SECTION 6

ENVIRONMENTAL ASSESSMENT APPROACH

DOMINION DIAMOND

Section 6 Table of Contents

Figures

Tables

Section 6 Abbreviations

Abbreviation	Definition
AANDC	Aboriginal Affairs and Northern Development Canada
BIPR	Bathurst Inlet Port and Road
DAR	Developer's Assessment Report
Dominion Diamond	Dominion Diamond Ekati Corporation
De Beers	De Beers Canada Inc.
EA	Environmental Assessment
e.g.,	for example
EIS	Environmental Impact Statement
Ekati Mine	Ekati Diamond Mine
Elgin	Elgin Mining Inc.
GIS	Geographic Information System
GNWT	Government of the Northwest Territories
i.e.,	that is
Jericho	Jericho Diamond Mine
KLOI	Key Line of Inquiry
MMG	MMG Limited
MVRB	Mackenzie Valley Review Board
Newmont	Newmont Mining Corporation
NIRB	Nunavut Impact Review Board
NWT	Northwest Territories
pH	potential of hydrogen, provides measure of the acidity or alkalinity of a solution on a scale of 0 to 14.
Project	Jay Project
RFD	Reasonably Foreseeable Development
Sabina	Sabina Gold & Silver Corp.
SON	Subject of Note
Tahera	Tahera Diamond Corporation
TCWR	Tibbitt to Contwoyto Winter Road
TOR	Terms of Reference
Tyhee	Tyhee NWT Corp.
VC	valued component

Section 6 Units of Measure

Unit	Definition
%	percent
km	kilometre
km^2	square kilometre

6 ENVIRONMENTAL ASSESSMENT APPROACH

6.1 Introduction

6.1.1 Context

This section describes the environmental effects assessment approach that was used for the Key Lines of Inquiry (KLOIs) and Subjects of Note (SONs) provided by the Terms of Reference (TOR) for the Dominion Diamond Ekati Corporation (Dominion Diamond) Jay Project (Project) (Appendix 1A). According to the Environmental Impact Assessment Guidelines (MVRB 2004), the Developer's Assessment Report (DAR) must contain sections on issue identification, mitigation, effects prediction, the developer's determination of significance, and a cumulative effects assessment. This section describes the approach used to meet these requirements.

6.1.2 Purpose and Scope

The purpose of this section is to meet the requirements of the TOR for the Project (Appendix 1A), which includes describing the methods and approach to analyzing, assessing, and determining the significance of impacts. As defined under the *Mackenzie Valley Resource Management Act*, an environmental assessment means an examination of a proposal for development undertaken by the Mackenzie Valley Review Board (MVRB) pursuant to Section 126. This section of the DAR provides a general overview of the assessment approach used to complete the Environmental Assessment (EA) and to prepare the DAR.

The approach entails a systematic consideration of how Project components and activities may interact with the environment and result in an effect on one or more environmental components. The *Mackenzie Valley Resource Management Act* defines "impact on the environment" as "any effect on land, water, air or any other component of the environment, as well as on wildlife harvesting, and includes any effect on the social and cultural environment or on heritage resources." Where potential adverse effects are identified (either from normal activities or from potential accidents and malfunctions), feasible environmental design features and/or mitigation practices are implemented to avoid or reduce the effects, which follows the precautionary principle. In the context of the DAR, the precautionary principle is defined as "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing reasonable measures to prevent environmental degradation" (MVLWB 2011).

Environmental design features can include project engineering design elements, environmental best practices, management policies and procedures, and social programs. Mitigation practices can also include contingency plans and emergency response plans to prevent effects that could result from accidents and malfunctions (i.e., corrective actions).

In addition to assessing the effects from the Project, the assessment must include an analysis of the cumulative impacts that are likely to result from the Project in combination with other developments (MVRB 2004, 2007). Consideration is also given to the potential effects of the environment on the Project.

Importantly, the EA process is a tool for developers to integrate environmental and social factors into project planning and decision-making. The goal of the EA process is:

- to engage First Nations, Métis, government agencies, and the public; and,
- to assess whether the Project is likely to have significant adverse effects after mitigation.

The use of the EA process as a planning tool for design of the Project was accomplished through an iterative process between the Project's engineers and environmental scientists to avoid or mitigate effects, where possible. The EA team worked closely with the Project design team to incorporate appropriate mitigation into the Project design and implementation plans so that predicted effects should be acceptable. In cases where an initial analysis of effects indicated unacceptable results, the EA team collaborated with the Project design team to identify additional Project design elements to reduce effects. The results of this iterative process are reflected in the design of the proposed Project described in Section 3, and form the basis for the assessment and prediction of potential effects of the Project.

The Project incorporates technically and economically feasible environmental design features, as well as mitigation practices and procedures to limit potential adverse effects including:

- limiting the area of the Project footprint;
- designing the Project to limit or minimize effects (e.g., placement of waste rock storage areas away from sensitive features);
- implementing procedures, practices, and management policies to limit an effect (e.g., use of dust suppression on roads) and progressive reclamation of available disturbed areas; and,
- using projects or designs to offset potential effects.

The DAR presents sufficient information to allow for an understanding of the technical and economic feasibility and sustainability of the environmental design features and mitigation practices and procedures incorporated into the Project. It is possible that additional mitigation may be identified following commencement of Project operations if monitoring indicates that effects are greater than predicted in the DAR.

6.1.3 Content

Similar to the recent EAs for the Gahcho Kué (De Beers 2010) and NICO projects (Fortune 2011), the structure of the DAR for the Project includes KLOIs and SONs. The following presents the two key features of the approach.

- The MVRB has not only identified issues, but also prioritized the issues. The five KLOIs presented by the MVRB are "areas of the greatest concern that require the most attention during the environmental assessment and the most rigorous analysis and detail in the DAR" (Appendix 1A).
- Subjects of Note "require a thorough analysis, including a cumulative effects assessment, but do not require the same level of detail as Key Lines of Inquiry." Through this approach, the MVRB has identified a two-tiered approach to issues, and this is reflected in the level of detail in the DAR.

The following bullets present the overall approach and method for assessing effects from the Project on the biophysical and human (social, cultural, and economic) environments. Further details are provided in the sections below.

- Define valued components (VCs) of the biophysical, economic, social, heritage, and health aspects of the environment potentially affected by the Project, and associated assessment endpoints and measurement indicators (Section 6.2).
- Define spatial and temporal boundaries of the assessment (Section 6.3).
- Summarize the information on previous (where possible) and existing conditions from comprehensive baseline reports (annexes) that is pertinent to the assessment of Project effects (not presented in Section 6, but included in all KLOIs and SONs).
- Provide the definition of pathways, environmental design features and mitigation, and approach and methods for evaluating relevant effects pathways (interactions) between the Project and the biophysical, economic, social, heritage, and health VCs (Section 6.4).
- Present the approach to analyzing Project-specific and cumulative effects for biophysical and socio-economic VCs after implementing environmental design features and mitigation (Section 6.5).
- Identify and manage the uncertainty associated with the analysis of residual effects (Section 6.6).
- Define residual impact criteria and the approach and method for determining environmental significance of predicted residual effects (Section 6.7).
- Identify follow-up and monitoring programs to test predicted residual effects, evaluate success of planned mitigation designs, policies, and practices, and address key sources of uncertainty (Section 6.8).

The assessment approach for the DAR is based on ecological, cultural, and socio-economic principles, and EA best practice. Several elements of the approach can be consistently applied to all biophysical and human environment components. However, certain elements of the assessment approach may have to be modified for some components.

For example, the definition of a VC can be applied to all environmental disciplines (e.g., hydrogeology, air, aquatics, soil, wildlife, and socio-economics). There is general consistency in the approach for identifying pathways that link the Project to potential effects on VCs of the biophysical and human environments. Likewise, the approach to determining the spatial and temporal boundaries for the effects analysis and assessment is similar across biophysical and human environment components.

In contrast, the methods for analyzing effects, classifying residual impacts (e.g., direction [nature and type of effect], magnitude and duration), and predicting environmental significance can differ between biophysical and socio-economic components (MVRB 2004, 2007). For example, human effects from a specific project are difficult to isolate from the ongoing processes of interdependent social, cultural, and economic change. Evolving social trends, government policy and programming decisions, and individual choice all have effects that will be concurrent with potential Project effects. Biophysical components are also influenced simultaneously by natural and human-related factors. However, for many disciplines, Project-specific effects can be quantified (e.g., incremental changes to ground and surface water supply, air quality, soil, and fish and wildlife habitat).

Because the socio-economic status of different communities, subpopulations, and individuals may vary, a socio-economic effect may have both positive and negative aspects (MVRB 2007). An effect on a biophysical component is typically negative or positive. Therefore, differences in the overall approach and methods between biophysical and socio-economic components are identified in this section, and details are provided in the human environment section of the DAR.

Throughout the assessment process, Dominion Diamond has engaged with the public, and to a greater degree, the potentially impacted communities, to inform them of the proposed Project, to gather local and traditional knowledge for incorporation into the assessment (Section 5), and to identify concerns and issues so that they are addressed appropriately in the DAR.

6.2 Selection of Valued Components, Assessment Endpoints, and Measurement Indicators

6.2.1 Valued Components

Valued components represent physical, biological, cultural, social, and economic properties of the environment that are considered to be important by society. The inter-relationships between components of the biophysical and human environments provide the structure of a social-ecological system (Folke 2006). Examples of physical properties that can be considered VCs include groundwater, surface water, terrain, and air (Appendix 1A). Aquatic and terrestrial plant and animal populations represent biological properties that can be considered VCs. Traditional and non-traditional uses of water, plants, and animals and other biophysical properties (e.g., ecological resources) can be VCs of the cultural, social, and economic environment.

The following factors were considered when developing a list of VCs for the Project:

- presence, abundance, and distribution within, or relevance to, the area associated with the Project;
- potential for interaction with the Project and sensitivity to effects;
- species conservation status or concern;
- valued components chosen and assessed in the Environmental Impact Statement (EIS) for the NWT Diamonds Project (BHP 1995);
- local and traditional knowledge, and related concerns obtained during the community scoping sessions for the Project in Behchokǫ̀, Yellowknife, and Lutsel K'e, and a technical scoping session in Yellowknife (Section 4);

- previous and ongoing engagement with communities involved in the Ekati Diamond Mine (Ekati Mine);
- ecological and socio-economic value to communities, government agencies, the Independent Environmental Monitoring Agency, and the public;
- traditional, cultural, and heritage importance to Inuit, First Nations and Métis peoples; and,
- recent experience with similar projects in the Northwest Territories (NWT) and Nunavut.

These factors and the TOR (Appendix 1A) were used to select the following list of biophysical and socio-economic VCs:

- air quality;
- permafrost;
- groundwater;
- surface hydrology;
- water quality
- aquatic life other than fish;
- fish (Arctic Grayling, Lake Trout, Lake Whitefish);
- physical terrestrial environment (soils, eskers, and vegetation);
- caribou;
- carnivores (grizzly bear, wolverine, and wolf);
- breeding birds (upland breeding birds, waterbirds, and raptors);
- species at risk;
- archaeology and heritage sites;
- land use and traditional land use;
- employment and economy (socio-economic and employment); and,
- human health.

In nature, VCs can be found at the beginning, middle or end of pathways, or analogously, at the bottom, middle, or top trophic levels of food chains (Section 6.4). For example, benthic invertebrates and plankton are at the lower trophic level (towards the beginning of the pathway) in an aquatic ecosystem, while Northern Pike and Lake Trout are the top predators in some aquatic systems not fished by people (at the end of the pathway). In arctic ecosystems, changes to soil and vegetation represent initial pathways to ground squirrel and caribou, which influence top trophic level predators such as grizzly bear, wolverine and wolf. Cultural and socio-economic VCs typically enter at the middle and top levels of pathways. For example, people hunt caribou that occur in the middle of the food chain, and fish for lake trout, which occur at the top of food chains. Exceptions include drinking water, and harvesting berries and medicinal plants that occur at the lower trophic level of food chains.

The DAR integrates Project-related effects on biophysical, cultural, and socio-economic VCs through the KLOIs and SONs. Key Lines of Inquiry and SONs are interdisciplinary and can involve several VCs (Appendix 1A). Project effects predicted in one KLOI or SON have the potential to interact with other components of the environment and influence other KLOIs and SONs. If the Project could affect one aspect of the environment that could cause effects on other aspects, then that information was shared among disciplines and related KLOIs and SONs. For example, if a change in surface water flow was predicted, then this information was passed to other disciplines completing assessments for surface water quality and aquatic health, vegetation, wildlife and wildlife habitat, and fish and fish habitat.

6.2.2 Assessment Endpoints and Measurement Indicators

Assessment endpoints are qualitative expressions used to determine the significance of effects on VCs and represent the key properties of VCs that should be protected for future human generations (i.e., incorporates sustainability). For example, maintenance or suitability of water quality, self-sustaining and ecologically effective fish and wildlife populations, and continued opportunities for traditional and non-traditional use of these ecological resources may be assessment endpoints for surface water, fish and wildlife, and traditional and non-traditional land use. Identification of assessment endpoints for VCs in the DAR was determined partially from the outcome of the community, including local and traditional knowledge and the public and regulatory engagement process (Section 4).

Assessment endpoints are typically not quantifiable and require the identification of one or more measurement indicators that can be directly linked to the assessment endpoint. Measurement indicators represent properties or attributes of the environment and VCs that, when changed, could result in, or contribute to, an effect on assessment endpoints. Measurement indicators may be quantitative (e.g., concentrations of metals in surface water) or qualitative (e.g., movement and behaviour of wildlife from disturbance to habitat and travel corridors). Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are key variables for study in follow-up and monitoring programs.

The significance of effects from the Project on a VC is evaluated by linking changes in measurement indicators to effects on the assessment endpoint (Section 6.7). For example, changes in habitat quantity and quality (measurement indicators) are used to assess the significance of effects from the Project on the ability of a wildlife population to remain self-sustaining and ecologically effective (an assessment endpoint). Briefly, self-sustaining populations continue to be resilient and stable to changes in environmental conditions and random fluctuations in population processes. Ecologically effective VCs are highly interactive with the environment (e.g., caribou and Lake Whitefish) and can change in abundance and distribution, but still maintain ecosystem function.

The assessment on biophysical VCs focuses on measurement indicators and assessment endpoints derived from ecology and conservation science. As stated above, community and regulatory engagement, and local and traditional knowledge were key considerations for selecting VCs, but the assessment endpoints for water quality, fish, caribou, and other wildlife VCs do not explicitly consider societal values such as desire to maximize intrinsic or aesthetic values or otherwise benefit human populations (i.e., drinking water, availability for harvesting). Societal values concerning changes in fish and wildlife populations are important and must also be considered to understand the full suite of potential effects of the Project (i.e., ecological and human dimensions). Consequently, measurement indicators from these biophysical VCs were carried forward so that effects on societal values could be appropriately captured in the section dealing specifically with those values (Culture: Section 15).

All VCs have measurement indicators, but not every VC has an explicit assessment endpoint. For example, VCs such as permafrost, groundwater, surface water quantity (hydrology), and soils are strictly considered as measurement indicators for other VCs, and do not have assessment endpoints. The results of the analysis of changes in measurement indicators for VCs such as permafrost, groundwater, surface hydrology, and soils are provided to other VCs with assessment endpoints (e.g., vegetation, fish and wildlife populations, and human health) for inclusion in the analysis and evaluation of significance of residual effects. Importantly, VCs with no explicit assessment endpoint are still analyzed for Project-specific and cumulative (if applicable) changes in measurement indicators. The changes are characterized in terms of magnitude, duration, and geographic extent, but are not classified using typical definitions of impact criteria (e.g., low magnitude and long-term duration). These VCs may also be included in follow-up and monitoring programs. The same systematic and rigorous approach is applied to VCs with and without assessment endpoints, except that effects on VCs without explicit assessment endpoints are not classified using impact criteria or evaluated for significance. Valued components, assessment endpoints, and measurement indicators used in the DAR are presented in Table 6.2-1.

DOMINION DIAMOND

Table 6.2-1 Assessment Endpoints and Measurement Indicators Associated with Valued Components, Key Lines of Inquiry, and Subjects of Note

Key Line of Inquiry/ Subject of Note	Valued Components	Assessment Endpoints	Measurement Indicators
KLOI: Water Quality and Quantity	Groundwater[a]	• Suitability of surface water quality for healthy and sustainable ecosystems	• Groundwater levels and flow rates • Spatial and temporal distribution of groundwater • Concentrations of physical analytes (e.g., pH, conductivity) • Concentrations of major ions and nutrients • Concentrations of total and dissolved metals
	Surface hydrology[a]		• Lake water levels and outflow discharge rates • Stream channel parameters (e.g., channel depths, widths) and shoreline integrity • Basin water yields
	Surface water quality		• In situ water quality parameters (e.g., temperature, dissolved oxygen, pH, conductivity) • Major ions, suspended solids, nutrients, and metals in water • Distribution of particle size in surficial sediment • Nutrients and metals in sediment
KLOI: Fish and Fish Habitat	Aquatic life other than fish[a]	• Self-sustaining and ecologically effective fish populations • Ongoing fisheries productivity	• Concentrations of chlorophyll *a*, nutrients • Phytoplankton species composition, abundance, and biomass • Zooplankton species composition, abundance, and biomass • Benthic invertebrate species composition, richness, abundance, and biomass
	Arctic Grayling Lake Trout Lake Whitefish		• Habitat quantity (includes surface hydrology and water quality indicators) • Habitat arrangement and connectivity (fragmentation) • Habitat quality (includes surface hydrology and water quality indicators) • Survival and reproduction • Abundance and distribution of fish
KLOI: Caribou	Caribou	• Self-sustaining and ecologically effective caribou populations	• Habitat quantity • Habitat arrangement and connectivity (fragmentation) • Habitat quality (occupancy, movement, and behaviour) • Survival and reproduction • Abundance and distribution of caribou

Table 6.2-1 Assessment Endpoints and Measurement Indicators Associated with Valued Components, Key Lines of Inquiry, and Subjects of Note

Key Line of Inquiry/ Subject of Note	Valued Components	Assessment Endpoints	Measurement Indicators
KLOI: Analysis of Alternative Means	All VCs of the biophysical and human environments	• Not applicable[b]	• Technical feasibility • Economic viability (capital and operating costs) • Socio-economic attributes (employment and benefits) • Environmental attributes (caribou, fish, and other biophysical VCs)
SON: Air Quality	Air quality	• Compliance with regulatory air emission guidelines and standards	• Total suspended particulates, coarse particulate matter, and fine particulate matter • Sulphur dioxide, nitrogen oxides, carbon monoxide, dioxins, furans • Metals (e.g., arsenic) • Deposition rates
SON: Vegetation	Plant populations and communities Listed plant species and plant habitat potential Traditional use plants	• Self-sustaining and ecologically effective plant populations and communities	• Quantity, arrangement and connectivity (fragmentation) of plant communities • Plant community health and diversity • Abundance and distribution of plant populations and communities • Abundance and distribution of habitat for listed and traditional use plants • Presence of invasive species
	Soil and eskers[a]		• Soil quality, quantity, and distribution • Abundance and distribution of eskers
SON: Wildlife and Wildlife Habitat	Grizzly bear Wolverine Wolf Upland breeding birds Waterbirds Raptors Species at risk	• Self-sustaining and ecologically effective wildlife populations	• Habitat quantity • Habitat arrangement and connectivity (fragmentation) • Habitat quality (occupancy, movement, and behaviour) • Survival and reproduction • Abundance and distribution of VCs
SON: Terrain	Terrain	• Not applicable[a]	• Quantity and distribution of terrain units • Topography and slope stability • Soil quantity and distribution • Surface hydrology • Permafrost distribution
KLOI: Maximizing Benefits and Minimizing Impacts to Communities	Employment and business opportunities	• Sustainability of long-term socio-economic properties	• Employment and income • Business activity • Education, training, and opportunities for youth • Capacity of labour pool
	Community health and well-being		• Employment and income • Community infrastructure and services • Social disparity

Table 6.2-1 Assessment Endpoints and Measurement Indicators Associated with Valued Components, Key Lines of Inquiry, and Subjects of Note

Key Line of Inquiry/ Subject of Note	Valued Components	Assessment Endpoints	Measurement Indicators
SON: Culture	Heritage resources Traditional land use Non-traditional land use	• Protection of heritage resources • Continued opportunities for traditional and non-traditional land use	• Archaeology and heritage sites • Tourism potential and wilderness character • Viewscape • Access to caribou, other wildlife, and fish • Availability of caribou, other wildlife, and fish • Human health risks from consumption of water, fish, caribou, and other wildlife

a) No assessment endpoint because the VC represents measurement indicators and pathways to other VCs with assessment endpoints.

b) Determination of significance from the Project on assessment endpoints is completed in applicable KLOIs and SONs. Significance is not assessed for Project alternatives.

KLOI = Key Line of Inquiry; SON = Subject of Note; VC = valued component; e.g. = for example.

6.3 Environmental Assessment Boundaries

Assessment boundaries define the geographic and temporal scope or limits of the analysis and determination of significance of effects from the Project on the environment. The TOR require that the developer provide the rationale for selecting the areas (spatial boundaries) and times (temporal boundaries) that will be used to assess the effects from the Project on VCs.

6.3.1 Spatial Boundaries

Individuals, populations, and communities function within the environment at different spatial (and temporal) scales (Wiens 1989). In addition, the response of physical, chemical, and biological processes to changes in the environment can occur across several spatial scales at the same time (Hollings 1992; Levin 1992). Because the responses of physical, biological, cultural, and economic properties to natural and human-induced disturbance will be unique and occur across different scales, the DAR has adopted a multi-scale approach for describing baseline conditions (existing environment) and predicting effects from the Project on VCs. As indicated in the TOR, the spatial boundaries for analyzing and predicting effects from the Project should be appropriate for capturing the processes and activities that influence the geographic distribution and movement patterns specific to each VC (Appendix 1A).

For the DAR, baseline study areas were designed to characterize existing environmental conditions on a continuum of spatial scales from the Project site to broader, regional levels. Data collected at the Project site and local scales were used to provide precise measures of baseline environmental conditions and predict the direct and indirect changes from the Project on VCs (e.g., changes to terrestrial and aquatic habitat from the physical footprint and dust and air emissions). Data collected at larger scales were used to measure broader-scale baseline environmental conditions, and provide regional context for the combined direct and indirect effects from the Project on VCs. Baseline study areas may not necessarily represent the spatial boundary for the effects analysis (i.e., effects study area or effects assessment area). The overall EA study area is defined by the combined effects study areas for all VCs. The rationale for the effects study area for VCs is provided in each KLOI and SON.

In the DAR, selection of the boundary for effects study areas was based on the physical and biological properties of VCs. In addition, effects assessment areas were designed to capture the maximum spatial extent of potential effects from the Project and other previous, existing, and reasonably foreseeable future developments. Effects from the Project on the biophysical environment are typically stronger at the local scale, while larger-scale effects are more likely to result from other ecological factors and human activities. For example, Project-specific effects on environmental components with limited movement (e.g., soil and vegetation) will likely be restricted to local changes from mining and associated infrastructure. Some indirect changes to vegetation from dust deposition and air emissions may occur, but the effects should be limited to the local scale of the Project. For soil and vegetation VCs, and other VCs with similar physical and biological properties, the baseline study areas may be also suitable for the analysis and assessment of incremental and cumulative effects from the Project and other developments (if applicable).

For VCs with more extensive distributions, such as fish that can move within a watershed and wildlife species with large home ranges, effects from the Project have a higher likelihood of combining with effects from other human developments and activities at a larger scale. Watersheds may be influenced by multiple users that generate cumulative effects on aquatic resources. Similarly, larger animals (e.g., caribou and grizzly bear) that are influenced by the Project will likely encounter other human activities and developments in their daily and seasonal ranges. Consequently, effects from the Project could combine with influences from other developments in the individual's home range. In addition, the home ranges of several individuals may be affected, which results in cumulative effects on the population. For VCs that are distributed and move over large areas, the baseline study areas used to measure existing conditions around the Project are not sufficient for analyzing and assessing Project-specific and cumulative effects, and a larger study area is required. Similarly, the effects assessment area for the human environment considers both primary and potentially affected communities (Appendix 1A).

6.3.2 Temporal Boundaries

The DAR was designed to evaluate the short- and longer-term changes from the Project on the biophysical and human environments. In accordance with the TOR, the duration of effects may extend beyond specific phases of the Project, and is dependent on the physical and/or biological properties of VCs (Appendix 1A). The temporal boundary of the Project is defined as having the following phases:

- construction - 2016 to 2019;
- operations - 2019 to 2029; and,
- closure - 2030 to 2033.

Baseline studies associated with each VC identify temporal variation (e.g., annual or seasonal changes in water flow or habitat use, or trends over time in populations and employment) and other biophysical and socio-economic constraints relevant to the assessment of the Project.

For all VCs, residual effects are assessed for all phases of the Project, but not necessarily for each specific phase. For example, effects on wildlife begin during the construction phase with the removal and alteration of habitat (results in direct and indirect changes), and continue through the operation phase and for a period after the closure phase until reversed (unless determined to be irreversible or permanent). Therefore, effects on wildlife are analyzed and predicted from construction through closure, which generates the maximum potential spatial and temporal extent of effects and provides confident and ecologically relevant impact predictions.

Alternately, for some VCs, the assessment was completed for those phases of the Project where predicted effects would be expected to peak (e.g., most air quality effects from emissions occur during the initial period of operations due to open pit mining), or at several key snapshot points in time. These snapshots may be taken at several points within a Project phase or phases. An example is evaluating surface water quality predictions at specific times that represent key milestones throughout the life of the Project. For other VCs, the assessment of effects will continue into post-closure (e.g., long-term water quality predictions for Lac du Sauvage following the breaching of dike and reconnection at closure).

Similarly, the temporal boundaries identified for cumulative effects assessments are specific to the VCs being assessed. Temporal boundaries include the duration of residual effects from previous and existing developments that overlap with residual effects of the Project, and the period of time over which the residual effects from reasonably foreseeable developments will overlap with residual effects from the Project. The temporal boundaries considered for each VC are defined in the KLOIs and SONs.

6.4 Pathways Analysis

Interactions (linkages) between Project components or activities and potential changes to measurement indicators of the environment are identified by a pathway analysis, which is then used to assess residual effects (i.e., after mitigation) on VCs. The first step in the pathways analysis is to identify all potential effects pathways for the Project. Each pathway is initially considered to have a linkage to potential effects on VCs. Potential pathways through which the Project could affect VCs were identified from a number of sources including the following:

- a review of the Project Description (Section 3) and scoping of potential effects by the environmental and engineering teams for the Project;
- local and traditional knowledge obtained from community scoping sessions in Behchokǫ̀, Yellowknife and Lutsel K'e, and a technical scoping session in Yellowknife (Section 4);
- previous and ongoing engagement with communities involved in the Ekati Mine;
- scientific knowledge and experience with other mines in the NWT; and,
- consideration of potential effects identified from the TOR (Appendix 1A).

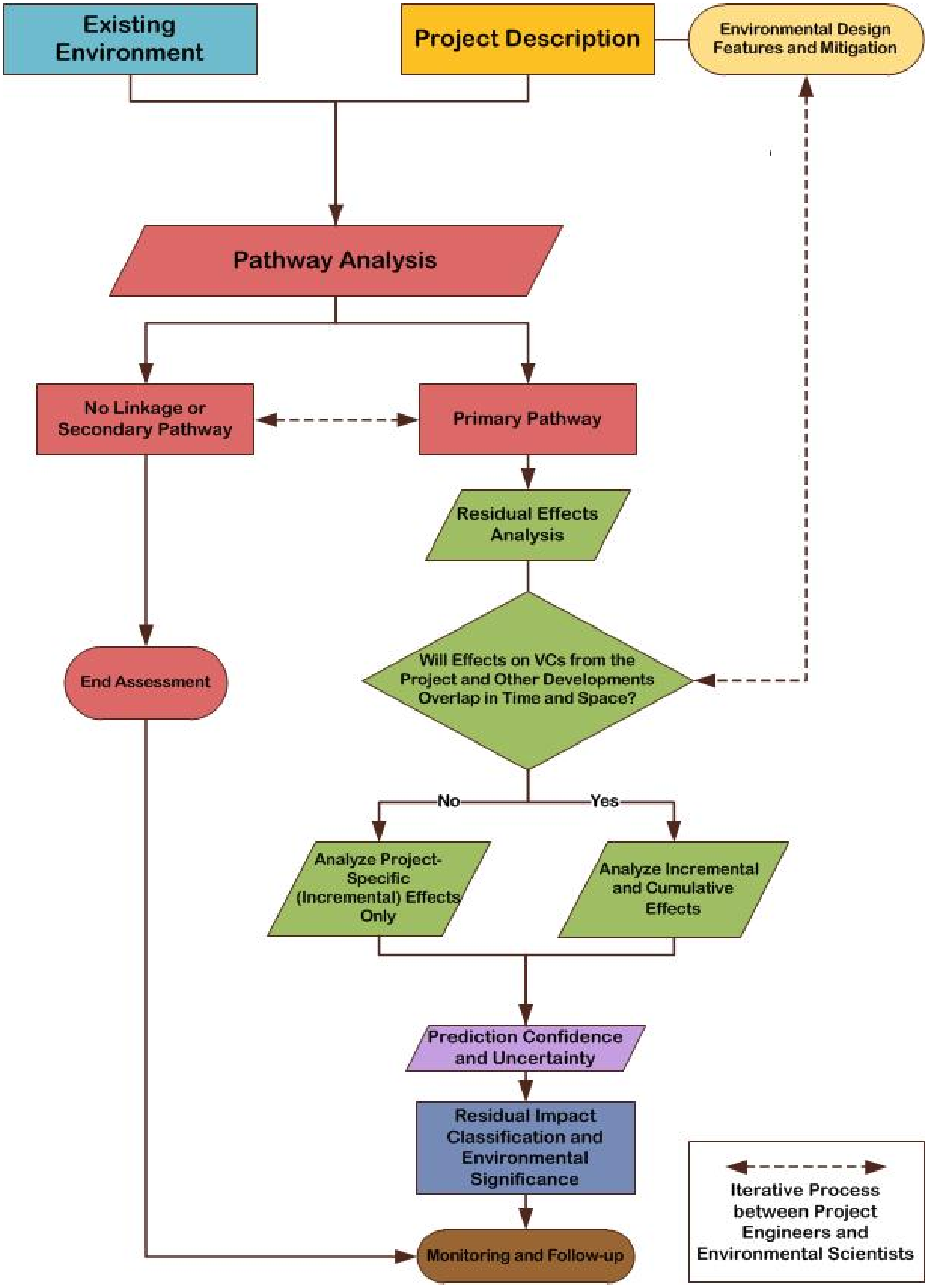
This step is followed by the development of environmental design features and mitigation that can be incorporated into the Project to remove a pathway or limit (mitigate) the effects on VCs, and includes application of the precautionary principle (Section 6.1.2). Project designs and mitigation can include local and traditional knowledge, such as avoiding important esker habitat and using small rocks and gravel to build ramps that make it easier for caribou to cross roads. Environmental design features include Project design elements, environmental best practices, management policies and procedures, spill response and emergency contingency plans, and social programs. Environmental design features and mitigation are developed through an iterative process between the Project's engineering and environmental teams to avoid or limit effects (Figure 6.4-1). The DAR includes an evaluation of the effectiveness and success of existing environmental designs and mitigation policies and procedures.

Knowledge of the environmental design features and mitigation is then applied to each of the pathways to determine the expected amount of Project-related changes to the environment and the associated residual effects (i.e., effects after mitigation) on VCs. Changes to the environment can alter physical measurement indicators (e.g., water and soil chemistry, and amount and availability of habitat) and biological measurement indicators, such as animal behaviour, movement, and survival (Table 6.2-1). For an effect to occur, there has to be a source (Project component or activity) that results in a measurable environmental change to a measurement indicator (i.e., there is a pathway for an interaction to have an effect) and a corresponding effect on a VC:

Project Activity → **Change in Environment** → **Effect on VC**

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 (Figure 6.4-1). Similar to defining spatial and temporal boundaries for the assessment, predicting the magnitude, geographic extent, and duration of changes in measurement indicators, and subsequent effects from pathways, is highly dependent on the VC (Section 6.3.1). For example, localized changes in surface water flow and levels would be predicted to have larger effects on soils than on waterbirds, which are characterized by larger geographic distributions and movement patterns.

Figure 6.4-1 Flow Diagram for the Assessment Approach



VC = valued component.

Pathways are determined to be primary, secondary (minor), or to have no linkage, using scientific and traditional knowledge, logic, and experience with similar developments and environmental design features. Each potential pathway is assessed and described as follows:

- **No linkage –** Analysis of the potential pathway reveals that there is no linkage, or the pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change. Therefore, the pathway would have no residual effect on a VC relative to the Base Case (Section 6.5.2.2) or guideline values (e.g., air, soil, or water quality guideline).
- **Secondary –** Pathway could result in a measurable minor environmental change, but would have a negligible residual effect on a VC relative to the Base Case or guideline values (e.g., an increase in a water quality parameter that is small compared to the range of baseline values and is well within the water quality guideline for that parameter). Therefore, the pathway is not expected to contribute to effects of other existing, approved, or reasonably foreseeable projects to cause a significant effect.
- **Primary –** Pathway is likely to result in environmental change that could contribute to residual effects on a VC relative to the Base Case or guideline values.

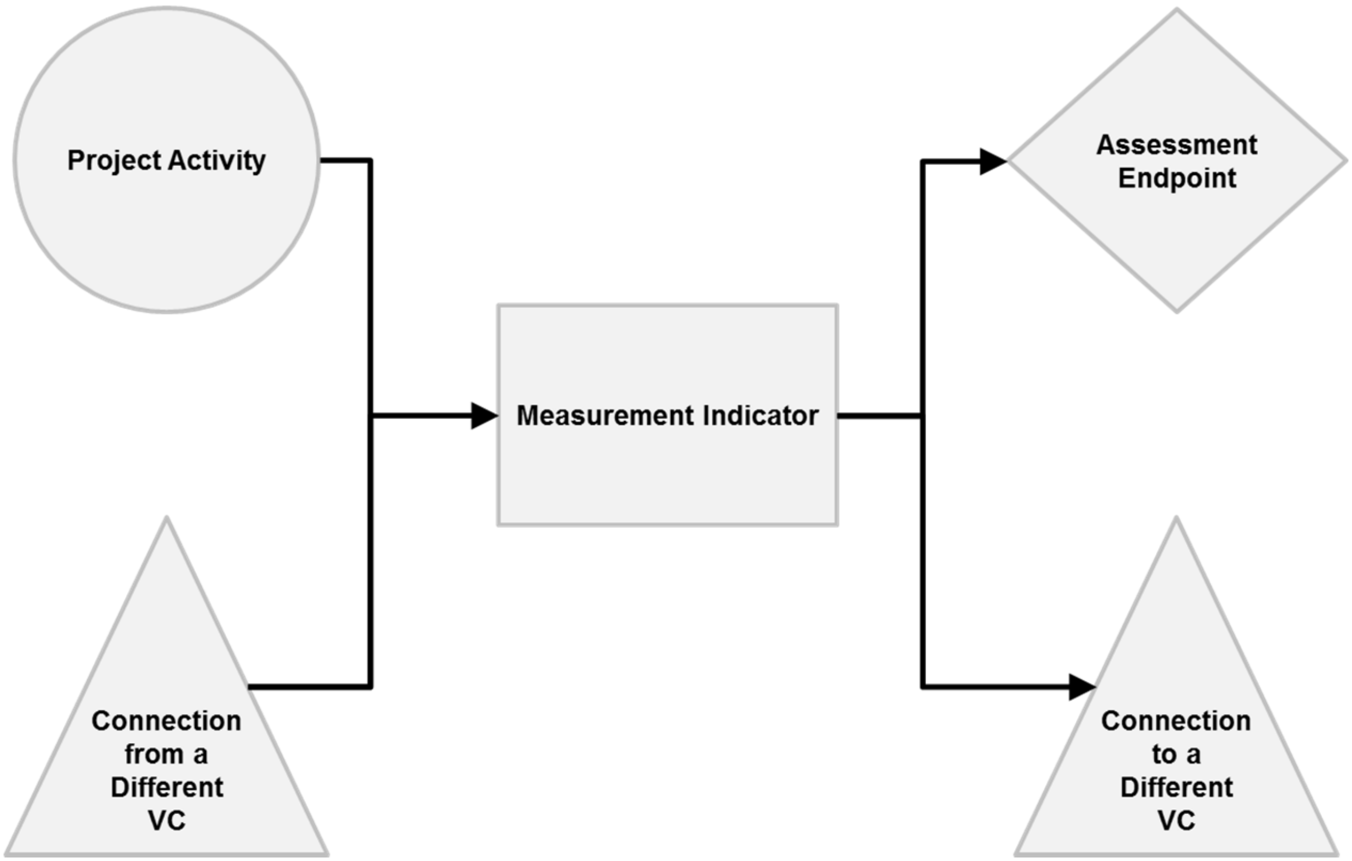
Pathways with no linkage to a VC are not assessed further because environmental design features or mitigation will remove the pathway. Pathways that are assessed to be secondary and are demonstrated to have a negligible residual effect on a VC through simple qualitative or semi-quantitative evaluation of the pathway are also not advanced for further assessment. In summary, pathways determined to have no linkage to a VC or those that are considered secondary are not expected to result in environmentally significant effects on the assessment endpoint of VCs.

Primary pathways require further evaluation through more detailed quantitative and/or qualitative effects analysis and classification to determine the environmental significance of the Project effects on VCs (Figure 6.4-1 and Section 6.5). Project activities and associated mitigation implemented during Project phases are summarized in a table within each KLOI and SON. Potential environmental effects from each Project interaction, and their associated classification, are also summarized in the table. More detailed descriptions of the environmental effects and relevant mitigations are provided in subsequent sections with the pathway analysis results.

To meet the TOR (Appendix 1A), linkage diagrams are used to provide a visual representation of the pathways (i.e., linkages) through which the Project may affect a VC assessment endpoint (Figure 6.4-2). Each linkage diagram depicts the relationships among the Project activities, measurement indicators, and assessment endpoints. Linkage diagrams also help to show the inter-relationships among VCs of the biophysical and human environments. Symbols on the linkage diagrams include:

- Project activities (i.e., the physical works and activities that constitute the Project) represented by circles;
- potential changes in the environment (measurement indicators) represented by rectangles;
- assessment endpoints for a specific VC represented by diamonds; and,
- connections to or from a different VC (or discipline) represented by triangles.

Figure 6.4-2 Example of a Linkage Diagram Illustrating Potential Project Effects on a Valued Component



VC = valued component.

6.5 Residual Effects Analysis

6.5.1 Project-Specific Effects

In the DAR, the effects analysis considers all primary pathways that are likely to result in measurable environmental changes and residual effects on VCs (i.e., after implementing environmental design features and mitigation). Thus, the analysis is based on residual Project-specific (incremental) effects that are verified to be primary in the pathway analysis (Section 6.4; Figure 6.4-1). Residual effects on assessment endpoints may have more than one primary pathway that link a Project activity to an interaction with the environment and a subsequent effect on a VC. For example, the pathways for effects on the ability of fish populations and fish habitat to remain self-sustaining and ecologically effective could include alteration of local flows, water levels, and water quality. Incremental effects from the Project on the ability of wildlife populations to remain self-sustaining and ecologically effective may include changes in habitat quantity and quality, and survival and reproduction.

Results from the effects analyses are used to describe the magnitude, duration, and geographic (spatial) extent of the predicted changes to measurement indicators and residual effects on VC assessment endpoints. A strong effort is made to express the expected changes quantitatively or numerically. For example, the magnitude (intensity) of the effect may be expressed in absolute or percentage values above (or below) baseline conditions or a guideline value. The duration (which includes reversibility) of the effect is typically described in years relative to the phases of development of the Project, and the spatial extent of effects is typically expressed in area or distance from the Project. In addition, the direction, frequency, reversibility, and probability of effects are described, where applicable. Expressions such as "short-term" duration or "moderate" magnitude are not used in the effects analysis. These expressions are reserved for the classification of effects and determination of environmental significance, where definitions of these expressions are provided.

Effects on social, economic, and cultural properties include positive and negative changes to employment, training, and education, family income, traditional land use, family and community cohesion, and long-term social, cultural, and economic sustainability. Some of these measurement indicators can be analyzed quantitatively (e.g., number of jobs created and estimated income levels). Other indicators, such as community cohesion and traditional land use, are more difficult to quantify, and involve information from public engagement, literature, examples from similar projects under similar conditions, and experienced opinion. The effects analysis considers the interactions among the unique and common attributes, challenges, and opportunities related to social, cultural, and economic measurement indicators. A key aspect of the effects analysis is to predict the influence from the Project on the development and sustainability of socio-economic conditions in the defined effects assessment (study) area.

A detailed description of the methods used to analyze residual effects from the Project on VCs is provided in each KLOI and SON section. Where possible and appropriate, the analyses are quantitative, and may include data from field studies, modelling results, scientific literature, government publications, effects monitoring reports, and personal communications. Information from monitoring programs and special studies is valuable for understanding and making predictions about Project-specific and cumulative effects. Follow-up monitoring has been ongoing at the Ekati Mine since construction, and includes the following programs, plans, and studies:

- Surveillance Network Program;
- Aquatic Effects Monitoring Program;
- Fish Habitat Compensation Monitoring associated with *Fisheries Act* Authorizations;
- Waste Rock and Waste Rock Storage Area Seepage Survey Program;
- Geotechnical Inspections;
- Air Quality Monitoring Program;
- Wildlife Effects Monitoring Program;
- Archaeology Monitoring Program; and
- Reclamation Project, Research, and Monitoring Program.

Through the Wildlife Effects Monitoring Program, Dominion Diamond contributes to regional cumulative effects and management programs such as:

- Barren-Ground Caribou Management Strategy; and,
- Grizzly bear and wolverine hair sampling.

To meet the TOR (Appendix 1A), available local and traditional knowledge are incorporated into the analysis and results. Due to the amount and type of data available, some analyses are necessarily qualitative, and include professional judgement or experienced opinion.

6.5.2 Approach to Cumulative Effects Assessment

6.5.2.1 Definition and Application

Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, cultural, and economic components of the environment through time and across space. Some changes may be human-related, such as increasing industrial and mineral development, and some changes may be associated with natural phenomena, such as extreme rainfall events and periodic harsh and mild winters. Where information is available, the cumulative effects assessment estimates or predicts the contribution of effects from the Project and other developments on VCs, in the context of natural changes in the system.

Not every VC requires an analysis of cumulative effects. The key is to determine if the effects from the Project and one or more additional existing, approved, and/or reasonably foreseeable developments/activities overlap (or interact) with the temporal or spatial distribution of the VC (Section 6.4; Figure 6.4-1). For some VCs, Project-specific effects are important; however, there is little or no potential for cumulative effects because there is little or no overlap with other developments (e.g., surficial geology, soils, and terrain). For other VCs that are distributed or travel over large areas and can be influenced by a number of developments (e.g., surface water quality, fish, and caribou), the analysis of cumulative effects can be necessary and important. Socio-economic components also must consider the potential cumulative effects of the Project and other developments and human activities.

In the DAR, cumulative effects are identified, analyzed, and assessed in the KLOIs and SONs where applicable (Appendix 1A, Section 6.2). The approach is the same as that used for the Project-specific effects analysis (Section 6.5.1) and residual impact classification and determination of significance (Section 6.7). If significant adverse cumulative effects are identified, then the opportunity for technically and economically feasible additional mitigation is considered and applied to the assessment (Appendix 1A, Section 6.1).

6.5.2.2 Assessment Cases

For VCs that require cumulative effects analysis, the concept of assessment cases is applied to the associated spatial boundary of the assessment (effects study area; Section 6.3.1) to estimate the incremental and cumulative effects from the Project and other developments (Table 6.5-1). The approach incorporates the temporal boundary for analyzing the effects from previous, existing, approved, and reasonably foreseeable developments before, during, and after the anticipated life of the Project (Section 6.3.2). Analyzing the temporal changes to the biophysical and human environments is fundamental to predicting the cumulative effects from development on VCs that move over large areas, such as caribou, fish, and traditional land users.

Table 6.5-1 Contents of Each Assessment Case

Base Case	Application Case	Reasonably Foreseeable Development Case
Range of conditions from little or no development to previous and existing developments[a] before the Project	Base Case plus the Project	Application Case plus reasonably foreseeable developments

a) Includes approved projects.

The Base Case represents a range of conditions over time within the effects assessment (study) area before application of the Project. The timeframe for the Base Case includes the planned operation of the Ekati Mine to 2019. Environmental conditions on the landscape prior to human development (e.g., mining, mineral exploration, outfitting, and transportation), which represent reference conditions, were considered independently within the Base Case, where possible (Appendix 1A, Section 4.1).

To prepare the Base Case, baseline studies were completed to develop an understanding of the existing physical, biological, and social conditions that may be influenced by the Project. Other sources of existing and historical information were also reviewed. Baseline conditions represent the historical and current environmental selection pressures that have shaped the observed patterns in VCs. Environmental selection pressures include both natural (e.g., weather, changes in gene frequencies, predation, and competition) and human-related factors (e.g., mineral development, forestry, traditional and sport hunting/fishing). Depending on which selection pressures are currently driving changes to the VC and system, baseline conditions typically fluctuate within a range of variation through time and space. The fluctuations are generated by variation in natural factors (natural variation) and variation associated with human influences. Relative to ecological time and space, baseline conditions are in a constant state of change due to the pushing and pulling of environmental selection pressures. Thus, baseline conditions can be thought of as a distribution of probability values, and the location of the value (e.g., middle or ends of the distribution) is dependent on which environmental factors are currently playing a key role in the trajectory of the VC and system.

The Base Case also describes the existing environment before the application of the Project to provide an understanding of the current physical, biological, and social conditions that may be influenced by the Project. Base Case conditions include the cumulative effects from all previous and existing developments and activities that are approved to take place within the effects study area of a VC. For example, environmental and social effects from the construction and operation of Ekati, Diavik, and Snap Lake mines and the Tibbitt to Contwoyto Winter Road (TCWR) are considered to be part of the existing conditions in the Base Case, if applicable to the VC effects study area. Approved but not yet completed developments, such as the Lynx (Dominion Diamond 2013), Gahcho Kué (De Beers 2010), NICO (Fortune 2011), and Nechalacho (Avalon 2014) projects are also identified for inclusion in the Base Case.

The Application Case represents predictions of the cumulative effects of the developments in the Base Case combined with the effects from the Project. Where relevant, this case was also used to identify the incremental changes from the Project that are predicted to occur between the Base and Application cases. 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 (Section 6.3.2). For several VCs, the temporal extent of some effects likely will be greater than the lifespan of the Project because the effects will not be reversible until beyond closure. For other VCs, the effects may be determined to be irreversible within the temporal boundary of the Application Case. Such effects may be permanent, or the duration of the effect may not be known, except that it is expected to be extremely long (say, more than 100 years past closure).

The Reasonably Foreseeable Development (RFD) Case includes the Application Case plus the cumulative effects of future projects. In accordance with the TOR (Appendix 1A), a scenario analysis was used to identify future projects and assess potential cumulative effects on VCs. The RFDs are defined as projects that:

- are currently under regulatory review or have entered a regulatory application process;
- have a reasonable likelihood of being initiated during the life of the Project;
- or may be induced by the Project; and,
- have the potential to change the Project or the effects predictions.

For the DAR, the scenario analysis used the maximum number of potential future projects that could occur within the effects study (assessment) area of VCs. The assessment did not evaluate different combinations of numbers, types, and locations of projects, but used a conservative approach that provides the maximum potential cumulative effects on a VC. The RFD Case includes the predicted duration of residual effects from the Project, plus other previous, existing, and future projects and activities. Thus, the minimum temporal boundary for the Application Case and RFD Case is the expected lifespan of the Project, which like the Base Case, includes a range of conditions over time.

Unlike the analyses of cumulative effects for the Base and Application cases, which are largely quantitative, the analysis for the RFD Case is quantitative where possible and qualitative where necessary. The analysis was quantitative for those future projects that could be assigned a location and known or hypothetical physical footprint area on the landscape. Analysis was qualitative for developments for which this information was not available (Section 6.5.2.3). For all RFDs, the DAR used the best and most current information available for the location, size, and type of activity associated with a project.

Although large parts of the analyses are numerical, it is important to acknowledge the low level of confidence in predicting cumulative effects on VCs for the RFD Case. There are uncertainties associated with the exact location, physical footprint area, activity level of a development, and the timing and rate of future developments in the effects study area for each VC. There are also uncertainties in the direction, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of effects from the Project and other developments. These uncertainties are discussed with respect to confidence in the effects predictions and determination of environmental significance (Section 6.6).

6.5.2.3 Previous and Existing Developments

Previous and existing developments in the overall assessment study area include mineral exploration programs, historic remediated and non-remediated contaminated sites, winter roads, all-weather roads, hydro power development, transmission lines, communities, hunting and fishing lodges, proposed and existing protected areas, mines, mineral exploration camps, staging areas, quarries, and communication structures. Data on the location and type of developments were obtained from the following sources:

- Wek'èezhìi and Mackenzie Valley land and water boards: permitted and licensed activities within the NWT;
- Aboriginal Affairs and Northern Development Canada: permitted and licensed activities in the NWT and Nunavut;
- Aboriginal Affairs and Northern Development Canada: contaminated sites database;
- National Resources Canada GeoGratis website: Geographic Information System (GIS) file of community locations;
- Government of the Northwest Territories (GNWT): location of parks within the NWT;
- company websites; and,
- knowledge of the area and project status.

Details on the data and assumptions used to estimate the area of each development are provided in the applicable KLOI and SON sections.

Operating mines such as Ekati, Diavik, and Snap Lake, and the TCWR are included as previous and existing developments. Information on approved, but not yet completed, developments that were included in the Base Case is provided below.

Gahcho Kué Project

The Gahcho Kué Project is a proposed diamond mine at Kennady Lake, 280 kilometres (km) northeast of Yellowknife. The project is a joint venture between De Beers Canada Inc. (De Beers) (51 percent [%]) and Mountain Province Diamonds Inc. (49%). The mine plan includes open pit mining of three kimberlite pipes, which requires lowering water levels in Kennady Lake. In October 2013, the federal minister of Aboriginal Affairs and Northern Development Canada (AANDC) approved the MVRB's Environmental Impact Review recommending project approval. De Beers is currently undergoing the process to obtain the necessary regulatory approvals for project construction and operations, expected in late 2014 (MVLWB 2013). The Gahcho Kué Project has an estimated 11-year lifespan and is expected to employ between 400 and 700 people (De Beers 2010). Access to the site will be via air and the 120 km spur road from the TCWR at Mackay Lake (MVRB 2013a). For the cumulative effects assessment, it is assumed that the Gahcho Kué Project will enter production as scheduled in 2016, and that it is part of the existing environment.

Nechalacho Project

The Nechalacho Project is a rare earth elements deposit owned by Avalon Rare Metals Inc.
The property is located approximately 100 km southeast of Yellowknife near Hearne Channel on the East Arm of Great Slave Lake. Rare earth elements will be mined underground from the Nechalacho deposit. Ore will be processed at a hydrometallurgical plant, which is to be constructed at the old Pine Point site on the southern shores of Great Slave Lake. Concentrates will be loaded into bulk transport containers, hauled to the seasonal dock facility along the north shore of Great Slave Lake, and barged during the summer to the hydrometallurgical plant. In November 2013, the federal minister of AANDC approved the MVRB's Report of Environmental Assessment recommending project approval.
In January 2014, Avalon Rare Metals Inc. submitted applications to the Mackenzie Valley Land and Water Board to begin site preparation and construction. It is expected that construction will be complete by the end of 2016 (Avalon 2014). If adequate financing can be obtained to complete construction and proceed into operations, it is expected that production could begin by the end of 2016 or early 2017. Access to the mine site will be via air and barge. Access to the hydrometallurgical site will be via existing highways and all-season access roads (MVRB 2013b).

NICO Project

The NICO Project is a cobalt, gold, and bismuth deposit located in the Tłı̨chǫ region, approximately 50 km northwest from the community of Whatì. Fortune Minerals Limited proposes to mine the deposit using a combination of open pit and underground methods. Ore processing at the NICO Project will be limited to crushing, grinding, and flotation consisting of primary and secondary stages to produce bulk concentrate. The resulting bulk concentrate will be thickened and filtered, packaged, and shipped to a second site, the Saskatchewan Metals Process Plant in Langham, Saskatchewan. In July 2013, the federal minister of AANDC approved the MVRB's Report of Environmental Assessment recommending project approval. In October 2013, Fortune Minerals Limited updated its land use permit and water licence applications for the NICO Project. It is estimated that NICO reserves will support an 18 to 20-year mine and employ up to 300 people. Access to the NICO Project requires an all-season road connection to Highway 3 near Behchokǫ̀. A land use permit for the NICO Project Access Road from Whatì to the mine site has been submitted (Fortune 2013).

Lynx Project

The Dominion Diamond Lynx Project involves mining a small satellite pipe in the southeastern portion of the Ekati Mine lease property about 30 km from the main facilities and approximately 3 km southwest of the Misery Pit. The project involves dewatering Lynx Lake to Lac de Gras, open pit mining of the Lynx Pit, development of a 1 km access road, and an extension of the Misery waste rock storage area. No new processing facilities, camp facilities, or waste storage facilities are required, and the existing Ekati workforce will be used for the Lynx Project. Construction is planned for 2015. The project will involve one to two years of pit development activities, producing the equivalent of four to five months of feed to the Ekati processing facilities. Access to the project will be as for the Ekati Mine (existing airstrip and TCWR).

6.5.2.4 Reasonably Foreseeable Developments

To meet the TOR (Appendix 1A), the cumulative effects analysis included forecasted developments and human activities (RFDs) that could overlap with the temporal and spatial distribution of VCs and the Project. Based on a scenario analysis and definitions of RFDs (Section 6.5.2.2), the following text provides a summary of the potential future projects that could contribute to cumulative effects on VCs of the biophysical and human environments.

Nunavut

Jericho Diamond Mine

The Jericho Diamond Mine (Jericho) is in the Kitikmeot Region, about 250 km south of Kugluktuk. Shear Diamonds Ltd. is the owner of the property, and in 2012 extracted 3,500 carats from the mine (Jamasmie 2012); however, the project is now in the care of AANDC's Contaminated Sites Program (CBC 2013). Tahera Diamond Corporation (Tahera) operated Jericho from 2006 to 2008, at which time the mine was closed as Tahera moved into bankruptcy. Jericho was a small diamond mine, producing about 300,000 carats annually when it was open and employing less than 300 people on average. Jericho can be accessed by air or via an extension of the TCWR. According to the 2003 EIS submitted by Tahera in 2003, if Jericho is re-opened for exploration and mining, it will occupy and disturb a footprint of approximately 221.8 hectares (Tahera 2003). Although Jericho is now closed and its future is uncertain, it is assumed for the cumulative effects assessment in the RFD Case that Jericho will re-open.

Doris North (Hope Bay) Project

The Doris North (Hope Bay) Gold Mine is in the Kitikmeot Region, about 90 km south of Cambridge Bay. The mine site was previously operated by Hope Bay Mining, a subsidiary of Newmont Mining Corporation (Newmont). This small underground mine was one of the properties in the larger Hope Bay Greenstone Belt under exploration license to Newmont. In 2012, the nearly completed mine remained inactive for more than a year and was shut down just months after the company announced an expansion. In 2013; however, TMAC Resources Inc. acquired the property, with Newmont as a principal shareholder, and announced its intentions to get the mine into production by 2015 (CBC 2013). Currently, TMAC Resources Inc. is carrying out an exploration drilling program at the site (TMAC 2013). In 2006, Miramar Hope Bay Ltd. anticipated that the mine would employ up to 165 people. Access to the Hope Bay Project is by air or by ship and a proposed all-season road from Roberts Bay, 4.8 km away (Miramar 2005).

Hackett River Project

The Hackett River Base Metals Mine is in the Kitikmeot Region, near Bathurst Inlet. The Hackett River Project was previously owned by Sabina Gold & Silver Corp. (Sabina) and is near Sabina's Back River Project. The Hackett River Project is now owned by Glencore Xstrata (formerly Xstrata Zinc Canada Ltd.). Resources from the Hackett River Project are estimated at 25 million tonnes and include silver, zinc, lead, copper, and gold (Sabina 2013a). Capital costs have been estimated at $700 million, project life at 16 years, and operational employment at approximately 600 people. There is currently no road access to the Hackett River Project, but it is located 75 km south of Bathurst Inlet and 23 km from the proposed Bathurst Inlet Port site (Sabina Silver Corp. 2008). In response to a project proposal submitted in 2008, the Nunavut Impact Review Board (NIRB) issued guidelines for the EIS in early 2009; if approved, Glencore Xstrata had estimated a potential production date of 2018 (Xstrata 2013a). In August 2013; however, Glencore Xstrata suspended all work at the site (ERM Rescan 2013). Although the Hackett River Project is currently inactive and its future is uncertain, it is assumed for the cumulative effects assessment that the Hackett River Project will re-open.

Back River Gold Project

Sabina's 100%-owned Back River Gold Project consists of seven properties totaling about 120,000 acres (about 486 square kilometres [km^2]) that host known or observed gold mineralization in banded iron formations. Only two of these properties, the Goose and George properties, have been the focus of exploration and resource development to date, but there are up to eight mining areas within these properties. A Preliminary Feasibility Study was released by Sabina in late 2013 and the company plans submit its Draft EIS to NIRB in early 2014. Operations are expected to begin in 2016 to 2017 (Sabina 2013b). The mine is projected to operate for at least 10 to 15 years and employ up to 900 people. Access to site would be via air or winter road from Bathurst Inlet, while all-season roads would provide access between the Goose and George properties. A short-term winter road link for construction to the TCWR has also been proposed (Rescan 2012).

Bathurst Inlet Port and Road

The Bathurst Inlet Port and Road (BIPR) Project is currently a joint venture between of Glencore Xstrata and Sabina, although there have been different owners since the proposal was first made to NIRB in 2004. In its current iteration, the BIPR consists of a deep water port and airstrip in Bathurst Inlet and an 83 km all-weather road to the Back River and Hackett properties (Phase I), with the possibility of an additional 134 km of all-season road to Contwoyto Lake (Xstrata 2013b). However, further investigations during April 2013 indicated that the proposed port site was not suitable for the required infrastructure, and submission of the updated Draft EIS to NIRB (planned for the summer of 2013) has been delayed (NNS 2013). Further, the Back River Project is presented as a stand-alone project that could go ahead without the BIPR (NNS 2013).

Izok Corridor Project

The Izok Corridor Project includes the High Lake and Izok Lake deposits containing base metals in the Kitikmeot Region, about 290 km south and 255 km southwest of Kugluktuk, respectively. These properties are operated by MMG Limited (MMG) and are expected to produce silver, zinc, copper, and lead. The Izok Lake deposit is estimated to contain 15 million tonnes of ore and the High Lake deposit is estimated to contain 14 million tonnes of ore (MMG 2013). Previous owners of the projects had submitted a draft EIS for High Lake to NIRB; however, MMG's priority has shifted to Izok Lake. In September 2012, MMG submitted its Izok Corridor Project Proposal to NIRB and is now in the environmental assessment phase of project review. MMG has since begun its feasibility study and expects to provide an update to NIRB in late 2014 (MMG 2012a). Izok Lake is expected to be operational for at least 12 years and employ between 710 and 1,140 people. Access to the Izok Corridor Project will involve a 350 km all-season road connecting the Izok Mine to the High Lake Mine and north to a port at Grays Bay (MMG 2012b).

Lupin Gold Mine

The Lupin Gold Mine is an historic gold mine that was in production from 1982 to 2004 under Echo Bay Mines Ltd. A merger of Echo Bay Mines Ltd., TVX Gold Inc., and Kinross Gold Corporation placed the property under the ownership of Kinross Gold Corporation in 2002. Due to low gold prices, Kinross Gold Corporation began closure of the mine in 2005 and the site has been under care and maintenance. Now, Lupin Mines Incorporated, a subsidiary of Elgin Mining Inc. (Elgin), is in possession of the property, which it obtained from MMG in July 2011. Lupin is located approximately 400 km north of Yellowknife on the western side of Contwoyto Lake. The mill and all associated infrastructure have been decommissioned but surface infrastructure remaining at the mine site consists of mine and mill facilities, a power plant, tailings/waste storage facilities with sufficient capacity for a restarted operation, and a residential complex that can accommodate approximately 250 people. Elgin began exploration activities at the Lupin site in September 2011 (Elgin 2011). Ongoing activities involve work for up to 40 employees. In 2012, a technical report on the Lupin Mine property (G.A. Harron & Associates Inc. 2012) recommended the rehabilitation of the Lupin Mine. Access to the site is via air or spur road from the TCWR. As the Project is currently in exploration and a mine plan has not yet been developed, there is uncertainty regarding the size and duration of the project.

Northwest Territories

Sable, Pigeon and Beartooth Projects

In 1999, BHP applied for an expansion to the Ekati Diamond Mine to include three new kimberlite pipes that were not included in the original application; the Sable, Pigeon and Beartooth pipes (BHP 1999; BHP Billiton 2008). BHP noted in their 1999 application that the expansion was discussed in the original 1995 EA process for the Ekati Mine, and that no new processes or methods would be required for the expansion. Further, no new waste streams would be generated (i.e., kimberlite would be processed at the existing plant, and processed kimberlite and process water would be deposited in the existing Long Lake Containment Facility). As such, the new application was considered an expansion of the existing mine (rather than a new project), and the Review Board issued a Terms of Reference that reflected these conditions.

Mining of the Beartooth kimberlite pipe was completed in 2009 and development of the Pigeon kimberlite pipe was initiated in 2014. Development of the Sable kimberlite pipe is not scheduled, and was not included in the RFD Case.

Yellowknife Gold Project

The Yellowknife Gold Project is an advanced gold exploration project owned by Tyhee NWT Corp. (Tyhee). It is located 88 km north of Yellowknife near the historic Discovery Mine site. In September 2006, applications for the development of the Yellowknife Gold Project were referred to EA. Due to inactivity on the part of Tyhee, the EA has been suspended until Tyhee is prepared to advise the MVRB that it is in a position to move forward with the project and the EA process. In the meantime, Tyhee has applied for new land use permits and amendments to existing permits to continue exploration activities at Clan Lake, Goodwin Lake, Ormsby Lake, and Nicholas Lake. Though the existing mine plan is expected to change in response to results of the 2012 Feasibility Study and an anticipated date of construction and development is not known, the Yellowknife Gold Project is expected to last for approximately 14 years once operational and employ over 250 people (SRK Consulting, Lyntek Inc., and Knight Piesold Consulting 2012). Access to the project is via an existing winter road built from Prosperous Lake. However, this project has been in the EA process since 2005, and the process was recently suspended indefinitely by the MVRB until such time as Tyhee can show cause why it should be reinstated (MVRB 2013c).

Indin Lake Gold Property

The Indin Lake Gold Property includes a series of five separate gold deposits owned by Nighthawk Gold Corp., including the Colomac and Damoti lakes sites (Nighthawk 2014). Previous owner, Merc International, completed bulk sampling in 1996, and exploration drill programs have been conducted since then to expand the known resources (Merc 2010). The property is accessed via air or by winter road spurs from the existing Tłı̨chǫ Winter Road. As the project is currently in exploration stage and a mine plan has not yet been developed, there is uncertainty regarding the size and duration of the project.

Tłı̨chǫ Road Route

The GNWT Department of Transportation currently operates and maintains a winter road system that connects the Tłı̨chǫ communities of Whatì and Gamètì with Highway 3. This route functions in the region as a seasonal resupply conduit, but other interests within the Tłı̨chǫ Settlement Area are also served by the system. The existing winter road alignment traverses frozen rivers, lakes, and ponds, as well as wetland areas, but warmer temperatures in recent winters have caused construction and operational delays for the sections of the route that cross these areas. The result has been an overall reduction of the winter road's operational season, which substantially impacts residents and commercial interests who depend on the road for travel and resupply. As such, an alternate, all-season road alignment has been discussed. This route will initially be a winter road also, but could be upgraded to an all-season road, as required by the NICO Project.

Hydroelectric Grid Expansions

In December 2013, Northwest Territories Energy Corporation released A Vision for the NWT Power System Plan (NT Energy 2013). Although most communities and industrial load centres in the NWT are electrical islands, there are two multi-community electrical grids. The Snare grid serves Yellowknife, Dettah, N'Dilo and Behchokǫ̀, and the Taltson grid serves Fort Resolution, Fort Smith, Hay River, and Enterprise. The electrical energy for these grids is provided primarily by hydroelectric plants, supplemented by diesel generators. The communities and industrial sites not connected to either the Snare or Taltson grids rely on local diesel generation. NT Energy is planning to connect these grids using a 240 kilovolt transmission line around the west side of Great Slave Lake, and expanding the grid from Yellowknife to service the diamond mines. This is the long-term vision of NT Energy within the next 6 to 20 years, and not a project proposal (NT Energy 2013). As such, details such as timelines and transmission line routes have not yet been studied.

Courageous Lake Project

The Courageous Lake Project is an advanced gold exploration project owned by Seabridge Gold Inc. It is located approximately 240 km northeast of Yellowknife near the historical Tundra Mine site, near Courageous Lake (Seabridge Gold Inc. 2012). In July 2012, Seabridge Gold Inc. released the results of Courageous Lake's first Preliminary Feasibility Study, which estimated a mine life of 15 years (Seabridge Gold Inc. 2011). Exploration drilling continued in 2013. As the project is currently in exploration and a mine plan has not yet been developed, there is uncertainty regarding the size and duration of the project. Currently, access to the Courageous Lake Project is by air or the TCWR.

Thaidene Nene (East Arm) National Park

The proposed Thaidene Nene National Park includes McLeod Bay, Reliance, Pike Portage, the Lockhart River, and Artillery Lake at the East Arm of Great Slave Lake. In 1970, an area of 7,400 km^2 in the East Arm of Great Slave Lake was permanently withdrawn or set aside from further development and land disposition to allow a national park proposal to proceed (the East Arm National Park Land Withdrawal) (Parks Canada 2006). In 2005, the Łutselk'e Dene First Nation delineated an area it calls "Thaidene Nene," a part of its traditional territory that it proposes to protect through the establishment of a national park and other conservation actions. This, in part, prompted Parks Canada to reassess the boundaries of the East Arm National Park proposal, proposing a new study area of 33,525 km^2 (Parks Canada 2006). In 2012, a larger area of approximately 26,350 km^2 was withdrawn from future development (Government of Canada 2012). The Łutselk'e Dene First Nation and Parks Canada initialed the draft Thaidene Nene Establishment Agreement on November 13, 2013 (Łutselk'e Dene First Nation 2013). Overall, the proposed East Arm National Park will be beneficial to the environment, and will lead to local jobs (Łutselk'e Dene First Nation 2010). It is not clear when this park would be fully established, but the existing permanent land withdrawal has already removed the core area from further development. The larger 2006 boundary was used for the cumulative effects assessment.

The analysis and assessment of cumulative effects from these RFDs was quantitative and/or qualitative depending on the information available (Section 6.5.2.2). The following RFDs have enough details such as location and physical footprint area (actual or hypothetical) to be included in a numerical and spatial analysis of potential effects on applicable VCs:

- Jericho Mine;

- Hope Bay Project;
- Hackett River Project;
- Back River Gold Project;
- Bathurst Inlet Port and Road (Phase 1 to Back River and Hackett River Projects);
- Izok Corridor Project;
- Lupin Gold Mine;
- Yellowknife Gold Project;
- NICO Project;
- Tłįchǫ Road Route;
- Thaidene Nene (East Arm) National Park;
- Courageous Lake Project; and,
- Indin Lake Gold Project.

The following RFDs do not have enough details to be included in a quantitative analysis, but will be qualitatively assessed for potential cumulative effects on applicable VCs:

- Bathurst Inlet Port and Road (Phase 2 to Contwoyto Lake); and,
- Hydroelectric Grid Expansion.

6.6 Prediction Confidence and Uncertainty

The purpose of an EA is to predict the future conditions of the biophysical and human environments, which change naturally and continually through time and across space. Subsequently, most assessments of effects embody some degree of uncertainty. The purpose of the uncertainty sections of the DAR 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. Confidence in effects analyses can be related to many elements, including the following:

- adequacy of the baseline data for providing an understanding of the existing conditions and future changes unrelated to the Project (e.g., rate and extent of future developments, climate change, catastrophic events);
- model inputs (e.g., changes in chemical concentration in water over time and space);
- understanding of Project-related effects on complex ecosystems that contain interactions across different scales of time and space (e.g., how and why the Project will influence wildlife);
- limited knowledge and experience with the type of effect in the system; and,

- knowledge of the effectiveness of the environmental design features for reducing or removing effects (e.g., environmental performance of the waste rock storage areas).

Uncertainty in these elements can decrease confidence in the prediction of environmental significance. In accordance with the TOR (Appendix 1A), assumptions for models and statistical tests, and details on models are presented and discussed within the applicable KLOIs and SONs. The intent of the review is to show that the models used are justified for use in the EA. Where possible, a strong attempt is made to reduce uncertainty in the DAR to increase the level of confidence in effect predictions, as shown in the following examples:

- using the results from several models and analyses to help reduce bias and increase precision in prediction;
- using data from effects monitoring programs and literature as inputs for models rather than strictly hypothetical or theoretical values; and,
- implementing a conservative approach when information is limited so that effects are typically overestimated (e.g., defining the key input variables so that the result is a conservatively high effects prediction).

Where appropriate, uncertainty may also be addressed by additional mitigation and in follow-up and monitoring programs, which would be implemented as required. Each KLOI and SON includes a discussion of how uncertainty is addressed and provides a qualitative evaluation of the resulting level of confidence, which is included in the residual impact classification and determination of significance.

6.7 Residual Impact Classification and Determination of Significance

6.7.1 Residual Impact Classification

The purpose of the residual impact classification is to describe the residual incremental and cumulative adverse effects from the previous and existing developments and the Project (Application Case) and future developments (RFD Case, if applicable) on VCs using a scale of common words rather than numbers and units. The use of common words or criteria is accepted practice in environmental assessment. It is difficult (and not appropriate) to provide definitions for all residual adverse effects criteria and significance that are universally applicable to each VC. Consequently, specific definitions will be provided for each VC in the KLOI and SON sections of the DAR.

The classification of residual impacts from associated primary pathways and the determination of environmental significance are only completed for those VCs that have assessment endpoints. This is because assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations (i.e., assessment endpoints consider sustainability; Section 6.2.2). Results from the residual impact classification are then used to determine the environmental significance from the Project (and other developments) on assessment endpoints. To provide clarity and consistency across VCs with assessment endpoints, effects are described using the following criteria, and reflect the impact descriptors provided in the TOR (Appendix 1A, Section 4.1). Together, these criteria are used to describe the nature (e.g., severity or intensity of change, and the area and amount of time over which the change occurs) and type (e.g., direction of the change) of an effect on a VC.

Direction – Direction is related to the type of an effect and indicates whether the effect on the environment is negative or adverse (i.e., less favourable), positive (i.e., an improvement), or neutral (i.e., no change). The main focus of the EA is to predict if the Project is likely to cause a significant adverse effect on the environment or to cause public concern. Although positive changes associated with the Project are also reported, neutral and positive effects are not assessed for significance.

Magnitude – Magnitude is a measure of the intensity of an effect or the degree of change caused by the Project (and other developments, if applicable) relative to baseline conditions, guideline value, or established threshold values. Magnitude is often classified as negligible, low, moderate, and high. The number and definitions of scales of magnitude are specific to VCs. Where possible, magnitude is reported in absolute and relative terms. Important context for classifying magnitude for VCs is derived from the geographic extent and duration of the effect. For example, if 20% of habitat is altered for a fish or wildlife VC, is this over a geographic extent of 100 hectares or 100 km^2? Does the habitat loss last for a season, 10 years, or 100 years? Answering these questions can assist in determining whether a 20% habitat loss represents a low, moderate, or high magnitude effect on the VC population.

Geographic Extent – Geographic (spatial) extent refers to the area (or distance covered or range) of the effect, and is different from the spatial boundary (i.e., effects study area) for the effects analysis. The study area for the effects analysis represents the maximum area used for the assessment and is related to the spatial distribution and movement of VCs (Section 6.3.1). However, the geographic extent of effects can occur on a number of scales within the spatial boundary of the assessment, and is VC-specific. Geographic extent is categorized as local, regional, and beyond regional. Effects at the local scale are largely associated with the predicted maximum spatial extent of combined direct and indirect changes from the Project (i.e., cumulative effects that are specific to the Project). For some VCs, cumulative direct and indirect changes from the Project and other developments may also occur at the local scale (e.g., cumulative effects on soils with the existing Ekati Mine and the Jay Project). Effects at the regional scale occur within the effects study area, and are associated with incremental and cumulative changes from the Project and other developments. The beyond regional scale includes cumulative residual effects from the Project and other developments that extend beyond the effects study area. The principle applied when using geographic extent to understand magnitude is that local effects from the Project are less severe than effects that extend to the regional or beyond regional scales, all other factors being equal.

Duration – Similar to magnitude and geographic extent, duration is VC-specific and defined as the amount of time from the beginning of an effect to when the effect on a VC is reversed, and is typically expressed relative to Project phases (usually in years, species lifespans, or human generations). Duration has two components; the amount of time between the start and end of a Project activity or stressor (which is related to Project development phases), plus the time required for the effect to be reversible. Essentially, duration is a function of the length of time that VCs are exposed to Project activities and reversibility.

The timing, duration of individual events, and the overall period during which the residual effect may occur are considered. Timing includes when a residual adverse effect occurs as some effects may exhibit temporal variation over the life of the Project (e.g., during breeding or spawning season, and high or low point of a population cycle). Some residual effects may be reversible soon after the stressor has ceased (e.g., change in distribution of some wildlife species following the decrease in noise and activity levels after closure), while other residual effects may take longer to be reversed (e.g., change in abundance of some species on mine-altered habitat after reclamation and revegetation). By definition, residual effects that are short-term, medium-term, or long-term in duration are reversible.

In some cases, available scientific information and experienced opinion may predict that the residual effect is irreversible. Alternately, the duration of the residual effect may not be known, except that it is expected to be extremely long and well beyond the temporal boundary of the Project. Any number of factors could cause a VC to never return to a state that is unaffected by the Project. In other words, science and logic predict that the likelihood of reversibility is so low or uncertain that the residual effect is classified as irreversible.

Reversibility – After removal of the Project activity or stressor, reversibility is the likelihood that the Project will no longer influence a VC at a future predicted time. This term usually has one alternative: reversible or irreversible. The period is provided for reversibility (i.e., duration) if a residual effect is reversible. Permanent residual effects are considered irreversible.

Frequency – Frequency refers to how often an effect will occur and is expressed as infrequent (isolated or confined to a discrete period) or frequent (occurs intermittently, but repeatedly over the assessment, or continuously over the assessment period). Frequency is explained by identifying when the source/effect occurs (e.g., once at the beginning of the Project or several times during operations).

Likelihood – Likelihood is the probability of an effect occurring. Likelihood is described in parallel with uncertainty, which may be influenced by a variety of factors such as the likelihood of a negative response by the VC occurring or the likelihood of mitigation being successful. Three categories are used:

- **Unlikely** – residual effect is possible, but unlikely (less than 10% chance of occurring);
- **Likely** – residual effect is possible, but is not certain (10% to 80% chance of occurring); and,
- **Highly likely** – residual effect is mostly certain to occur (greater than 80% chance of occurring).

The rationale for the definitions of residual effects criteria is based on the ecological or socio-economic processes and properties of the VC. Although some professional judgement or experienced opinion is inevitable in determining the scales for effects predictions, a strong effort is made to classify residual effects using scientific principles, established guidelines, established thresholds or screening values, and supporting evidence.

6.7.2 Determination of Significance

The classification of primary pathways and the associated predicted changes in measurement indicators provide the foundation for determining the significance of incremental and cumulative effects from the Project and other existing, approved, and reasonably foreseeable developments on VC assessment endpoints. For some VCs, there may be no RFD Case and the assessment is limited to determining the significance of incremental and cumulative effects from the Project and previous and existing developments (i.e., Application Case). For those VCs that may be influenced by forecasted future developments, the assessment includes classifying and determining the significance of cumulative effects from all previous, existing, and future developments (including the Project; RFD Case). The significance of the contribution of incremental effects from the Project on VCs is provided, but the evaluation is focused on determining the significance of cumulative effects on assessment endpoints of the biophysical and human environments. To be transparent, each KLOI and SON provides a table showing the specific definitions of effects criteria (e.g., definitions of low, moderate, and high magnitude) and environmental significance for VCs. The classification of residual effects and the determination of environmental significance are only completed for those VCs that have assessment endpoints (Section 6.2.2).

Magnitude is the primary criterion used to determine environmental significance, while other criteria are used as modifiers and to provide context when assigning magnitude. Geographic extent and duration provide important ecological and socio-economic context for classifying the magnitude of effects on VC assessment endpoints. For example, determining the magnitude of an effect from changes in habitat availability and connectivity on a fish or wildlife VC depends on the spatial extent (amount of area or proportion of the population) and duration of the changes in habitat (how long the population is adversely affected). Duration includes reversibility, and a reversible effect from development is one that does not result in a permanent adverse effect on population processes (e.g., survival and reproduction) and properties (e.g., stability and resilience). Frequency and likelihood are also considered as modifiers when determining significance, where applicable.

Duration is also a function of resilience, which is the ability of the population to recover or bounce back from a disturbance (e.g., rate and degree of fluctuation in population abundance and distribution after a disturbance). Resilience is largely a function of demographic and behavioural life history traits such as size and number of litters or number of eggs and survival of fry, age at reproduction, inter-birth interval, age-specific survival rates, lifespan of individuals, habitat selection, and effective dispersal (probability of leaving the natal range and successfully establishing a breeding range and reproducing). The capacity or ability of individuals in a population to change and accommodate disturbance is also related to resilience. For example, some wildlife species that avoid human features in relatively undisturbed landscapes can change their behaviour to accommodate disturbance where it is more prevalent (Martin et al. 2010; Knopff 2011). Other populations may be able to increase reproduction to compensate for harvest mortality. Fish species, such as Lake Trout, have been shown to actively seek out alternate spawning sites when their traditional habitat is lost (McAughey and Gunn 1995; Gunn and Sein 2000).

Resilience can vary with population size, stability, and the likelihood of demographic rescue from neighbouring populations. During periods of low abundance, animal and plant populations can become less resilient to natural environmental and human-related disturbances, which may reduce stability (i.e., trajectory of the population). Stable populations exhibit no long-term increasing or declining trend in abundance outside of natural fluctuations and cycles (e.g., predator-prey cycles). The model of an Arctic fish population in a steady or stable state is one with the ability to absorb annual fluctuations in year-class strength; if the juvenile population is depleted through several years of poor hatching, it is quickly restored with the advent of a good year (Johnson 1976). Resilience and stability are properties of a population that influence the amount of risk to VCs from development (Weaver et al. 1996). The duration of development-related effects may be shorter for VCs that are highly resilient and stable.

As much as possible, effects are classified and significance determined using established guidelines, thresholds or screening values, and scientific principles. In accordance with the TOR (Appendix 1A), for those environmental effects that are determined to be not significant, a reasoned narrative is given that provides a potential significance threshold level. For some VCs, such as water quality, guideline or threshold values are known, which provides confidence in effects predictions and determining environmental significance. For other VCs of the biophysical and human environments, social and ecological benchmarks or effects thresholds are not known and challenging to define, which creates uncertainty in determining the significance of predicted effects. For example, critical thresholds and screening levels for measurement indicators such as habitat quality, quantity, and connectivity, and ecologically effective population size are frequently not available for plant, fish, and wildlife species. Moreover, thresholds vary by species, landscape type, and spatial scale (Fahrig 2001; Swift and Hannon 2010). Because of the uncertainty regarding the effects of development on VCs, magnitude classification was applied conservatively to increase the level of confidence that effects will not be worse than predicted (Section 6.6). Furthermore, the determination of significance considers the key sources of uncertainty in the effects analysis, the management of uncertainties, and the correspondent level of confidence in effects predictions.

The evaluation of significance for biophysical VCs considers the entire set of primary pathways that influence a particular assessment endpoint; thus, significance is not explicitly assigned to each pathway. Rather, the relative contribution of each pathway is used to determine the significance of the Project (and other developments) on an assessment endpoint, which represents a weight-of-evidence approach (i.e., evaluating the persuasiveness of evidence indicating that an effect is significant or not significant). For example, a pathway with a high magnitude, a large geographic extent, and a long-term duration is given more weight in determining significance relative to pathways with smaller scale effects. The relative effect from each pathway is discussed; however, pathways that are predicted to have the greatest influence on changes to assessment endpoints are assumed to contribute the most to the determination of environmental significance. This method is used to identify predicted residual adverse effects that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to a VC, and therefore, result in significant impacts.

Classification of residual effects and determination of significance for the human environment generally follow the methods used for biophysical VCs; however, there are some differences in the selection and definition of effects criteria (MVRB 2007). For socio-economic VCs, direction, magnitude, geographic extent, and duration are the criteria used to classify effects and evaluate the significance of changes to assessment endpoints. The assessment of significance considers the scale of these criteria (e.g., low magnitude, regional geographic extent, and long-term duration) and professional opinion, which is based on the context of the communities involved, and the informed value and judgement of interested and affected organizations and specialists. The level of significance also assesses the efficacy of the proposed mitigation (i.e., policies, practices, and investments) and benefit enhancement programs to limit negative effects and foster positive effects on the continued persistence of long-term sustainable social, cultural, and economic features of the environment. Details on the approach and methods for classifying residual effects and determining significance on VCs of the biophysical and human environments is provided in the applicable KLOIs and SONs of the DAR.

The following is a summary of some of the key factors considered in the determination of environmental significance on VCs of the biophysical and human environments:

- results from the residual impact classification of primary pathways and associated predicted changes in measurement indicators;
- magnitude is the primary criterion used to determine significance, with geographic extent and duration providing important context for assigning magnitude. Frequency and likelihood act as modifiers, where applicable; and,
- the level of confidence in predicted effects, scientific and socio-economic principles (e.g., resilience and stability), and scientific interpretation are also included in the evaluation of determining environmental significance. Where uncertainty was high and the cumulative effect might be either significant or not significant, the assessment conservatively identified the effect as significant and provided additional follow-up actions to reduce uncertainty.

DOMINION DIAMOND

6.8 Follow-Up and Monitoring

In the DAR, monitoring programs are proposed to deal with the uncertainties associated with the effect predictions and the performance of environmental design features and mitigation. In general, monitoring is used to verify the effects predictions. Monitoring also is used to identify any unanticipated effects and provide for the implementation of adaptive management to limit these effects. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Project:

- **Compliance inspections** – monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and conditions of approval and company commitments (e.g., inspecting the installation of a silt fence; monitoring mine water discharge quality and volumes).
- **Follow-up monitoring** – programs designed to test the accuracy of effects predictions, reduce/address uncertainties, determine the effectiveness of environmental design features, and/or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., monitoring downstream lakes for aquatic effects, wildlife effects monitoring, and socio-economic monitoring). Results from these programs can be used to increase the certainty of effect predictions in future environmental assessments.

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 identifies the need for improved or modified design features and mitigation, then adaptive management will be implemented. This may include increased monitoring, changes in monitoring plans, or additional mitigation.

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