The Canadian Environmental Assessment Act

Comprehensive Study Report

DIAVIK DIAMONDS PROJECT

Canada

June 1999

020238

C0352-001

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020240

C0352-003

EXECUTIVE SUMMARY

"The elders have instructed Diavik and the government to take care of our land, the water and the caribou".

Rachel Crapeau

Yellowknives Dene First Nation

March 01, 1999 Yellowknife Public Technical Sessions

INTRODUCTION

Diavik Diamond Mines Inc. (Diavik) and Aber Diamond Mines Ltd. have formed a joint venture to mine four diamond-bearing kimberlite pipes at Lac de Gras, located about 300 km northeast of Yellowknife, Northwest Territories (NWT). The proposed Diavik Diamonds Project is subject to federal legislation including the NWT Waters Act, the Territorial Lands Act, the Fisheries Act, the Navigable Waters Protection Act, the Explosives Act and the Canadian Environmental Assessment Act (CEAA). Diavik holds mining leases and mineral claims under the Canada Mining Regulations, which are administered through the Department of Indian Affairs and Northern Development. Responsible authorities (RAs) were determined to be the Department of Indian Affairs and Northern Development (DIAND), the Department of Fisheries and Oceans and the Department of Natural Resources Canada. The RAs, in consultation with the Government of the Northwest Territories (GNWT), federal authorities (FAs), potentially affected Aboriginal governments/organizations, communities and non-government organizations determined that the Diavik Diamonds Project would be reviewed at the comprehensive study level. This decision was based on previous experience with the BHP panel review and the description of the project provided by Diavik. A steering committee composed of Aboriginal representatives, the RAs and the GNWT was struck to provide guidance throughout the comprehensive review of this project including the public consultation process.

Diavik submitted its environmental assessment report to the federal government in September 1998. This submission consisted of an environmental assessment overview, six environmental effects reports (climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources, and socio-economics), an Environmental Management System and an integrated socio-economic and environmental baseline report. The submission was based on geotechnical, environmental and socio-economic investigations, public consultation and discussions that took place between 1994 and 1998.

The comprehensive study Report was subsequently prepared from Diavik's environmental assessment submission with additional information derived from technical reviews and public consultations. Draft versions of the comprehensive study report were reviewed by the RAs, the steering committee, the Canadian Environmental Assessment Agency and a federal-territorial intergovernmental working group between March and May 1999.

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DESCRIPTION OF THE PROJECT

Project Overview

The proposed Diavik Diamonds Project would be situated on East Island in Lac de Gras. Project facilities would be situated on the island, with open mining pits behind water retention dikes located immediately offshore. A processed kimberlite containment facility, country rock areas, a diamond recovery plant, accommodation buildings, power generation facilities, mechanical and administration buildings and a 2,000 m airstrip would all be located on East Island. Other site development would include mine haul roads, access roads, service roads and quarry and borrow sites. The proposed Diavik Diamonds Project consists of four kimberlite pipes (A154 South, A154 North, A418 and A21) which have a combined geological resource of 37.4 million tonnes at an average grade of 3 to 4 carats per tonne. These pipes are all found beneath Lac de Gras and it is planned that temporary water retention dikes would expose these pipes for open pit and underground mining.

If approved, construction on the project would commence in the year 2000, with the development of infrastructure and dredging, dike construction (including the North Inlet dike) and dewatering for the A418 and A154 open pits. After the start-up year, kimberlite would likely be mined and processed at a rate of approximately 1.3 million tonnes to an upper limit of 1.9 million tonnes per year depending on market conditions. Kimberlite processing would start in 2002, and continue until approximately 2025. Initially, the mining would be by open pit with underground mining beginning in 2014. Diavik has developed water management plans for all water at the mine site as well as waste management plans to minimize waste products. Activities related to mine closure would occur throughout the life of the mine such as site reclamation and the creation of fish habitat. It is expected that active mining would cease approximately in 2025 with final closure in 2030.

Project Purpose and Need

The primary purpose of the Diavik Diamonds Project would be to extract diamonds from four diamondiferous kimberlite pipes at Lac de Gras to provide an additional diamond source to international buyers and dealers. This purpose is intended to be consistent with Canada's overall strategy of encouraging private corporations to generate national export commodities and tax revenues from natural resource development. The national objective is to encourage sustainable resource development for the benefits of increased employment, contracting opportunities and expanded services at the local, regional and national levels without causing significant adverse effects on the environment.

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Alternatives

As required under the Canadian Environmental Assessment Act, alternative means of carrying out the proposed project were considered by Diavik and by the RAs through independent analysis carried out during the technical review of the project. During the initial stages of project engineering scoping level studies were conducted to assess potential mining alternatives which included: 1) all underground mining without a dike, 2) underground mining with limited open pit mining within a dike and 3) open pit mining with limited underground mining within a dike. A comparison which included technical feasibility, economic viability and environmental effects as well as community perspectives was completed for these options. The preferred alternative proposed by Diavik was the third option of open pit mining with limited underground mining within a dike. The RAs concurred with this selection as the preferred mining method with the recommendation that mine plan improvements be considered by Diavik on an ongoing basis. Alternatives were also considered for the siting of major project facilities such as the processed kimberlite containment (PKC), country rock areas, accommodation buildings and diamond recovery plant areas. Finally alternatives were considered for the water management plan, water treatment technology, dike design, dike alignment and power generation.

Public Consultation

Diavik initiated community consultations in 1994 during its exploration phase and continued these consultations through April 1999. Consultation by the RAs has been carried out with affected Aboriginal governments/organizations, communities, and other parties following the guidance of the steering committee. A public registry has been maintained to ensure public access to records relating to the comprehensive study. Public consultation on Diavik's environmental assessment submission was carried out between September 1998 and April 1999. Technical sessions were held between January 1999 and April 1999 in various communities. In addition, public technical sessions were held in Yellowknife from February 22 to March 5, 1999 and follow-up workshops and meetings were held to resolve outstanding issues. All meetings were recorded and summaries of the key issues raised at both Diavik meetings as well as government hosted technical meetings have been prepared and placed on the public registry. Diavik has funded a variety of traditional knowledge studies and has used community information gathered during the public consultation process to guide the development of environmental baseline studies, the development of the Environmental Management System, mitigation measures and the development of monitoring programs.

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DESCRIPTION OF THE ENVIRONMENT

Climate

The climate in the proposed project area is representative of Arctic tundra with a continental polar climate. The area experiences long, cold winters, relatively short summers and only a moderate amount of precipitation.

Vegetation and Terrain

The predominant vegetation type/land cover type within the proposed project area is heath tundra, heath tundra with boulders and tussock/hummocks. Glacial till is the dominant surficial material and soils are of the Cryosolic order where permafrost occurs within 1 to 2 m of ground surface.

Wildlife

The area surrounding the proposed project supports an array of wildlife species including eighty-four bird species and sixteen mammal species. This region is used by the Bathurst caribou herd during spring migration to their calving grounds further north, and during the summer return and fall migration movements. Up to 100,000 caribou have been observed in the regional area during the spring migration. Wolves and an estimated thirty barren-land grizzly bears are found in the regional wildlife study area.

Fish and Water

The water of Lac de Gras has extremely low concentrations of metals, nutrients and suspended sediments. The aquatic communities in Lac de Gras are characteristic of arctic lakes, with low diversity and low productivity.

Heritage Resources

A total of 195 archaeological sites have been identified in the regional study area for the proposed Diavik Diamonds Project. For example, one stone marker was identified as a burial site by the Yellowknives Dene First Nation.

Socio-Economic Conditions

Dene, Métis and Inuit communities have mixed economies where wage income, income transfers and hunting/trapping coexist. Formal education and training levels vary, particularly for persons of different ancestry and age groups. These communities are characterized by high unemployment rates, low participation in the wage-based economy, a high proportion of government employment and limited economic diversification. Aboriginal people from the communities view stewardship of the land and its resources as an important responsibility.

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ENVIRONMENTAL EFFECTS

The comprehensive study report for the proposed Diavik Diamonds Project contains an analysis of the potential environmental effects, mitigation, significance, and comments and concerns from the responsible authorities (RAs), federal authorities, Government of the Northwest Territories, Government of Nunavut and Aboriginal governments/ organizations and communities. A proponent response and RA conclusions are also included for each potential environmental effect. Environmental effects were identified based upon information contained in Diavik's environmental assessment submission and augmented with information from technical sessions, meetings and workshops. Mitigation measures include those already taken into account by Diavik as well as those identified during the technical and public sessions.

The following areas were covered in the environmental effects analysis:

1. Climate and Air Quality - the RAs conclude that no significant adverse effects by the proposed project on air quality would occur with the application of mitigation measures.
2. Global Climate Change - the RAs conclude that the proposed project would not make a significant contribution to national or global emissions.
3. Vegetation and Terrain - the RAs are satisfied that there would be no significant adverse effects on vegetation or biodiversity on a regional scale. A follow-up program is required to monitor vegetation loss on site and to develop reclamation techniques that are best suited for site conditions. A monitoring program to link the effects of dust on vegetation and subsequent relationship to wildlife is required. DIAND will require a Pit and Quarry Management Plan for all pits and quarries prior to regulatory approvals. The RAs conclude that there would be no significant adverse environmental effects provided that an Abandonment and Restoration Plan is prepared and approved.
4. Wildlife:
    - Caribou - the RAs generally agree with Diavik's analysis that there would not likely be significant adverse impacts on caribou in particular with respect to the abundance or distribution of the Bathurst caribou herd. A follow-up program is required to test predictions and evaluate the effectiveness of mitigation measures.
    - Grizzly Bears - the RAs conclude that the project is not likely to result in significant adverse effects to the abundance and distribution of grizzly bears in the Slave Geological Province. A follow-up program is required to test predictions and evaluate the effectiveness of mitigation measures.
    - Other Carnivores - the RAs conclude that project related decreases in habitat availability would cause long-term reduction in the ability of East Island to support wolves, wolverine and foxes. However, no project-related or cumulative significant adverse effects to these species would be expected in the regional study area. A follow-up program is required to evaluate the effectiveness of the mitigation measures and determine if they need to be modified over the life of the project.

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- Raptors - the RAs agree that potential impacts to raptors would not be likely to extend beyond the local study area and that no significant adverse effects including cumulative effects would occur. A follow-up program is required to identify mine-related causes in population fluctuations and the RAs direct Diavik to participate with the GNWT and BHP in a co-ordinated monitoring program.
- Waterfowl and other Avifauna - the RAs concur that there would be no significant adverse environmental effects, including cumulative effects. The RAs agree that there should be strict control of non-essential boat use on Lac de Gras and that a follow-up monitoring program is required.
- Small Game - the RAs conclude that the potential effects on small game would be restricted to the proposed project footprint. A prey-monitoring program is proposed in conjunction with the raptor effects monitoring program.
- Biodiversity - the RAs conclude that there would be no significant adverse environmental effects on biodiversity, including cumulative effects.

5. Surface Water:

- Surface Water - the RAs consider that Diavik has adequately addressed the environmental assessment requirements related to hydrology (surface water quantity). However, Diavik will be expected to provide detailed information on overall water balance and the use of North Inlet at the regulatory stage.
- Water Quality - the RAs conclude that water quality issues associated with the PKC facility can be mitigated through proper engineering design that would be approved at the regulatory stage.
- Surface Runoff - construction, operation, closure and abandonment/reclamation of the proposed Diavik Diamonds Project will affect the surface water drainage patterns on East Island. The RAs conclude that potential acid rock drainage and other water quality issues can be mitigated by the options proposed by Diavik. The RAs further conclude that follow-up by Diavik is required to verify predictions and to ensure that the appropriate water quality criteria are met in Lac de Gras and East Island lakes. In addition monitoring of shallow ground water is required to ensure that drains are intercepting subsurface drainage from the country rock storage areas.
- Dike Construction and Sediment Management - the improved dike design presented by Diavik in March 1999 is acceptable to the RAs. The RAs conclude that Diavik's draft sediment and till management plan is acceptable with the understanding that refinements will occur at the regulatory stage. The RAs conclude that the effect from cadmium levels as a result of dike construction shall be determined through Diavik's water quality monitoring program, and appropriate mitigation measures will be implemented as required.

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- North Inlet - the RAs concur with Diavik's plans to isolate the North Inlet from Lac de Gras with an impermeable barrier and to treat the North Inlet water before discharge. An assessment of reclamation options for North Inlet must be incorporated in project planning at the regulatory stage.
- Effluent Discharge - the RAs conclude that no significant adverse environmental effects are likely and recommend that a follow-up monitoring program is required to confirm and verify the year-round effectiveness of Diavik's proposal. The RAs conclude that there would be no significant adverse residual effects of nutrient enrichment on Lac de Gras. The design of the aquatic effects monitoring program should be such that mitigation can be applied as required. Finally, sewage treatment options should be determined at the regulatory stage.

6. Groundwater - the RAs agree with Diavik's conclusions that the project would have negligible effects on local groundwater resources. A follow-up groundwater monitoring program for the life of the mine is required to verify Diavik's prediction regarding the quantity and quality of groundwater.
7. Fish and Fish Habitat - the RAs conclude Diavik shall adopt a no fishing policy and that this be a condition of employment. The RAs have determined that follow-up programs are required as a condition of approval to ensure that no significant adverse effects on fish and fish habitat occur as a result of this project.
8. Permafrost - the RAs direct Diavik to further consider the effects of climate warming on the long-term integrity of frozen structures at the regulatory stage should the project be allowed to proceed.
9. Severe Weather - the RAs conclude that severe weather conditions and the impact on mine operation procedures be incorporated into Diavik's Environmental Management System (EMS).
10. Caribou on Roads - the RAs conclude that Diavik has adequately considered the potential environmental effects of caribou on roads.
11. Accidents and Malfunctions - the RAs direct Diavik to put in place monitoring programs and planning mechanisms/response measures at the regulatory stage to reduce the overall risk for each of the accident and malfunction scenarios considered.

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Socio-Economic Effects

Diavik predicted how environmental changes as a result of the proposed project would affect people in the following areas:

- Human Health
- Heritage Resources
- Socio-economic Conditions

The review of human health included climate and air quality, drinking water quality and fisheries. Dene, Métis and Inuit place inherent value on heritage resources that form part of their spiritual and cultural life. Heritage resources also convey information about the past and provide a deeper understanding of existing and past cultures. This information enriches and strengthens the cultural and spiritual well-being of Aboriginal governments/organizations and communities and increases the collective knowledge of the site and the region. In terms of socio-economic conditions the impacts on wildlife harvesting, recreational use and outfitting, current use of land and resources for traditional purposes by Aboriginal persons and plant harvesting were also considered.

The RAs conclude that Diavik's contaminants predictions in the context of the effect on the local fishery must be verified through a follow-up program. Diavik must also undertake routine monitoring of ambient air quality in the open pits and monitor radon levels. The RAs conclude that the impact on heritage resources can be adequately mitigated at the regulatory stage and that archaeological impact assessment must be conducted in consultation with Aboriginal organizations. The RAs agree that there are no significant adverse environmental effects associated with drinking water quality, wildlife and fish. The RAs direct that Diavik obtain baseline information on the palatability and texture of fish in Lac de Gras.

In addition, the proposed Diavik mining project in conjunction with other mining projects could have a cumulative impact on outfitting opportunities in the Lac de Gras area. The RAs therefore recommend that Diavik monitor the effects of its activities on outfitting operations. The RAs have determined that the proposed project will not interfere with hunting and fishing and other Aboriginal land uses under treaties and land claims. Diavik also predicted that there would be no significant adverse effects on fisheries in Lac de Gras.

Diavik also addressed components of socio-economic environment including:

a) Wage Economy
b) Mine Purchases
c) Mine Employment
d) Cultural Well-Being, Traditional economy, Land Use and Resources
e) Social Stability and Community Wellness
f) Net Effects on Government
g) Sustainable Development

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Overall in the wage economy, Diavik predicted a positive and long-lasting effect. During operations Diavik estimates that of 411 jobs, 66% of these would go to northerners at start-up. It is estimated that northern employment will reach 84%. Diavik predicted that Aboriginal employment will be 40% at start-up. Diavik has committed to strive to achieve 100% northern and Aboriginal employment over the life of the proposed project.

Diavik had difficulty assessing socio-cultural effects. Employment and income may contribute to the strengthening of the mixed economies enabling a more complete expression of both the wage economy and the traditional economy. There is also the possibility that wage-based activities may erode Aboriginal cultures. Diavik concluded that the project would not have a significant negative impact on traditional "on-land" activities.

Diavik predicted that while the proposed project will offer positive opportunities that could contribute to employee and family health and wellbeing, it could also add to the complexity of human health issues in communities. The proponent predicted both positive and negative effects because of the proposed project.

Diavik projected that the construction phase would generate $16M in territorial and $42M in federal personal tax revenues. The operations phase would increase labour income in the local study area by $20M per year. In 2002, Diavik estimates the project would directly generate 1.8M in territorial and $6.1M in federal personal tax revenues. In additional to personal taxes, the project would directly generate $70M in other tax revenues annually. Diavik predicted the proposed project would have positive effects on community and territorial infrastructures and services.

Diavik stated employment and income effects associated with the project would be positive, long-lasting and complementary to northern and Aboriginal aspirations. Diavik committed that through its cooperative initiatives, business, employment, education and training opportunities would be enhanced. It predicts the positive effects and associated benefits would extend beyond the life of the project.

The RAs concur with Diavik's analysis and the GNWT's conclusions that the project will not likely result in significant adverse socio-economic effects. The RAs require, however, that in order to minimize the identified potential risk of negative effects, Diavik will implement mitigation measures outlined in its environmental assessment submission, its commitments document and action plan. The RAs further conclude that a follow-up program is required to evaluate the effectiveness of mitigation measures and determine if they need to be modified or adapted over the course of the project. This socio-economic follow-up program will be included in an agreement. The RAs agree that Diavik should develop a training and education strategy that considers the recommendations made by the GNWT, Status of Women Council of the NWT, and Aboriginal organizations. The establishment of a secondary value-added diamond industry is also considered to be a worthy social and economic goal for the NWT.

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RESOURCE SUSTAINABILITY

Sustainable development is defined as " development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Some level of development is needed to create opportunities, wealth and choices for northern and in particular, Aboriginal Canadians. The RAs believe that the capacity of renewable resources would not be significantly affected by the proposed Diavik project should it proceed.

CUMULATIVE EFFECTS

The RAs are satisfied with Diavik's analysis of the potential cumulative effects of the proposed project on the environment and the follow-up programs identified to verify their predictions. However, the RAs also conclude that a regional cumulative effects management framework is required to consider the impacts and potential impacts from all development in the Slave Geological Province to support sound decision making.

FOLLOW-UP PROGRAM

The Canadian Environmental Assessment Act (CEAA) requires that the responsible authorities (RAs) consider the need for a follow-up program as part of a comprehensive study. An environmental agreement and a socio-economic agreement are required as the formal mechanisms to ensure the mitigative measures outlined in Diavik's submissions and in the RAs conclusions of the CSR are appropriately implemented. The following is a summary of follow-up monitoring programs which are required:

- Ambient air quality conditions;
- Vegetation and terrain conditions including permafrost conditions during the life of the project;
- Wildlife including caribou, grizzly bears, other carnivores, raptors, waterfowl and other avifauna and small game;
- Water including surface water and groundwater quality;
- Fish and fish habitat;
- Accidents and malfunction scenarios to lower overall risk and provide for early warning systems;
- Socio-economic monitoring including human health, heritage resources, impacts on outfitting operations and impact on traditional fisheries, and other socio-economic effects, and
- Cumulative effects.

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CONCLUSIONS

Information contained in Diavik's environmental assessment submission, review comments from federal and territorial governments, Aboriginal governments/organizations and communities, non-government organizations and the public, resolutions from meetings, workshops and technical sessions involving all stakeholders and correspondence received on the public registry have been considered during the preparation of this comprehensive study report. The RAs have concluded that this information is adequate for the assessment of environmental effects of the proposed Diavik Diamonds Project pursuant to the requirements of CEAA.

The effects of the proposed Diavik Project on the environment, human health, physical and cultural heritage, socio-economic conditions and resource sustainability, as well as other effects such as accidents and malfunctions are described and assessed in this comprehensive study report. With the mitigation measures proposed by Diavik, no significant adverse environmental effects on the biophysical and social-economic environments have been identified. However, mechanisms are required to ensure the co-operative development and implementation of monitoring and mitigation measures.

The RAs believe that Diavik has conducted an adequate assessment of potential cumulative effects of the proposed project, in conjunction with the Ekati diamond project and other projects and activities in the region. The RAs conclude that the potential for the Diavik project to interact with other known projects and activities in the regional study area to produce significant cumulative adverse effects is unlikely.

The region holds considerable mineral wealth and other economic potential. There is a need to develop a cumulative effects management framework to address the potential effects of future developments in the region. Initiatives such as the West Kitikmeot Slave Study and the Coppermine River Basin Study assist in gathering baseline data that is essential when examining cumulative effects in the region. In addition, the Mackenzie Valley Resource Management Act makes provisions for monitoring cumulative effects of projects in the Mackenzie Valley region and provides the foundation for a cumulative effects management framework.

The follow-up program proposed by Diavik is considered adequate to verify the accuracy of the assessment and to determine the effectiveness of mitigation measures. Additional follow-up requirements outlined in the comprehensive study report are required to address specific environmental and socio-economic concerns. Implementation of the follow-up program will be assured through environmental and socio-economic monitoring agreements, terms and conditions to regulatory approvals and Diavik's Environmental Management System.

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Diavik has demonstrated a willingness to work with northern communities and Aboriginal organizations to ensure that employment, training and social programs meet the needs of northern residents. Predictions of positive economic impacts and minimal project effects on social structures are dependent on proposed adaptive follow-up programs. Further, Diavik has stated its commitment to northern sustainable development, maximum employment opportunities for northern people and respect of the northern environment and health of northern communities. Diavik has also committed to an ongoing monitoring and mitigation process. The RAs are satisfied with Diavik's expressed socio-economic commitments.

The RAs have concluded that with implementation of mitigation measures and follow-up requirements described in this comprehensive study report, the Diavik Diamonds Project will not result in significant adverse environmental effects.

In support of the above, the RAs conclude that:

1. An environmental agreement must be developed that establishes appropriate responsibilities of Diavik and federal, territorial and aboriginal governments in the co-operative development, on-going review and modification of follow-up programs to mitigate potential project effects on the biophysical environment;
2. A socio-economic monitoring agreement must be developed that establishes appropriate responsibilities of Diavik and federal, territorial and aboriginal governments in the co-operative development, on-going review and modification of follow-up programs to mitigate potential project effects on the socio-economic environment, and
3. Diavik must submit an annual report to the RAs through its Environmental Management System, that documents activities and progress relating to follow-up programs and initiatives described in this comprehensive study report. The annual report is to be made available to all stakeholders.

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1.0 INTRODUCTION

1.1 REGIONAL SETTING

1.1.1 Regional Context

The proposed Diavik Diamonds Project mine site would be located at Lac de Gras, approximately 300 km northeast of Yellowknife, Northwest Territories (NWT) (Figure 1-1). Lac de Gras is about 100 km north of the treeline in the central tundra at the headwaters of the Coppermine River. The Lac de Gras area is characteristic of the northwestern Canadian Shield physiographic region, with rolling hills and relief limited to approximately 50 m. The landscape consists of diffuse watersheds with numerous lakes interspersed among boulder fields, eskers and bedrock outcrops. Lac de Gras is within the continuous permafrost zone. Harsh physiographic conditions have resulted in little soil development and low-growing vegetation cover (further detail is provided in Section 7.1).

1.1.2 Regional Land Use

Historically, three groups of Aboriginal peoples have used the Lac de Gras area: the Inuit, Métis, and Dene. Through time, the intensity of hunting and trapping in the area has been decreasing, but that does not diminish the level of concern from Aboriginal people for the landscape and its wildlife.

The Ekati Diamond Mine, which is in early production, currently dominates human activity in the Lac de Gras area (Figure 1-2). This project currently consists of a main camp and kimberlite pipes suitable for mining. Four of these pipes are located close to the Ekati main camp, which is less than 30 km northwest of the proposed Diavik site. A fifth pit (Misery pipe) is about 29 km from the main camp and less than 30 km northeast of the proposed Diavik site. The Ekati Diamond Mine is serviced by a winter road (referred to as the Echo Bay winter road in this report) operated by Echo Bay Mines to service the Lupin mine. The road, which passes within 1.5 km of the Diavik site, will also provide the surface transportation route for Diavik.

A number of guiding and outfitting camps are located in the area. Outfitting camps are located on Courageous Lake, Jolly River, Mackay Lake and Desteffany Lake (Figure 1-2). No hunting camps are currently active on Lac de Gras although valid leases are in place and one operation is suspended. A limited amount of hunting by non-Aboriginal NWT residents occurs. Exploration and expediting camps are dotted throughout the area, including Echo Bay Road Camp, Bathurst Inlet Developments Expediting Camp, Yamba Lake, Monopros Camp and Rhonda Mining Corporation. The area in which the project would be situated is sparsely populated. Wekweti (population 135), located 187 km west southwest of the proposed site, is the closest community to the proposed Diavik Diamonds Project.

1.1.3 Status of Land Claims

The North Slave region of the NWT, along with adjacent regions to the southwest (Deh Cho) and southeast (South Slave), forms part of the former Dene/Métis land claim area,

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which once included the entire Mackenzie Valley. The Dene/Métis initialed an agreement with the Governments of Canada and the Northwest Territories (GNWT) in April 1990, but in July 1990, the 16-year comprehensive claim negotiation process ended when the Dene/Métis assembly rejected the provisions that called for the extinguishment of Aboriginal title.

The status of land claims continues to evolve. Two types of claims are being sought within the North Slave region. Akaitcho Territory Dene (communities of Dettah and Ndilo [Yellowknives Dene First Nation], Lutsel K'e and Fort Resolution) are exploring negotiation of fulfilment of Treaty 8 through a treaty entitlement process. A portion of the area being claimed by Akaitcho Territory Dene as their traditional territory overlaps with the area being claimed by Treaty 11 Dogrib Dene, and includes the site for the proposed mine. The NWT Akaitcho Territory Tribal Council has adopted a resolution defining the Akaitcho Traditional Territory, which it claims stretches from Fort Chipewyan in Alberta to just south of Kugluktuk. In 1996, representatives of Akaitcho Territory, the GNWT and the federal government participated in an interest-based exploratory workshop. A joint work plan to further explore interests was agreed on, including the creation of a tripartite working group.

The second type of claim currently being negotiated within the North Slave region is a comprehensive land claims agreement with self-government provisions being sought by Treaty 11 Dogribs (Dogrib communities of Rae-Edzo, Wekweti, Wha Ti and Gameti). Treaty 11 was signed in 1921. In January 1994, the Dogrib Treaty 11 Council, which represents the above Dogrib communities, began negotiations for a comprehensive land claims agreement. A framework agreement, which outlines the process, scope and time frame for the negotiation of a combined land claim and self-government agreement-in-principle, was signed in August 1996. The Diavik Diamonds Project area lies within the settlement/traditional area being considered by the Dogrib Treaty 11.

The mandate of the North Slave Métis Alliance (NSMA) is to represent the indigenous Métis who traditionally used and occupied the North Slave Region. The NSMA claim Aboriginal rights and treaty rights as descendants of signatories to Treaty 11 in 1921. On January 19, 1998, the NSMA submitted a statement of claim to the federal government for lands in the North Slave Region, including the area of Lac de Gras. The federal government has engaged in exploratory discussions with the North Slave Métis Alliance but these discussions have not progressed to the negotiations stage.

1.2 PROJECT OVERVIEW

Information on the proposed project was extracted, in part, from Diavik's environmental assessment submission which includes an environmental overview, environmental effects reports (climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources and socio-economics), and other related documents.

Diavik Diamond Mines Inc. (Diavik) and Aber Diamond Mines Ltd. (ADM) formed a joint venture to mine four diamond-bearing kimberlite pipes at Lac de Gras, NWT. The proposed Diavik Diamonds Project would be located on an island, about 20 km^2, in Lac de Gras, known as "Ekadi" in the Dogrib language, and referred to as the East Island in this report.

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The kimberlite pipes are located immediately offshore of the East Island. The proposed project is located about 30 km southeast of the Ekati Diamond Mine main camp, operated by BHP Diamonds Inc. (BHP) and about 30 km southwest of BHP's Misery pipe.

If approved, the proposed project would begin construction in the year 2000, with the development of infrastructure (e.g., camp, water management system) and the A154 dike. Kimberlite processing would start in 2002, and continue until approximately 2025. Initially, the mining would be open-pit. Around 2014, underground mining would begin. During mine operations, reclamation of country (waste) rock areas and dikes around the kimberlite containment area would be ongoing. By about 2025, kimberlite mining would be completed with closure shortly after.

1.2.1 The Resource

Kimberlites are volcanic rocks with extremely variable mineralogical composition. Most of the world's natural diamonds are associated with kimberlite. The formation originates deep beneath the earth's surface and ascends through the earth's upper crust. Sometimes diamonds are carried within the kimberlite, although most kimberlites in the world do not contain economic concentrations of diamonds. Throughout the world, 5,000 pipes are known, of which about 1% are economic. In the context of kimberlites world-wide, the Diavik Diamonds Project resource is unusual. The Diavik kimberlite deposits are small, less than two ha in surface area, compared to a world average of twelve ha, and of a relatively high grade.

As of January 1998, 49 kimberlite occurrences have been identified. Diamonds have been recovered from 24 of these occurrences. Known kimberlites continue to be reviewed and the search for additional pipes continues. The estimated Diavik geologic resource currently consists of four kimberlite pipes aligned along a northeasterly trend adjacent to the East Island in Lac de Gras. Three of the pipes – A418, A154S and A154N are located within one kilometre of the proposed project site on the East Island. The A21 pipe is situated 4.5 km southwest of this main cluster. Kimberlite A21 was the first of the four pipes to be discovered. The A154S kimberlite was discovered shortly after A21, in May 1994.

1.2.2 The Proponent

1.2.2.1 Joint Venture Relationship

The proposed Diavik Diamonds Project is a joint venture between Aber Diamond Mines Ltd. (ADM), a NWT corporation, and Diavik Diamond Mines Inc. (Diavik), a Canadian corporation. Both companies are registered under the laws of the NWT, and have been formed by their parent companies for the sole purpose of developing and operating the proposed Diavik Diamonds Project. Diavik is the manager of the project, under the guidance of a joint venture management committee consisting of one member appointed by Diavik and one member appointed by ADM. Voting power is equal to participating interests (i.e., ADM – 40%; Diavik – 60%).

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Aber Resources Ltd's (ADM's parent company) association with the Diavik area began in 1991, shortly after an unrelated company, Dia Met Minerals Ltd. of Kelowna, British Columbia, announced the discovery of diamonds in a drill core at Lac de Gras, NWT. Aber Resources Ltd. (Aber) and other exploration companies worked together to stake about 4,850 km^2 (1.2 million acres) of mineral property in and around Lac de Gras. After conducting early exploration work, Aber identified Kennecott Canada Inc., as a joint venture partner to provide needed financing and experience.

In June 1992, Aber signed an option agreement with Kennecott Canada Inc. (Kennecott), ultimately a subsidiary of Rio Tinto plc. The option agreement entitled Kennecott to earn a 60% interest in Aber's interest in the Lac de Gras area claims in return for a payment to Aber of $300,000 and the spending of $9.7 million for exploration on the claims. The four kimberlite pipes proposed for development under the Diavik Diamonds Project were discovered in 1994 and 1995 by a team including Aber and Kennecott geologists.

On March 23, 1995, Aber and Kennecott signed the Diavik joint venture agreement, under which Kennecott exercised its option and became manager of the project. On November 29, 1996, Kennecott transferred its interest to Diavik Diamond Mines Inc. and Diavik replaced Kennecott as manager. On January 30, 1998, Aber transferred its interest in the Diavik area, including the project and the blocks subject to the Diavik joint venture agreement, to ADM.

1.2.2.2 Aber Diamond Mines Ltd.

Aber Diamond Mines Ltd. (ADM) was incorporated under the laws of the NWT in January 1998. ADM is a wholly owned subsidiary of Aber Resources Ltd., a mineral exploration company headquartered in Vancouver, British Columbia. Aber has interests in a number of active exploration ventures in the NWT and West Greenland. Aber is a publicly traded company with shares listed on the Toronto Stock Exchange and the National Association of Securities Dealers Automated Quotation (NASDAQ) system in the United States.

1.2.2.3 Diavik Diamond Mines Inc. Corporate Relationship

In November 1996, Diavik Diamond Mines Inc. was formed, a Canadian company (subsidiary ultimately of Rio Tinto plc) to oversee the management responsibilities of the proposed Diavik Diamonds Project. At that time, Diavik assumed the activities and responsibilities of the joint venture previously held by Kennecott Canada. As manager of the joint venture, Diavik is responsible for the development and operation of the proposed project, including the environmental assessment and submission of the project application. Diavik has its head office in Yellowknife, NWT.

Diavik is a wholly owned subsidiary of Rio Tinto plc, an international mining company based in London, England. Minerals extracted from the Rio Tinto Group's mines include copper, gold, iron ore, coal, bauxite, silver, lead, zinc, uranium and nickel. Rio Tinto's industrial mineral mines include titanium dioxide, borates, talc, industrial salt, gypsum and diamonds. In 1997, Rio Tinto Group companies were involved in 45 major projects around the world, with a total land use of almost 45,000 ha.

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1.3 PURPOSE AND NEED

1.3.1 Project Purpose

The primary purpose of the project would be to extract diamonds from four diamondiferous kimberlite pipes at Lac de Gras for purposes of providing an additional diamond source to international buyers and dealers. The purposes are intended to be consistent with Canada's overall strategy of encouraging private corporations to generate national export commodities and sustainable tax revenues from natural resource development. The national objective is to encourage sustainable resource development for its benefits of increased employment, contracting opportunities and expanded services at the local, regional and national level without significantly impacting the environment including renewable resources.

1.3.2 Project Need

The proposed Diavik Diamonds Project would provide an additional diamond source to buyers and dealers worldwide and return a reasonable rate on investment to shareholders while fostering sustainability of northern resources and communities.

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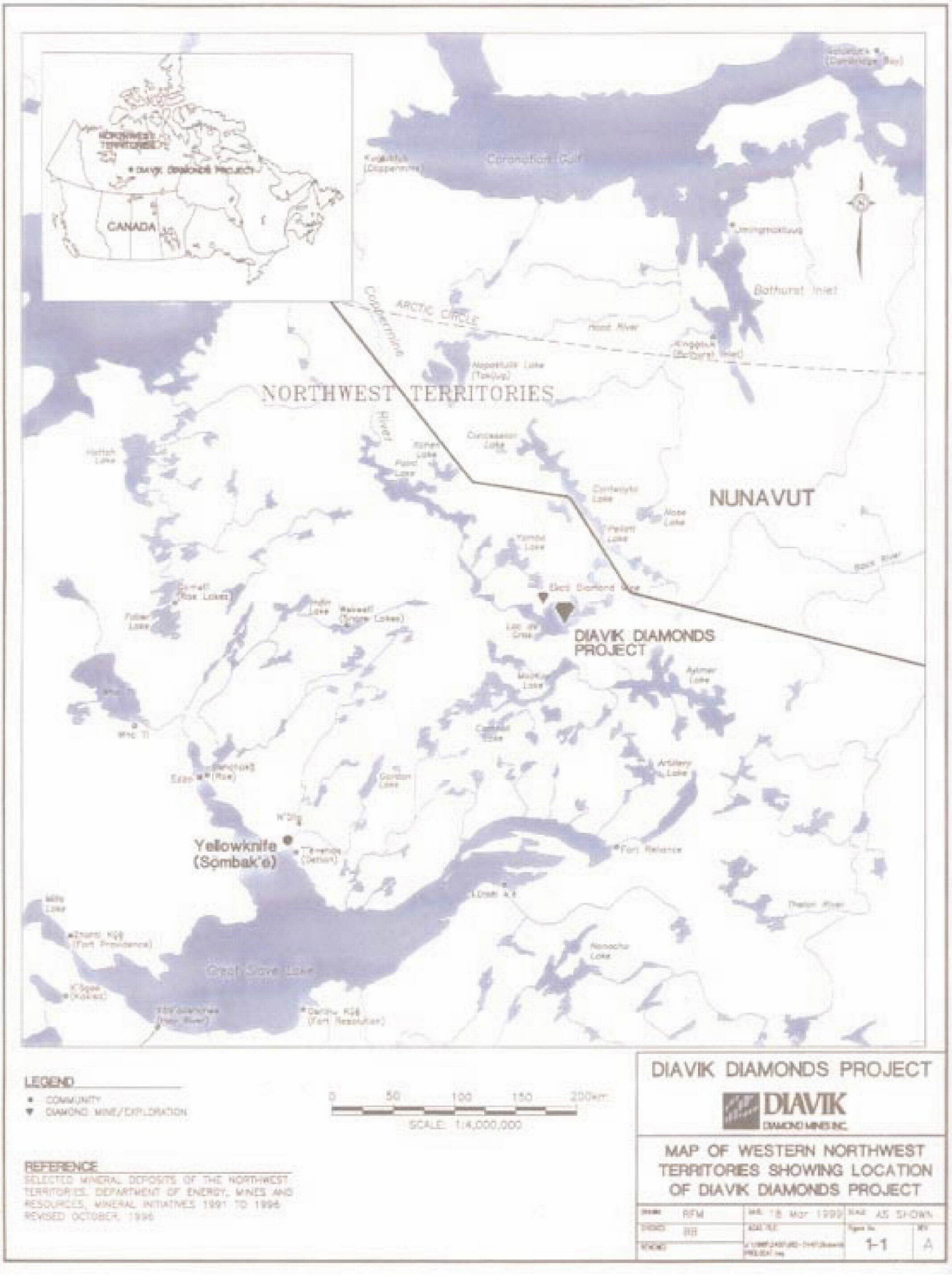

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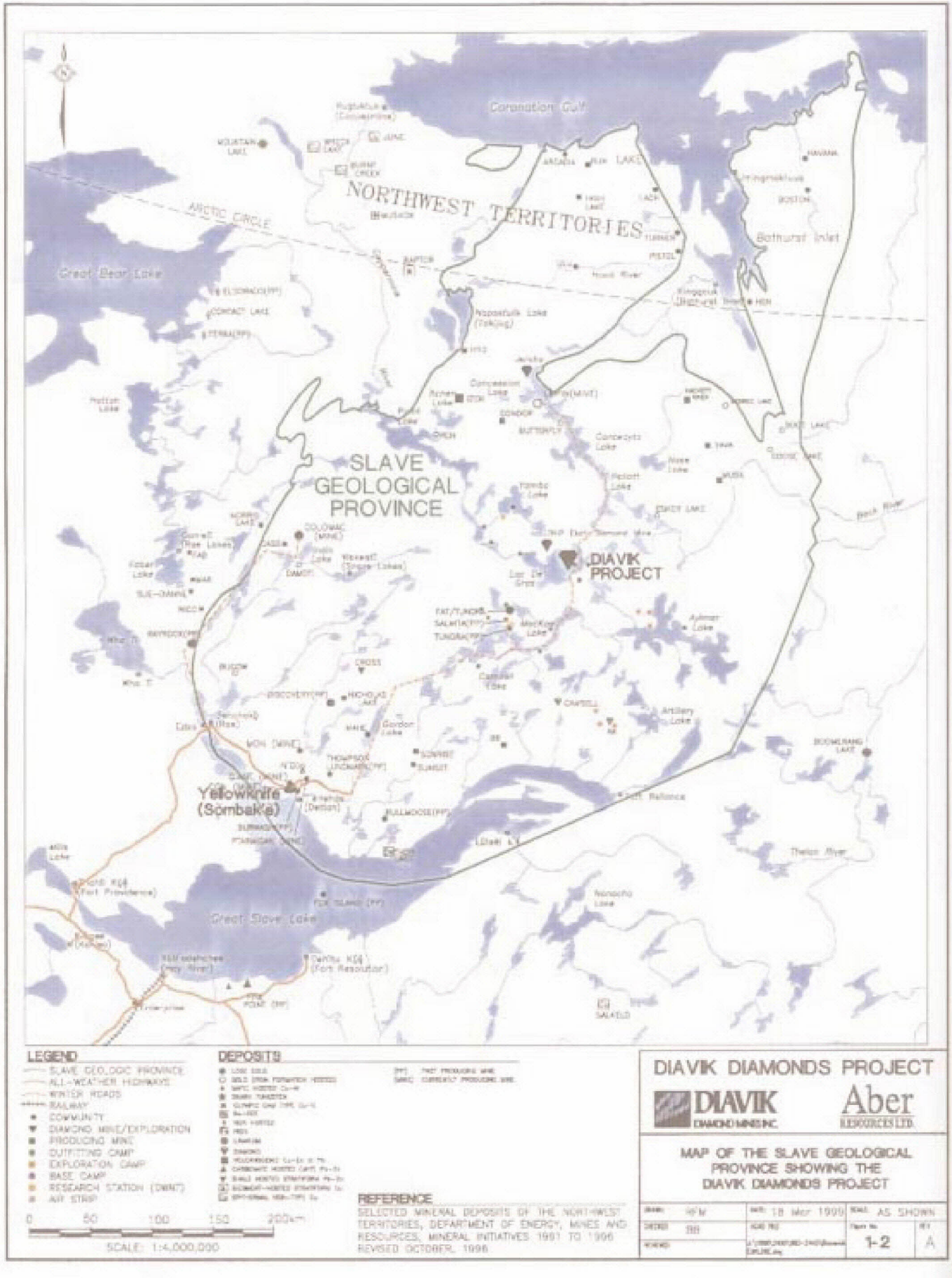

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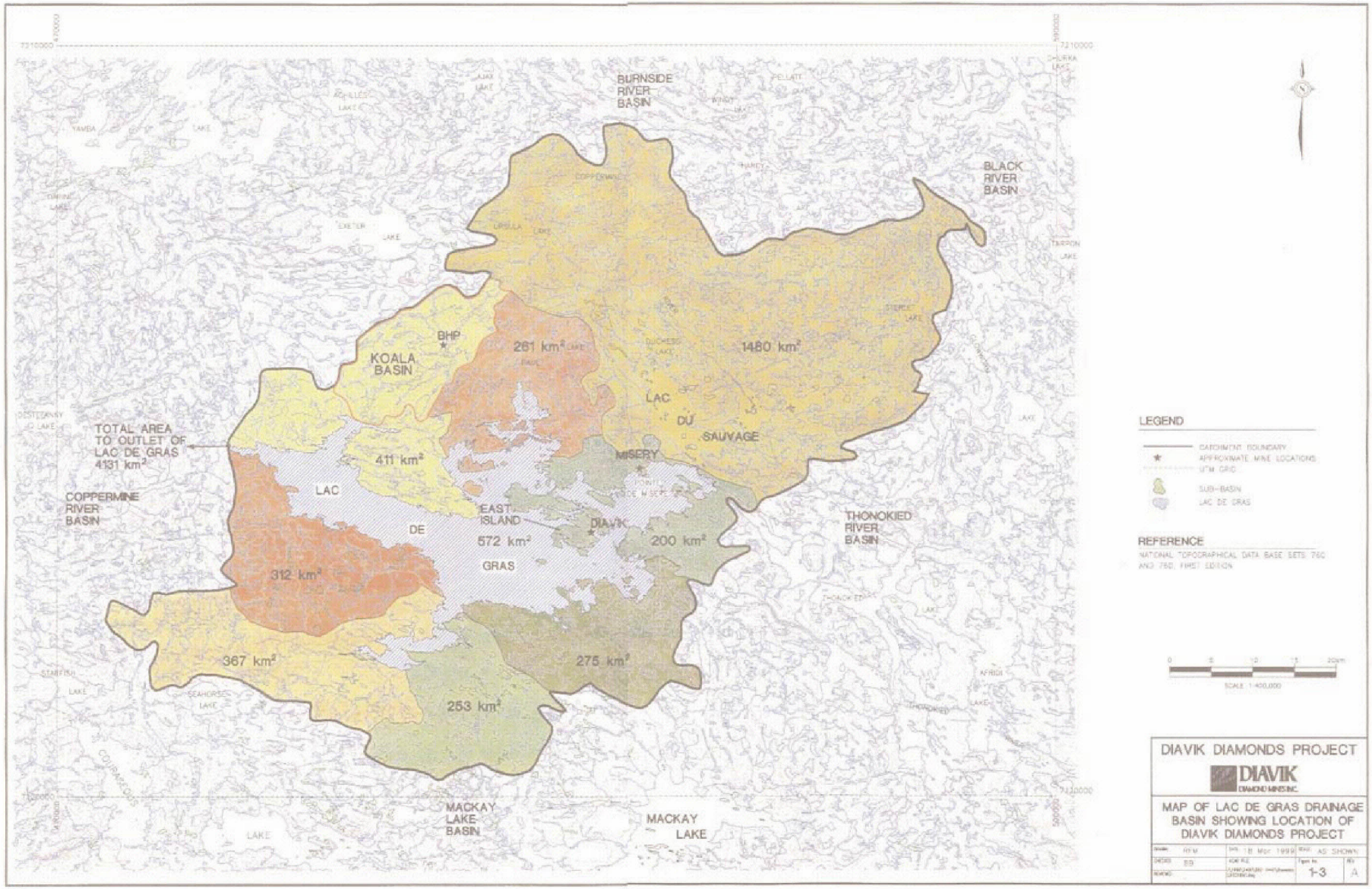

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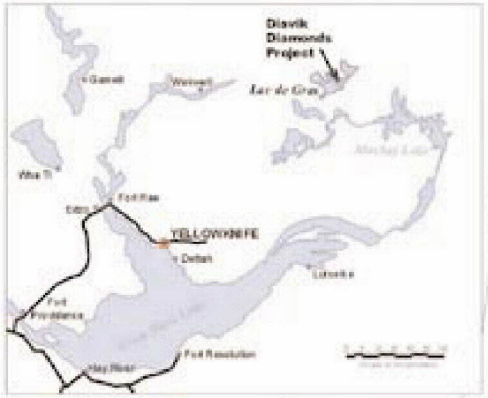
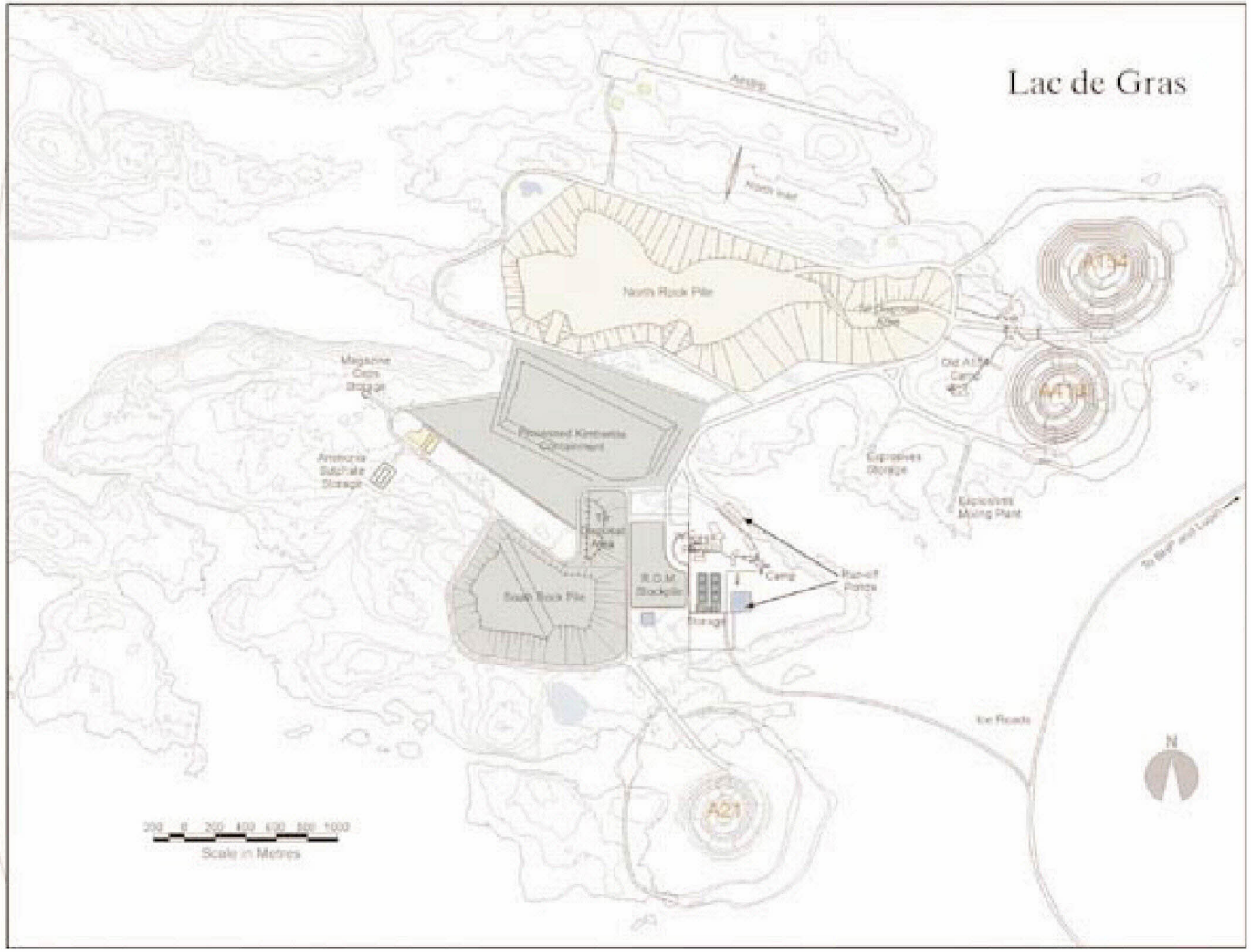
DIAVIK
DIAMOND MINES INC.

Figure 1-4 Proposed Infrastructure Layout Scheme





LEGEND

- Run-off Ponds
- 5 Meter Contours
- Infrastructure Development
- Water Retention Dike Outlines
- Road Limits

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20 ENVIRONMENTAL ASSESSMENT PROCESS

21 DIAVIK'S ENVIRONMENTAL ASSESSMENT

Diavik has been collecting, analyzing and reporting information about the environment at Lac de Gras since 1994. This information is contained in a series of reports and technical memoranda that vary in the level of detail and technical information. The reports are listed below:

Executive Summary: Brief report that describes the key project elements and key findings of the environmental assessment.

Environmental Assessment Overview (EA Overview): Summary document that provides the results of investigations that are reported in detail in the supporting environmental effects reports.

Environmental Effects Reports: Six separate environmental effects reports on the potential effects of the proposed project on climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources and socio-economics.

Integrated Socio-Economic and Environmental Baseline Report: Summary of data collected in the baseline inventory program, as well as a description of the regional context in which the proposed project is situated.

Environmental Management System (EMS): Formalized system to organize and deal with environmental, health and safety issues based on ISO (International Standards Organization) 14001 Environmental Management System standards.

In addition to preparing paper documents, Diavik produced a CD-ROM that contains all of the above-listed documents and many of the supporting documents and reference material related to the project. Hard copies and/or the CD-ROM have been distributed to government agencies, Aboriginal communities, non-government agencies and the public libraries in Yellowknife, Hay River, Fort Smith and Edmonton. All material is available in the Canadian Environmental Assessment Act (CEAA) public registry available at the Department of Indian Affairs and Northern Development office in Yellowknife. At the request of communities and Aboriginal groups, certain reports have not been released to the general public as they contain sensitive community specific information or proprietary traditional knowledge. Only each respective community, Diavik and the relevant experts within government have access to these confidential documents.

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2.2 COMPREHENSIVE STUDY REPORT

2.2.1 Canadian Environmental Assessment Act

The Canadian Environmental Assessment Act (CEAA) identifies responsibilities and procedures for the assessment of projects that involve the federal government. The CEAA process applies to the proposed Diavik Diamonds Project because the Government of Canada is exercising regulatory duties (i.e., issuing a licence, permit or approval) that are included in the Law List Regulations (Section 5(1)(d)).

The licences and approvals are a Class A Water Licence, a Fisheries Act Authorization, an Explosives Act Permit, and a Navigable Waters Protection Act Permit. CEAA also applies because the federal government would be required to provide a disposition of land (i.e. Land and Water lot leases) to enable the project to proceed. This requires an environmental assessment under Section 5(1)(c) of the Act. Since an airstrip is proposed as an all-season runway with a length greater than 1,500 m, a comprehensive study is required in accordance with Part IX, Section 30(c) of the Comprehensive Study List Regulations.

The responsible authorities (RAs) that are required by CEAA to ensure that an environmental assessment for the proposed Diavik Diamonds Project is conducted are:

- Department of Indian and Northern Affairs (lead RA) – Land and Law List triggers
- Department of Fisheries and Oceans – Law List triggers
- Natural Resources Canada – Law List trigger

Results from consultations with federal authorities (FAs) and confirmations from RAs in fulfilling the Federal Coordination Regulations requirements are provided in Appendix A or are attached to the comprehensive study report. Environment Canada, Transport Canada and Health Canada are identified as expert FAs. The lead RA also established a public registry for the proposed Diavik Diamonds Project located in Yellowknife. The Federal Environmental Assessment Index (FEAI) number for the project is 17345.

2.2.2 Management Structure

Prior to making the decision to proceed with a comprehensive study, the RAs consulted with potentially affected Aboriginal organizations and interested non-government organizations at a stakeholders meeting held in Yellowknife, NWT on April 29, 1998. Representatives from the Akaitcho Territory Tribal Council, Dogrib Treaty 11 Council, North Slave Métis Alliance, Kitikmeot Inuit Association, Canadian Arctic Resources Committee, World Wildlife Fund and Ecology North all expressed concern regarding their level of participation in the environmental assessment process.

Following a period of consultation and review, RAs confirmed the project would be reviewed through a comprehensive study. The RAs believed that the information as presented by Diavik did not warrant a referral of the project to a panel review. The decision to proceed with a comprehensive study was also based on public dissatisfaction with a process similar to the BHP panel review.

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The environmental non-government organizations expressed concern regarding the need for adequate resources to meaningfully participate in a comprehensive study review process. Although participant funding is not a legal requirement for a comprehensive study review, the need for financial resources was recognized and DIAND made funds available for Aboriginal and non-government organizations to participate in the project review process. Diavik also funded community participation. The Aboriginal organizations felt that a comprehensive study review was appropriate provided they were adequately involved.

In early June, the Aboriginal leadership agreed that the proposed steering committee be composed of one representative from each of the Akaitcho Territory Tribal Council, Dogrib Treaty 11 Council, North Slave Métis Alliance, Kitikmeot Inuit Association, the federal RAs and the GNWT. It was determined at this meeting that other interested stakeholders such as environmental organizations, the NWT Chamber of Mines, the NWT Status of Women Council, etc. would have full opportunity to participate in the review through the public consultation process.

The RAs, in consultation with stakeholders, designed a management structure and public consultation process appropriate for the federal environmental assessment of the proposed Diavik Diamonds Project (Appendix B). The comprehensive study management structure included a RA caucus, steering committee, experts pool and project secretariat. The RA caucus had representation from each of the federal departments with project regulatory responsibility, namely the departments of Fisheries and Oceans, Indian Affairs and Northern Development, and Natural Resources Canada. In general terms, this caucus was responsible for decision making in relation to the comprehensive study process.

The management structure was presented to stakeholders at a June 18, 1998 meeting. Based on feedback from the participants at this meeting, the comprehensive study management framework was refined (Appendix B) to reflect the comments from the other federal authorities, the Government of the Northwest Territories and key organizations.

At the first meeting of the steering committee, August 11, 1999, the committee finalized its terms of reference (Appendix B). The Dogrib Treaty 11 Council has not been able to participate on the committee given that its resources are directed primarily towards land claims negotiations, its current priority. As well, the Dogrib Treaty 11 Council informed DIAND that it would be undertaking its own independent review of the proposed project, and would be submitting a report on its findings directly to the Minister of the Environment and the Minister of DIAND. DIAND, as lead RA, continued to involve the Dogrib Treaty 11 Council by providing all key documents produced from the steering committee and the review process.

The Kitikmeot Inuit Association (KIA) participated on the steering committee early in the process. Mid-way through the review however, it informed the RAs that given the timetable established for the balance of the review, KIA's resources would be better placed elsewhere. As a result, the KIA stated they would not continue as a full member of the committee. The KIA requested to be informed of all steering committee activities and choose to participate where it felt its resources would be best utilized. The KIA was provided all relevant documents from the steering committee and the review process.

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2.2.3 Technical Review Process

As a component of the comprehensive study process, the RAs undertook a technical review of Diavik's environmental assessment submission from September 1998 through to April 1999. This review involved the experts pool consisting of federal (DIAND, Fisheries and Oceans, Natural Resources Canada, Environment Canada, Transport Canada and Health Canada), territorial (Resources, Wildlife and Economic Development, Education, Culture & Employment, Health & Social Services, Bureau of Statistics, Mine Safety Division of the Workers' Compensation Board) and external experts as required, as well as representatives from the Aboriginal organizations and the public.

The technical review process involved three major components:

i) Community and information sessions: (October – December ,1998)

Following Diavik's environmental assessment submission and subsequent consultation in interested communities by Diavik, government-hosted meetings were held in each community to allow the public a first-hand opportunity to ask government questions about Diavik's submission and when possible to receive answers directly from government experts. All issues were recorded and addressed through the review process.

ii) Technical Sessions: (January – April, 1999)

In November 1998, the steering committee recommended to the RAs that technical meetings should be held in various communities and that they should have the option to attend these meetings. In response to this recommendation, technical meetings were conducted in various communities in the Northwest Territories. The steering committee members (along with community members) received invitations and adequate resources to enable their attendance. Information generated from those meetings was forwarded to the steering committee members and placed on the public registry.

The agendas for all the meetings were coordinated by the lead RA and were based on issues identified during Diavik's public consultation on its environmental assessment submission and government review.

Technical meetings in various communities took place from late January to early February 1999. Issues examined related to Diavik's fish habitat compensation plan, fish and water, geotechnical aspects of the project, and issues concerning wildlife, air, vegetation, social impacts, economy and cultural (heritage) resources. Following the daytime technical discussions, evening public meetings were held to allow more members of the public an opportunity to ask questions and talk to experts directly. Attendees to these sessions included: representatives of Aboriginal organizations, steering committee members, government (including contracted experts) and Diavik experts.

Additional technical meetings were held following recommendations from the public technical sessions, which ended March 5, 1999.

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iii) Public Technical Sessions: (February 22 – March 5, 1999)

These sessions were an important part of the environmental assessment review process as they provided an opportunity for government to report on its findings and allow for public discussion of issues raised during the public consultation on the environmental assessment submission. These sessions also provided an open invitation for the public to ask questions, make presentations, and get answers from government, Diavik and the steering committee. Where possible, issues were resolved or a course of action was identified on how to resolve outstanding technical issues.

Following the public technical sessions, additional workshops and meetings were held to resolve any remaining outstanding technical issues. Results of all the government-hosted technical meetings/workshops are available on the public registry. A summary of all technical-related meetings is included in Appendix E.

2.3 REGULATORY CONTEXT

The proposed Diavik Diamonds Project is subject to federal and territorial legislation. It is subject to federal legislation that includes the Canadian Environmental Assessment Act (CEAA), Fisheries Act, Navigable Waters Protection Act, Explosives Act, Territorial Lands Act and Northwest Territories Water Act. The proposed project would also be subject to Section 159(2) in the Mackenzie Valley Resource Management Act, which came into force December 22, 1998. The proposed Diavik Diamonds Project would also be subject to territorial legislation.

2.3.1 Licences and Permits

2.3.1.1 Claims Block

Diavik holds 11 mining leases totalling 11,435.05 ha (28,256 acres). It also holds 206,486 ha (510,220 acres) in mineral claims, of which 11,155.81 ha (27,566 acres) have leases pending. The Government of Canada administers mineral rights. The claim block includes almost all of the East Island and a relatively small area of the mainland directly north of the East Island. The bulk of the claim block extends up to 70 km east of the East Island, with a north-south spread of less than 60 km.

Under the Canada Mining Regulations, a mineral claim may be held for a period of 10 years from the date of recording. The original Diavik claim block was recorded in 1992. Since then, some claims have been relinquished while others have been taken to mining lease. Mineral claims not taken to mining lease by the year 2002 must be abandoned.

Diavik uses lands near Lac de Gras under two Land Use Permits (LUP) issued by DIAND. LUP#N97C718 allows for ongoing exploration work and reconnaissance drilling, and LUP#N97C719 covers the infrastructure in relation to the current camp on the East Island and associated drilling activities. Diavik currently operates under Water Licence #N7L2-1645, issued by DIAND, for use of water and disposal of wastewaters. The licence covers disposal from a water treatment plant if required and camp sewage treatment plant, and allows Diavik to use water.

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2.3.1.2 Applications

Diavik has applied to DIAND to lease lands that would be occupied by the proposed project. The five leases would be for the purposes of:

- Airstrip and associated structures;
- Infrastructure lease;
- Quarry area, processed kimberlite containment area and country rock area;
- Water lot lease (A418, A154N, A154S and North Inlet), and
- Water lot lease (A21).

If approved, the proposed project would be subject to regulatory requirements administered by the federal government. Key acts are the Fisheries Act, the Explosives Act, Navigable Waters Protection Act, Territorial Lands Act and the Northwest Territories Waters Act. Applications have been submitted to the applicable regulatory agencies. Diavik will be required to comply with these requirements and has established mechanisms in its Environmental Management System (EMS) to ensure continuing compliance. Following the completion of the environmental assessment, additional information specific to each application will be submitted separately to each of the relevant regulatory agencies.

2.3.2 Non-Regulated Requirements

In addition to legislative and regulatory requirements, Diavik's environmental performance will be guided by a number of guidelines that establish criteria for environmental performance and management. The governments of Canada and the territories also have policies, programs, incentives and strategies that relate to mining. Diavik proposes to address these requirements through operational procedures.

2.3.3 New Legislation (Mackenzie Valley Resource Management Act)

The Mackenzie Valley Resource Management Act (MVRMA) is federal legislation which, when fully implemented, will establish a co-ordinated system of resource management to regulate the use of land and water in the Mackenzie Valley. The MVRMA has received Royal Assent, and is in force with the exception of Part IV of the Act.

Section 159 (2) of the MVRMA requires consultation with the Mackenzie Valley Environmental Impact Review Board prior to the Minister of the Environment making a decision on the proposed Diavik Diamonds Project. The Mackenzie Valley Environmental Working Group, and the successor Board, have had opportunity to be included in all phases of the review.

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2.4 METHODS

2.4.1 Environmental Effects

This section summarizes the methods used to identify and evaluate potential effects, including cumulative effects, of the proposed Diavik Diamonds Project on climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources and socio-economic and socio-cultural conditions. Information was obtained from Diavik's environmental overview and environmental effects reports.

2.4.2 Evaluation of Effects

2.4.2.1 Linkage Diagrams

Linkage diagrams are illustrations that show connections between a proposed project activity and potential environmental changes caused by the activity. Although each discipline's linkage diagrams are unique, they followed a similar approach. Figure 2-1 is an example of a generalized linkage diagram. Activities associated with the proposed project were identified. The ways those activities could cause an effect (called pathways in a number of the reports) were illustrated and investigations were conducted to predict potential effects. The objective of the investigation was to answer a "key question". Frequently, the answer to the "key question" was also required to address issues raised in other reports. For example, the proposed project's potential effects on wildlife also relate to socio-economic effects.

2.4.2.2 Definition of Effects Criteria

Diavik's environmental assessment described potential effects according to three main effects criteria (i.e. magnitude, duration and geographic extent). These criteria related primarily to biophysical effects, with explanations of socio-economic effects being more descriptive. In addition to the three main effects criteria of magnitude, duration and geographic extent, additional criteria were frequently considered where appropriate. Effects on vegetation, wildlife, fish and water were defined according to the overall level of effect. The RAs are generally in agreement with the approach that Diavik used to determine if the proposed project would have significant adverse environmental effects. Definitions of the three main effects criteria are as follows:

Magnitude describes the amount of change in a measurable parameter or variable relative to baseline conditions (Table 2-1). The specific criteria used to determine the magnitude of an effect are related to the characteristic being investigated, methods available to measure the effect and accepted practice in different scientific disciplines. Given this, definitions of magnitude are unique to each characteristic. Each environmental effects report describes how the concept of magnitude was studied for each characteristic and readers are referred to those reports for details. The environmental effects for each topic generally addressed the project period of the greatest effect in the assessment of magnitude.

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Diavik states that currently no accepted methodological basis exists (in the territories) for the assignments of quantitative values of magnitude to potential change in socio-cultural parameters. Diavik also states that because potential socio-cultural effects are induced by direct or indirect effects associated with project activities and are influenced by many unidentifiable variables, the ability to accurately determine the direction of the effect is constrained. Therefore Diavik concludes that its predictions are qualitative in nature and based on professional judgement and experience.

Duration is the measure of the length of time that a potential effect could last. The duration of a potential effect is often closely related to the duration of the activity that could cause the effect. However, the effect may last longer than the activity in some cases. The duration of potential environmental effects can be broadly divided into three classifications: short-term effects lasting for less than three years, mid-term effects lasting from three to 30 years and long-term effects lasting longer than 30 years.

Geographic extent is the spatial area affected by an activity. Both a regional and a local study area were selected by each discipline to evaluate the extent of the effects of the proposed project. For the purposes of the environmental effects assessment, potential effects that were restricted to the local study areas were judged as local in geographic extent. If an effect extended beyond the local study area, it was considered to be a regional effect. In some cases, effects have the potential to extend even farther and were considered beyond regional.

2.4.2.3 Modifiers

In addition to the three main effects criteria of magnitude, duration and geographic extent, additional criteria were frequently considered.

Ecological context is a measure of the relative ecological importance of an environmental component. It indicates the degree to which an effect on the component would substantially affect the functioning of the ecosystem within the local or regional study area. Ecological context was occasionally used to modify the magnitude classification assigned to an effect. In many cases, ecological context is implicit in the selection of the resource component being addressed.

Frequency of an effect is related to duration. For the proposed project, most activities will be continuous over the duration of the project phase. Where the effect of a proposed project activity is infrequent or different than the project phase, these differences are described and assessed.

Reversibility is also a factor related to duration. Loss of heritage sites, for example, is not reversible because the site is not replaceable. Plant reclamation of disturbed sites is not reversible in the short-term, but natural processes would eventually result in vegetation recovery.

Because environmental effects assessments deal with predictions of future circumstances, or must predict how complex environmental systems could respond to disturbances, effects assessments vary in their level of certainty. In some cases, predictions can be made with a high degree of confidence. Each environmental effects report addressed issues of certainty when it is an important factor in judging the project's potential effects.

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2.4.3 Significance of Effects

Within each of Diavik's environmental effects reports, effects of the proposed project on the environment are described primarily with respect to geographic extent, duration, and magnitude. This information has been used to determine the significance of any adverse environmental effects. The definition of a significant adverse effect is an effect that has a high probability of a permanent or long-term effect of high magnitude, within the regional area, that cannot be technically or economically mitigated. Definitions of regional effects and effect magnitudes are specific to each environmental component. Local and regional areas are defined in Section 4.0. Definitions of duration are defined in Table 2-1.

Definitions of magnitude of effects for vegetation, fish and water and wildlife are summarized in Table 2-2. Rationale for the selection of these areas and magnitude definitions are included in Diavik's specific environmental effects reports.

2.4.4 Cumulative Effects

Under CEAA, the assessment of the cumulative effects of a project in combination with other projects and activities that have been or will be carried out is required. Diavik identified and evaluated potential cumulative effects if a change in the environment was identified as a result of the proposed project that, when combined with changes caused by other projects and activities in the regional study area, could potentially result in a cumulative effect. Cumulative effects were assessed using the same effects criteria and modifiers as those described for project-specific effects and are discussed in more detail throughout Chapter 8.

Table 2-1 Summary of duration definitions

Duration	Biophysical	Socio-economic – effects that are not environmentally induced	Socio-economic – environmentally induced effects	Socio-cultural
Short term	Impact is not measurable beyond three years (construction)	Impact is not measurable beyond one year	Impact is measurable for less than one generation (less than 30 years)	Impact is measurable for less than one generation (less than 30 years)
Mid term	Impact is measurable for 3 to 30 years (operations)	Impact is measurable for 1 to 5 years	Impact is measurable for one generation; people born to those alive today (30 to 60 years)	Impact is measurable for one generation; people born to those alive today (30 to 60 years)
Long term	Impact is measurable for more than 30 years (post-closure)	Impact is measurable for more than 5 years	Impact is measurable for more than one generation (more than 60 years)	Impact is measurable for more than one generation (more than 60 years)

NOTES: Modifications of definitions for specific applications are described in the relevant environmental effects reports.

Environment Canada 1990 Ambient Air Quality Objectives were used to establish duration definitions for climate and air quality impacts.

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Table 2-2 Summary of magnitude definitions.

Magnitude	Wildlife	Water Quality	Water Quantity	Fish	Vegetation	Socio-economic (not environmentally induced)	Socio-economic (environmentally induced)	Socio-cultural
Negligible	Not defined	Concentration is below threshold	Change is less than 5%	Change in fish population(s) is less than 1%	Change in measurement endpoint is less than 1%	Not defined	Change is less than 5%	Not applicable
Low	Selected parameter changes by less than 1% from baseline conditions within impact area	Concentration exceeds threshold by 10% or less	Change is between 5% and 10%	Change in fish population(s) is between 1% and 10%	Change in measurement endpoint is between 1% and 5%	Change is less than 5%	Change is between 5% and 10%	Not applicable
Moderate	Selected parameter changes by between 1% and 10% from baseline conditions within impact area	Concentration exceeds threshold by between 10% and 20%	Change is between 10% and 20	Change in fish population(s) is between 10% and 20%	Change in measurement endpoint is between 6% and 30%	Change is between 5% and 10%	Change is between 10% and 15%	Not applicable
High	Selected parameter changes by more than 10% from baseline conditions within impact area	Concentration exceeds threshold by more than 20%	Change is greater than 20%	Change in fish population(s) is greater than 20%	Change in measurement endpoint is greater than 30%	Change is greater than 10%	Change is greater than 15%	Not applicable

NOTES: Modifications of definitions for specific applications are described in the relevant environmental effects reports.

Environment Canada 1990 Ambient Air Quality Objectives were used to establish magnitude definitions for climate and air quality impacts.

Magnitude ratings were not assigned to socio-cultural effects (see section 2.4.2.2 for details).

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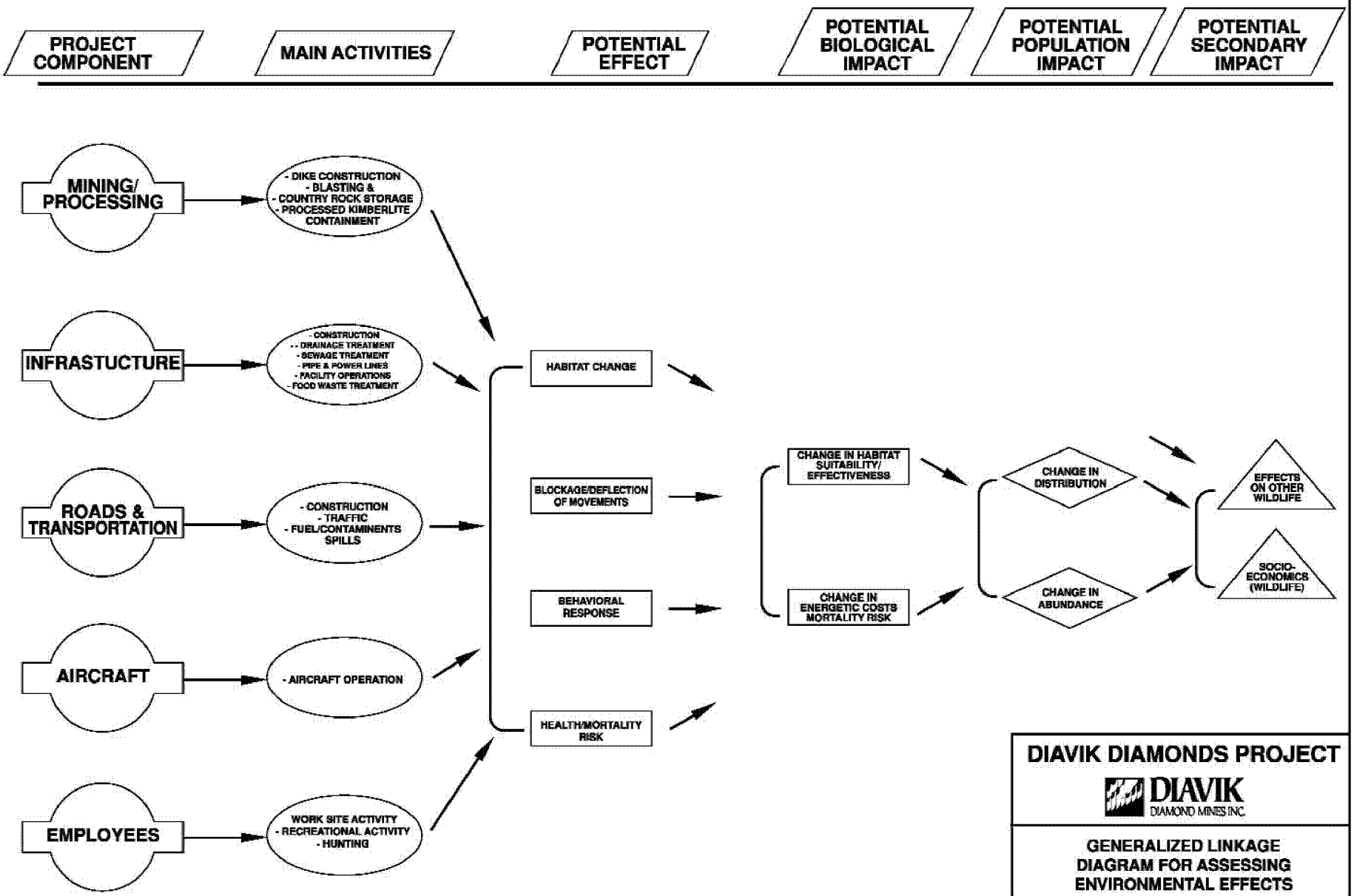

DIAVIK DIAMONDS PROJECT

DIAVIK DIAMOND MINES INC.

GENERALIZED LINKAGE DIAGRAM FOR ASSESSING ENVIRONMENTAL EFFECTS

DRAWN: RFN	DATE: 18 Mar 1999	SCALE: AS SHOWN	
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3.0 PROJECT DESCRIPTION

3.1 PROJECT DEFINITION

The project description contained in this report is presented as proposed by Diavik in its environmental assessment submission and includes changes made during the comprehensive study process. Diavik proposes to mine four diamond-bearing kimberlite pipes located at Lac de Gras. The proposed project facilities would be situated entirely on the East Island, with the open-pits located just offshore, in Lac de Gras.

The environmental assessment was based on pre-feasibility engineering design. Engineering efforts will continue to advance to detailed design starting in 1999. This will include additional field testing and sampling to support engineering studies. As engineering proceeds, and as the proposed project is further reviewed and discussed with communities and regulators, improvements in the project design may be identified that result in changes to the final project description that would eventually receive permits.

After the start-up year, the rate at which kimberlite would be mined and processed would likely vary between 1.5 and 1.9 million tonnes (Mt) in a typical year. Depending on market conditions, decisions of the partners, and increasing operating experience, this rate could increase to an upper limit around 1.75 to 1.9Mt/y. It is always possible that situations may intermittently warrant lower production rates. This range of processing rates has been considered in Diavik's environmental assessment. A processing rate of 1.9 Mt/y was used as an upper estimate of conditions for evaluating potential environmental effects on Lac de Gras. Conversely, a processing rate of 1.5 Mt/y has been assumed for the socio-economic analysis.

3.1.1 Geological Resource

The kimberlite being evaluated at the proposed Diavik Diamonds Project site represents explosively emplaced volcanic deposits, samples of which have been dated as circa 53 million years old. The kimberlite material is contained in steep-walled, cone-shaped diatremes (pipes) within the crystalline basement rocks. The project's estimated geologic resource is made up of four kimberlite pipes: the A154 South (A154S) and A154 North (A154N) pipes some 150 m apart; the A418 pipe, approximately 1 km to the southwest, and the A21 pipe, 4 km farther to the southwest (Figure 1-4). The pipes are all located beneath Lac de Gras, near the shoreline of the East Island. The two highest-grade pipes, A154S and A418, have estimated grades of 4-5 carats per tonne. Current resource estimates indicate an average grade of 3-4 carats per tonne to the 400 metre depth level.

3.1.2 Mining Plan

The mine plan for the proposed project would include construction of temporary water retention dikes, followed by open-pit mining and underground mining for selected pipes. The main objective of the mine plan is to enhance the value of the project by providing a consistent supply of kimberlite for the diamond recovery plant which, in turn, supplies a reasonably consistent output of diamonds.

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Three open-pits would be developed to mine the top portions of the kimberlite pipes. The open-pit would have a diameter of about 750 m at the top and then angle down to a base diameter just slightly wider than the diameter of the kimberlite pipe. The A154 pit would be the largest and deepest (285 m). It would be used to mine both the north and the south A154 kimberlite pipes. Only a small amount of the north pipe would be mined from the open-pit, with the pit bottom being centred on the south pipe. Pits would be developed by blasting, loading and hauling away country rock in layers (benches) that are 15 m high and cover the full surface of the open-pit area. When kimberlite is reached, it would be blasted and trucked away in a manner similar to the country rock, but it would be hauled to the ore stockpile instead of the country rock area. Open-pit excavations and underground work would involve blasting. Blasting would not necessarily occur every day.

Before closure, mined country rock and finer sediment material would be placed in the area between the inside toe of the dike and the pit crest to create fish rearing habitat. When mining is complete in each open-pit, water would be re-introduced to the pit, initially through a siphon system and followed by a limited dike breach, to levels equal to Lac de Gras water levels. The breaches would be sized and located to achieve the desired water circulation. Closure plans for the open-pits are described in Diavik's initial Abandonment and Restoration Plan.

At closure, portions of the mine areas would be returned to productive fish habitat, wherever possible. Baseline environmental studies determined that shallow (3 to 5 m) sheltered areas are relatively uncommon in Lac de Gras. These areas tend to have higher primary productivity, providing good rearing habitat for fish. Additionally, shallow, south-facing shorelines could provide spring shorebird habitat.

3.1.3 Proposed Project Schedule

Assuming permits are received in the fall of 1999, construction would commence in 2000. Initial construction activities would include:

- Establishment of quarries for construction materials;
- Construction of roads and airstrip;
- Dredging, dike construction and dewatering for the A418 and A154 open-pits and North Inlet dikes;
- Dam construction for the sedimentation ponds;
- Development of the main facilities areas, including site grading and construction, and
- Temporary facilities and camp.

Construction activities would largely be completed within the first 2 to 3 years. For the purpose of the environmental effects assessment, this period is referred to as the construction period. The A154 pit would be mined from 2002 until 2011. The A418 pit would be mined from 2008 to 2013. The A21 pit would be mined from 2012 to 2014 with ore being hauled either directly to the process plant or to the stockpile area. Underground mining is proposed to occur from 2014 until 2021.

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Activities related to closure would occur throughout the life of the mine. Initial activities would include reclamation studies and fish habitat creation. During the latter half of the mine life, mined A21 rock could begin to be placed over the coarse processed kimberlite and/or the north country rock pile as part of final closure. At the end of the mine life (around 2025), activities would include removal of buildings, regrading and ecological restoration. These activities would likely be completed by 2030 (Figure 3-1).

3.2 PROJECT COMPONENTS AND ACTIVITIES

3.2.1 Water Retention Dikes

Three water retention dikes would be constructed around the kimberlite pipes to facilitate mining. The proposed dikes are temporary water retaining structures designed to enable safe open-pit and underground mining over the life of the proposed project. Natural water conduits and the porous, weak nature of the kimberlite mean that underground mining without a dike for water control would pose an unacceptable risk to life and property. One dike would surround the A154N/S kimberlite pipes, one around A418, and one around A21. Additionally, one small dike would be placed across the end of the North Inlet so that this area could be used as a component of the water management system.

The general location of each dike is based upon the location of the kimberlite pipes. Three key factors considered in the selection of optimal alignments include: 1) minimizing the amount of construction material and dike footprint, therefore reducing costs and environmental effects by maximizing use of shallow water and islands; 2) allowing appropriate set-back distance from edge of mine-pit wall to ensure safe operating conditions in the open-pits, and respecting the Diavik mineral lease boundary, and 3) allowing economic mining of the crown pillar.

Diavik subjected the dike design presented in its environmental assessment submission to a constructability analysis. This analysis concluded that building the original, non-conventional dike cross-section would be relatively complicated, as it required the placement of a number of different rock layers in discrete zones. From a construction perspective this would require a large number of resources and it would be challenging to build in short Arctic construction seasons. As a result, a simpler conventional dike cross-section has evolved that satisfies all safety and performance criteria.

The proposed dike design satisfies the most stringent design criteria of the Canadian Dam Safety Committee. The proposed alignment of the optimized dikes is generally the same, except for a subtle revision to the A154 alignment to include the crescent shaped island at the northeast corner of the dike. A smaller amount of rockfill is needed to build the dike over this small island than would be required in the water to the south. As a result of making the dike cross-section more conventional, the footprint area of the dike has been reduced by about 30%.

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3.2.2 Lakebed Sediment Removal

Sediments at the bottom of Lac de Gras are not suitable materials for the dike foundation. They are typically composed of soft, fine mud that has been deposited into the lake by erosion of on-land bedrock and till. Dredging of the A154 and A418 dike footprints would remove approximately 300,000 m^3 and 170,000 m^3 of sediment, respectively. The dredge would cut the sediments and then pump them up a pipeline in a slurry form. Dredging would dilute the sediments with lake water for transport, so though they exist at about 60% solids on the lake bottom, they would be pumped out of the pipeline at an average of about 15% solids.

3.2.3 Country Rock Areas

Country rock, mined to access the four kimberlite pipes, would be placed in two areas on the East Island. One location is near the A418 and A154N/S pipes on the north part of the East Island, and the other in the centre of the southern portion of the East Island. In total, the three open-pits would produce about 125 million m^3 (250 million tonnes) of country rock. The maximum height of the piles would be about 85 m above Lac de Gras (500 m elevation), approximately 50 m higher than the maximum elevation on the East Island. In total, the two areas cover about 3.5 km^2. More details regarding the design, layout, development sequence and closure plans are provided in Diavik's country rock management plan.

Subject to field experimentation during operations, the current plan for restoring soils and vegetation is to establish pioneer island communities of vegetation at closure. These islands would be created using the lake bottom till and vegetation/seed material taken from patches of undisturbed tundra within the mine area. The islands of vegetation could only be considered as a head start to the revegetation process. The remainder would occur naturally over time, as these islands of vegetation spread, although the rate of natural vegetation would be very slow. More information on revegetation at closure is found in Diavik's initial Abandonment and Restoration Plan.

3.2.4 Diamond Recovery Plant

The proposed location for the diamond recovery plant is on the southeast side of East Island. It would be adjacent to the accommodation complex, and in proximity to all four pipes as well as the processed kimberlite containment. A treatment plant crushes, washes, screens and separates the kimberlite into a diamond-bearing fraction that would then be passed to the recovery plant. This reduced volume concentrate would then be subject to x-ray sorting and magnetic separation to recover diamonds.

3.2.5 Processed Kimberlite Containment (PKC)

Processed kimberlite (kimberlite from the diamond recovery plant that has the diamonds removed) would be transported by slurry pipeline (fine fraction) and truck (coarse fraction) to a containment area. The PKC is being designed to take advantage of local topography, local construction material and Arctic climatic conditions. The proposed engineered structure would be located at the central, low point on the East Island. Progressive

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development would provide for storage of 15.6 million cubic metres (Mm^3) of fine, 8.5 Mm^3 of coarse kimberlite and around 1.0 Mm^3 of collected water for recycling. A summary description of this facility is provided below. More detailed information can be found in Diavik's processed kimberlite management plan.

Two streams of kimberlite, coarse and fine, would be stored separately but in the same area. The fine kimberlite, transported by slurry line, would be released into a natural valley dammed at either end by a large dam structure. Coarse kimberlite, which is trucked from the diamond recovery plant, would be placed to the north and south of the fines containment area, as well as being used in the construction of the containment dams. Similar containment dams would be constructed around the entire perimeter of the coarse processed kimberlite storage.

Closure of the PKC is intended to provide long-term isolation of the processed kimberlite from the environment. To achieve this, the first step would be to design the facility to accommodate closure as described. The next step would be to treat and discharge the free pond water that remains at the end of operations. It is expected that this draw down would begin in the last few years of operation and be completed shortly thereafter. At this point, the processed kimberlite would be exposed to air and would begin to freeze. It is expected that it would take many years before the entire mass would be frozen. The PKC would be capped with country rock at closure.

The closure plan would evolve over the life of the mine, based on information and experience gained during operations. Options that may be considered include the partial backfilling of processed kimberlite into the pit. This, however, would be fully investigated and these plans would be submitted for review by the regulatory authorities. Diavik's initial Abandonment and Restoration Plan has been prepared and provides more information on the initial closure plans for the PKC.

3.2.6 Roads and Airstrip

There would be three types of roads constructed at the proposed site: haul roads for mining haul truck traffic, service roads to provide vehicle access to all areas of the proposed project, and an access road for the winter ice road. Roads would be constructed above grade, using quarry or mined country rock of the appropriate size as the principal source of fill. General construction configuration was presented in the environmental assessment overview.

Mine Haul Road: The mine haul road is designed to accommodate a 177 or 218-tonne off-highway truck, which requires a minimum travel surface width of 22 m. Safety berms would be provided only in locations where road elevations are greater than 3 m above original ground in accordance with the NWT Mine Safety Act. The safety berm cross-section would be developed by end dumping rock fill.

Access Roads: A network of site access roads would provide site circulation linking the airport, plant site and ice haul road. The access road design is based on a commercial transport vehicle with a B-train configuration. The road cross-section would provide a 12 m wide travel surface.

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Service Roads: Service roads would be provided throughout the site for light vehicle traffic for operations and maintenance purposes. To accommodate light vehicle traffic, the road cross-section was revised to provide an 8 m travel surface, rather than 12 m as originally described. Perimeter service roads would be included for all facilities.

The roads and airstrip (unless determined at closure to be useful) would be regraded and reclaimed ecologically at closure. Details of the closure plan for the roads and airstrip are presented in Diavik's initial abandonment and restoration plan.

Airstrip: For most of the year, the primary link to the proposed mine site would be by air. A 2,000 m airstrip would be located on the northern peninsula of the East Island, and would be able to accommodate Boeing 747 and Hercules C130 aircraft. The airstrip would be constructed according to Transport Canada requirements for this type of air traffic. The airstrip would be built with the proper lighting and control requirements to facilitate 24-hour access to the site. About 10 to 20 flights per week during construction and four to seven flights per week during operations would be required to transport personnel and perishable supplies. These supplies would be the primary aircraft loads.

3.2.7 Quarry and Borrow Sites

One of the first construction activities would be to establish sites to quarry construction material. The primary quarry site is along the exposed bedrock ridge where the north country rock would ultimately be placed. The base of the quarry would be up to 30 m deep. Planned quarry production from this site would total around 7.5 Mm^3. Additional material would also be excavated from grading of the main facilities area. This would amount to around 1.5 Mm^3. Limited esker material is available on the East Island. Material from one esker, which is also within the north country rock area, is proposed for use in construction.

After further analysis on the feasibility study, Diavik determined that it would require approximately 100,000 m^3 of material upon starting construction. Diavik proposes to utilize a mainland quarry location near Echo Bay's Lac de Gras camp to meet this demand for granular material. The granular material would be removed from an esker at this location and trucked over the ice road to the construction site. The gravel pit would be used for only one season and then restored and recontoured.

3.2.8 Power Supply and Fuels

A power supply system of five 5 MW diesel generator sets is proposed. Four generator sets from the construction phase (each with a 1.25 MW capacity) would be used for stand-by power. Two glycol-heat recovery and circulation systems are proposed: low heat and high heat.

Diesel fuel would be the primary fuel for the site. It would be used for a number of operations including electrical generation, pumps, and mining equipment. A diesel storage tank farm would contain tanks with sufficient capacity to supply 12 months of operation. Tanks would have secondary containment systems that include berms, release prevention barriers and a synthetic liner. Self-contained gasoline storage with secondary containment

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would be available to contain up to 25,000 L of fuel for snowmobiles, boats, gas-powered tools and small mobile equipment. A 40 m by 40 m lined containment facility would be provided for drum storage of jet fuel required for helicopters, turbine, fixed-winged and jet-equipped aircraft. Several storage tanks ranging in size from 40,000 to 130,000 L would be required for lubricating oil, heating glycol, engine oil, hydraulic fluid and antifreeze. Additionally, a waste oil storage tank approximately 350,000 L in volume would be required. Each of the tanks would be located within secondary containment berms.

3.2.9 Water Management Plans

Diavik has developed a water management plan for all waters at the mine site. This includes process water used in the diamond recovery plant, potable water, mine water (infiltration of lake and groundwater plus surface runoff), water seepage through the dikes, sewage, and runoff from the mine site, roads and the airstrip. The underlying principle behind the water management plan is to ensure that Lac de Gras water is not adversely impacted. Diavik has considered the proposed siting for the mine (i.e., the East Island) in developing a plan that provides an integrated water collection, reuse and treatment system.

3.2.9.1 Role of the North Inlet

The small inlet on the north end of the island is a component of the proposed water management plan. It would perform several important functions:

- Settling pond for removal of suspended solids;
- Surge pond for event-based runoff to open-pit areas, and
- Temporary storage prior to treatment for any turbid water that is unsuitable for discharge.

In the initial year of construction, an impermeable dike would be built across the end of the North Inlet. Water levels behind the dike would be reduced by several meters to create storage capacity. This water would be pumped directly to Lac de Gras and a fish salvage would also be undertaken to minimize the number of fish trapped in the North Inlet.

3.2.9.2 Mine Water

Water that collects within each of the open-pit areas would be composed of groundwater discharged from the pit walls and underground workings, and runoff (rainfall and snowmelt). This water would be collected from in-pit sumps and pumped to the east end of the North Inlet. Some initial settling of suspended solids would occur before the water would be brought into a water treatment plant for final suspended solids removal prior to discharge to Lac de Gras. No pit wall dewatering systems are planned at this time.

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3.2.9.3 Dike Seepage

Toe drains along the inside edge of the dikes are included in the design of the dikes and the water management system. The purpose of the drains would be to collect any water that seeps under the slurry wall or grout curtain, as well as surface runoff in the buffer area. Highest flow quantities would occur in the initial years before the open-pits have been developed to depth. During this time, the water would be pumped to join the mine water through the submerged discharge line to Lac de Gras. Once the open-pits have been developed, any groundwater seepage would report to the mine-water sumps as groundwater. Estimates of dike seepage flow rates are 1,800, 7,250 and 6,500 m^3/d for dikes A418, A154 and A21, respectively. Water quality of seepage is expected to be comparable to Lac de Gras. If suspended solids were introduced within the collection system, the water would instead be directed to the North Inlet followed by suspended solids removal at the water treatment facility.

3.2.9.4 Country Rock Area Runoff

Mined country rock would cover sizeable areas of the East Island. Rainfall and snowmelt in these areas would be collected and pumped to the PKC. Collection would be achieved primarily by diverting water to collection ponds using perimeter roads. Excavations may be necessary where natural topography cannot be used. Most of the runoff is expected to result from snowmelt. As such, the management plan accounts for storage of the spring melt water within collection ponds. This water would be pumped down by the fall of each year. Directing the water to the PKC would allow for permanent storage of as much of the water as possible within the void spaces of the processed kimberlite.

3.2.9.5 Plant Site Area Runoff

The plant site area would include the process plant buildings, kimberlite ore stockpile, permanent camp, shops, tank farms and the graded surface area around these facilities. A grading plan has allowed for collection of runoff to two storm-water ponds. From here, water would be pumped directly to the diamond recovery plant for use, or to the PKC. Stormwater ponds are designed for 1:100 year, 24-hour rainfall events. Annual average runoff that could flow into these ponds is in the order of 0.06 Mm^3. Due to the presence of shops, diesel and stockpiled kimberlite, it is anticipated that this water quality would not be suitable for direct discharge to Lac de Gras.

3.2.9.6 Diamond Recovery Plant Water

Water would be used to wash and thaw kimberlite in the diamond recovery plant. This water would be extensively recycled, using a thickener to remove the solids. Recycling within the plant would likely result in one parcel of water being used several times before being routed to the PKC with the processed kimberlite. The plant would require about 143 m^3/h of make-up water that would be provided by water recovered from the PKC. This make-up is the difference between the water that enters the diamond recovery plant with the mined ore (18 m^3/h) and the water leaving the plant with the processed kimberlite (~161 m^3/h).

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3.2.9.7 Processed Kimberlite Containment Water

Water within the PKC would be composed of water from the diamond recovery plant, runoff from the country rock areas and plant site, as well as rain or snow that falls within the containment area. Some of this water would eventually be tied up within the void spaces of the deposited processed kimberlite. On the surface of the processed kimberlite there would be a pool of water. This pool would be used as make-up water for the diamond recovery plant and to mix with the thickener underflow to dilute the fine fraction of processed kimberlite. This would enable transport via slurry line to the PKC. It is estimated that 0.5 to 1.0 Mm^3 of free pond water would be stored in the pond. Over time, the volume of this pond is expected to increase to the point that it would require treatment and discharge to Lac de Gras via North Inlet.

The quantity of water that would reside in either the pore spaces or as free water in the pond is a function of many variables, but primarily the physical properties of the processed kimberlite, particle size distribution and consolidation rates. Initial information from the bulk sampling program has been used to develop a water balance for the operating life of the mine. Initial pond water volumes are assumed to start at 0.5 Mm^3, which would likely come initially from the dewatering or dredging of the A154 area. Diavik predicted that by 2013, a continuous discharge would be required. The expected quality of the water within the containment area has been estimated based on country rock runoff quality, diamond recovery water quality and leaching from processed kimberlite.

3.2.9.8 Domestic Sewage

A sewage treatment facility would be constructed to service the permanent camp and diamond recovery plant area. Wastewater sources would include toilets, showers and a kitchen. Expected volumes are less than 100 m^3/d. Sewage would be treated for the removal of suspended solids and biological oxygen demand (BOD), in addition to disinfection. This would be achieved using biological digestion/aeration and either ozonation or UV for disinfection. Expected treatment performance is 10 mg/L of total BOD, 10 mg/L suspended solids and <5 counts/100 mL fecal coliforms. Treated domestic sewage would go to the PKC. Sludge from the treatment plant would be dried and incinerated.

3.2.9.9 Water Treatment Plant

The treatment system proposed for the mine water has been designed to remove suspended solids to less than 25 mg/L, and sized to treat up to 30,000 m^3/d of water in phases. Process flow diagrams are provided in Diavik's water management plan. In summary, there are three main components: flow equalization, filtration and filter backwash.

The objective of the processed kimberlite water treatment system would be the control of suspended solids, pH and metals. A 2-stage hydroxide and sulphide precipitation system is proposed for the removal of metals. Design criteria include capacity for 2,500 m^3/d of water and treatment performance that can achieve concentrations for most metals in the < 0.1 mg/L range. Performance capabilities are element specific, and will require site-specific testing and modifications during operations.

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3.2.9.10 Water Management Operations

Two wastewaters would be discharged to Lac de Gras via North Inlet. The mine water would be a continuous discharge increasing in volume over time. This water would be treated for suspended solids. The processed kimberlite water discharge would be a continuous discharge predicted to start in year 12 when the water balance in the PKC reaches a positive level. This water would be treated for suspended solids, pH and metals. Contingency measures are built into the water management plan for operations.

3.2.9.11 Water Management During Construction

During the early phases of construction, there would be disturbed areas creating a potential exposure to elevated suspended solids in runoff water. To manage this, a perimeter containment system would be constructed during initial construction to provide some level of water control. The proposed sedimentation ponds have been sized and located to accompany the perimeter road, and allow adequate retention time for solids to settle prior to overflow to natural drainage routes and Lac de Gras. In addition, sediment control through construction management practices, and use of control devices such as sediment fences would be employed. These are described in Diavik's construction area/activity environmental management plan.

3.2.9.12 Water Management at Closure

Diavik's closure objective is to design and manage each of the facilities to enable the site to be left without requirements for long-term water treatment. Closure activities would be required to achieve this objective, and monitoring would be required as verification. The detailed requirements necessary to achieve this objective can only be determined with information gained through operations. The following describes current closure concepts with respect to water management. These are also discussed within Diavik's initial Abandonment and Restoration Plan.

Pond water from the PKC would be treated and discharged to Lac de Gras via North Inlet. Following dewatering, the exposed pond floor would be covered with country rock and a low permeability cap that would shed water to natural drainage routes and Lac de Gras. The collection ponds used during operations could function as settling ponds or provide wetland polishing, if appropriate.

Throughout operations, monitoring would assess the closure requirements for the country rock areas. If water quality proves to be unacceptable for discharge, a low permeability cap could be placed on the country rock. Monitoring would be required to ensure adequate runoff/seepage water quality. Once verified, the collection system would be allowed to overflow to natural drainage and ultimately, Lac de Gras. Collection ponds could function as settling basins and/or wetland polishing ponds.

With respect to water management, the ultimate contingency (should the closure objectives prove infeasible), would be to collect runoff waters (as during operations) and to continue to treat and discharge the collected water. Refilling the open-pits with Lac de Gras water at closure would require monitoring and verification of water quality conditions prior to breaching of the dikes. This water is expected to meet guidelines established for drinking water and for the protection of aquatic life.

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3.2.10 Explosives Factory

Explosives would be used during construction for excavation purposes and during mine operations. An explosive mixing plant for operations would be located northeast of the process plant and it would be licenced under the federal Explosives Act for Class 2 explosives containing nitrate mixtures. A temporary mixing plant will be utilized for construction activities prior to the completion of the permanent facility. The primary explosive material would be ANFO, which is a mixture of ammonium nitrate and fuel oil. Emulsions are two immiscible liquids – one an oxidizer phase and the other a fuel phase. Ammonium nitrate is used in the oxidizer phase. Other chemicals that may be used to manufacture explosives are nitric acid, acetic acid, sodium formate, soda ash, ethylene glycol, dye-orange oil, polymers, sodium thiocyanate, sodium nitrite, and paraflex process oil.

The emulsions manufactured on site would be stored in a tank located at the mix plant which would be approved by Natural Resources Canada Explosives Regulatory Division pursuant to the federal Explosives Act. Ammonium nitrate stock for the manufacturing of explosives would be stored in a building on the west side of the site. Boosters and detonating cords would be stored in lined and fortified seacan containers located approximately 1 km northeast of the permanent camp. Detonators would be stored in a separate magazine on the west side of the site. The magazines would be licenced by the Territorial government. Fencing and storage design requirements pertaining to detonator magazine and explosives magazine are outlined in Diavik's Explosives Management Plan.

3.2.11 No Net Loss of Fish Habitat

The Department of Fisheries and Ocean's policy for management of fish habitat recognizes that fish habitats constitute healthy productive systems for Canada's fisheries resources, and reaffirms the need for their management and protection. The objective of the policy is to maintain a net gain in the productive capacity of fish habitat in Canada. Conservation of existing habitats is one goal. Diavik's No Net Loss Plan describes the proposed plan for achieving no net loss of fish habitat.

Avoiding alterations to fish habitat is the preferred approach of both Diavik and the Department of Fisheries and Oceans for achieving no net loss. Avoiding fish habitat alteration was a significant factor in reviewing project design alternatives. However, some habitat alteration is unavoidable. This includes the dike areas, North Inlet, and several small lakes on the East Island that would be covered by the proposed project footprint. Mitigation has been proposed in the form of habitat creation similar to that which would be altered.

Fish habitat types altered by the proposed project would be primarily average to low quality rearing and foraging habitat. Only a small percentage of the total available spawning and nursery habitat (for most species) would be altered by the proposed project. Mitigation efforts would focus on the creation of high quality shallow-water rearing and foraging habitat for the fish species most likely to be in a position to take advantage of this type of habitat.

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Modifying the dikes to provide productive habitat would create additional fish habitat. The external edge of the dikes would have rock below the riprap (erosion control), to a maximum depth of 6 m, to promote spawning activities. During operations, the bench between the inside toe of the dike and the open-pit crest would be built up to create artificial shoals and other habitat structures that would ultimately lie beneath shallow water when the dikes were breached. This would provide high quality rearing and foraging habitat. Specifications for this design would be developed using input from communities, Department of Fisheries and Oceans, as well as other expert advice available to Diavik.

Several small fish-bearing lakes on the East Island would be covered by constructed facilities. Mitigation is proposed as the modification of other lakes on the East Island provides only limited habitat. Habitat in these lakes would be modified to allow for both deep overwintering habitat and a shallow productive zone for foraging. Again, specifications for the design would be developed using input from communities, Department of Fisheries and Oceans scientists, as well as other expert advice available to Diavik.

3.2.12 Waste Management Plan

The primary objective of Diavik's waste management plan is to minimize waste. Ultimately, waste disposal would be required when reduce, reuse, recycle and recover approaches are no longer applicable or practical. Waste disposal would be conducted in a manner that recognizes the physical and biological conditions at Lac de Gras. The following is a summary of key features of the waste management plan.

A waste storage facility would be located adjacent to the maintenance shop and would be fully bermed and lined with an impervious liner to contain potential spills or release of materials to the environment. The design volume for the containment would be for the capacity of the largest single container plus 10% of the total volume of the rest of the containers. The site would be secured, signed, have first aid equipment and all applicable spill kits for stored wastes. All transfers, draining, loading, and unloading would occur in the lined area. Staff would be fully trained in the necessary procedures and protocols.

Two incinerators are proposed during operations. One would be a small diesel-fired, single-chamber unit that would be located adjacent to the workshop and diamond recovery plant, used to dispose of non-hazardous combustible waste that could not be practically recycled. The second incinerator would be a multiple chamber, in-line diesel-fired unit designed to handle rubbish, refuse and garbage, including domestic garbage, sewage sludge, food waste and non-hazardous industrial waste. This incinerator would be operated to combust 100 kg/hr of waste, six hours per day, and would be located in an enclosed building close to the camp. During construction, the same incinerator would be used, but would require continuous operation to manage the larger volumes of waste. Incinerator ash would be transported in a closed truck to the on-site landfill.

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3.2.13 Hazardous Materials

Some of the materials to be used by the proposed project are considered hazardous, and are subject to special storage and handling protocols. These materials include fuel, lubricants, process chemicals, and explosives. The Hazardous Materials Management Plan, in Diavik's Environmental Management System, provides a discussion of hazardous materials management.

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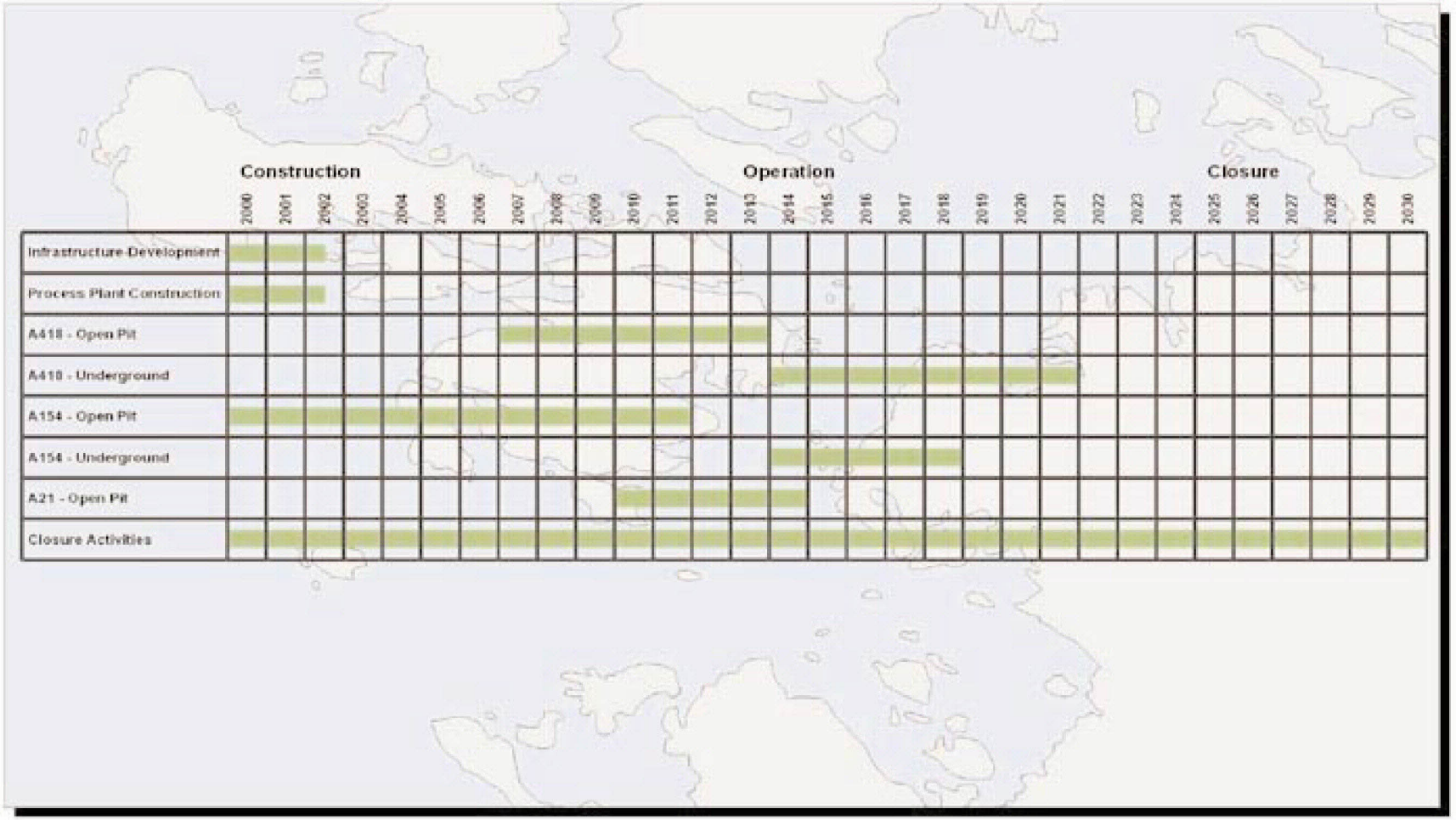

DIAVIK DIAMONDS PROJECT

DIAVIK DIAMOND MINES INC.

PROPOSED PROJECT SCHEDULE

		3-1	B

4.0 PROJECT ALTERNATIVES

4.1 APPROACH

Every comprehensive study under the Canadian Environmental Assessment Act (CEAA) must consider alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means (CEAA 16(2)(b)).

Information on project alternatives was extracted, for the most part, from Diavik's environmental assessment overview, environmental effects reports, Diavik's Environmental Management System (EMS) and from supplemental information submissions from Diavik. Additional information, clarification and interpretation was provided by an independent mining engineer contracted by the Department of Indian Affairs and Northern Development (DIAND).

A summary of the analysis of environmental effects of the proposed alternatives is presented in Chapter 8.

Examining alternative means of carrying out a project involves answering the following four questions:

1. What are the alternatives?
2. Are these alternatives technically and economically feasible?
3. What are the environmental effects associated with the feasible alternatives?
4. What is the rationale for selecting the preferred alternative?

Throughout the Diavik Diamonds Project design process, various mining concepts were developed, analyzed, refined and eventually focused down to preferred alternatives. This section describes alternatives that were considered by Diavik, the potential environmental effects of the technically and economically feasible alternatives and the selection of the preferred alternatives based on pre-determined criteria. Unless otherwise noted in the separate sections, the general selection criteria of technical feasibility, economics, environmental effects and community perspective were used as outlined below.

- Technical feasibility - Is the performance of the method proven under site conditions? What is the level of confidence or risk associated with the method and its performance?
- Economics – How is the method considered in relation to factors such as capital, operating and closure costs, and risks to investment?
- Environmental effects – What are the environmental effects of the alternative? Are the effects adverse, significant and/or likely and what is the environmental advantage of the alternative considered?
- Community perspective – Is the alternative acceptable, appropriate or desirable? These perspectives were difficult to factor into some of the evaluations but were the dominant factors in others.

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4.2 MINING ALTERNATIVES

During the initial stages of project engineering, scoping level studies were conducted by Diavik to assess potential mining options suitable for the site conditions. These conditions included the physical pipe setting within the lake, hydrological and geotechnical characteristics of the orebody and surrounding rock, mass pipe geometry, ore quality, ore recovery, ore dilution and production and operating requirements. Potentially applicable mining methods were identified including methods with and without a water retention dike. Such methods included a variety of caving and non-caving underground mining methods, open-pit mining and more unconventional methods such as blindhole drilling, jet boring and dredging.

Based on the studies, the unconventional methods that were determined by Diavik to be technically unpractical or unproven at a commercial scale were rejected. Diavik determined that either a combination of open-pit and underground mining behind a dike or all underground mining without a dike would be considered in further analysis. All underground mining without a dike was defined as Alternative #1.

Diavik then conducted economic analyses on possible open-pit/underground combinations to determine the most suitable depth for the transition from open-pit to underground mining. Using this information as a guide, more detailed mine plans were developed to verify the selected transitional depth. A mine plan focussing mainly on underground recovery with smaller open-pits to recover the 100 m crown pillar area was defined as Alternative #2. A mine plan with open-pits ranging from 190 m to 280 m in depth was defined as Alternative #3 (also referred to as the preferred or proposed alternative or plan).

In summary, the alternative mining approaches evaluated in Diavik's environmental assessment and detailed in this section were:

Alternative #1 – All underground mining without a dike and leaving a crown pillar barrier,

Alternative #2 – Underground with open-pit mining of the crown pillar zone within a dike,

Alternative #3 – A larger open-pit mine combined with some underground mining with a dike.

Figure 4-1 is a schematic representation of the three alternatives showing the dikes, mined and un-mined segments of the kimberlite pipes and the open-pits and underground projections.

As Diavik selected Alternative #3 as the preferred alternative, more detailed engineering and environmental information is available for this plan. The same level of analysis was not applied to Alternative #2, the less preferred alternative, or to Alternative #1 which was rejected as not being economically viable.

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Figure 4-1 Schematic representation of three mining alternatives

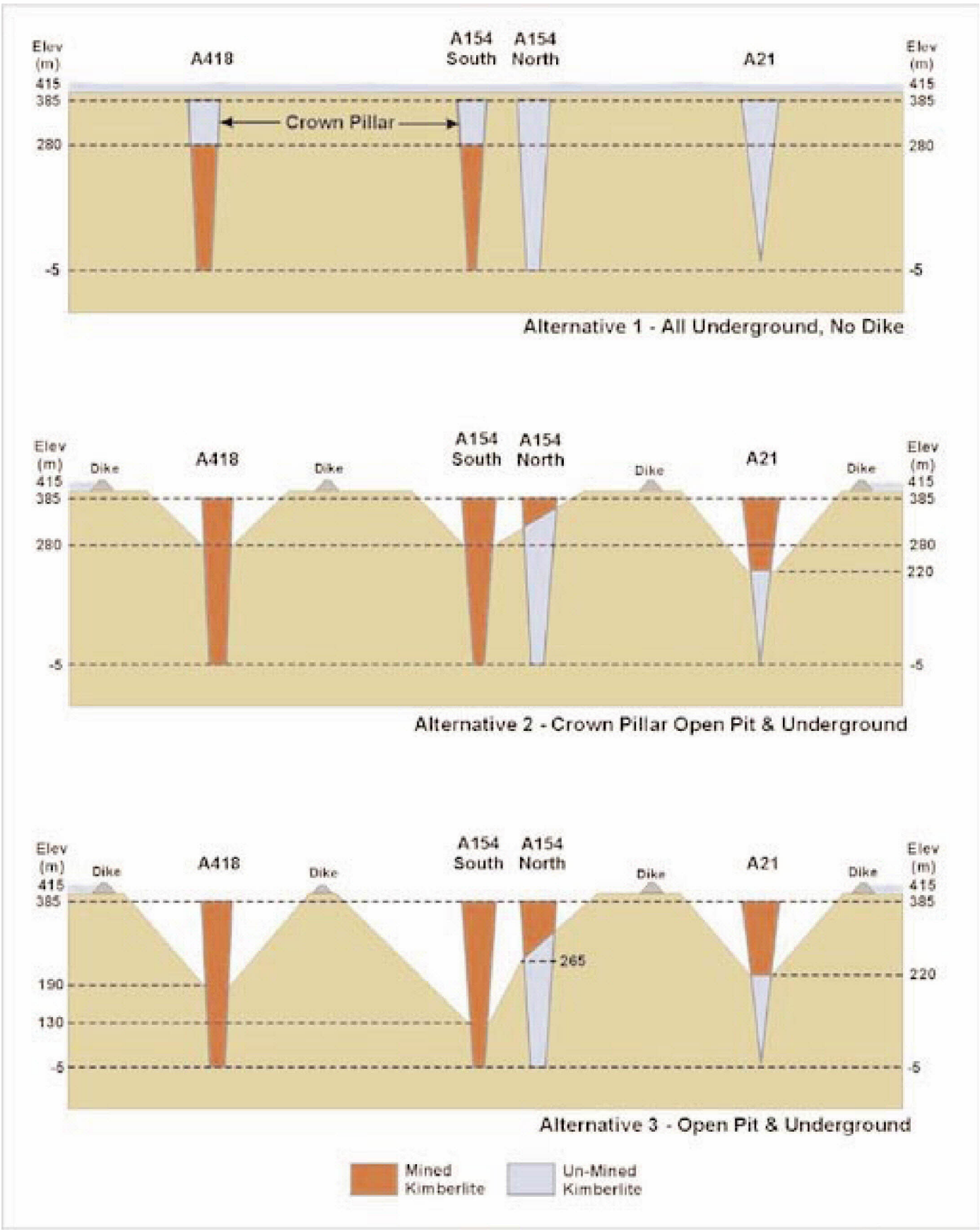

Figure 4 - 1

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4.2.1 Alternative #1

Alternative #1 would involve mining from underground only without a water retention dike. A mineshaft would be sunk to gain access to underground workings. A 100 m thick layer of kimberlite (referred to as the crown pillar) would have to be left in the top of the kimberlite pipe to separate the workings from the water of Lac de Gras. An underhand cut-and-fill mining method (a low productivity/high cost method) would be needed since ground conditions prevent the creation of large spans or openings in the kimberlite.

Diavik stated that this alternative would have the lowest resource recovery at a higher cost, which would result in an unacceptable project economic value for the following reasons:

- Open-pit mining operating costs average 30-50% of underground mining costs. The lower value ore in A154N and A21 would not support higher-cost underground mining and these reserves would be removed from the mine production schedule if open-pits were omitted.
- The estimated ore reserve using this mine plan would decrease from 26 million tonnes (proposed alternative) to 14 million tonnes. The loss of reserves from crown pillars would total 7 million tonnes of ore while the loss of A21 and A154N from the reserve would remove another 5 million tonnes. This would result in a reduction in diamond production from 102 million carats to 60 million carats. The reduction in diamond production is less than the reduction in ore since much of the ore that would not be mined is of lower grade. Assuming a value of US$56/carat, the potential loss in revenue would be about US$2.3 billion (Cdn$3.5 billion).
- As a result of the reduced ore reserve, the all underground mine life would be reduced to about 14 years compared to 20 years with the proposed plan. In addition, the development time would increase from 2 years to 3 thereby delaying investment return for an extra year.

In its assessment of the financial viability of this alternative, Diavik considered the expected returns to the investor as well as the risk associated with that return. Diavik determined that the higher underground mining costs, loss of ore reserve, lower annual production rate and shortened mine life would severely impact the economics of the project as well as the socio-economic benefits locally, regionally and nationally. While open-pit mining is a well proven, low cost mining method, there is little experience in underground mining of Northwest Territories kimberlite pipes and there are uncertainties associated with ground control requirements, backfill performance and water management requirements. Diavik concluded that mining the pipes by underground methods without a dike has higher risks and is not economically viable for investors.

Although Alternative #1 was determined not to be economically feasible, it did present the best mining situation from an environmental perspective. For this reason, Diavik carried the evaluation of Alternative #1 forward and supplied the following additional information:

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- This alternative would minimize environmental disturbance since neither dikes nor country rock piles are required. This would remove any concerns with respect to effects on fish and fish habitat and water quality as they relate to dikes or country rock. The total terrestrial footprint of the project for Alternative #1 would be 3.0 km^2, which is less than half the footprint of either Alternative #2 or #3.
- It would be technically difficult to ensure water control and the structural integrity of the crown pillar with the waters of Lac de Gras immediately above--especially given the number of exploration boreholes drilled through the kimberlite pipes.
- Risks to worker safety would be higher than with other options due to the relatively weak kimberlite beneath a large lake. The existence of grouted exploratory drill holes would further increase the risk of sudden water and mud inflows. While it is technically possible to find these holes and re-grout them during underground development, there are increased operating risks in attempting to do so.
- Underground production rates are lower than for open-pit, but nearly the same number of people would be required for an open-pit operation of 2 – 3 times the capacity. Open-pit miners, however, require about 2 weeks of training while underground mining requires a much longer training period due to the specialized skill requirements. Currently the specific skills required for underground mining do not exist in the targeted Aboriginal communities and substantially more time would be required to enable employment opportunities for Aboriginal people. Alternatively, some Aboriginal workers currently possess skills required for open-pit operations (e.g. heavy-equipment operation). This alternative presented the lowest immediate employment potential for Aboriginal workers and northern workers in general, limiting overall northern employment benefits. Additionally, community members preferred to work in open-pit operations. It is uncertain whether they would be willing to take advantage of underground mining employment opportunities.

4.2.2 Alternative #2 Description

Alternative #2 would be a combination of open-pit and underground mining within the confines of a water retention dike. It would be similar to Alternative #3 except that the open-pits would be much smaller and there would be more underground mining at pipes A418 and A154S. The open-pits would be designed with depths around 100 m to recover the crown pillar ore. The mining of A21 would only be by larger pit, as in Alternative #3, since underground mining of this pipe is not economical due to lower ore value. Similarly, underground mining of A154N would not occur.

In this mine plan, access to the underground workings would be by mine shaft rather than spiral ramp due to the shallow pit depths and since underground development must be concurrent with open-pit mining in order to provide a constant supply of ore to the process plant.

This alternative would require less total dike length, a smaller north country rock pile and a smaller diked-off area. The water management plan and other infrastructure components would remain unchanged from Alternative #3. A comparison of this alternative with Alternative #3 follows in section 4.2.4.

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4.2.3 Alternative #3 Description

Alternative #3 would involve a larger open-pit mine combined with limited underground mining with a dike. Following the construction of a water retention dike and the removal of pool water within the dike, open-pit mining of the overburden material, country rock and ore is proposed using conventional mining equipment such as hydraulic shovels, front-end loaders and large tonnage off-highway trucks. Ore reserves below the open-pits would be extracted using underground mining methods incorporating undercut and also blast hole techniques followed by backfilling. Three water retention dikes would be required as well as two country rock piles to accommodate 250 million tonnes (Mt) of rock. This was the preferred mining plan proposed by Diavik.

Three open-pits at A154S, A418 and A21 with pit depths of 280m, 220m and 190m respectively would be developed. Economics and the dike requirements determined the projected size of the open-pits. A portion of the A154N pipe would be mined in conjunction with the mining of the A154S open-pit. Underground mining would occur at A418 and A154S only, as in Alternative #2. The resources below the A21 open-pit and within the deeper A154N pipe were determined to be uneconomic using underground mining techniques. The proposed mining plan contained a mineable ore reserve of approximately 26 million tonnes. Diavik proposed to mine the reserves by economic rank starting with the largest A154S open-pit and followed by pits A418 and A21. Underground mining from A154N and A418 would take place concurrently immediately following the completion of all open-pit mining to minimize the transition period between the two methods.

Diavik submitted that Alternative #3 would have the best economic-risk profile; highest project economic value; achieve maximum resource recovery; provide the greatest economic benefits to northerners as well as shareholders; provide maximum employment opportunities within the open-pit operation (community preferred operation), and would have minimum technical and economic risks. Also, Diavik concluded that extensive environmental analysis has indicated that no significant adverse environmental effects would be associated with this alternative.

4.2.4 Comparison of Alternatives #2 and #3

Diavik determined that both Alternative #2 and Alternative #3 would be technically and economically feasible and would involve a combination of open-pit and underground mining following the construction of water retention dikes. The main technical, economic and environmental differences between the two alternatives stemmed from the significant difference in scale between the open-pit components and also the uncertainty associated with some aspects of underground mining. The differences in project schedule would impact the timing of capital expenditures and hence project economics. Resource recovery was determined to be similar for both alternatives.

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i) Technical Feasibility

The main technical advantages of Alternative #3 were based on an assessment of the relative risk factors between open-pit and underground mining. The technical risks associated with underground mining were considered to be greater than for open-pit and were:

- mine stability risks associated with the weak ground conditions;
- water management risk due to the presence of potentially ungrouted exploratory drill holes, and
- ore production rate limitations due to the logistics of the underground mining and backfilling cycle

The successful mitigation of these risks would likely result in increased costs and reduced operating efficiency.

Open-pit mining relies on well-proven and relatively simple mining methods and technical risks associated with open-pit mining are generally easier to manage than underground. Alternative #3 would have a smaller underground component and consequently has a lower technical risk.

ii) Economic Viability

Diavik stated that, while both alternatives presented economic potential, the higher mining cost and higher up-front capital requirements of Alternative #2 would result in less favourable economics. The shallower pits of Alternative #2 would necessitate the construction of an underground mine shaft earlier and for a longer development period. Additionally, Alternative #3 dike construction would be spread over a longer period of time allowing some capital cost to be deferred.

Diavik has determined that the project economic value for Alternative #3 would be acceptable to its investors whereas Alternative #2 would not be considered financially attractive.

Although the mineable reserves for Alternative #2 and 3 mine were similar, the slightly higher mining recovery for open-pit methods favoured Alternative #3. Neither alternative however, would recover the deeper resources of A21 nor A154N pipes that were considered uneconomic by exclusively open-pit or underground methods.

iii) Environmental Effects

Diavik prepared a submission in response to a request from the responsible authorities (RAs) for more information regarding the potential environmental effects of Alternative #2. Diavik reiterated that the assessment of effects for Alternative #2 did not include the same level of quantitative analysis, as did the proposed alternative. Effects for Alternative #2 were presented as qualitative effects at the regional level.

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Table 4-1 Mining alternative comparison of key quantities and areas of disturbance.

	Element	Alternative #3	Alternative #2
Mine	Open-pit ore Underground ore Total country rock including till Biotite schist estimate Total terrestrial area	21 Mt 5 Mt 250 Mt 10% 8.3 km2	12 Mt 14 Mt 110 Mt NA 7.9 km2
Dike	Total length Total rock requirements Quarry requirements for A154 dike Dredging volume Area enclosed	7.9 km 6.5 Mm^3 1.9 Mm^3 900,000 m^3 2 km^2	4.9 km 5 Mm^3 1.3 Mm^3 600,000 m^3 2.2 km^2

The size of the Alternative #3 open-pit operations would be greater than for Alternative #2 and would result in a larger dike system and country rock storage area. Diavik predicted that, although Alternative #2 leads to a reduced environmental disturbance at a local level, it did not offer any clear environmental advantage over Alternative #3 with respect to regional scale impacts. A comparison of the approximate quantities and areas of disturbance as reported by Diavik is shown in Table 4-1.

Diavik noted that the differences in Alternative #2 relative to Alternative #3 could translate to a small reduction in local environmental effects since:

- the loss of vegetation/land cover would be reduced from 8.3 km^2 to 7.9 km^2;
- caribou, grizzly bear, carnivore, small game and raptor areas of potential habitat loss would be reduced from 8.3 km^2 to 7.9 km^2;
- the temporary loss of shallow water waterfowl habitat would be reduced from 0.5 km^2 to 0.3 km^2 and the shoreline loss would be reduced from 24 km to 20 km;
- the areas of reduced water quality due to dike construction and operation would be reduced from a length of 7.3 km along the dike to 4.9 km along the dike;
- the predicted area of sediment deposition during dike construction would be reduced due to a reduced volume of dredged material from 0.9 Mm^3 to 0.6 Mm^3 ;
- there is a reduced chance of trapping fish behind the dikes as the total dike area is reduced from 3.2 to 2.2 km^2, and
- there would be a reduced temporary fish habitat loss caused by the dikes from 2.5 km^2 to 1.6 km^2 and a reduction in footprint loss from 0.8 km^2 to 0.6 km^2.

Since the A154 dike would be built with quarry rock, there could be a small reduction in quarry requirement with the smaller dike (Alternative #2). Diavik stated that this would be an insignificant reduction in light of the quarry requirements for site development, road construction, etc. that are common to both alternatives. In both cases, the A154 dike would be built with quarried rock and A418 and A21 would be built from excavated country rock.

Diavik concluded that, on a regional basis where significance of adverse effects would be determined, there would be no difference in magnitude or duration of predicted effects between Alternative #2 and #3.

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iv) Community Perspective

Diavik stated that communities have expressed a number of concerns including a preference for open-pit rather than underground mining from employment, safety and general northern benefits perspectives. The proposed Alternative #3 would maximize the open-pit mining component and therefore would satisfy this request.

Diavik claimed that the current skills of northern people are more closely aligned to the requirements of open-pit mining than the higher skills requirements of an underground operation. Alternative #3 therefore, would provide better employment potential than methods requiring a greater underground component.

Diavik stated that the extended dike construction schedule of Alternative #3 also would allow for greater opportunity for northern businesses to prepare and become involved in construction activities.

Diavik stated that communities also requested that, if the natural environment of East Island was to be disturbed, Diavik should maximize resource recovery and should not just take the best parts. Diavik considered Alternative #3 would maximize diamond recovery and would provide the most royalty tax revenue, profit-based royalties and taxes paid.

4.2.5 Preferred Alternative Selection

Alternative #3 was selected by Diavik as the preferred alternative since it would best achieve its objectives for the project, in that the design would minimize environmental effects while maximizing employment and business opportunities for northerners and would provide an optimum return to investors, to government and to the Canadian public.

Diavik rejected Alternative #2 primarily due to its overall economic-risk profile. Underground mining at Las de Gras presents higher risks, both economically and technically, than those of open-pit mining. The pit depths described for Alternative #3 represented the economic optimum. Pits shallower or deeper than this would result in substantial increases in overall mining costs. Initiating an underground operation earlier would require an additional injection of capital earlier. This increased capital (and interest) would be used to develop a less efficient and more costly underground operation. Consideration of the community's perspective (in terms of open-pit versus underground mining options) also supported the rejection of Alternative #2 due to the extent of underground mining. Although the environmental footprint would be reduced with Alternative #2, as described above, the overall adverse environmental effects would remain comparatively unchanged when compared to Alternative #3.

Diavik proposed to maximize mine life as well as return on investment by the manner in which it set the production rate, how it would take material out of the resource and put it into the reserves and by staying within environmental, socio-economic and health and safety management objectives.

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Diavik considers mine planning to be an ongoing process and will continue to seek improvements in its approach. Examples of this might include segregation of biotite schist, backfilling of country rock into completed open-pits if geochemical testing verifies acceptability, use of processed kimberlite as underground backfill, etc.

4.2.6 Independent Analysis

The independent evaluation of Diavik's alternative analysis involved; i) examination of the alternatives and review of Diavik's work to determine if there are any ways to reduce environmental disturbances, and ii) examination of the proposed Alternative #3 presented by Diavik to see whether there are opportunities within the plan to enhance the project from a technical, economic and environmental perspective.

The independent analysis resulted in the following observations:

- The decisions made by Diavik for the purposes of project design and mine planning are based on limited, prefeasibility level information but provide a reasonable basis for detailed design. Key decisions and design elements should be re-evaluated as mine development proceeds and prior to the commencement of major construction milestones. Any review should be carried out in conjunction with the collection of additional information (e.g. during construction and mining activities).
- Diavik has done a reasonable job of setting the main assessment criteria and organizing and ranking a wide range of conventional and non-conventional mining concepts.
- The importance of using a well-proven technology in the Lac de Gras environment for a project of this magnitude is clear. The alternative selected must be proven in terms of maximizing the economic benefit of the project and must also be environmentally sound.
- Diavik has done a thorough assessment of the proven technologies and has chosen a minimum risk approach that is prudent given the current knowledge of the project. The economic cornerstone to the project is the A154S pipe and the decision to use a dike and open-pit mine a large portion of this resource is sound.
- There appear to be some alternative approaches to mining which, although not proven on a commercial scale or in the specific Lac de Gras environment, may have the potential to provide future benefits. A more efficient approach to mining may be possible which would provide opportunities to reduce operating costs, increase environmental benefits, as well as expand the reserve base and mine life.
- There are two well-proven methods of mining, open-pit and underground, and there are numerous possible combinations of sizes for the two. Diavik's preferred alternative allows a large scale open-pit mining operation within a large dike followed by underground mining where economic. Its alternative to this (Alternative #2), involves a smaller pit to mine the "crown pillar", and again followed by underground mining.
- The selected alternative provides a reasonable economic balance between open-pit and underground mining. Open-pit mining is a safe proven technology and provides a low risk approach that maximizes ore recovery. While this selection provides the most comfort for investors, it would also create the largest environmental disturbance in terms of construction, mining activity and project footprint size.

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- Another important aspect of the project is the proposed development and production sequence. There are three main resources that are mined, and the current plan recovers the highest grade, lowest cost resources first and then progresses through to the lower grade, higher cost resources. Diavik has also chosen to link the open-pit and underground development to avoid concurrent open-pit and underground production. While this decision results in some development and operating cost savings, it reduces production-scheduling flexibility and the ability to backfill mined-out pits. The benefit of this approach is that it minimizes the initial risk to the investor and maximizes the net present value of the project. The longer-term disadvantage is that this approach leaves the lower profitability ore to the end and may make the operation more vulnerable to changes in market conditions.
- There appear to be opportunities to enhance the overall efficacy of the project, reduce environmental disturbance, and reduce project closure and abandonment requirements. If the project is approved, these opportunities should be actively pursued during engineering, construction and early operation, prior to 'locking in' the complete mine development sequence. Such opportunities may include the assessment of alternate mining technologies and the back filling of mined out pits as options to reduce operating costs and long term environmental mitigation requirements.

A qualitative comparison of Alternative #2 and #3 is presented in Table 4-2. The descriptors used are not equal for each criteria or between items. This table, however, provides a summary for verification of alternative preference using Diavik's pre-determined selection criteria.

Table 4-2 Mining alternative comparison for the selection of a preferred alternative.

Criteria	Item	Alternative #3	Alternative #2
Technical Feasibility	Resource recovery	Similar	Similar
	Mine life	20 years	23 years
	Mining methods risks	Lower	Higher
	Mine production risk	Lower	Higher
	Mine water management risks	Lower	Higher
	Mine worker health and safety risks	Lower	Higher
	Dike constructability risks	Similar	Similar
	Mine constructability risks	Lower	Higher
	Mine operability risks	Lower	Higher
Project Economics	Capital requirements	Higher	Lower
	Operating costs	Lower	Higher
	Return on investment	Higher	Lower
Environmental Effects	Dike and Mine construction	Higher	Lower
	Country rock size	Larger	Smaller
	Pit footprint	Larger	Smaller
	Biotite schist generation	Larger	Smaller
	Local air quality	Greater	Smaller
	Water quality	Greater	Smaller
Community Perspective	Potential for employment	Greater	Smaller
	Total job opportunities	Smaller	Greater
	Royalty and tax generation	Greater	Smaller

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4.2.7 RA Conclusions

The RAs conclude that Diavik has considered reasonable alternative means of mining the proposed resource and concur with Diavik's determination that Alternative #1 is not economically feasible. The RAs accept Diavik's selection of Alternative #3 over Alternative #2 as the preferred mining method.

The RAs support Diavik's proposal to maximize mine life as well as return on investment. The RAs agree that consideration should be given to maximizing long-term social and economic benefits for all stakeholders.

The RAs support Diavik's policy of monitoring and assessing environmental performance on a continuous basis and implementing improvements as appropriate. If the project is approved, Diavik will submit recommendations for these improvements on an annual basis. Aspects of the mine development which would be re-evaluated as more information is obtained with development and mining may include:

- The re-evaluation of alternate mining technologies at A418 and A21 pipes prior to the commencement of A418 and A21 dike construction;
- the evaluation of alternative or emerging technologies to recover currently uneconomic resources
- the pursuit of emerging opportunities to reduce on-land disturbance
- the evaluation of alternate biotite schist management programs to reduce long term mitigation requirements
- the pursuit of opportunities to use of processed kimberlite as underground backfill to reduce the long term mitigation requirement of the PKC facility.

4.3 SITING

Diavik proposed that environmental effects of the project could be mitigated through the location of major facilities. Some facilities such as roads and airstrip have limited siting options. The locations of other facilities, like the diamond recovery plant, were more flexible. There are numerous interdependencies among facilities that tended to dictate the order in which they would be located. Initially there was considerable flexibility in where the diamond recovery plant could be placed. However, once the processed kimberlite containment (PKC) was located, proximity to that facility limited the location alternatives for the diamond recovery plant. Diavik determined the locations for major facilities following a specific order: 1) PKC, 2) country rock areas, and 3) accommodations and diamond recovery plant areas.

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4.3.1 Processed Kimberlite Containment (PKC)

Diavik initially considered three alternative locations for the PKC facility:

Alternative #1 - T-lake, a natural topographic feature on the mainland, east of East Island;

Alternative #2 - Central valley on the East Island, and

Alternative #3 - Lac de Gras, between East and West Islands.

The proposed location for the PKC facility is the central valley on the East Island.

Diavik rejected the alternative of T-lake for the disposal of processed kimberlite based on environmental and community perspective considerations. Diavik understood that there was a general preference in the communities to minimize the extent of the development and to keep the footprint of the project as small as possible. Also, Diavik predicted that there would be a greater potential for effects on wildlife movement with a greater east-west footprint. Furthermore, with the T-lake option, Diavik predicted that there could be a greater effect on fish and water quality due to the requirement for a causeway from the mainland to the East Island and water diversion at T-lake and loss of habitat at T-lake.

Diavik stated that the disposal of significant volumes of processed kimberlite in Lac de Gras was an unacceptable option from the perspective of communities. This was a clear indication that the Lac de Gras option, while possibly advantageous from a geochemical and closure perspective, would not be preferred. This alternative was also discussed with the Department of Fisheries and Oceans and reviewed by fisheries biologists. Diavik observed that considerable concern was expressed over the Lac de Gras option because the area between the East and West Islands is shallow, sheltered habitat that is uncommon in Lac de Gras. Permanently removing this habitat from use by fish in Lac de Gras was deemed undesirable from a fisheries perspective.

Diavik decided that the preferred alternative would be a site on East Island. This would achieve the objectives of avoiding the fish destruction of valued fish habitat while respecting the concerns of the community. In the central portion of East Island, there is a valley that runs east-west. This topographic feature, when supplemented with engineered structures, provided a technically and economically feasible location for storage of processed kimberlite. Diavik concluded that potential environmental effects associated with this option would be mitigable with known technology and would be more easily managed than potential effects associated with other alternatives.

4.3.2 Country Rock Areas

Country rock refers to the non-diamond material that is mined in conjunction with the development and mining of the open-pit and underground ore. The proportion of country rock to ore varies significantly with the pit depth. The quantity of country rock from the development of the underground mine is relatively small.

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In general, the materials contained in the country rock stockpiles would include lake bottom sediments, glacial till, granite and pegmatite bedrock and metamorphic-sedimentary biotite schist.

Diavik estimated that 250 million tonnes of country rock would be removed in the process of mining the kimberlite ore. Three general locations were considered by Diavik when evaluating alternative sites to store the mined country rock:

Alternative #1 - Typical country rock area would be placed on land on East Island near the open-pit being mined;

Alternative #2 – An open-pit that would already have been mined would store country rock from an active open-pit (backfilling), and

Alternative #3 - Country rock would be placed in Lac de Gras as a widening of the dike (top widths of greater than 500 m were considered).

Diavik stated that geochemistry was a factor in determining the site of the country rock area since there is the potential for acid generation and metal leaching from the biotite schist component (10%) of the rock. Two of Diavik's proposed alternatives focused on geochemical control; Alternative #2 pit backfilling into a flooded pit and Alternative #3 direct placement in Lac de Gras. Both offer the potential for permanent, sub-aqueous storage and the desirable attribute of long-term reduction of leaching reactions.

It is Diavik's position that, to achieve geochemical control with the backfilling option, the completed pit must be either flooded before the rock is placed or flooded immediately after to prevent development of reaction products which would subsequently be washed into solution and enter the environment. Therefore, the open-pit mining as well as the underground mining beneath the open-pit must both be complete to take advantage of this alternative. Diavik concluded that, to accept this alternative, the mining sequence (which currently follows an order from highest-grade ore to lowest grade ore) would have to be changed resulting in a significant economic penalty. Diavik therefore rejected alternative #2.

Further, Diavik stated that the movement of country rock back into the pits, following both open-pit and underground mining, would not completely mitigate the potential effects associated with on-land storage. An on-land stockpile would still be required since the volume of blasted country rock would be approximately 30% greater than the volume that could be returned to the pits. Also, while technically feasible, backfilling of the pits after mining is complete has two significant disadvantages. First, double handling the rock would effectively require re-mining the pile. At a minimum, a combination of blasting and ripping would be needed (especially if the country rock is frozen with interstitial ice) along with loading and haulage back to the open pits. Diavik determined that it would not be economically feasible to incur the costs associated with this secondary movement of country rock. Third, during the time (about 20 years) that the country rock was stored on the island, the rock surfaces could have developed metals precipitates from secondary reaction products of sulphide oxidation and mineral weathering. These reaction products could be dissolved and transported into Lac de Gras if the country rock was returned to the pits and then covered with Lac de Gras water. For these reasons, backfilling of country rock after completion of mining was rejected.

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Diavik considered the benefits of geochemical control created by subaqueous disposal in Lac de Gras against the potential effects on fish habitat and determined that it was unlikely that the net loss objective required by the Department of Fisheries and Oceans' fish habitat compensation policy could be achieved with extension of the dikes to allow storage of mined country rock. Furthermore, Diavik stated that, from a community perspective, placement of country rock in Lac de Gras as an extension of the dikes was viewed as placing waste where waste did not belong. For these reasons, Diavik rejected Alternative #3.

Diavik's proposed Alternative #1 is two on-land country rock piles, one on the north part of the island for the rock from A154S/N and A418 pits and one on the south part of the island for the A21 rock. Site selection on the island was predominantly determined by drainage boundary perimeter and haul distance. Diavik recognized that there would be disadvantages with this alternative, namely lower geochemical control and greater potential for effects on wildlife habitat and movement, and vegetation/land cover. However these effects were not predicted to be significant and mitigation measures such as a drainage collection network and wildlife migration routes were proposed.

4.3.3 Accommodation and Diamond Recovery Plant Areas

Diavik determined the preferred location for the accommodations, diamond recovery plant and other facilities (e.g., power generation and truck shop) after selecting preferred sites for the PKC facility and country rock areas. The following alternatives were considered on East Island:

Alternative #1 – Near the existing camp;

Alternative #2 – On the west side of the island, and

Alternative #3 - On the southeast peninsula.

Diavik selected the southeast peninsula as the preferred site for the accommodation and diamond recovery facilities. Diavik predicted that the differences in the three locations, from an environmental perspective, would be minimal so other factors were considered when siting these facilities.

One design feature for the proposed diamond recovery plant site on the southeast peninsula is the direct dumping of kimberlite ore into the plant instead of using a large conveyor to lift the material to the required elevation. The appropriate elevation of the diamond recovery plant would be obtained by excavating the area where the plant would be located so that the plant would sit against a large rock wall. Kimberlite ore could then be dumped from the top of the wall directly into the top of the diamond recovery plant. Diavik predicted that this gravity flow system would reduce energy requirements for the conveyance system and reduce the size of the building and energy requirements for heating. The topography of the southeast peninsula could accommodate this plant design.

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View, noise, and access to work areas were important considerations for Diavik when siting the accommodation facility. The current camp location (northeast) was not considered a good accommodation location relative to the other two sites. A disadvantage of the southeast peninsula alternative was the distance from the airstrip.

4.3.4 RA Conclusions

The RAs conclude that Diavik has considered reasonable alternative means of siting the project facilities and agree with Diavik's selection of the central valley on East Island for the processed kimberlite containment facility as the preferred alternative.

The RAs agree that Diavik's selection of a preferred option for country rock disposal is acceptable for waste rock storage. The RAs require that final disposal and closure options continue to be evaluated throughout the life of the mine. The RAs accept Diavik's selection of the southeast peninsula as the preferred location for the accommodation and diamond recovery plant areas.

4.4 WATER MANAGEMENT

Diavik's first step in designing the water management system was to characterize the water sources (quality and quantity) that would be used or require disposal and determine the water use requirements. Once the source waters were characterized, alternative water management plans were developed and evaluated. These plans focussed initially on matching water use requirements with wastewater sources to identify opportunities to recycle and reuse water. Any remaining surplus water would be considered for discharge to Lac de Gras, after treatment requirements and alternatives were examined. The following sections describe the different water management alternatives considered by Diavik. It was determined that there would be three primary water sources that require management:

1. Runoff from the country rock areas and facilities area (diamond recovery plant, fuel storage, etc.), would total about 90 m^3/h on an annual average basis at full development. Much of this water would be snowmelt that would result in flows of about 250 m^3/h during peak months of May/June;
2. Processed kimberlite water and wastewater from the diamond recovery plant would collect in the PKC. Estimated excess water volumes would be around 100 m^3/h on an annual average basis, accounting for recycling and storage with the processed kimberlite, and
3. Mine water is predominantly groundwater that would seep into the open-pits and underground mine workings. At full mine development this volume could represent 1,250 m^3/h.

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4.4.1 Water Management Plan

Excluding fresh water required as potable water (4 m^3/h), Diavik predicted that the proposed project would require about 150 m^3/h of make-up water to the plant at full development. The alternative water management plans presented by Diavik and based on the general water qualities and quantities previously described were:

Alternative #1 - Treat and release the runoff and processed kimberlite water while using the minewater as make-up for the processing plant, and

Alternative #2 - Treat and release minewater while using processed kimberlite and runoff water as make-up for the processing plant.

Diavik determined that the second alternative of treating and releasing mine water while using processed kimberlite and runoff water as make-up water had some distinct advantages. Minewater is expected to have a good water quality requiring only filtration to remove suspended solids. It is also expected to have the largest volume. Therefore, minewater was considered as better water to discharge. Processed kimberlite water and runoff water would have the potential to contain elevated metals, which would have a greater potential to adversely effect water quality and fish, while having relatively low volumes. The total estimated volume of this water would provide a close match with expected make-up water demand. Therefore, processed kimberlite and runoff water were considered to be the best waters for recycling. However, excess water would collect in the PKC that would require treatment and discharge. Some of this water would ultimately be contained with the processed kimberlite.

Diavik's proposed water management plan would have a primary discharge of minewater and a secondary discharge of processed kimberlite and runoff water (PKC water). Both of these discharge streams would require some level of treatment. A broad range of treatment alternatives was developed based on the water quality and quantity of both proposed discharges. Concerning treatment alternatives, Diavik considered the quality of minewater and PKC water for:

- total suspended solids (TSS) levels in both minewater and PKC water have the potential to be greater than 25 mg/L, which is a recognized discharge standard for long-term releases;
- metal levels in the minewater are expected to be low to very low, as this water would be predominantly groundwater. However, PKC water could contain elevated levels of metals;
- total dissolved solids (TDS) levels in the minewater would have the potential to increase over time if saline groundwater were drawn up into the mine;
- nutrient (phosphorus and nitrogen) levels in both the minewater and the PKC could be elevated, and
- groundwater, the predominant source for minewater, would have elevated phosphorous levels. Nitrogen levels are expected to be elevated due to blasting residuals.

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4.4.2 Water Treatment Technology

Diavik considered five water treatment technology alternatives:

Alternative #1 - Settling ponds - use of gravity and retention time to allow suspended solids to settle from the water prior to discharge.

Alternative #2 - Coagulation, flocculation, clarification and filtration – removal of suspended solids using the addition of flocculants and coagulants that bind to very fine particles to improve the performance of filters.

Alternative #3 - Hydroxide/sulphide precipitation - use of a two staged system that removes metals from solution through precipitation. Some metals would precipitate with the addition of hydroxide (lime) at a pH of 10.5 whereas others would precipitate with the addition of sulphide at a pH of 8.5.

Alternative #4 - Reverse osmosis – process of forcing water through a semi-permeable membrane, leaving behind concentrated brine that contains most of the dissolved material. About 15% of the water would remain within the brine concentrate.

Alternative #5 - Ion exchange - use of a series of exchange resins to remove TDS (salts). Exchange resins have specific cationic or anionic charges that bind with dissolved salts from the discharge water. Strong acids and bases are used to regenerate the resins.

Diavik evaluated the treatment alternatives based upon after-treatment water quality, environmental performance (including waste streams and energy requirements), operating feasibility in a remote northern environment and economics. As a result of these evaluations, Diavik proposed to treat minewater discharge through a combination of settling ponds (North Inlet) with coagulation, flocculation, clarification and filtration for TSS removal. Diavik proposed to treat PKC runoff through a combination of settling ponds and hydroxide/sulphide precipitation for metals removal, within a treatment plant. Reverse osmosis and ion exchange were rejected even though they would result in higher quality effluent. These alternatives would have the potential to increase effects on air quality due to increased power demand and would increase effects on wildlife habitat and movement and vegetation/land cover due to increased terrestrial disturbance for disposal of treated wastes. Also, Diavik decided that reverse osmosis and ion exchange are not economically feasible.

Diavik also stated that settling ponds would have the potential to increase effects on water quality and fish due to variable treatment performance.

4.4.3 RA Conclusions

The RAs conclude that Diavik has considered reasonable alternative means of water management and water treatment and concur with Diavik's selection of the water management option to treat and release minewater while using processed kimberlite and runoff water as make-up for the processing plant. The RAs concur with Diavik's selection of water treatment alternatives to treat all water to prescribed levels prior to discharge. The prescribed levels will be determined by regulators in the regulatory process.

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4.5 DIKES

4.5.1 Dike Design

Diavik developed three alternative dike designs during pre-feasibility engineering:

Alternative #1 - Two parallel, rock- filled shells with glacial till in the middle.

Alternative #2 - Single rock-filled shell on the outside, with crushed rock on the inside penetrated by a slurry wall of concrete.

Alternative #3 - Single rock-filled shell on the inside, till on the outside and thermosyphons to create a frozen, watertight centre.

Safety and cost were the predominant criteria for Diavik in developing these dike design alternatives. Diavik predicted that the primary environmental variable in the consideration of these dike alternatives was the type of construction activity that would occur on the Lac de Gras side of the dike. Construction with smaller-sized material on the outside would be more likely to introduce suspended solids into Lac de Gras. Of the three designs, the first and second have rock-filled shells made of larger-sized material on the outside. Diavik proposed a design that was a combination of the first two alternatives. It included two parallel rock-shells and a slurry wall to reduce the width of the dike. When Diavik conducted constructability analysis on this alternative it concluded that this design would require a large number of resources and would be challenging to build in short Arctic construction seasons.

During the optimization study, Diavik determined that the water retention dikes could be constructed more efficiently while still achieving the same performance criteria. Diavik presented a fourth alternative January 22, 1999. This alternative incorporated a single crushed rock core with protective coarse rock layers on each side of the core.

Diavik predicted that optimization of the dike construction would not change the conclusions regarding the overall predicted environmental or socio-economic effects of the proposed project. Some small differences in effects that Diavik anticipates are reduction in fish habitat loss from dike footprint; reduction in suspended solids generated during dredging and dike construction; reduction in dredged lakebed sediments from dike footprint requiring disposal; reduction in quarried material required for dike construction, and reduction in fuel used and dust generated from material crushing.

As a result of Diavik selecting the new smaller, simpler alternative as preferred, the A154 dike could be built first allowing the most desirable resource to be developed first. As a result of the revised mine schedule, Diavik also predicted a potential slight increase in mine water quantities over the first 10 years; reduced water treatment quantities over the life of the second and third pits; and, an opportunity for earlier, progressive reclamation of the third pit (A21).

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4.5.2 Dike Alignment

The specific location proposed for each dike is referred to as the alignment. Diavik considered two alternative alignments:

Alternative #1 - a circular alignment with the inside toe of the dike set at the minimum set-back distance from the edge of the open-pit.

Alternative #2 - an alignment that respects the minimum set-back distance but then follows a path of shallow water.

Diavik predicted that the environmental advantage of the circular alignment is that it would minimize the surface area removed from Lac de Gras thereby reducing the potential effects on fish and fish habitat. On the other hand, this alignment would require some sections to be constructed in deeper water, requiring placement of more material and a longer period of in-lake activity allowing an increase for potential effects on fish and water.

Diavik stated that following shallow water areas and using islands, where possible, would result in a longer dike and the dewatering of a greater surface area of Lac de Gras. It would also increase the volume of country rock storage required. The volume of mine water to be treated and the amount of lake sediment disturbed during construction would be higher. However, this alignment would minimize the in-lake construction time and the total amount of material to be placed. Diavik selected Alternative #2 as the preferred alternative.

As a result of the dike optimization exercise, Diavik expects only a subtle revision to the A154 dike alignment from the earlier plan.

4.5.3 RA Conclusions

The RAs conclude that Diavik has considered reasonable alternative means of dike design and dike alignment and accept Diavik's selection of the optimized dike design as the preferred alternative.

The RAs accept Diavik's selection of a dike alignment that respects the minimum setback distance from open-pits but then follows a path of shallow water.

4.6 PROCESSED KIMBERLITE CONTAINMENT (PKC)

4.6.1 Alternatives

Once a proposed location for the processed kimberlite containment area was selected, Diavik developed and evaluated alternative designs for the containment dams. During pre-feasibility engineering, three alternative designs were considered:

Alternative #1 - This alternative used a combination of mined country rock and a PVC liner to create dam structures. The dams would be raised as storage requirements increased, by adding mined country rock to the outside. Both the fine and coarse fractions of the processed kimberlite would be contained behind these structures;

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Alternative#2 – This would include construction of starter dams similar to Alternative #1. Alternative #2 would then place coarse (1 to 6 mm) processed kimberlite, frozen in lifts, on the inside face of the dam instead of country rock to raise the dam as needed. This would reduce the top surface area over time. Both fractions of processed kimberlite, coarse and fine (<1.0 mm), would be contained behind these structures, and

Alternative #3 – This would create starter dams consisting of two parallel rock dikes with the area between the berms filled with compacted, frozen till. Dam lifts would then occur on the centre line with both the inside and outside slopes moving toward the centre. The lifts would be constructed with mined rock on the outside face and coarse kimberlite on the inside face. In this design, excess (not included in dam lifts) coarse processed kimberlite (1 to 6 mm) would be trucked and placed around the perimeter of the fine processed kimberlite (<1 mm) cell. A perimeter dam, with a design similar to that described above, would eventually be constructed around the entire coarse kimberlite area.

Diavik selected Alternative #3 as the preferred alternative.

Diavik determined that all three of the pre-feasibility design alternatives for the PKC would be technically and economically feasible. Diavik then considered whether the design could be constructed within the proposed time frame, given climatic conditions. It concluded that no one design would be significantly easier or harder to construct but from an economic perspective, Alternatives #2 and #3 were the least expensive to construct and operate.

Environmental considerations included long-term seepage containment. Seepage during the life of the mine was less of a concern as it could be collected and pumped back to the containment. With respect to long-term seepage, it is expected that the third alternative would have the least risk. Alternatives #1 and #2 include a geomembrane for containment during operations. However, in the long-term there would always be a risk of seepage due to puncturing of the liner material. Alternative #3 is therefore the preferred alternative considering environmental and economic issues.

4.6.2 RA Conclusions

1) The RAs conclude that Diavik has considered reasonable alternative means of processed kimberlite containment.
2) The RAs accept Diavik's selection of a processed kimberlite containment design.

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4.7 POWER GENERATION

4.7.1 Alternatives

Diavik evaluated alternative means of providing around 20 MW of power. These included:

Alternative #1 - Diesel generators would require about 30 ML of diesel per year to fuel six generators to provide site wide electricity;

Alternative #2 - Wind-driven generators would involve the installation of numerous large propeller type windmills, and

Alternative #3 - Hydroelectric generators would involve using natural water flows to power turbine generators. Locations considered include the Lockhart River (3 sites), Snare River (2 sites), Coppermine River (2 sites) and Hood River (2 sites).

Diavik presented diesel generation of power as the preferred alternative. Diesel power generation would create emissions due to combustion but would have a small disturbance footprint. Diavik would be able to produce diesel power reliably, economically and efficiently. Waste heat produced by the generators could be recovered to heat related buildings (accommodations, recovery plant) and infrastructure. This would allow up to 90% efficiency as opposed to approximately 45% efficiency where waste heat is not recovered from diesel generators (as in remote communities). Without heat recovery, Diavik would be required to construct steam plants or additional alternative sources of heat for buildings.

The preferred alternative from an environmental perspective would be wind-generated electricity as it does not result in any air emissions and has a minimal disturbance footprint. However, wind-driven generators, even as a possible supplemental power source, were considered not feasible due to low wind conditions at the site (average windspeed of 18 km/h).

Diavik hydroelectric power generation requires a relatively large disturbance of land and water through impoundment, but does not create atmospheric emissions. Hydroelectric power generation, while feasible, would also be costly.

Diavik evaluated the alternative of hydroelectric power generation. Locations considered include the Lockhart River (3 sites), Snare River (2 sites), Coppermine River (2 sites) and Hood River. No existing source of hydroelectric power is available in the vicinity of the project and no existing producer could supply the mine without substantial expansion and the construction of greater than 300 km of transmission line.

Diavik determined that there was sufficient hydraulic gradient at these sites to generate enough power for the proposed project. However, power supply from a small hydroelectric plant with a long power distribution line, would be vulnerable to power outages that would disrupt mining. Long-term maintenance of the lengthy transmission line would also be difficult and very costly. In addition, the likelihood of low flow years at the sites selected is probable and therefore the potential exists for long periods of time when hydroelectric power supply would be unreliable. Diavik would require the same diesel generating capacity on-site as described in the project description to ensure reliable, consistent power supply during potentially long periods without hydroelectric power.

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From a financial perspective, Diavik's cost estimates for the development of these sites have indicated a substantially higher overall cost for hydroelectric power (without eliminating the capital cost of on-site diesel generators) as compared to diesel-generated power. Diavik determined that a larger power demand than that required by the proposed project would be needed to reduce the cost per MW to an acceptable level. Diavik concluded that hydroelectric power was not an economically feasible alternative.

Furthermore, Diavik predicted that potentially significant destruction of habitat and the flooding of large areas of wildlife habitat (including wetlands) would result from the development of a dam and hydroelectric generating station at all of the sites reviewed. Potential loss of historical sites along rivers would occur and loss of the ability to navigate those waters was also predicted to occur.

4.7.2 RA Conclusions

The RAs conclude that Diavik has considered reasonable alternative means of power generation and concur with Diavik's determination that hydroelectric power generation is not presently economically feasible. The RAs accept Diavik's selection of diesel power generation as the preferred alternative.

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5.0 SCOPE OF ASSESSMENT

5.1 GENERAL SCOPE OF ASSESSMENT

5.1.1 Scope of the Project

The scope of the proposed Diavik Diamonds Project is defined in the environmental assessment (EA) guidelines to include the construction, operation, closure and post-closure or any other undertaking in relation to the project. The scope of the project includes:

- Ore reserves and resources, mining rate and mining methods;
- Open-pit and underground mining;
- Retention dikes;
- Waste rock (country rock) or/and overburden stockpiles;
- Mill (diamond recovery);
- Water management (treatment and recovery systems);
- Water supply;
- Tailings (processed kimberlite) containment area including structure, stability;
- Power generation and transmission facilities;
- Explosive factory and storage;
- Air and ground traffic;
- Mainland and island quarries, and
- Site facilities and infrastructure.

5.1.2 Scope of the Assessment

The environmental assessment guidelines were developed in a manner that required Diavik to consider the factors and scope of factors necessary to meet the legal requirements of the Canadian Environmental Assessment Act (CEAA). Requirements are set in the definition of environmental effect and in Section 16 (1 & 2) of the Act:

- Environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- Significance of the environmental effects;
- Comments from the public received in accordance with the Act and regulations;
- Technically and economically feasible mitigation measures that would mitigate any significant adverse environmental effects of the project;
- Purpose and need of the project;
- Technically and economically feasible alternative means of carrying out the project and the environmental effects of any alternative means;
- Need for, and requirements of, any follow-up program;
- Capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future, and
- Any other relevant matter that the RA or the Minister of the Environment, after consulting with the RA, may require.

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The environmental effects of the project include any change in the environment such as effects on human health, socio-economic conditions, physical and cultural heritage, current use of lands and resources for traditional purposes by Aboriginal persons, structures, sites or things that are of historical, archaeological, palaeontological or architectural significance, and changes to the project that may be caused by the environment.

The scope of the assessment, and therefore this review, does not include the ongoing process of land claim negotiations and the establishment of impact benefit agreements. While these concerns are acknowledged as important matters, they are best addressed outside the comprehensive study report.

5.1.3 Temporal Scope

Environmental conditions from which environmental changes have been measured are based on field studies conducted from 1994 to 1997. Potential environmental effects of the proposed project are predicted for four phases associated with the proposed project. These four phases are construction, operation, closure and post-closure. Project activities associated with each of these phases are described in Section 3.0 of this comprehensive study report. Not all of the environmental components would be affected at similar intensities at the same stage of project development. The environmental assessments for the different resources focussed on the project phase(s) where maximum effects were predicted. Further details on temporal boundaries for each discipline are provided in the environmental effects reports.

5.1.4 Spatial Scope

In general, each discipline identified three study areas in which to analyze likely effects on the environment: local, regional and cumulative (Table 5-1). The size of these areas varied among disciplines according to the context necessary to best understand and quantify potential effects. In general, the potential effects in the immediate vicinity of the proposed project were assessed within the local study area that most commonly was the East Island and adjacent water (Figure 5-1). On a regional basis, study areas were more varied (Figure 5-2). For example, the drainage basin of Lac de Gras (3,559 km^2) was considered to be sufficiently large to examine the potential regional effects of the proposed project on fish and water. However, to adequately assess potential regional effects on wildlife, a much larger area (approximately 11,500 km^2) was used. Usually, the cumulative effects were assessed using the regional study area and beyond regional study areas. Further details on spatial boundaries for each discipline are provided in the environmental effects reports.

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5.1.5 Scope of the Cumulative Effects Assessment

Table 5-2 lists and briefly describes the projects and activities in the region surrounding the proposed Diavik project that were considered in Diavik's cumulative effects assessment. More detail on these activities and projects can be found in Axys Environmental Consulting Ltd and UMA Group, July 1998. Human Use of the Lac de Gras Area.

In scoping the projects and activities to include in its cumulative effects assessment, Diavik considered the following:

- All activities in operation up to and including 1996 were included in the cumulative effects assessment as the baseline was established at that time.
- Diavik considered all projects in operation or proposed as of August 26, 1998 (definition in EA guidelines).
- No further analysis was undertaken on those with insignificant effects or without potential for a cumulative effect or overlap.
- Projects were not analyzed further if they were not anticipated to continue past 1996.
- Environmental effects contributed by the proposed project include all effects on ecosystem components from all sources site-wide (additive project-related effects).

Table 5-3 provides additional detail on which projects were included for further cumulative effects assessment and the rationale for the exclusion of the remaining projects and activities for each valued ecosystem component.

5.2 ISSUES CONSIDERED

The RAs, in consultation with Aboriginal organizations, the steering committee, other federal and territorial government agencies and the public, produced environmental assessment guidelines that defined the scope of issues to be considered in the environmental assessment of the proposed project. The scope of issues included potential effects to air quality and climate, vegetation and terrain, wildlife, fisheries, water quantity and quality, heritage resources, and socio-economic and cultural circumstances.

The RAs acknowledge the extensive consultation Diavik undertook in its own identification of issues to be considered. Diavik identified issues that needed to be addressed based on consultations with local Dene, Métis and Inuit communities, the public (including non-government organizations), regulators and Diavik's own technical team. As issues were raised, Diavik modified the project design (where technically and economically possible) to address the issues. Because Diavik integrated the mine planning and environmental assessment processes throughout the development of the proposed project, environmental effects assessed in the environmental assessment report are potential effects that could occur after mitigation (i.e., residual effects). The RAs generally support the approach that Diavik has taken to assess environmental effects.

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Table 5-1 Descriptions of the Local, Regional and Cumulative Study Areas Used for Assessing Potential Effects in Each Discipline.

Discipline	Local Study Areas (Figure 5-1)	Regional/Cumulative Study Areas (Figure 5-2)	Rationale for Selection of Study Areas
Air Quality	East Island and adjacent waters of Lac de Gras	Area 25 km east-west by 35 km north-south centred around East Island	Local study area was selected as the area where ambient particulate concentrations and deposition rates would likely be the greatest. The regional study area encompasses the entire area within which ambient concentrations are likely above the thresholds commonly used to define the distance from the emissions sources to locations where modelling is no longer necessary.
Vegetation and Terrain	The East Island	Drainage basin of Lac de Gras	Study areas were selected because they are representative of the areas that could be affected by the proposed project. The local study area was selected for assessing direct effects from the project, while the regional study area provides the context for understanding effects at the regional level.
Wildlife	East and West Islands; small islands in east half of Lac de Gras; and mainland along south, east and north shores of Lac de Gras	North to Yamba Lake; west to Destaffaney Lake; south to Mackay; and east to Glowworm and Afridi lakes	Study areas were selected to effectively represent and assess the diversity in patterns of use by wildlife. The local study area provides a framework for assessing effects on sedentary species with small seasonal ranges, and the regional study area provides a framework for assessing effects on species that have large seasonal ranges. Migratory species that use an area seasonally are also considered using these study areas. The Slave Geological Province was used to assess cumulative effects for several species. Some projects outside of, but with activities occuring within, the regional study area were included in cumulative effects assessment.
Water and Fish	East Island and surrounding water, within 1 km of the East Island shoreline	Drainage basin of Lac de Gras	Local study area was selected as a framework for presenting the effects on the aquatic environment that are likely to occur in the immediate vicinity of the proposed project (e.g., fish habitat alterations on the East Island, alterations to water quality directly adjacent to the dikes). The regional study area was selected to present effects in a regional context which is most appropriate for assessing effects on fish populations in Lac de Gras and water quality in Lac de Gras as a whole. Given concerns raised, the regional study area was expanded to include the Coppermine River and the Echo Bay winter road for assessment of potential cumulative effects.
Heritage Resources	East Island	East and west islands and adjacent mainland to north and east	Local study area corresponds to the area potentially effected by the footprint of the proposed project. The regional study area corresponds to the initial baseline studies, which encompasses the widest geographic area in which the project facilities could have been situated.
Non-traditional Economy and Economic Diversification Infrastructure and Services	Gameti, Wekweti, Dettah, Ndilo, Yellowknife, Rae Edzo, Wha Ti, Lutsel K'e	Western NWT	The proponent will provide direct transportation to study area communities, and the spatial boundary was chosen on that basis. The regional study area was determined by the model available to calculate indirect / induced impacts.

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Table 5-1 Descriptions of the Local, Regional and Cumulative Study Areas Used for Assessing Potential Effects in Each Discipline (continued).

Discipline	Local Study Areas (Figure 5-1)	Regional/Cumulative Study Areas (Figure 5-2)	Rationale for Selection of Study Areas
Cultural Well-Being Social Stability and Community Wellness	Rae Edzo, Wha Ti, Wekweti, Gameti, Dettah, Ndilo, Lutsel K'e, Reliance, North Slave Metis	Yellowknife, Hay River, Hay River Dene Reserve, Fort Smith, Inuvik, Fort Providence, Enterprise, Fort Resolution, Cambridge Bay, Kugluktuk, Umingmaktok, Bathurst Inlet	Local communities are those likely to experience changes to traditional land use and occupancy, wage-based employment and community infrastructure. Regional study area consists of those communities that may experience employment and business changes by virtue of their locations and accessibility.
Traditional Economy	n/a	Dene / Métis land claim area (covers – and groups together – all of Western NWT except for the Inuvialuit land claim area)	Study area based on the 1990 NWT Bureau of Statistic's Harvester Survey, as this was the most directly-related data source.
Government Revenue	n/a	GNWT and federal governments	Included in study area to the extent these governments are affected by economic impacts in the western NWT.

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Table 5-2 Summary of projects and activities considered for cumulative environmental effects assessment.

Project	Location	Activity / Associated Infrastructure	Activity Status	Approval
Traditional Harvest	Wildlife regional/ cumulative study area	Hunting, trapping, fishing.	Past	N/A
Resident Harvest (Aboriginal)	Wildlife regional/ cumulative study area	Small camp: hunting, trapping, fishing. Most activity within approximately 1 km on either side of Echo Bay winter road.	Current – ongoing	N/A
Resident Harvest (Non-Aboriginal)	Wildlife regional/ cumulative study area	Small camp: hunting, fishing. Most activity within approximately 1 km on either side of Echo Bay winter road.	Current – ongoing	N/A
Diavik Exploration: Airborne Geomagnetic Survey	Wildlife regional/ cumulative study area	Aircraft survey over grid pattern.	Current – ongoing during winter months	Prospecting permits
Diavik Exploration: Staking	Wildlife regional/ cumulative study area	Small temporary camp, survey activity.	Current – ongoing during winter months	Prospecting permits, mineral claim
Diavik Exploration: Drilling (on ice)	Local study area and claims block	Drilling rig on ice, helicopter flights. Access by Echo Bay winter road.	Current – ongoing during winter months	Prospecting permits, mineral claim
Diavik Exploration Camp and Echo Bay Winter Road Access	East Island	Airstrip, generator, several buildings, fuel tanks, traffic, large transport trucks, service vehicles.	Current – ongoing Access road used in winter	Land use permits, water licence
Echo Bay Winter Road	Transportation corridor, 140 km intersects regional study area	Traffic, large transport trucks, service vehicles, public traffic.	Current – ongoing during mid- January to late March	Approved annually through land use permit under a lease (easement agreement)
BHP Ekati Mine	30 km northwest of Lac de Gras	Active mining project: airstrip, generators, fuel tanks, process facility, PKC, 4 kimberlite pipes associated with main camp, 1 kimberlite pipe (Misery Pipe) located near north shore of Lac de Gras, 29 km from main camp. All-weather road linking Misery pipe, camp, and other infrastructure to main camp. Accessible by Echo Bay winter road.	Current - ongoing year round operation	Water licence, land leases, fisheries authorization
BHP Exploration	Within BHP/Diamet Claims Block	Typical winter drilling exploration activities.	Current – during winter	Water licence, land use permits
Echo Bay Road and Expediting Camp and Quarry	South shore of Lac de Gras, 10 km SSE of the Diavik site	Staging for transport vehicles, accommodations, helipad, airstrip, maintenance shop, diesel generator, quarry, accessible by Echo Bay winter road.	Current – during Echo Bay winter road access period only	Water licence, land lease

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Table 5-2 Summary of projects and activities considered for cumulative environmental effects assessment (continued).

Project	Location	Activity / Associated Infrastructure	Activity Status	Approval
Bathurst Inlet Developments Expediting Camp	Site of the old Tundra Minesite (Salmita), north end of Matthews Lake	1200 m airstrip, bunkhouses, diesel generator, accessible by Echo Bay winter road.	Currently inactive (although can be active year-round)	Land lease, land use permit
Yamba Lake Exploration Camp	Yamba Lake claims block on northern boundary of BHP/ Diamet block	Tent frames, shed, helicopters, diesel generator, water pumps, fuel storage.	Currently inactive (since 1997), no plans to develop property	N/A
Monopros Exploration Camp	Outside regional wildlife study area, west of BHP property	Base camp facilities: tent frames and generator.	Past activity: camp removed in 1997	N/A
Rhonda Mining Corporation Exploration Camp	North shore of Courageous Lake, 10 km west of Courageous Lake Guiding and Outfitting Camp	Tents, small generator, active in summer.	Past activity: closed since 1996	N/A
GNWT Wildlife Research Station	On Daring Lake, physically outside of, but zone of influence extends within, wildlife regional wildlife study area	A few small structures, small generator, active in summer.	Current: active in summer	Land lease
Courageous Lake Guiding and Outfitting Camp	Courageous Lake	Tents, tent frame, quonset hut, 1 small frame building, storage silo, accessible by float plane, boat use.	Past activity: closed since 1996	Guiding licence, recreational land lease
Jolly River Guiding and Outfitting Camp	Caribou Pass outfitters camp at Jolly River outside of, but zone of influence within, regional wildlife study area	Steel grain silo, tent frames, aluminum boats.	Past activity: closed since 1996	Guiding licence, recreational land lease
Mackay Lake Guiding and Outfitting Camp	Main camp and Snake River satellite fishing camp outside of, but hunting and fishing extend within, wildlife regional study area	19 buildings, generator, accessible by float plane, airstrip, and Echo Bay winter road; satellite camp accessible by float plane.	Currently in operation	Guiding licence, recreational land lease
Desteffany Lake Guiding and Outfitting Camp	Base camp outside regional wildlife study area boundary, hunting within area along Coppermine River	Tent frames, storage silos, wood building, generator, fuel storage area. Boat use, accessible by float plane or helicopter.	Past activity: closed since 1996	Guiding licence, recreational land lease

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Table 5-3 Summary of projects and activities, by environmental component, included or excluded in further cumulative effects analysis.

Environmental Component	Projects and activities considered and rationale for exclusion from further in-depth analysis	Projects and activities included in in-depth cumulative effects analysis
AIR QUALITY (dust and emissions)	• Traditional Harvest, Resident Harvest – no air quality effects • Diavik Exploration Airborne Geomagnetic Survey – short duration, local insignificant residual effects • Diavik Exploration Staking – short duration, limited extent, insignificant air quality effects • Echo Bay Winter Road – short duration, limited extent, insignificant air quality effects • Diavik Exploration Drilling (on ice) – insignificant residual air quality effects • BHP Exploration – limited extent, low magnitude, short duration, insignificant residual air quality effects • Bathurst Inlet Developments Expediting Camp – currently inactive, no residual air quality effects, limited future activity anticipated • Yamba Lake Exploration Camp, Rhonda Mining Corporation Exploration Camp, Jolly River Guiding and Outfitting Camp, Desteffany Lake Guiding and Outfitting Camp, Courageous Lake Guiding and Outfitting Camp – currently inactive, no residual effects, no anticipated future activity • Monopros Exploration Camp – local insignificant effects, not within proximity • Mackay Lake Guiding and Outfitting Camp – insignificant air quality effects due to limited extent and magnitude	BHP Ekati Mine, Diavik Exploration Camp
VEGETATION AND TERRAIN (Vegetation: cover, biodiversity, rare or endangered plant species Terrain: landscape aesthetics, landscape diversity)	• Likely no effects from changes to vegetation/terrain from winter projects and activities. Non-winter projects and activities insignificant residual effects.	BHP Ekati Mine, Diavik Exploration Camp
HERITAGE RESOURCES (Archaeological, historical and palaeontological sites)	• Traditional Harvest, Resident Harvest – no effects on heritage resources • Diavik Exploration Airborne Geomatic Survey – no physical undertaking, no effects on heritage resources • Diavik Exploration Staking – no disturbance, no effects on heritage resources • Echo Bay Winter Road – no change in disturbance due to Diavik, original disturbance unrecorded • Diavik Exploration Drilling (on ice) – no physical disturbance of heritage sites, no effects • Bathurst Inlet Developments Expediting Camp, Yamba Lake Exploration Camp, Rhonda Mining Corporation Exploration Camp, Courageous Lake Guiding and Outfitting Camp, Jolly River Guiding and Outfitting Camp, Desteffany Lake Guiding and Outfitting Camp – currently inactive, limited disturbance, no or insignificant effects on heritage resources, no anticipated future activity • Monopros Exploration Camp – limited disturbance, insignificant effects on heritage resources, not within study area • Mackay Lake Guiding and Outfitting Camp – insignificant effects due to limited extent and magnitude of disturbance	BHP Ekati Mine, Echo Bay Road and Expediting Camp and Quarry, Diavik Exploration Camp

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Table 5-3 Summary of projects and activities, by environmental component, included or excluded in further cumulative effects analysis (continued).

Environmental Component	Projects and activities considered and rationale for exclusion from further in-depth analysis	Projects and activities included in in-depth cumulative effects analysis
WATER AND FISH	• Traditional Harvest – no residual effects on fish and water • Resident Harvest – limited activity, low intensity, low frequency, limited extent, insignificant effects on fish and water • Diavik Exploration Airborne Geomagnetic Survey– no effects on fish and water • Diavik Exploration Staking — limited activity, low intensity, low frequency, short duration, limited extent, no effects on fish and water • Diavik Exploration Drilling (on ice) – low intensity, low frequency, limited extent, short duration, no effects on fish and water • BHP Exploration – limited extent, low magnitude, short duration, no effects on fish and water • Bathurst Inlet Developments Expediting Camp – currently inactive, no residual effects on fish and water, limited future activity anticipated • Yamba Lake Exploration Camp, Rhonda Mining Corporation Exploration Camp, Courageous Lake Guiding and Outfitting Camp, Jolly River Guiding and Outfitting Camp, Desteffany Lake Guiding and Outfitting Camp – currently inactive, no residual effects, no anticipated future activity • Monopros Exploration Camp – currently inactive, no residual effects, not within regional study area • Mackay Lake Guiding and Outfitting Camp – no significant effects on fish and water	BHP Ekati Mine, Diavik Exploration Camp
CARIBOU	• Traditional Harvest – no residual effects on caribou • Diavik Exploration Drilling (on ice) – no effects, no activity during migration periods • BHP Exploration – no effects, no activity during migration periods • Yamba Lake Exploration Camp, Rhonda Mining Corporation Exploration Camp, Courageous Lake Guiding and Outfitting Camp, Jolly River Guiding and Outfitting Camp, Desteffany Lake Guiding and Outfitting Camp – no evidence of residual effects, currently inactive, no anticipated future activity • Monopros Exploration Camp – insignificant effects, outside of study area	Habitat Effectiveness Suitability: Diavik Exploration Camp, BHP Ekati Mine, Courageous Lake Guiding and Outfitting Camp, Resident Hunting, Echo Bay Winter Road, GNWT Wildlife Research Station, Echo Bay Road and Expediting Camp and Quarry, Mackay Lake Guiding and Outfitting Camp Energetic Costs/Mortality: Diavik Exploration Camp, BHP Ekati Mine, Courageous Lake Guiding and Outfitting Camp, Resident Harvest, Echo Bay Winter Road, GNWT Wildlife Research Station, Echo Bay Road and Expediting Camp and Quarry, Mackay Lake Guiding and Outfitting Camp, Bathurst Inlet Developments Expediting Camp
RAPTORS	• Traditional Harvest – no residual effects on raptors • Resident Harvest – no effects on raptors • Diavik Exploration Airborne Geomatic Survey – no likely effects on raptors • Diavik Exploration Staking – no likely effects with mitigation and management strategies in place • Diavik Exploration Drilling (on ice) – no likely effects on raptors from winter activity • BHP Exploration – no significant likely adverse effects on raptors if effective mitigation applied • Yamba Lake Exploration Camp, Rhonda Mining Corporation Exploration Camp, Courageous Lake Guiding and Outfitting Camp, Jolly River Guiding and Outfitting Camp, Desteffany Lake Guiding and Outfitting Camp – no residual effects, currently inactive, no anticipated future activity • Monopros Exploration Camp – no residual effects, outside of study area • Mackay Lake Guiding and Outfitting Camp – no effects on raptors	BHP Ekati Mine, Echo Bay Winter Road, Echo Bay Road and Expediting Camp and Quarry, GNWT Wildlife Research Station, Courageous Lake Guiding and Outfitting Camp, Bathurst Inlet Developments and Expediting Camp, Diavik Exploration Camp

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Table 5-3 Summary of projects and activities, by environmental component, included or excluded in further cumulative effects analysis (continued).

Environmental Component	Projects and activities considered and rationale for exclusion from further in-depth analysis	Projects and activities included in in-depth cumulative effects analysis
CARNIVORES	• An assessment of change in carnivore habitat availability resulting from existing or potential land use activities in the regional study area was not undertaken, as cumulative regional loss of habitat is not considered to be an issue at present. Suitable habitat is not limiting.	N/A
WATERFOWL AND OTHER AVIFAUNA	• Given the low magnitude and localized nature of predicted impacts, the proposed project would not contribute measurably to cumulative effects on the distribution and abundance of regional waterfowl and other avifauna populations.	N/A
GRIZZLY BEARS	• Traditional Harvest – no residual effects on grizzlies • Diavik Exploration Staking – no likely effects on grizzlies with effective mitigation and management strategies in place. • Diavik Exploration Drilling (on ice) – no likely effects on grizzlies from winter activity • BHP Exploration – no significant likely adverse effects on grizzlies if effective mitigation applied • Yamba Lake Exploration Camp – currently inactive, no evidence of effects on grizzlies, limited future activity anticipated • Monopros Exploration Camp – no evidence of effects, outside regional study area • Rhonda Mining Corporation Exploration Camp, Courageous Lake Guiding and Outfitting Camp, Jolly River Guiding and Outfitting Camp, Desteffany Lake Guiding and Outfitting Camp – past activity, no evidence of residual effects on grizzlies, no anticipated future activity • Mackay Lake Guiding and Outfitting Camp – no evidence of effects on grizzlies	BHP Ekati, Echo Bay Winter Road (Yellowknife to Lupin Mine), Resident Harvest (Aboriginal), GNWT Wildlife Research Station, Diavik Exploration Camp, Mackay Lake Guiding and Outfitting Camp, Bathurst Inlet Developments Expediting Camp, Courageous Lake Guiding and Outfitting Camp
SMALL GAME	• Effects from project would likely overlap in an additive fashion with other projects and activities (past, present, future); however, the cumulative reduction in habitat is currently very low, and it is considered unlikely that the population parameters of such widespread species have measurably been affected . Therefore no further consideration of cumulative effects was undertaken for small game.	N/A
BIODIVERSITY	• Based on the known distribution of shallow water cover types and land use activities under baseline conditions, it appeared that no high quality shallow water habitats of this type have been lost or affected by existing land use developments in the regional study area.	All activities and projects in wildlife regional study area
SOCIO-ECONOMICS (Social: Including community well-being and cultural and social conditions)	• Project-specific changes assessed from baseline conditions established with consideration for all existing economic activity (projects) for economic assessments in two study areas: local (including those communities Diavik would provide a direct link to the proposed site resulting in most of the direct employment) ; regional study area including all those communities within the Western NWT at 1995/96 • CEA of economic factors considered the project-related effects with the addition of predicted effects associated with BHP Ekati, as the only approved project not yet in operation within the regional study area • Project related social impacts assessed as a change from existing conditions in communities (as at 1995/96) which includes consideration for all existing projects and economic activities (sources of wage income and employment) in all primary impact communities (local social study area). Cumulative effects assessment considered additive effects predicted for BHP Ekati Mine.	Economic CEA: All projects in existence in the Western NWT, including effects associated with the proposed project and those predicted for the BHP Ekati Mine, BHP Exploration and Diavik exploration. Social CEA: Those projects and activities in existence in the directly affected communities, including effects associated with the proposed project and those predicted for the BHP Ekati Mine, BHP Exploration and Diavik exploration.

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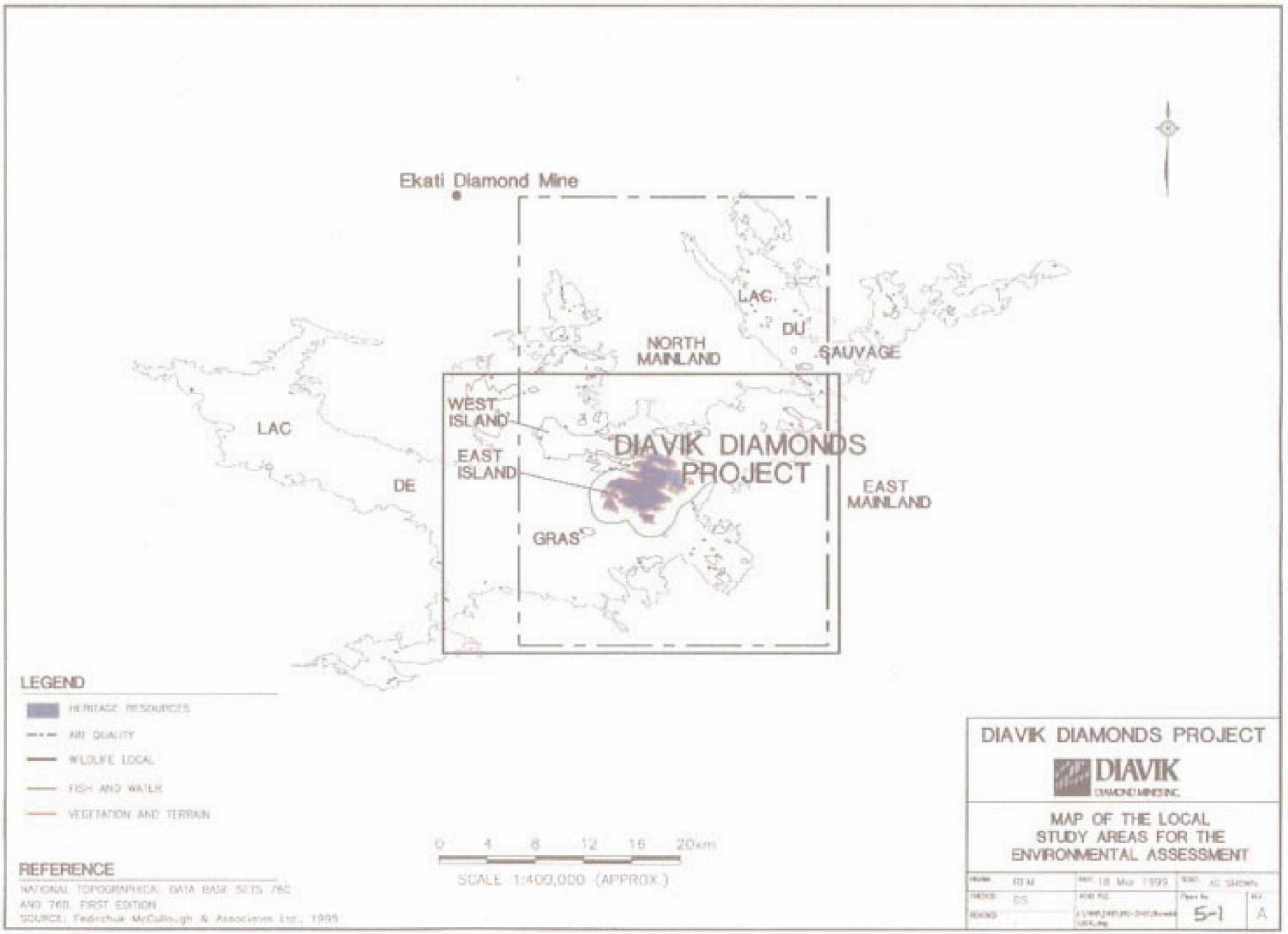

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DIAVIK DIAMONDS PROJECT
DIAMOND MINES INC.
MAP OF THE LOCAL
STUDY AREAS FOR THE
ENVIRONMENTAL ASSESSMENT
5-1
SCALE 1:400,000 (APPROX.)
0 4 8 12 16 20km
DIAVIK DIAMONDS
PROJECT
EAST
MAINLAND
GRAS
EAST
ISLAND
WEST
ISLAND
NORTH
MAINLAND
SAUVAGE
LAC
DU
DE
Ekati Diamond Mine

6.0 PUBLIC CONSULTATION

Public consultation on the content of Diavik's environmental assessment submission is a critical and vital component of the comprehensive study review. The consultation process is examined in two contexts: 1) Diavik's initial consultation prior to submission of its environmental assessment report, and 2) Diavik's and the RAs' consultation following the environmental assessment submission.

6.1 DIAVIK'S INITIAL CONSULTATION

6.1.1 General Approach

Diavik has been involved with northern communities since early in the planning of the proposed project. Communication, consultation and active participation between Diavik and communities began in 1994.

Initially, the purpose of the consultation was to provide information on the type and amount of exploration work that was proposed to those with interest in the proposed project. The consultation process evolved in response to participants' suggestions and as people became aware of the project, they were able to contribute information to Diavik. For example, communities helped Diavik develop and formulate an appropriate information-sharing protocol.

Early in 1996, in-depth community consultations were initiated to discuss preliminary findings of the environmental baseline studies. Communities and regulators assisted Diavik in identifying appropriate baseline studies through the identification of potential issues and information requirements. Primarily, Diavik identified which groups to approach by reviewing all presentations and interventions made to the BHP environmental assessment review panel and by responding to those indicating their interest directly to Diavik. Some meetings were formal but more were informal and on a one-on-one basis. Between February 1994 and August 1998, Diavik met on more than 250 occasions with individuals, groups and communities to share information (Appendix C).

In addition to meeting with local people, Diavik also encouraged and provided opportunities for local people to participate in the project. Employing and involving local people in Diavik's business helped Diavik understand local concerns and values as well as providing guidance on how to interact with the communities. Late in 1995, Diavik established its head office in Yellowknife and built a team of northern employees.

6.1.2 Public Involvement

Issues identified through Diavik's consultation, up until the release of the environmental assessment submission, were recorded in an issues database. This enabled Diavik to follow-up on issues to ensure they were addressed during the project design process. In addition to issues identified in the community-consultation process, other potential issues were identified by Diavik's professional and technical staff and through the federal panel review of the Ekati Diamond Mine. The issues database is included as part of the Diavik Diamonds Project environmental assessment submission. It summarizes the issues raised, identifies the origin of the issue, and indicates either a planned action, response to the issue or the location of the information requested.

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6.2 COMPREHENSIVE STUDY CONSULTATION

The Canadian Environmental Assessment Act (CEAA) clearly supports the principle of early and meaningful consultation on all phases of a comprehensive study review. The CEAA Guide to the Preparation of a Comprehensive Study recommends the preparation of a public involvement plan to recognize all interested publics, provide them with a variety of opportunities to be informed at all stages of the comprehensive study, offer ideas and information, react to proposals in order to influence recommendations and decisions, and be informed of all decisions.

Following the preparation of a comprehensive study report, the Minister of the Environment, with the advice of the Canadian Environmental Assessment Agency, determines whether environmental effects have been satisfactorily addressed or whether there remain significant effects, uncertainties, or public concerns that justify referral to a panel or mediation.

6.2.1 Public Registry

In accordance with CEAA, DIAND, as lead RA, established a public registry in Yellowknife for the proposed Diavik Diamonds Project. The Act requires that the public registry be established for the purpose of facilitating public access to records relating to the comprehensive study and is operated in a manner to ensure convenient public access. The public registry consists of all documents and a document list.

6.2.2 Management Structure and Steering Committee

As discussed in section 2.2.2 – Management Structure, RAs undertook extensive consultation with Aboriginal organizations, federal and territorial governments and other interested stakeholders in the design of a management structure to guide completion of the comprehensive study and the subsequent development of the comprehensive study report. The steering committee was established to advise and make recommendations to the RAs to help ensure that issues were adequately addressed. The committee played an important role throughout the comprehensive study review, particularly in ensuring that public consultation on the environmental assessment submission was carried out in a meaningful and inclusive manner. A summary of meetings held by the steering committee is found in Appendix D.

6.2.3 Environmental Assessment Guidelines Review (July – August, 1998) and Conformity Review (October 1998 – January, 1999)

RAs undertook the development of project-specific environmental assessment guidelines in consultation with expert departments, the GNWT, Aboriginal groups, non-government organizations and the general public, with guidance of the steering committee. The guidelines are intended to define the scope of the comprehensive study. Initial issues scoping utilized Diavik's environmental issues database and the proposed guidelines submitted along with Diavik's project description. Opportunities were provided for public review of the draft guidelines prior to their issuance which occurred August 26, 1998.

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In October 1998, the public was invited to comment on the conformity of Diavik's EA submission to the environmental assessment guidelines. The steering committee provided the RAs with valuable input and comments during this conformity review.

6.2.4 Diavik's Consultation Tools

Diavik utilized a number of communication tools to reach a variety of audiences about the content of its environmental assessment. These included a newsletter ("dialogue"), an executive summary of the environmental overview, a CD-ROM (electronic version of the project description and related information), all of which were broadly distributed, a toll-free number (1-877-DIAVIK1), news releases and media briefings, workshops, meetings, tradeshows and open houses. General formats utilized for community consultations and meetings included group meetings, workshops, leadership meetings, individual consultations/communications, open houses, field/site visits, site tours, and field-work research site visits.

6.2.5 Public Consultation Sessions (October – December, 1998)

The RAs received Diavik's environmental assessment submission on September 26, 1998. This marked the beginning of an involved consultation process on the content and adequacy of the submission. The RAs agreed that Diavik would carry out consultation on its environmental assessment submission. Diavik developed a public involvement plan (PIP) that was presented to the steering committee for review and comment.

The initial public review period for the environmental assessment submission, extended from September 26, 1998 through to December 31, 1998. As a result of a recommendation from the steering committee, this period was extended until March 8, 1999, the end of the public technical sessions. It is important to note that while the official public period ended on this date, the RAs and Diavik continued to work with Aboriginal organizations and other interested parties and the steering committee to further resolve technical issues up to the final completion and submission of the comprehensive study report.

6.2.5.1 Aboriginal Communities

Diavik's PIP presented a two-phase consultation for Aboriginal communities. Phase 1 involved Diavik approaching Aboriginal communities and interested stakeholders to discuss when and how they would like to be consulted on the content of its environmental assessment submission. In Phase 2, Diavik proposed individual community consultations lasting up to five days.

While the steering committee agreed with much of Diavik's approach, it recommended a "two-step" approach for Phase 2 of the consultation. This involved an additional government-hosted meeting following Diavik's detailed consultation with communities. It was left up to individual communities to decide on the timing of these meetings and the respective agenda. Most of the communities choose the two-step consultation process, with the exception of the Dogrib Treaty 11 communities, which decided to conduct their own review of the EA submission. A listing of meetings Diavik held to consult on its EA submission is found in Appendix C.

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With the exception of the Phase 1 Dogrib Treaty 11 consultations, the project secretariat attended all sessions, and documentation of these consultations can be found on the public registry. A listing of Diavik's public consultations on the EA submission are provided in Appendix C and summaries of the RAs public consultations on the EA submission are provided in Appendix E.

6.2.5.2 Non-Government Organizations

Diavik consulted with a number of non-government organizations (including public interest groups) early in the environmental assessment review. A separate meeting (Phase I) was held with environmental organizations, where they were asked how they would like to be further consulted on the EA submission. These organizations did not get back to Diavik and as a result did not participate in a Phase II consultation with the exception of the World Wildlife Fund-NWT which met with Diavik on two occasions to discuss and resolve concerns. DIAND, as the lead RA, recognizes the value of non-government organizations input into the process and made funding available to interested organizations upon approval of their applications.

While a coalition made up of Canadian Arctic Resources Committee (CARC), Canadian Parks and Wilderness Society (CPAWS)-NWT, NWT Wildlife Federation and Ecology North applied for and was offered funding by DIAND to assist it to participate in the review, the coalition rejected the offer as inadequate. Subsequently, the coalition dissolved. Nevertheless, CARC and Ecology North have maintained a presence throughout the review and have requested and received information. A separate application for assistance was later received from CPAWS and funding was approved by DIAND. NWT Wildlife Federation has not been involved directly in the review to date. The Status of Women Council of the NWT applied for and received funding to participate in the review.

6.2.5.3 General Public

The public was provided many opportunities to participate in the review of the environmental assessment submission. As part of the public involvement plan, open houses were held in Yellowknife, Hay River, Fort Resolution, and Fort Providence. As well, a government-hosted meeting was held in Yellowknife to allow the general public an opportunity to directly address the RAs about the proposed project. The public was provided opportunities to communicate ideas and issues to the project secretariat, to Diavik through the toll free 1-877 line, through direct interaction with the RAs and Diavik staff, and there was an open invitation to submit written comments at any time to both Diavik and the government. Diavik advertised meetings on the local radio, on CBC Radio, in local newspapers, in News North and in the Hay River Hub. DIAND, as the lead RA, placed advertisements in local newspapers NWT-wide to keep the public informed of critical dates and avenues available for providing comments on Diavik's environmental assessment submission.

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6.2.6 Technical Sessions (January – April, 1999)

In November 1998, the steering committee recommended to the RAs that technical meetings should be held in various communities and that they should have the option to attend these meetings. In response to this recommendation, many of the technical meetings were conducted in various communities in the territories. The steering committee members (along with community members) received invitations to attend, and information generated from those meetings was forwarded to the steering committee members, the public registry, and federal, territorial and Aboriginal governments.

The agendas for all the meetings were coordinated by the lead RA and were based on issues identified during Diavik's public consultation on its environmental assessment submission and government review.

Technical meetings were held in various communities and following the daytime technical discussions, evening public meetings were held to allow public an opportunity to ask questions and talk to experts directly. Attendees to these sessions included: Aboriginal organizations, steering committee members, government (including contracted experts) and Diavik experts.

6.2.7 Public Technical Sessions (February 22 – March 5, 1999)

These sessions were an important part of the environmental assessment review process as they provided an opportunity for government to report on its findings and allowed for public discussion of issues raised during the public consultation on Diavik's environmental assessment submission. The public was given an open invitation to ask questions, make presentations, and get answers from government, Diavik and the steering committee during these sessions. Where possible, issues were resolved or a course of action was identified as to how to resolve outstanding technical issues.

Following the public technical sessions, additional workshops and meetings were held to resolve any remaining outstanding technical issues. Results of all the government-hosted technical meetings/workshops are available on the public registry. A summary of all technical-related meetings is included in Appendix E.

6.2.8 Summary of Public Consultations

All meetings were recorded and summaries of the key issues raised at both the Diavik and the government-hosted technical meetings were put on the public registry. Also placed on the public registry were audiotapes of the entire proceedings of those community meetings in which communities allowed taping and the public technical sessions held in Yellowknife. A summary of the issues and concerns raised during the comprehensive study process is provided on the public registry.

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6.3 TRADITIONAL KNOWLEDGE

6.3.1 Background

The EA guidelines directed that Diavik "shall fully consider traditional knowledge where appropriate when assessing the effects of the project". The guidelines defined traditional knowledge "as knowledge and values which have been acquired through experience and observation from the land and/or instructions from elders".

The guidelines also stated that: "This expertise and knowledge are expected to play a valuable role in the environmental assessment including: scoping of valued ecosystem components; description of existing environmental conditions; impact predictions; development of mitigation measures and techniques; evaluation of significance; and monitoring and follow-up as required." In addition, the guidelines specified that where traditional knowledge was not available to the proponent despite appropriate diligence, a description of the proponent's efforts was required.

6.3.2 Diavik's Actions to Solicit Traditional Knowledge

Diavik sought to collect traditional knowledge for use in its environmental assessment by funding traditional knowledge studies and assembling information presented in meetings by elders and other traditional knowledge holders.

Diavik and BHP co-funded a traditional knowledge study by the Yellowknives Dene First Nation. Diavik has also contributed financially to the West Kitikmeot Slave Study (WKSS). Under the WKSS, preliminary reports for three on-going traditional knowledge studies have been completed. These include two studies prepared by the Dogrib Treaty 11 (a study on place names as indicators of biogeographical knowledge and a study on caribou migration and habitat) and a study by Lutsel K'e Dene First Nation (on monitoring community health).

The proponent is also funding an on-going traditional knowledge study being conducted by the Kugluktuk Anogonaitit Association (KAA). The KAA is compiling information from Inuit land use, water use, fish and terrestrial wildlife use to assist in the identification and mitigation of the potential impacts from individual projects and the cumulative effects of development within the Slave Geological Province. In addition, Diavik solicited information regarding land use from various organizations such as the Dene Nation, Nunavut Planning Commission, and the Kitikmeot Hunter and Trappers Association. Recently, Diavik agreed to co-fund a traditional knowledge study with DIAND by the North Slave Métis Alliance (NSMA). This study will be completed after the comprehensive study report is submitted to the Minister of the Environment, however, the NSMA will forward a report of its findings to the Minister for her consideration during the comprehensive study public review period.

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In addition to formal studies, information provided in meetings to Diavik by elders and communities was used in the EA submission. Diavik stated that meetings with elders and communities were generally built on the progress made at a previous meeting. A large component of the information presented during a meeting that focussed on traditional knowledge consisted of a recount of the knowledge shared at a previous meeting. Reconfirmation of what was understood from discussions with elders and the appropriateness of actions designed in response to concerns was regularly undertaken.

6.3.3 Diavik's Incorporation of Traditional Knowledge

Diavik used information provided during meetings with community members, including elders, and the traditional knowledge studies to guide the development of baseline studies. By identifying what environmental components Aboriginal people value, Diavik sought to incorporate this information into the project design process, the development of the Environmental Management System, mitigation measures, and the development of monitoring programs. In particular, elders who visited the proposed mine site provided valuable information that influenced the project design. Their knowledge of caribou movements, wildlife habitat, natural drainage patterns, blowing snow and seasonal changes in ice conditions assisted Diavik in determining specific locations and design features for various project components.

6.4 ABORIGINAL COMMENTS/CONCERNS

The NSMA has pointed out that Diavik did not collect sufficient data from the NSMA with regard to the project's effects on North Slave Métis community wellness, cultural well-being, traditional land use and economy, and heritage resources, and no traditional knowledge input was solicited from the NSMA. As a result, the NSMA found that Diavik did not conform to seven elements of the RAs Environmental Assessment Guidelines.

To address the outstanding data requirements and given insufficient time to collect the data for integration into the CSR prior to its submission to the Minister of the Environment, the NSMA agreed, in negotiations with DIAND, to divide its studies into a two phase approach. Funding was received from Diavik and DIAND for the NSMA to complete Phase I of the study, and a separate report entitled North Slave Métis Alliance Environmental, Social, Economic and Cultural Concerns – A Companion to the CSR on the Diavik Diamonds Project will be submitted directly to the Minister of the Environment on June 30, 1999. This report will address the immediate needs of the NSMA regarding the CSR process. Phase II findings will be completed by April 2000 and are designed to complete the required ecological, economic, social and cultural baselines necessary to monitor, measure and manage impacts relevant to the NSMA concerns. DIAND has also committed to provide some funding for Phase II.

The Lutsel K'e Dene First Nation stated that while Diavik developed an "issues database" throughout its consultations that took place between February 1994 and August 1998, there was no process for verification in place. Diavik did not for example, follow-up after each meeting (i.e. send out minutes to be verified) to ensure that they had accurately recorded and interpreted the issues discussed during that meeting.

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The Lutsel K'e Dene First Nation felt that the consultation process did not provide a balance of information about the proposed project's negative and positive effects. It was only during the technical workshops of the comprehensive study process that balanced information about the proposed project and its potential effects was provided to the communities.

The Lutsel K'e Dene First Nation noted that comments provided by elders visiting the proposed mine site, while perhaps useful to the proponent, should not be considered traditional knowledge.

6.5 RA CONCLUSIONS

The RAs acknowledge the concerns raised by the North Slave Métis Alliance (NSMA) regarding the treatment of indigenous Métis knowledge by Diavik (see Chapter 8 for further information) and potential impacts to its cultural, social and community well-being. However, upon further technical review of Diavik's environmental assessment submission and its subsequent commitments for follow-up monitoring, and through the NSMA's extensive and valuable involvement and participation in the comprehensive study process, the RAs conclude that the seven outstanding requirements in the Environmental Assessment Guidelines have been adequately addressed.

With respect to indigenous knowledge, the RAs believe that the NSMA had the opportunity to bring forward its knowledge and expertise throughout the consultation period. The RAs conclude that the NSMA has brought information forward that has been considered and incorporated into the RAs conclusions and the follow-up program. The President of the NSMA noted during a meeting with representatives from Aboriginal governments/ organizations, Steering Committee, FAs, RAs, Government of Nunavut and Government of the NWT on May 18, 1999 in Yellowknife, that the North Slave Métis Alliance felt it was consulted and well-represented during the comprehensive study process.

The Environmental Assessment Guidelines had also requested Diavik to consider the potential project effects on social and cultural patterns. Specifically Diavik was required to develop indicators for cultural well-being, social stability and community wellness as defined by the affected traditional groups and affected communities. In its environmental assessment submission, Diavik had considered the potential project effects on social and cultural patterns but had not developed specific indicators with affected groups or communities. Based on the GNWT's recommendations, the RAs conclude that the information presented by Diavik was adequate to determine that there would be no significant adverse social, economic and cultural effects. However, Diavik would be required to verify its predictions through the development of indicators as part of the follow-up program (see Section 9.8.2).

Diavik has noted that its assessment of socio-economic effects was based on the most recent demographics information available from Statistics Canada. It is unfortunate that the NSMA are not identified as a distinct community in this database. However, Diavik indicated that in its view, no other reliable source of baseline information is available from which Diavik could identify a distinct or physical community. Despite its inability to

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identify specifically the community which the NSMA represents, Diavik has stated that it respected the NSMA's position, involved the NSMA in the consultation process since 1996 and have provided it ample funding to enable its meaningful participation throughout the process. Further, Diavik stated that the information provided by the NSMA has been respected and utilized wherever feasible.

The NSMA had also raised a concern that Diavik had not conducted a land use survey with its members to determine current traditional land use in the Lac de Gras area. Diavik has assessed land use by all Aboriginal peoples using existing sources of research, studies and government records such as fur harvest data. While no land use surveys have been conducted by Diavik, the RAs in consultation with the GNWT, have concluded that existing conditions as described in Diavik's environmental assessment submission have provided a reasonable description of current activities in the study area and that the proposed project would not significantly adversely affect socio-economic conditions. The RAs have also concluded that Diavik will be required to monitor the effects of its activities on Aboriginal people who may use the Lac de Gras area for traditional purposes.

The NSMA has also raised a concern that Diavik did not involve its members in identifying the potential project effects on the heritage resources of the North Slave Metis. The RAs conclude that the project will not likely significantly adversely affect the heritage resources related to all Aboriginal peoples in the regional study area. In its technical review, the GNWT also concluded that Diavik has adequately mitigated the loss of the 57 archaeological sites in accordance with the Territorial Lands Act and the NWT Archaeological Sites Regulations. As part of follow-up, Diavik will be required to conduct an archaeological site assessment of the mainland quarry and determine the cultural importance of archaeological sites in the local study area with the appropriate Aboriginal governments/organizations, which would include the NSMA. The RAs conclude that the NSMA's concern had been adequately addressed and is no longer considered a non-conformity.

Notwithstanding, the NSMA has stated it will provide a report on the North Slave Métis' use of the study area and additional comment on the Diaivk environmental assessment submission to the Minister of the Environment by June 30, 1999, during the public comment period. The RAs view this report as supplemental information, and information not essential at this time to complete the comprehensive study report.

The RAs recognize that the NSMA feels its input regarding project effects was not adequately solicited or incorporated by Diavik. The RAs also recognize that because of this, the NSMA's position is that Diavik still has not conformed with certain aspects of the Environmental Assessment Guidelines. However, the RAs are satisfied that adequate information was available from other sources, including Diavik's environmental assessment submission and the GNWT, and that this information has been taken into consideration by Diavik and the RAs in reaching the conclusions contained in the comprehensive study report. The RAs appreciate and encourage the NSMA to continue providing its valuable input and expertise as part of the follow-up program should the project be allowed to proceed.

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The RAs acknowledge the Lutsel K'e Dene First Nation's comment regarding the lack of verification of Diavik's issues database. While Diavik could have improved its verification of information collected, there was opportunity provided to communities to bring forward concerns about accuracy of the issues database, as it was attached to the Diavik Project Description, which had a broad distribution. The RAs also feel that there were opportunities to bring forward any outstanding issues through the environmental assessment consultation process and agree with the Lutsel K'e Dene First Nation that the technical sessions provided an avenue to provide additional information and to highlight and address technical issues.

The RAs believe that the Aboriginal organizations and the communities are the best judges of the use of traditional knowledge. Based on comments received and the involvement of Aboriginal governments/organizations, the RAs conclude that traditional knowledge has been adequately addressed as part of the comprehensive study review process. The involvement of Aboriginal governments/organizations in follow-up activities will be essential in ensuring that traditional knowledge will continue to play an integral role in monitoring and adaptive management.

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7.0 ENVIRONMENTAL DESCRIPTION

Information for the environmental description was extracted from Diavik's environmental assessment submission, which includes environmental overview and environmental effects reports on climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources and socio-economics.

7.1 ECOLOGICAL CONTEXT

The Lac de Gras area is characteristic of the northwestern Canadian Shield physiographic region, with rolling hills and relief limited to approximately 50 m. In this area, the terrain has been formed as a result of multiple glaciation periods, the most recent being the Late Wisconsin. The landscape consists of relatively diffuse watersheds with numerous lakes interspersed among boulder fields, eskers and bedrock outcrops. Lac de Gras is within the continuous permafrost zone. Harsh physiographic conditions have resulted in little soil development and low growing vegetation cover.

Lac de Gras is located in the Slave Geological Province which forms part of the mainland of the Northwest Territories. The mainland includes the Slave, Bear and part of the Churchill geological structural provinces. The Slave Geological Province is about 190 000 km^2 in size, and contains some of the oldest known rocks in the world, dated at 3.96 billion years old. Metamorphosed sedimentary and volcanic rocks underlie about one-third of this Province, while two-thirds are granitic rocks.

Underlain for the most part by Precambrian granitic bedrock, the terrain consists largely of broadly rolling uplands and lowlands. Discontinuous glacial moraine deposits mantle much of it. Strung out across the landscape are long, sinuous eskers reaching lengths of up to 100 km in places. Cryosols are the dominant soils, and are underlain by continuous permafrost with active (thaw) layers that are usually moist or wet throughout the summer.

The project area climate is characterized by long, cold winters and short, cool summers. The mean annual temperature is –11°C. Mean summer temperature ranges from 4 to 6°C, producing a short growing season, which is enhanced by long periods of daylight. The mean winter temperature is -28°C and the mean annual precipitation is less than 400 mm.

The area represents a major transition between the taiga forest to the south and the treeless Arctic tundra to the north. Vegetation cover is characterized by shrub tundra, consisting of dwarf birch, willow, northern Labrador tea, mountain avens, blueberry and mountain cranberry species. Depressional sites are dominated by willow, sphagnum moss and sedge tussocks. Scattered stands of stunted black spruce occur along the southern boundary of the ecoregion. Characteristic wildlife includes barren ground caribou, muskoxen, barren ground grizzly bears, wolverines, hares, foxes, wolves, raptors, shorebirds, seabirds and waterfowl.

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Aquatic productivity is relatively low in Arctic lakes that are clear and oligotrophic and have relatively low concentrations of nutrients, especially nitrogen and phosphorus. Other factors contributing to low productivity include low light levels during the winter months, extended periods of ice cover and low water temperatures. Fish species found here include lake trout, cisco, round whitefish, lake whitefish, Arctic grayling, burbot, longnose sucker, slimy sculpin, lake chub, Arctic char, northern pike, walleye, and ninespine stickleback.

7.2 EXISTING ENVIRONMENTAL CONDITIONS

7.2.1 Air Quality and Climate

The climate surrounding the proposed project and Lac de Gras is representative of Arctic tundra. The area experiences long, cold winter conditions, relatively short summer conditions, and only a moderate amount of precipitation; this is characteristic of a continental polar climate. Wind monitoring on the East Island indicates northwest winds dominate, although winds from the east are also common. The mean wind speed is approximately 18 km/h and there is a low frequency of calms (3%). The lack of prominent terrain to channel the wind means more variable wind directions. This would decrease annual mean concentrations of ambient air quality parameters. These wind conditions would provide good dispersion of any emissions that may be released by the proposed project.

At Diavik's location, air quality is reported to be good. Ambient concentrations of parameters such as particulates, CO_2, SO_2, and NO_2 are normally low.

7.2.2 Vegetation and Terrain

The predominant vegetation/land cover types in the study area include heath tundra, heath tundra with boulders, and tussock/hummocks types. Heath tundra is the most widespread and characteristic vegetation/land cover type, encompassing some 38% of the local study area. The existing vegetation communities within the local and regional study areas are described in more detail in the integrated socio-economic and environmental baseline report.

Glacial till is the dominant surficial material in the local study area. Soils in the local study area are of the Cryosolic order. These soils form where permafrost occurs within 1-2 m of the ground surface. They are characterized by horizons or layers that have been disrupted, mixed or broken by freeze-thaw activity.

7.2.3 Wildlife

The wildlife habitat types support an array of wildlife species. Eighty-four bird species and sixteen mammal species have been confirmed as permanent or summer residents, migrants or summer visitors within the regional study area. Half of the bird species breed in the area, while the remainder are migrants or uncommon visitors. Caribou migrate into and through the area during spring, summer and fall. The remaining mammal species are permanent residents.

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Part of the 350,000 strong Bathurst caribou herd uses the regional study area during its spring migration north to its calving grounds, and during the summer/fall when it returns to spend winter in the south. Up to 100,000 caribou have been observed in the regional study area during spring migration. Up to 7,000 caribou have been observed passing through the local study area near the proposed project site in some years. Wolves follow caribou for most of the year, but also den in the regional study area during May to August. The home ranges of an estimated 30 adult and sub-adult barren-ground grizzly bears also overlap the regional study area.

Comprehensive information on wildlife populations and habitat is provided in the wildlife baseline report. Additional information on key wildlife species is provided in Diavik's wildlife environmental effects report.

7.2.4 Water and Fish

Data were gathered between 1994 and 1997 on the existing (baseline) condition of water quality and aquatic resources in the Lac de Gras area. Information about species composition and relative abundance of plankton, benthic invertebrates and fish, as well as detailed information on fish habitat was collected. Data were also collected on water quality, hydrology (water quantity), and the groundwater regime of the Lac de Gras area. Baseline technical information relating to aquatic resources was summarized in Diavik's integrated socio-economic and environmental baseline report. The following summary of the relevant baseline data is intended to provide a context for understanding the environmental effects assessment summarized later in this report.

7.2.4.1 Lac de Gras Drainage Basin

Lac de Gras is situated about 100 km north of the treeline in the NWT. The landscape consists of numerous lakes interspersed among boulder fields, eskers and bedrock outcrops. There are no permanent human settlements on or near Lac de Gras. The Lac de Gras drainage basin is located at the headwaters of the Coppermine River drainage basin. Lac de Gras discharges water west into the Coppermine River which flows north into the Arctic Ocean via Point Lake. The community of Kugluktuk is located where the Coppermine River meets the Arctic Ocean. The principal inflow to Lac de Gras is through a narrow channel from Lac du Sauvage, located to the northeast. Over 200 small tributary streams, many of which are ephemeral (i.e., flow intermittently, usually during snowmelt), also discharge directly to Lac de Gras.

Lac de Gras is approximately 60.5 km long and up to 16.5 km wide and has a water surface area of 572 km^2. The average depth of the lake is 12 m, although depths reach 56 m at some points. The shorelines of Lac de Gras are rugged and are interspersed with numerous bays and inlets. A gravel-cobble-boulder mixture dominates the substrate of the lake to a depth of approximately 6 m, below which fine sand, silt and clay predominate.

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7.2.4.2 Water Quality

The water of Lac de Gras has extremely low dissolved ion concentrations, hardness, and total dissolved solids and is mildly acidic with very low nutrient concentrations. The majority of metal concentrations are also low and are commonly near or below analytical detection limits. However, iron, manganese and zinc are often detectable. Aluminum occurs in higher levels than other metals, and natural background levels can significantly exceed guideline concentrations established for the protection of aquatic life. Nevertheless, aluminum concentrations in Lac de Gras are consistent with other lakes in the Slave Geological Province.

7.2.4.3 Fish and Fish Habitat

Lac de Gras supports a stable, slow-growing community of coldwater fish which is characteristic of a cold, ultra-oligotrophic lake. Species captured from Lac de Gras during the summer of 1996 include lake trout, round whitefish, cisco, longnose sucker, Arctic grayling, burbot and slimy sculpin. Overall, seven fish species were identified in the small lakes surveyed on the East and West Islands and the east mainland: longnose sucker, lake trout, round whitefish, lake whitefish, cisco, lake chub and Arctic grayling. Fish were not present in many of the lakes surveyed. There is little flow in or out of most of the lakes on the East Island because the streams connecting these lakes to other lakes on the East Island or Lac de Gras are ephemeral and flow for only short periods of time, typically during snowmelt.

7.2.4.4 Groundwater

At the proposed project site there are several rock types, which have varying groundwater flow characteristics. Permafrost (i.e., soil or rock that is continuously below 0°C for two or more years) is present within the proposed project site. The thickness of permafrost decreases towards Lac de Gras and is absent beneath the lake itself. Permafrost underlies all of the small lakes on the East Island. This effectively prevents groundwater from flowing into Lac de Gras.

The estimated levels of naturally occurring total dissolved solids (TDS) increase exponentially with depth. The increase in TDS with depth in the groundwater is consistent with data from other mines in the Canadian Shield, including mines in the Yellowknife area. The general groundwater chemistry is typical of water that has a lengthy residence time in association with granitic rock.

7.2.5 Heritage Resources

During the baseline study, 195 archaeological sites were identified in the regional study area. These consist of 17 isolated finds, 71 artifact scatters, 96 quarries, seven campsites, one meat cache, one burial site, one site consisting of wooden poles, and one stone marker identified as a burial site by the Yellowknives Dene First Nation. Of these sites, 66 occur on the mainland, one occurs on a small island adjacent to the northern mainland, 21 occur on the West Island and 107 occur on the East Island. The site types present in the

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local study area include three isolated finds, 14 artifact scatters and 40 quarries. Of these 57 sites in conflict with the proposed project footprint, 21 (about 37%) are associated with scientific heritage values. With the assistance of Aboriginal organizations, these sites have been further examined and documented.

7.3 EXISTING SOCIO-ECONOMIC CONDITIONS

Details in respect of the existing socio-economic conditions at the proposed Diavik site are contained in Diavik's integrated environmental and socio-economic baseline report. Further detail can be located in community profiles that have been produced by respective communities to include specific socio-economic details.

7.3.1 Communities

Study area communities could be characterized as either market or mixed-economy communities. The smaller, predominantly Dene, Métis and Inuit communities have mixed economies in which wage income, income transfers and hunting/trapping coexist. These communities are characterized by high unemployment rates, low participation in the wage-based economy, a high proportion of government employment and limited economic diversification. The larger wage-based communities are characterized by dependence on wage employment, comparatively higher participation and employment rates and considerably larger economies.

The size, distribution and characteristics of the population vary among study area communities. Typically, populations in Dene, Métis and Inuit communities are small and predominantly composed of people of Aboriginal ancestry. For example, the mainly Dene communities range in size from 135 people (Wekweti) to 1,662 people (Rae-Edzo), with about 90% of the population having Aboriginal ancestry. Young people (24 years of age and younger) make up about 45% of the population and seniors over 65 about 8%. The largest study community, Yellowknife, has a population of 17,275. Over 40% of Yellowknife's population are younger than 24 and only 2% is over 65 years old.

7.3.2 Education and Training

Formal education and training circumstances vary among the population, particularly among persons of Aboriginal and non-Aboriginal ancestry and of different ages. Aboriginal populations in study area communities have historically had lower participation and achievement levels than non-Aboriginal peoples. The reasons for this are wide ranging: the nature of historical relationships between Aboriginal people and the education system; residential school experiences; the separation of school, home and community, and educational directions and philosophies.

In recent years education levels, particularly among Aboriginal people, have risen. This may be attributed to more positive views toward formal education and greater access to higher levels of education at the community level. It may also be related to a growing awareness, the prospect of, and desire for jobs. In some communities, stronger linkages between formal education, employment, place and position within the home and community have improved educational participation and achievement.

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7.3.3 Human Health

The state of human health in the NWT is mirrored in local and regional communities. The main health issues are alcohol abuse, relatively high cancer rates and a high incidence of sexually transmitted diseases. In study communities, social problems have been described as modest to severe and closely related to substance abuse. Substance abuse has been identified as threatening human health, personal safety and well being. It is a significant factor in high rates of family violence and crime; poor motivation, physical health, self-esteem and mental health; unstable interpersonal relationships; and untimely deaths. It is a negative force in the lives of young people and is a factor in the growing number of children requiring special services and care.

7.3.4 Culture

Aboriginal people from communities within the study area view stewardship of the land and its resources as an important responsibility. It is a responsibility that reflects the holistic and interconnectedness of the human and natural environments, and expresses cultural values. Stewardship is a responsibility that reflects the ethics of wellness, of sharing and of sustainability from one generation to the next.

The socio-cultural patterns of local and regional communities spring from long traditions and from the influences of change over time. Cultural values are expressed in the family and in interpersonal relationships. Among Aboriginal people there is wide-spread concern that traditions and customs are not practised as they once were, contributing to a lack of a common understanding and connection, of shared beliefs and values. Dene, Métis and Inuit have been striving to maintain cultural values of the land and resources, as well as a land base through which to express these values. The land is the fabric of the Aboriginal culture. The land gives a sense of place and identity, provides the context for expression, shapes values and beliefs, and influences customs and practices. The land provides the philosophical context for Aboriginal culture.

7.3.5 Governance

Governance traditions have differed greatly for Aboriginal and non-Aboriginal people in local and regional communities. The traditions of governance among non-Aboriginal peoples are grounded in British traditions while those of Aboriginal people are based on the land and the natural environment. Contemporary approaches and structures of governance have evolved from these two different orientations.

7.3.6 Infrastructure and Services

Local infrastructure and services vary considerably between the larger study area communities of Yellowknife, Hay River, Fort Smith, Inuvik and other study communities. The larger centres have piped service delivery, larger schools with more offerings, a greater range of family and health services, fire protection and police services and well-developed recreational services and infrastructure. The smaller study area communities in contrast generally have "pump-out" services, schools that may or may not offer high school grades, as well as limited health and social services, and fire protection and police services that may or may not be locally available. Recreation services and infrastructure options are comparatively modest.

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8.0 ENVIRONMENTAL EFFECTS ANALYSIS

8.1 APPROACH

The objective of this section is to summarize potential environmental effects, outline mitigation measures and evaluate significance of residual effects for the proposed Diavik Diamonds Project. Cumulative effects of the proposed project in combination with other projects and activities in the regional study area are presented. Environmental effects analyses are based on information contained in Diavik's environmental assessment overview and environmental effects reports, augmented with information from technical sessions, meetings, workshops and follow-up documentation. Mitigation measures proposed by Diavik include those taken into account by Diavik in the design of the project as well as those identified through the technical sessions. The responsible authorities (RAs) have made the final determination of significance of residual environmental effects based on the information provided by Diavik and through the comprehensive study. Comments and concerns were developed through technical reviews of Diavik's environmental assessment submissions and the findings of technical sessions, meetings and workshops. RAs, federal authorities (FAs), Government of the Northwest Territories (GNWT), Aboriginal governments/organizations/communities, non-government organizations and public were the main sources. The proponent was asked to respond to the comments and concerns. The RAs determined the validity of the proponent's assessment of significance, the effectiveness of proposed mitigation measures, the need for follow-up and the significance of the residual environmental effects.

8.2 CLIMATE AND AIR QUALITY

8.2.1 Ambient Air Quality Conditions

i) Environmental Effects

Diavik predicted that of the six parameters investigated, total suspended particulates (TSP), inhalable particulates, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and ozone(O_3)), five would be below established ambient air quality guidelines beyond the project site. The exception is TSP, which would exceed guidelines adjacent to areas of intense activity such as blasting for short periods. On-site, particulate concentrations would be higher, but within the occupational health criteria used for mining by NWT Safety and Public Services.

Dust deposition is associated with potential effects to aquatic, vegetation and wildlife resources and was calculated by Diavik based on information about the release of particulates to the air. The largest size of particulate, greater than 100 µm, usually settles out within 6 to 9 m of the source. That type of dust deposition would remain within the pits or be adjacent to haul roads on East Island. Particles 30 to 100 µm in size would tend to settle out approximately 100 m from the source, on, or very near, East Island. Smaller particles travel greater distances, and would tend to be primarily deposited either on East Island or in adjacent portions of Lac de Gras.

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With the exception of the small amounts of particulate emissions from burning fossil fuels and from miscellaneous sources (e.g., the camp incinerators), the majority of particulate emissions would be from handling of natural materials on the site (e.g., granite rock). The deposition rate of particulates is expected to vary from about 10 $mg/dm^2/y$ on the western portion of East Island to 100 $mg/dm^2/y$ within the project footprint. A typical rate would be less than 20 $mg/dm^2/y$ in Lac de Gras while deposition adjacent to the accommodation camp would be 58 $mg/dm^2/y$.

Diavik concluded that the cumulative effect of the proposed project and the Ekati Diamond Mine would not lead to cumulative ambient concentrations that exceed guidelines, but would be a minor contributor to greenhouse gas emissions, where global warming is acknowledged to be a potential cumulative effect rather than an individual loading.

ii) Mitigation

Diavik reported in its environmental assessment submission that mitigation for climate and air quality and other resource components was identified during planning and incorporated into the design stage of the project. Diavik has proposed mitigation measures in its Environmental Effects Report, including use of low sulphur diesel fuel and use of water as a particulate dust suppressant when appropriate, and have provided plans for managing potential issues related to air quality and climate in its Environmental Management System.

iii) Significance

Diavik predicted that residual environmental effects of ambient air quality conditions for the proposed project would be limited to the local area. Effects would be negligible at the regional level even with inclusion of cumulative sources. On this basis, the proponent did not identify any significant adverse effects for ambient air quality.

iv) Comments/Concerns

Federal Authorities
Environment Canada recommended that the meteorological stations for the project be relocated as soon as possible and before construction commences to ensure consistent, long-term data collection. Early relocation is particularly important in light of anticipated changes in the local climate at the site as the nearby terrain is modified through mine development. The major concern is the change in the local wind flow regime resulting from the creation of the country rock piles and other alterations of the landscape. Given the probability of climatic change over the life of the project, the establishment of adequate meteorological monitoring stations early in the development would also help confirm the validity of the values used for event return periods. The data from the new site(s) can be correlated with results from the monitoring stations maintained at the Lupin Gold Mine and Ekati Diamond Mine.

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Monitoring of precipitation is important to Diavik's Water Management Plan. The limited on-site precipitation data introduces considerable uncertainty in the precipitation climatology for the project area. Precipitation measurements over the last few years appear to be of relatively poor quality for a parameter that is so important to the design and operation of the project. Meteorological monitoring should include a manual, year-round precipitation monitoring program operated to standards utilized by Environment Canada's precipitation network. Automatic precipitation measurements are not dependable. The Nipher-shielded snow gauge should be serviced on a daily basis. Precipitation gauges should be located well away from roads and other high traffic areas where measurements may be affected by project activities. Most other meteorological parameters of importance to the mine operation (e.g. wind, temperature, humidity, and radiation) can be monitored using automatic systems.

Environment Canada commented that dispersion modelling was, for the most part, well done, and for particulates, noted that the restricted modelling domain was appropriate, given the rapid settling of particulates near the mine pits, country rock piles and roads.

Environment Canada was concerned that there may be instances when exhaust plumes from the Ekati Diamond Mine diesel generators, including future generators at Misery Lake, and the proposed Diavik Diamond Mine diesel generators could combine under certain wind conditions and exceed the maximum acceptable NO_2 level of 400 µg/m^3. In response to this concern, Diavik provided a detailed explanation of some of the assumptions that were built into the modelling of NO_2 levels and why the 400 µg/m^3 objective would not be exceeded.

Diavik and government specialists agreed on emission rates for NO_2. Discussions focused on the conversion rate of nitrogen monoxide (NO) to NO_2 in the presence of ozone and the likely background levels for ozone at the proposed mine site and surrounding area. The conversion rate is nearly instantaneous in the presence of ozone. In its modelling, Diavik used the ozone limiting method to determine ground level concentrations of NO_2. For this method, Diavik used a higher ozone value for a background level that was nearly twice that reported for sites in northern Alberta and the high Arctic. Therefore the emission and conversion rates were highly conservative and there is only a remote possibility that NO_2 concentrations would exceed 400 µg/m^3 under any wind conditions.

Although Environment Canada concurred with the predictions, the department recommended that Diavik undertake periodic monitoring of NO_2 to both confirm the assumptions and validate the predictions.

Government of the Northwest Territories

The Government of the Northwest Territories (GNWT) provided comments on greenhouse gas emissions (see Section 8.2.2. – Global Climate Change) and dust deposition. Ambient dust levels measured on site by Diavik are < 10 mg/m^3, and indicative of very clean air. Diavik's predictions of total particulate emissions are supported by measurements made at the Ekati Diamond Mine site and were used in a

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computer dispersion model to predict effects on and off site. The highest ambient levels of TSP would occur on site where the NWT Mine Health and Safety Regulations are the applicable standard. The NWT 24-hour ambient air quality standard for TSP was predicted by Diavik to be exceeded for a distance of 2 km under worst-case conditions. The annual standard would not be exceeded off site and the annual average would drop to the natural background of < 10 mg/m^3 within 3 km of the site.

The GNWT recognized that dust effects would be more likely to result from the rates of deposition on vegetation and water, or from dust-induced acceleration of snowmelt, rather than from exceedences of ambient air quality standards. Dustfall effects were predicted by Diavik to be minimal at distances greater than 50 m from the mine footprint. Standards for the assessment of dust deposition do not exist and so monitoring programs should assess the effects of dust on vegetation, wildlife and water.

The GNWT concluded that any effects due to dust will be confined to the mine footprint if the mitigation measures described by Diavik are applied. Such measures must be accompanied by programs to monitor the effectiveness and to determine if they need to be modified. Monitoring should be part of an environmental agreement. If water is inadequate as a dust suppressant, Diavik should investigate other approaches to fugitive dust. The GNWT has provided Diavik with a copy of the dust suppression guideline issued under the authority of the NWT Environmental Protection Act.

The GNWT also noted that Diavik will have a subtle impact on regional air quality, however, incremental increases in air pollutants may contribute to cumulative effects in the region. The GNWT believes that cumulative effects from air pollutants need to be considered in the context of keeping areas clean to ensure critical loading rates are never reached. "Keeping Clean Areas Clean" provisions for particulate matter are being developed under the Canada Wide Standards process by the Canadian Council of Ministers of the Environment (CCME). CCME and member jurisdictions are committed to broad stakeholder consultations.

Aboriginal Governments/Organizations/Communities
A frequent concern raised during the public consultation period on the environmental assessment submission by Aboriginal people related to fugitive dust emissions and the means to control them.

The Lutsel K'e Dene First Nation (LKDFN) submitted a project review by Dr. Josef Svoboda who raised questions regarding project effects on primary production, effects of noxious and acid-forming gases on lichens, the potential for dust storms and greenhouse gas emissions that lead to irreversible effects. Among his concerns, Dr. Svoboda noted that dust monitoring may be of academic interest only since it would not change the situation (irreversible effects) as it develops.

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Technical Session Recommendations
Resolutions reached for air quality conditions were: i) Diavik will document procedures to ensure the safety of aircraft during blasting and other mine activities in its Environmental Management System; and ii) Diavik is committed to work with the GNWT and Aboriginal governments and organizations to develop protocols for dust monitoring and to document them in its Environmental Management System. An agreement can be developed after approvals, if required.

v) Proponent Response

Diavik has committed to carrying out the remaining technical session resolutions related to air quality. Diavik also plans to build a more sophisticated meteorological station if the project receives approval and will consider Environment Canada's comments at that time.

Diavik stated its preference to utilize water as a dust suppressant and should other dust suppressants be considered, Diavik has committed to consulting with the GNWT in accordance with the Environmental Guideline for Dust Suppression.

Regarding the GNWT comment about the development of "Keeping Clean Areas Clean" provisions under development, Diavik believes that it is premature to address proposed standards for particulate matter prior to the completion of scientific reviews, public consultations on the proposed standards, and the potential adoption of any standards by government. The proposed standards are not expected to take effect (following acceptance) until 2010.

vi) RA Conclusions

The responsible authorities (RAs) conclude that no significant adverse effects by the project on air quality are expected with the application of its mitigation measures and follow-up.

The RAs agree with the GNWT's conclusion that incremental increases in air pollutants may contribute to cumulative effects in the region. The RAs however agree with Diavik's conclusion that the proposed project and the Ekati Diamond Mine will not lead to cumulative ambient concentrations that exceed guidelines. While not a requirement of this process, the RAs also encourage Diavik to participate in the consultations on the CCME's "Keeping Clean Areas Clean" provisions for particulate matter.

The RAs agree with Diavik's commitment to modify its Environmental Management System to reflect the recommendations from the technical sessions and its commitments should the project be allowed to proceed (see Section 9.2.1 – Climate and Air Quality).

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The RAs acknowledge the submission of an Air Quality Monitoring Program, Wildlife Management Program and Aquatic Effects Monitoring Program by Diavik. Diavik has committed to modify these programs in accordance with the environmental agreement, water licence and/or land lease. The follow-up program as specified in the environmental agreement or regulatory instrument will also require Diavik to: i) establish a more sophisticated meteorological station to confirm assumptions and validate predictions; ii) validate whether impacts from deposition on vegetation (habitat), wildlife, water and air quality were accurately predicted by monitoring ambient air levels, dust emissions and deposition rates, and iii) include periodic monitoring of NO_2 during mining operations.

The RAs believe that the monitoring program will not be of academic interest. The RAs have a high level of confidence that the dust suppression mitigation measures will adequately address any potential for adverse environmental effects on not only ambient air quality, but also on minimizing adverse effects on vegetation and water quality.

8.2.2 Global Climate Change

i) Environmental Effects

The proposed Diavik Diamonds Project has been designed for efficient use of energy and energy recovery, minimizing greenhouse gas emissions. Nevertheless, the proposed project would emit greenhouse gases through fuel use on the project site and transportation of personnel and materials to the site. Emissions would primarily consist of carbon dioxide (CO_2), with smaller amounts of methane (CH_4) and nitrous oxide (N_2O). The proposed project would be a minor emission contributor to Canadian and global emissions. For example, the CO_2, CH_4 and N_2O emissions from the proposed project would be about 0.03%, 0.00048% and 0.022% respectively of Canada's total.

ii) Mitigation

Diavik reported in its environmental assessment submission that mitigation for climate and air quality and other resource components was identified during planning and implemented during the design stage of the project. Mine planning and specific operational procedures including energy reduction and recovery initiatives, were identified as mitigation measures for global climate change in the proponent's environmental assessment overview and climate and air quality environmental effects report.

iii) Significance

Diavik predicted that while a contributor, in itself the proposed Diavik project has too low an emission rate of greenhouse gases and too short a time frame to have any demonstrable effect on global climate change. Effects from the Diavik project would be negligible at the regional level even with inclusion of cumulative sources. The proponent has predicted no adverse environmental effects regarding global climate change.

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iv) Comments/Concerns

Federal Authorities
Environment Canada noted that over the past 50 years, the Western Arctic has experienced a warming trend accompanied by not only increased annual rainfall but also an increase in the magnitude of daily and longer duration extreme events. General circulation models, including the Canadian Model, predict significant warming at high latitudes over the next century. Although there is no immediate concern of permafrost degradation, Environment Canada recommended more stringent design criteria for the processed kimberlite containment facility during operations at closure. Examples are provided in Section 8.6.2 – Global Warming and Structural Integrity.

Carbon dioxide emissions from this project represent about 9% of the combined 1990 Yukon and NWT emissions level. When combined with the Ekati Diamond Mine, they represent 20% of the 1990 territorial emissions. The NWT is particularly sensitive to potential climate change, such as systematic warming and increases in precipitation. The cumulative emissions of greenhouse gases from all developments in the NWT will affect Canada's emissions profile and its ability to meet international commitments arising from the Kyoto conference. Environment Canada recommended that Diavik continue to examine opportunities to reduce greenhouse gas emissions through energy efficiency and energy reduction measures as well as the use of alternative energy sources.

Government of the Northwest Territories
The Government of the Northwest Territories (GNWT) noted that greenhouse gas reduction programs in Canada are voluntary, there is no regulatory regime requiring Canadian companies to reduce emissions and energy efficiency measures make good economic sense in remote Arctic locations. The GNWT indicated that Diavik needs to give more consideration to alternative energy sources, such as wind power, but acknowledged that the environmental benefits of alternative technologies may not make economic sense given current technology. Over the lifetime of the project, however, it is expected that Canada and the NWT will develop measures to reduce greenhouse gas emissions and Diavik will be expected to respond to these changes. Proactive measures, such as tracking emissions and investigating alternatives, would be prudent and Diavik is encouraged to register with the Voluntary Challenge and Registry and to participate as a stakeholder in development of a Greenhouse Gas Emission Control Strategy for the NWT.

With respect to wildlife, the effects of global warming were not considered despite the potential for important effects related to energetic costs of spring migration of caribou, insect harassment, or the costs of later freeze-up and fall migration. The GNWT felt that there could be changes in baseline conditions caused by climate change. These changes add uncertainty to predicted effects. Therefore, the GNWT recommended that Diavik acknowledge that the cumulative effects of global warming will add uncertainty to the predicted effects on caribou.

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Aboriginal Governments/Organizations/Communities
The Yellowknives Dene First Nation want Diavik to consider solar power in a hybrid system with wind or diesel power. The Lutsel K'e Dene First Nation recommended further study into alternative power generation.

Technical Sessions Recommendations
Diavik was to provide a written response for the public registry to address concerns raised regarding carbon emissions and effects on wildlife. The GNWT agreed to make its expertise available to assist, if required.

Diavik is committed to work with the GNWT to analyse the environmental and economic benefit of wind-generated power on site.

v) Proponent Response

Diavik submitted a response to the public registry regarding its carbon emissions and what effects they may have on caribou. Diavik noted that there is evidence of climate change as a result of greenhouse gas emissions but that the regional extent of change requires further research, which is likely to take place during the project life. Diavik's response outlined its commitments to reduce greenhouse gases but also indicated that consideration of emission offsets was considered premature in absence of government regulations and guidance. Diavik also stated that its approach to greenhouse gas emissions is consistent with that of the GNWT. Diavik noted that the discussion of potential effects of climate change on wildlife was not warranted on the basis of uncertainty in predictions of climate change and the long-term range in climate variation encountered by existing wildlife communities. As such, Diavik concluded that there are no reasonable scenarios that greenhouse gas emissions from the proposed Diavik project would adversely affect those species through climate change (or other air quality related processes). Diavik is committed to considering the use of wind power on site as well as registering and participating in voluntary government programs designed to reduce greenhouse gases.

vi) RA Conclusions

Climate change predictions are based on regional responses to global emissions of greenhouse gases. The proposed project would not make a significant contribution to national or global emissions and so no significant adverse effects on climate are expected. Nevertheless, production of large amounts of greenhouse gases as a consequence of fossil fuel used to generate power in remote Arctic locations, the incremental contribution of each source to a cumulative global problem, the sensitivity of Arctic regions to climate warming, and the potential for future regulatory initiatives all suggest that positive and proactive measures to reduce the emission of greenhouse gases are warranted. Diavik, the GNWT and Environment Canada are committed to investigating means to reduce greenhouse gas emissions over the life of the project.

The responsible authorities (RAs) encourage Diavik to register in the Voluntary Challenge and Registry and to participate meaningfully as a stakeholder in the development of a Greenhouse Gas Emission Control Strategy for the NWT.

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The RAs also encourage Diavik to work with the GNWT and Aboriginal governments and organizations to examine opportunities to reduce greenhouse gas emissions through energy efficiency and energy reduction measures.

The RAs note the GNWT's views and observations regarding the potential effects of global warming to the predicted effects on caribou energetics. The RAs also take note of the GNWT's comments on changes in baseline conditions for caribou caused by climate change. However, given that the mine life is relatively short in terms of detecting ecological change that may result from global warming, the RAs conclude that there will be little impact on caribou and caribou habitat over the next 25 years as a result of climate change. Therefore, the RAs are of the view that global warming will not likely cause significant environmental effects on caribou as a result of this project.

With respect to Environment Canada's recommendation on design criteria for the processed kimberlite containment facility see Section 8.6.2 – Global Warming and Structural Integrity.

8.3 VEGETATION AND TERRAIN

i) Environmental Effects

Diavik assessed the project and cumulative effects on vegetation and terrain against baseline conditions including the assessment of effects from its exploration camp. Diavik indicated that the main effect on vegetation during both construction and operation would be a reduction in the areal extent of all vegetation and land cover types due to surface disturbance caused by the mine and its associated infrastructure. Approximately 1148 ha (51%) of the existing vegetation and land cover and water types within the local study area (East Island, small adjacent islands and waters) would be directly affected by facilities and operations. Within the regional study area (Lac de Gras drainage basin), loss from the proposed project would amount to less than 1%. The changes in vegetation cover would be offset somewhat through reclamation. Conditions typical of Arctic environments would result in very slow recovery of vegetation, resulting in long-term effects to vegetation.

Diavik noted that vegetation losses may occur outside the proposed project footprint due to changes in drainage patterns and the deposition of dust generated by construction and operation activities. Vegetation changes are predicted to occur as the new moisture regime is established but Diavik concluded that impacts will be confined to the mine margins. Vegetation cover will be adversely affected by localized dust deposition. However, Diavik concluded that the potential impact of incremental vegetation losses due to dust would be limited in spatial extent, of moderate magnitude and long-term.

While no rare or endangered plant species or communities are found within the local study area, other changes to biodiversity would occur. Diavik reported in its environmental assessment submission that, at the landscape level, the number of naturally-occurring terrain units may decrease, but man-made units would increase, such that a low magnitude increase in terrain diversity would result. At the community

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level, richness (number) of vegetation/land cover units would decrease by 14%. Introduction of disturbed types could result in an increase, although artificial, in the diversity of community types. The size and range of patches for most vegetation/land cover types would decrease due to the proposed project. At the species level, a reduction of some 44% of species diversity and richness units would be expected within the local study area.

Cumulative loss in vegetation and land cover at the maximum mine extent of both the proposed project and the Ekati Diamond Mine would amount to approximately 1% of the regional study area. The potential cumulative effect on wildlife habitat is addressed in the wildlife effects analysis. Diavik concluded that the project would not affect rare or endangered plant species and that the biodiversity project-effects would not extend beyond the local study area for vegetation/terrain. Therefore, Diavik did not undertake an in-depth cumulative effects analysis on vegetation/terrain biodiversity or rare and endangered plant species.

ii) Mitigation

Diavik reported in its environmental assessment submission that mitigation for vegetation and terrain (including permafrost) was incorporated into the project design. The proposed Abandonment and Restoration Plan has as a goal the restoration of the site to as near as possible original conditions.

iii) Significance

Diavik predicted that environmental effects of the proposed project on vegetation would be restricted to the proposed mine footprint and areas immediately adjacent in response to dust deposition and changes in drainage conditions. The impact at the local level would be of a high magnitude and long term. Diavik predicted that the impact to areas immediately outside the mine footprint would be local, of medium magnitude and long-term. Diavik concluded that the effects do not extend to the regional area, no rare or endangered plants were identified and effects on biodiversity were restricted to the local study area.

iv) Comments/Concerns

Responsible Authorities
The Department of Indian Affairs and Northern Development (DIAND) requested information on all sites (eskers and bedrock) required for granular materials, including location of storage areas, a detailed map of the area being utilized and information on reclamation plans. DIAND recognized the draft Quarry Management Plan submitted with the environmental assessment submission that outlines Diavik's environmental practices with respect to pits and quarries. However, DIAND indicated that because the requirement for the use of the mainland borrow site was identified late in the process, there is no consideration given to it in this plan. DIAND requested a revised description of the terrain and physical environment with respect to the location of the new borrow site, as well as a revision to the spatial and temporal boundaries. There is a high potential for ground ice that can melt out if exposed thereby requiring in-pit strategies to minimize the potential environmental effect of ground-ice melt outs.

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DIAND requested an evaluation of the level of confidence associated with implementing the proposed end land cover, an outline of opportunities and plans for progressive reclamation including any experimentation and research work that could begin early in the life of the project, and further detail on how the design of each project component could assist in meeting the objectives for reclamation.

DIAND questioned Diavik on its policy statement regarding abandonment and restoration, noting the contradiction between the policy and Diavik's plans for several burial options. A financial forecasting breakdown for restoration options was not submitted by Diavik.

DIAND requested that the impacts of each restoration option be assessed, the level of confidence for each be evaluated, an outline of the financial program for restoration be provided, closure cost estimates be provided, all equipment, facilities and infrastructure be removed from the site at the end of mining, and structures remaining after completion of mining, be identified and appropriate amendments to leases/permits applications be made.

DIAND identified the lack of information on environmental effects of the processing plant, specifically with respect to permafrost. The environmental effects of this practice were not detailed. DIAND requested further information related to the airstrip including identification of potential environmental effects resulting from that project component. Specific issues include the impact of the airstrip on permafrost and the underlying till material, especially during the initial construction phase given that construction was proposed to occur during the summer months, as opposed to the winter months. The potential for water ponding around the edges of the airstrip during spring run-off, and the effects on the permafrost and underlying till were also a concern.

Federal Authorities

Environment Canada accepted Diavik's statement that the project would result in a low magnitude increase in terrain diversity. However, it was not possible to predict if artificial landforms resulting from the mine would result in usable wildlife habitat. Environment Canada recommended research on possible reclamation measures during operations to improve the chances of successfully reclaiming as much of the area as possible. Diavik should work cooperatively with other operators in the regional study area and possibly beyond to develop reclamation techniques that are best suited to the local climate and geology.

Transport Canada requested additional information from Diavik to assess the potential environmental effects of the infrastructure including buildings, roads and airstrip on terrain and permafrost. Transport Canada requested information related to infrastructure layout, runway headings, topography, typical cross sections, slopes, sub-grade, sub-base and base courses, natural drainage flow patterns in the area of the airstrip, planned modifications to those natural flows of any natural bodies of water in the area, the type of base courses to be used to construct the airstrip, grain size specifications, quantities, sources of borrow, a description of how the design elevations would be achieved, the required pavement load rating to meet the proposed 737 class aircraft, and decommissioning plans.

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Government of the Northwest Territories

The Government of the Northwest Territories (GNWT) characterized Diavik's baseline data on vegetation and terrain as detailed and comprehensive and suggested that Diavik's use of field data, remote sensing techniques and modelling become the standard. The GNWT felt that the project-specific assessment was adequate, although it noted the lack of an assessment of cumulative losses of vegetation and land cover and requested Diavik to consider including the effects of the Ekati Diamond Mine as a minimum. The GNWT noted that Diavik submitted a revised estimate of vegetation loss that showed vegetation and land cover increased from 1148 ha to 6580 ha of the regional study area when the Ekati Diamond Mine is included. Given this, the GNWT concluded that vegetation and land cover loss would contribute to an overall minor loss in the region due to the cumulative effects of Diavik and other projects and the impact is not significant.

The environmental assessment failed to clearly link dust deposition to snow melt and resultant effects on vegetation and wildlife. GNWT's view was that Diavik's general statements on restoration and re-vegetation did not constitute a commitment to return the mine site to productive capacity given the absence of information on a research program on restoration techniques or reference to other attempts to restore tundra vegetation.

Aboriginal Governments/Organizations/Communities

The Lutsel K'e Dene First Nation (LKDFN) submitted a project review by Dr. Josef Svoboda who raised questions regarding project effects on primary production, effects of noxious and acid-forming gases on lichens, the potential for dust storms and greenhouse gas emissions that lead to irreversible effects. Among his concerns, Dr. Svoboda noted that dust monitoring may be of academic interest only since it would not change the situation (irreversible effects) as it develops. Should the project proceed, the LKDFN recommends that more expert consultation is required regarding the most appropriate indicators and methods for monitoring the effects of dust on vegetation (caribou habitat).

In addition, Lutsel K'e Dene elders have raised concerns that the vegetation and terrain in the Lac de Gras area represents critical caribou habitat and that the "real" loss may be greater than 1%.

The North Slave Métis Alliance (NSMA) stated that Diavik has not considered its knowledge in the development of the environmental assessment submission. Therefore, the NSMA stated that it will be completing a report by June 1999 and will independently submit it to the Minister of the Environment as a "companion piece to the comprehensive study report".

The NSMA and the Yellowknives Dene First Nation have both pointed out that Diavik's proposal to use the mainland esker is different than what was originally proposed in the environmental assessment submission. Both have stated that they must be involved in any further archaeological assessment work that may be carried out by Diavik should the project be allowed to proceed (see Section 8.8 - Socio-Economics).

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Non-Government Organizations/General Public
The Canadian Parks and Wilderness Society-NWT (CPAWS-NWT) raised the following abandonment and restoration comments/questions:

- during short-term shutdowns, has consideration been given to the advancement of rehabilitation procedures?
- when would some of the long-term closure procedures commence?
- has the spreadsheet of estimated closure costs been submitted?
- will there be a requirement for Diavik to post a restoration bond prior to being granted approval of the project?
- alien (plant) species should not be introduced.

The CPAWS-NWT further supported the commitment made by Diavik at the public technical sessions in February-March 1999 with respect to not burying equipment in the open-pits. The Canadian Arctic Resources Committee also raised similar concerns regarding abandonment and restoration.

Technical Session Recommendations
Diavik will develop a program for monitoring vegetation loss on site and document it in its Environmental Management System. Diavik will continue to work with the GNWT, Aboriginal governments and organizations and other partners to develop a regional monitoring program to address cumulative vegetation loss.

v) Proponent Response

Diavik is committed to developing and implementing a follow-up program to monitor vegetation loss on site and to work cooperatively in the development of a regional program to monitor cumulative vegetation loss.

Diavik provided a description and map outlining the location of the granular material storage area on East Island. The proposed area is presently near the end of the existing airstrip. When construction-quarrying activities are complete and the north country rock area is utilized, a granular storage area would be established for maintenance purposes. Final plans regarding the size and configuration of this area will be detailed in final engineering design should the project be allowed to proceed to the regulatory phase.

Diavik will also apply for a land use permit to remove 100,000 cubic metres of esker material from the new borrow site located off East Island, on the northeast side of the Echo Bay road camp airstrip, if required. The new borrow site is located at the end of an esker that runs approximately 7 to 10 km along the eastern mainland of Lac de Gras, approximately 30 meters away from the shoreline. Additional field work at the borrow site is planned for the spring of 1999 and Diavik will submit a detailed map that outlines the shape and boundaries of the proposed borrow area. Diavik will submit additional information when an application for a quarry permit is made. Diavik has stated that the site will be reclaimed according to DIAND's Guidelines for Pits and Quarries that will be outlined in the Quarry Management Plan to be submitted along

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with the regulatory application. Diavik indicated that the information provided on the mainland borrow site and the potential environmental effects described have been captured in the regional study area and were considered in Diavik's environmental assessment submission.

Diavik stated that a financial forecasting breakdown for restoration options would be included in the final Initial Abandonment and Restoration plan to be submitted during the water licensing process.

Diavik contended that there was adequate discussion around early green-up in its Wildlife Environmental Effects report. Diavik stated that it is committed to undertaking re-vegetation studies throughout the mine life in its draft Abandonment and Restoration Plan.

Diavik stated that "as a component of the Abandonment and Restoration Plan, Diavik will remove the burial of equipment in the bottom of the open-pits as a closure option. The Abandonment and Restoration Plan will be revised to reflect this and resubmitted in support of the regulatory process."

Diavik provided engineered drawings and details on construction methods for the airstrip that would allow for permafrost aggradation and preservation. Diavik proposes to place the heavy foundation load buildings directly on bedrock. Diavik explained that this is likely to result in a thaw bulb in the permafrost in the bedrock that will not result in any impacts on structural integrity. Cold air vents will be used in the foundations to limit the thawing where there is a requirement to do so to prevent difficulties with respect to the structural integrity of buildings. The building at the airstrip will be placed aboveground on pilings to eliminate any thawing of the permafrost.

vi) RA Conclusions

The responsible authorities (RAs) realize that the impacts of the project on vegetation and biodiversity would be more important at the local level as predicted by Diavik. However, taking into consideration the effects of those impacts on the environment and its representativeness on larger scale (e.g. regional), the RAs conclude that the project and cumulative effects on vegetation and biodiversity are not significant. Diavik will be required to modify its Air Quality Monitoring Program and Wildlife Management Monitoring Program in accordance with the environmental agreement and/or land lease. The follow-up program to be specified in the environmental agreement or land lease will also require Diavik to monitor the linkage between dust deposition, rate of snow melt and vegetation loss (with respect to wildlife habitat) as part of the Wildlife and Air Quality Monitoring Programs. While not a specific requirement of this review, the RAs encourage Diavik to work cooperatively with the GNWT and Aboriginal governments/organizations to develop and implement a regional program to monitor vegetation (habitat) should the project proceed.

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The RAs believe that the monitoring program will not be of academic interest. The RAs have a high level of confidence that the dust suppression mitigation measures will adequately address any potential for adverse environmental effects on not only ambient air quality but also on minimizing adverse effects on vegetation and water quality.

The RAs are satisfied that the potential for environmental effects as a result of removing additional borrow material from the new pit and quarry on the mainland and on East Island will not be significant. However, Diavik should modify its Quarry Management Plan for all pits and quarries before quarry permits are issued should the project be allowed to proceed.

The RAs conclude that there will be no significant adverse environmental effects provided that the mine is properly decommissioned. Diavik must prepare a comprehensive Abandonment and Restoration (A&R) Plan, and have it reviewed and approved by regulatory authorities. The approved A&R Plan will not allow burial of buildings, machinery and equipment on the mine site. It will include an estimate of implementation costs at various stages in the life of the mine. Should this project be allowed to proceed, Diavik must provide to the regulatory authorities adequate financial security for assuring that the A&R Plan will be fully implemented, independent of the corporation's financial status when the mine is closed. The A&R Plan must be submitted within two years from the time of regulatory approvals should the project be allowed to proceed. The A&R plan will address the time frame associated with the commencement of long-term closure procedures, advancement of rehabilitation procedures and identification of indigenous plant species to be used for re-vegetation. The follow-up program to be specified in the environmental agreement or land lease will also require Diavik to refine reclamation techniques in consultation with other developers that are best suited to the local climate and geology.

The RAs conclude that there will be no significant adverse environmental effects on permafrost provided that Diavik implements its proposed geotechnical monitoring plan. As a requirement of the follow-up program, Diavik will monitor and report on the results of its geotechnical monitoring plan to ensure the operations are performing as designed.

The RAs recognize that the NSMA believe that Diavik has not fully incorporated its knowledge into the development of the environmental assessment submission. However, the opportunity to participate and raise concerns throughout the review process was available and the NSMA actively participated (see Section 6.5 RA Conclusions, for more detailed information).

The RAs agree that the appropriate Aboriginal governments and organizations will be involved in further archaeological assessment work. This will be assured through the environmental agreement (see Section 8.8 – Socio-Economics).

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8.4 WILDLIFE

The assessment of potential project effects on wildlife, the proposed mitigation measures and the conclusions are presented in separate subsections for various species in order to accommodate the complexity and range of analyses that were undertaken.

8.4.1 Caribou

Assessments were carried out by Diavik to evaluate potential project-specific effects on caribou distribution, abundance and potential cumulative effects of existing and known future human activities and developments in the regional study area. Parameters included effects on summer habitat suitability and effectiveness, and potential increases in energetic costs and mortality during spring and fall migration. Additional information that was requested by the GNWT at the public technical sessions has been incorporated into the environmental effects section.

i) Environmental Effects

Diavik stated that long-term changes in the seasonal distribution of caribou are generally the result of long-term changes in habitat availability. The proposed project and cumulative land use activities would result in moderate (3.45%) and low (0.17%) reductions in summer habitat availability at full production in the local and regional study areas, respectively, compared to 1996 baseline conditions. Diavik concluded that as habitat effects would not extend beyond the regional study area, the calving and over-wintering distributions of the Bathurst herd would be unaffected. Within the broad migratory corridor and summer range of the herd, the level of habitat reduction predicted from the project and other land use activities could result in very localized shifts in habitat use with no measurable effect on broad seasonal distribution.

Changes in the abundance of caribou (either short-term or long-term) result from direct changes in mortality rates and from reductions in health and reproductive fitness through altered energetics or diseases. Diavik expects that changes in caribou mortality within the regional study area during construction and at full production would be very low.

Diavik stated that the effects of its proposed project and other current land use activities within the wildlife regional study area are not expected to measurably affect fitness, reproductive performance or abundance of the Bathurst caribou herd. Diavik predicted no potential measurable indirect effects on other species dependent on caribou within or beyond the wildlife regional study area as the effects of the Diavik project and other current land uses on caribou are negligible.

During caribou migration through the wildlife regional study area in spring and fall, Diavik expects low to moderate increases in caribou energetic costs (0.2 – 2%). The potential for increased energetic costs for female caribou during spring migration represents less than a 1% increase in energy expended for the entire migration between wintering and calving grounds. However, when the energetic costs for annual variations in insect harassment are added to a single cow's behavioural responses

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associated with the mine activities in an energetics model, the output suggests that pregnancy rates could decrease between 1 and 25% for individual cows in the vicinity of the mine site, depending on the circumstances involved. This would be the case only if individual cows were "tethered" to the area for the specified time periods utilized in the model. Diavik noted that this is not a realistic scenario as caribou can move from these areas freely and are not constrained in any way. Those energetic costs have been modeled.

However, Diavik noted that given the number of animals likely to be exposed to the project's zone of influence, the effect still represents a non-measurable change in production parameters at the population level. While predicted project effects are considered non-measurable at the population level, they nevertheless represent incremental stresses to the Bathurst caribou herd population, and have the potential to act in an additive fashion with similar stresses from other land use activities. Regional planning initiatives supported by federal and territorial governments, Aboriginal governments/organizations and industry are required to ensure that future increases in such cumulative stresses from unforeseen projects do not jeopardize the viability of the Bathurst caribou herd. Diavik is committed to participating in initiatives of this nature. Diavik states that it would appear that the energetics evaluation as presented offers a possible tool for tracking such cumulative stresses and assisting with the development of integrated land use decisions necessary for ensuring the sustainability of the herd.

ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project and implemented during construction of the mine to mitigate adverse effects on caribou are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation and management that would be implemented during construction and mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on caribou in the environmental assessment overview report and the wildlife environmental effects report.

iii) Significance

Diavik predicted that the likely residual effects on caribou associated with its project would not be expected to be of high magnitude extending into the regional study area (or beyond) for a long term.

iv) Comments/Concerns

Government of the Northwest Territories
The Government of the Northwest Territories (GNWT) commented that Diavik has adequately described project effects on caribou but that its approach limited its ability to determine whether the distribution or abundance of caribou would be limited by the project. Methods used included collection of baseline information, literature review, extensive consultation with the GNWT and development of friction and energetics models.

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The GNWT noted shortcomings of the methodology used by Diavik. The analyses relied too heavily on the two models without adequate consideration of their strengths and weaknesses. The analyses only partially considered inclusion of ecological variation. Effect classification did not consider the probability of an event or effect to allow for separation of common but innocuous from rare but catastrophic events, and confused effects with disturbances. The use of scientific literature was thorough but uncritical, the energetic model used was exported from the Porcupine herd to the Bathurst caribou herd without consideration of the effect of ecological differences between the herds on model predictions, and the friction model was not validated by observation. In addition, the effect of variability in fall migration on the model was not acknowledged.

The GNWT agreed with the results of Diavik's analysis of project and cumulative effects on habitat. The GNWT have concluded that there will not likely be significant adverse impacts as a result of the project. However, to add more certainty to its predictions, the GNWT stated that Diavik should have considered additive cumulative effects of air borne pollution, particularly dust deposition, its linkage to caribou habitat, and the potential effects of global warming on freeze-up and consequent changes in the energetics of fall migration. The GNWT noted that Diavik's analysis partially acknowledged uncertainties in its assessment that the Bathurst herd is not expected to be affected by project-specific or cumulative effects on migratory movements. The GNWT also noted that changes in caribou behaviour predicted as a result of the project were partially linked to activities such as foraging, learned behaviour or with ecological interactions to assess cumulative changes in energetic or reproductive costs.

While the GNWT generally concurred with Diavik's conclusion that the proposed project will not change the abundance or distribution of the Bathurst caribou herd, there are several issues that give rise to concern. The concerns from the GNWT include: the Diavik site is located on an island in a major migratory pathway which may expose as much as one third of the herd in any given year; there is no comparable experience to draw on in predicting potential effects; friction and energetics models are innovative and useful but lack specific validation for the Bathurst herd and there is no acknowledgement of its limitations and its limited application for considering cumulative effects; and, effects on caribou depend on successful mitigation and monitoring.

Although Diavik has proposed a thorough list of mitigation measures in its Environmental Management System, the linkage between procedures and monitoring results need to be clarified. Some of the proposed measures must adapt to potential orders-of-magnitude differences in caribou numbers on site during migration or the possibility of emergency responses (i.e. fuel spills) coinciding with large numbers of caribou on East Island during migration periods. The GNWT requested more detailed mitigation for preventing caribou from reaching East Island through deflection or other means, or provide sufficient detail on existing movement pathways. An Elder's Caribou Workshop was held in March 1999 to discuss additional mitigation measures and the GNWT agreed with the recommendations put forth that mitigation measures

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for caribou on East Island and monitoring must be adaptive and flexible. The GNWT also identified the need to monitor key ecological parameters to distinguish cause and effect and the need for co-operation with other parties, such as Ekati Diamond Mine, in monitoring.

The GNWT have also noted that the revised rating of effects (moderate to high) for the wildlife regional study area provided by Diavik will not change the overall predictions for project-related impacts because at the herd level, the predicted changes in pregnancy rates would be undetectable. Diavik also reported that the probability of this occurring would be very low. Diavik acknowledged the potential for changes to become additive with other stresses from land use activities. The GNWT concurred with Diavik regarding the need for regional planning to address additive issues.

The GNWT noted that Diavik restricted the worst case scenario for the energetics assessment, using the 1995-97 baseline studies, to an exposure of 35,000 caribou. However, in the cumulative effects assessment, Diavik included the Ekati Diamond Mine Misery Lake Road and, in July 1997, there were closer to 84,000 caribou in the area. The GNWT stated that this raises the possibility that, from the model predictions, a larger proportion of the Bathurst herd could be expected to have reduced pregnancy rates, especially in years when insect harassment is severe.

The GNWT noted that Diavik's response to the potential worst case scenario during thin ice periods in the fall acknowledged a worst case scenario of 8,000 to 10,000 caribou in a panic retreat during a time of thin ice with subsequent mortalities. Diavik stated that during this time period where thin ice conditions would exist at East Island, the majority of the caribou herd would be located south of Lac de Gras. Diavik also acknowledged that if herding failed (as a mitigative technique), implementation of humane measures and a salvage operation may be required to prevent the animal from suffering. The predictions of global warming relative to the timing of freeze-up and fall migration are likely to introduce uncertainty into the probability analysis and this is not acknowledged. However, the GNWT concluded that the adaptive and flexible approach to monitoring should adequately address any adverse environmental effects associated with worst case scenarios.

Aboriginal Governments/Organizations/Communities

Aboriginal people frequently expressed concern about the proposed project contaminating the caribou. They are concerned with caribou drinking from the processed kimberlite containment area, drinking water near the mine discharge and air emissions contaminating caribou. Safety of the caribou at the proposed mine site was also frequently expressed as a concern.

The North Slave Métis Alliance (NSMA) felt that Diavik should have included Monopros Limited's Winter Bulk Sampling Project within its temporal scope for cumulative effects assessment. The NSMA pointed out that caribou are of critical importance to the culture, economy, community, health, and wellness of the NSMA. Lutsel K'e Dene First Nation (LKDFN) and the NSMA have both indicated the need for a Bathurst caribou management plan.

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The Yellowknives Dene First Nation (YDFN) and the NSMA raised concerns regarding the Echo Bay Mine winter road contributing to increased hunting pressures on caribou. The YDFN have concerns that a significant portion of those hunters might be hunting in an irresponsible manner (e.g. not taking out all edible parts of carcasses, taking more wildlife than they need) and expressed the need for greater government enforcement to prevent wastage. Both organizations expressed the need for Aboriginal involvement in monitoring these activities. The YDFN have expressed concern that construction and operations may cause changes to the migratory patterns which may potentially affect caribou mortality.

The Kitikmeot Inuit Association (KIA) suggested many refinements to Diavik's Environmental Management System (EMS) regarding on-site wildlife management in relation to caribou. These suggested wildlife management refinements included such things as fencing, caribou herding, traffic management, caribou migration monitoring, and problem wildlife. The exact refinements are recommended to be incorporated into Diavik's adaptive EMS. The KIA also supported the Canadian Parks and Wilderness Society – NWT (CPAWS-NWT) suggestion that a fund similar to that for fish habitat compensation be created to compensate for wildlife habitat loss.

As a result of Diavik's additional energetics information and the GNWT's review, the LKDFN recommended careful monitoring of the Bathurst caribou herd health and migration and caribou use of the Lac de Gras area. This information is needed in order to better understand the combined effects of the Ekati Diamond Mine and the proposed Diavik project on the caribou herd.

The Dogrib Treaty 11 Council submitted to the public registry its consultant's evaluation of Diavik's environmental assessment in relation to the Bathurst caribou herd. This review raised many of the same questions as the GNWT but expressed greater uncertainty in the overall project assessment. One of the key conclusions of the review was that the very complex ecology of the Bathurst caribou herd is not well understood leading to uncertainties that limit the ability to understand the effects of this project and other developments on the herd. The report stated that the proposed mitigation measures have high degrees of uncertainty and cannot be assured. Other parts of the report indicated that the effects on caribou will depend on how well Diavik's EMS is implemented. The EMS must be adaptable and designed to deal with unforeseen and changing circumstances identified through monitoring programs. Specific recommendations identified in the Dogrib Treaty 11 consultant's report identified the need for:

- detailed analysis of the potential contamination of the food chain by processed kimberlite;
- feasibility analysis of constructing a barrier to prevent caribou access to East Island;
- factoring advanced exploration activities and its mitigation into the cumulative effects analysis;
- refilling the mining pits with excavated rock;
- detailed mapping of wildlife movement pathways on East Island;
- detailed mitigation plans and analysis of cumulative effects for transportation activities on the Echo Bay Mine winter road;

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- leadership in a study of cumulative effects development in the region; and
- co-operative development and implementation of follow-up programs and specific recommendations for their content.

Non-Government Organizations/General Public
Ecology North and the CPAWS-NWT have both expressed concerns regarding the temporal scope of the cumulative effects assessment. Existing and future projects suggested for the temporal scope include Jericho and Monopros Limited bulk sampling projects, BHP's Boston gold project, the Slave Geologic Province Transportation Corridor, BHP-Ekati Misery Road and Mine expansion and its impact on the Bathurst caribou herd (see Section 8.10 – Cumulative Effects).

The CPAWS-NWT expressed the view that other increased energetic costs were not adequately considered as identified by the GNWT at the public technical sessions, particularly the behavioural response to mine activities that could affect energetics. The CPAWS-NWT also felt that the spatial boundary for the caribou cumulative effects assessment should have included the entire Bathurst herd range.

The CPAWS-NWT is concerned that noise levels were dealt with only quantitatively and suggests that Diavik commit to coordinating blasting schedules with Ekati Diamond Mine to avoid or minimize potential problems and also suggests that Diavik adopt mitigation measures to minimize project noise on wildlife where feasible.

The CPAWS-NWT believes that many of the effects of the Diavik mine will be cumulatively significant and it will not be feasible to mitigate them. It suggested that a fund similar to that for fish habitat compensation be created to compensate for wildlife habitat loss.

Technical Session Recommendations
Several resolutions and requests for clarification were identified during the public technical sessions:

- Diavik will work with the GNWT to expand the analysis of energetic costs to caribou resulting from their behavioural responses to the project and this analysis will include annual variation in factors influencing caribou responses such as insect density and timing of freeze-up (refer to the results in the environmental effects section and the GNWT comments/concerns);
- Diavik and the GNWT will meet to use reliable data to define the scope, and then analyze the probability of occurrences, adaptive mitigation plans and contingencies if mitigation fails regarding worst case scenarios of: i) large numbers of caribou present near the mine at a time when thin ice impedes safe passage; and ii) increased air and truck traffic on site as a result of an emergency response action at a time when large numbers of caribou are near the mine (refer to the results in the environmental effects section and the GNWT comments/concerns);
- Aboriginal governments and organizations and representatives of the GNWT indicated that there is need for their involvement in monitoring all aspects of the project; and

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- A workshop was recommended to use the traditional knowledge of elders to assist with the development of mitigation plans for caribou on the East Island (see below).

Caribou Workshop
The caribou workshop was held in the community of Dettah on March 8 and 9, 1999. Recommendations from the workshop are included in the responsible authorities (RAs) conclusions.

v) Proponent Response

In response to the GNWT's comment that the linkage between procedures and monitoring results need to be clarified, Diavik stated that its Environmental Management System clearly lays out procedures for linking monitoring results with action/activity changes and respective responsibility.

Diavik provided supplementary information (refer to Diavik's response outlined in the Environmental Effects section) to clarify assumptions and predictions of the energetics model to reflect the range of natural environmental variation. Diavik predicted that probable annual variations in insect harassment combined with the caribou responses to the mine site could annually influence caribou pregnancy rates between 1 and 25% for an individual cow that passed through Diavik's site. Diavik's model also considered that the caribou remained in the area for specified time periods during both summer and fall migrations. The prediction for a 25% decrease is for a summer with high insect harassment and with caribou at the mine site in the summer and again during the fall, illustrating a worst case scenario with little probability of occurring.

At the request of the LKDFN, Diavik provided the LKDFN and the public registry with a submission on the percentage of disturbed habitat within the wildlife regional and local study areas that would be intercepted by caribou migrating along a path between the BHP and Diavik sites.

Diavik has committed to a monitoring program to link dust deposition to potential wildlife effects.

Diavik has committed to the following:

- Diavik will continue to consult with the GNWT and Aboriginal governments and organizations to prepare adaptive mitigation plans that will be incorporated into relevant sections of Diavik's Environmental Management System when it is revised prior to commencement of construction;
- The adaptive mitigation and management plans will be reviewed on an annual basis to determine if they require revisions as the mine operation is developed, and
- Diavik will incorporate the comments provided by elders at the caribou fencing workshop into its adaptive mitigation plans.

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Diavik provided a response to the concerns raised by the GNWT regarding worst-case scenarios, an explanation as to why parameters from the Porcupine herd were utilized instead of those specific to the Bathurst herd and how these differed.

Diavik, in response to the concern in the Dogrib Treaty 11 Council consultant's report about potential contaminants, indicated that it has conducted a study of potential sources of contaminants that the animals may come into contact with at the proposed Diavik site. Diavik reported that there are no unacceptable health risks predicted for local wildlife populations, including caribou, that may forage on East Island.

Other concerns raised in the Dogrib Treaty 11 Council consultant's caribou report have been addressed in previous Diavik responses or commitments in this or other sections of the comprehensive study report.

vi) RA Conclusions

The RAs agree with the GNWT conclusions that the project-related and cumulative effects on the Bathurst caribou herd and caribou habitat would not likely significantly adversely affect the herd.

The GNWT has noted concerns regarding ecological and technical uncertainty of both project-related and additive cumulative effects on caribou. However, the GNWT concurred with Diavik's conclusion that the proposed project would not change the abundance or distribution of the Bathurst caribou herd.

The RAs also take note of the GNWT's concerns regarding the scientific uncertainty inherent in predicting potential environmental effects of the proposed project on the Bathurst caribou herd and its ecology. However, the RAs are of the view that scientific information used by Diavik in its effects analysis was adequate in predicting potential environmental effects of the proposed project on the Bathurst caribou herd and its ecology. The RAs are also of the view that caribou migration corridors and caribou energetics would not be affected by global warming because the mine life is relatively short in terms of ecological change that may result from global warming. The RAs conclude that the contribution to global warming from this project would not likely cause significant environmental effects on caribou.

The GNWT has raised concerns regarding increasing development in the Slave Geological Province and its effect on caribou and caribou habitat. The RAs conclude that there would be no direct project-related or cumulative effects if the project were to proceed. The RAs encourage the GNWT to address its concerns on the overall management of the Bathurst caribou herd in the context of the regional cumulative effects management framework (see Section 8.10 – Cumulative Effects) and a Bathurst caribou management plan. The GNWT and the Government of Nunavut should consider the establishment of a Bathurst caribou management board.

Diavik's prediction of minimal project effects on caribou is dependent on detailed mitigation and management techniques that may include deflecting caribou away from East Island. The RAs conclude that the trails mapped from aerial photographs must be used to help choose possible deflection sites.

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The RAs note the Dogrib Treaty 11 Council consultant's observations regarding the potential effects of the project on the Bathurst caribou herd. The RAs are of the view that Diavik has adequately addressed the concerns through its responses and commitments.

Aboriginal Elders advised the GNWT and the RAs that at a minimum, the current mitigation techniques proposed by Diavik for the protection of caribou herd's health and safety are satisfactory but the mitigation must be adaptive and flexible. The RAs concur with the GNWT and the Aboriginal Elders' conclusions on mitigation measures and Diavik's conclusion that there are no likely significant adverse environmental effects.

The RAs conclude that a follow-up program is required to ensure that no significant environmental effects are realized and that the Wildlife Management Plan identified in Diavik's EMS be modified through consultation. The requirement to carry out monitoring and mitigation will be in accordance with the environmental agreement (see Chapter 9 – Follow-up Program).

The follow-up program to be specified in the environmental agreement and/or land lease will also require Diavik to: i) at a minimum, fence areas including the open-pits, fuel and explosive storage areas and the processed kimberlite containment area (the type of fencing remains to be determined). Fencing and diversion must be adaptive. Should monitoring determine that deflection is required, deflection methods will be tested; ii) map trails using aerial photographs to help choose possible deflection sites; iii) develop and update its plans for managing and monitoring likely worst-case scenarios; iv) assist in monitoring caribou migration movements as they relate to the proposed Diavik mine, and v) assist in monitoring the effects on caribou of the operation and use of the Echo Bay Mine winter road as it relates to the proposed Diavik mine.

The RAs note the recommendation put forth from the LKDFN and the NSMA regarding the need for a Bathurst caribou management plan. While the RAs have concluded that the proposed Diavik project would not have significant adverse effects on the Bathurst caribou herd, the RAs do recognize concerns related to the potential cumulative effects of future development in the Slave Geological Province on the herd. The RAs support the development of a Bathurst caribou management plan and encourage the GNWT and the Government of Nunavut to consider the creation of a Bathurst caribou management board.

The RAs encourage the GNWT to continue involving the Aboriginal governments and organizations in monitoring hunting activities on the Echo Bay Mine winter road as an aspect of Bathurst caribou herd management.

The RAs have considered Diavik's spatial and temporal boundaries used in its cumulative effects assessment of potential impacts on caribou and caribou habitat and concur with the approach taken by Diavik (see Section 8.10 – Cumulative Effects).

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The CPAWS-NWT's suggestion regarding the establishment of a wildlife habitat compensation fund similar to DFO's Fish Habitat Management Policy (No Net Loss Plan) is interesting but is not feasible with respect to caribou habitat.

The RAs believe that noise from the Ekati Diamond Mine and the proposed Diavik project will not have a significant cumulative effect on wildlife (including raptors, waterfowl, other avifauna, carnivores, and small game). However, to verify Diavik's predictions that there will be no impact from noise, the follow-up program will determine the need to coordinate blasting schedules.

The RAs recognize the suggestions from the KIA regarding refinements to Diavik's EMS. Diavik will be required to modify its Wildlife Management Program and it is the RAs conclusion that many of the suggestions raised by the KIA have been discussed and will be considered as part of the adaptive management for caribou and other wildlife in accordance with the environmental agreement.

8.4.2 Grizzly Bears

i) Environmental Effects

Diavik predicted that project-specific residual effects on the availability of grizzly bear habitat availability would be low in magnitude, long-term and would not be expected to result in changes to the population distribution and abundance of bears in the regional study area or in the Slave Geological Province.

The potential effects of the project on the mortality of grizzly bears was estimated by Diavik to be potentially high in magnitude on a regional scale over the midterm, and low to moderate over the midterm in the Slave Geological Province, relative to current baseline conditions. Barren-ground grizzly bear populations can likely sustain a 3% total human-caused mortality rate on an annual basis. Projected project-specific mortality effects in the regional study area (at full development) would increase human-caused mortality rates from 0.5 bears per year (or one every two years) at baseline (1.6% of the estimated minimum population of 30 bears in the regional study area, and 1% of the high population estimate) to as many as 0.74 deaths per year or one every year and one half. (2.4% of the lower, conservative regional study area population estimate, and 1.4% of the high population estimate).

Total human-caused mortality is less than the estimated 3% sustainable threshold and Diavik predicted that project-specific mortalities at full development may not affect the grizzly bear population in the regional study area. Regional population estimates are uncertain, however, and so the proximity of the higher estimated mortality rate (2.4%) to estimated sustainable thresholds (3%) is additional rationale for a conservative assessment and high level of mitigation to reduce or eliminate project-specific mortality of bears.

Beyond the regional study area, human-caused mortality rates have averaged 14.3 per year, comprising 3.5% of the minimum population estimate in the Slave Geological Province (407 bears) or 1.9% of the high population estimate of 750 bears. The average

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annual human-caused mortality may already have exceeded sustainable levels if the conservative population estimate is used but mortality would be sustainable if the population size were closer to the higher estimate. A project-specific increment of 0.24 bear deaths per year (one bear every four years) would add slightly to mortality levels in the Slave Geological Province.

In terms of cumulative effects, Diavik predicted that changes in habitat availability as a result of regional land use and the proposed project would not cause changes in the population distribution or abundance of the grizzly bear population in the wildlife regional study area or the Slave Geological Province relative to baseline conditions. Cumulative mortality effects from regional land use were estimated to be potentially high in magnitude within the wildlife regional study area and low to moderate in magnitude in the Slave Geological Province, relative to baseline conditions. The grizzly bear is a top predator and highly dependent upon caribou in the regional study area and Slave Geological Province. Given the low number of bears expected to be lost as a result of the project (0.12 to 0.24 bears/year (one bear every four to eight years) or < 5 bears over 20 years), Diavik concluded that it is unlikely that project-related bear deaths would result in measurable changes in predation pressures on caribou in the regional study area.

ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project and would be implemented during construction of the mine to mitigate adverse effects on grizzly bears are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation that would be implemented during mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on grizzly bears in the environmental assessment overview report and the wildlife environmental effects report.

iii) Significance

Diavik's environmental effects analysis identified potential residual effects on grizzly bears that would not result in changes to the distribution and abundance of bears in the regional study area or in the Slave Geological Province. None of the residual effects identified for grizzly bears are considered by the proponent to be significant adverse environmental effects. Diavik's management plans are expected to achieve zero project-related grizzly bear mortalities.

iv) Comments/Concerns

Government of the Northwest Territories
The Government of the Northwest Territories (GNWT) commented that mine infrastructure and the supporting roads and airstrip will be the major factors affecting carnivores and it is inevitable that there will be an absolute loss of potential habitat. Calculations of habitat availability are straightforward but estimates of changes in habitat effectiveness are based on an extensive set of assumptions regarding

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behavioural responses of bears to human activities. Diavik has not documented the assumptions made in determining zones of behavioural influence around the project, and has not assessed behavioural response to exploration activity (i.e. aircraft) and scientific studies are not currently available to refute or confirm the assumptions. This uncertainty should be acknowledged in the assessment and reduced through monitoring behavioural responses to the project.

The GNWT noted that grizzly bears do not currently den in the esker (also known as the Echo Bay quarry) located on the mainland, to the southeast of East Island.

The GNWT established inaccuracies in Diavik's data on human-related grizzly bear mortalities in the Slave Geological Province and requested that an erratum notice to Diavik's environmental assessment report be prepared.

Diavik's assumption that construction phase effects of the project on grizzly bears could be estimated from peak operations phase effects was challenged on the basis that the 800 workers present during construction represented twice the employment during operations. The GNWT pointed out that these workers represented contractors and that they would not be as well trained in mitigation as full time employees. Additional mitigation measures recommended by the GNWT included: comprehensive training for environmental staff with a refresher course conducted every spring (April); large incinerator(s) used for food waste to be located within, or directly adjacent to the building that is generating the waste; adequate lighting and skirting (e.g. electric fencing and other fencing/barriers) at the landfill; and the development, in consultation with the GNWT, of comprehensive guidelines and procedures for dealing with problem wildlife (including grizzly bears). The GNWT feel that mitigation measures should be applied and monitored for effectiveness for all phases of the proposed project.

The GNWT agreed with Diavik's conclusions on project-specific effects to grizzly bears and noted that the cumulative effects of increased development and human presence on the tundra are a concern and must be addressed. Uncertainties in the estimates of human caused bear mortalities as well as the high degree of confidence associated with proposed mitigation measures were recognized by the GNWT. Inadequate scientific understanding of grizzly bear ecology meant that an adaptive management approach was "all that can be reasonably implemented" but that this approach should include all reasonable mitigative efforts to reduce uncertainties and mortalities. Mitigation includes ongoing staff training and co-operative development of programs to deal with problem wildlife.

The need for studies to verify predictions of project and cumulative effects, assess population size and habitat effectiveness, and evaluate mitigation procedures was noted. Monitoring during the construction phase to verify the predicted effects during the construction phase is recommended.

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The GNWT concluded that although no good estimate of population size exists, the Diavik project is not likely to result in significant adverse effects to the abundance of grizzly bears in the Slave Geological Province. Further research and diligent efforts in mitigation and effectiveness monitoring are required to ensure this conclusion.

Aboriginal Governments/Organizations/Communities
The Kitikmeot Inuit Association (KIA) believes that Diavik's Environmental Management System (EMS) Wildlife Policy should i) state that feeding all wildlife species is prohibited; ii) recommend bi-weekly inspections of incinerators; iii) require recurrent training programs for environmental personnel; iv) require development and implementation of strict regulations for outdoor cooking; v) require an efficient communication system to alert environmental staff of bear sightings; and vi) establish electrical fencing where necessary.

The North Slave Metis Alliance (NSMA) stated that Diavik has not considered its knowledge in the development of the environmental assessment submission. Therefore, the NSMA stated that it will be completing a report by June 1999 and will independently submit it to the Minister of the Environment as a "companion piece to the comprehensive study report".

Non-Government Organizations/General Public
Ecology North and Canadian Parks and Wildnerness Society – NWT (CPAWS-NWT) have both expressed concern regarding the temporal scope of the cumulative effects assessment for grizzly bears. Existing and future projects suggested for the temporal scope include Jericho and Monopros Limited bulk sampling projects, BHP's Boston gold project (see Section 8.10 - Cumulative Effects), the Slave Geologic Province Transportation Corridor, BHP-Ekati Misery Road and Mine expansion. CPAWS-NWT does not feel that the predicted high magnitude cumulative increase in human-caused mortality rate of grizzly bears is an acceptable effect, particularly in light of the major additional assumptions.

The CPAWS-NWT is concerned that noise levels were dealt with only quantitatively and suggests that Diavik commit to coordinating blasting schedules with BHP to avoid or minimize potential problems and also suggests that Diavik adopt mitigation measures to minimize project noise on wildlife where feasible.

The CPAWS-NWT believes that many of the effects of the Diavik mine will be cumulatively significant and will not be feasible to mitigate. They suggest that a fund similar to that for fish habitat compensation be created to compensate for wildlife habitat loss.

v) Proponent Response

Diavik submitted an erratum notice on human-related bear mortality that was satisfactory to the GNWT. Diavik also provided a written response that removed the GNWT's uncertainties in its assessment of population and mortality estimates. Further, Diavik stated that it believes that zero bear mortality for the life of the project is an achievable goal and are committed to follow-up programs to ensure this. Diavik noted that the Ekati Diamond Mine Misery Road was included in its cumulative effects assessment.

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vi) RA Conclusions

The responsible authorities (RAs) have considered Diavik's spatial and temporal boundaries used in its cumulative effects assessment of grizzly bears and concur with the approach taken by Diavik (see Section 8.10 – Cumulative Effects). The RAs have considered the concerns raised by CPAWS – NWT and note that Diavik predicted a high magnitude impact of mid-term duration in the regional study area. Diavik has also predicted that cumulative effects of bear mortalities in the Slave Geological Province have a moderate magnitude impact of mid-term duration. The RAs agree with the GNWT's conclusions that with effective mitigation measures to prevent human-bear interactions, Diavik can effectively reduce bear mortalities to prevent significant adverse effects on the abundance of grizzly bears in the Slave Geological Province.

The RAs conclude that in addition to the mitigation measures identified by Diavik, the mitigation measures identified by the GNWT and the KIA shall be applied to all phases of the proposed project. The construction phase mitigation and management plans should reflect the nature and extent of construction activity with respect to bears; similarly, operation phase plans should be tailored to the nature and extent of full-scale operation activities. Should the project proceed, the Wildlife Management Monitoring Program (identified in Diavik's Environmental Management System) must be modified to reflect these recommendations on follow-up measures in accordance with the environmental agreement or land lease.

The objectives of the follow-up program will require Diavik to monitor the effectiveness of its mitigation measures in order to achieve its goal of zero project-related bear mortality. The RAs will determine if mitigation measures need to be modified over the course of the project.

The RAs recognize that the NSMA believe that Diavik has not fully incorporated its knowledge into the development of the environmental assessment submission. However, the opportunity to participate and raise concerns throughout the review process was available and the NSMA actively participated (see Section 6.5 RA Conclusions, for more detailed information).

The RAs believe that noise from the Ekati Diamond Mine and the proposed Diavik project would not have a significant cumulative effect on wildlife (including raptors, waterfowl, other avifauna, carnivores, and small game). However, to verify Diavik's predictions that there will be no impact from noise, the follow-up program will determine the need to coordinate blasting schedules.

The RA's also support the GNWT assessment that a co-operative regional cumulative effects management program is required to test impact predictions and determine cumulative effects of all development and increased human activity on grizzly bears (see Section 8.10 – Cumulative Effects).

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8.4.3 Other Carnivores

i) Environmental Effects

Diavik predicted that project-related decreases in habitat availability, both for prey species and for denning sites, would cause a long-term reduction in the ability of East Island to support wolves, wolverine and foxes. Particularly during the full development phase of the mine, most carnivores would likely avoid the island. Red foxes would likely exhibit a high degree of tolerance to mining activities and might remain as residents on less disturbed portions of the island, assuming that an adequate prey base also remained. Wolves and wolverine likely would be less tolerant of mining activities, and might avoid East Island to a greater degree than foxes. In either case, Diavik predicted that these localized shifts in habitat use off the island would not represent a measurable shift in the distribution of these species within the regional study area.

Diavik does not expect the proposed project to have measurable effects on the population levels of wolves and foxes in the regional study area. Habitat lost to the mine and its zone of influence would represent a loss of less than 1% of the available hunting habitat in the regional study area. Similarly, although at least one and possibly two fox den sites might be abandoned as a result of mining activities, comparable denning areas are widely distributed within the regional study area, and the loss of East Island sites would not measurably affect regional denning potential. Direct mortalities from vehicle kills and the relocation of animals would be expected to be minimal, given the environmental management strategies adopted for the proposed project. Consequently, project-specific effects on wolves and foxes at the population level are predicted by Diavik to be low.

Due to uncertainty regarding the status of wolverine populations and the effectiveness of mitigation, project-specific effects on wolverine populations have been classified by Diavik as low to moderate. Even moderate level project-specific effects would not be expected to affect wolverine population parameters within the Slave Geological Province.

Because the effects on carnivore habitat from regional development is low and because project-effects on this habitat would be limited to East Island, Diavik did not further consider cumulative effects on habitat availability in the wildlife regional study area. However, Diavik stated that if regular and/or frequent project-related mortalities or relocations of wolverines occurred, further consideration of cumulative effects within the regional study area and implementation of remedial actions would be required to ensure that the viability of the regional wolverine population is not jeopardized.

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ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project and would be implemented during construction of the mine to mitigate adverse effects on carnivores are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation and management that would be implemented during mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on carnivores in the Environmental Assessment Overview and the Wildlife Environmental Effects Report.

iii) Significance

Diavik's environmental effects analysis identified potential residual effects on carnivores that would not be expected to be measurable in the regional study area. None of the residual effects identified for carnivores are considered by the proponent to be significant adverse environmental effects.

iv) Comments/Concerns

Government of the Northwest Territories
Project infrastructure will be the main factor reducing the absolute amount of carnivore denning habitat on East Island. Further study of wolf responses to human activity, behavioural responses to aircraft overflight (including denning abandonment) and the energetic costs of avoidance responses are recommended, in particular a wolf den near T Lake. Conclusions regarding the sustainability of wolverine harvest are based on preliminary data.

Additional mitigation measures recommended by the Government of the Northwest Territories (GNWT) include: large incinerator(s) used for food waste to be located within, or directly adjacent to the building that is generating the waste; adequate lighting and skirting (e.g. electric fencing and other fencing/barriers) at the landfill, and the development, in consultation with the GNWT, of comprehensive guidelines and procedures for dealing with problem wildlife. The GNWT feel that mitigation measures should be applied and monitored for effectiveness for all phases of the proposed project to reduce potential project effects on carnivores.

Although the mine may only cause effects to distribution and abundance of wolves and foxes under extreme conditions, monitoring of spring occupancy of known den sites in the regional study area and carnivore movement corridors is recommended to gain useful information for cumulative effects monitoring. Continued involvement in co-operative wildlife research programs and monitoring of the effectiveness of mitigation programs is also recommended (see Section 8.10 – Cumulative Effects).

Aboriginal Governments/Organizations/Communities:
The Kitikmeot Inuit Association (KIA) believes that Diavik's Environmental Management System (EMS) Wildlife Policy should i) state that feeding all wildlife species is prohibited; ii) recommend bi-weekly inspections of incinerators; iii) require recurrent training programs for environmental personnel, and; iv) develop and implement strict

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regulations for outdoor cooking. The KIA believes that if boulder barriers are to be constructed to prevent access by caribou and other large animals from mining pits, processed kimberlite containment, fuel, petroleum products and chemical storage areas, then it should be noted that this barrier system will most likely not keep out carnivores (e.g. wolverines). Diavik needs to consider the employment of a combination of fencing and boulder barriers around areas of concern. In addition, the proposed development will destroy one traditional red fox den and an associated alternate den, as well as an old, collapsed denning site on a kame. It is further acknowledged that the GNWT does not have a great deal of data on foxes and acquiring more information would be desirable. If dens must be destroyed, then it is strongly recommended that researchers conduct a partial excavation for Diavik. Doing so may gain insights on the den's history that might otherwise not be attainable. More information will be gained if (an) elder(s) supervises the excavation with the researcher (possibly an elder or hunter who may have dug up dens in his youth). An elder may be able to comment on what was found and relate what other dens were like in the past.

The North Slave Metis Alliance (NSMA) are concerned with the potential impacts of the proposed project on the health and reproduction of wolves, foxes and wolverines. The NSMA states that Diavik has not considered its knowledge in the development of the environmental assessment submission. Therefore, the NSMA states that it will be completing a report by June 1999 and will independently submit it to the Minister of the Environment as a "companion piece to the comprehensive study report".

Non-Government Organizations/General Public:
The Canadian Parks and Wilderness Society – NWT (CPAWS-NWT) is concerned that noise levels were dealt with only quantitatively and suggests that Diavik commit to coordinating blasting schedules with BHP to avoid or minimize potential problems and also suggests that Diavik adopt mitigation measures to minimize project noise on wildlife where feasible.

CPAWS-NWT believes that many of the effects of the Diavik mine will be cumulatively significant and will not be feasible to mitigate and suggests that a fund similar to that for fish habitat compensation be created to compensate for wildlife habitat loss.

iv) Proponent Response

Diavik made a commitment to monitor the T Lake wolf den at the wildlife technical meeting in Rae and supported the need for follow-up programs on co-operative wildlife research and the need to monitor the effectiveness of mitigation measures.

v) RA Conclusions

The responsible authorities (RAs) conclude that in addition to the mitigation measures identified by Diavik, the mitigation measures identified by the GNWT and the KIA shall be applied to all phases of the proposed project.

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The RAs recognize that the NSMA believe that Diavik has not fully incorporated its knowledge into the development of the environmental assessment submission. However, the opportunity to participate and raise concerns throughout the review process was available and the NSMA actively participated (see Section 6.5 RA Conclusions, for more detailed information).

The RAs believe that it is not necessary to require Diavik to conduct a partial excavation of the red fox den that would be destroyed and conclude that there would be no significant adverse effects on red foxes habitat. However, the RAs encourage the GNWT to consider the KIA's recommendation for possible research purposes.

The RAs believe that noise from the Ekati Diamond Mine and the proposed Diavik project would not have a significant cumulative effect on wildlife (including raptors, waterfowl, other avifauna, carnivores, and small game). However, to verify Diavik's predictions that there would be no impact from noise, the follow-up program will determine the need to adjust its blasting schedules.

Project-related decreases in habitat availability would cause a long-term reduction in the ability of East Island to support wolves, wolverine and foxes. No project-related or cumulative significant adverse effects to these species are expected in the regional study area. Should the project proceed, Diavik will be required to modify its Wildlife Management Plan (identified in Diavik's Environmental Management System) to reflect the mitigation measures and the requirement to do so will be in accordance with the environmental agreement. The objectives of the follow-up program require Diavik to monitor the effectiveness of its mitigation measures as they relate to carnivores and the RAs will determine if mitigation measures need to be modified over the course of the project (e.g. electrical fencing and other barriers, adjusting blasting schedules).

8.4.4 Raptors

i) Environmental Effects

Diavik expects habitat suitability for hunting and nesting by raptors to be reduced within the mine footprint and a surrounding zone of influence (800 m around facilities). However, this effect, combined with the low probability of raptor mortality, would not likely result in measurable effects to raptor population distribution or abundance beyond the local study area. Consequently, Diavik predicted that project-specific effects on raptors at the regional population level would be low.

Diavik estimated that less than 1% of the available lands within the local study area having high to very high nest site potential would be lost due to the proposed project. Within the regional study area, Diavik estimated that there would be a worst case loss of 1.8% of such habitat with Diavik's project compared to a 1.2% loss without its project due to regional projects and activities. While the proposed project alone would not be expected to cause measurable effects on raptor population distribution or abundance within the regional study area, it would contribute to cumulative effects on raptor nesting habitat and could result in moderate magnitude and midterm cumulative effects on raptor populations.

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Diavik predicted that the magnitude of effects would be reduced at post-closure due to removal of sensory disturbances and possible gains in habitat suitability due to reclamation. In the worst case scenario (assuming unsuccessful reclamation and some continuing sensory disturbance), post-closure cumulative effects would be regional, moderate in magnitude and midterm in duration. According to Diavik, the removal of sensory disturbance and restoration of nesting habitat suitability in the physically affected area at post-closure would more reasonably be expected to reverse the direction of effects to neutral, resulting in a post-closure assessment of no residual effects. Diavik stated that measures specified in the Environmental Management System will be implemented at closure, and project contributions to cumulative effects will be largely removed at that time.

ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project would be implemented during construction of the mine to mitigate adverse effects on raptors and are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation that would be implemented during mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on raptors in the environmental assessment overview report and the wildlife environmental effects report.

iii) Significance

Diavik's environmental effects analysis identified potential residual effects on raptors that would not likely extend beyond the local study area. None of the residual effects identified for raptors are considered by the proponent to be significant adverse environmental effects.

iv) Comments/Concerns

Federal Authorities
Environment Canada did not support the prediction that country rock piles and other disturbed areas can be strategically reclaimed and that this would lead to an increase in nesting habitat. In addition, there is no guarantee that these areas can be returned to a state where they will support the small mammal and bird populations that serve as a prey base for raptors. Environment Canada agreed that the effects of the project on raptors should form an important component of the proposed Wildlife Monitoring Program.

Government of the Northwest Territories
The proponent provided adequate information on baseline conditions and the potential effects of the project on raptors. Although the behavioural response of raptors to disturbance may vary between individuals, early phases of the nesting season are particularly sensitive. Mitigative measures pertaining to nesting raptors should therefore reflect seasonality. The raptor monitoring program described in the Environmental Management System addresses the major issues associated with the

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project. However, the Government of the Northwest Territories (GNWT) stated that the dissemination of nesting information should be restricted to those who have a legitimate need for it, to reduce the potential for harassment, and should include submission of nest site and visit forms to the GNWT. Prey levels (lemming and ptarmigan) should be included in raptor monitoring programs to help distinguish natural and mine-related causes in population fluctuations. The GNWT recommended that Diavik participate with the GNWT and BHP in a coordinated effects monitoring program for raptors in the region.

Aboriginal Governments/Organizations/Communities
No comments or concerns relating to raptors were received by the public registry or noted during public meetings.

Technical Session Recommendations
Diavik is to develop and document specifics for a raptor and prey monitoring program through discussions with all governments, including Aboriginal governments.

v) Proponent Response

Diavik is committed to developing and maintaining a co-operative approach to monitoring programs to ensure proper dissemination of information and with respect to the effects of the project on of raptors.

vi) RA Conclusions

The responsible authorities (RAs) agree with the GNWT's mitigative measures outlined for nesting raptors. The RAs concur with the results of Diavik's analysis and the GNWT's conclusions that potential impacts to raptors are not likely to extend beyond the local study area. The RAs conclude that no significant adverse effects, including cumulative effects, would occur.

The RAs agree that dissemination of nesting information should be restricted to those who have a legitimate need for it, to reduce the potential for harassment, and should include submission of nest site and visit forms to the GNWT.

Should the project be allowed to proceed, Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement will specify how Diavik will monitor the effectiveness of its mitigation measures and the RAs will determine if mitigation measures need to be developed or modified over the course of the project (e.g. restoration of nesting habitat, adjusting blasting schedules). The follow-up program to be specified in the environmental agreement will also require Diavik to identify and monitor mine-related causes in population fluctuations. While not a specific requirement of this environmental review, the RAs encourage Diavik to participate with the GNWT in a coordinated effects monitoring program for raptors in the region.

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8.4.5 Waterfowl and Other Avifauna

i) Environmental Effects

Diavik predicted that habitat change and behavioural disturbance to waterfowl (e.g. white-fronted geese and northern pintail) from project activities would be restricted to the local study area and would not be expected to affect regional distributions. Important regional waterfowl staging areas would not be affected by the proposed project. Overflights of migrant flocks of geese and ducks might break formation, resulting in a deviation in their flight path in response to mine-related disturbances, but in Diavik's review this is unlikely to affect regional migration patterns.

Diavik expects that the levels of habitat change and increases in energetic costs and mortalities that might accrue from the project would not affect the regional abundance of staging or breeding waterfowl. Based on the low magnitude and localized nature of predicted biological effects, Diavik concludes that the proposed project would not be expected to have measurable effects on waterfowl population parameters outside the local study area.

Diavik stated that the effects of the proposed project on waterfowl, aquatic birds and shorebirds would be confined largely to East Island, and an offshore zone of influence. It includes an area 3 km off the ends of the airstrip and 1 km on either side of the airstrip. The zone is an area of reduced habitat effectiveness for these species. Given the slow rate at which habitat recovery occurs in such a northern setting, the incremental effects of the development would act in an additive fashion (i.e., through overlap in time) with other past, present and future footprints of disturbance in the region, such as the Ekati Diamond Mine. However, the cumulative contribution of such developments to reductions in wildlife habitat in the region is currently very low, and Diavik considers it unlikely that the population parameters of such widespread species have been measurably affected to date. Therefore, further consideration of cumulative effects assessment was not undertaken for waterfowl, aquatic birds and shorebirds.

ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project and would be implemented during construction of the mine to mitigate adverse effects on waterfowl are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation that would be implemented during mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on waterfowl in the environmental assessment overview report and the wildlife environmental effects report.

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iii) Significance

Diavik's analysis identified that potential residual effects on waterfowl, aquatic birds and shorebirds would not be expected to be measurable (negligible) on population parameters outside of the local study area. None of the residual effects identified for waterfowl, aquatic birds and shorebirds are considered by the proponent to be significant adverse environmental effects.

Comments/Concerns

Federal Authorities
Environment Canada recommended that the Diavik Diamonds Project environmental monitoring program should: i) include other ecological or taxonomic groupings of birds, such as terrestrial breeding birds, loons and diving ducks, and ii) validate predictions on potential environmental effects resulting from noise and the use of new, open water areas created by mining activities such as the processed kimberlite containment facility.

To further minimize adverse environmental effects on migratory birds, Environment Canada recommended that there should be strict control of non-essential boat use on Lac de Gras. A no-fishing policy for company staff would provide an added benefit of reducing boat-related disturbance to birds on Lac de Gras. Nesting and brood-rearing loons are sensitive to boating activity, particularly between break-up and the end of July. At least during this period, boat traffic on Lac de Gras should be minimized or restricted to essential mining related activities only (e.g. no recreational boating).

Environment Canada supported the conclusion that there will likely be no measurable cumulative effects resulting from the combined effects of the two diamond mines within the regional study area on the two waterfowl species considered in Diavik's wildlife environmental effects report. The department also requested that Diavik make more quantitative predictions/estimates of birds displaced at the maximum mine footprint in support of cumulative effects analysis. This was agreeable to Diavik and was further discussed in a follow-up meeting. The information provided by Diavik in a supplemental information package was satisfactory to Environment Canada.

Aboriginal Governments/Organizations/Communities
The Kitikmeot Inuit Association (KIA) expressed concern over recreational activities such as boating and the potential disturbance to habitat and wildlife.

The North Slave Metis Alliance (NSMA) stated that Diavik has not considered its knowledge in the development of the environmental assessment submission. Therefore, the NSMA stated that it will be completing a report by June 1999 and will independently submit it to the Minister of the Environment as a "companion piece to the comprehensive study report".

Lutsel K'e Dene First Nation (LKDFN) elders have raised concerns about the mine activity (powerlines) disturbing or acting as obstacles to migrating ducks and their potential use of waste water (tailings ponds) as staging areas.

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iv) Proponent Response

In response to Environment Canada's concerns, Diavik submitted revised analyses of potential project effects on shorebirds, passerines and waterfowl. Diavik predicted the total number of birds displaced by the proposed project at full-development are as follows: 3960 to 5930 passerine birds, 165 to 304 shorebirds and 20 to 24 waterfowl and aquatic birds. The revised analyses were considered acceptable to Environment Canada. None of the new analyses changed any of the conclusions of the assessment, in that effects would be confined to the local study area of East Island and immediately adjacent waters.

v) RA Conclusions

The RAs recognize that the NSMA believe that Diavik has not fully incorporated its knowledge into the development of the environmental assessment submission. However, the opportunity to participate and raise concerns throughout the review process was available and the NSMA actively participated (see Section 6.5 RA Conclusions, for more detailed information).

Effects on waterfowl population parameters are not expected outside the local study area. The RAs concur with Diavik's assessment and Environment Canada's review that there would be no significant adverse effects, including cumulative effects. The RAs agree with the mitigation measure identified by Environment Canada and the KIA that there be strict control of non-essential boat use on Lac de Gras (e.g. no recreational boating).

The RAs conclude that power lines on site would not significantly affect waterfowl and waterfowl that may land on the processed kimberlite containment area and other containment areas are unlikely to be affected.

Should the project be allowed to proceed, Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement will specify how Diavik will monitor the effectiveness of its mitigation measures and the RAs will determine if mitigation measures need to be modified over the course of the project. The follow-up program to be specified in the environmental agreement also requires Diavik to: i) include those ecological or taxonomic groupings of birds best suited to measure possible environmental effects on both terrestrial and aquatic avifauna, and ii) validate accuracy of predictions of potential environmental effects resulting from noise and the use of new, open water areas created by mining activities such as the processed kimberlite containment facility.

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8.4.6 Small Game

i) Environmental Effects

Diavik expects that decreased habitat availability would cause a long-term reduction in the ability of East Island to support Arctic hare, rock ptarmigan and willow ptarmigan. Direct habitat loss would displace an estimated 18 Arctic hare, 48 rock ptarmigan and 128 willow ptarmigan (adult birds) from the proposed project footprint. Diavik predicted that this change would be restricted to the project footprint and would not be expected to affect the regional distribution of these species.

Low levels of hare and ptarmigan mortality would be expected to occur during the lifetime of the proposed project. Populations of Arctic hare and ptarmigan undergo periodic natural fluctuations and project-related mortalities would be compensated through natural replacement. Diavik expects that the levels of habitat change and increases in mortality that might accrue from the proposed project would not affect the regional abundance of these species.

Based on the low magnitude and localized nature of the predicted biological effects, Diavik expects that the proposed project would not have measurable effects on small game populations outside the local study area. Therefore, Diavik classified the project-specific effect on small game populations as low. As with effects to waterfowl, the cumulative contribution of the proposed project, together with other disturbances in the region (e.g. Ekati Diamond Mine) to small game would not likely affect population parameters. Consequently, Diavik did not undertake further consideration of cumulative effects assessment for small game.

ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project and would be implemented during construction of the mine to mitigate adverse effects on small game are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation that would be implemented during mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on small game in the environmental assessment overview report and the wildlife environmental effects report.

iii) Significance

Diavik's environmental effects analysis identified that potential residual effects on small game would be restricted to the project footprint and would not be expected to affect the regional distribution of these species. None of the residual effects identified for small game are considered to be significant adverse environmental effects by the proponent.

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iv) Comments/Concern

Aboriginal Governments/Organizations/Communities
Lutsel K'e Dene First Nation (LKDFN) has raised a concern about carnivores and small animals (wolf, wolverine, fox and hare) frequenting the mine site and recommended fencing off tailings areas, fuel caches etc. to prevent animals from getting into those areas.

v) Proponent Response

No response required.

vi) RA Conclusions

Potential effects on small game would be restricted to the project footprint and would not be expected to affect the regional distribution of these species. Neither project effects or cumulative effects on small game are considered to be significant. The responsible authorities (RAs) accept Diavik's commitment to fence some areas and mitigation measures with respect to garbage disposal and handling will be required (see Sections 8.4.2 – Grizzly Bears and 8.4.3 – Other Carnivores).

Should the project be allowed to proceed, Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement will specify how Diavik will monitor the effectiveness of its mitigation measures and the RAs will determine if mitigation measures need to be modified over the course of the project. The follow-up program to be specified in the environmental agreement will also require Diavik to monitor prey species in conjunction with the raptor follow-up requirements.

8.4.7 Biodiversity

i) Environmental Effects

Diavik stated that the proposed project would not eliminate any special restricted habitat features, and would not reduce wildlife biodiversity within the wildlife regional study area. Consequently, Diavik expects that the proposed project would have a low-level effect on biodiversity. Diavik assessed the cumulative effect on wildlife biodiversity for shallow bays and associated shorelines, which are habitat/ecological features of restricted occurrence and abundance. Satellite imagery interpretation and follow-up ground-truthing and site characterization within the wildlife regional study area indicated that no high quality restricted habitats of this type have to-date been affected by land use developments. Consequently, Diavik concluded that the cumulative effect on shallow bays and associated shorelines would not be significant.

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ii) Mitigation

Mitigation measures that have been taken into account during the design of the proposed project and would be implemented during construction of the mine to mitigate adverse effects on wildlife biodiversity are described in Diavik's environmental assessment overview and wildlife environmental effects report. Policies and guidelines for mitigation that would be implemented during mining operations are detailed in Diavik's Environmental Management System and are highlighted, as appropriate, in the analyses of project effects on biodiversity in the environmental assessment overview report and the wildlife environmental effects report.

iii) Significance

Diavik's environmental effects analysis predicted that the project would not eliminate any special habitat features and would not reduce biodiversity within the wildlife regional study area.

iv) Comments/Concerns

Environment Canada was satisfied with Diavik's approach of focusing on several restricted habitats and ecological features that represent a considerable degree of biodiversity within the local and regional study areas. None of the residual effects on restricted habitats are considered by the proponent to be significant adverse effects on biodiversity.

v) Proponent Response

No response required.

vi) RA Conclusions

Potential residual project-related effects on wildlife biodiversity would not eliminate any special restricted habitat features and would not reduce biodiversity within the regional study area. The responsible authorities conclude that none of the effects, including cumulative effects, identified for biodiversity are considered to be significant.

8.5 WATER AND FISH

A number of concerns were identified and shared by the responsible authorities (RAs), federal authorities (FAs), Government of the Northwest Territories (GNWT), Aboriginal governments and organizations, non-government organizations and the public on surface water and groundwater issues. Therefore, the comments and concerns for all organizations are consolidated into one section under Comments/Concerns for Section 8.5.1 – Surface Water, Section 8.5.2 – Groundwater, and Section 8.5.3 – Fish and Fish Habitat.

Resolution of deficiencies in Diavik's analysis and final determination of effects and significance was an iterative process, involving community-based technical sessions in January and February 1999, public technical sessions in Yellowknife in February and March 1999 and many requests for further information and clarification. The water and fish issues are grouped in this section according to surface water, groundwater and fish and fish habitat.

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8.5.1 Surface Water

Surface water effects are discussed under the following sub-headings:

a) East Island Infrastructure
b) Surface Runoff
c) Dike Construction and Sediment Management
d) North Inlet
e) Effluent Discharge

a) East Island Infrastructure

The proposed diamond processing facility and supporting infrastructure, processed kimberlite containment facility, the airstrip, various pits, quarries, country rock and waste rock piles will be constructed or placed on East Island. All of these infrastructure components have potential environmental effects on hydrology and water quality.

i) Environmental Effects

Hydrology
Diavik predicted that the potential changes in Lac de Gras water levels and outflows from construction, operation and closure of the proposed project will be small and well within the range of natural variability. Diavik predicted 0.04 metres maximum potential change in mean lake level and increase in discharge of 0.24 m^3/s (1.2%) during construction and a reduction of 0.82 m^3/s (4.0%) during closure activities. These changes are not predicted to affect water supply. Diavik also predicted that there would be no effect on the small lakes surrounding Lac de Gras.

The analysis of cumulative effects of the proposed project and the Ekati Diamond Mine on the quantity of the surface water and groundwater resources has shown that only negligible changes are expected to occur to the surface water level and discharges from Lac de Gras. Diavik predicted that the cumulative effects of the two projects would not limit water supply.

Water Quality Changes
Diavik predicted some potential changes in water quality in the immediate vicinity of East Island as a result of deposition of dust particles in water during construction and operation. The increase in total suspended solids (TSS) will not exceed Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life. Diavik determined that any effects on water quality from dust deposition are negligible.

Diavik evaluated water quality for a number of fish-bearing lakes on East Island. During operations, all fish bearing lakes potentially affected by the mine would be drained and discharged to Lac de Gras or used as a component of the diamond-processing infrastructure. Therefore, water quality effects on East Island lakes were not evaluated during operations.

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ii) Mitigation

Diavik reported in its environmental assessment submission that mitigation for fish and water, and other resource components was identified during early planning to be incorporated through the design stage of the project planning. No additional mitigation measures were identified for water supply in the proponent's environmental assessment submission.

The potential effects of changes in water quality in East Island lakes will be evaluated further based on actual runoff monitoring information collected during operations. Diavik will verify its predictions as part of the monitoring program proposed in the Environmental Management System.

iii) Significance

Diavik expected that the potential effects of changes to Lac de Gras water levels and outflows to the Coppermine River would be negligible and would not extend beyond closure. No measurable effect (i.e. <1% change) is predicted for flow in the Coppermine River downstream from the outlet of Point Lake.

Diavik determined that effects of dust deposition on water bodies and changes in lake levels and outlet flows will be negligible and of mid-term duration at both a local and regional scale. The discussion of the significance of water quality effects on Lac de Gras is located in later sections of 8.5.1 (i.e. Surface Water).

iv) Comments and Concerns

Hydrology
Reviewers expressed concern regarding Diavik's water balance, stating that each of the mine components and the overall linked water balance required better definition. Because there are so many variables within the system, an underestimation of one component could affect the whole system. The need for a sensitivity analysis to be conducted was also identified so that the capacity of each component and the adequacy of design and operational plans are more apparent.

Reviewers also expressed concern regarding the assumed in-situ dry density of processed kimberlite. Because of the extended period of freezing conditions, the processed kimberlite may occupy more space than Diavik had assumed and significant amounts of the processed kimberlite transport water will be trapped in the facility as frozen kimberlite. The overall effect is an increase in the operating PKC pond volume and a possible requirement for more make-up water from Lac de Gras because less recycled water would be available for processing purposes.

Water Quality Changes
Diavik is committed to monitoring the water quality in the pits to confirm acceptability prior to breaching the dikes. The GNWT considered that this represented adequate mitigation to address the lack of sufficient information on the post-closure effects on water quality in Lac de Gras.

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Reviewers identified the inadequacy of the detection limits used to characterize baseline water quality for some parameters but acknowledged that improvements were only required to improve scientific understanding and were not critical to the assessment. NRCan commented on schemes to derive and interpret trigger levels in the monitoring program and questioned the adequacy of Diavik's predictions of sediment transport.

Reviewers recommended that measures to address geochemical processes, such as freeze concentrating and freeze-dry evaporation, be included in water monitoring programs and contingency plans as these processes may result in unexpectedly high salinity and toxic seepage from the proposed process kimberlite containment facility.

The Department of Indian Affairs and Northern Development (DIAND) and Natural Resources Canada (NRCan) noted that the Diavik's documentation of ice lenses and ice content in the minesite areas was insufficient to allow assessment of the potential effects of ice underlying the mine structures. Thawing of ice-rich materials has the potential for drainage beneath impoundment, or failure of impoundment or structures and subsequent release of contaminants.

The Kitikmeot Inuit Association (KIA) made strong recommendations regarding the need for visual indicators of effluent discharge into Lac de Gras (see Section 8.8.1 – Effects Resulting from Environmental Changes).

The Yellowknives Dene First Nation (YDFN) recommended that Diavik assume responsibility for mitigating water quality problems caused by its operation and compensating for alternate water supplies, should that become necessary. The YDFN requested treatment of discharge water to drinking water guideline levels and a mechanism of informing communities if drinking water became impaired as a result of Diavik's operations.

The Lutsel K'e Dene First Nation (LKDFN) recommended that the federal government, Diavik and BHP Inc. provide resources for the LKDFN to conduct a traditional knowledge study on the drainage patterns in the Lac de Gras region.

v) Proponent Response

Hydrology
Diavik provided a revised water balance including a sensitivity analysis to address concerns regarding overall linked water balance. In the January 28, 1999 technical meeting in Ndilo, Diavik verbally reported that ore production levels would be reduced by approximately 30% below original levels, thereby mitigating possible increases in processed kimberlite containment (PKC) pond volume requirements, and reducing the volume of recycle and make-up water required. Original PKC design pond volumes would be maintained to compensate for possible increased volume demands required by the application of revised bulk density assumptions.

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With respect to the PKC water balance and a resolution to model high flow years when the plant will be discharging and to estimate effects on water quality, Diavik submitted two reports: Sensitivity of the PKC Water Balance to Selected Specific Conditions and Dynamic Water Balance Simulations Around the PKC.

Water Quality
Diavik provided a ground ice distribution map (Drawing 4200-41D9-1045).

vi) RA Conclusions

Hydrology
The RAs consider that Diavik has adequately addressed the environmental assessment requirements related to hydrology. Diavik would however be expected to provide more detailed information on overall water balance and the use of the North Inlet at the regulatory stage. Diavik's explanation of reduced amount of kimberlite to be processed over the life of the mine and the consequent reduced requirement for PKC capacity is considered acceptable by the RAs for the environmental assessment review. The RAs are prepared to discuss with the LKDFN its request for funding to support a traditional knowledge study on the drainage patterns in the Lac de Gras region. However, they acknowledge that some work has been done with respect to drainage patterns in the Lac de Gras region with elders in the past.

Water Quality
Permafrost will aggrade into the saturated pond sediments of the PKC after mine abandonment, under the current proposal. Permafrost aggradation and the consequential build-up of pore water pressure ahead of the freezing front will enhance horizontal and vertical movement of metal-contaminated pore fluids, especially if there is no residual pond following abandonment. Permafrost may then rupture and contaminated PKC pore waters could be outside the confines of the PKC. The RAs conclude that the potential environmental effects from porewater release of contaminants to the environment can be mitigated through proper engineering design that would be detailed at the regulatory stage. Diavik must also develop appropriate closure and contingency plans for inclusion in its Abandonment and Restoration Plan (see also subsection 8.5.1 d) North Inlet).

b) Surface Runoff

Construction, operation, closure and abandonment and reclamation of Diavik's proposed mine at Lac de Gras would affect the surface drainage patterns on East Island. Runoff from snowmelt and rainfall will be directed away from main structures such as the pits and quarries, country rock piles, ore stockpile and the PKC facility through a series of collection ditches. Runoff effects are generally of two types - changes in base chemistry from exposure to natural rock, and physical changes from erosion and increased sediment loads.

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i) Environmental Effects

Diavik proposes to collect runoff from East Island during mine operation and to treat it, if necessary, before discharge to prevent adverse effects on Lac de Gras. Runoff would flow naturally to the lake after mine closure. Diavik predicted that aluminum, cadmium and chromium concentrations in the post-closure run-off from reclaimed areas will exceed CCME guidelines for the protection of aquatic life. Diavik has also predicted enrichment of localized areas by total phosphorus. Both of these will create a high magnitude, long-term effect locally, at locations where runoff streams enter Lac de Gras. These effects are predicted by Diavik to be non-reversible. Diavik will verify these predictions through a follow up monitoring program.

Diavik proposed to collect and treat runoff for as long as water quality parameters exceed aquatic life thresholds. Natural drainage to the lake would be re-established only after the water quality meets CCME guidelines for the protection of aquatic life.

Diavik conducted toxicity testing of run-off from various rock types collected on site. No toxicity to rainbow trout or water fleas was observed.

Diavik acknowleged that there is a potential for localized acid generation and associated metal leaching from the waste rock piles and surface runoff. Diaivk determined that an estimated 10% of the waste county rock was biotite schist and further determined that only 5% of the biotite schist has the potential to be acid generating. The waste rock piles represent the largest potential source of acid generation from biotite schist. Diavik identified two closure options. One option is to continue to collect runoff and direct it to the water treatment plant with subsequent release to Lac de Gras. The other option is to cap the country rock areas with a low permeability cover at closure to prevent infiltration of water.

Aquatic life in two fish-bearing East Island lakes could be affected during post-closure. Diavik predicted that East Island post-closure runoff will produce high magnitude, long-term local changes in water quality in these lakes from increased concentrations of aluminium, cadmium, chromium, copper, lead, mercury, nickel, silver, selenium and zinc. These changes in water quality could decrease the abundance and reproductive success of sensitive aquatic organisms. Diavik further predicted that phosphorus could change the trophic level of two East Island lakes (E3 and E21) from ultra-oligotrophic to eutrophic with a resultant increase in productivity, variety and abundance of aquatic life.

ii) Mitigation

Diavik has committed to the collection and treatment of surface runoff during operation to mitigate the effects of poor quality drainage. Diavik's Water Management Plan states that runoff water of poor quality (i.e. does not meet CCME guidelines for the protection of aquatic life) will be collected during operation and post-closure. Furthermore, Diavik has committed to the treatment of

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the North Inlet facility water by filtration to meet a discharge criterion of no more than 25 mg/L total suspended solids. The potential for elevated levels of metals in surface runoff streams would be reviewed through actual run-off monitoring information collected during operations. Treatment of runoff with elevated levels of metals would be required if concentrations exceeded prescribed levels.

iii) Significance

The magnitude of irreversible effect is high, over a long-term, and a local geographic extent for total phosphorus, cadmium and chromium at the mouth of streams running into Lac de Gras at post-closure. Diavik considers the effect of runoff to East Island lakes to be of high magnitude, long-term duration, at a local scale.

iv) Comments / Concerns

Reviewers concluded that there was the potential for acid generation from biotite schist in the country rock piles. Environment Canada, Fisheries and Oceans Canada (DFO), DIAND, the GNWT and Aboriginal governments and organizations did not believe that treatment in perpetuity or some other unspecified future time was technically or economically feasible. It was recommended that Diavik explore alternative mitigation options to address runoff quality during operations.

Inadequate management of acidic post-closure runoff from biotite schist in the country rock piles was also identified as a shortcoming by reviewers, who recommended that Diavik develop a post-closure monitoring strategy. Although Diavik's commitment to collect and treat runoff during operation to minimize the effects of acid drainage was considered appropriate mitigation, it did not address the potential requirement for long-term mitigation to eliminate acidic runoff. Segregation and confinement of biotite schist from the rest of the country rock is preferred in order to reduce the volume of runoff needing treatment or to allow more cost-effective long-term mitigation techniques such as capping.

The Dogrib Treaty 11 Council submitted to the public registry its consultant's evaluation of Diavik's Geochemistry and Waste Disposal Analysis. This review raised many of the same concerns that were previously described by the RAs and discussed during the public technical sessions.

DIAND expressed concern about the suitability of the design cross-sections of seepage collection ditches. DIAND noted that the design of the drainage ditches did not accommodate deepening of the seasonally thawed active layer. Ditch water, potentially containing high metal concentrations from country rock runoff or PKC seepage would normally be conveyed to the wastewater treatment plant. It is possible that seepage water and country rock runoff water might not be intercepted by the proposed geotextile ditch liner, but instead flow beneath the liner and therefore escape collection and treatment. It would then have the potential to find its way to Lac de Gras. Although the effects of permafrost on the design of these ditches is important, they will be further defined in any future regulatory process.

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v) Proponent Response

Diavik provided a plan to identify and segregate biotite schist (Biotite Schist Management Plan, March 1999). Although this marked a change from an earlier position that segregation was impractical (public technical sessions, February 1999), Diavik's management plan only addresses occurrences of biotite schist in large and manageable, by its definition, units. Diavik concluded that there are no geochemical benefits of segregating biotite schist on East Island and identified subaqueous disposal on the outside slope of the dikes or in deep portions of Lac de Gras as a preferred option if large and manageable units of biotite schist are encountered. If water quality impacts associated with subaqueous disposal prove unacceptable, Diavik recommends uniform distribution of schist in the rock piles to minimize the development of discrete, acidic seepages. Regarding post-closure runoff, Diavik clarified that re-establishing natural flow of runoff to Lac de Gras will not be considered until adequate water quality is demonstrated.

Diavik responded directly to the concerns raised by the Dogrib Treaty 11 Council consultant in documents dated April 8, 1999. These responses provided additional information to address the concerns raised by the Dogrib Treaty 11 consultant's review. Diavik's response was also provided to the public registry.

Diavik has committed to review the designs of the collection ditches.

vi) RA Conclusions

The RAs conclude that the potential acid rock drainage can be mitigated by implementing an on-site collection and treatment system and by developing plans for segregating and managing biotite schist, or by capping or other equivalent engineering technique. Diavik has submitted a draft Biotite Schist Management Plan in response to the technical session resolution to mitigate acid rock drainage. Diavik must implement the Biotite Schist Management Plan to the fullest extent possible using currently available technologies. The RAs require that the Biotite Schist Management Plan be included in the Environmental Management System (EMS), with operational guidelines to assist mine personnel in the segregation and management of biotite schist. Revisions to the management plan are expected as the project progresses.

The RAs consider that the concerns raised by the Dogrib Treaty 11 Council's consultant have been addressed in Diavik's response. The concerns identified by the Dogrib Treaty 11 Council's consultant are more appropriately considered at the regulatory phase should the project be allowed to proceed.

Filtration of water containing high levels of suspended sediment is considered appropriate mitigation by the RAs. Discharge levels or limits will be determined in any future regulatory phase.

Diavik will mitigate potential effects by implementing an on-site collection and treatment system. For long-term performance of the surface runoff collection system, Diavik must also ensure that runoff collection ponds and ditches linking the

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collection system are provided with an appropriate design for arctic permafrost conditions. These surface water collection systems will accumulate sediments and leachate from the country rock piles, plant site and road ditches, and Diavik must develop an Abandonment and Restoration Plan that fully addresses restoration of the collection system.

The RAs realize that the potential residual environmental effects at post-closure as a result of localized increases in phosphorus, cadmium and chromium from the proposed project have been predicted by Diavik to have high magnitude, long-term duration. However, Diavik's revised phosphorus model predicts that there will be smaller changes to the water quality of Lac de Gras than those originally predicted. The RAs conclude that these changes will not be detrimental to the overall water quality of Lac de Gras.

In addition to Diavik's predictions and mitigation measures, Diavik shall undertake the additional mitigation measures identified by RAs in order to ensure that significant adverse environmental effects would not occur.

RAs conclude that follow-up is required to: i) verify predictions and ensure that appropriate water quality criteria are met in Lac de Gras; ii) verify predictions regarding water quality in East Island lakes, and iii) monitor shallow groundwater to ensure that surface drains are effectively intercepting potential subsurface drainage from country rock storage areas (see Section 8.5.2 – Groundwater).

c) Dike Construction and Sediment Management

i) Environmental Effects

Four main environmental effects associated with the construction of dikes in Lac de Gras were identified: resuspension of sediment from dike construction; management of sediments due to dredging activities and dike construction; leaching of metals such as cadmium from the rock material used in dike construction, and the loss of fish habitat due to dike construction and associated effects (which is discussed in Section 8.5.3 - Fish and Fish Habitat).

Construction of Water Retention Dikes
Diavik stated that lakebed sediments would be redistributed in Lac de Gras during dredging and to a lesser extent by the dumping of rock material during construction of the dikes. This operation also has the potential to release sediment porewater containing elevated levels of metals such as manganese, copper and aluminium.

Diavik expects that leaching of metals from the face of the dikes and breaching of the dikes to allow water into the open-pits (upon closure) may negatively affect water quality within the proximity of dikes and the local study area.

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Management of Dredged Sediments
Diavik originally proposed an on-land lakebed sediment containment facility to hold sediment and that excess water would be released to the North Inlet after clarification. In its January 1999 revision, Diavik proposed to place all dredged sediments in the North Inlet. Diavik's final plan, presented in February 1999, proposes a combination of an on-land sediment containment facility (A154), use of the North Inlet (A418) and PKC or North Inlet (A21). Diavik stated that the storage structure is being designed to perform the same as originally described in the environmental assessment submission and the potential impacts from dredged sediments are expected to be equal to, or less than those previously described. That is, release of water into Lac de Gras would not exceed predicted concentrations of 25mg/L for total suspended solids (TSS) and potential effects are considered negligible.

Cadmium Leaching from Dikes
Diavik predicted that leaching from dikes in Lac de Gras would result in short-term cadmium concentrations above its assessment under ice cover within a 0.01 km^2 zone around the dikes. Under ice-free conditions Diavik predicted that cadmium concentrations would not exceed its assessment threshold. Diavik stated that the level of certainty in its effect predictions related to leaching of cadmium outside the dikes and related effect on the aquatic ecosystem is low.

ii) Mitigation

Diavik proposed the use of silt curtains to limit the extent of sediment redistribution during dredging of the dike footprint and dike construction. Treatment prior to discharge to Lac de Gras is proposed by Diavik for TSS and metals if required. No mitigation is proposed for cadmium leaching from the dikes or elevated metals from sediment porewater release.

iii) Significance

Diavik predicted effects from TSS associated with dredging and dike construction to be negligible to moderate magnitude, of local geographic extent and short-term duration. Effects from porewater release (phosphorus, aluminium, copper) and dike leaching (cadmium) are predicted by Diavik to be high magnitude, local geographic extent and short-term. Diavik predicted these dredging operations would result in moderate, local and short-term (<1 yr.), effects through the release of suspended sediments to Lac de Gras.

Diavik concluded that no significant effects associated with cadmium leaching to Lac de Gras will result from dike construction. The potential effects from on-land sediment containment facility are predicted to have a negligible impact to Lac de Gras (also see Section 8.5.1 d) North Inlet).

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iv) Comments and Concerns

Construction of Water Retention Dikes
Diavik presented changes to the cross-section design for the water retention dikes during the technical meetings on January 28-29th, 1999. DIAND questioned the ability of Diavik to construct the dikes as presented in the new information.

DFO was concerned about potential metal release from porewater. Diavik provided clarification that dredging for each dike will take place over one, three-month period. This clarification, the reduced dike footprint and DFO's confirmation that expected concentrations of manganese were an order of magnitude below the lowest concentrations found to produce effects on fish, alleviated the concerns DFO had regarding porewater metal release (January 22, 1999 supplemental information).

Ecology North raised concerns regarding Diavik's plans to discharge mine water directly to Lac de Gras and to dike off portions of Lac de Gras to access the kimberlite.

The LKDFN requested that additional information regarding the proposed use of silt curtains, the results of their use elsewhere and an assessment of the benefits of silt curtain use in Lac de Gras.

Management of Dredged Sediments
DIAND and NRCan raised issues about stability and possible failure of containment structures during extreme events and disturbance of ice-rich till associated with country rock storage. The LKDFN raised a concern regarding the potential impact of anoxic phosphorous release from lakebed sediments stored on land.

DIAND expressed concern about Diavik's final plan for sediment management and requested that Diavik provide updated Sediment and Till Management Plan.

DIAND and NRCan noted that there may be a potential for overtopping of the on-land sediment containment facility, if the 1/100 year precipitation event occurred late when the water level was approaching the 421.5m crest elevation level of the dike. DIAND and NRCan also raised concern about the potential for freezeback in the lakebed sediment storage areas forcing pore water expulsion after closure. Either condition could result in the uncontrolled release of contaminants to the surrounding environment.

Cadmium Leaching from Dikes
Diavik's predictions of cadmium losses from the dikes are conservative. The likelihood of detectable increases in concentration is low and any increases would be confined to the immediate vicinity of the dikes (<200m) for approximately 3 years after construction. Free swimming fish would not be exposed for extended periods, a small portion of the Lac de Gras fish community will use the area around the dikes for spawning and effects on eggs would be unlikely. Although reproduction of some species of sensitive zooplankton may be impaired the potential effect was not considered significant in light of the uncertainties inherent in predicting increased cadmium and the small areas affected.

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Reviewers suggested that cadmium release could result in significant adverse effects. DFO and DIAND subsequently met with Diavik to discuss this issue further. DFO research in the Experimental Lakes Area (ELA) in northwestern Ontario, showed that approximately 95% of cadmium added to a lake was lost to the sediments. Further input by DFO and Diavik suggested that direct effects on adult fish would be unlikely, as fish would not spend extended periods in the zone of effect. Although this would reduce direct uptake, cadmium would be made available to the benthic food chain and maintain some potential for dietary uptake. Although there were no population effects at the concentrations achieved at ELA, sub-lethal effects were exhibited. No effects from cadmium on lake trout eggs were noted in the ELA studies and so effects were considered unlikely in Lac de Gras. Information was not available to assess the potential effects on fry.

v) Proponent Response

Construction of Water Retention Dikes
Diavik provided an improved dike design (Letter to DIAND, March 30th, 1999).

Management of Dredged Sediments
Diavik provided a draft Sediment and Till Management Plan and agreed to update it in the Environmental Management System. This report provided more details on the sediment containment dams and proposed operating system.

Diavik responded to the concerns about anoxic phosphorous release from lake bed sediments stored on land and concluded that any phosphorous that is leached over time in on-site storage areas would be collected and pumped to the PKC where water would be treated before release to Lac de Gras.

Cadmium Leaching from Dikes
Diavik confirmed its position that the cadmium leaching rate was conservative and probably lower and of shorter duration than originally predicted. Diavik's response also showed that granite contributed most of the potential for cadmium leaching from the dikes and that the contribution from biotite schist was negligible. Diavik committed to verification of these predictions by monitoring cadmium concentrations at the dike/water interface.

A further literature review by Diavik suggested that reproductive rates of zooplankton would be reduced if cadmium concentrations reached the original predictions of .310 µg/L around the dikes. Diavik provided an estimate of potential bio-accumulation of cadmium in fish. This estimate showed that through constant exposure to the predicted elevated concentrations at the 200 m zone around the dikes, the average fish flesh concentrations of cadmium would not exceed 0.037 µg/g. This is an order of magnitude below the consumption guideline (see Section 8.8 a) Human Health).

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Diavik completed a literature search to identify studies that have been done on the effects of cadmium on lower trophic levels and submitted its findings to the RAs. Cadmium concentrations at the dike/water interface have not been predicted and the potential for effects on sensitive life stages has not yet been determined. Diavik noted its intention to monitor cadmium in the lower trophic levels.

vi) RA Conclusions

Construction of Water Retention Dikes
The improved dike design presented by Diavik in March 1999 is acceptable to the RAs. The RAs agree that expected concentrations for manganese released from porewater are an order of magnitude below the lowest concentrations found to produce effects on fish.

Management of Dredged Sediments
The RAs conclude that Diavik's draft Sediment and Till Management Plan is acceptable. Diavik has committed to refine its plans in the regulatory phase if the project proceeds. Should the project proceed, Diavik shall provide LKDFN with the information it has requested regarding silt curtains.

The RAs agree that potential environmental effects from overtopping of the on-land sediment containment facility and release of porewater after closure can be mitigated through proper engineering design that would be detailed at the regulatory stage. Appropriate contingency plans must also be developed in Diavik's Environmental Management System.

Cadmium Leaching from Dikes
The RAs conclude that losses of cadmium from dike construction would have no significant adverse effects on Lac de Gras. Losses of cadmium from the dikes to Lac de Gras shall be determined as part of Diavik's water quality monitoring program. Should the project proceed, the objectives of the follow-up program will require Diavik to determine and monitor: i) cadmium concentrations within fish muscle and metallothionein in fish kidney and liver tissue every five years; ii) cadmium concentration within interstitial water of the dikes at regular intervals once the dikes are constructed, and iii) monitor and verify predictions of cadmium in the lower trophic levels, water, sediments and biota and take action as required.

d) North Inlet

Overview
The purpose of the North Inlet in Diavik's Water Management Plan underwent conceptual changes after submission of Diavik's environmental assessment. Initially Diavik indicated that the North Inlet would be used to settle suspended solids from site runoff, act as a surge pond for storage of storm water and to store water that was unsuitable for direct discharge to Lac de Gras. Supplemental information submitted by Diavik on January 22, 1999 proposed an additional use of the North Inlet for containment of large volumes of lakebed sediments. In February 1999, in response to concerns from reviewers, Diavik again modified the North Inlet Plan.

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i) Environmental Effects

The loss of fish habitat is the central environmental effect related to the current plan for the North Inlet. Sedimentation issues and dike leachate issues (including mitigation and significance) are dealt with elsewhere in this report.

ii) Mitigation

See Section 8.5.1 c) Dike Construction and Sediment Management.

iii) Significance

The significance of environmental effects on fish and fish habitat is dealt with in Section 8.5.3 – Fish and Fish Habitat.

iv) Comments and Concerns

Following the submission of the January 1999 revision, DFO and DIAND reviewers questioned the use of the North Inlet for a lakebed sediment settling pond, in particular the ability to mitigate dispersion of sediment in the lake using silt curtains. Uncertainties were identified about the predicted concentration of TSS beyond the silt curtains, dispersion patterns in the lake and suspension time, and RAs challenged Diavik's conclusions that there would be no changes to the predicted environmental effects of the project.

The YDFN are opposed to the use of North Inlet for disposal of dredged sediments and support Diavik's original plan for disposal of dredged sediments on land.

v) Proponent Response

Diavik responded to concerns raised by communities and government by revising the purpose of the North Inlet again in a February 16, 1999 submission. The North Inlet is now propsed to serve as a surge protection pond, and sediment storage facility to contain lake bed sediments dredged from the A418 and possibly for A21dikes. An impermeable dike would be built across the mouth of North Inlet to prevent the release of water of poor quality. Upon completion of this dike, water from North Inlet would be pumped to Lac de Gras to increase capacity in the inlet. Water from behind the main dikes in Lac de Gras would be pumped to Lac de Gras until water quality decreases below acceptable limits. At this point Diavik proposes to pump unacceptable sediment-laden dike water to the North Inlet to allow suspended sediment to settle.

In summary, Diavik committed to mitigate sediment losses to Lac de Gras by making the outlet dam from the North Inlet impervious and by treating all water within North Inlet for solids reduction before discharge to Lac de Gras. Diavik also provided information that clarified DIAND's concerns about water storage capacity following sediment storage in the North Inlet. The fate of the North Inlet at closure has not yet been established. Diavik's closure options will depend on the quality and quantity of sediments in the inlet at that time.

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vi) RA Conclusions

Reviewers concerns were addressed by Diavik in its North Inlet submission of February 1999. Significant adverse environmental effects are unlikely. The RAs concur with Diavik's commitment to isolate the North Inlet from Lac de Gras with an impermeable barrier and to treat the North Inlet water before discharge to Lac de Gras. The RAs conclude that there will be no significant adverse environmental effects provided that the mine is properly decommissioned.

Since no closure plan has been proposed for the North Inlet, Diavik must prepare a comprehensive Abandonment and Restoration (A&R) Plan, have it reviewed and approved by the regulatory authorities. The approved A&R Plan will include an estimate of implementation costs at various stages in the life of the mine. Should this project be allowed to proceed, Diavik must provide to the regulatory authorities within two years of regulatory approvals, adequate financial security for assuring that the A&R Plan will be fully implemented, independent of the corporation's financial status when the mine is closed.

e) Effluent Discharge

Water that seeps into the pits or accumulates from precipitation will be pumped to the North Inlet for settling then further treatment before discharge. Within the treatment facility waste streams are combined prior to discharge into Lac de Gras.

Diavik has described two methods for the handling of sewage effluent depending on the project phase. During construction, wastes would be treated and discharged to wetlands eventually reaching Lac de Gras. During operations, discharges would be directed to the PKC after treatment.

i) Environmental Effects

Diavik predicted that treated mine water discharge would introduce higher levels of nutrients, particularly phosphorus from the natural groundwater, to Lac de Gras which is an extremely nutrient poor and generally unproductive lake. The dikes and post-closure runoff could also contribute a small amount of additional phosphorus. Diavik also predicted elevated concentrations of ammonia nitrogen in the mine water discharge, as a result of leaching of blast residues from waste rock and in the pits.

In the absence of CCME guidelines for the protection of aquatic life for total phosphorus, Diavik established a site-specific threshold of 0.005 mg/L to maintain the ultra-oligotrophic nature of trophic (productivity) status in Lac de Gras. Up to 20% of the surface area of Lac de Gras is expected to exceed this threshold during peak operations. Phosphorus concentrations in the remainder of the lake are predicted to remain slightly below the threshold. Levels would decline to background levels after closure. The precise effects of increased trophic status cannot be predicted, but could include increased, algae growth, increases in fish growth rates, improvements in fish health and increases in the abundance of some

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aquatic species and a decline in the abundance of others. Diavik also completed additional assessment of phosphorus following discussions at technical sessions to incorporate higher baseline values to total phosphorus concentrations and determined no change in original predictions.

Large volumes of treated sewage may potentially affect the water quality of Lac de Gras through elevated levels of nutrients, suspended solids and biological oxygen demand (BOD).

ii) Mitigation

Diavik committed to treat all effluent from the proposed mine to achieve ambient thresholds for aquatic life and drinking water within the 0.01 km^2 mixing zone with the exception of phosphorus. There is no proposed treatment planned for phosphorus from groundwater inflows.

Diavik proposed to construct and operate a sewage treatment facility, which would treat for the removal of suspended solids and biological oxygen demand (BOD) as well as disinfect. This would be achieved using biological digestion/aeration and either ozonation or untra-violet (UV) for disinfecting.

iii) Significance

Diavik predicted that concentrations of all water quality parameters (e.g. metals, ammonia, chloride) would be below drinking water and aquatic life thresholds at the smallest assessment boundary (0.01 km^2) around the discharge except for phosphorus. The magnitude of the effect for the mine water discharge is considered by Diavik to be negligible at a local geographic extent. The potential impacts for phosphorus has been predicted by Diavik to be of mid-term duration, moderate magnitude at a regional extent that is ultimately reversible.

The effects of treated sewage water discharge during construction on water quality in Lac de Gras would be negligible, local, and short-term duration.

iv) Comments and Concerns

General
DFO, DIAND and the KIA questioned Diavik's conclusions that the mine water discharge would mix fully and rapidly with the ambient waters in Lac de Gras. Stratification caused by differences in temperature and dissolved solids content has the potential to inhibit mixing of the mine water discharge and create a plume of water of poor quality. DIAND also questioned the effectiveness of the submerged mine discharge diffuser in that its location and year-round mixing effectiveness were not fully addressed for all potential wind-induced lake conditions. DIAND requested more detail related to wind-induced conditions and also the efficiency of the submerged discharge under ice cover.

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The large volumes of mine water being discharged could increase cadmium loading to Lac de Gras, although concentrations would be low. Diavik's estimates of total cadmium loading were based on conservative assumptions and did not account for any losses to sediments in the North Inlet. Reviewers suggested that geochemical conditions favour the rapid adsorption of dissolved trace metals to the sediments. Diavik's predictions of increased metal concentrations in Lac de Gras were therefore considered to be very conservative.

NRCan questioned the spatial resolution of Diavik's analysis of dispersion of the mine water discharge.

Diavik's analysis of ammonia release did not quantify the amounts of ammonia nitrogen expected over time or from specific sources nor did it identify means to reduce the discharge of toxic ammonia to Lac de Gras.

The CPAWS-NWT stated that the national water quality guidelines are generic and cannot be completely relied upon to adequately reflect the sensitivities of Lac de Gras.

Nutrients

Reviewers raised concerns about nutrient enrichment, in-lake phosphorus retention assumptions, accuracy of background phosphorus levels and relevance of assumed threshold levels. Since these issues were unresolved after the public technical sessions, a nutrient workshop was held on March 15, 1999 and the following points of agreement resulted:

- Studies of other Arctic lakes suggest that phosphorus, not nitrogen or other components of mine water discharge, will limit primary production in Lac de Gras.
- The 0% retention model used by Diavik as the basis of its environmental assessment submission was inappropriate. There is a linear response of phosphorus concentration to increased load. If water load remains the same, an approximate 40% increase in response to a 40% increase in loading makes sense and is reflected in a model showing 76% phosphorus retention.
- Phosphorus concentrations showed seasonal and inter-annual variability and although lake-wide enrichment can be expected, increases beyond 40% tend to be confined to 20% of the surface area of Lac de Gras adjacent to the mine site. Highest concentrations are predicted under ice in winter. Participants agreed that this presentation provided the detailed analysis that was previously missing from the EA submission.
- The revised phosphorus model predicts that there will be smaller changes to the water quality of Lac de Gras than those originally predicted by Diavik. The changes predicted are not detrimental.
- A maximum potential decrease in dissolved oxygen of 0.14 mg/L due to nitrogenous oxygen demand was calculated at a point several kilometres from the discharge. The predicted effects of oxygen depletion were small enough to be of little concern to aquatic life. The issue was resolved, and unforeseen effects can be detected in the monitoring program.

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- The maximum predicted total phosphorus concentration would be less than the ambient threshold limit within 500 m of the discharge of treated sewage from the construction camp. Pulse loading of nutrients can be eliminated through a combination of nutrient removal and year-round subsurface discharge of treated effluent from the construction camp to Lac de Gras. The effect of continuous discharge is not significant. Nevertheless, given the sensitivity of Lac de Gras, the following recommendations should be considered during the regulatory process, should the project proceed: i) phosphorus removal with a target of 1 mg/L; ii) year round discharge directly to Lac de Gras via a pipeline to avoid effects on the wetland and decrease the project footprint, and iii) sewage nutrient removal during the operations phase.

The LKDFN recommended that it and other Aboriginal governments/organizations be involved in monitoring the levels and effects of phosphorous in Lac de Gras.

Reviewers commented that Diavik's statement that increasing a lake's trophic status could improve fish health is misleading. Fish may already be in optimal health in pre-impact Lac de Gras. Increasing primary productivity can lead to increased condition indices but this does not necessarily equate to improved physiological or reproductive health.

The CPAWS-NWT stated that there would be likely significant residual effects of the project arising from uncertainties about kimberlite toxicity, effects of phosphorus and nutrification, and a lack of confidence in fish habitat compensation measures.

DIAND questioned the ability of the proposed treatment option with effluent discharged to a wetland to perform as predicted. This was further amplified when in January 1999; Diavik increased the construction camp size from 600 to 800 personnel.

The GNWT Department of Health and the YDFN also expressed concern that workers in the processing plant may be exposed to recycled PKC water containing sewage.

Environment Canada recommended that Diavik, in collaboration with government, conduct in-situ nutrient studies to validate predictions regarding the potential environmental effects of nutrient inputs to Lac de Gras.

v) Proponent Response

General
On February 12, 1999, Diavik provided additional information on the effects of effluent temperature on mixing and showing that effluent would mix freely into Lac de Gras and any plume would disperse by the mixing zone boundary. Diavik confirmed that the outfall diffuser would be designed to enhance mixing and made a commitment to monitor plume dispersion using total dissolved solids. Diavik also provided modelling results showing that eddies in the vicinity of the outfall would not impede mixing of the mine water with Lac de Gras. Diavik's modelling results show that there is no reason to suspect that density and temperature will impede full and rapid mixing of Diavik's mine water discharge

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with Lac de Gras. Diavik agreed to follow-up with the KIA regarding water flow from the water treatment plant.

Nutrients
Diavik agreed to complete an accurate estimate of total nitrogen and nitrogen speciation concentrations in wastewater (including mine water) discharge resulting from blasting. This will form part of Diavik's submission for the regulatory process, which will stipulate discharge of safe ammonia levels, as a function of pH and temperature in receiving waters for the protection of aquatic life. Diavik also agreed to participate in in-situ studies to evaluate nutrient loading to Lac de Gras. Diavik provided all its information presented at the March 15th Nutrients Workshop to the public registry.

Diavik committed to evaluate the option of using a subaqueous discharge instead of wetland disposal for treated sewage during construction.

vi) RA Conclusions

General
The RAs agree that with the application of the proposed mitigation measures, Diavik can achieve all ambient aquatic life and drinking water thresholds, except for phosphorus at the 0.01 km^2 boundary. Therefore no significant adverse environmental effects are likely. The short-term potential exposure of fish to elevated metal concentrations in the 0.01 km^2 local study area is not likely to have significant effects on the fish community of Lac de Gras. A follow-up monitoring program is required to confirm and verify the year-round mixing effectiveness under variable conditions and scenarios as they occur including diffuser location and micro-wind climate effects on lake circulation arising from the country rock piles.

The RAs agree with Environment Canada's recommendation that Diavik undertake a quality control program for the handling of explosives and management of blasting activities to reduce discharges of ammonia to Lac de Gras. An objective of the follow-up program will require Diavik to manage the handling of explosives and blasting activities to minimize discharges of ammonia to Lac de Gras and monitor ammonia discharges.

Nutrients
As result of revised phosphorus modelling and assumptions, the RAs conclude that there would be no significant adverse residual effects of nutrient enrichment on Lac de Gras during operations and post-closure. Phosphorus in surface runoff should be minimized with proper storage and management of on-land sediment and till storage. With proper mitigation techniques, the effect of continuous sewage discharge during construction would not be significant. The modification of Diavik's Aquatic Effects Monitoring Program will focus on areas of enrichment, oxygen depletion and the verification of thresholds, so that mitigation can be applied as and when required.

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The follow-up program will require Diavik to monitor under ice oxygen levels and chlorophyll a levels as an early warning of the onset of enrichment in order to initiate further mitigation efforts as required.

As part of the follow-up program, and prior to the discharge of mine water, predictions regarding potential effects of nutrient inputs to Lac de Gras should be validated through the completion of in-situ nutrient studies. The results of the in-situ studies will support informed decision-making as to the level of treatment required before mine water discharge.

Aboriginal government/organizations will participate in the modification and implementation of Diavik's proposed Aquatic Effects Monitoring Program in accordance with the environmental agreement or regulatory instruments.

Given the sensitivity of Lac de Gras, the RAs conclude that the following recommendations regarding sewage treatment should be considered during the regulatory process: i) phosphorus removal with a target of 1 mg/L; ii) year round discharge directly to Lac de Gras via a pipeline to avoid effects on the wetland and decrease the project footprint, and iii) sewage nutrient removal during the operations phase.

8.5.2 Groundwater

The following section describes the de-watering of pits and underground mines, which is the principal activity of the proposed project related to groundwater.

i) Environmental Effects

Open-pit dewatering during the construction and operations phases, and flooding of the open-pits at closure are not expected to have adverse effects on groundwater quality and quantity. As mining proceeds and groundwater inflows increase, the quality of shallow groundwater is expected to improve due to an overall decrease in total dissolved solids (TDS). Concentrations of TDS are expected to be higher near the bottom of the pits, but lower at the sides of the pits resulting in an overall decrease in TDS in groundwater.

Groundwater levels will be reduced near the mine excavation during operations, but the degree of drawdown diminishes with depth and distance from the pit. Upon closure, groundwater levels will recover as water from Lac de Gras is reintroduced to the diked-off area. Total recovery to original levels is predicted to take two years.

ii) Mitigation

Diavik reported in its environmental assessment submission that mitigation for fish and water, and other resource components was identified during planning and implemented during the design stage of the project. No additional mitigation measures were identified for groundwater quality in the proponent's environmental assessment overview and fish and water environmental effects report.

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iii) Significance

Diavik determined that the effect of the proposed project on groundwater quality and quantity would be negligible. This is because groundwater under Lac de Gras is unlikely to be pumped for human water supply purposes, effects are local in geographic extent and water levels and quality will recover to original conditions upon closure.

iv) Comments/Concerns

Reviewers recommended that a groundwater monitoring program be developed for the life of the mine to allow on-going refinement of groundwater modelling predictions. Both Environment Canada and the Department of Indian Affairs and Northern Development (DIAND) requested monitoring be conducted to evaluate the quantity and quality of groundwater being pumped from the open-pits and underground workings. While such monitoring would not pertain to the effects on groundwater, minewater represents a major potential contaminant and volume source to surface water. As well, contingency plans should be developed to deal with a broader range of inflow and quality conditions.

Environment Canada also expressed concern about the protection of shallow groundwater quality on-site. Environment Canada recommended monitoring of shallow groundwater quality in the active layers in the vicinity of the processed kimberlite containment (PKC) facility to confirm that permafrost indeed acts as an impermeable barrier to retain PKC contaminants (see also Section 8.5.1 b) Surface Runoff).

Natural Resources Canada (NRCan) asked that Diavik provide background fluoride levels in minewater.

Technical Session Recommendations:
Although DIAND identified concerns with the groundwater results from the October 1998 final hydrogeology report, it does not change the validity of the original estimate of 30,000 cubic metres/day (which occurs only at the peak of mine life) or the predicted environmental effect. Water quality in the pits after closure may change but the environmental effect is considered minimal because deep pit waters are not expected to mix with Lac de Gras and the deep pit is not suitable habitat for aquatic life. Diavik is to monitor water quality in the pits to confirm acceptability prior to breaching the dikes.

v) Proponent Response

Diavik plans to implement the groundwater monitoring program as soon, as is feasible.

Diavik determined that fluoride had mistakenly been omitted from all prior analyses and committed to add fluoride to the parameter list for any future groundwater sampling and minewater discharge monitoring. Diavik also provided some estimates of what the fluoride levels might be, based on the kinetic leach test conducted at the site. Diavik committed to confirming these estimates in its future groundwater monitoring program.

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vi) RA Conclusions

The responsible authorities (RAs) agree with Diavik's conclusions that the project would have negligible effects on local groundwater resources. The RAs agree with Diavik's commitment to add fluoride to the parameter list for any future groundwater and minewater monitoring. The RAs support Environment Canada's recommendation that a monitoring program be developed by Diavik to validate its prediction that permafrost surrounding the PKC facility will form an impermeable barrier between the facility and the East Island shallow groundwater. Because the quality and quantity of groundwater affect surface water management, a follow-up groundwater monitoring program for the life of the mine is required to verify Diavik's predictions regarding the quantity and quality of groundwater. As well, contingency plans must be developed to deal with a broader range of inflow and quality conditions.

Diavik will be required to modify its Aquatic Effects Monitoring Program, Water Management Plan and Geotechnical Monitoring Program in accordance with the environmental agreement and/or a water licence. The environmental agreement or water licence will specify that Diavik is to monitor the effectiveness of its proposed mitigation measures and determine how adaptive management of the mitigation measures is required and implemented over the course of the project. The follow-up program that will be specified in the environmental agreement and/or the water licence will also require Diavik to: i) validate predictions that permafrost surrounding the PKC facility will form an impermeable barrier between the facility and the East Island shallow groundwater; ii) include fluoride for future groundwater and minewater monitoring, and iii) monitor groundwater for the life of the mine to verify its quantity and quality and develop contingency plans to deal with a broader range of inflow and quality conditions.

The RAs recognize that some information will not be available until detailed engineering design is finalized however certain items raised during the technical review are highlighted for attention during the regulatory stage:

- a presentation of the open-pit and underground mine design to show how Diavik will effectively manage the potential for groundwater ingress that exceeds predicted rates during the mine life. Additional components and planning measures should be presented that can address the probability of mine inflows up to 2 times higher than Diavik's averaged "base case" (40% probability), up to 5 times higher (30% probability), and up to 10 times higher than the "base case" (18% probability);
- the need for detailed plans to adequately address year-round water and ice removal from the open-pit and water removal from underground mine areas, and
- given the possibility that averaged mine inflow rates could be consistently higher than predicted, Diavik should describe the reserve capabilities of the North Inlet and treatment equipment to mitigate higher volumes of potentially poor water quality, (e.g. phosphorus and TDS loads).

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8.5.3 Fish and Fish Habitat

Resolution of deficiencies in Diavik's analysis and final determination of effects and significance on fish and fish habitat was an iterative process, involving many requests for further information and clarification. As such, the following section departs from the structure of other portions of Chapter 8, in that comments from reviewers, Diavik's response and final determinations are presented as one narrative, instead of individual sections. This format prevents repetition and allows a clearer presentation of the process leading to the final determinations. The technical documentation of the review process was provided to the public registry.

i) Environmental Effects

Diavik proposed a policy allowing angling by employees during the operations phase of the proposed project, with restrictions. Angling by Diavik operations staff was predicted to change the structure of the fish populations in Lac de Gras through a decrease in some age classes, an increase in the forage base in the lake, and faster growing lake trout.

Diavik acknowledged that the use of explosives could affect fish in Lac de Gras. Any incubating fish eggs within the zone of influence of shock waves radiating out about 700 m from the open-pits could be susceptible to mortality. In a regional context, the effect would not likely be detectable since the spawning habitat that may be affected by the use of explosives comprises approximately 7% of that which is available in the local study area. In addition, only a fraction of this spawning habitat would be affected at any one time, due to the staggered development of the open-pits.

Another potential direct effect identified by Diavik for fish populations is the effect of fish salvage operations in the areas behind the dikes around the kimberlite pipes and North Inlet. Mortality from capture, handling and transport of these fish is expected to be relatively minor; it is not anticipated that any losses would be detectable in the Lac de Gras fish populations.

Diavik predicted the net losses and gains in fish habitat due to dike construction in Lac de Gras during all phases would have a negligible effect on fish habitat in the regional study area (i.e., < 1% habitat lost). In the local study area, a reduction in slimy sculpin habitat of up to 7.7% during the construction and operations phases was predicted. However, during the post-closure phase, there would be increases in all types of slimy sculpin habitat, at the local level. The changes in lake circulation patterns and current velocity caused by the dikes are not expected to have adverse effects on fish habitat. Thus, effects on fish habitat are expected to be negligible at the regional level, as well as at the local level, with the exception of the mid-term effect on slimy sculpin habitat.

Diavik predicted that the total suspended solids (TSS) in Lac de Gras resulting from dike construction would be a low magnitude of a short-term duration effect on a local level. Diavik has determined threshold values for TSS for the protection of fish that will not be exceeded within 200 m of the dike construction activities.

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Diavik estimated that between 2 and 5% of spawning and rearing habitat in the local study area is expected to be subject to sediment accumulations greater than 1 mm during dike construction. This was the criterion used to determine when an adverse effect due to sedimentation could occur. As the potential does exist for incubating eggs to be present within some of this habitat when sedimentation occurs, it was considered likely that some egg mortality would result. A small fraction (2 to 5% in total but not all at the same time) of the available spawning habitat in Lac de Gras is predicted to be affected by sediment accumulations and the effect would be restricted to the construction phase. Effects are expected to be reversible, as the deposited sediment would be scoured from the spawning and nursery shoals by wave action in Lac de Gras.

In Diavik's analysis of potential effects of mine infrastructure development on fish-bearing lakes on East Island, it was predicted that there would be an effect of high magnitude and mid-term duration as a result of the loss of four fish-bearing lakes on East Island during construction and operations. During the closure and post-closure phases, aquatic habitats are to be rehabilitated and enhanced, and there is expected to be an overall net gain in fish habitat from mitigation efforts. Based on the proposed strategy, there is expected to be a net loss in longnose sucker and burbot habitat, as these species were not targeted for mitigation efforts. A small (4.5%) residual reduction in lake trout rearing habitat on East Island lakes is expected.

Spawning or rearing habitat in East Island streams does not exist. However, Diavik expects a small reduction in stream migration corridor habitat on East Island, a habitat type that would only exist under very high flow conditions. The migration corridor habitat would be mitigated during operations by habitat enhancement on the West Island.

Diavik examined the potential for higher metal concentrations in fish flesh or for tainting in fish in Lac de Gras or East Island lakes. The results of the analysis determined that metal concentrations in the flesh of fish in Lac de Gras are not expected to exceed the guidelines for safe human consumption. The analysis further indicated that tainting of fish flesh, as a result of the proposed project, would not be likely. However, post-closure runoff to two lakes on East Island could result in elevated metals concentrations in fish flesh in those two lakes. The potential of this effect would be evaluated further based on actual runoff monitoring information collected during operations.

No adverse cumulative effect on fish was identified in Diavik's analysis. Changes to water quality hydrology, direct habitat alteration and harvest were determined to have no cumulative effects on fish or fish habitat in Lac de Gras. The cumulative effects of the winter road are based on the potential effects of spills on aquatic life. The effects of spills on aquatic life are expected to be of low magnitude, limited in geographic extent and mid-term in duration (see Section 8.7.6 Accidents on Roads – Winter Conditions).

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ii) Mitigation

Diavik stated that it would ensure that water column TSS concentrations remained below targets for the protection of fish within a 200 m zone around the dredging site by, for example, use of silt curtains or by curtailing dredging activities if thresholds are approached. Mitigation for harmful destruction of fish habitat is identified in Diavik's no net loss plan for fish habitat. No further mitigation measures were identified for fish in the proponent's environmental assessment overview and environmental effects report.

iii) Significance

Diavik determined that effects of the proposed project on fish populations due to angling were low in magnitude at the regional level. All other residual effects were considered negligible at the regional level. The proponent determined no residual significant adverse effects on fish.

iv) Comments/Concerns

Responsible Authorities:
Recreational Angling
The department of Fisheries and Oceans (DFO) review of the enviornmental assessment submission determined that Diavik had not provided adequate justification for its conclusion of no adverse project effects on fish. Specific shortcomings included the effect of recreational angling by employees, the effect of blasting on fish eggs and use of spawning habitat, losses of fish habitat from sediment resuspension and deposition and the combined effect of blasting and sediment deposition.

DFO determined that fish populations, and therefore sustainable yields, for Lac de Gras and the inland lakes have not been adequately determined and that there were uncertainties in the effectiveness of restrictions that Diavik proposed to limit angling-related effects on fish populations. DFO concluded that recreational angling could not be justified in the light of these uncertainties and that mitigation would not prevent potentially significant effects of angling on the fish populations and structure of Lac de Gras and the inland lakes.

Blasting
DFO agrees that blasting is unlikely to have effects on free swimming fish, but there may be some mortality of eggs deposited within the 450 m blast zone. Up to 7% of the spawning habitat near the dikes could be negatively affected by blasting. Diavik has provided additional information that indicates that as the pits deepen, the impact zone decreases.

Sediment Dispersion and Deposition
Dredging of lakebed sediment and dike construction by the top-down method of rock filling in open lake water will re-suspend sediment and will result in a high magnitude short-term local adverse effect of total suspended solids on fish and fish habitat. Several iterations of information request and analysis of effects were required to address uncertainties which DFO and the Department of Indian Affiars and Northern

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Development (DIAND) saw in Diavik's assessment of TSS and sediment deposition effects on fish and habitat in Lac de Gras. DFO and DIAND requested clarifications in order to evaluate Diavik's conclusions on duration of predicted impacts, predicted distribution of sediments and TSS in Lac de Gras and predicted target sediment concentrations for the protection of fish. NRCan raised the concern that changes in lake circulation as a result of dike construction could reduce water velocity, resulting in sediment accumulation in areas adjacent to project structures.

The numerical modelling used in Diavik's environmental assessment submission assessed a six-month dike construction time frame, which was later changed to three months. DIAND and DFO requested verification of whether or not the modelling findings remained applicable to the shortened construction period. Diavik clarified that dredging operations would be completed over a single three-month period in the first year of dike construction. This reduced concerns over applicability of the original models and of long-term effects of TSS and sediment deposition.

Diavik predicted water column TSS concentrations using a three-dimensional numerical model which used depth-averaging of sediment concentrations released during dredging and dike construction. Target concentrations of TSS for the protection of fish were established based on a dose-response model and a lake circulation model. DIAND found the modelling to be comprehensive regarding wind direction scenarios and concurred with the overall conclusion that the majority of sediments would settle in close proximity to the dike footprint (within 200 m). DFO felt that inherent uncertainties in the dose-response model and a lake circulation model reduced its confidence in Diavik's predictions.

DFO challenged the target threshold values established by Diavik for the protection of fish during sediment disturbance activities. Although the target values are stated as being protective of juvenile fish, they are set close to the boundary between individual and population effects, were developed for stream environments not lakes and the number of lake trout references actually used for developing the severity of effects ranking was very small. In addition, the effects of sedimentation on the young-of-the-year are difficult to assess because the habitat classification system used to identify sensitive areas is based on the physical attributes of the habitat and not on an assessment of how the habitat is currently being used.

DFO determined that the depth averaged predictions provided by Diavik might mask regions in the water column where thresholds are exceeded and, as a result, there was no clear presentation of what the TSS conditions would be like during the three months of dredging. The Government of the Northwest Territories (GNWT) also noted this inadequacy. Diavik provided DFO with some non-depth averaged TSS data for specific dates as well as the original computer model (simulation) used to determine TSS concentrations. DFO reviewed some of the simulation material and determined that the assumptions made by Diavik appear to be reasonable approaches to addressing uncertainties.

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The effects of reduced light penetration on phytoplankton photosynthesis are unlikely to be significant on a lake-wide basis. However, Diavik has not provided an estimate of the spatial extent of the zone of decreased water clarity, therefore, the potential for reductions in primary productivity in the east end of the lake are not fully known.

The deposition of a large amount of sediment over a relatively short time period, may overcome the ability of benthic communities to adapt. Although the importance of the area to benthic foraging fish such as whitefish is unknown, the affected areas represent a small portion of Lac de Gras.

The zone, within which blasting effects could occur, overlaps with the area to be impacted by sediment deposition due to dredging and dike construction. DFO had concerns with these simultaneous sources of disturbance. A review of the mining schedule for blasting and dredging for dikes showed that these activities would not occur simultaneously and therefore alleviated the concerns of DFO.

The outer edge of the dike may be utilized for spawning and some concern was expressed by DFO and Aboriginal people that fish would be attracted to the area only to have the eggs killed by blasting and/or the fry affected by leaching metals. Fish may avoid the outer edge of the dike for the first few years until disturbance levels become acceptable. During this period, leaching rates are expected to dramatically decline, reducing the potential for adverse effects on fry.

DFO also expressed concern that the modelling analysis should have examined the combined effects on the life span of the mine plus a reasonable recovery period. There are instances where different activities contribute to the same problem but each activity has been analyzed separately when a combined analysis would be more useful. When and where each source of phosphorus and suspended sediment reaches the lake may vary.

Fish Habitat
Concerns were raised regarding the impacts of the proposed project on fish habitat in Lac de Gras and in some inland lakes on East Island. Diavik submitted preliminary plans for compensation of this lost habitat in its environmental assessment report. This No Net Loss Plan detailed the habitat types and areas to be loss as well as approaches to compensate for these losses. DFO has met with Diavik on a number of occasions since the fall of 1996. Diavik also discussed its proposed approach with the communities during its public consultation phase.

Technical Session Recommendations:
Diavik committed to verify prediction of blasting effects by monitoring/ experimentation during early stages of the mine and to modify its blasting protocol accordingly.

DFO was urged to adopt an open process for the approval of the No Net Loss Plan. All parties are encouraged to provide comments on the plan to DFO. DFO was advised to hold meetings to discuss the No Net Loss Plan on dates closer to the regulatory phase.

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Aboriginal Governments/Organizations/Communities:
Aboriginal governments and organizations want increased and meaningful participation during the development of a No Net Loss Plan for compensation of fish habitat. Representatives of the Kitikmeot Inuit Association (KIA), the North Slave Metis Alliance (NSMA), the Yellowknives Dene First Nations (YDFN) and the Lutsel K'e Dene First Nation (LKDFN) all advised that they had repeatedly voiced opposition to Diavik regarding its proposed policy to allow recreational angling by mine employees. A recommendation was made that no fishing be permitted. Additional benefits of a no fishing policy identified by the YDFN include reduced impacts on wildlife such as caribou and loons.

The KIA submitted concerns relating to mitigation of silt during dike construction and requested clarification on the sequence of dredging for the dike and pit footprints. Other questions were submitted on fish habitat compensation, fish population monitoring methodology, salvage of fish from lakes on East Island, requests for clarification of the effects models used in establishing thresholds for sediment and blasting effects on fish.

At post closure, metal concentrations in fish flesh in some of East Island lakes are predicted to exceed consumption guidelines. The KIA recommends that a plan be developed to warn people fishing these lakes (e.g. posting signs), if the predictions are correct.

The YDFN requested that Diavik undertake studies of palatability and texture of fish flesh and expressed concerns that Diavik may have underestimated fish usage of lakes on East Island and numbers of spawning fish in Lac de Gras. The YDFN sought clarification from Diavik that a forage base for fish stocked into East Island lakes would be established. The YDFN also requires clarification on the timing and methods for fish salvage from behind dikes. A commitment is required from Diavik that it will implement (as opposed to investigate) alternative mitigation techniques if those proposed are not successful. Diavik should review its benthic monitoring program with a view to detecting small to moderate impacts.

The LKDFN recommended that all measures be taken to protect aquatic habitat in the area of the proposed Diavik Diamonds Project from disturbance and contamination. Drawing on its experience and extensive knowledge of the land, water, and wildlife and what they have learned about the lack of northern-based habitat enhancement examples, the LKDFN do not approve of activities that would result in the re-creation or enhancement of aquatic habitat near or away from the mine site. This includes: no moving of fish; no recreating or enhancing habitat on the exterior of the dike walls; no creating or enhancing inland lakes (moving fishing), and no breaching the dikes after closure.

The LKDFN does not approve of the No Net Loss Plan as proposed by Diavik Diamond Mines Inc. Although it recognizes the plan was developed to comply with policies of DFO, it is in conflict with Traditional Dene Laws. Because of the size of the proposed project and its potential to dramatically affect such a large and significant watershed,

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critical and careful monitoring within the context of adaptive management must be undertaken under all business conditions to assist in managing and mitigating effects. (April 14, 1999 document)

Non-Government Organizations/General Public:
The Canadian Parks and Wildnerness Society-NWT (CPAWS-NWT) is concerned that proposed compensation for lost fish habitat may not prove effective as a habitat mitigation measure because lake trout exhibit fidelity to spawning grounds and there is a potential shortage of suitable shallow areas in Lac de Gras. The organization would like to be involved in evaluating the conditions put on restoration bonds to ensure that effects caused by Diavik are mitigated. The CPAWS-NWT lacks confidence in proposed fish habitat compensation measures and therefore disagrees with predictions of residual effects of the project.

v) Proponent Response

Diavik's responses to individual comments have been incorporated into the relevant sections of the report. An addendum to the No Net Loss Plan addressing additional issues identified has been submitted to DFO and to the public registry.

vi) RA Conclusions

The responsible authorities (RAs) conclude that based on the strong opinions of the Aboriginal governments and organizations and the potentially significant effects of angling on fish, a no fishing policy shall be implemented by Diavik. This will apply to all Diavik employees, contractors and visitors to the site unless otherwise determined by DFO in consultation with Aboriginal governments/organizations.

The RAs have determined that follow-up programs are required as a condition of approval to ensure that no significant adverse effects on fish and fish habitat occurs as a result of this project. Critical and careful monitoring within a context of adaptive management must be undertaken under all business conditions to assist in managing and mitigating effects. The Aboriginal governments/organizations shall be given the opportunity to be directly involved in the design and implementation of these follow-up programs.

Potential effects of blasting will be confined to the calculated 450 m blast zone. Effects within this zone, however, are unlikely to be significant based on the relatively localized area affected by blasting in a given pit, the duration of effects (3 years for the A154S dike), and the conservative nature of the thresholds used for the protection of eggs. Diavik is required to verify this conclusion by monitoring spawning activity, conducting egg survivability studies in the vicinity of the dikes and adjusting the blasting protocol if mitigation is warranted. DFO would assist Diavik with the development of plans for monitoring of blasting effects.

Recognizing the shortcomings in the model used and after examining the additional information, DFO agrees that Diavik has modelled the TSS effects with the best available information. Although up to 5% of the available spawning habitat in the

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local study area may be affected by sediment deposition during dike construction, the effects are not likely to be significant. Spawning habitat is abundant in the lake, fish may seek alternative spawning shoals if their preferred shoal or water quality in the vicinity of the shoal becomes 'unsuitable', and effects of sediment deposition are reversible through wave action. Any effects on a given year class are not expected to significantly affect fish populations.

It is important that the predictions of TSS concentrations during construction, sediment accumulation on critical habitat, and any resultant effects on fish and primary productivity be verified through a monitoring program. Any potential effects on fish due to TSS will be limited to within a 200 m zone surrounding the dredging and dike construction activities. Target thresholds for TSS have been established for beyond the 200 m boundary and monitoring must be undertaken to confirm that these targets are not exceeded.

In developing its monitoring program, Diavik must provide estimates and verify the spatial extent of a TSS plume in Lac de Gras. The total area of habitat potentially affected by TSS must also be provided as a percentage of the total habitat available. Potential depositional areas also need to be compared to actual depositional areas immediately following construction and again in the following open-water season for verification of dispersion modelling. The assumption that shoals would be 'washed' clean within one year of activities must be confirmed through monitoring. Should the spatial extent, biological impact and duration of sediment deposition be greater than predicted, remediation work, stop work orders, and/or habitat compensation may be required.

Diavik must monitor the use of spawning shoals by fish within the vicinity of TSS disturbance and sediment deposition, and verify predictions that fish will seek alternate habitats. The timing of dredging may have to be adjusted to accommodate the high oxygen demand of hatching eggs.

Although significant effects on the benthic community are unlikely, this prediction should be verified by monitoring before and after construction activities to assess any changes in deposition and the benthic community. Diavik should review its benthic monitoring program with a view to detecting small to moderate impacts.

The RAs conclude that Diavik must also monitor fish population and fish health over the life of the mine.

Individual effects of metals, blasting and sediment deposition will not cause significant environmental effects. The RAs have concluded that there is no scientific framework for interpreting additive mine-related environmental effects. The RAs also concluded that there is no scientific evidence of cumulative effects from the proposed Diavik mine. However, despite the lack of a scientific framework for considering additive mine-related impacts, a guiding principle of the follow-up program will be to monitor and manage the additive mine-related environmental effects where possible.

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At post closure, metal concentrations in fish flesh in some of the East Island lakes are predicted to exceed consumption guidelines. The RAs agree that Diavik should monitor metal concentrations post-closure and agree with KIA's recommendation that a plan be developed to warn people fishing these lakes (e.g. posting signs), if the predictions are correct.

Should the project proceed, the RAs encourage Diavik to involve Aboriginal governments/organizations in the development and implementation of plans for fish salvage. DFO and Diavik will conduct an open process for the development, approval and implementation of the No Net Loss Plan, and will hold further meetings to ensure effective Aboriginal participation. The RAs have concluded that the impacts on fish habitat can be compensated for through the implementation of an extensive fish habitat compensation and enhancement program with appropriate follow-up monitoring. The details of this plan are to be finalized in the regulatory phase.

8.6 EFFECTS OF ENVIRONMENT ON THE PROJECT

The following section provides a discussion on the effects of the natural environment including the following:

- Permafrost
- Global warming and structural integrity
- Severe weather
- Caribou on roads
- Frost penetration into pit walls

8.6.1 Permafrost

Diavik has defined permafrost as ground that remains at or below a temperature of 0°C for at least two consecutive years. Permafrost develops in areas where the heat loss from the ground (during winter) exceeds the combined gain in heat during the summer and heat radiating upward from depth. Permafrost generally develops under dry land masses. On the East Island, permafrost has been measured up to 380 m thick. The upper zone of permafrost will thaw and refreeze seasonally. This is known as the active layer, and is typically 1.5 to 2 m deep at the Diavik site, although it may reach up to 4 to 5 m in bedrock. Under Lac de Gras, permafrost does not occur, except near shorelines and islands. Beneath water bodies that do not freeze at depth, taliks, or thawed zones, occur. For example, one of the thaw zones has been measured to 75 m below an East Island lake.

Diavik's engineering design process for the facilities and structures proposed for the project has taken into consideration local permafrost conditions. In some cases, the presence of permafrost is an advantage, providing favourable geotechnical and hydrogeological properties. For example, permafrost below the processed kimberlite containment (PKC) provides a natural low-permeability barrier. In other instances, permafrost may be a disadvantage in that it can create settlement problems if thawed by constructed facilities, or it could possibly creep while still frozen. An example of this consequence is the ground condition below the country rock areas where the placed rock could theoretically cause thawing of ice-rich tills. Therefore, flatter side slopes have been proposed in these areas to account for creep in the ice rich tills.

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Diavik has indicated that there is no single engineering approach for permafrost. Permafrost conditions have been addressed for each facility according to:

- the depth and temperature of the permafrost at specific locations,
- the type of permafrost (i.e., ice-rich till, ice-poor till, or bedrock),
- the type, size, and function of the structure being considered,
- the sensitivity of the structure to settlement deformation, and
- the long-term closure plan intended for the structure.

Diavik has agreed to put in place a long-term its Geotechnical Monitoring Program to assess the performance of the various structures and verify assumptions used in the design.

RA Conclusions
The responsible authorities (RAs) conclude that Diavik has satisfactorily incorporated potential permafrost effects into the engineering design of the project. Diavik has committed to a long-term Geotechnical Monitoring Program to assess the performance of the various structures and verify assumptions used in design. The RAs agree with this approach and the results of the monitoring program shall be reported annually with remedial action as required. For detailed discussion on permafrost, see Section 8.3 - Vegetation and Terrain, Section 8.5 - Water and Fish and Section 8.7 - Accidents and Malfunctions.

8.6.2 Global Warming and Structural Integrity

Diavik has indicated that it is difficult, and beyond the scope of this environmental assessment, to predict if climate changes are likely to occur and what they would likely be. Nevertheless, the sensitivity of major project facilities to changes in ambient temperatures was evaluated. Thermal modelling was undertaken for Diavik's main facilities, including the dikes, processed kimberlite containment (PKC), sediment pond structures and country rock areas. Some of these same models were used to conduct a thermal analysis using an assumed global warming scenario. Temperature changes assumed for this analysis were estimated based upon a review of current scientific opinion (Nixon, 1998). This analysis was conducted over a 50 year time period and indicates that some warming of the structures takes place. The internal core of the structure warms by about 1°C while the foundation warms by about 0.5°C. Neither of these temperature increases is sufficient to thaw the foundation or dam cores. Core temperatures would remain below –1°C.

Comments/Concerns
Environment Canada has determined that over the past 50 years the Western Arctic has experienced a warming trend accompanied by not only increased annual rainfall but also an increase in the magnitude of daily and longer duration extreme events. Although there is no immediate concern of permafrost degradation, the design objectives and criteria of the processed kimberlite facility require special attention. Four aspects of the facility should receive special attention in regard to a possible continuation of the current warming trend: permeability and stability of the containment dams, emergency spillway and rock cap proposed for closure. Environment Canada also recommended that more reliance should be placed on geomembrane structures and less reliance on frozen core

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dams designed to be an impermeable barrier. In addition, the emergency spillway for the processed kimberlite containment facility should be capable of handling the 24-hour probable maximum precipitation event while maintaining a 2.0 m freeboard and a 500-year return period should be used as the minimum standard for the processed kimberlite facility design criteria.

Ecology North has expressed concern regarding the warming effects from global climate change on the stability of the retention dikes that rely on permafrost for stability.

RA Conclusions
The responsible authorities (RAs) concur with Environment Canada's recommendations and direct Diavik to further consider the effects of climate warming on the long-term integrity of frozen structures at the regulatory stage should the project be allowed to proceed. Geotechnical monitoring must continue for the life of the project to ensure the integrity of the frozen dam structures for the abandonment and restoration (see Section 8.3 - Vegetation and Terrain).

8.6.3 Severe Weather

Diavik has described the severe weather conditions in its environmental assessment submission, and anticipates no potential environmental effects.

RA Conclusions
The Diavik site will experience severe weather conditions, such as white-outs, fog and extreme temperature, over the life of the project. Severe weather conditions will be taken into account in design and operation practices to minimize risk of environmental effects and to ensure the health and safety of workers. The operation procedures during severe weather conditions are prescribed by the Workers Compensation Safety Board - Mine Safety Branch and must be incorporated into management plans as part of Diavik's Environmental Management System.

8.6.4 Caribou on Roads

Diavik's operations can be affected by caribou congregating on or beside haul roads by shutting down traffic until they are herded away or move on. For caribou congregating on or beside roads, if one assumes 30 minutes lost per day for herding over a 5-week period, the net impact would be in the range of 18 hours per season, or 36 hours per year.

Diavik's site layout plan included a wildlife migration corridor to direct animals away from the haul roads. In addition to this there will be operating procedures such as reduced speeds on haul roads during these key times, as outlined in its Environmental Management System. Granite stockpiles will be constructed with low angle exterior slopes to facilitate caribou access during migration (twice annually, spring and fall). The Red Dog mine in Alaska is a good example of operations accommodating migrating caribou herds. The Red Dog Mine typically loses 1 to 2 days per year with similar caribou herd sizes. Diavik predicts that the potential delays due to caribou will be different for the 4 to 6 week spring and fall migration periods. During the spring, the caribou can travel along the ice and therefore they will likely spend less time on the island, possibly tending to bypass it. In the

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fall, the caribou will be forced to swim and therefore may congregate more on the island. Diavik estimates that the total downtime due to caribou would be in the range of 84 hours per year. In total, 434 hours (18 days) have been deducted from planned operations to account for the caribou migrations.

RA Conclusions
The RAs conclude that there are no potential adverse environmental effects from the proposed project on caribou on roads. Diavik has developed a draft Traffic Management Plan in its Environmental Management System that identifies traffic procedures when caribou are present on the proposed site. These procedures will be modified, monitored and implemented in accordance with the environmental agreement.

8.6.5 Frost Penetration into Pit Walls

Diavik conducted geothermal modeling of the exposed pit walls to determine the rate of frost penetration. Extensive frost development in pit walls will affect the hydraulic conductivity which has the potential to effect groundwater flow to the pits. The study also indicted that areas of low seepage quantity will likely freeze, and once frozen will remain frozen, however zones of higher seepage will continue to seep water throughout the winter period. The inflow estimates described previously do not take into account the formation of any frozen rock faces.

RA Conclusions
See Section 8.5.2 - Ground Water.

8.7 ACCIDENTS AND MALFUNCTIONS

For each of the scenarios listed below Diavik has described design features to minimize the likelihood of occurrences, early warning monitoring programs, commitments to follow contingency or emergency plans, quantification of release of contaminants to the environment, and the potential environmental effects. Details are provided in a letter from Diavik to the Department of Indian Affairs and Northern Development (DIAND) dated January 6, 1999. Diavik's approach to accidents and malfunctions was to primarily consider the potential for accidents and malfunctions in the design of the proposed project and ensure contingencies are in place. Potential for accidents and malfunctions will continue to be evaluated and contingencies developed during detailed engineering and throughout the life of the mine. Regardless of the improbability of an accident or malfunction, an evaluation of the following scenarios was completed:

Processed Kimberlite Containment (PKC) Dam Malfunction
Diesel Storage Accident
Water Treatment Plant Malfunction
Accidental Kimberlite Slurry Release
Water Retention Dike Malfunction
Accidents on Roads-Winter Conditions
Pit Wall Instability

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8.7.1 PKC Dam Malfunction

Description of Scenario
Diavik identified a possible scenario where a malfunction may be caused by thawing of foundation or dam structures at the east and west ends of the PKC that may result in seepage of volumes greater than what can be collected by the secondary containment systems at the outside base of the dams.

Environmental Effects
Diavik predicted that the potential environmental effects of uncontrolled release of large volumes of water will be temporary and local in extent and would not adversely affect water quality at the outlet of Lac de Gras. With the exception of aluminium and copper, the maximum area within which the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life would be exceeded and be less than 1 km^2. Under summer conditions (worst-case), Diavik predicts that the CCME guidelines for the protection of aquatic life may be exceeded for aluminium and copper in zones ranging up to 8 km^2 and 3 km^2 respectively. Within these zones, reduced fish growth rates and reduced fish reproductive success could result.

Comments/Concerns
Environment Canada indicated that there is no immediate concern of permafrost degradation due to climate change however, special attention should be placed on the design objectives and criteria of the PKC facility. See Section 8.6.2 - Global Warming and Structural Integrity for a description of Environment Canada's recommendation on design details.

RA Conclusions
The responsible authorities (RAs) concur with Environment Canada's recommendations and direct Diavik to further consider the engineering design to ensure the long-term integrity of frozen structures at the regulatory stage should the project be allowed to proceed. See the RAs Conclusions in Section 8.6.2 - Global Warming and Structural Integrity for a description of Environment Canada's recommendation on design details and follow-up geotechnical investigations. Diavik has committed to developing a monitoring program and contingency and emergency response plans before the start of construction activities that will be monitored in accordance with a lands instrument or the environmental agreement. The requirements for a Geotechnical Monitoring Program are discussed in Section 8.3 – Vegetation and Terrain.

8.7.2 Diesel Storage Accident

Description of Scenario
Accident causing ruptures in fuel outlet pipes that were left unattended, draining the complete contents of two storage tanks and resulting in fuel overtopping the perimeter containment berms.

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Environmental Effects
Diavik described this scenario as an extreme worst-case that would involve not only the initial accident but also concurrent failure of all other monitoring, response and contingency measures. The environmental consequence of this scenario would be the contamination of a significant amount of ground. Diavik predicts that it would take many years to adequately remediate the site. During this time, wildlife would be prevented from using this area. Potential environmental effects would be restricted to the plant site and area immediately surrounding the plant site.

Comments/Concerns
Environment Canada recommended that Diavik develop approved contingency and hazardous materials management plans before the start of construction activities. Contingency plans (e.g. spill and emergency response plans) and hazardous materials management plans are important mitigative measures. Such plans help prevent the possibility of adverse environmental effects caused as a result of accidents and help minimize adverse environmental effects when there are accidents.

RA Conclusions
The RAs conclude that potential adverse environmental effects from hazardous material spills (e.g. diesel storage facilities, fuel transfers, fuelling operations) can be mitigated through engineering design, development of management and programs. Diavik has developed a Hazardous Materials Management Plan in its Environmental Management System that must be modified to include contingency and emergency response plans before the start of construction activities. Monitoring requirements will be specified in a lands instrument or the environmental agreement.

8.7.3 Water Treatment Plant Malfunctions

Description of Scenario
Malfunction in the water treatment plants may cause discharge of untreated mine water and excess PKC water to enter Lac de Gras. Since the two wastewater streams are independent and have independent treatment systems, the malfunction would have to occur to both systems at once.

Environmental Effects
Diavik predicted that the potential environmental effects of uncontrolled release of large volumes of water would be temporary and local (East Island) in extent. With the exception of aluminium and copper, the maximum area within which the CCME guidelines for the protection of aquatic life would be exceeded and be less than 1 km^2. Under worst-case conditions, Diavik predicts that where aluminium would exceed ecological thresholds would be up to 19 km^2 and 4 km^2 for copper. Within these zones, effects on fish growth and reproduction could occur. Potential effects would be of short-term duration as the concentration gradients would quickly equalize once the treatment plants return to normal operations. This emergency release scenario represents a mass load equal to 1% of the natural basin load for aluminium and 60% for copper. Water quality at the outlet of Lac de Gras would remain within guidelines for the protection of aquatic life and drinking water.

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RA Conclusions

The RAs conclude that adverse environmental effects from a water treatment malfunction can be mitigated through engineering design and monitoring. The RAs acknowledge the design features considered by Diavik and agree with its proposed monitoring program that will provide for "early warning" of such a malfunction as well as the contingency plans to contain accidental spills of both PKC and minewater. The design features, monitoring programs and contingency plans are identified in Diavik's January 6, 1999 submission on Accidents and Malfunctions and will be specified in a lands instrument or the environmental agreement before the start of construction activities.

8.7.4 Accidental Kimberlite Slurry Release

Description of Scenario

Diavik identified that there may be an accidental rupture in the pipeline carrying processed kimberlite slurry to the PKC from the diamond recovery plant. For this scenario, the release of slurry was assumed to continue until slurry material overflowed secondary containment systems and was released into Lac de Gras.

Environmental Effects

The maximum area within which CCME guidelines for the protection of aquatic life that may be exceeded would be less than 1 km^2 for all parameters. The slurry line rupture scenario would release a relatively small mass loading of water quality parameters to Lac de Gras and would not adversely affect water quality at the outlet of Lac de Gras.

The maximum total lake bottom area that could receive more than 1 mm of sedimentation as a result of the slurry line rupture would be 1.7 km^2, assuming a uniform distribution. As there is only a relatively small amount of more sensitive shoal habitat in the vicinity of where a slurry line rupture would enter Lac de Gras, habitat loss would be limited. Diavik predicted that the potential environmental effects of uncontrolled release of processed kimberlite slurry will be of low consequence, short duration and localized in extent.

RA Conclusions

The RAs conclude that adverse environmental effects from a processed kimberlite dam malfunction can be mitigated through engineering design and monitoring. The RAs acknowledge the design features considered by Diavik and agree with its proposed monitoring program that will provide for "early warning" of such a malfunction as well as the contingency plans to contain accidental rupture in the pipeline carrying processed kimberlite slurry to the PKC from the diamond recovery plant. The design features, monitoring programs and contingency plans are identified in Diavik's January 6, 1999 submission on Accidents and Malfunctions and will be specified in a lands instrument or the environmental agreement agreement before the start of construction activities.

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8.7.5 Dike Malfunction

Description of Scenario

Diavik stated that the volume of water collected in an open-pit dewatering sump may continue to rise in excess of the maximum pumping capacity due to major seepage through the dike. This seepage would not result in a failure of the dike. Diavik also states that this scenario would most likely originate with seepage through a pervious zone in the till or the rock. Water collected in the pit would remain within the pit area and would not be immediately released to the environment. For the purpose of this evaluation, it is assumed the water would be released directly to Lac de Gras. It has been assumed that the water would contain 1,000 mg/L of total suspended solids (TSS) and would be discharged for 30 days.

Environmental Effects

Diavik stated that a short duration release of turbid water to Lac de Gras has the potential to affect juvenile and adult fish residing in the area of the release. It is assumed that this emergency discharge would be through the existing mine water submerged pipeline. The expected TSS concentration at the boundary of the smallest assessment area (0.01 km^2) around the discharge point, would be less than the 30-day aquatic life threshold of 165 mg/L. Potential effects on adult and juvenile fish would be restricted to this local area.

Comments/Concerns

Responsible Authorities

Natural Resources Canada (NRCan) identified further issues on possible dike malfunctions. NRCan requested additional information from Diavik on:

- the dike abutments and the integrity of the underlying frozen/unfrozen boundary at shorelines, the ability to maintain the boundary using the proposed thermosiphons and insulation, potential for frost heave and/or thaw settlement, and alternative designs for the boundary transition, such as removal of the till;
- the need for field verification to confirm till depth and design conditions for the cut-off wall, and
- the influence of underlying till thickness on the design safety factors of the dikes during drawdown, and potential contingency measures should porewater pressures in the till exceed design criteria.

Clarification was also sought by NRCan regarding the classifications from the Canadian Dam Safety Guidelines chosen for the various dam structures on site, and the selected design parameter for the earthquake return period. The structures included:

- the water retention dikes (very high consequence, design based on 1 in 10000 return period);
- the PKC dams (high consequence, design based on a 1 in 1000 return period), and
- the lakebed sediment containment dams (high consequence, design based on a 1 in 475 return period).

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NRCan also questioned why the classifications and earthquake design criteria varied. NRCan also noted that Diavik should have considered the hazard from a rare large shield earthquake close to the site (i.e. magnitude 6 at a distance of 90 km), in order to satisfy the Canadian Dam Safety Guidelines.

Proponent Response
Diavik addressed the NRCan's questions on the importance level and probability of seismic events it placed on the various containment structures and indicated that a rare large shield event close to the site was considered.

Diavik responded to NRCan's concerns regarding:

- variation in foundation till thickness and the rate of de-watering, and influence on the safety factors associated with the dam design;
- construction procedures, methods to avoid segregation of coarse and fine dike material, procedures for densification, details of angle repose, and
- thermal analysis and undertook a literature review on the use of active thermosiphons to control permafrost, and indicated that the thermal performance of the abutments would be continuously monitored.

RA Conclusions
The RAs are satisfied with Diavik's response regarding the effect of a magnitude 6 earthquake located within 90 km of the Diavik site.

The RAs are satisfied with Diavik's response regarding the influence on the dike design factor of safety from varying foundation till thickness and de-watering rates. The RAs conclude that the submitted information from Diavik on dike construction procedures is appropriate. The details of monitoring porewater pressures in the till foundation (via piezometers) and re-evaluation of factors of safety will be dealt with in subsequent detailed design reports in the regulatory phase.

The RAs are satisfied with Diavik's response that the design of the abutments of the dikes and the transition zone between the frozen and unfrozen foundations include a thermal analysis, a literature review, and a commitment to continuously monitor the thermal performance of the abutments through its Geotechnical Monitoring Program. The RAs believe that the abutment concerns are mitigable and will be addressed in more detail in the regulatory phase.

8.7.6 Accidents on Roads – Winter Conditions

Description of Scenario
Diavik expects that the spill incident rate for existing users on the Echo Bay Mine Winter Road may increase from the present 0.8 per year to 1.1 to 1.3 per year over the next decade. Diavik would add from 0.6 (during construction) to 0.4 (during operations) for a cumulative rate of 1.5 – 1.7 per year. For the scenario, the experience from implementing the existing spill response mitigation plans was used to conservatively assume a recovery of 90% of spilled hazardous materials.

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Environmental Effects
The environmental effects (including cumulative effects) of the winter road are based on the potential effects of spills on aquatic life. The effects of spills on aquatic life would be of a low magnitude, local in geographic extent and of mid-term duration. The overall cumulative effect of the winter road on aquatic life would be of low magnitude, short-term, limited extent and considered insignificant.

Diavik has stated that there is a high level of certainty that the effects would not be greater than predicted. The lowest known toxicity levels were used in the assessment, combined with conservative assumptions regarding spill volumes and fate of materials in lakes (assumed complete mixing with no breakdown or neutralization). The assessment was based on spill frequencies occurring less than once in ten years for all materials.

Comments/Concerns
As with Section 8.7.2. Diesel Storage Accidents, Environment Canada recommended that Diavik develop approved contingency (spill and emergency) and hazardous materials management plans before the start of construction activities which would include the use of winter and all-season roads.

The Yellowknives Dene First Nation raised concerns about possible spills on the ice road.

Proponent Response
Diavik stated that Echo Bay Mine's current road design features and monitoring and emergency plans are in place to minimize the potential for adverse environmental effects.

RA Conclusions
The RAs agree with Diavik that the cumulative environmental effect from a hazardous materials spill along the winter road on aquatic life would not be significant. However, the potential of short-term, high impact of localized spills does exist but can be minimized through the implementation of effective spill response measures and are not considered significant. As with Section 8.7.2 – Diesel Storage Accidents, the RAs concur with Environment Canada's recommendation that Diavik develop approved contingency and hazardous materials management plans before the start of construction activities. Monitoring requirements will be specified in a regulatory instrument or the environmental agreement.

8.7.7 Pit Wall Instability

Comments/Concerns
Diavik did not specifically address pit wall instability in its environmental assessment submission. DIAND raised concerns regarding this issue at the technical meetings held in January 1999.

DIAND stated that the potential for a pit wall failure could compromise the stability of the lake retention dike. Diavik stated that it had evaluated pit wall stability and concluded that reported factors of safety are adequate given the specific in-situ conditions simulated.

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DIAND is concerned about the structural integrity of the pit wall based on the possibility of potential planes of weakness and higher than assumed pore pressures. Specifically, Diavik should consider the potential flattening of the pit slope to address how the kimberlite in this area might effect the size of the pit, location of the confining dike, extent of the dike footprint and volume of waste rock that might be produced.

Proponent Response
Diavik confirmed that geotechnical monitoring will be continuous during pit excavation and during site life. This will ensure worker safety, advance notice of instability, and up-to-date detailed geotechnical information for design of potential remedial measures. Diavik noted that the final approval of pit design would be the responsibility of the Chief Mine Inspector under the NWT Mine Health and Safety Act.

RA Conclusions
The RAs conclude that potential environmental effects are not significant and the main concern is worker safety. However, Diavik has committed to conduct continuous in-situ geotechnical monitoring and based on results, adjust pit design during excavation and construction. The RAs recommend that the Chief Mine Inspector consider the pit wall stability issues raised by DIAND prior to permitting should the project be allowed to proceed. Considering both these actions, the RAs conclude that the issues raised can be adequately addressed in the regulatory phase.

8.8 SOCIO-ECONOMICS

8.8.1 Effects Resulting from Environmental Changes

i) Socio-economic Effects

Diavik documented the potential environmental changes likely to occur from the proposed project to climate and air quality, vegetation and terrain, wildlife, fish and water, and heritage resources. Information provided in Diavik's environmental assessment submission, together with an understanding of how people use the resource, provided for an assessment of how environmental changes could affect socio-economic conditions. The following summary identifies how Diavik predicted the biophysical environmental changes would affect people using the following sub-headings:

Human Health
Heritage Resources
Socio-economic Conditions

a) Human Health

Climate and Air Quality
Particulate concentrations at the project site were predicted by Diavik to be higher relative to baseline levels, but within NWT Safety and Public Services occupational health criteria for mining. Other contaminants would be within levels set by the Government of the Northwest Territories (GNWT). Regulatory mechanisms would be in place to address the protection of occupational health as the proposed project progresses and the open-pits approach their maximum depth.

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Diavik predicted that air quality effects would be negligible beyond East Island and the immediate area and cumulative effects, taking into account the Ekati Diamond Mine, are predicted to be insignificant. No existing use or activity would likely be affected by the changes in air quality. Consequently, effects on the socio-economic or cultural environment from air quality changes would be negligible.

Drinking Water Quality

Diavik predicted that the proposed project is expected to affect drinking water quality in a small area around the dikes during construction. Diavik stated that dust and air emissions, mine water discharge and East Island runoff will have negligible magnitude effects on Lac de Gras drinking water quality beyond a 1 km^2 zone outside the lake water retention dikes, i.e., will not exceed the Canadian drinking water quality guidelines. However, lakebed sediment porewater release during dike construction could cause manganese levels to exceed drinking water criteria threshold within 1 km of the dikes.

Diavik predicted low magnitude short-term local (Level I) effect within a 0.01 km^2 zone around dike construction activity, related to the dredging disturbance of lake bed sediments and the release of manganese contained within lake bed pore waters. The manganese threshold is based on an aesthetic objective, intended to protect against staining in laundry and precipitation in water distribution systems. Manganese can be safely consumed up to concentrations of 0.05 mg/L (Health Canada, 1996). No other dredging-related effects were predicted by Diavik to exceed Canadian drinking water quality guidelines. After closure, the proposed project would not affect the drinking water quality of lakes on East Island that are outside the perimeter of the mine water collection system. No effects are considered likely to occur as a result of changes in levels or flows in Lac de Gras and the Coppermine River.

Water quality beyond this 1 km^2 area is expected to meet all drinking water quality guidelines and Lac de Gras is expected to continue to provide high quality drinking water. Diavik expects that changes to water quality in Lac de Gras associated with the proposed project would not result in any health risks to people drinking water from the lake. However, Northerners value all components of the environment, and activities that may affect the environment are viewed cautiously. Consequently, people may have an aversion to drinking the water near the mine site.

The Ekati Diamond Mine, located approximately 30 km north-west of East Island, has the potential to influence stream flows and water quality and create hydrological changes in the head waters entering Lac de Gras. However, predicted loads of all water quality parameters from the Ekati Diamond Mine operation are such that very little change in water quality of Lac de Gras is expected. Therefore, the cumulative water quality effects with respect to drinking water quality are not expected to be different (see Section 8.5 - Water and Fish).

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Fisheries

Diavik predicted that there would be a net loss of habitat in the small lakes on East Island during construction and operations. This loss of small lake habitat could be completely mitigated during post-closure. Diavik has stated that fish flesh in Lac de Gras would continue to be safe for consumption. At post-closure, water quality in two small lakes on East Island could result in elevated metals concentrations in fish flesh but Diavik proposes to verify water quality during operations. If the water quality provides the potential for high metal concentrations in fish flesh, fish would not be re-stocked and fisheries enhancement efforts would be focused on alternative waterbodies. Because northerners value all components of the environment they view with caution any activities that may affect the environment. People may therefore have an aversion to harvesting fish near the mine site.

b) Heritage Resources

Diavik acknowledged that the Dene, Métis and Inuit place inherent value on heritage resources that form part of their spiritual and cultural context. Heritage resources also convey information about the past and provide a deeper and richer understanding of existing and past cultures. This information enriches and strengthens the cultural and spiritual well being of First Nations and increases our collective knowledge of the site and the region. A potential change to the interpretative potential of the archaeology of the East Island may affect community cultural and spiritual well-being through increased knowledge of the site and region, and through effects on the cultural context of communities and affected First Nations.

Diavik predicted that increased human presence and activity may increase the chances of purposeful or accidental altering of heritage sites left in-situ and undisturbed, while mine infrastructure and the use of borrow material from East Island would likely change the archaeological potential of the East Island. Tourism in the area is primarily "wilderness" oriented, although increased information and awareness of the archaeological potential of the Lac de Gras area may contribute to more archaeological research and diversification of the tourist market.

Diavik predicted the effect of increased knowledge of the site and region would likely be high and positive. Effects to the cultural context of communities and First Nations are mixed. After mitigation and enhancement there should be more awareness, knowledge and appreciation of Dene, Inuit and Métis culture as well as more information on how the area and the region were used historically. There would also be a permanent change that would contribute to the cumulative loss of archaeological and cultural sites. The disturbance of heritage resources may also result in a low negative effect on a sense of cultural and spiritual loss.

The magnitude of effect at the local level, for the 57 heritage sites (primarily quartz outcrops with evidence of past use) within the mine footprint, would be high. However, the information collected through the heritage inventory and mitigation program will enrich people's understanding of how previous people

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used the land. Although at the local level, effects would occur at a high number of pre-contact quarries, when viewed from the context of regional level of data; the magnitude of effect would not be high. Because heritage resource sites are non-renewable, the duration of effect would be long-term (i.e., permanent). Given the nature of heritage resources, the confidence placed in the likelihood of the predicted effects occurring is high.

The assessment of the cumulative effects of the proposed project on heritage resources considered the individual archaeological sites and site types, as well as the effects of the activities of both the proposed project and the Ekati Diamond Mine. The archaeological inventories resulting from the studies associated with the proposed project and the Ekati Diamond Mine constitute the entire database for the Lac de Gras region. Some comparisons were made with the results of the studies in the Contwoyto Lake area.

Cumulatively, 25.4% of the recorded archaeological sites in the Lac de Gras area would be affected by the proposed project and the Ekati Diamond Mine. The proposed project would contribute 20.1% to the cumulative effect on archaeological sites, while the Ekati Diamond Mine has resulted in a loss of 5.3% of the archaeological sites. These results are not directly comparable because of different inventory methods.

c) Socio-economic Conditions

Wildlife Harvesting
Diavik predicted there would be displacement from East Island of larger animals such as bear and caribou and smaller animals such as ptarmigan and Arctic hare. There would also be a reduction in the use of habitat on East Island and the zone of disturbance around the mine. There would likely be a loss of smaller animals on East Island (e.g. Arctic hare, ptarmigan). Larger, more mobile wildlife populations (e.g., caribou) would be essentially unaffected at the regional level. Resident, subsistence or commercial hunting of wildlife on East Island is negligible. Diavik stated that some hunting does occur along the Echo Bay winter road, but that public road use north of Gordon Lake is infrequent. Use of the area around the mine for wildlife harvesting is negligible, and as such it will have a negligible effect on the socio-economic environment. As the effects of the project, including cumulative effects, are predicted to be low, effects on hunting are also predicted to be low.

Recreational Use and Outfitting
Diavik stated there is currently one guiding and outfitting camp located within the wildlife regional study area. However, Diavik reported that hunting activities from three other guiding and outfitting camps occur within the wildlife regional study area. Caribou is the primary species of interest for all camps with fishing being of interest at the Destaffany Lake camp. Diavik concluded that since the overall biophysical effects of the project, including cumulative effects, are predicted to be low, the impact to hunting and outfitting camps are also predicted to be low. However, activities would not likely occur in close proximity to East Island.

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Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Diavik stated that three groups of Aboriginal peoples have used the Lac de Gras area: the Inuit, the Métis, and the Dene. In recent times, the intensity of hunting and trapping in the Lac de Gras area has been relatively light, although that does not diminish the importance of the land to these groups, nor the level of concern from Aboriginal people for the land and its wildlife. In addition to traditional land use, human activity in the Lac de Gras area today includes the Ekati Diamond Mine and the winter road that supplies them, outfitting and guiding camps, and a number of exploration and expediting camps. The closest community to the proposed project is Wekweti (population of approximately 135) which is 187 km west-southwest.

Diavik reported that there is very little current public use of East Island or the general vicinity of Lac de Gras. In the short and mid-term (i.e., during construction and operation) the proposed project would result in some reduction of opportunities in the Lac de Gras area, primarily related to the opportunity to occupy and travel across East Island. Use of East Island and the immediate vicinity post-closure could return to past levels.

Plant Harvesting
The proposed project would increase the relief of selected areas of East Island, and there would be loss of vegetation cover and changes to biodiversity. Once disturbed, vegetation would take generations to recover. Therefore, the project's use and occupation of East Island would be evident for many years after closure. East Island is not used for plant harvesting and there is no evidence of recent human use of East Island. Diavik predicted that the cumulative effects on vegetation cover in the vegetation regional study area would be low. Therefore, Diavik concluded that the effect of the proposed project, including cumulative effects on the socio-economic environment through changes in vegetation and terrain, would be negligible but would last a long time.

Fisheries
Diavik predicted that fish flesh would not have any off-flavour as a result of the proposed project.

ii) Mitigation Measures

a) Human Health

Diavik reported in its environmental assessment submission that mitigation for human health issues was identified during planning and incorporated during the design stage of the project. No additional mitigation measures were identified for human health in the proponent's environmental assessment overview and environmental effects report.

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b) Heritage Resources

Diavik reported in its environmental assessment submission that mitigation measures for heritage resources and other resource components were identified during planning and implemented during the design stage of the project. Diavik has committed to ensure the archaeological integrity of new and existing sites is maintained. Diavik would strictly enforce a "no disturbance" policy for all protected sites. Conditional on Aboriginal governments and organizations, and regulatory approval, Diavik has committed to an on-site display that depicts East Island's significance and use through generations, and, with the permission of the respective Aboriginal governments and organizations, contribute archaeological finds to the Prince of Wales Northern Heritage Centre.

c) Socio-economic Conditions

Diavik reported in its environmental assessment submission that mitigation for socio-economics conditions was identified during planning and implemented during the design stage of the project. No additional mitigation measures were identified for socio-economics conditions in the proponent's environmental assessment overview and environmental effects report.

iii) Significance

Diavik predicted that the socio-economic effect of environmental changes associated with the proposed project would be negligible with the exception of heritage resource effects.

a) Human Health

See Sections 8.5.1 - Surface Water and 8.5.3 - Fish and Fish Habitat for Diavik's predicted environmental effects related to drinking water quality and fish.

b) Heritage Resources

Diavik predicted the magnitude of the effect of the project on heritage resources is high within the footprint of the mine. Because heritage resource sites are non-renewable, the duration of effect would be long-term (i.e., permanent).

c) Socio-economic Conditions

Based on available information and data, Diavik stated that both East Island and the wildlife regional study area are not actively used for commercial and traditional renewable resource harvesting and that will likely continue. Physically, East Island would be altered with inland lakes filled and the relief increased. Environmental links would not result in any likely adverse effects to Treaty 8, Treaty 11, Inuit or Métis communities as a result of the proposed project. Nevertheless, the physical presence of the mine may be seen as a physical intrusion on the environment. No adverse effects of predicted environmental change on socio-economics were determined by the proponent.

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iv) Comments/Concerns

Responsible/Federal Authorities and the Government of the Northwest Territories

a) Human Health:

Air Quality
Environment Canada recommended that, as a worker safety precaution, Diavik should undertake routine monitoring of carbon dioxide (CO_2), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) in the open-pits during the operational phase of the project in order to evaluate the effects of temperature inversions on air quality in the bottom of the open-pits.

Health Canada expressed concern that X-rays may be emitted during the use of the machine for ore processing and sorting out of diamonds from the crushed ore. Should the project proceed, the proponent would be required to comply with the requirements of Schedule II, Part XV of the Radiation Emitting Devices Act. If the regulations are complied with, there would be no potential radiation hazard to the workers.

Health Canada and Natural Resources Canada (NRCan) recommended monitoring of radon levels at all times, to ensure that levels stay below the guideline limit of 800 Bq/m^3. For other radionudides, it is recommended that a set of rock samples be taken and analyzed and routinely monitored.

Drinking Water
The Government of the Northwest Territories (GNWT) concurred with Diavik's conclusion that dredging and dike construction will not affect drinking water quality in Lac de Gras and that releases of metals and nutrients during dike construction will not impair surface water quality in the long term. Under the Public Health Act, any drinking water for camp use must be treated.

The GNWT supported Diavik's conclusion that there will be no adverse impacts on the drinking water of Kugluktuk. The GNWT is satisfied that the follow-up proposed by Diavik will ensure that changes would not occur downstream.

Fisheries:
The GNWT reviewed the concern the Yellowknives Dene First Nation (YDFN) raised with respect to mercury contamination and fish, and agree that the mercury consumption guideline of 200 µg/kg mercury guideline be applied to fish used for sport and subsistence fishing.

b) Heritage Resources

The GNWT noted that Diavik identified 195 archaeological sites within the regional study area. Of these, 107 were located in the local study area and 57 of these within the project footprint. The number of sites within the project footprint that will be lost is 36 and losses to the other 21 were mitigated by archaeological studies. The GNWT agree with Diavik's assessment that the loss of 57 archaeological sites has been adequately mitigated and based on the scientific importance of the sites, represents an acceptable level of project and cumulative loss.

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The GNWT recommended that Diavik: i) continue to work with Aboriginal governments/organizations to determine cultural importance of archaeological sites within the local study area; ii) examine ways to provide special protection to the possible burial site identified by the YDFN, and iii) ensure that environmental management plans reflect legal requirements to a) protect archaeological sites by establishing and monitoring a 30 m buffer around such sites; b) impose strong penalties on employees and contractors caught disturbing archaeological sites; and c) restrict employee access to sites and sensitive areas.

The GNWT stated that an archaeological assessment on the mainland quarry (esker) located near Echo Bay's Lac de Gras camp has not been completed. The GNWT strongly recommended that an archaeological impact assessment of the quarry (including mitigation of any recorded sites) be undertaken before permits are issued to borrow material (see Section 8.3 – Vegetation and Terrain).

c) Socio-economic Conditions

Wildlife Harvesting
The GNWT agreed with Diavik that the distribution of the Bathurst caribou, at the herd level, will not be affected. The GNWT noted that Diavik's analysis partially acknowledged uncertainties in its assessment that the Bathurst herd and is not expected to be affected by project-specific or cumulative effects on migratory movements. The GNWT recommended that monitoring caribou migration movements as part of the follow-up program should ensure there are no negative socio-economic impacts on wildlife harvesting as a result of the Diavik project.

Recreational Use and Outfitting
The Department of Indian Affairs and Northern Development (DIAND) noted that Qaivvik Ltd., an outfitting company, currently has three land leases for outfitting camps in good standing that are located within the wildlife regional study area. In addition, Qaivvik Ltd. has an outfitting licence in good standing.

The GNWT stated that Diavik did not consider the full range of effects on outfitting and did not provide any details for the mitigation of lost outfitting opportunities. The GNWT indicated that Diavik predicted the zone of influence where outfitting activities would be displaced around the mine site itself. The GNWT believes that the zone of influence should be based on approximate distance of visibility of the mine and also a zone where, for safety purposes, hunting should not take place. This would be the area of direct impact to outfitting camps. The zone of indirect impact would be larger than this and would be as a result of annoyance activities such as increased air and road traffic. However, the GNWT noted that this type of activity is associated with a number of undertakings such as exploration, research and tourism. It would be difficult in the GNWT's opinion to attribute disturbance of this kind to any one particular project. However, the GNWT concluded that because Diavik did not consider fully the potential impacts to outfitting, Diavik should follow-up on the potential effects of mine activities on outfitting within the area.

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Aboriginal Governments/Organizations/Communities:

a) Human Health

Drinking Water Quality
The Kitikmeot Inuit Association (KIA) and the community members of Kugluktuk expressed concern at many public meetings over the potential effects of the project on drinking water quality. They are also concerned that there will be no way of knowing what effluent is being deposited into Lac de Gras. The KIA would like to see the wastewater being placed on land or into another lake prior to it entering into Lac de Gras.

Fisheries
The YDFN raised a concern with respect to mercury contamination and fish. Specifically, they are concerned with the use of the 500 µg//kg mercury consumption guideline applied to commercially marketed fish rather than the 200 µg/kg mercury guideline applied to fish used for sport and subsistence fishing. Natural background level of mercury in lake trout are reportedly at 181.5 µg/kg. Therefore, the concern is with the small incremental increase required to reach the consumption guideline. Even though the fish of Lac de Gras are currently not utilized as a sport or subsistence fishery, it has the potential to be used in the future. The YDFN want assurance that the fish are safe to eat if they do choose to utilize them.

b) Heritage Resources

The YDFN noted that Diavik will be extending the footprint of the mine beyond East Island to include the esker on the mainland east of the Island. The YDFN would like to see an archaeological impact assessment completed (see Section 8.3 – Vegetation and Terrain).

The Lutsel K'e Dene First Nation (LKDFN) is concerned about the potential disturbance of its heritage resources. Diavik has not involved LKDFN in the documentation of archaeological sites and recommended that Diavik work with LKDFN to assess the potential that its heritage resources would be affected by the project.

The North Slave Métis Alliance (NSMA) indicated that its members have traditionally used and occupied the area of Lac de Gras and were not invited to participate in the collection of artifacts or interpretation of archaeological sites located within the mine footprint and feel that an unknown number of sites and artifacts may be of Métis origin. Therefore, the opportunity to contribute to knowledge about Métis history, culture and land use activity in the North Slave region was missed. The NSMA recommended that a proper assessment include the NSMA as part of the environmental assessment process.

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c) Socio-economic Conditions

Current Use of Land and Resources for Traditional Purposes by Aboriginal People
The KIA indicated that there is not a discussion on the predicted potential effects that the project may have on Inuit traditional activities in the Lac de Gras area. The Inuit possess wildlife harvesting rights under the Nunavut Final Agreement. A resident of Kugluktuk also asked whether berries had been studied by Diavik.

The LKDFN is concerned about the potential loss of plant biodiversity including traditional medicines and recommended Diavik work with the LKDFN to document traditional and scientific knowledge about species likely to be affected by the proposed project.

The NSMA believes that the intensity of hunting, trapping, and fishing in the Lac de Gras area is unknown, but will probably be heavier in the future once land claims are settled. The NSMA indicated that Diavik did not conduct a land and resource use survey with the North Slave Métis as prescribed in the Environmental Assessment Guidelines. The level of North Slave Métis resource use, past, present and future, has not been assessed, considered or understood by Diavik. The NSMA also indicated there is a high level of concern among all Aboriginal people, especially the North Slave Métis, about the impacts of wildlife in this area, and how these impacts will undermine or erode traditional Aboriginal relationships with and dependence on lands and resources in this area. The NSMA will be completing its own report by June 1999 and will independently submit it to the Minister of the Environment as a "companion piece to the comprehensive study report".

The LKDFN feels that future opportunities for resource harvesting have not been adequately addressed in Diavik's environmental assessment. The LKDFN also stated that Diavik has assumed that land use resource harvesting by the LKDFN and other Aboriginal people will likely continue at the same level or decrease over time. The LKDFN people have expressed frustration over their inability to prevent damage to the land from past activities such as the Talston Hydro-electric development. It is LKDFN's view that the frustration or anxiety to prevent damage manifests itself in social ills such as alcoholism, abuse or outward shows of violence within the community. The LKDFN noted that this frustration has also been expressed by Chief Jonas Sangris, YDFN, that the people of Akaitcho territory may be forced to take "action" if unplanned resource development continues.

Fisheries
The YDFN are also concerned with an impact of the mine on the palatability and texture of fish. They recommended that a taste panel be convened prior to construction to establish baseline information on fish palatability and texture for comparison with similar panels during the mine life.

Non-Governmental Organizations
The Canadian Parks and Wilderness Society – NWT (CPAWS-NWT) feels that the loss of wilderness values is a social and cultural effect of the project that has not been adequately considered yet, and requested that the RAs consider this issue when weighing out the total impact of the proposed project.

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Qaivvik Limited holds three land leases and two outfitting camps on Lac de Gras – one within a few miles of the Diavik site. Mr. Freeland, the former owner of Qaivvik Limited, stated the company had not been able to operate in the area due to increased exploration activity. He believes Qaivvik Limited, as a company, is most affected by the proposed project. Mr. Freeland has also raised a concern regarding water quality and quantity and the outfitting business' dependence on clean water for human consumption while operating.

Technical Session Recommendations
Diavik should continue to work with Aboriginal governments and organizations (in particular, the KIA) to build trust regarding the safety of drinking water through non-numeric means.

Mechanisms for the co-operative development and on-going review and, where necessary, the modification of social, economic and cultural monitoring programs will be captured in a socio-economic agreement or agreements. The agreement(s) should establish the appropriate responsibilities of federal, territorial and Aboriginal governments, and of Diavik. The precise implementation vehicle should be determined through an inclusive consultation process.

X-ray exposure is governed by regulations to protect workers and Diavik developed an x-ray protocol during its bulk testing phase. Monitoring would be undertaken to ensure radon levels stay below guideline values and to characterize background radionuclide levels in mine rock that are covered under regulations.

v) Proponent Response

Diavik will work with Aboriginal governments and organizations to determine the most appropriate way of protecting the stone/burial cairn located on East Island. Diavik provided a response to Health Canada's concerns regarding X-rays emitted during the use of the machine for ore processing and sorting out of diamonds from the crushed ore and radon levels at all times. Diavik also responded to NRCan's request for clarification on the Baseline Radionuclide Study at A154 decline, Lac de Gras.

In accordance with applicable laws and regulations, Diavik will ensure that all appropriate measures will be taken to protect workers from negative changes in air quality.

Diavik has not identified mercury as an element of concern nor was this discussed with Diavik during the technical public sessions.

Diavik has committed to working with the KIA to demonstrate the safety of drinking water.

Diavik noted that Qaivvik has not been in operation since 1996. Diavik has met with the outfitters and argued that its exploration activities could not have influenced outfitting activities as the former occurred during inactive outfitting periods. Diavik is committed to meet with outfitters, hunters, trappers and other land users yearly to discuss any concerns or suggestions respecting the mine and its operation.

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vi) RA Conclusions

a) Human Health

The RAs concur with the GNWT's conclusion that there would no adverse impacts on the drinking water of Kugluktuk. The RAs encourage Diavik to fulfill its commitment to work with the KIA to demonstrate the safety of drinking water.

The YDFN challenged Diavik's use of consumption guidelines for mercury of 500µg/kg for commercially marketed fish as the basis of its contaminants assessment. Diavik's predictions showed that mercury concentrations will not increase above the existing background concentration of 181.5 µg/kg and so, will remain below the guideline of 200 µg/kg for sport and subsistence fisheries (i.e. mean operational concentration is the same as the existing background). Diavik's prediction in this regard among other heavy metals shall be verified through a follow-up program. The objectives of the follow-up program will require Diavik to monitor heavy metals, including mercury concentrations, in fish tissue to verify its predictions in relation to Health Canada's consumption guidelines.

The RAs conclude that in order to achieve worker safety, Diavik shall undertake routine monitoring of ambient air quality in the open-pits and monitor radon levels. The monitoring program will also include sampling of a representative set of rocks for other radionuclides.

The RAs require Diavik, as set out in its Environmental Management System to: i) a) monitor radon levels at all times, to ensure that levels stay below the guideline limit of 800 Bq/m^3; b) predict radon levels for underground mining, and c) prepare a radon monitoring plan that ensures worker safety and include routine analysis and monitoring of rock for other radionuclides. ii) undertake routine monitoring of CO_2, SO_2 and NO_2 in the open-pits during the operational phase of the project in order to evaluate the effects of temperature inversions on air quality on the bottom of the open-pits, and iii) monitor heavy metals, including mercury concentrations, in fish tissue to verify Diavik's predictions in relation to Health Canada's consumption guidelines.

b) Heritage Resources

The RAs agree with the GNWT conclusions that the loss of the 57 archaeological sites have been adequately mitigated in accordance with the Territorial Lands Act and the NWT Archaeological Sites Regulations. The GNWT has determined that an archaeological impact assessment must be completed for the mainland quarry (esker) located near Echo Bay's Lac de Gras camp prior to permit issuance. It is the RAs conclusion that the archaeological impact assessment to be conducted in consultation with the Aboriginal governments and organizations and existing legislation will adequately mitigate any adverse environmental effects.

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The RAs concur with the GNWT that Diavik: i) continue to work with Aboriginal governments/organizations to determine cultural importance of archaeological sites within the local study area; ii) examine ways to provide special protection to the possible burial site identified by the YDFN; iii) ensure that environmental management plans reflect legal requirements to a) protect archaeological sites by establishing and monitoring a 30 m buffer around such sites; b) impose strong penalties on employees and contractors who deliberately disturb archaeological sites; and c) restrict employee access to sites and sensitive areas, and iv) conduct an archaeological impact assessment at the Echo Bay quarry in consultation with the Aboriginal governments/ organizations prior to permit issuance.

c) Socio-economic Conditions

Recreational Use and Outfitting

The RAs concur with the conclusion of the GNWT and Diavik that the opportunity for outfitting activities and recreational use would be displaced around the mine site itself. However, an Outfitter Licence does not guarantee exclusive use in a specific licence area. Diavik has stated that the existing outfitting camps within the wildlife regional study area are currently not in operation but the RAs note that Qaivvik Ltd. currently holds land leases and a valid Outfitter Licence. The RAs agree with Diavik's conclusions that there are no significant adverse environmental effects associated with drinking water quality, wildlife and fish. The RAs conclude that the proposed project may interfere with Qaivvik Ltd's ability to operate its business at the pre-development level. The RAs conclude that the potential impact is mitigable and recommend that Diavik and Qaivvik Ltd. negotiate a mutually acceptable mitigation strategy.

The RAs further recognize that this mining project and future mining projects in the area could have a cumulative impact on future outfitting opportunities in the Lac de Gras area over the long term. The RAs conclude that there will be no significant adverse effects on recreational use and outfitting from the proposed project and the RAs believe that these impacts are mitigable. The RAs therefore require that Diavik carry out its commitment monitor the effects of its activities on outfitting operations within the wildlife regional study area through consultation with local operators and other affected parties should the project be allowed to proceed.

The RAs concur that the proposed project will not have a significant adverse effect on wilderness values at a regional scale. The footprint of the mine and its zone of influence is small, particularly in relation to the remaining wilderness of the barren lands.

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Current Use of Land and Resources for Traditional Purposes by Aboriginal People
The RAs have determined that there are no significant adverse environmental effects associated with vegetation, wildlife and fish. Diavik has assessed land use by Aboriginal peoples using existing sources of research, studies and government records such as fur harvest data. While no land use surveys were directly conducted by Diavik, the RAs in consultation with the GNWT, have concluded that existing conditions as described in Diavik's environmental assessment submission have provided a reasonable description of current activities. However, the RAs believe it is beneficial to require Diavik to monitor the effects of its activities on Aboriginal people using the Lac de Gras area.

Given these determinations, the RAs conclude that the proposed project will not unduly interfere with hunting and fishing and other Aboriginal land uses assured under Treaties and Land Claims. However, Aboriginal people will no longer be able to hunt on East Island. Areas outside of the mine footprint would still be available for traditional land uses.

The RAs conclude that the LKDFN's concerns regarding potential related social effects have been adequately addressed in the review of the environmental assessment. Aboriginal people have an important and integral role in monitoring to ensure no significant adverse effects occur as a result of the proposed Diavik project.

The NSMA has stated that the Diavik did not consult directly with its members regarding its existing land use in the Lac de Gras area. The RAs conclude that while this specific information is not currently available, the existing land uses have been adequately presented in Diavik's environmental assessment submission and would not alter the RAs conclusion that this proposed project does not significantly affect current land use in the area.

Fisheries
The RAs conclude that there will be no significant adverse environmental effects on fisheries in Lac de Gras. The Diavik will be required to modify its Aquatic Effects Monitoring Program in accordance with the environmental agreement and/or the Fisheries Act (FA) authorization. However, given concerns raised by the Aboriginal people, a follow-up program that will be specified in the environmental agreement and/or the FA authorization will require Diavik to: i) collect baseline information regarding the palatability and texture of fish in Lac de Gras, and ii) undertake periodic monitoring of fish flesh for palatability and texture.

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8.8.2 Effects Not Resulting from Environmental Changes

i) Socio-economic Effects

Diavik's socio-economics environmental effects report documented potential environmental changes the proponent expects will occur from the proposed project. Effects predicted in the report are residual effects occurring after mitigation. Information in this report, together with an understanding of how resource development relates to elements of the socio-economic environment, provides for an assessment of how environmental changes could affect socio-economic conditions. The following summary discusses how the proponent expects the project may affect components of the socio-economic environment and are addressed under the following sub-headings:

a) Wage Economy
b) Mine Purchases
c) Mine Employment
d) Cultural Well-Being, Traditional Economy, Land Use and Resources
e) Social Stability and Community Wellness
f) Net Effects on Government
g) Sustainable Development

Currently, within the Northwest Territories (NWT) context, numerous changes are occurring that will contribute to the overall socio-economic conditions in the NWT. As examples, the settlement of land claims, devolution, the creation of the Nunavut territory and the related transfer of government services and associated jobs to Nunavut, Aboriginal self-government and the potential closure of existing mines all have the potential to contribute to socio-economic effects. Diavik considered these effects, however there was not enough information available to include them into the analysis. The changes were also outside the scope of this project and were not addressed by Diavik.

a) Wage Economy

Most of the economic impacts resulting from the construction phase would accrue to the southern provinces. However, anticipated increases in economic activity should stimulate local economies and support their development. There is expected to be expansion of existing businesses, and creation of new businesses. Diavik stated that 41% (558 person years) of direct employment would go to northerners.

The economic spin-off from construction activity should provide 1,300 person-years of indirect employment and another 450 person-years of induced employment. In total, it is estimated that construction of the proposed project would provide opportunities for over 2,300 person-years of employment for NWT residents. The construction phase is also projected to increase NWT labour income by $154.5M.

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Economic spin-offs from mine operating activities should provide about 100 person-years of indirect employment opportunities and more than 50 induced jobs in the NWT. In total, it is estimated that the operating mine would create opportunities for more than 400 person-years of employment for northern residents (i.e., direct, indirect and induced). By the year 2016, as more northerners are trained to work at the mine, Diavik-related NWT employment would rise to more than 550 person-years. Diavik suggested there will be an overall decrease in NWT unemployment.

Diavik cited research indicating there will be opportunities for women to enter the workplace as local economies are stimulated. In small communities, the lack of employment opportunities for women, not other barriers, is often a primary reason why women are not considered part of the labour force.

Diavik predicted the cost of living may increase if there is sustained and sufficient increase in net community income that improves the economic security of the community. At the same time, stimulation of local economies may positively affect (reduce) cost of living as the opportunity for new businesses and services are identified and competition increases, which in turn has a general tendency to reduce costs. The project will not directly cause an increase in the cost of living, although employees may experience higher costs of living during closure. There was no predicted project related impact on the general level of prices in the communities.

Diavik stated that cumulatively, positive and long-lasting employment and income effects are expected. The proponent predicted both Ekati and Diavik can hire its workforces from the NWT. It is forecast that although some currently employed people will choose to work for Diavik for personal reasons such as career advancement, the jobs they leave will likely be filled by people in the same community who are currently unemployed. The current available labour force will be able to meet the demand for employees in the small business sector.

b) Mine Purchases

The project's pre-feasibility estimated capital cost, including allowances, is approximately $875M (in constant 1997 dollars) with about $705M spent on materials and equipment. During operations, about $90M on average will be spent purchasing goods and services each year. It is expected that $28M (32%) would be spent annually on NWT businesses. Diavik estimated that 38% of all materials would be purchased in the NWT. The proponent predicted the NWT would be able to take advantage of opportunities associated with the project due to the long timeframe of mine operations.

In a project revision dated January 22, 1999, the estimated construction work force was projected to peak at eight hundred employees (original estimate was 600 employees) for a short period when the A154 pit is being constructed. Purchase requirements were not predicted to change.

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c) Mine Employment

The project's pre-feasibility estimated capital cost, including allowances, is approximately $875M (in constant 1997 dollars) with about $170M spent on direct labour. The project will create 1,353 person years of direct employment during the construction phase (2000 and 2001) and it is estimated that 558 person years would go to northerners. Since the construction phase is short-run and many of the skills required are not readily available in the NWT, Diavik predicted that it is not likely it would be possible to hire a majority of the workforce from the north.

Diavik submitted a revised construction plan on January 22, 1999, which increased the construction work force from 600 to 800. The proportions of Aboriginal and northern employment were not predicted to change.

Average annual operating expenditures of the proposed mine include an average of about $30M for labour. The proponent stated that at this time, it cannot assess how closely the skills of potential northern workers will match job requirements. It is not anticipated that much of the direct employment at the mine will come from outside the local study area. Professional, technical and skilled tradespersons would likely be difficult to initially recruit in the NWT. While some may leave other NWT-based companies to take jobs at Diavik, the majority of candidates for these positions would be located and recruited from centres in the south. Diavik indicated it will not encourage southern employees to relocate, and estimates 138 southerners will be flown directly from their homes in the south. This position was taken in order that the medium and long term training and education initiatives of Diavik and the communities could lead to the replacement of these southern employees with northern residents.

The operating phase of the proposed project would begin around 2002. During operations, there will be 411 jobs and 66% of these would go to northerners at start-up. It is estimated that northern employment will reach 84%. Of a workforce of 411, 163 positions, or 40%, are classified as 'trainable.' Aboriginal employment is predicted to be 40% at start-up. Over the life of the proposed project, Diavik has committed to strive to achieve 100% northern and Aboriginal employment.

Proposed project initiatives would advance employment opportunities for women and increase participation of women in the workforce. With education and training initiatives planned or underway, the local population is expected to overcome barriers to future employment.

The number of unemployed in the regional labour pool in 1996 was estimated at 4,896 and the number, using the status quo case, was predicted to rise to 5,541 by year 2002. During the same period, the labour force is projected to rise from 24,272 to 27,471. The net result is that the unemployment rate remains unchanged at 20%. In 2002, Ekati's project would employ another 689 people and the proposed Diavik Diamonds Project would employ another 485 people, for a total increase in employment of 1,174 people. Diavik predicted the net effect of the cumulative impact is a decline in the number of unemployed by 1,174. This would result in a drop in the western NWT unemployment rate from 20 to 16%.

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Diavik predicted that the projected labour market has more than sufficient capacity to absorb the anticipated northern employment labour demand resulting from the cumulative impact of employment for both diamond mines. Consequently, there should be no new migration into the territory and hence no incremental population growth or pressure on infrastructure capacity. Diavik predicted the cumulative employment and income effects associated with the proposed project would be positive, long lasting, and complementary to northern and Aboriginal aspirations and needs and should address one of the most pressing issues in the study area communities – lack of employment and business opportunities.

d) Cultural Well-Being, Traditional Economy, Land Use and Resources

Diavik reported that it had difficulty in assessing the cultural effects of the proposed project because of the projects relatively small size compared to the enormous level of change that is occurring throughout the NWT and Nunavut. Currently there are a number influences on Aboriginal culture and language in the North that are occurring regardless of whether the Diavik project proceeds Because of the design of the Diavik project, it contends that its influence on any individual community will be minimal. Employment and income may contribute to a strengthening of the mixed economies, enabling a more complete expression of both. It is also possible wage-based activities may erode Aboriginal culture in the region. In addition, employment at the mine site in an English-only environment may pose a risk to Aboriginal languages.

Several socio-cultural effects are predicted to be felt throughout both the local and regional spatial boundaries. Two medium term effects are expected. One is out-migration from smaller aboriginal communities, which may negatively affect community organization and culture. Another is in-migration to Yellowknife, Ndilo and Dettah, which may also affect cultural values. A shift in labour force activity from a mixed to an industrial economy is predicted to be a medium-term effect occurring with high frequency. A long-term, high frequency effect of industrial work may be the eroding of traditional harvesting practices and the expression of Aboriginal culture. Although this was considered, Diavik's final conclusion was that there would be no migration related to the project and there would be no negative impact on the traditional economy.

A long-term, medium frequency effect predicted to occur solely in the local study area, is the alienation of areas for traditional use from in-migration. Diavik predicted the in-migration of workers may change recreational activities and harvesting patterns and that this may result in competition for land and resources. This may undermine cultural values, including sense of place, tradition and spiritual connection to the land.

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The proponent recognized that wage employment has the potential to weaken or strengthen the traditional economy. Given the increasing cost of land-based activities, wage incomes could enhance or subsidize participation in "on-land" activities. If this were to occur, the proposed project could contribute to the strengthening of Aboriginal culture. However, the proponent also recognized that wage-based activities may erode Dene, Métis and Inuit culture, and that the continuity of Aboriginal culture and traditions is a significant concern of Dene, Métis and Inuit communities. Diavik concluded that the project would not have a significant negative impact on traditional "on-land" activities.

e) Social Stability and Community Wellness

The proposed Diavik Diamonds Project, while offering positive opportunities that could contribute to employee and family health and wellbeing, could also add to the complexity of human health issues in communities. The proponent predicted both positive and negative effects because of the project. Potential positive effects relate to education and training, which lead to positive community role models and increased community capacity. The proposed project has the potential to increase employment, countering one of the foremost social concerns of study communities. Regular wage income creates opportunities to strengthen the economic and social security of northern people and enables the fulfilment of expectations beyond the subsistence level. Wage employment may also encourage different consumer expectations and lifestyles that are not supportable in a non-wage economy. For some families, the challenge of managing disposable income combined with frequent absences of household wage earners may result in negative effects.

Predicted negative effects stem primarily from i) rotation cycles; ii) increased income, and iii) migration. These effects are strained relationships, alcohol and drug abuse, and a degeneration of community and individual wellbeing. Effects are predicted to occur over the medium term (one to five years).

Rotation Cycles
In the late 70s and 80s, all governments suggested that any remote mines developed in the future in Northern Canada should be developed using a fly-in/fly-out rotation work schedule versus the establishment of a permanent or semi-permanent townsite. In accordance with this direction, Diavik researched the various rotations used at other mine sites and determined that a two-week/two-week-out rotation was the rotation preferred by employees and companies.

Diavik recognized that long distance commuting may create employee stress, and alter family and community relationships. Associated family conflict is predicted to be an effect felt over the entire regional boundary for the medium-term, occurring with medium frequency. Negative effects of rotation work and associated time away from home are predicted to place additional demands on family and social services and on protection services. Family caregivers may experience anxiety and depression in maintaining a family lifestyle with intermittent spousal absence.

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Continual role transition and transfer of control from one parent to another during times of parting and reunion may strain and disrupt family behaviours and relationships. Family problems at home may go unresolved or may be put on hold during work rotations. Spousal absences may lead to difficulties in resolving conflicts over money and non-work time.

Diavik noted that typically, the long distance worker receives higher income and blocks of free time to spend with his/her family. Long distance commuting allows family members to continue to enjoy social, educational and recreational activities in their home communities and interaction/support from relatives and friends. The 2 weeks-in - 2 weeks-out rotational schedule is thought to give workers the opportunity to participate in harvesting activities, providing important country food to share with family members.

Long distance commuting effects associated with rotational work schedules will depend largely on the strength of the family and the experience and success families have had, or have, in coping with this type of lifestyle.

Increased Income
Diavik noted that for some families, the challenge of managing disposable income combined with frequent absences of household wage earners may result in insecurity within the family. Increased disposable income spent on alcohol and drugs may worsen human health conditions of individuals, families and the community. Employment of women in higher-paying non-traditional jobs outside the community may undermine roles and relationships within the home and community. At the same time, marginalization of women because they cannot access higher-paying jobs in the mining industry has also been raised as an issue.

Migration
Diavik stated that out-migration from smaller Aboriginal communities may affect the effectiveness and efficiency of community governance. This is predicted to occur over both local and regional spatial boundaries. Out-migration is expected to be a medium-term effect, occurring with medium frequency. In-migration to communities may affect interpersonal and family relations. These are local effects, felt over the medium term and occurring with medium frequency.

f) Net Effects on Government

Revenue
Diavik projected that the construction phase would increase labour income in the NWT by $154.5M, resulting in $16M in territorial and $42M in federal personal tax revenues. The operations phase would increase labour income in the local study area by $20 million per year. In 2002, it is estimated the project will directly generate $1.8M in territorial and $6.1M in federal personal tax revenues. In addition to personal taxes, the project would directly generate $70M in other tax revenues annually.

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Infrastructure and Services

Diavik predicted the proposed project would have positive effects on community and territorial infrastructure and services, both during and after mine operations. Diavik acknowledged activities could contribute both positively and negatively to short-term effects on family and social services and protection services, depending on individual and family circumstances.

As the study area labour market has a very high unemployment rate, limited in-migration to the NWT is predicted to result from the proposed project. However, possible growth is predicted to occur in larger communities, as out-migration from smaller aboriginal communities takes place. This is a local effect of medium-term duration and medium frequency.

At the start-up and closure of the proposed project, there could be a short-term increase in the demand for protection and social services. During the construction and early operation phases of the proposed project there could be additional demands placed on education services and infrastructure as people prepare themselves for possible employment at the Diavik mine site. Although the project will augment existing community recreation services and infrastructure in the local study area, the local area could also experience increases in recreational and health service requirements.

If industrial work erodes traditional harvesting practices, there would be a long-term effect of high frequency felt throughout the regional boundary. Alienation of areas for traditional use from in-migration is also a predicted long-term effect, although restricted to the local area with only medium frequency. These changes may affect renewable resource infrastructure such as community freezers, docks and cabins, and may affect organizations such as local Hunters and Trappers Associations or Land and Environment Committees.

Diavik stated the addition of its proposed services would complement and benefit community and territorial health initiatives. However, it also recognizes that rotational wage employment may lead to greater demands on already taxed front-line workers and community resources. Rotation work and associated time away from home would likely result in a period of personal and family adjustment lasting about two years. Potential effects could include additional demands on family and social services, and on protection services. A two-year increase in community and territorial social and protection services during the start of the operation phase and shortly after closure of the proposed project is also anticipated.

Highway "wear and tear", as well as conflict with road users such as tourists, is predicted to be minimal to negligible. Use of the rail system to transport goods and fuel will have a positive effect. Continued use of the rail line would increase its viability and would enhance the role of Hay River and Enterprise as northern gateway communities. Project activities are not expected to affect study area communication services or infrastructure.

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Although Diavik predicted the project would not affect municipal utilities, services and infrastructure the employment income and associated economic changes may enable residents to privately purchase or rent houses.

Diavik indicated that cumulatively, both projects would have short and long term effects on community and territorial infrastructure and services. In the short term, it may contribute to increased demands for family and social services and protection services, either positively or negatively, depending on individual and family circumstances. Initially the effects would likely be negative, but Diavik claimed that, based on the experience of similar projects, effects should stabilize to pre-project levels if not lower.

Both projects would augment existing health and recreation services and infrastructure available in the study area. As staffing and workloads are a significant concern for local heath care providers, the addition of health services would complement community and territorial health initiatives. Employment income and associated economic changes should enable residents of study area communities, particularly the smaller Dene, Métis and Inuit communities, to address their personal and family housing needs.

g) Sustainable Development

Diavik stated employment and income effects associated with the project would be positive, long-lasting and complementary to northern and Aboriginal aspirations. Diavik committed that through its own and co-operative initiatives, business, employment, education, and training opportunities would be enhanced. It predicts the positive effects and associated benefits would extend beyond the life of the project.

Employment and income effects on tourism services and infrastructure would likely occur during the construction and operations phases of the project. Tourism services and infrastructure may improve and expand as a result of the project, particularly in the smaller Dene, Métis and Inuit study area communities as local economies grow and diversify.

Mining can play a significant role in creating new and long-term business and employment opportunities that can lead to increased business capacity for small, medium and larger enterprises located in the north. The effect of closure on future generations is an important question. In a February 15, 1999 supplemental letter, Diavik predicted that as a result of proactive employment and business development the project will not dominate any community economy and therefore few, if any, significant negative effects will be felt at closure. However, negative effects are predicted in the socio-economics environmental effects report.

With economic diversification spurred by the project, prices and cost of living were predicted to decrease. At closure, loss of regular wage income and higher costs of living may stress employees. During the adjustment period, there may be a greater

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demand for protection services. This will be a local and regional medium-term effect, occurring with medium frequency. Loss of wage employment during closure is predicted to occur with high frequency over the medium-term. The socio-economics environmental effects report defines a medium-term effect as one whose effect is felt for 30 to 60 years.

Potential effects during construction may include temporary shortages of tourism sector employees and wage inflation. Diavik concluded that given the high rate of unemployment in many of the study area communities, there would be sufficient flexibility to accommodate any short-term labour adjustments. During the operational phase, community economic growth could enhance services available to tourists and improve the tourism potential of the area.

ii) Mitigation

a) Wage Economy

Diavik predicted prices will not change because wage employment will replace transfer payments with no net effect on demand, and because economies in some NWT centres are depressed. In its response to the Draft Conformity Report, Diavik committed to reduce labour competition through a benefits package on par with that provided by other employers in the NWT.

In its Commitments Document, Diavik committed to maintaining its corporate headquarters in the north during the life of the project and, once construction has been completed, to close its Calgary office and relocate the remaining employees to the north.

Diavik projected the long timeframe of project operations is a naturally-occurring mitigation that will allow northern business development to occur. Diavik's purchasing policy will be to buy as many goods and services in the north as practical.

Diavik will work closely with all groups and agencies mandated to achieve the greatest degree of northern business participation in the project that is technically and financially possible. Diavik believes it can enhance business development by creating the opportunities and providing technical support and assistance in accessing sources of commercial capital throughout the business assessment, planning and development phases. Diavik will make the best use of publicly available economic development programs in matching project-related business opportunities with new entrepreneur and existing business capabilities. Encouraging the use of these programs will be a priority of the proposed Diavik Diamonds Project.

Diavik will work closely with northern communities to cooperatively achieve success in creating long-term business and employment opportunities and in increasing business capacity. Diavik will actively initiate the business development process, enabling the provision of complete technical business development support services through existing public and private sector programs. Diavik will identify project

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components at all stages of development and operations that should be targets for a business development strategy. Diavik will design and communicate clear business development strategies for affected groups, communicating the scope and scale of business opportunities and project requirements in a timely and effective manner. Diavik will develop clear guidelines and schedules regarding what communities, people, and groups would be affected by the project, and what resources the company will commit to project-related business opportunity developments.

These measures will accompany development of a business development tracking system. Diavik proposed to involve all affected communities in designing that system.

Diavik has a mandate to recruit and employ as many local NWT residents as possible during the construction, operation and closure stages of its mine at Lac de Gras. The first priority in hiring will be accorded to Aboriginal people from the NWT. Emphasis will be placed on the directly affected communities of Wekweti, Gameti, Wha Ti, Rae-Edzo, Dettah, Ndilo, Lutsel K'e and the Métis of the North Slave, however, people from other Inuit, Dene and Métis communities will be recruited, trained and employed.

During the construction phase Diavik will strive to have 66% northern hires, of which at least 40% would be Aboriginal residents. Over the life of the mine, as more northerners receive on- and off-the-job training, Diavik proposes to gradually hire more northerners until the workforce approaches 100% northern hires by the time of closure. Diavik do not expect they will hire more than five percent of the available labour force in any single community.

Recruiting procedures common in the industry in other parts of Canada would be blended with those that have been successful at other northern remote mines. Diavik will use tools such as community-based advertising and personal interviews when selecting candidates for training and employment. References would be gathered through "face-to-face" discussions with community-based groups and with people who are respected and who are aware of the community and its people. In making its recruitment decisions, Diavik will consider familiarity with life in northern communities and climate, length of northern residency, cultural sensitivity, community contributions, familiarity with mining, and employment history.

A minimum of grade nine was established as a standard for the trainable positions. If an NWT resident has Grade 9 and has indicated in the 1994 Labour Force Survey that he or she is willing to relocate to take a job, then that person is employable at the project. Diavik intends to hire only those who have already indicated they want a job and want to be in the labour force.

Mine jobs require a basic level of literacy, but candidates can be trained either on the job or with existing NWT educational services. As English as a second language could be a barrier to employment and advancement, Diavik educational and training initiatives will encourage potential employees to secure the needed communication skills.

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Diavik's Human Resource policies encourage equal access to employment and training by both men and women. Although child and elder care are recognized as potential barriers to employment, it is too early to describe specific mitigation. Diavik also feels it is too early to provide the detailed data needed to design and implement the appropriate programs in conjunction with communities and with the territorial government. Diavik will provide whatever assistance possible through the implementation of human resource policies that recognize this issue. Impact and benefit agreements would help address barriers to employment, including elder care issues, as these can provide funding and opportunities for women. By working with communities, Diavik can try to tailor rotations and work schedules to reduce barriers. Diavik is willing to fund and co-fund community research projects directed at gathering information and addressing barriers to successful employment issues. Extended families and higher incomes should mitigate the demands working caregivers may place on other family members and community childcare services.

Training initiatives will focus replacing southern hires with Aboriginal northerners. Diavik will collaborate with Aboriginal people to encourage development and delivery of training regimes based on cultural value systems. Development and delivery of these training programs will be the responsibility of Aboriginal people. All training programs will introduce new employees to rotation employment and the importance of scheduled work. Diavik intends to continue "on-the-job" training throughout the life of the mine.

Diavik will recruit potential process plant operators from communities in the Territories six months before start-up. Diavik will initiate a pre-employment training program for the process plant about three months before commissioning of the new Lac de Gras plant. This three-month program will provide the new plant with the operators and skills required for optimal production. When trainees have successfully completed the pre-employment program they will be offered regular employment at the proposed Diavik Mine. They will work with the commissioning group for the three months prior to start-up.

Diavik will carry up to 18 apprenticeships during operations. These will include positions in all trades disciplines on site. The program will abide by all conditions as laid out in the NWT apprenticeship program guides. Prior to production in June 2002, Diavik will encourage apprenticeships in the impact communities and on other industry projects by providing funding to be applied towards wages. Diavik will sponsor apprentices in these communities during 1999, 2000 and 2001.

Diavik stated its long-term training and education strategy will address building capacity of NWT residents in mining professions. One element of this strategy will be a scholarship program. Diavik will support programs that encourage careers in technology, science, and engineering. Diavik proposed that the specific training programs be identified and, if need be, formulated over the next several months in

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co-operation with the GNWT and the Aboriginal communities. This will ensure that as Diavik gets closer to finalizing the job descriptions and linking skills to these jobs, it will also be able to quantify the gaps in the labour force and focus on programs to fill those gaps. Diavik proposed to use as many of the existing training programs and opportunities as possible to supply the required skills throughout the life of the mine, and will supplement these programs with on the job training as much as possible. Diavik will participate in regional career fairs.

d) Cultural Well-Being, Traditional Economy, Land Use and Resources

Employee Relations Personnel will be able to communicate in at least two languages spoken in the NWT. There will be interpreters at community meetings. The presence of other Aboriginal language speakers at the minesite and the opportunity for Aboriginal workers to reside in their home communities may reduce the risk to Aboriginal languages. In addition Diavik, co-operation with communities, will provide and maintain Dene, Métis and Inuit reading and video materials on-site.

Diavik Diamond Mines Inc. will develop and implement a mandatory and comprehensive employee orientation program. This orientation program will introduce new employees to the demands and opportunities of rotational employment. All training will address cultural sensitivity and cross-cultural awareness. Diavik Diamond Mines Inc. is committed to a "made in the North" training program, which will be driven by the respective stakeholders of the North.

Traditional Aboriginal food will be served at the mine site, and freezers will be available for storing traditional food. Employees will have one week of unaccountable leave. Diavik suggests the 14-day rotation, combined with annual leave and a liberal leave policy, would prevent interference with subsistence lifestyles. Zero in-migration will mitigate against alienation from land or competition for use of land areas.

e) Social Stability and Community Wellness

Diavik will provide communication links to home communities. Periodic spousal tours of the work site will be permitted.

Diavik will maintain an Employee and Family Assistance Program (EFAP). It will extend the EFAP to all future employees and to their immediate families. New employee orientation will include information on the EFAP program.

The Employee and Family Assistance Program contract provides for the development of partnerships with local support agencies in all affected communities. Provision of EFAP services by local and trusted people is an integral part of the Diavik strategy to recruit and retain Aboriginal employees. Employee and Family Assistance Program contractors will, among other things, be chosen for their expertise and experience in the field of addictions and addiction rehabilitation.

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Employee Relations Personnel will be employed in directly-affected communities. They will be familiar with the conditions in communities that may affect the employee at work and vice versa. They will act as liaison people between the company, the employee, and the community.

Space will be maintained at site for spiritual or other employee-driven requirements (such as AA meeting rooms). There will also be recreation facilities and a recreation co-ordinator. The work site will have a zero tolerance sexual harassment policy, and will be alcohol- and drug-free with a zero tolerance policy for the possession or use of any alcohol or illegal drugs at any Diavik property.

Diavik will encourage employees to maintain residency in their home communities in the Territories. Workers hired from local communities will receive subsidized transportation services to their jobs at the minesite. Diavik will, wherever logistically, safely, and economically possible, ensure that flights to and from the minesite originate in the community of residence for all northern employees, to minimize disruption to family life as much as possible for employees living in smaller communities.

Diavik will, in conjunction with existing and new airline companies, try to establish scheduled or charter routes linking western NWT communities with Lac de Gras. This will also be considered for Cambridge Bay and Kugluktuk. Diavik will establish pick-up points in the directly-affected communities as well as the centres of Yellowknife and Hay River. This group of pick-up points could be expanded if there were an incentive from the outlying communities or from government.

Diavik anticipates that a significant portion of the employees will be NWT residents and that the use of northern pick-up point communities, a fly-in camp, and accommodations complex should serve to discourage in-migration. The absence of predicted negative infrastructure effects is based on a projection of no net in-migration.

To minimize other infrastructure and services effects, Diavik will share information sharing with front-line community workers. To prevent accidents, Diavik will notify communities along Highways 1 and 3 of increased truck traffic.

g) Sustainable Development

Diavik is proposing to hire its workforce from a number of communities so that no community will have its economy dominated by the proposed Project. On closure, Diavik will mitigate negative effects by gradually reducing employment at the mine. In supplemental material submitted February 15th, Diavik made additional commitments to mitigate negative effects of closure on employees. Diavik stated its conditions of employment will meet or exceed legislated requirements. Based on acceptable industry practices of today, Diavik will address the following topics: outplacement counselling, family adjustment seminars in the impacted communities, pension and savings plans. Its severance package will meet the legislative requirements and practice of the day.

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Diavik confirmed in its March 31,1999 Commitments Document that it is committed to northern sustainable development and to providing maximum business opportunities to northern companies. Diavik will work to identify new northern business opportunities that may result from the purchase of goods and services for the mine, to lead to the establishment of new northern businesses. Diavik will encourage businesses to subscribe to the principle that, to be sustainable, they must be competitive and meet the service and quality standards of the mining industry. Long-term sustainability will be a primary consideration in encouraging and assisting northerners in fostering business relationships with the company.

Diavik will encourage the development of sustainable businesses that will not be uniquely dependent on the mine project. Prior to, during and after closure, Diavik Diamond Mines Inc. will work closely with mandated government agencies to develop a strategy to diversify the regional and local economies.

iii) Significance

Diavik predicted that the project will make a significant positive contribution to employment, income and government revenues in the North and Canada.

Diavik's overall conclusion or prediction was that the proposed Diavik project would have no significant negative effects on Aboriginal culture well-being, transitional economy, land uses, and social stability and community wellness. Diavik agrees that there may be a general impact on the territorial community as a result of this project and other government, community and industrial activites. Therefore, it agrees to participate in the development of a mechanism to monitor these changes.

Diavik predicted the impact of the proposed project on demographic change would of medium-term duration and of medium frequency at a local to regional extent for out-migration from smaller Aboriginal communities. The prediction of in-migration to Yellowknife, Ndilo and Dettah affecting interpersonal and family relations and cultural values would be of medium-term duration and of medium frequency at a local geographic extent.

Diavik predicted that the change in the shift in labour force activity away from mixed to the industrial economy and the loss of industrial wage employment during closure would be of medium-term duration and of high frequency at a local to regional extent.

Diavik predicted the effect on the change in health of its employees from rotational employment and the loss of regular wage income and higher costs of living at closure would be of medium-term duration and of medium frequency at a local to regional extent.

Diavik predicted the change in socio-cultural patterns would be of long-term duration and medium to high frequency at a local to regional extent. Diavik stated that employees may not be able to fully participate in community governance because of the rotational nature of the employment. Diavik predicted this effect would be of medium-term duration and of high frequency at a local to regional extent.

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Socio-cultural effects will vary depending on the nature and extent of direct effects induced by the proposed project. The likelihood and nature of socio-cultural changes induced by employment, income and work effects would be variable and highly dependent on individual and community circumstances and numerous other factors that are, and have affected the culture of Aboriginal people.

None of the residual negative socio-economic effects that are predicted are considered by the proponent to be significant.

iv) Comments/Concerns

Responsible Authorities
The Department of Indian Affairs and Northern Development's (DIAND) independent expert reported that the socio-economic assessment placed a high level of effort on description of the study environment, the methodology and prediction of some types of effects. Other areas, such as cumulative socio-economic effects, post closure "boom-bust", assessment of significance and detailed follow-up received less attention in the assessment. The need for detailed follow-up lead would best be achieved through a three-tiered approach to socio-economic impact management, as follows:

- preparation of a "Diavik Commitments Document" to outline implementation mechanisms for the principles and broad policies outlined by Diavik and the areas of concern identified by stakeholders;
- development of detailed "Action Plans" for achieving these commitments, and
- development of an acceptable mechanism to facilitate ongoing stakeholder involvement in monitoring, project reporting and impact management.

Additional recommendations included the need:

- to elaborate on the roles and responsibilities of various stakeholders, and to include government representation in a "Communities Group" which was proposed by Diavik;
- for additional details, commitments, targets and schedules for employment and training;
- for additional details and commitments related to sustainable economic development, with specific reference to Aboriginal business activities;
- to provide leadership and support in involving communities and governments in developing programs for traditional land use activities;
- to address post-closure effects of the project more completely by determining the significance of the "boom-bust" economy and details for mitigating its effects;
- for more details on cumulative effects or a rationale for the scope chosen, and
- for a more explicit summary of conclusions with respect to predicted effects, mitigation significance and follow-up.

Government of the Northwest Territories
The Government of the Northwest Territories (GNWT) acknowledged the efforts made by Diavik in consulting and working with communities and recognized the unique challenges posed in socio-economic impact assessment. The GNWT's review was guided by three necessary conditions for the proposed project:

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- it should provide positive, long-term economic and social benefits to the residents of the NWT;
- potential socio-economic effects of the project need to be monitored, particularly when we cannot fully predict the outcomes, and
- government, Aboriginal governments and organizations, communities and industry must work together to help minimize negative social effects and increase benefits to northerners.

The structure of Diavik's environmental assessment document impeded the GNWT's comprehensive review of the material and no logical sequence existed to link effect hypotheses, potential effects and proposed mitigation through to monitoring and follow-up. Although the proponent did a satisfactory job of analyzing potential effects, two main areas were identified where detail was lacking. One deficiency was the lack of a thorough cumulative effects analysis of i) other stresses acting in the socio-economic environment, and ii) the interaction of individual project effects. The second area identified the need for a more thorough treatment of mitigation and monitoring. The GNWT felt the inherent difficulty in predicting and assessing socio-economic effects required greater emphasis on the follow-up program.

The GNWT presented the major elements of its socio-economic review at the technical and plenary sessions held in Yellowknife in February and March 1999. In addition to discussing the difficulty of predicting effects and the importance of a follow-up monitoring and mitigation plan, the GNWT also emphasized the importance of diversifying the economy including opportunities in the secondary diamond industry. The GNWT stressed the importance of this industry, as it is a mitigation tool for the negative effects of out-migration from small communities, closure, as well as addressing the limiting effects of employment barriers and an underdeveloped manufacturing base. Diavik provided a commitment to respond to many of the outstanding issues.

For many components of the project, the proponent predicted positive or insignificant negative effects without describing the methodology leading to the prediction. The predicted effects appeared to be based on professional judgement, a limited choice of the literature or research that might not be validly extrapolated to the project. Although the GNWT recognizes the unique challenges in socio-economic assessment and do not dispute the validity of most conclusions, it recommended that Diavik acknowledge the lack of confidence in prediction of effects by developing detailed mitigation plans and a monitoring and reporting program to verify the effectiveness of those plans. The monitoring, reporting and mitigation of social, cultural and economic effects and the diversification of the economy must be formalized in a socio-economic agreement with Diavik. It is the GNWT's contention that this framework must be in place before the Minister of the Environment makes a determination on the project.

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Diavik has proposed measures for preserving cultural well-being, community wellness and social stability among its employees, but should work with communities and government to develop the necessary indicators and monitor the success of its efforts and to revise mitigation as required. The monitoring program proposed by Diavik should contribute to a better understanding of project effects by developing relevant indicators which are complimentary to or consistent with those used by government and communities. The monitoring program should encompass, but not be limited to, cultural well being, social stability, community wellness, human health, business opportunities, traditional economy, economic diversification, infrastructure, employment, education and training.

The GNWT identified inconsistencies in the proponent's definition of spatial boundaries for assessment of effects on cultural well-being and the effects of in-migration on potentially affected communities and recommended these be reconsidered when developing the monitoring program.

a) Wage Economy

The GNWT was concerned that the predicted project effects on cost of living were not clearly determined, and that Diavik did not propose any mitigation. The GNWT therefore recommended the inclusion of prices and cost of living in the follow-up program.

b) Mine Purchases

The GNWT identified shortcomings in Diavik's analysis of business opportunities, distribution of benefits and amount of northern purchases but agreed to continue working with Diavik to clarify these concerns. The tracking system for northern expenditures proposed by Diavik will not provide the GNWT with the information it needs to fulfil its responsibilities for northern development and it should be incorporated into the co-operative monitoring program to allow refinement as needed.

The long timeframe of mine operations was offered as the rationale for predicting that the NWT would be able to take advantage of opportunities associated with the project. However, NWT experience would indicate that project duration and business opportunities are not directly related. Diavik's environmental assessment report would also have been strengthened by recognition that, in the absence of a manufacturing industry, NWT benefits accrue largely from wholesale and transportation margins and are, therefore, limited.

c) Mine Employment

Diavik has shown leadership, demonstrated a willingness to train northerners and intends to develop an education and training strategy but has not yet made a commitment or provided the details necessary for the GNWT to determine the effects of the project on participation by northerners. The GNWT recommended that Diavik begin developing a training and education strategy which:

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- identifies and quantifies specific occupations in order to assist schools, colleges and government programs to plan for labour market demand;
- recognizes learning acquired outside of the formal education process;
- addresses education at the workplace and training on the job to progress to higher-level positions;
- identifies apprenticeship opportunities;
- identifies and mitigates barriers to employment, and
- maximizes long-term employment of northerners.

This recommendation can be addressed in the details of a socio-economic agreement.

d) Cultural Wellbeing, Traditional Economy, Land Use and Resources

The GNWT expressed concern about Diavik's extrapolation of the literature to predict that the renewable resource economy of study area communities would benefit from the project. It suggested the hypothesis that employment income finances traditional harvest remains to be tested. Diavik has proposed zero in-migration to mitigate competition for land and resource use but this goal may not be achievable and should therefore be included in the monitoring program. The GNWT also noted the need to monitor how changes between wage and traditional economies alter hunting practices and the cumulative effects of changes in hunting on sustainable development.

Diavik provided no discussion of how it will mitigate lost tourism potential associated with the mine land use during operation and post-closure. The GNWT concluded that Diavik did not consider fully the potential impacts to tourism and provide specific details on mitigation measures for lost tourism opportunities.

e) Social Stability and Community Wellness

Theoretical support for Diavik's prediction that project effects on workers' social health will be observed over one to five years is lacking and the GNWT acknowledged that rotational work, while a mitigation measure for reducing time away from home, does have potential effects on worker health. Diavik needs to acknowledge the stresses associated with rotational work and work with communities and government to assist employees and families. Impacts on social stability and community wellness also need to be monitored and appropriate mitigation applied.

f) Net Effects on Government

There is a direct relationship between socio-economic effects affecting the public and the cost of providing services and infrastructure. Although this relationship has been the subject of considerable study, Diavik's prediction of effects is based solely on professional judgement and its conclusions are questioned by the GNWT. No monitoring of project effects on social infrastructure has been proposed and the GNWT requires assurance that the information it requires will be accessible. The GNWT therefore recommends that a vehicle for predicting effects on public services

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and infrastructure be developed and included in the co-operative project monitoring program. The GNWT also identified the need to clarify project effects on net revenues and royalties.

Diavik's socio-economics environmental effects report estimated personal tax revenues due to the federal and territorial governments. However, those estimates are not sufficient to provide a complete picture of the effects of the project on the fiscal position of the GNWT.

Although the GNWT receives personal tax revenues from personal taxes, corporate and consumption taxes, this revenue is partially offset in calculating the formula financing grant. The GNWT estimated the net fiscal benefit of the mine to GNWT revenues would be $200M over the 25-year life of the mine. This does not account for infrastructure and program costs associated with the mine.

Diavik's Socio-economics Environmental Effects Report does not provide an estimate of the royalties due to the federal government, and potentially to Aboriginal governments and organizations, under the Canada Mining Regulations. The GNWT estimated the Diavik project would generate between $650M and $700M in royalty revenues over the 25-year life of the mine.

g) Sustainable Development

Diavik did not present a comprehensive or informative description of predicted effects on economic diversification. A fuller discussion of diversification opportunities should have been presented to show how the proposed project will contribute to sustainable development. There is no detail or documentation on what direct and induced effects on community tourism or recreation would be from the project. Tourism discussion is generalized, with no specific data.

Diavik has provided sufficient assurance that its closure plans will meet or exceed industry standards, the Labour Standards Act and other appropriate legislation. However, Diavik should assess the significance of closure and economic viability on community wellness in the ongoing monitoring program, including economic diversification at the community level and steps taken to avoid negative post-closure effects.

Economic diversification is seen by the GNWT as a critical component of sustainable development of the NWT. Although Diavik states that it will work towards increasing the capacity of mining-related businesses in the north and the local study area, it has not addressed secondary industry. The GNWT identified the significant value-added industry that has developed in the processing of diamonds and notes that large opportunities for economic development and diversification exist in sorting, cutting, polishing and jewelry manufacturing. The key to the development of any secondary diamond industry is access to a reliable, steady supply of rough diamonds. The GNWT would like Diavik to address how NWT diamonds will be marketed and sold and a commitment that Diavik will establish off-site valuation and sorting facilities in the NWT and make rough diamonds available for sale, at fair market price, in the NWT. This must be part of the socio-economic agreement referred to above or a condition attached to the land lease.

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Aboriginal Governments/Organizations/Communities

Two main socio-economic issues were raised by Aboriginal governments and organizations in community consultations: employment and increased social problems stemming from increased income and rotational work patterns. All communities considered it important that Diavik provide opportunities for employment for Aboriginal people. In association with this, many communities asked that Diavik provide training, which would allow for better participation of Aboriginal people in the mine workforce. In order to make the training broadly accessible some courses should be offered in the communities. There were also concerns expressed that employment at the mine was increasing social problems, such as substance abuse and family dissension, and that Diavik should endeavour to assist in reducing these impacts to the extent possible.

Several Aboriginal governments and organizations including North Slave Métis Alliance (NSMA), the Yellowknives Dene First Nation (YDFN), the Lutsel K'e Dene First Nation (LKDFN) and the Kitikmeot Inuit Association (KIA) also expressed an expectation to be actively involved in the monitoring of mine impacts. Participation in monitoring would allow Aboriginal people to gain skills in non-mine activities.

The NSMA also raised a concern that the socio-economic baseline studies did not specifically address its communities.

The LKDFN recommended that Diavik work with its community to support the community land use and subsistence activities. The LKDFN also identified that one of the major obstacles to employees and their families spending time on the land appears to be the 2 week on – 2 week off work schedule. Therefore, they also recommended that Diavik provide a flexible working schedule (1 month-on/1 month-off or leave with pay/leave without pay) for its employees and the employees of subcontractors.

The LKDFN stated that due to its isolation and relative small size, they are at a disadvantage in pursuing business opportunities. They therefore recommended the LKDFN must be given advanced notice of business development opportunities.

The LKDFN recommended that Diavik, the LKDFN and the GNWT should work together to develop a "job readiness program". This would include the following elements: life skills and job readiness; adult upgrading; pre-employment training; on the job training, and career development.

The YDFN recommended that all mine employees, especially those in management positions should be required to receive orientation seminars in intercultural since so many different aboriginal cultures will be working together alongside southerners at the mine.

The KIA raised a concern of potential erosion of traditional subsistence practices and competition for land resources, which are summarized in Diavik's "Socio-Economics Report", Table 32. If these are considered unmitigable the KIA recommended that funding for traditional knowledge studies need to be encouraged and other initiatives to ensure that at least the knowledge of traditional uses of the land are recorded for posterity.

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Value-Added

It is the position of the KIA, the NSMA, and the LKDFN is that as a condition of approval Diavik must negotiate a value added agreement with the GNWT with the consent and involvement of the Aboriginal governments.

The Aboriginal governments/organizations stated that the duty of the federal government and the principle of the Canadian Environmental Assessment Act (CEAA) Section 4(b) is to promote sustainable economic development. This is particularly important in a region that has been characterized by unsustained development, limited opportunity for expansion and overpowering problems which may compromise the ability of future generations to lead healthy lives in their traditional homes and homelands. The intention of CEAA and the project guidelines was to identify negative adverse impacts and to empower communities to seek mitigation measures of those impacts. The environmental assessment report identifies possible negative effects arising from this project.

The effects, which warrant mitigation, are:

- the likelihood of limited employment at the mine site for Aboriginal people based on their experience with similar projects at remote sites;
- as acknowledged by Diavik, a major finding of the Royal Commission on Aboriginal Peoples is that a great number of barriers exist for Aboriginal employment and this further decreases the likelihood of communities benefiting from jobs at the mine site;
- consistent with new fiscal arrangements identified in Gathering Strength;
- out-migration has been identified as a possible effect. This negatively affects the ability of communities to govern themselves, to maintain their capacity and it strikes at their viability;
- another effect identified is the effect on cultural well-being. Aboriginal peoples wish to maintain their cultural identity and must have the tools to do so, and
- boom-bust economies, while temporarily creating wealth for some, leave a legacy of social problems and lack of transferable skills. While the environmental assessment report did not recognize this as an affect, it was raised as an issue during the technical review.

The Aboriginal governments/organizations stated that the Government of Canada has a fiduciary obligation to minimize the infringement of Aboriginal Rights caused by resource development initiatives on traditional Aboriginal lands. Multiple land claims to the region (section 1.1.3) have not been settled. Until land claims are settled, if the federal government attempts to allow the exploitation of the Aboriginal resource, they must consider the Aboriginal best interest.

Development of secondary industries through local sale of rough diamonds is one option that would help mitigate some of these negative effects and could ensure that Aboriginal communities will realize some benefit from resource development on Aboriginal lands. Establishment of a secondary diamond industry can open the door for economic opportunities for small communities. This option makes possible sustainable small community employment. In doing so, it may remove the problems

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associated with employment barriers and migration out of small communities. It is the position of the KIA, NSMA, and LKDFN that; as a condition of approval Diavik must negotiate a value added agreement with the GNWT with the involvement and consent of the Aboriginal governments. The agreement and negotiations must be guided by the following principles:

- northerners have a right to access northern resources;
- diamonds should be sold at fair market value;
- benefits should be balanced between affected communities;
- information should be presented to communities to educate and train people on what value added means and how they can participate;
- promote sustainable communities while trying to foster healthy economic relationships between industry and affected communities. The process should not incur an unreasonable financial burden to industry;
- continue to be consistent with federal government commitments guaranteed to assist Aboriginal communities in building community capacity and meeting self-defined goals;
- must be designed as a measure to mitigate the adverse socio-economic effects identified in the CSR and also as a measure to address sustainable development;
- Aboriginal governments must be provided the resources for meaningful involvement in the negotiations and have final consent over the agreement, and
- the agreement should contain a dispute resolution mechanism that includes the Aboriginal governments and a means for regular review and maximum funding to optimize participation in amendment if necessary.

Technical Session Recommendations
All levels of government are to play an important role in diversifying the economy to accommodate the eventual termination of mining operations. All parties are to develop and document socio-economic action plans addressing closure in an agreement.

GNWT is to work with Diavik to produce a statement for "net fiscal impact" of the project on the NWT.

Diavik has committed to developing measures of community wellness and how they will be monitored, in consultation with Aboriginal governments and organizations and government agencies by final approval of the Diavik Diamonds Project.

The NSMA expressed a concern that the socio-economic baseline studies do not specifically address its communities. It is completing its own report by June 1999 and will independently submit it to the Minister of Environment as a "companion piece to the comprehensive study report".

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Mechanisms for the co-operative development, implementation and on-going review and modification (where necessary) of social, economic and cultural monitoring programs, are to be captured in an appropriate agreement(s). The agreement(s) should establish the responsibilities of federal, territorial and Aboriginal governments, and of Diavik. The precise implementation vehicle should be determined through an inclusive consultation process.

Many social, economic and cultural responses to the Diavik project cannot be known with certainty at this time. Any effects will represent interplay between individual choice, community culture and specific assistance programs of government and industry. The environmental assessment review has identified the need to address on-going concerns with development effects on traditional land use and practices, cultural awareness and community cohesion. There is a need for partnerships among Diavik, other industries, government and communities in mitigation and subsequent monitoring of any cultural responses to this and other projects.

Regarding employee pay procedures, Diavik has indicated that they will develop an approach acceptable to the majority of the employees. Diavik has indicated that its family assistance program will look at the effects of long-distance commuting and is providing direct commuting to home communities. Diavik will also consider pre-employment drug test programs, employee agreements, orientation programs, community and group monitoring and site security to control substance abuse.

It was the GNWT's recommendation that the issue of value-added industries, resulting from the diamond industry in the NWT, be specifically dealt with in the environmental assessment review.

Non-governmental Organizations/General Public
The Status of Women Council of the NWT (SWC) consulted with women within the communities and raised several concerns with respect to Diavik's socio-economic impact assessment and proposed mitigation strategies. Three main areas of concern were identified, 1) opportunity for women's employment; 2) effects of long distance commuting, and 3) impacts on family and social services infrastructure.

1. Opportunity for women's employment

   The SWC is concerned that while Diavik states that they will support and encourage women in the mining industry, they do not identify any mechanisms for doing so, and therefore barriers identified by women in the communities remain. Several mitigation measures could be adopted by Diavik to address this concern and are outlined below.

   Opportunities for women's employment should include:

   - the development of a comprehensive strategy to encourage and hire women into positions at the mine, and to retain and promote female employees;
   - targeting job promotion to women in communities;

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- better information in communities about what women can expect at the mine site;
- work site counselling and support services specific to women;
- education on sexual and gender harassment to all employees as part of employee orientation;
- developing and offering training specific to women and mining in the communities;
- providing supervisors and co-workers with sensitivity training, and
- promoting opportunities in mining to female high school students.

2. Effects of long distance commuting

The SWC also believe Diavik places too much confidence in the 2 weeks-in, 2 weeks-out schedule for mitigating the effects of long distance commuting. While it may be preferable to other schedules, the negative effects are not eliminated. Community women raised concerns about the isolation of the employee at the mine site, the stress on the spouse in the community, the difficulties in managing older children when the other parent is away, and the drinking and angry behaviour of some spouses when they return from the mine rotation. While Diavik's other mitigation measures are good, the SWC suggests adding the following mitigation measures:

- making phone calls home free;
- providing information in the communities about the possible impacts on families of long distance commuting;
- providing a family orientation/education program to help prepare employees and their families for employment at the mine site;
- allowing family visits to the work site;
- providing on site sessions to promote a better understanding by workers of what the spouse has to deal with at home;
- providing drug and alcohol counsellors at the mine site;
- ensuring that workers with spouses/children are not on rotation over Christmas, or allow families to join workers on site;
- providing support in the community for families of rotational workers, and
- providing opportunities to maintain strong links with communities.

3. Impacts on family and social services infrastructure

The SWC does not agree with Diavik's prediction that these will be a short-lived (two years) increase in social problems due to increased incomes. Northern experience would indicate that no lessening of social problems with time has occurred, and therefore, the increased pressure on family and social services infrastructure would likely remain for the duration of the mine. While mitigation proposed by Diavik is appropriate, the SWC believes that the proposed measures must be a firm and unconditional commitment for the most impacted communities. In addition, the SWC suggested that Diavik undertake the following:

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- provide drug and alcohol counsellors at the mine site;
- provide programs for workers that include anger management and personal counselling;
- provide opportunities for potential workers to go to treatment, in addition to mine employees and their families;
- provide more healing options for families to work together on problems directly related to mine employment, and
- support aftercare programs in the communities.

The SWC believes that Diavik has also failed to adequately assess the cumulative socio-economic effects of the project has failed to provide sufficient information on its proposed monitoring program, and has not included any policies or information related specifically to women. Many community women expressed concerns to the SWC regarding the effects of mining employment on the social fabric of communities and its desire to see women benefit from employment in mining. Therefore, the SWC recommended that Diavik be required to address these insufficiencies before a final decision regarding its proposal is made.

v) Proponent Response

Diavik supports the intent of a cooperative implementation, monitoring and reporting process for follow-up on socio-economic effects and made a proposal for a community monitoring group during the technical public sessions. Discussions with communities and government continue. Diavik commits to initiate discussions among communities and government to define indicators of social stability and cultural wellness that reflect local values, prior to December 31, 1999. Diavik commits to work with appropriate authorities to meet or exceed industry standards for closure. Diavik will also provide its employees with written notice of termination of one year, out placement counseling, family adjustment seminars, pension and savings education and a severance package.

- to elaborate on the roles and responsibilities of various stakeholders, and to include government representation in a "Communities Group" which was proposed by Diavik;
- for additional details, commitments, targets and schedules for employment and training;
- for additional details and commitments related to sustainable economic development, with specific reference to Aboriginal business activities;
- to provide leadership and support in involving communities and governments in developing programs for traditional land use activities;
- to address post-closure effects of the project more completely by determining the significance of the "boom-bust" economy and details for mitigating its effects;
- for a more detailed discussion of cumulative effects or a rationale for the scope chosen, and

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- for a more explicit summary of conclusions with respect to predicted effects, mitigation significance and follow-up.

Diavik believes that the spatial boundaries used in the assessment were appropriate and that in a January 1999 meeting with senior representatives of the GNWT, Diavik and the RAs, it was concluded that spatial boundaries would no longer be considered a methodological issue following Diavik's explanation of the basis for these boundaries.

Diavik used data including those from the NWT Bureau of Statistics in support of its prediction that the renewable resource economy of study area communities would benefit from the project. The GNWT did not offer evidence that this work was flawed.

Diavik stated, in a letter of February 15, 1999, that "as a result of proactive employment and business development the project will not dominate any community economy" and do not feel that its project will generate any significant negative effects at closure.

Diavik will attempt to hire local people in the communities and this should not increase the demand on local housing as these people live there already. The real impact should be to reduce the demand for public housing as residents are able to afford private housing.

Diavik stated it is not contributing to "boom-bust" economy in communities as it will not be the primary employer in communities and will not be creating a new community reliant on a single resource. Diavik predicted no significant impact on prices in its environmental assessment submission.

It is Diavik's position that the issue of secondary diamond industry and the commitment to sell rough diamonds in the NWT is outside the scope of the environmental assessment.

Diavik feels that there has been detailed discussion of cumulative effects and the rationale for the scope chosen. Additional information on cumulative effects was provided in Diavik's response dated March 31, 1999.

Diavik committed to support and help develop and increase the capacity of northern business and has developed a northern business participation policy. Diavik supports the need for secondary industry, and made a commitment to sorting in the NWT five years ago. Diavik has not yet developed its marketing strategy to sell rough diamonds. However, Diavik has indicated its willingness to sell rough diamonds in the NWT will be dictated by what makes good business sense.

Diavik provided detailed information to the GNWT to facilitate its production of a statement for "net fiscal impact" of the proposed project on the NWT.

In response to public technical session resolutions concerning socio-economic effects, Diavik submitted additional information:

Diavik Socio-Economic Commitments – Diavik is committed to:

- the north and maintaining its headquarters in the NWT;
- northern sustainable development and providing maximum employment opportunities to northern people;
- northern sustainable development and providing the maximum business opportunities to northern companies;
- minimizing any potential impacts on its employees and their families;
- developing its project with utmost respect for the northern environment and the health of northern communities;
- establishing a Communities Operations Group, and
- an ongoing monitoring and mitigation process.

Diavik Communities Operations Group – This group would provide a link between the communities impacted by the Diavik diamond mine, residents of the NWT, Nunavut and Diavik Diamond Mines Inc.

Diavik's response to the GNWT's written clarification provided on March 4 to the Socio Economic public technical sessions – Diavik does not think a downward revision in the predicted employment impacts for northerners in the socio-economic effects report is warranted or required. The proposed project was designed to maximize the employment and business opportunities for northerners and nothing in the GNWT presentation would indicate a need to revise the estimates. Diavik offers further substantiation in support of its response.

vi) RA Conclusions

Based on Diavik's analysis, additional information provided for clarification and the GNWT's conclusions, the responsible authorities (RAs) conclude that the proposed project will not likely result in significant adverse socio-economic project-effects and cumulative effects. However, the RAs recognize the inherit difficulties in predicting and assessing some of the socio-economic effects of the proposed project. The RAs believe that in order minimize the potential risk of negative effects identified, Diavik will be required to implement mitigation measures outlined in its environmental assessment submission and commitments document and action plan.

The RAs recognize that the NSMA believe that Diavik has not fully incorporated its knowledge into the development of the environmental assessment submission. However, the opportunity to participate and raise concerns throughout the review process was available and the NSMA actively participated (see Section 6.5 – RA conclusions, for more detailed information).

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The RAs agree that Diavik must develop a mine specific training and education strategy that considers recommendations by the GNWT, SWC and Aboriginal governments and organizations. In addition, Diavik is to work with the SWC and the GNWT to develop policies and a program that encourages and retains women workers.

Substantial benefits would accrue to the NWT through the establishment of secondary, value-added diamond industries. This form of economic diversification is a very worthy social and economic goal. In support of this, DIAND is working with the GNWT to identify options to enhance the secondary industry based on diamond production in the Northwest Territories. While the RAs understand the position of the GNWT and Aboriginal governments/organizations, and support the establishment of northern-based secondary diamond industries, the RAs have concluded that the value-added issue is outside the scope of the comprehensive study. The federal government is prepared to work with the GNWT, the Aboriginal organizations and Diavik to resolve this issue outside the environmental assessment process.

The RAs recognize the need for co-operative development, implementation and reporting of a follow-up program. The RAs will play an active role in the development and approval of a follow-up program. The RAs support the recommendation from the public technical sessions that a social, economic and cultural follow-up program will be carried through an agreement that must be in place before the project proceeds.

Effective social, economic and cultural monitoring and responsive mitigation will require a partnership among Diavik, federal, territorial and Aboriginal governments, Aboriginal and non-government organizations and communities to establish programs, devise indicators, and assemble and analyze data. The follow-up program would also examine cumulative socio-economic effects associated with the Ekati Diamond Mine and any future projects in the region.

The objectives of the follow-up program for inclusion in the socio-economic monitoring agreement are to:

i) develop indicators, monitor and verify predictions of the project's effects on cultural well-being (including effects of closure, rotational work and in-migration) and develop action plans for alternative mitigation where necessary;
ii) develop indicators, monitor and verify predictions of the project's effects on community wellness (including effects of closure, rotational work and in-migration) and develop action plans for alternative mitigation where necessary;
iii) develop indicators, monitor and verify predictions of the project's effects on social stability (including effects of closure, rotational work and in-migration) and develop alternative mitigation where necessary;
iv) monitor and verify predictions with respect to economic diversification for opportunities for northern business development (i.e. mine purchases and other goods and services) and develop action plans to accomplish this;

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v) monitor and verify predictions of proposed project effects on public services and infrastructure (social and physical);
vi) monitor Diavik's hiring and turnover rates in order to confirm predictions;
vii) monitor and verify predictions of employment levels at the Diavik mine and develop action plans for training;
viii) monitor changes in Diavik's employee pursuits in traditional economies due to the transition from traditional to wage economies;
ix) monitor in-migration and verify predictions of the proposed project's impact on competition for community land and resources, and also the impact of the project on competition for human resources, and
x) monitor and verify Diavik's predictions regarding the cumulative socio-economic effects in the regional study area.

8.9 SUSTAINABILITY OF RENEWABLE RESOURCES

Sustainable development is defined as " development that meets the needs of the present without compromising the ability of future generations to meet their own needs" . Some level of development is needed to create opportunities, wealth and choices for northern and in particular, Aboriginal Canadians, and that development must proceed in a way that leaves choices available for future generations.

Sustainable development requires that options available for future generations be maintained. After mine closure, access to East Island would be restored. Although vegetation on East Island would take several generations to return to baseline conditions, wildlife populations would continue to be available for harvest. Water quality in Lac de Gras would return, in time, to baseline levels. Information about heritage resources will continue to enhance people's understanding of previous generations and cultures. Most environmental effects of the project would be restricted to the mine site and it is not expected to affect the way people use the resources beyond the mine site.

The economy of the north is currently unsustainable, depending significantly on government transfer payments. The proposed Diavik Diamonds Project is expected to strengthen the NWT economy by providing jobs, business opportunities, and tax revenues. Diavik stated that the environmental effects of the project would be minimal and most would be restricted to the mine site. Those effects that did extend beyond the site would likely be difficult to detect, and would not affect the way people use the resource.

Establishing long-term commitments with local communities and creating sustainable livelihoods is an indispensable requirement for sustainable development. Diavik proposed this can be achieved by its commitment to making lasting positive contributions to local communities by: providing employment opportunities, transferring technology and skills, stimulating economic activity, and involving local partnerships. Although physical evidence of the project would remain on East Island, it is Diavik's view that northern people would retain a legacy of training, knowledge and economic strength that would enhance their futures long after the proposed mine has closed.

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Comments/Concerns

Government of the Northwest Territories

The GNWT supports the sustainable development of natural resources that contribute to the social and economic well-being of northerners. Sustainability implies that development activities are conducted in an environmentally sound and responsible manner so that present uses do not jeopardize potential future uses of the land and the health of communities.

The responsibility for developing resources in a sustainable manner is a shared responsibility. Governments, Aboriginal organizations and industry all have roles in ensuring that this goal is met.

Aboriginal Governments/Organizations/Communities

The North Slave Métis Alliance (NSMA) stated that Diavik has not considered its knowledge in the development of the environmental assessment submission. Therefore, the NSMA stated that it will be completing a report by June 1999, and will independently submit it to the Minister of the Environment as a "companion piece to the comprehensive study report".

Non-Government Organizations/General Public

The Canadian Parks and Wilderness Society–NWT (CPAWS-NWT) feels that there is massive exploitation of non-renewable resources in a particularly fragile ecosystem and the project is not a genuinely sustainable undertaking. CPAWS-NWT submitted that the area of the proposed project could sustain traditional activities and well-planned eco-tourism indefinitely, unless wilderness character is lost as a result of non-sustainable industrial development.

RA Conclusions

The responsible authorities (RAs) believe that the capacity of renewable resources would not be significantly affected by the project should it proceed. The RAs agree with the GNWT comments specifically that the responsibility for developing resources in a sustainable manner is a shared responsibility between governments, Aboriginal governments and organizations and industry.

The RAs conclude that the effects on eco-tourism and other land use activities will have a local effect (to East Island), however the effect on sustainability of activities on a regional scale is manageable and is not a significant effect. The RAs are confident that through the environmental assessment and regulatory processes, significant adverse effects from the project will be avoided.

The RAs recognize that the NSMA believe that Diavik has not fully incorporated its knowledge into the development of the environmental assessment submission. However, the opportunity to participate and raise concerns throughout the review process was available and the NSMA actively participated (see Section 6.5 – RA conclusions, for more detailed information).

The RAs recognize the implementation of the Protected Areas Strategy, once approved, will contribute to sustainable resource development. Work will continue on the identification of priority areas of interest in the Slave Geological Province.

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8.10 CUMULATIVE EFFECTS

Background
Section 16(1) of the Canadian Environmental Assessment Act (CEAA) states that "Every ... comprehensive study of a project ... shall include a consideration of ... any cumulative environmental effects that are likely to result from the project, in combination other projects or activities that have been or will be carried out..." The Canadian Environmental Assessment Agency's Operational Policy Statement (March 1999) offers advice to responsible authorities (RAs) on the assessment of cumulative effects. The advice included the following:

Definition: In conducting project assessments the RAs should consider whether the scope of the cumulative effects assessment should consider indirect social effects as well as direct biophysical effects.

Identifying future projects: The RAs should be guided by a clear rationale in selecting future projects to include in the assessment of cumulative effects and need to exercise judgement in distinguishing projects that are certain, reasonably foreseeable and hypothetical. The approach should be adequate to understand the implications of development activity on the future well-being of environmental resources.

Level of effort: RAs should give particular attention to the selection of future projects where certain and reasonably foreseeable projects may have an effect on the same valued ecosystem components as the project under assessment, where rapid development of the project area is anticipated, or where particular environmental sensitivities or risks are involved.

The purpose of assessing cumulative effects is to determine if the combination and interaction of the environmental effects from past, present and likely future projects and activities will create aggregate effects, including effects that may be different in nature or extent from the effects of individual activities. Diavik identified and evaluated potential cumulative environmental effects if a change in the environment was identified as a result of the proposed project that, when combined with changes caused by other projects and activities in the regional study area, could potentially result in a cumulative effect.

Cumulative effects are included in each of the environmental component sections above. Detailed information on cumulative effects is available in the Diavik's environmental effects reports that form part of their environmental assessment submission. The projects and activities occurring in the region around the proposed Diavik Diamonds Project are summarized in Table 5-1. Diavik used this table to select projects and activities to be included in its cumulative effects assessment. Table 5-2 explains which projects and activities Diavik considered in its cumulative effects assessment and those incorporated in in-depth analysis. For some environmental components (e.g., small game and avifauna), regional cumulative effects were not assessed because interactions between other projects and activities and the proposed Diavik project would not occur. Similarly, Diavik did not include other projects and activities which it determined had no or unlikely residual effect and therefore, had no or little potential to interact with the proposed mine. For example, exploratory drilling on ice was considered but excluded from further detailed analysis because it is temporary activity.

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RAs are satisfied with projects and activities considered and included in the Diavik's cumulative effects assessments.

Comments/Concerns

Federal Authorities
Environment Canada was satisfied with Diavik's analysis of the potential cumulative environmental effects for air quality, avifauna and water quality, the areas where the department holds expertise. However, the department is concerned about the potential effects on the larger ecosystem of additional developments over the next several years and beyond as the region holds considerable mineral wealth. As a result, Environment Canada believes that there is a clear need to develop a framework for assessing cumulative environmental effects in the region. Such a framework would provide a basis for sound decision-making and adaptive management of cumulative effects of multiple developments as well as clear, consistent direction to industry regarding development and operating requirements. An overall goal of the proposed framework would be to build upon current baseline studies and monitoring programs in order to define critical thresholds within the carrying capacity of the regional environment and consistent with traditional uses in the area.

Government of the Northwest Territories
The GNWT has stated that it is concerned with the larger regional environmental and socio-economic cumulative effects. The barrenlands remain a vast and relatively undisturbed wilderness. With increasing development in the Slave Geological Province, this quality is diminished. In addition, effects, both positive and negative are experienced in the socio-economic environment and interact cumulatively with increasing activity in the region.

A cumulative effects monitoring program will ensure proper planning and management of the area as well as providing clearer direction to industry. Diavik has also recognized the need for regional cumulative effects monitoring and has outlined several possible approaches to address this issue. This is an issue that requires input from government, industry, Aboriginal organizations, non-government organizations and the public.

Technical Session Recommendations
Recognizing that concrete action on cumulative effects assessment and management is required by all parties in the short and long term, it is recommended that the comprehensive study report address the need:

i) to extend, refocus, and restructure the West Kitikmeot/Slave Study on cumulative effects;
ii) for regional land use planning in the Slave Geological Province;
iii) to convene a major workshop, as soon as possible, on cumulative effects assessment and management, including an overall framework, and
iv) to settle land claims fairly and quickly.

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Non-Government Organizations/General Public

The Canadian Parks and Wilderness Society – NWT (CPAWS-NWT) feels that the cumulative effects of the project that have been predicted are unacceptable. It has raised concern that the scope of the cumulative assessment did not adequately consider the effects of Diavik in conjunction with other human activities likely to cause effects on wildlife. CPAWS-NWT believes that many of the effects of the Diavik mine will be cumulatively significant and will not be feasible to mitigate and suggests that a fund similar to that for fish habitat compensation be created to compensate for wildlife habitat loss.

The CPAWS-NWT considered the cumulative effects assessment for aquatics to be inadequate and has concerns over the high uncertainties associated with this prediction in light of the variety of potential problems. CPAWS-NWT is concerned that it is impossible to tell how the system will react to such a variety of changes, and that the present level of uncertainty carries with it an unacceptably high risk of significant non-mitigable adverse effects. CPAWS-NWT recognizes that decisions must be made in light of some uncertainty and does not want regulators to gamble more than the NWT can afford to lose.

The CPAWS-NWT is concerned that there has been no serious consideration of the cumulative effects of the proposed Diavik Diamonds Project on wilderness. The CPAWS-NWT believes that the area around the proposed Diavik project will have much lower wilderness values, as the region grows more industrial in nature. The CPAWS-NWT urges RAs to consider the increased likelihood of effects from related future developments as a cumulative impact of Diavik. A wilderness issue of concern to the CPAWS-NWT is the increasing industrialization of one of the world's few remaining vast wilderness areas.

The CPAWS-NWT believes that considering existing projects is a serious oversight because the cumulative effects of the project are the most important concern arising from the proposed mine. The CPAWS-NWT is concerned that the current environmental assessment does not reflect what the entire Diavik project is likely to become and would like the RAs to fully consider the likely effects on Diavik's explorations and probable future development from this assessment. The CPAWS-NWT feels that the RAs should consider the compound effects of other developments likely to occur in the relatively near future.

While the CPAWS-NWT agrees with government being responsible for managing cumulative effects or that regional bodies be formed to do so, the CPAWS-NWT feels that Diavik should still be responsible for the environmental effects it produces including those that act cumulatively.

Subsequently, CPAWS-NWT provided support for a major workshop on cumulative effects assessment and management and expressed an interest in being an active participant. CPAWS-NWT also expressed the need for regional land use planning in the Slave Geological Province and to extend and re-focus the West Kitikmeot Slave Study on cumulative effects as stated in the public technical sessions.

Proponent Response

Diavik indicated that it would participate in a regional cumulative effects monitoring program in partnership with governments, industry, Aboriginal organizations and other interested parties.

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RA Conclusions

The RAs are satisfied with Diavik's analysis of the potential cumulative effects of the proposed project on the environment and the follow-up programs identified to verify the predictions made by Diavik.

In response to concerns about the scope of the cumulative effects assessment raised by environmental non-governmental organizations and others, the rationale why exploration activities and specific projects were excluded from the cumulative effects assessment is provided below.

Mineral exploration is a relatively common activity around the proposed Diavik Diamonds Project and includes base camps, drilling and surveying activities. Mineral exploration was considered and then excluded from further cumulative effects analysis by Diavik because it is temporary, usually spanning only several weeks, and generally occurring during the winter months when the potential environmental effects on vegetation, terrain, and wildlife are negligible. The mitigation measures required under land use permits ensure that water quality, air quality, heritage resources and wildlife are protected. Consequently, the residual effects of exploration are negligible and the potential for cumulative effects with the proposed Diavik Diamonds Project are unlikely. This applies to exploration occurring within the cumulative wildlife study area and beyond to such projects as the Monopros diamond and BHP Boston gold exploration sites.

BHP is proposing to expand its mine to include three new kimberlite pipes and a 19 km all-weather road to access one of these pipes. BHP applied for a water license in December 1998 and a land lease in February 1999 for this proposed expansion. An environmental assessment of the proposed expansion has not yet been completed by BHP. Diavik is not responsible for assessing the cumulative effects of its project and the proposed BHP expansion since the design details and environmental effects of the BHP expansion have not yet been determined and a cumulative effects assessment of the two projects would only be speculative at this time. The RAs believe that a more effective and thorough approach to assessing the cumulative effects from the proposed BHP expansion and the proposed Diavik Diamonds Project is to examine these effects in the environmental assessment of the proposed BHP project, as will be required under the Mackenzie Valley Resource Management Act.

The Tahera Corporation submitted a project description for a diamond mine (Jericho Diamond Project) in early May 1999 to the Nunavut Water Board. The proposed mine would be located approximately 27 km northeast of the Lupin Mine and use the Lupin Mine facilities. Like the BHP expansion, Diavik is not responsible for including the Jericho Diamond Project in its cumulative effects assessment since the design details and environmental effects of the proposal have not yet been determined and a cumulative effects assessment of the two projects would only be speculative at this time. The RAs

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consider that a more effective and thorough approach to assessing the cumulative effects from the proposed Jericho Diamond Project and the proposed Diavik Diamonds Project is to examine these effects in the environmental assessment of the proposed Jericho Diamond Project, as will be required under the Nunavut Land Claims Agreement.

The Slave Geological Transportation Corridor is a concept describing a road from either Yellowknife or Rae to the Arctic coast. The RAs do not require Diavik to consider this project in its cumulative effects assessment because there is no identified proponent or funding for the concept. The concept of a transportation corridor has been under discussion for approximately the past forty years, and there is no support among companies currently active in the region for this concept, making it a highly unlikely future project.

While the RAs are satisfied with Diavik's cumulative effects analysis and follow-up programs, the RAs also conclude that a regional cumulative effects assessment and management framework is required to consider existing and potential impacts from all development in the Slave Geological Province to support sound decision-making and adaptive management. While it is not a condition of the Diavik project approval, the framework should be developed in cooperation with Diavik and other developers in the regional study area, governments, Aboriginal organizations and interested non-government organizations.

The framework should be developed in the context of environmental assessment and planning processes under the Mackenzie Valley Resource Management Act and the Nunavut Comprehensive Land Claim Agreement. It should build on existing initiatives such as the West Kitikmeot/Slave Study, the Coppermine River Basin Cumulative Effects Monitoring Program and the Mackenzie Valley Cumulative Impact Monitoring Program and work toward defining critical environmental thresholds and carrying capacities for the region.

As a key step in the development of a regional cumulative effects management framework, DIAND has committed to conducting a workshop in the late fall of 1999. This workshop should set the stage for the further definition of the framework, which should be clearly set out by DIAND by March 31, 2000.

DIAND's commitment to conduct a workshop on a cumulative effects management framework addresses the third point of the technical session recommendation. With regard to the first point, the extension, refocusing, and restructuring of the West Kitikmeot/Slave Study is being discussed by the parties and development of the framework will build on the Study, among other initiatives. The second point highlights the need for land use planning while the fourth point identifies the need to settle land claims fairly and quickly. The Nunavut Land Claims Agreement contains provisions for land use planning. Where claims have not been settled, the development of thresholds through a cumulative effects management framework will aid in linking project effects with land use goals. The federal government is actively involved in discussions and/or negotiations on land claims with the appropriate Aboriginal governments/organizations.

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9.0 FOLLOW-UP PROGRAM

The Canadian Environmental Assessment Act (CEAA) requires that the responsible authorities (RAs) consider the need for a follow-up program as part of a comprehensive study. The Act defines a follow-up program as a program for verifying the accuracy of the environmental assessment and determining the effectiveness of measures taken to mitigate adverse effects of the project.

The RAs have the overall responsibility to ensure that all appropriate mitigation measures are implemented and that follow-up is designed and carried out as identified in the comprehensive study report. The responsibility for implementing mitigation measures identified in Diavik's submissions and the comprehensive study report (CSR) and conducting required follow-up rests with Diavik Diamonds Mines Inc. unless otherwise specified.

Where regulatory processes exist for a specific environmental component, the mitigation measures and follow-up requirements will be specified as the terms and conditions by the regulatory instruments (e.g. NWT Class A Water Licence, Fisheries Act authorization, Navigable Waters Protection Act permit, Explosives Act permit, land lease) unless captured elsewhere.

The need for environmental and socio-economic monitoring agreements that complement the regulatory instruments to ensure the implementation of mitigation measures, compliance, monitoring and reporting was a recommendation that emerged from the public technical sessions held in February and March 1999. The RAs agree with the recommendation for separate agreements that will, in addition to regulatory instruments, ensure mitigation measures and follow-up are carried out. The two agreements will also provide for a consultative and cooperative approach to environmental and socio-economic management of the Diavik Diamonds Project involving federal, territorial and Aboriginal governments/organizations as well as Diavik.

The follow-up monitoring and mechanisms to ensure the implementation of mitigation measures that are outlined in this chapter will appear in either of the two agreements or in specific regulatory instruments as appropriate. The Government of the Northwest Territories (GNWT) has committed to lead the development and coordination of a socio-economic agreement with other governments (including Aboriginal organizations) and Diavik. DIAND will lead the development and coordination of an environmental agreement with other governments (including appropriate Aboriginal organizations) and Diavik. Responsibilities of each party will be specified in the agreements. The opportunity for public participation will also be specified in the agreements. The agreements must be concluded prior to project approval.

Reports prepared by the proponent will be submitted to RAs, GNWT, Government of Nunavut and Aboriginal government/organizations as appropriate and as set out in the agreements or instruments. The specific requirements of the reports will be described in the agreements and regulatory instruments.

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The RAs recognize the proactive approach taken by Diavik in the development and submission of draft environmental management plans in its Environmental Management System (EMS) including monitoring programs for air quality, wildlife, fish and water and geotechnical disciplines. For the most part, the EMS demonstrates the commitment and methodology for implementation of mitigation measures and management of environmental issues. The RAs will require modification or additions to the draft management plans as outlined in the following sections.

9.1 ENVIRONMENTAL AGREEMENT

The environmental agreement required for the proposed Diavik project is one of the formal mechanisms which will be utilized to ensure that the mitigative measures outlined in Diavik's submissions, and in the RAs conclusions documented in the CSR are appropriately implemented as required in respect of associated biophysical environmental effects. The purpose of monitoring under the agreement and regulatory instruments is to i) verify the predicted impacts of the project; ii) verify whether commitments are being fulfilled; iii) establish or confirm thresholds or "early warning" signs; iv) trigger action by mitigative measures where necessary.

Guiding Principles:

- cooperative approach for ongoing environmental management that is adaptive and flexible;
- development of capacity-building opportunities and achievement of sustainable development;
- a meaningful role for the appropriate Aboriginal government/organizations in the development and implementation of monitoring plans;
- identification of opportunities to discuss progress and problems encountered, recommend solutions and adaptations, and monitor the process;
- consideration of effective and efficient coordination of environmental effects monitoring in the Slave Geological Province where it pertains to the proposed Diavik mine;
- provide for flexibility over time, to accommodate unforeseen events;
- consideration of traditional knowledge in monitoring and follow-up activities, and
- monitoring will meet commonly accepted technical and ethical standards of traditional and scientific research.

Scope of Agreement:
At a minimum, the environmental agreement shall provide for:

- a statement of purpose;
- identification of monitoring objectives, mitigation and monitoring programs committed to by Diavik and as identified in the CSR;
- clearly defined elements of the follow-up requirements as identified in the CSR;
- the parties involved and their responsibilities (e.g. final decision-making, timing, financing and carrying out the follow-up program);
- mechanism to ensure that monitoring plans are developed or modified as required to ensure mitigation measures are successful;

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- mechanism for dispute resolution and timing;
- security deposits if deemed necessary;
- identification of public participation/involvement, and
- reporting requirements.

9.2 CLIMATE AND AIR QUALITY

9.2.1 Ambient Air Quality Conditions

Diavik will be required to modify its Air Quality Monitoring Program, Wildlife Management Monitoring Program and Aquatic Effects Monitoring Program in accordance with the environmental agreement, water licence and/or land lease. The environmental agreement or regulatory instrument will specify how Diavik will evaluate the effectiveness of mitigation measures and the RAs will determine if mitigation measures need to be modified over the course of the project. The follow-up program as specified in the environmental agreement or regulatory instrument will also require Diavik to:

i) establish a more sophisticated meteorological station to confirm assumptions and validate predictions;
ii) validate whether impacts from deposition on vegetation (habitat), wildlife, water and air quality were accurately predicted by monitoring ambient air levels, dust emissions and deposition rates, and
iii) include periodic monitoring of NO_2 during mining operations.

9.2.2 Global Climate Change

No follow-up is required.

9.3 VEGETATION AND TERRAIN

Diavik will be required to modify its Air Quality Monitoring Program, Wildlife Management Monitoring Program, Quarry Management Plan, Abandonment and Restoration Plan and Geotechnical Monitoring Program in accordance with the environmental agreement and/or land lease. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program to be specified in the environmental agreement or land lease will also require Diavik to:

i) monitor the linkage between dust deposition, rate of snow melt and vegetation loss (with respect to wildlife habitat) as part of the Wildlife and Air Quality Monitoring Programs;
ii) refine reclamation techniques in consultation with other developers that are best suited to the local climate and geology, and
iii) monitor the results of Diavik's proposed Geotechnical Monitoring Program to ensure the operations are performing as designed.

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9.4 WILDLIFE

9.4.1 Caribou

Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement and/or land lease. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program to be specified in the environmental agreement or land lease will also require Diavik to:

i) at a minimum, fence areas including the open-pits, fuel and explosive storage areas and the processed kimberlite containment area; the type of fencing remains to be determined. Fencing and diversion must be adaptive. Should monitoring determine that deflection is required, deflection methods will be tested;
ii) map trails using aerial photographs to help choose possible deflection sites;
iii) develop and update its plans for managing and monitoring likely worst-case scenarios;
iv) assist in monitoring caribou migration movements as they relate to the proposed Diavik mine, and
v) assist in monitoring the effects on caribou of the use of the Echo Bay Mine winter road as it relates to the proposed Diavik mine.

9.4.2 Grizzly Bears

Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement and/or land lease. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of its mitigation measures (see – Section 8.4.2 Grizzly Bears - RA Conclusions for additional mitigation measures) in order to achieve its goal of zero project-related bear mortality. The environmental agreement will specify how Diavik will adjust mitigation measures, as required, over the course of the project.

9.4.3 Other Carnivores

Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of its mitigation measures as they relate to carnivores and how it will adjust mitigation measures, as required, over the course of the project (e.g. electrical fencing and other barriers, adjusting blasting schedules).

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9.4.4 Raptors

Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project (e.g. restoration of nesting habitat, adjusting blasting schedules). The follow-up program to be specified in the environmental agreement will also require Diavik to identify and monitor mine-related causes in population fluctuations.

9.4.5 Waterfowl and Other Avifauna

Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program to be specified in the environmental agreement also requires Diavik to:

i) include those ecological or taxonomic groupings of birds best suited to measure possible environmental effects on both terrestrial and aquatic avifauna, and
ii) validate accuracy of predictions of potential environmental effects resulting from noise and the use of new, open water areas created by mining activities such as the processed kimberlite containment facility.

9.4.6 Small Game

Diavik will be required to modify its Wildlife Management Monitoring Program in accordance with the environmental agreement. The environmental agreement or land lease will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program to be specified in the environmental agreement also requires Diavik to monitor prey species in conjunction with the raptor follow-up requirements.

9.4.7 Biodiversity

No follow-up is required.

9.5 WATER AND FISH

9.5.1 Surface Water Quality

Diavik will be required to modify its Aquatic Effects Monitoring Program, Water Management Plan, Blasting and Explosives Management Plans, Biotite Schist Management Plan, Abandonment and Restoration Plan and other plans related to surface runoff and dredged sediments in accordance with the environmental agreement, water licence, explosives permit and/or Fisheries Act (FA) authorization. The environmental agreement

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and/or regulatory instruments will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program that will be specified in the environmental agreement or regulatory instrument will also require Diavik to:

i) verify predictions and ensure that water quality criteria as determined in the water licence are met in Lac de Gras to post-closure;
ii) verify predictions regarding water quality in the East Island lakes to closure;
iii) monitor shallow groundwater to ensure that surface drains are effectively intercepting potential subsurface drainage from country rock storage areas;
iv) determine and monitor cadmium concentrations within fish muscle and metallothionein in fish kidney and liver tissue every five years;
v) determine and monitor cadmium concentration within interstitial water of the dikes at regular intervals once the dikes are constructed;
vi) monitor and verify predictions of cadmium in the lower trophic levels, water, sediments and biota and take action as required;
vii) as more data becomes available, confirm through further modelling the year-round mixing effectiveness under variable conditions and scenarios as they occur including diffuser location and micro-wind climate effects on lake circulation arising from the country rock piles;
viii) manage the handling of explosives and blasting activities to minimize discharges of ammonia to Lac de Gras and monitor ammonia discharges;
ix) design an aquatic effects monitoring program focused on areas of enrichment, oxygen depletion and the verification of thresholds. Monitoring will include under ice oxygen levels and chlorophyll a levels as an early warning of the onset of enrichment, and
x) prior to the discharge of mine water, validate predictions regarding potential effects of nutrient inputs to Lac de Gras through the completion of in-situ nutrient studies.

9.5.2 Groundwater Quality

Diavik will be required to modify its Aquatic Effects Monitoring Program, Water Management Plan and Geotechnical Monitoring Program in accordance with the environmental agreement and/or a water licence. The environmental agreement or water licence will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program that will be specified in the environmental agreement and/or the water licence will also require Diavik to:

i) validate predictions that permafrost surrounding the processed kimberlite containment (PKC) facility will form an impermeable barrier between the facility and the East Island shallow groundwater;
ii) include fluoride for future groundwater and minewater monitoring, and
iii) monitor groundwater for the life of the mine to verify its quantity and quality and develop contingency plans to deal with a broader range of inflow and quality conditions.

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9.5.3 Fish and Fish Habitat

Diavik will be required to modify its Aquatic Effects Monitoring Program in accordance with the environmental agreement and/or the Fisheries Act (FA) authorization. The environmental agreement or FA authorization will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program that will be specified in the environmental agreement and/or the FA authorization will also require Diavik to:

i) monitor fish population and fish health over the life of the mine;
ii) verify its predictions that there are no effects of blasting on eggs by monitoring spawning activity, conducting egg survivability studies in the vicinity of the dikes and adjusting the blasting protocol if warranted;
iii) verify its predictions of total suspended solids (TSS) concentrations during construction, sediment accumulation on critical habitat, and any resultant effects on fish and primary productivity. Diavik must provide estimates of the spatial extent of a TSS plume in Lac de Gras. The total area of habitat potentially affected by TSS must also be provided as a percentage of the total habitat available. Potential depositional areas also need to be compared to actual depositional areas immediately following construction and again in the following open-water season for verification of dispersion modeling. The assumption that shoals would be 'washed' clean within one year of activities must be confirmed through monitoring. If the spatial extent, biological impact and duration of sediment deposition are greater than established through a water licence, remediation work, stop work orders, and/or habitat compensation may be required;
iv) monitor the use of spawning shoals by fish (radio-tagging) within the vicinity of TSS disturbance and sediment deposition, and verify predictions that fish will seek alternate spawning sites. The timing of dredging may have to be adjusted to accommodate the high oxygen demand of hatching eggs;
v) verify any changes in deposition and the benthic community before and after construction activities. Diavik must design its proposed benthic monitoring program with a view to detecting small to moderate impacts;
vi) monitor metal concentrations in fish flesh for lakes on East Island lakes and if consumption guidelines are exceeded, Diavik will develop a plan to warn people from fishing (e.g. posting signs) and will include this in its final closure plans, and
vii) monitor the additive mine-related environmental effects where possible.

9.6 EFFECTS OF ENVIRONMENT ON THE PROJECT

9.6.1 Permafrost

See Section 9.3 - Vegetation and Terrain.

9.6.2 Global Warming and Structural Integrity

See Section 9.3 - Vegetation and Terrain.

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9.6.3 Severe Weather

No follow-up is required.

9.6.4 Caribou on Roads

The RAs conclude that Diavik has adequately considered the potential environmental effects of caribou on roads. Diavik has developed a draft Traffic Management Plan in its EMS that identifies traffic procedures when caribou are present on the proposed site. These procedures will be modified, monitored and implemented in accordance with the environmental agreement.

9.6.5 Frost Penetration into Pit Walls

See Section 8.5.2- Ground Water for details.

9.7 ACCIDENTS AND MALFUNCTIONS

9.7.1 Processed Kimberlite Containment Dam Malfunction

The RAs conclude that Diavik has adequately considered the potential environmental effects of a processed kimberlite dam (PKC) dam malfunction. Diavik has committed to developing a monitoring program and contingency and emergency response plans before the start of construction activities that will monitored in accordance with a lands instrument or the environmental agreement. Diavik shall, through engineering design, ensure the long-term integrity of frozen structures such as PKC dams. Requirements for the Geotechnical Monitoring Program are outlined in Section 9.3 - Vegetation and Terrain.

9.7.2 Diesel Storage Accident

The RAs conclude that Diavik has adequately considered the potential environmental effects of an accidental release of diesel fuel. Diavik has developed a Hazardous Materials Management Plan in its Environmental Management System that must be modified to include contingency and emergency response plans before the start of construction activities. Monitoring requirements will be specified in a lands instrument or the environmental agreement.

9.7.3 Water Treatment Plant Malfunctions

The RAs conclude that Diavik has adequately considered the potential environmental effects of a water treatment plant malfunction. Diavik has committed to developing a monitoring program that provides for "early warning" of malfunctions as well as the contingency plans to contain accidental spills of both PKC and minewater before the start of construction activities. Monitoring requirements will be specified in a lands instrument or the environmental agreement.

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9.7.4 Accidental Kimberlite Slurry Release

The RAs conclude that Diavik has adequately considered the potential environmental effects of an accidental kimberlite slurry release malfunction. Diavik has committed to developing a monitoring program that provides for "early warning" of malfunctions as well as the contingency plans to contain an accidental rupture in the PKC pipeline before the start of construction activities. Monitoring requirements will be specified in a lands instrument or the environmental agreement.

9.7.5 Dike Malfunction

See section 9.7.1 - Processed Kimberlite Containment Dam Malfunction.

9.7.6 Accidents on Roads – Winter Conditions

See subsection 9.7.2 - Diesel Storage Accident.

9.7.7 Pit Wall Instability

The RAs concur with Diavik's commitment to conduct continuous in-situ geotechnical monitoring and based on results, adjust pit design during excavation and construction. Monitoring requirements will be specified as part of an environmental agreement or required through the NWT Mines Safety Act.

9.8 SOCIO-ECONOMICS

9.8.1 Effects Resulting from Environmental Changes

a) Human Health

Diavik will be required to modify its Aquatic Effects Monitoring Program and Air Quality Monitoring Program in accordance with the environmental agreement and/or the Fisheries Act (FA) authorization. The environmental agreement or FA authorization will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program that will be specified in the environmental agreement or FA authorization will also require Diavik to:

i) a) monitor radon levels at all times, to ensure that levels stay below the guideline limit of 800 Bq/m^3;
   b) predict radon levels for underground mining, and
   c) prepare a radon monitoring plan that ensures worker safety and include routine analysis and monitoring of rock for other radionuclides.

ii) undertake routine monitoring of CO, SO_2 and NO_2 in the open-pits during the operational phase of the project in order to evaluate the effects of temperature inversions on air quality at the bottom of the open-pits, and

iii) monitor heavy metals, including mercury concentrations, in fish tissue to verify Diavik's predictions in relation to Health Canada's consumption guidelines.

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b) Heritage Resources

A lands instrument will specify how Diavik will monitor and evaluate the effectiveness of mitigation measures and how Diavik will determine if mitigation measures need to be modified over the course of the project. The follow-up program that will be specified in a lands instrument will also require Diavik to:

i) continue to work with appropriate Aboriginal governments/organizations on the cultural importance of archaeological sites within the local study area;
ii) examine ways to provide special protection to the possible burial site identified by the Yellowknives Dene First Nation, and
iii) ensure that environmental management plans reflect legal requirements to:
    a) protect archaeological sites by establishing and monitoring a 30 m buffer around such sites;
    b) impose strong penalties on employees and contractors who deliberately disturb archaeological sites;
    c) restrict employee access to sites and sensitive areas, and
    d) conduct an archaeological impact assessment at the Echo Bay quarry in consultation with the Aboriginal governments and organizations prior to permit issuance.

c) Socio-economic Conditions

The environmental agreement will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program that will be specified in the environmental agreement will also require Diavik to:

i) monitor the effects of its activities on outfitting operations within the wildlife regional study area through consultation with local operators and other affected parties/groups;
ii) develop a mutually agreeable mitigation strategy with Qaivvik Ltd, and
ii) monitor the effects of its activities on Aboriginal people using the Lac de Gras area for traditional purposes.

d) Fisheries

Diavik will be required to modify its Aquatic Effects Monitoring Program in accordance with the environmental agreement and/or the Fisheries Act (FA) authorization. The environmental agreement or FA authorization will specify how Diavik will evaluate and monitor the effectiveness of mitigation measures and how it will adjust mitigation measures, as required, over the course of the project. The follow-up program that will be specified in the environmental agreement and/or the FA authorization will also require Diavik to:

i) collect baseline information regarding the palatability and texture of fish in Lac de Gras, and
ii) undertake periodic monitoring of fish flesh for palatability and texture.

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9.8.2 Effects Not Resulting from Environmental Changes

A socio-economic monitoring agreement will provide a formal mechanism to ensure the mitigative measures outlined in Diavik's submissions (including its commitments document) and in the RAs conclusions of the comprehensive study report are appropriately implemented and monitored. The monitoring program is necessary to verify the impact of the project, verify whether commitments are being fulfilled, establish or confirm thresholds or "early warning" signs of change to trigger adjustment of mitigative measures or other actions where necessary. The parties will consider the North Slave Metis Alliance proposal for monitoring (see Appendix G). Details of the agreement will be further developed with the GNWT, Government of Nunavut, RAs, appropriate Aboriginal governments/organizations and Diavik and the following will guide its development.

Guiding Principles:

- cooperative approach for ongoing socio-economic management that is adaptive and flexible;
- development of capacity-building opportunities and achievement of sustainable development;
- a meaningful role for the appropriate Aboriginal government/organizations in the development and implementation of monitoring plans;
- identification of opportunities to discuss progress and problems encountered, recommend solutions and adaptations, and monitor the process;
- consideration of effective and efficient coordination of socio-economic effects monitoring in the Slave Geological Province;
- provide for flexibility over time, to accommodate unforeseen events;
- consideration of traditional knowledge in monitoring and follow-up activities, and
- monitoring will meet commonly accepted technical and ethical standards of traditional and scientific research.

Scope of Agreement:

At a minimum, the socio-economic monitoring agreement shall provide for:

- a statement of purpose;
- identification of monitoring objectives, mitigation and monitoring programs committed to by Diavik and as identified in the CSR;
- clearly defined elements of the follow-up requirements as identified in the CSR;
- the parties involved and their responsibilities (e.g. final decision-making, timing, financing and carrying out the follow-up program);
- mechanism to ensure that monitoring plans are developed or modified as required to ensure mitigation measures are successful;
- mechanism for dispute resolution and timing;
- security deposits if deemed necessary;
- identification of communities to be included in the monitoring programs;
- identification of public participation/involvement, and
- reporting requirements.

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The objectives of the follow-up program for inclusion in the socio-economic monitoring agreement are to:

i) develop indicators, monitor and verify predictions of the project's effects on cultural well-being (including effects of closure, rotational work and in-migration) and develop action plans for alternative mitigation where necessary;
ii) develop indicators, monitor and verify predictions of the project's effects on community wellness (including effects of closure, rotational work and in-migration) and develop action plans for alternative mitigation where necessary;
iii) develop indicators, monitor and verify predictions of the project's effects on social stability (including effects of closure, rotational work and in-migration) and develop alternative mitigation where necessary;
iv) monitor and verify predictions with respect to economic diversification for opportunities for northern business development (i.e. mine purchases and other goods and services) and develop action plans to accomplish this;
v) monitor and verify predictions of proposed project effects on public services and infrastructure (social and physical);
vi) monitor Diavik's hiring and turnover rates in order to confirm predictions;
vii) monitor and verify predictions of employment levels at the Diavik mine and develop action plans for training;
viii) monitor changes in Diavik's employee pursuits in traditional economies due to the transition from traditional to wage economies;
ix) monitor in-migration and verify predictions of the proposed project's impact on competition for community land and resources, and also the impact of the project on competition for human resources, and
x) monitor and verify Diavik's predictions regarding the cumulative socio-economic effects in the regional study area.

9.9 RESOURCE SUSTAINABILITY

No follow-up is required.

9.10 CUMULATIVE EFFECTS

Follow-up requirements have been identified in each of the subsections of Chapter 9.

See Chapter 10 for information on regional cumulative effects monitoring not specifically related to the proposed Diavik project.

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10.0 SUMMARY

This comprehensive study report for the proposed Diavik Diamonds Project was prepared in accordance with the requirements of the Canadian Environmental Assessment Act (CEAA). The guidance documents provided by the Canadian Environmental Assessment Agency, including the Guide to the Preparation of a Comprehensive Study and the RA Guide, were followed. The Department of Indian Affairs and Northern Development (DIAND), the Department of Fisheries and Oceans (DFO) and the Department of Natural Resources Canada (NRCan), as the responsible authorities (RAs) under CEAA, coordinated the study process and completed the comprehensive study report.

All CEAA section 16(1) and 16(2) factors were included for consideration in the comprehensive study. The RAs, in consultation with federal authorities and other parties, developed guidelines for the environmental assessment that detailed the section 16 factors as well as the scope of these factors. The RAs also took into account the factors which must be considered under the Mackenzie Valley Resource Management Act, which came into force (with the exception of Part IV) in December 1998.

The RAs considered information contained in Diavik's environmental assessment and supplemental information submissions; comments from federal and territorial governments, Aboriginal governments/organizations, non-government organizations and the public; recommendations from meetings, workshops and technical sessions, and correspondence received on the public registry. This information was adequate for the RAs to reach conclusions on the likelihood of environmental effects as a result of the proposed project.

10.1 OVERVIEW

Diavik Diamond Mines Inc. (Diavik), jointly owned by Rio Tinto plc and Aber Diamond Mines Ltd., proposes to mine four diamond-bearing kimberlite pipes at Lac de Gras, Northwest Territories. Mining facilities would be situated on an island, with open-pits and water retention dikes located just offshore in Lac de Gras. Diavik proposes to commence construction in 2000. After the start-up year, kimberlite would likely be mined and processed at a rate of 1.5 to 1.9 Mt/y in a typical year. The life of the mine is estimated to be 16 to 22 years. Total reserves are estimated at 102 million carats with an approximate value of $US 56 per carat. Removal of buildings, regrading and ecological restoration would be completed 5 years after closure of the mine.

Diavik submitted its project proposal to government in March 1998. Government determined that NRCan and DFO were RAs with law list triggers and DIAND was an RA with law list and land administration triggers. Environment Canada was identified as a federal authority (FA) as were Transport Canada and Health Canada. With input from the public, the RAs concluded that the project would be assessed by way of a comprehensive study in May 1998. DIAND was identified as the lead RA and established a public registry in Yellowknife. In June 1998, the RAs, in consultation with Aboriginal governments/organizations, Diavik, other government agencies and non-government organizations including environmental ones, developed a management structure for the

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review of the proposed project. The management structure outlined roles for a RA caucus, steering committee, experts pool and project secretariat, as well as for stakeholder organizations and members of the public.

The scope of the proposed Diavik Diamonds Project was defined in the environmental assessment guidelines, which were prepared by government and provided to Diavik in August 1998. The scope of the project was determined by the RAs, in consultation with the federal authorities (FAs) and other parties and includes the construction, operation, closure and post-closure or any other undertaking in relation to the project.

Diavik completed an environmental assessment submission and submitted it to the RAs in September 1998. The submission consisted of an environmental assessment overview, six environmental effects reports (climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources, and socio-economic conditions), an Environmental Management System and an integrated socio-economic and environmental baseline report.

Diavik's environmental assessment submission described four years of investigations and consultations on the environmental and socio-economic conditions of the region. Baseline conditions were documented and analyses were conducted on the effects of the proposed project on socio-economic conditions, heritage resources, air quality, vegetation and terrain, wildlife, and fish and water. Diavik integrated concerns about potential environmental and socio-economic effects and incorporated mitigation measures into the design of the proposed project.

In 1994, Diavik initiated consultation with the Dogrib Treaty 11 Council, Akaitcho Treaty 8 Tribal Council, Yellowknives Dene First Nation, Lutsel K'e Dene First Nation, North Slave Métis Alliance, and Kitikmeot Inuit Association as well as Dene, Métis and Inuit communities. Consultations were also conducted with municipal, territorial and federal governments, non-government organizations, the business community and the public.

As part of the public involvement plan, further information sessions, general information meetings and consultations with communities began in October 1998 and were conducted to provide opportunities for the public to identify and express concerns about the proposed project and the environmental assessment report. During and following community consultations, RAs undertook a technical review of Diavik's environmental assessment submission. The review involved federal, territorial and external expertise, including that provided by the Aboriginal governments/organizations. The review included technical meetings held in various communities and culminated in a 10-day public technical review session in late February and early March 1999. Additional workshops on caribou, nutrients, No Net Loss, and project alternatives were held in March and April 1999.

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10.2 ENVIRONMENTAL EFFECTS

The comprehensive study included consideration of the potential effects:

- of the project on environmental components (climate and air quality, vegetation and terrain, wildlife, fish and water, heritage resources and socio-economic and socio-cultural conditions);
- of environmental changes on human health, socio-economic conditions, physical and cultural heritage, current use of lands and resources for traditional purposes by Aboriginal persons and significant structures, sites or things;
- including socio-economic effects not directly related to environmental change;
- including cumulative environmental effects;
- of project alternatives;
- of the project on the sustainable use of renewable resources;
- of the environment on the project, and
- of possible malfunctions or accidents.

The methods used by Diavik to predict effects and the significance of residual environmental effects were largely accepted by the RAs.

Throughout Diavik's pre-submission consultation and the environmental assessment process, the following potential effects of the project were consistently raised by various parties as areas of concern:

- degradation of air quality from dust;
- detrimental changes to caribou behaviour and migration;
- grizzly bear mortality;
- degradation of water quality from metals, suspended solids and nutrient introductions;
- loss of fish and fish habitat;
- impairment of water quality from effects of the mine infrastructure on ground water and permafrost;
- loss of heritage resources;
- loss of potential for other commercial land use or for traditional land use;
- limitations to employment and training opportunities;
- loss or reduction in social well-being, and
- effects on drinking water quality.

The concerns raised during the comprehensive study were addressed by Diavik to the general satisfaction of the RAs. In most instances, there was consensus of support from the FAs, GNWT, Government of Nunavut and Aboriginal organizations for the RAs' conclusions that there would be no significant adverse effects from the project, subject to required monitoring and mitigation.

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10.3 MITIGATION

Mitigation includes measures taken into account by Diavik in the design of the project in Diavik's environmental management plans, as well as those identified through the technical sessions. The RAs considered that the mitigation measures proposed by Diavik to address potential biophysical and socio-economic effects are appropriate. Mechanisms are required to ensure the co-operative development and implementation of mitigation measures and management strategies. These mechanisms include environmental and socio-economic monitoring agreements, regulatory approvals with terms and conditions, and Diavik's Environmental Management System. The agreements and regulatory approvals must be in place before the project proceeds.

10.4 OUTSTANDING ISSUES

Although not an issue for the proposed Diavik project, the RAs recognize that there is a need to move beyond the monitoring of individual project effects and use regionally focussed research results to make and test hypotheses of cumulative effects in the Slave Geological Province. As understanding emerges, these results can be used to develop ecological thresholds for new development proposals. The increased understanding of cumulative effects would be used to identify carrying capacities and protected areas, and provide a context for future development in the region. While not a condition of the Diavik project approval, DIAND will convene a major workshop in the fall of 1999 to review progress on and develop an overall framework for cumulative effects management. DIAND will also discuss with the involved parties the potential to extend, refocus and restructure the West Kitikmeot Slave Study to address cumulative effects.

The North Slave Métis Alliance (NSMA) is collecting baseline ecological, economic, social and cultural information that it feels is required to monitor, measure and manage impacts relevant to NSMA concerns. The RAs feel there has been sufficient information to reach the conclusions set forth in the comprehensive study report and note that the NSMA has participated fully as a member of the Diavik review steering committee. DIAND and Diavik have provided funding for further NSMA study and reports and Phase I of the report will be completed by June 30, 1999 and will be submitted to the Minister of the Environment; Phase II will be completed by April 2000.

The Dogrib Treaty 11 Council did not take up its seat on the Diavik Review steering committee and has conducted an independent review of the project. The Council has written to DIAND and advised that government, "should not delay (its) schedule for completing the comprehensive study to accommodate the timing of the Dogrib report. Our timeline for the Working Group Review is independent of government's schedule for completing the assessment". The Dogrib Treaty 11 Council intends to submit its report directly to the Minister of the Environment and the Minister of Indian and Northern Affairs during the 30-day public review period of the comprehensive study report.

While the RAs agree that the Diavik project would not have significant adverse effects on the Bathurst caribou herd, the RAs also recognize the concerns related to the long term well-being of the herd in the context of future cumulative effects. The RAs encourage the GNWT and the Government of Nunavut to take the lead in developing a Bathurst caribou management plan and to consider the creation of a Bathurst caribou management board.

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10.5 FOLLOW-UP

The follow-up programs are required to verify the accuracy of the environmental assessment and determine the effectiveness of measures taken to mitigate adverse environmental effects of the project. Additional follow-up requirements outlined in Chapter 9 of the comprehensive study report are required to address specific environmental and socio-economic concerns.

Where a regulatory instrument is required for the project to proceed, follow-up requirements will be specified as terms and conditions by the regulatory authority. If approved, the proposed project would require: a Class A Water License under the Northwest Territories Waters Act; a Fisheries Act Authorization; a Navigable Waters Protection Act Permit; a Territorial Lands Act Land Use Permit, Quarry Permit and five leases; and an Explosives Act Permit.

The design and implementation of follow-up measures specified in this comprehensive study report that are not attached to a regulatory instrument will be assured through environmental and socio-economic monitoring agreements as discussed in Chapter 9. These agreements must be in place prior to the project proceeding.

DIAND will lead the development of an environmental agreement to establish the responsibilities of Diavik and federal, territorial and Aboriginal governments/organizations in the co-operative development, on-going review and modification of follow-up programs concerning the biophysical environment. Specific topics to be addressed in the agreement are described in the follow-up section of this comprehensive study report (Chapter 9).

A socio-economic monitoring agreement to establish the appropriate responsibilities of all parties in the co-operative development, on-going review and modification of follow-up programs concerned with the socio-economic environment will also be developed. The GNWT is currently leading this initiative. Specific topics to be addressed are described in the follow-up section (Chapter 9).

10.6 RA CONCLUSIONS

Input from the public was actively solicited and these comments were considered throughout the comprehensive study review. Comments received by the RAs in the course of the review were considered and addressed in the RA conclusions in Chapter 8 of this report and in the follow-up programs in Chapter 9. RAs provided a written response to comments received in writing and questions raised during public sessions were addressed during the session or followed up on in writing.

Mitigation measures that are technically and economically feasible that would mitigate any potentially significant adverse environmental effects of the project have also been incorporated in the conclusions and follow-up.

Alternative means of carrying out the project were considered in the comprehensive study. The potential environmental effects of the technically and economically feasible alternative means were assessed. The RAs accepted Diavik's preferred alternative; this alternative is not likely to result in significant adverse environmental effects should the project proceed. The RAs support Diavik's policy of continuous improvements to its mining plan and require Diavik to consider improvements on an ongoing basis.

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The follow-up program proposed by Diavik is adequate to verify the accuracy of the assessment and to determine the effectiveness of mitigation measures. Additional follow-up requirements outlined in the comprehensive study report are required to address specific environmental and socio-economic concerns. The detailed design and implementation of the follow-up program will be assured through environmental and socio-economic monitoring agreements, terms and conditions to regulatory approvals and Diavik's Environmental Management System.

The capacity of renewable resources to meet the needs of present and future generations is not likely to be significantly affected by the proposed project. The responsibility for the sustainable development of resources is the shared responsibility of governments, Aboriginal organizations, industry and the public.

With the implementation of appropriate mitigation measures, the Diavik Diamonds Project is not likely to cause significant adverse environmental effects. This determination includes consideration of the cumulative environmental effects that are likely to result and the environmental effects of malfunctions or accidents that may occur in connection with the project.

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11.0 REFERENCES

The following list of literature represents sources consulted in the preparation of the Comprehensive Study Report for the Diavik Diamonds Project. The list is not intended to be all-inclusive of references on the Diavik Project.

Acres International Ltd. 1998. Water Retention Dikes-Design Report. Prepared for Diavik Diamond Mines Inc.

Axys Environmental Consulting and Penner and Associates. Environmental Effects Report, Wildlife. Prepared for Diavik Diamonds Project.

Axys and UMA Group. 1998. Human Use of the Lac de Gras Area, August 1998 (Human Use). Prepared for Diavik Diamonds Project.

Canada. 1992. Canadian Environmental Assessment Act, Amendments and Regulations.

Canadian Environmental Assessment Agency. 1994. The Responsible Authority's Guide to the Canadian Environmental Assessment Act. Hull, Quebec.

Canadian Environmental Assessment Agency. 1997. Guide to the Preparation of a Comprehensive Study for Proponents and Responsible Authorities. Hull, Quebec.

Cirrus Consultants. 1998. Environmental Effects Report, Climate and Air Quality. Prepared for Diavik Diamonds Project.

Cirrus Consultants. 1998. Air Emissions Evaluation-BHP. Prepared for Diavik Diamonds Project.

Department of Indian Affairs and Northern Development, 1998. Environmental Assessment Guidelines for Completion of a Comprehensive Study of Proposed Diavik Diamonds Project. Departments of Indian Affairs and Northern Development, Fisheries and Oceans and Natural Resources. Yellowknife, NWT.

Department of Indian Affairs and Northern Development, 1998. Comprehensive Study Management Structure for the Review of a Comprehensive Study of the Proposed Diavik Diamonds Project. Departments of Indian Affairs and Northern Development, Fisheries and Oceans and Natural Resources. Yellowknife, NWT.

Department of Indian Affairs and Northern Development, 1998 (draft). Public Involvement Plan for the Preparation of a Comprehensive Study Report on the Proposed Diavik Diamonds Project. Departments of Indian Affairs and Northern Development, Fisheries and Oceans and Natural Resources. Yellowknife, NWT.

Diavik Diamond Mines Inc. 1997. Diavik Meteorology and Ambient Air Quality Database 1994 - 1997.

Diavik Diamonds Project (Diavik). 1998a. Diavik Diamonds Project Description Submission (Project Description Submission).

Diavik Diamonds Project (Diavik). 1998. Integrated Socio-Economic and Environmental Baseline Report.

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Diavik Diamonds Project (Diavik). 1998. Environmental Management System (EMS).

Diavik Diamonds Project (Diavik). 1998. Environmental Assessment Overview.

Diavik Diamonds Project (Diavik). 1998. Issues Database.

Diavik Diamonds Project (Diavik). 1998. Executive Summary for the Diavik Environmental Assessment.

Diavik Diamonds Project (Diavik). 1998. Aquatic Effects Monitoring Program.

Diavik Diamonds Project (Diavik). 1998. No Net Loss Plan.

Diavik Diamonds Project (Diavik). 1998. The Permafrost Environment at the Diavik Project Site (Permafrost Environment). Prepared for Diavik Diamonds Project.

Fedirchuk McCullough & Associates Ltd. 1998. Environmental Effects Report, Heritage Resources. Prepared for Diavik Diamonds Project.

Geochimica Inc. and Sala Groundwater Inc. 1998. Final Geochemistry Baseline Report. Prepared for Diavik Diamonds Project.

Geochimica Inc. and Sala Groundwater Inc. 1998. Geochemical Impact Analysis Report. Prepared for Diavik Diamonds Project.

Golder Associates Ltd. 1998. Environmental Effects Report, Vegetation and Terrain. Prepared for Diavik Diamonds Project.

Golder Associates Ltd. 1998. Environmental Effects Report, Fish and Water. Prepared for Diavik Diamonds Project.

Golder Associates Ltd. 1998. Vegetation and Land Cover Analysis for Maximum Mine Operations Phase, Year 2018. Prepared for Diavik Diamonds Project.

Graham, I. 1997. Overview Report: Diavik Project Geology. Prepared for Diavik Diamond Mines Inc.

IER Planning, Research and Management Services. 1999. Report on the Socio-Economic Impact Assessment (SEIA) Peer Review Diavik Diamond Mine. Prepared for DIAND, Yellowknife.

Nixon, D. 1998. Evaluation of Ground Thermal Conditions for Theoretical Global Warming Scenario: Prepared for Diavik Diamond Mines.

Penner and Associates Ltd. 1997. Wildlife Baseline Studies, Progress Report, 1995 and 1996 Investigations, Diavik Diamond Mines Inc. Project, Lac de Gras, NWT. Draft. Prepared for Diavik Diamond Mines Inc.

Penner and Associates Ltd. 1997. Wildlife Studies Maps: Diavik Diamond Mines Inc. Project. Prepared for Diavik Diamond Mines Inc.

Penner and Associates Ltd. 1997. Wildlife Studies Maps. Prepared for Diavik Diamond Mines Inc.

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Penner and Associates Ltd. 1998. Wildlife Baseline Report. 1995-97. Prepared for Diavik Diamond Mines Inc.

UMA Group. 1998. Environmental Effects Report. Socio-Economics. Prepared for Diavik Diamonds Project.

Yellowknives Dene First Nation Elders Advisory Council. 1997. Weledeh Yellowknives Dene, A Traditional Knowledge study of Ek'ati prepared and approved in 1997 by the Yellowknives Dene First Nation Elders Advisory Council.

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