable developments
  - Data sources: INAC, MVLWB, NRCAN, GNWT
    - Land-use permits
- 16 types of developments
  - Explorations camps are most abundant
  - Footprint sizes
    - Varied
    - Overestimated

Footprint cover for Bathurst home range <1%

12

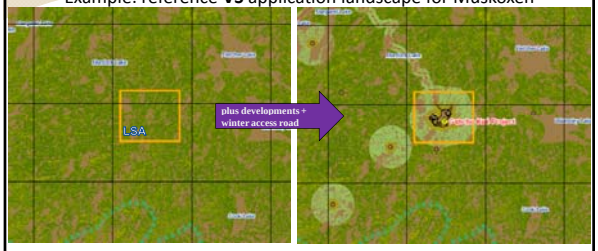
Methods Overview – Habitat Change

- Key measurement endpoint for Valued Components
- Habitat described using raster maps in GIS
  - large geographic areas comprised of small cells (e.g., 200 x 200 m)
- Habitat described as a class (or type) on raster maps in GIS
  - Where raster cells are either esker, forest, heath tundra, etc.
- Also described as habitat suitability (or quality) using a model
  - Where raster 'cells' ranked 0 to 1
  - Habitat Suitability Indices (HSIs)
  - Resource Selection Functions (RSFs)
- Direct changes to habitat calculated from development footprint
- Indirect changes calculated from a zone of influence (ZOI)

13

Methods Overview – Habitat Mapping

Example: reference **VS** application landscape for Muskoxen



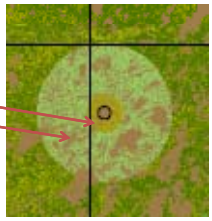
About 8% cumulative change for above assessment

- Dark green colors are high-quality habitats
- Assessments assumes constant successional stage

14

Methods Overview – Zone of Influence (ZOIs)

- Measures indirect effects from active developments
  - Can extend 1 to 15 km from active developments
    - Species-specific, disturbance-specific
  - Describes avoidance where probability of occurrences lower near footprint
  - Difficult to quantify (Polfus et al. 2011)
- How does it work in the assessment?
  - Reduces habitat quality by a disturbance coefficient (DC)
    - In this example:
      - Quality reduced high to low at 0-1 km
      - Quality reduced high to good at 1-5 km
- **Key assumption:**
  - mineral exploration camps were active for entire (5 yr) permit period



15

Terrestrial Presentation Outline

- Overview of Assessment and Key Concepts
- SON Vegetation
- KLOI Caribou
  - Baseline environment
  - Habitat, energetics, and population modeling
  - Effects of Winter Access Road
  - Assessment conclusion
- SON Carnivore Mortality
  - Baseline environment
  - Habitat and mortality analysis
- SON Other Ungulates
- SON Species at-risk and Birds

16

Gahcho Kué Project
SON: Vegetation (Section 11.7)

Subject of Note (SON) – Vegetation

- In section 5.2.12 of the Terms of Reference, the EIS must assess
  - The probability of introducing foreign, parasitic, or invasive species
  - The potential of dust to adversely affect vegetation

18

SON Vegetation – Baseline

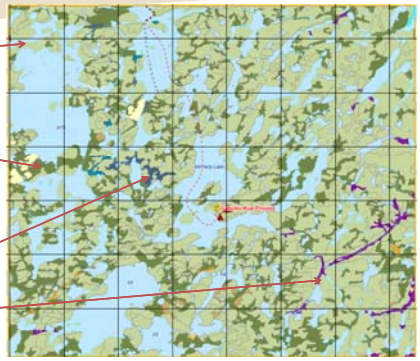
- Methods
  - Completed terrain, soils and vegetation mapping for LSA and RSA
    - Based on sampling at >34 plots
    - Consistent with other mines
  - Surveys for rare plants and traditional use plants in 2004/2005
  - Mapped rare species habitat (potential)

- Results
  - 21 traditional-use plants recorded
    - Assisted by Lutselk'e Dene First Nation
  - No 'rare' plant species detected
  - No invasive or exotic plant species detected
  - LSA composed of 37% upland, 33% wetland/riparian and 30% lakes

19

Dominant Ecosystem Classes in LSA

- Dominant types:
  - Scrub birch - Labrador tea tundra
  - Scrub birch - cloudberry - low shrub bog
- Less common:
  - Water sedge – narrow-leaved cottongrass fen
  - Willow – nagoonberry shrub



20

SON Vegetation – Baseline

- Measured metal concentrations in soils and selected plants in LSA
- Considered a range of plant species that have:
  - broad occurrence in the area
  - value for human and/or wildlife consumption
  - value as reclamation species

21

SON Vegetation – Assessment

- In summary, the Project should not result in significant impacts to the persistence of vegetation ecosystems, listed plant species and use of traditional plants
- The potential for introduction of invasive species is anticipated to have a minor influence on vegetation ecosystem composition (secondary pathway)
- Changes in vegetation communities due to dust deposition and air emissions are anticipated to be minor relative to baseline conditions (secondary pathway)

22

SON Vegetation – Assessment

- Approach
  - Vegetation described using
    - Dominant Ecosystem Classification for LSA (RIC 1998)
    - Broad Ecosystem Unit Classification for RSA (Matthews et al. 2001)
  - Applied Project footprint
- Results
  - 2% of existing terrestrial vegetation to be altered in LSA
  - 3% of ecosystems with traditional-use plants
  - 4% of potential rare plant habitat (potential)
  - Relative changes largest for
    - Water-sedge / narrow-leaved cottongrass fen
    - 8.7 ha (of available 47.4 ha) will be altered from flooding

23

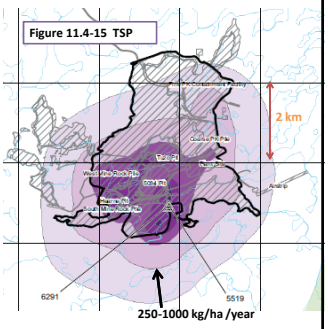
SON Vegetation – Assessment

- Ecosystem Units Affected:
  - Scrub Birch – Cloudberry Low Shrub Tundra (BR) unit
    - 128.1 ha altered
    - 0.7% altered in LSA
  - Scrub Birch – Labrador Tea Tundra unit
    - 176.3 ha altered
    - 0.9% altered in LSA

24

SON Vegetation – Assessment

- Total Suspended Particulate (TSP)
  - Deposition to be largely confined to development area boundary
  - Highest near haul roads (within 100m)
- Soil Properties
  - Minor changes to elemental concentrations
  - Concentrations remain below CCME guidelines
- Key Modeling Assumption
  - haul road dust in winter



25

Terrestrial Presentation Outline

- Overview of Assessment and Key Concepts
- SON: Vegetation
- KLOI: Caribou
  - Baseline environment
  - Habitat, energetics, and population modeling
  - Effects of Winter Access Road
  - Assessment conclusion
- SON: Carnivore Mortality
  - Baseline environment
  - Habitat and mortality analysis
- SON: Other Ungulates
- SON: Species at-risk and Birds

26

Gahcho Kué Project

KLOI: Caribou (Section 7)

Key Line of Inquiry: Caribou

- Terms of Reference:
  - the EIS must detail any effects on caribou, as well as their significance and likelihood
- The geographical scope must include 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
  - the Tibbitt-to-Contwoyto Road
- Observations from existing diamond mines must be used to establish how far from a mine site caribou show behavioural changes

28

Key Line of Inquiry: Caribou (continued)

- The following information must be included in the caribou 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
  - Estimate of the amount (absolute and relative) of habitat loss, change, degradation, or effective habitat loss for each potentially affected herd for all 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 per life stage

29

Key Line of Inquiry: Caribou (continued)

- 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 and for caribou exposure to contaminants
- Identification of potential changes to predator-prey dynamics and how this may affect the herds
- 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

30

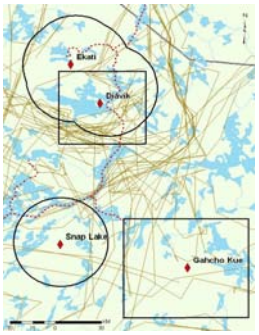
Key Line of Inquiry: Caribou (continued)

- 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 caribou herds
- Outline of any adaptive management strategies (i.e. what management response will occur if adverse effects on caribou are detected) and plans for monitoring effects on caribou

31

KLOI Caribou – Baseline

- Aerial surveys in RSA, LSA, and along access road 1999 to 2005
  - Surveys planned for autumn 2011
- Mapped summer (historical) trails in RSA in 2010
- Aerial survey for snow tracks
  - 2011 northern migration
- Summarized GNWT collar data for 1996 to 2009 to determine seasonal ranges and describe movement patterns



32

KLOI Caribou – Direct Changes to Habitat Type

- At the seasonal-range scale, cumulative direct disturbances of terrestrial habitat will be low (<2%) relative to a reference condition
- Cumulative direct disturbance on area of each habitat type will be <1% per seasonal home range (Ahiak and Bathurst)
- Analysis:
  - Per Season: N. migration, spring-summer, rut/autumn, and winter home ranges
  - Applied Landcover Classification of Canada and FRAGSTATS
    - 12 habitat types (e.g., esker, heath tundra, forest).
  - Applied footprints in development database plus Winter Access Road

33

KLOI Caribou – Changes to Habitat Quality

- The combined changes from dust deposition, noise and other sensory disturbances is predicted to be within 15 km from the Project footprint (i.e., the ZOI)
- The magnitude of cumulative declines in preferred habitat (from direct and indirect effects) across seasonal ranges is predicted to be low (ranging from 3 to 7% for Bathurst)

- Approach:
  - Mapped preferred habitat with RSF functions per season
    - Used equations in Johnson et al. (2005)
  - Considered direct and indirect effects
    - Historical, existing and future footprints from database
    - Hypothetical disturbance coefficients (DCs) and ZOIs (up to 15 km)

34

KLOI Caribou – Changes to Habitat Quality

- Largest decrease in preferred habitat in autumn/rut range
  - Incremental decrease from "2010 Baseline to Application" was 1.4%
  - Cumulative decrease from "Reference to Future" was 7.2%
    - Most losses occurred prior to 2006.

Habitat Quality	% Change Per Assessment Period					
	Reference to 2000	2000 to 2006	2006 to 2010 Baseline	2010 Baseline to Appl.	Application to Future	Reference to Future
High	-0.68	0.24	0.02	0.00	-0.03	-0.45
Good	-1.73	-4.93	3.29	-1.37	-2.03	-6.78
Low	-3.22	-2.23	1.49	-0.48	-1.72	-6.16
Poor	4.23	5.05	-3.22	1.33	2.55	9.94

35

KLOI Caribou – Autumn/Rut Habitat Maps

Historical Reference

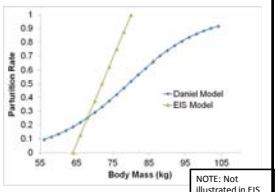
Future Condition

36

KLOI Caribou – Energetics

Why consider energy budgets?

- Sufficient energy reserves must be met by late autumn to increase likelihood of reproducing
- Post-calving energetic costs include:
  - Disturbance or agitation from sensory disturbances
  - Insect harassment
  - Other factors…



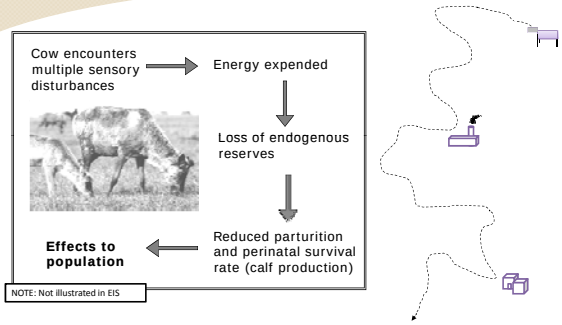
NOTE: Not illustrated in EIS

Key assumption:

- 1kg loss reduces parturition (calf production) by 0.063 units
  - vs. 0.02 units in Daniel Model

37

KLOI Caribou – Conceptual Energy Model

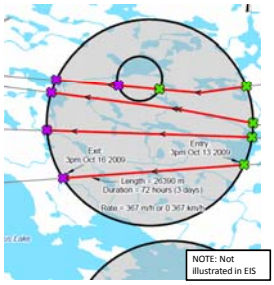


NOTE: Not illustrated in EIS

38

KLOI Caribou – Energetics Modelling

- The magnitude of the cumulative decrease in fecundity (calf production) from the Project and other developments is predicted to be low (<3.1%)
- Approach:
  - Identified caribou paths (n = 194)
    - Used GNWT caribou data
    - 138-day exposure period
  - Identified encounters with ZOIs
    - GIS analysis
  - Calculated energy loss (Bradshaw et al. 1998; Weladji et al. 2003)
    - About 0.047 kg cost / disturbance
    - About 0.15 kg cost / days of potential insect harassment



NOTE: Not illustrated in EIS

39

KLOI Caribou – Energy Modelling Results

- How many insect harassment days are caribou exposed to?
  - Cows may face up to 44 days of high insects
    - Thus, may lose up to 6.6 kg
- How many disturbances (ZOIs) do caribou encounter on average?
  - Bathurst cows may encounter up to 19 disturbances
    - Thus, may lose up to 0.5 kg
      - assumes strong response to most encounters
- Does weight loss from developments affect reproduction?
  - Effects are minor
    - Loss of 0.5 kg decreases parturition rate by ~3% (EIS model)
      - Or, decreases parturition by ~1% (Daniel model)

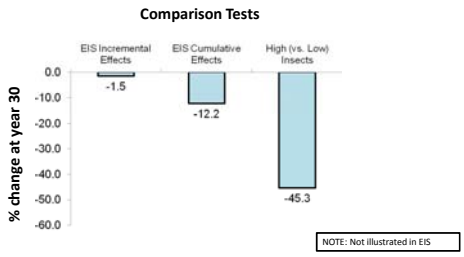
40

KLOI Caribou – Population Viability Analysis Tests

- Incremental changes from the Project did not statistically influence the persistence of the Bathurst herd
- Cumulative changes from the Project and other developments were statistically significant (moderate in magnitude)
- Population persistence most sensitive to changes in adult cow survival and harvest rate
- PVA Test Approach:
  - Compared model outcomes, e.g., reference versus future condition
  - Incorporated results from habitat and energetic assessments
  - Assessed relative contribution of natural and human-disturbances
  - Used RAMAS software
  - Measured changes using indicators of population persistence

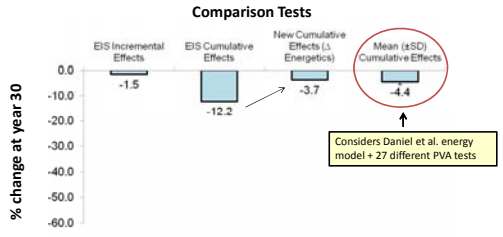
41

KLOI Caribou – PVA Test Results in EIS



42

KLOI Caribou – New PVA Tests



43

KLOI Caribou – Examples of New PVA Tests (of Ref. Vs Future)

Test ID	Environmental Trend Influencing Vital Rates			Risk Curve Comparison		% cumulative change on final abundance (yr 30)
	Parturition and Spring Condition	Parturition and Insect Harassment	Calf survival	D-statistic	P-value	
C1F1	Constant Ave	Degrading	Constant Ave	0.102	0.00010	-5.68
C1F2	Constant Ave	Improving	Constant Ave	0.054	0.10830	-2.38
C1F3	Degrading	Degrading	Constant Ave	0.063	0.03780	-3.51
C1F4	Improving	Improving	Constant Ave	0.093	0.00040	-4.89
C1F5	Improving	Degrading	Constant Ave	0.083	0.00200	-5.51
C1F6	Degrading	Improving	Constant Ave	0.084	0.00170	-4.49
C1F7	Constant Ave	Constant Ave	Constant Ave	0.073	0.00970	-4.86
C1F8	Degrading	Constant Ave	Constant Ave	0.070	0.01490	-4.09
C1F9	Improving	Constant Ave	Constant Ave	0.085	0.00150	-4.43

44

KLOI Caribou – PVA Summary

- EIS models overestimated effects of human development
  - results were biased but biased in the 'right' direction
- Sensitivity tests using natural range of inputs showed that assessment conclusions do not change
  - influence of potentially inaccurate inputs (e.g., carrying capacity, calf survival) on the predictability of the assessment is minor
- Precision of the assessment was maintained, in part, by executing 1000 simulations over a 30-year period per model
- The approach provides confident and ecologically relevant impact predictions

45

Effects of Winter Access Road

- In the Terms of Reference for the Project:
  - The Analysis must include potential development-related changes (i.e. increases in access) to harvest levels for each population
    - Caribou, other ungulates, and carnivores
- In the EIS, the pathway was considered minor for wildlife species because:
  - Access from winter roads is limited to 8-12 weeks per year
  - Harvest for residents and non-residents is regulated
  - De Beers staff will be prohibited from hunting while on site
  - Limited hunting beyond kilometre 100 on T-C road (D. Panayi, pers. comm.)
    - Winter Access Road for Project (kilometre 271)

46

Effects of Winter Access Road

- Additional Considerations
  - No evidence of harvest along Snap Lake Winter Access Road
  - Winter Access Road for Project (kilometre 271) is 43 km further than winter road to Snap Lake
  - For caribou, winter access road extends 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

47

KLOI Caribou – Summary

- Landscape will remain 'intact' and well below 40% habitat loss threshold where fragmentation effects occur for wildlife
  - Reviewed in Swift and Hannon (2010)
- The impacts from the Project should be reversible (except for the residual footprint, for example, the mine rock piles).
- The Project and other developments should not have a significant adverse effect on the persistence of caribou populations.
- Confidence based on consistently low effect sizes from analyses, and the 'conservatisms' that were considered in models

48

Terrestrial Presentation Outline

- Overview of Assessment and Key Concepts
- SON: Vegetation
- KLOI: Caribou
  - Baseline environment
  - Habitat, energetics, and population modeling
  - Effects of Winter Access Road
  - Assessment conclusion
- SON: Carnivore Mortality
  - Baseline environment
  - Habitat and mortality analysis
- SON: Other Ungulates
- SON: Species at-risk and Birds

49

Gahcho Kué Project

SON: Carnivore Mortality (Section 11.10)

Subject of Note – Carnivore Mortality

- In section 5.2.3 of Terms of Reference, the EIS must:
  - Assess the experiences with carnivore mortality and related mitigation measures at existing mines
  - Provide improvements over the mitigation measures applied at existing mines
  - Assess differences in impact predictions resulting from the proposed development's proximity to the tree line
- In the cumulative context for species with large ranges, the EIS must evaluate impacts in consideration of the full range used by each species

51

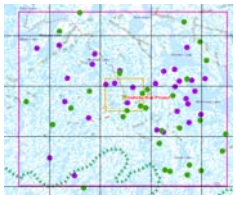
Subject of Note – Carnivore Mortality

- Specific information needs that were identified include:
  - potential attraction of carnivores to attractants such as garbage, the creation of habitat in the camp, etc.;
  - development components that may cause a sensory disturbance and effects to movements;
  - effects of hunting access from linear development components, such as the ice road;
  - effective habitat loss; and
  - measures that may be taken to avoid or reduce these impacts.

52

SON Carnivore Mortality – Baseline

- Grizzly Bear
  - Conducted surveys for bear sign in 2005 and 2007
  - Eskers surveyed in 1998, 1999, 2001, 2004, and 2007
  - 16 bears incidentally observed in 2004 and 2005
  - 4 active dens recorded since 1999
  - Hair snagging (pilot) program completed in 2010 and 2011
    - Local knowledge/ guidance from P. Enzoe



53

SON Carnivore Mortality – Baseline

- Wolverine
  - Hair snagging in 2005-06
    - 175 posts (1,600 km^2)
    - 17 animals identified
  - Surveys for snow tracks in 2004, 2005, 2010, 2011
    - Local knowledge and guidance from P. Enzoe
  - Since 1999, 4 wolverine dens have been located
    - Nearest ~16 km from camp

54

SON Carnivore Mortality – Assessment

- Previous mining have led to carnivore mortality in region
  - Examined long-term data for multiple mines in region
    - N = 54 mine years of data (1996 to 2009)
  - 4 historical grizzly bear deaths, or 0.074 bears per mine/year
    - Very low risk
  - 11 historical wolverine deaths, or 0.20 wolverine per mine/year
- EIS should overestimate mine-related mortality
  - The Project will implement waste management and wildlife mitigation procedures similar to that at the Snap Lake Mine
  - Mine outside the core area for grizzly bear population

55

SON Carnivore Mortality – Grizzly Bear Habitat

- Incremental decreases from indirect and direct changes to preferred habitat will be negligible (<1%)
- Cumulative decreases to preferred habitat will be moderate (12.4%)
  - Largest effect observed for spring habitat

Spring Habitat Quality*	% Change 2010 Base. to Application	% Change Application to Future Scenario	Cumulative% Change Reference to Future
High (preferred)	0.00	-1.34	-7.31
Good (preferred)	-0.11	-1.19	-5.09
Low	-0.78	-1.15	-5.45
Poor	0.19	0.63	3.17
*Described using RSF equation in Johnson et al. (2005)			

56

Incidental Observation at Kennady Lake

57

SON Carnivore Mortality – Wolverine Habitat

- Incremental decreases from indirect and direct changes to preferred habitat will be low (1.5%)
- Cumulative decreases to preferred habitat will be moderate
  - Largest change observed for winter season (18.8%)
  - Large influence from Tibbitt-to-Contwoyoto Winter Road

Winter Habitat Quality*	% Change 2010 Base. to Application	% Change Application to Future Scenario	Cumulative% Change Reference to Future
High (preferred)	-0.38	-2.04	-10.42
Good (preferred)	-1.08	-0.76	-8.39
Low	-1.04	-1.16	-9.30
Poor	4.74	5.86	73.40
*Described using RSF equation in Johnson et al. (2005)			

58

SON Carnivore Mortality - Wolf Habitat

- Incremental decreases from indirect and direct changes to preferred habitat will be negligible (<1%)
- Cumulative decreases to preferred habitat will be moderate (10.4%)
  - Majority of losses on landscape occurred prior to 2006

Spring-Autumn Quality*	% Change 2010 Base. to Application	% Change Application to Future Scenario	Cumulative% Change Reference to Future
High (preferred)	-0.70	-1.22	-5.59
Good (preferred)	-0.22	-1.22	-5.47
Low	-0.07	-2.14	-4.91
Poor	0.81	3.13	12.73
*Described using RSF equation in Johnson et al. (2005)			

59

Gahcho Kué Project

SON: Other Ungulates (Section 11.11)

Subject of Note – Other Ungulates

- In section 5.2.9 of the Terms of Reference, the EIS must assess
  - Frequency of moose and muskoxen using the study area
  - Project components that might cause sensory disturbances
  - Effects from potential changes to predator-prey relationships
  - And include measures to reduce impacts

61

SON Other Ungulates – Baseline

- Incidental observations recorded
  - during surveys for other wildlife species in RSA
  - 1995-2005, 2007, on-going
- Caribou surveys in 2004/2005 recorded 15 groups of muskox
  - 1-92 individuals per group
- Few moose have been recorded
  - 14 in total from 1995-2005
  - Poor habitat in RSA
    - Very little 'tall shrub' and 'birch seep' habitat types

62

SON Other Ungulates – Muskoxen and Moose

- Incremental and cumulative losses of good and high-quality habitats of Moose and Muskoxen were low in magnitude
- Changes from sensory disturbances are predicted to be within 5 km from the Project footprint (i.e., the ZOI)
  - Reviewed in Benitez-Lopez et al. (2010)
- Approach
  - Applied Habitat Suitability Indices derived from scientific literature
  - RSA-scale assessment
  - Included species-specific ZOIs
  - Summer model for moose (not in RSA during winter)
  - Winter model emphasized for muskoxen
    - to capture effects of winter access road

63

SON Other Ungulates - Muskoxen Habitat

Reference **VS** application landscape for Muskoxen

Dark green colors are high-quality habitats
-1.1% incremental loss and -7.9% cumulative loss

64

Gahcho Kué Project
SON: Species at-Risk and Birds (11.12)

Subject of Note – Species at-Risk and Birds

- In section 5.2.4 of the Terms of Reference, the analysis must be of sufficient detail to allow the Panel to discharge its responsibilities under the Species At Risk Act.
- "Species At Risk" includes all species:
  - Under any applicable schedule of the *Species At Risk Act*
  - Listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
  - Listed by the GNWT with designations "may be at risk", "at risk", or "sensitive"

66

Subject of Note – Species at-Risk and Birds

- In section 5.2.4 of the Terms of Reference, the analysis must provide:
  - All potential disturbances during nesting, rearing, molting, staging and migration
  - The potential for increased predation facilitated by development
  - Identification of all contaminant exposure routes and possible changes in contaminant levels
  - Identification of all potential alterations to bird habitat

67

Wildlife Species At-Risk

- 6 species at risk have been observed
- In NWT:
  - rusty blackbird may be at risk
  - others are sensitive or secure

Common Name	COSEWIC Status	SARA Status	NWT Status
grizzly bear	special concern	no schedule	sensitive
wolverine	special concern	no schedule	sensitive
peregrine falcon	special concern	no schedule	sensitive
short-eared owl	special concern	schedule 3	sensitive
rusty blackbird	special concern	schedule 1	may be at risk
horned grebe	special concern	no schedule	secure

68

SON Species at-Risk and Birds – Baseline

- Upland birds
  - 25 hectare plots surveyed in 2004 and 2005 (20 individual plots total)
  - 28 species of songbird, shorebird and ptarmigan detected
- Water birds
  - Surveyed lake perimeters and wetlands in LSA in 2004
  - 22 species observed
  - Kennady Lake and Lake X6 surveyed in spring 2010 and 2011
- Raptors
  - Surveyed known nest sites and suitable habitat from 1998 to 2005
  - 4 gyrfalcon and 11 peregrine falcon nests identified in RSA
  - short-eared owl, northern harrier, rough-legged hawk, golden eagle, bald eagle also observed
  - Additional surveys in 2010 and 2011

69

Nesting Peregrine near Margaret Lake

70

SON Species at-Risk and Birds – Assessment

- Relative to 2010 baseline, direct and indirect changes from the Project are expected to reduce the amount of suitable habitat for birds in the RSA by <1.0% (negligible in magnitude)
- Cumulative changes are expected to decrease suitable habitat for birds in the RSA by <2.6% relative to reference conditions (low in magnitude)

- Habitat Quality Modeling:
  - Estimated upland bird densities per habitat type (using baseline data)
  - Developed habitat suitability index (HSI) for water birds
  - Developed RSF for raptor nest habitat (using baseline data)
  - Mapped habitat quality across RSA
  - Applied disturbance coefficients and ZOIs to active developments

71

SON Species at-Risk and Birds – Water Birds

- A habitat suitability index identified key habitats as shallow/deep water, and sedge wetlands (36% of RSA)
  - Incremental changes are expected to (directly and indirectly) decrease suitable habitat by <1%
  - Cumulative changes are expected to decrease suitable habitat by 1.4% relative to reference.

Habitat Suitability Category	Reference (ha)	% Change Reference to 2010 Baseline	% Change 2010 to Application	% Change Application to Future	Cumulative % Change Reference to Future
High	108,287	-0.11	-0.17	-0.80	-1.08
Good	28,109	-0.03	-0.05	-0.26	-0.34
Low	14,755	0.12	0.11	1.04	1.27
Poor	417,393	0.03	0.12	0.02	0.16

72

SON Species at-Risk and Birds – Raptor RSF

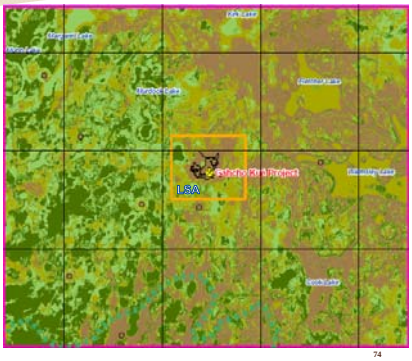
- An RSF identified preferred nesting habitat as areas of high slope and elevation (e.g., cliffs), which are uncommon in the RSA
  - Incremental changes are expected to (directly and indirectly) decrease suitable habitat by <1%
  - Cumulative changes are expected to decrease suitable habitat by 1.6% relative to reference.

Habitat Category	% Change Reference to 2010 Baseline	% Change 2010 to Application	% Change Application to Future	Cumulative % Change Reference to Future
High	-0.24	-0.05	-0.75	-1.04
Good	0.00	-0.09	-0.49	-0.58
Low	0.09	-0.40	-0.01	-0.32
Poor	0.16	0.54	1.25	1.94

73

SON Species at-Risk and Birds – Raptor RSF Map (Application) in RSA

- Best habitats (e.g., cliffs) west of LSA
- Abundance of high-quality habitats



74

SON Species at-Risk and Birds – 2010 Raptor Nest Survey Results

Currently all known raptor nests >18km from camp

Active nest = green circles

Successful nest = purple

Unoccupied nest = brown

75

Terrestrial Assessment Summary

- To meet the ToR and provide confidence in the assessment, the EIS used multiple approaches for making predictions
- The EIS integrated uncertainty throughout the assessment so actual impacts would not be worse than predicted
- Incremental and cumulative impacts from the Project and other developments will not have a significant negative influence on the resilience and persistence of terrestrial Valued Components
  - based on weight of evidence from analysis of primary pathways

Questions