GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

BIOPHYSICAL SUBJECTS OF NOTE

SECTION 11.1 OVERVIEW

December 2010 **09-1365-1004**

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11.1 OVERVIEW

11.1.1 Project Location

11.1.1.1 General Location

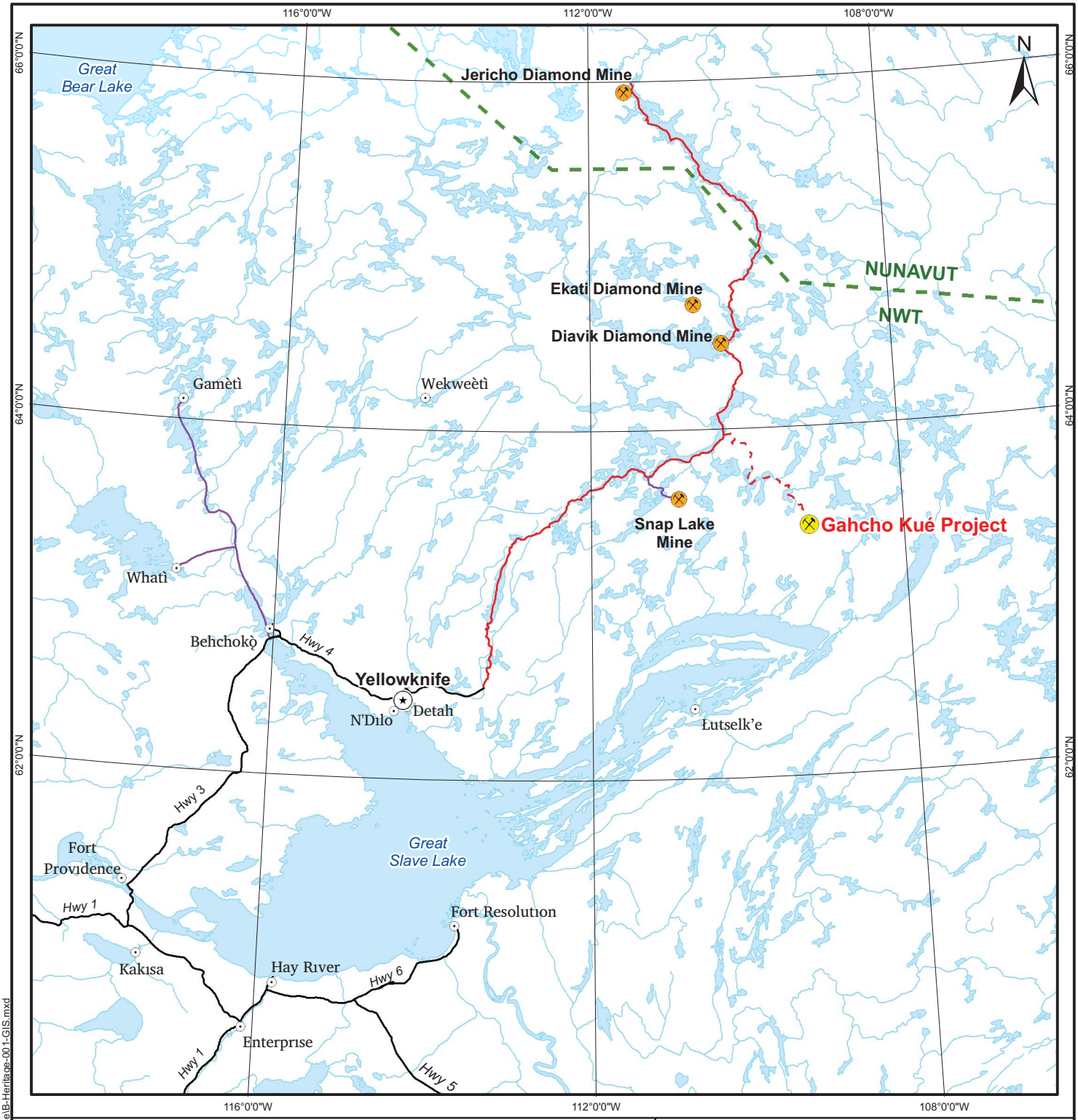
The Gahcho Kué Project (Project) is situated north of the northeastern arm of Great Slave Lake in the Northwest Territories (NWT) at Longitude 63° 26' North and Latitude 109° 12' West. The Project site is about 140 kilometres (km) northeast of the nearest community, Łutselk'e, and 280 km northeast of Yellowknife (Figure 11.1-1).

The Project is located near the tree line and the southern limit of continuous permafrost. It lies within an area that is transitional from boreal to tundra conditions.

The Project is also located in the watershed of Kennady Lake, a small headwater lake within the Lockhart River system, which drains into the East Arm of Great Slave Lake.

11.1.1.2 Project Site

The location of the Project site is determined by the diamond-bearing kimberlite deposits that occur mainly beneath Kennady Lake. Ore from the three economic ore bodies (5034, Hearne, and Tuzo) will be extracted by open-pit mining methods, following dewatering of the areas of Kennady Lake located above the ore.



LEGEND

- Gahcho Kué Project
- Existing Mine
- Territorial Capital
- Populated Place
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Winter Access Road
- Watercourse
- Waterbody
- Territorial/Provincial Boundary

NOTES

Base data source: The Atlas of Canada

GAHCHO KUÉ PROJECT

Location of the Gahcho Kué Project

PROJECTION: Canadian Lambert Conf. Conic	DATUM: NAD83	
Scale: 1:3,500,000		
50 25 0 50 Kilometres		
FILE No: B-Heritage-001-GIS		DATE: September 20, 2010
JOB NO: 09-1365-1004	REVISION NO: 8	Figure 11.1-1
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De Beers Canada

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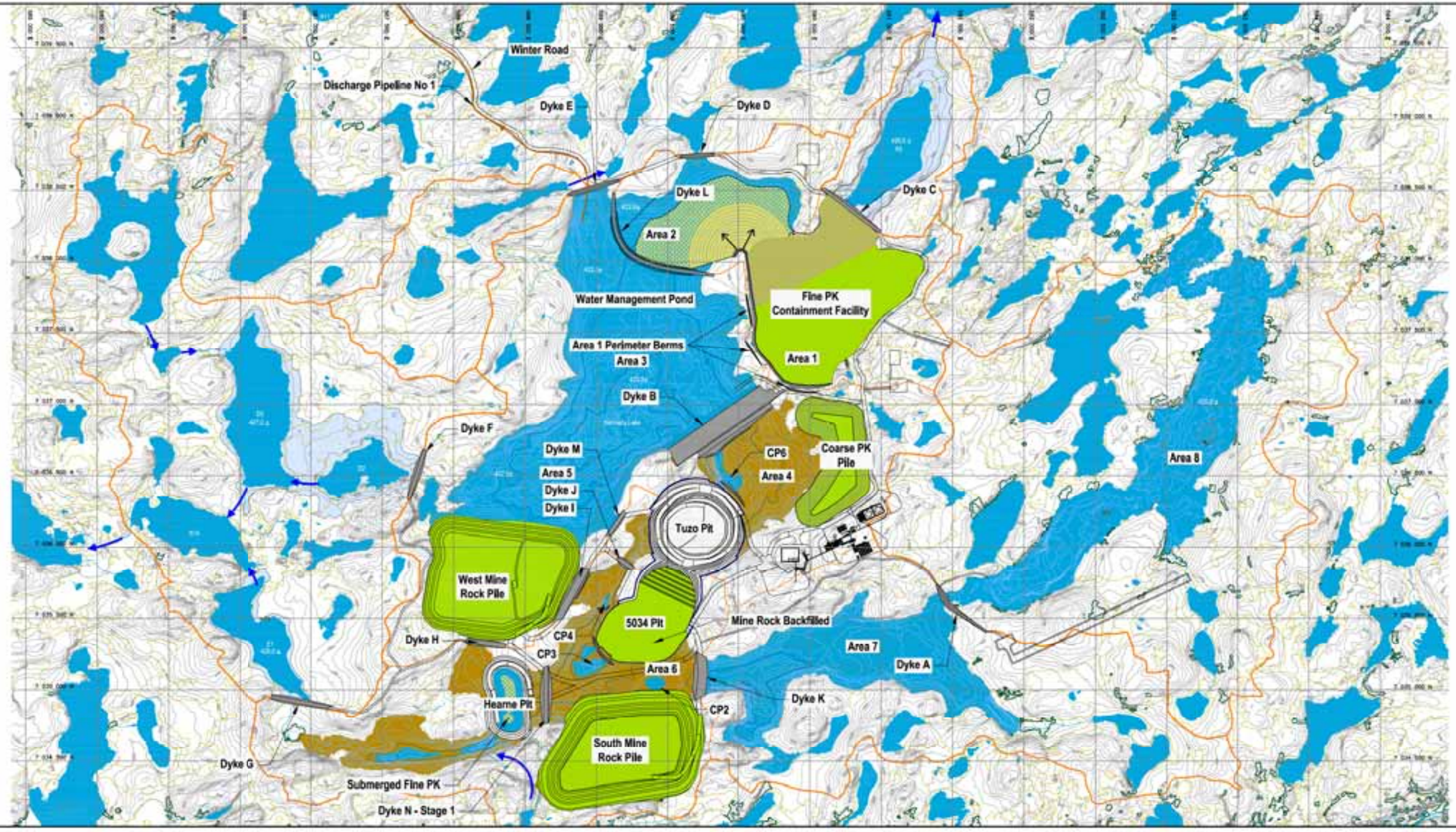
The plant site will be mainly constructed on a peninsula that extends into Kennady Lake, although the airstrip will be located southeast of the peninsula. Figure 11.1-2 shows the footprint for the Project, including the location of the plant site, airstrip, open pits, mine rock piles, the Coarse Processed Kimberlite (PK) Pile and Fine Processed Kimberlite Containment (PKC) Facility. The following major infrastructure will be required:

- accommodations complex;
- maintenance workshop, warehouse, and administrative offices;
- electrical power and heating;
- storage for oil, fuel, and de-icing fluid;
- production and storage of explosives;
- site roads;
- airstrip; and
- sewage treatment.

With the start of mining and processing operations, mine rock, and PK will be placed within areas sited and designed for the containment of these materials. Mine rock and PK will be managed and placed so that the work required for the eventual final closure of the site will be minimized. The main storage areas will include the south and west mine rock piles, the Fine PKC Facility, and the Coarse PK Pile (Figure 11.1-2). Mine rock will be deposited in the mined-out 5034 Pit and fine PK will be deposited in the mined-out Hearne Pit.

Access to the Project will be by air and a road constructed every winter. The 120 km Winter Access Road links this Project with the existing Tibbitt-to-Contwoyto Winter Road at MacKay Lake, just north of Lake of the Enemy. The Winter Access Road will be constructed and operated in accordance with license and regulatory conditions, and with appropriate updates and improvements as required.



LEGEND

- Existing Ground Contours, 5m Index - 1m Intermediate
- Bathymetry Contours, 5m Index - 1m Intermediate
- CP — Collection Pond
- Winter Road
- Marsh Area
- Scrub
- Sub-watershed Boundary
- Drainage Flow Direction
- Discharge Pipeline
- Coarse PK
- Drained Area
- Fine PK
- Flooded Area
- Lake/Pond
- Mine Rock
- Submerged PK

NOTES

Base data source: EBA Figure 4.10 - Stage 7 - Water Management During Mine Operation Year 8 (2022)

GAHCHO KUÉ PROJECT

Mining Operations Year 8 (2022)

PROJECTION	DATUM
UTM Zone 12	NAD83

500 0 500
SCALE METRES

De Beers Canada

FILE No	DATE
P-Other-017-CAD	December 7, 2010
JOB No	REVISION No
09-1365-1004	0
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Figure 11.1-2

11.1.2 Rationale for the Subjects of Note

The organization of the environmental impact statement (EIS) for the Project evolved from the issue scoping process conducted by the Mackenzie Valley Environmental Impact Review Board (MVEIRB). The issues were organized into three categories (MVEIRB 2006):

- **Key lines of inquiry** are topics of greatest concern that require the most rigorous analysis and detail in the EIS.
- **Subjects of note** have less priority than key lines of inquiry, but require serious consideration and a substantive analysis.
- **Remaining issues** require a sufficient analysis to demonstrate whether the issues are likely to be the cause of significant impacts. All issues are important and no issue can be excluded.

In the *Terms of Reference for the Gahcho Kué Environmental Impact Statement* (Terms of Reference) issued on October 5, 2007, the Gahcho Kué Panel (2007) adopted this organization of the issues and specified the way they will be addressed. To meet the Terms of Reference, the EIS is organized by key lines of inquiry and subjects of note with each being a comprehensive, stand-alone analysis that requires only minimal cross-referencing with other parts of the EIS. Remaining issues listed in the Terms of Reference are addressed in the most closely related key line of inquiry or subject of note.

The Gahcho Kué Panel (2007) clearly identified a hierarchy of effort in preparing the EIS. Subjects of note do not have the same priority as key lines of inquiry, but are nonetheless issues that require serious consideration and a substantive analysis. There are 18 subjects of note, of which 12 are biophysical (Gahcho Kué Panel 2007). Section 11 contains the biophysical subjects of note. Socio-economic subjects of note are discussed in Section 12.

11.1.3 Organization of Section 11

The headings of the subsections of Section 11 are based on the subjects of note, which include topics considered to be important that were identified during scoping. Therefore, they differ from the headings usually found in environmental assessments, where headings were related to the components of the environment that were assessed (e.g., aquatic environment organized as hydrogeology, hydrology, water quality, and fish). In this EIS, two subjects of note (e.g., Vegetation and Air Quality) represent environmental components; however, other subjects of note are related to the Project description (e.g., Mine Rock and Processed Kimberlite Storage), interactions with the Project

(e.g., Waste Management and Wildlife), locations (e.g., Impacts on Great Slave Lake), and species (Other Ungulates).

Although each subject of note is independent and separate, the order of the biophysical subjects of note within Section 11 was based, to the extent possible, on the bottom-up structure in natural systems (i.e., physical and chemical components → plants → animals), and an attempt to limit the amount of cross-referencing as recommended by the Gahcho Kué Panel (2007). The order of subjects of note in Section 11 is shown in Table 11.1-1.

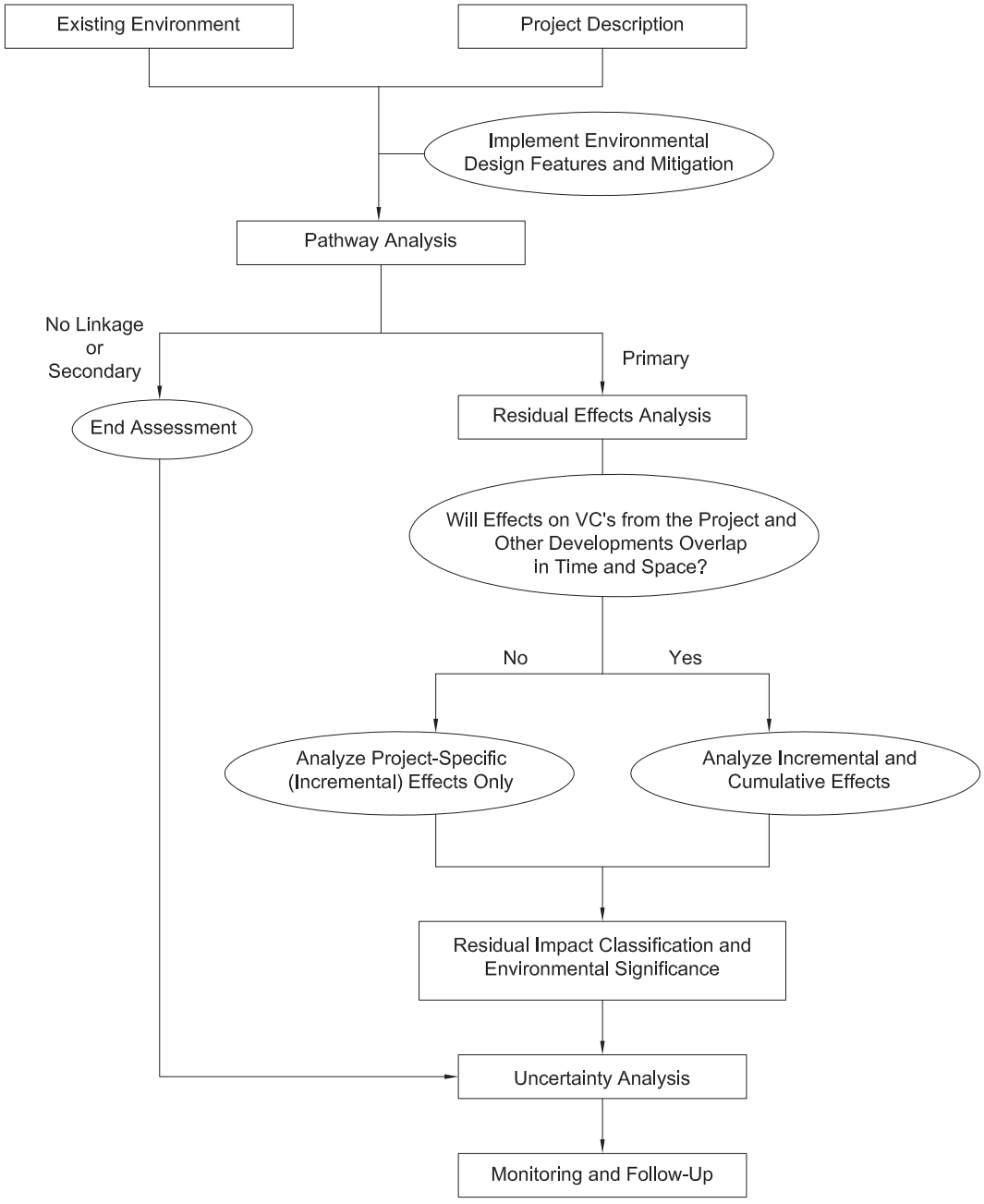
Table 11.1-1 Location of Subjects of Note in Section 11

Subject of Note	Location
Impacts on Great Slave Lake	Section 11.2
Alternative Energy Sources	Section 11.3
Air Quality	Section 11.4
Mine Rock and Processed Kimberlite Storage	Section 11.5
Permafrost, Groundwater, and Hydrogeology	Section 11.6
Vegetation	Section 11.7
Traffic and Road Issues	Section 11.8
Waste Management and Wildlife	Section 11.9
Carnivore Mortality	Section 11.10
Other Ungulates	Section 11.11
Species at Risk and Birds	Section 11.12
Climate Change Impacts	Section 11.13

The references, glossary, acronyms and units specific to each subject of note are located at the end of each subsection of Section 11.

11.1.4 Assessment Approach

The approach and methods described briefly below have been used to assess the effects of the Project on the environmental components (e.g., carnivores, other ungulates) specified for the biophysical subjects of note. The assessment approach is described in greater detail in Section 6. Figure 11.1-3 is simplified flow diagram of the assessment approach. If a modification of this approach was needed for a specific subject of note, an explanation is provided in that subject of note.



GAHCHO KUÉ PROJECT

Flow Diagram for the Assessment Approach

PROJECTION: N/A	DATUM: N/A	De Beers Canada
SCALE: NOT TO SCALE		
FILE No: P-Other-016-CAD		DATE: December 7, 2010
JOB No: 10-1365-1004	REVISION No: 0	**Figure 11.1-3**
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11.1.4.1 Valued Components

Valued components (VCs) represent physical, biological, cultural, social, and economic properties that society considers to be important. The Terms of Reference (Gahcho Kué Panel 2007) explains that numerous potential VCs were identified by MVEIRB (2006) in the diagrams of issues contained in the *Reasons for Decision and Report of Environmental Assessment for the De Beers Gahcho Kué Diamond Mine, Kennady Lake, N.W.T.* (Report of Environmental Assessment). Valued components were selected to focus the EIS on the key issues that were raised through the concerns of communities, individuals, government, and other stakeholders. Examples of biophysical VCs related to subjects of note from the MVEIRB (2006) diagrams are air quality, species at risk, ground water and hydrogeology, and permafrost.

The Gahcho Kué Panel (2007) used the MVEIRB (2006) information to further distinguish levels among VCs, identifying some VCs as highly valued components (i.e., the most important). The very fact that components are part of a subject of note means that they have priority and are valued. Thus, each subject of note was used as the principal method for selecting VCs (including highly valued components) in this section of the EIS.

11.1.4.2 Spatial and Temporal Boundaries

The spatial boundaries must be able to capture the scale-dependent processes and activities that influence the geographic distribution or movement patterns specific to each VC. The EIS uses a range of study areas for predicting effects from the Project on VCs.

The geographic scope of the study must be appropriate for the potential impact being assessed (Gahcho Kué Panel 2007). For example, individuals within populations of grizzly bear, wolverine, and wolf travel large distances during their daily and seasonal movements and can be affected by the Project, and several additional projects. For these species, the spatial boundary for the assessment of effects was defined by the range of the population, which conforms to the Terms of Reference (Gahcho Kué Panel 2007).

In the EIS, temporal boundaries are linked to two concepts:

- the development phases of the Project (i.e., construction, operation, and closure); and
- the predicted duration of effects from the Project, which may extend beyond closure (e.g., recovery of Kennady Lake).

Therefore, the temporal boundary for a VC is defined as the amount of time between the start and end of a relevant project activity or stressor (which is related to development phases), plus the duration required for the effect to be reversed. After removal of the stressor, reversibility is the likelihood and time required for a VC or system to return to a state that is similar to the state of systems of the same type, area, and time that are not affected by the Project.

Reversibility does not imply returning to environmental conditions prior to development of the Project. Because ecological systems continually evolve through time (Chapin et al. 2004; Folke 2006), the biophysical ecosystem at closure likely will be different than the current observed patterns, independent of Project effects. Ecological systems are complex, non-equilibrium systems and return to pre-Project conditions may not be possible or even desirable. The state of ecological systems at and beyond Project closure may be equally functional with the desired structure, but likely will not be the same as before development.

Construction, operation, and closure (refilling) phases for the Project are anticipated to occur over about 2 years, 11 years, and approximately 8 years (site closure and lake refilling), respectively. For VCs such as air quality, the duration of the effects from the Project will likely cease at the end of closure. In contrast, effects to vegetation and wildlife may continue past closure phase. Thus, for most of the subjects of note, the temporal boundary includes all phases of development, and the predicted duration until effects are reversed.

11.1.4.3 Pathway Analysis

Pathway analysis identifies and assesses the linkages between Project components or activities (e.g., Project-related traffic on roads) and the corresponding potential residual effects to VCs (e.g., road dust on vegetation).

Project activity → change in environment → effect on VC

Pathways reflect potential changes due to the Project on the physical and biological properties of the ecosystem. For some subjects of note, the purpose and scope were defined in the Terms of Reference so specifically that they precluded the need for a pathway analysis.

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the Project. This screening step is largely a qualitative assessment, and is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on VCs. Pathways are determined to be primary,

secondary (minor), or having no linkage using scientific and traditional knowledge, logic, experience with similar developments, environmental design features (e.g., engineering design elements, environmental best practices, and management policies and procedures) and mitigation. Each potential pathway is assessed and described as follows:

- no linkage – pathway is removed by environmental design features and mitigation 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 measurable and 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.

Pathways with no linkage to a VC or that are considered minor are not analyzed further.

11.1.4.4 Assessment Endpoints and Measurement Endpoints

Assessment endpoints represent the ultimate properties of the VC that should be protected or developed for use by future human generations. Assessment endpoints are general statements about what is being protected (e.g., protection of air quality). Assessment endpoints for VCs were determined primarily from the outcome of the community, public, and regulatory engagement process (MVEIRB 2006).

Measurement endpoints are defined as quantifiable (i.e., measurable) expressions of VC assessment endpoints. For example, measurement endpoints for predicting impacts to air quality include particulate matter (dust), sulphur dioxide, and oxides of nitrogen. These measurement endpoints will be compared to standards to assess the impact of the Project on air quality (the assessment endpoint).

11.1.4.5 Effects Analysis

The effects analysis considers all primary pathways that are likely to result in measurable environmental changes and residual effects to VCs (i.e., effects after implementing environmental design features). Residual effects to VCs are analyzed using measurement endpoints and expressed as effects statements

(e.g., Effects to Plant Populations and Communities). Effects statements may have more than one primary pathway that link a Project activity with a change in the environment and an effect on a VC.

For the biophysical subjects of note, the effects analyses were quantitative, where possible, and included data from field studies, scientific literature, government publications, effects monitoring reports, and personal communications. Traditional knowledge and community information were incorporated where available and compared to the scientific results. Due to the amount and type of data available, some analyses were qualitative and included professional judgment or experienced opinion.

A summary of residual effects follows the effects analysis. Results from the effects analyses were used to quantitatively describe the magnitude, duration, and geographic (spatial) extent of the predicted residual changes to VCs. For example, the geographic extent of effects is expressed in area (hectares [ha]) or distance (km) from the Project.

Expressions such as “short-term” duration or “moderate” magnitude are not used in the summary of residual effects. These expressions are reserved for the classification of impacts, where definitions of these expressions are provided.

11.1.4.6 Residual Impact Classification

The purpose of the residual impact classification is to describe the residual effects from the Project on VCs using a scale of common words (rather than numbers and units). The classification of impacts leading to a determination of significance is based on the following criteria specified in the Terms of Reference:

- direction;
- magnitude;
- geographic extent;
- duration;
- reversibility;
- frequency;
- likelihood; and
- ecological context.

These criteria are defined and explained in Section 6.7.2.

Pathways associated with each effects statement are then classified for each impact criterion (e.g., magnitude) using a scale (e.g., negligible, low, or high magnitude). The definitions for these scales were ecologically or logically based on the VC, although professional judgment is inevitable in some cases. Scales are specifically defined for each VC, and tables with definitions of scales for each criterion (e.g., low, moderate, and high magnitude) are provided in the subjects of note, when applicable.

Not every subject of note in the EIS is carried through to the residual impact classification and determination of significance. Environmental significance is determined for those VCs that have assessment endpoints, because assessment endpoints represent the key properties of the VC or system that should be available for their use by future human generations. Assessment endpoints represent sustainability statements upon which to evaluate the significance of impacts. Three biophysical subjects of note have not been classified for residual impacts or evaluated for environmental significance:

- Alternative Energy Sources;
- Permafrost, Groundwater, and Hydrogeology; and
- Mine Rock and Processed Kimberlite Storage.

These subjects of note are analyzed and assessed for effects on VCs in other key lines of inquiry and subjects of note. For example, effects of PK storage on fish in Kennady Lake are assessed in Section 8.

11.1.4.7 Environmental Significance

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 are the principal criteria used to predict significance (FEARO 1994, internet site). Other criteria, such as frequency and likelihood are used as modifiers (where applicable) in the determination of significance (see also Section 6.7.4).

The evaluation of significance for biophysical VCs considers the entire set of primary pathways that influence a particular assessment endpoint, but significance is not explicitly assigned to each pathway. Rather the relative contribution of each pathway is used to determine the significance of the Project's effect on assessment endpoints.

Environmental significance is used to identify predicted impacts that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to a VC. Significance is determined by the risk to the persistence and function of populations (i.e., population level effects) within aquatic and terrestrial ecosystems. Specific definitions are provided for each assessment endpoint in the EIS. The following is an example of definitions for assessing the significance of impacts on the persistence of the wildlife VCs, and the associated continued opportunity for traditional and non-traditional use of wildlife.

Not significant – impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease the resilience of the population.

Significant – impacts are measurable at the population level and likely to decrease the resilience of the population. A number of high magnitude and irreversible impacts at the population level would likely be significant.

11.1.4.8 Cumulative Effects

Cumulative effects represent the sum of all natural and human-induced influences on a physical and biological system within a period of time and space. Some changes may be human-related, such as increasing development, and some changes may be associated with natural phenomenon such as extreme rainfall events, and periodic harsh and mild winters.

Not every VC requires an analysis of cumulative effects. For some VCs, Project-specific effects are important and there is little or no potential for cumulative effects because there is little or no overlap with other projects. For VCs that are distributed or travel over large areas (e.g., carnivores), the analysis of cumulative effects is necessary and important because they can be influenced by a number of developments.

In this EIS, cumulative effects are identified, analyzed, and assessed in the section on the VC where applicable, and follows the approach used for the Project-specific effects analysis (Section 6.6.1), and impact classification and determination of significance (Section 6.7). To meet the Terms of Reference (Gahcho Kué Panel 2007), Section 13 provides a summary of cumulative effects for all VCs (i.e., for components influenced and not influenced by cumulative effects).

For VCs that require cumulative effects analysis, the concept of assessment cases is used to estimate the incremental and cumulative effects from the Project

(Table 11.1-2). The approach incorporates the temporal boundary for analyzing the effects from previous, existing, and reasonably foreseeable developments before, during, and after the anticipated life of the Project.

Table 11.1-2 Contents of Each Assessment Case

Baseline Case	Application Case	Future Case
Previous and existing projects [(a)] prior to the Gahcho Kué Project	Baseline Case plus the Gahcho Kué Project	Application Case and reasonably foreseeable projects

[(a)] Includes approved projects.

The baseline case represents a range of conditions over time and not a single point in time. The temporal boundary of the application case begins with the anticipated first year of construction of the Project, and continues until the predicted effects are reversed. The future case includes the predicted duration of residual effects from the Project, plus other previous, existing, and reasonably foreseeable projects and activities. Thus, the minimum temporal boundary for the application and future case is the expected lifespan of the Project, which like the baseline case, includes a range of conditions over time.

Analyses of the effects for the baseline and application cases are largely quantitative. Effects analyses for the future case are more qualitative due the large degree and number of uncertainties.

11.1.4.9 Uncertainty

Most assessments of impacts embody some degree of uncertainty. The purpose of the uncertainty subsections for the biophysical subjects of note is to identify the key sources of uncertainty and discuss how uncertainty is addressed to increase the level of confidence that effects will not be worse than predicted. Where possible, a strong attempt is made to reduce uncertainty in the EIS to increase the level of confidence in impact predictions. A discussion of uncertainty is provided in the biophysical subjects of note as required in the Terms of Reference (Gahcho Kué Panel 2007). Uncertainty is also discussed in Section 6.8

11.1.4.10 Monitoring and Follow-up

Monitoring programs are proposed to deal with the uncertainties associated with the impact predictions and environmental design features. In general, monitoring is used to test (verify) impact predictions and determine the effectiveness of environmental design features. These programs form part of the environmental management system for the Project. If monitoring or follow-up detects effects that are different from predicted effects, or the need for improved or modified

design features, then adaptive management will be implemented. This may include increased monitoring, changes in monitoring plans, or additional mitigation.

11.1.5 References

11.1.5.1 Literature Cited

Chapin, F.S., G. Peterson, F. Berkes, T.V. Callaghan, P. Angelstam, M. Apps, C. Beier, Y. Bergeron, A.S. Crépin, K. Danell, T. Elmqvist, C. Folke, B. Forbes, N. Fresco, G. Juday. J. Niemelä, A. Shvidenko, and G. Whiteman. 2004. Resilience and vulnerability of northern regions to social and environmental change. Ambio 33:344-349.

Folke, C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. Global Environmental Change, 16:253-267.

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

MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2006. Reasons for Decision and Report of Environmental Assessment for the De Beers Gahcho Kué Diamond Mine, Kennady Lake, NWT. June 28, 2006.

11.1.5.2 Internet References

FEARO (Federal Environmental Assessment and Review Office). 1994. Reference Guide: Determining whether a project is likely to cause significant adverse environmental effects. Available at: http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=3939C665-1&offset=30&toc=show.

11.1.6 Acronyms and Glossary

11.1.6.1 Acronyms and Abbreviations

EIS	environmental impact statement
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NWT	Northwest Territories
PK	processed kimberlite
PKC	processed kimberlite containment
Project	Gahcho Kué Project
Terms of Reference	Terms of Reference for the Gahcho Kué Environmental Impact Statement
VC	valued component

11.1.6.2 Units of Measure

ha	hectare
km	kilometre

11.1.6.3 Glossary

Assessment endpoint	Assessment endpoints represent the ultimate properties of the valued component that should be protected or developed for use by future human generations. Assessment endpoints are general statements about what is being protected (e.g., protection of air quality).
Cumulative effects	Cumulative effects represent the sum of all natural and human-induced influences on a physical and biological system within a period of time and space.
Environmental Management System (EMS)	The environmental management system (EMS) identifies how De Beers will manage its environmental responsibilities, and defines specific procedures and instructions that will be followed when performing certain tasks.
Environmental design feature	Environmental design features (also called mitigation measures) include Project designs and environmental best practices, management policies and procedures, and social programs. They remove an effects pathway between the Project and the environment or limit the associated effects (e.g., spraying water on roads to reduce dust).
Kimberlite	Igneous rocks that originate deep in the earth's mantle and intrude the earth's crust. These rocks typically form narrow pipe-like deposits that sometimes contain diamonds.
Key Line of Inquiry	Topics of greatest concern identified in the Terms of Reference that require the most rigorous analysis and detail in the Environmental Impact Statement.
Measurement endpoint	Measurement endpoints are defined as quantifiable (i.e., measurable) expressions of valued components assessment endpoints (e.g., changes to chemical concentrations). For example, measurement endpoints for predicting impacts to air quality include particulate matter (dust), sulphur dioxide, and oxides of nitrogen.
Pathways analysis	Pathway analysis identifies and screens the linkages between Project components or activities and the potential resulting effects to receptors in the environment (e.g., caribou, fish, and traditional and non-traditional land users).
Processed kimberlite	The material that remains after all economically and technically recoverable diamonds have been removed from the kimberlite during processing.
Residual effects	Effects that remain after environmental design features (mitigation) have been implemented.
Subjects of Note	Topics identified in the Terms of Reference that have less priority than Key Lines of Inquiry, but require serious consideration and a substantive analysis in the Environmental Impact Statement.
Valued component	Valued components represent physical, biological, cultural, social, and economic properties of the biophysical environment that are considered to be important by society.
Watershed	The entire catchment area of runoff containing a single outlet.