INTERIM CLOSURE
AND
RECLAMATION PLAN

Version 2
September 2006

Golder Associates Ltd.

Document Control #: RPT-197 Ver. 0

EXECUTIVE SUMMARY

This Interim Closure and Reclamation Plan has been prepared as per the requirements of DDMI's Class "A" Water License. The report, along with its companion document titled Cost Estimates for Interim and Final Restoration Plan, August 2001, details the complete Interim Closure and Reclamation package.

Both reports describe major areas and main closure activities including engineering design, research objectives and planning, as well as revegetation and fish habitat replacement and monitoring.

This plan outlines what can be expected in terms of costs of closure at various stages of operations, from premature shutdown through to scheduled closure.

An inherent component of closure and reclamation planning is the research and ongoing monitoring that will ultimately enable a Final Closure and Reclamation Plan to be completed. Several research programs are underway and this plan will be updated as the results of these studies become available.

Throughout the development of this Interim Closure and Reclamation Plan and the associated cost estimate, it became clear that synergies were available if progressive reclamation were to be carried out. The degree to which may be quite substantial due to the apparent viability of segregating potential acid generating rock in permanent enclosed and capped cells. With the addition of natural permafrost development, it is possible that a near "walk away" scenario can be achieved at the scheduled end of mine life.

Progressive reclamation will not only enable natural flora and fauna to establish early on in the project life but will provide for several years of monitoring data to be collected prior to planned shutdown. Given this extra time during operations, when a variety of professional scientific and engineering personnel are typically on-site, sound research programs should evolve; one which would include site specific solutions to problem areas. Of final significance is the expected annual reduction in bonding costs realized as credit for reclamation is progressively achieved.

This Interim Closure and Reclamation Plan also presents, on an interim basis, an updated reclamation schedule for the mine site. The schedule entails a progressive reclamation effort, which is planned to reduce the exposure of DDMI's environmental liability and maximize the benefit of operational resources throughout mine life to achieve final closure objectives.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The Diavik Diamonds Mine is an unincorporated joint venture established by Diavik Diamond Mines Inc. (DDMI) and Aber Diamond Mines Ltd. (ADM) to develop a diamond mine at Lac de Gras, in the Northwest Territories of Canada.

DDMI is a wholly owned subsidiary of Rio Tinto plc of London, England, while ADM is a wholly owned subsidiary of Aber Diamond Corporation of Toronto, Ontario, Canada. Under the Joint Venture Agreement, DDMI has a 60% participating interest in the project and ADM a 40% participating interest. DDMI has been appointed Manager and is the corporate entity responsible for conducting Project activities.

This document presents an updated Interim Closure and Reclamation Plan (Interim CRP) for the Diavik Diamond Mine per the requirements of Class "A" Water License N7L2-1645, and is the first update since the original Interim CRP submitted in 2001. Included in this document are:

- A brief Project history and summary of permit and authorization requirements relating to closure and reclamation (Chapter 1);
- Background to interim closure and reclamation planning at the Diavik Diamond Mine (Chapter 2);
- Site specific closure and reclamation standards and objectives (Chapter 3);
- A description of pre-disturbance environmental conditions at the mine site (Chapter 4);
- A description of the primary mine facilities and infrastructure (Chapter 5);
- Proposed interim shutdown measures (Chapter 6);
- Initiated, completed and proposed progressive reclamation measures (Chapter 7);
- Proposed permanent closure and reclamation measures (Chapter 8);
- A description of the anticipated post-closure environment and land-use (Chapter 9);
- An updated Reclamation Monitoring and Maintenance Plan (Chapter 10); and
- An updated closure and reclamation implementation schedule (Chapter 11).

The Reclamation Research Plan (DDMI June 2002) and Cost Estimate for the Interim and Final Restoration Plan (DDMI August 2001) were completed under separate covers and are companion reports to this document.

It should be noted that the Diavik Class "A" Water License uses the term "Abandonment and Restoration" in reference to the specific requirements for closure of the mine including progressive reclamation. In contrast, the current Mine Site Reclamation Guidelines for the Northwest Territories (DIAND 2006) utilizes the term "Closure and Reclamation". While Diavik assumes these terminologies to be synonymous with respect to closure planning for the mine, "Closure and Reclamation" has been adopted throughout this document for consistency purposes.

1.1 Site Location

The Diavik Diamond Mine is located on East Island, a 17 km^2 island in Lac de Gras, NWT, approximately 300 km northeast of Yellowknife (64°31' North, 110° 20' West) (Figure 1-1). The area is remote, and major freight must be trucked over a seasonal winter road from Yellowknife. Worker access is by aircraft to the mine's private airstrip.

The Diavik Diamond Mine involves open pit and selective underground mining of four diamond-bearing kimberlite pipes. The pipes, designated as A154North, A154South, A418, and A21, are located directly off shore of East Island (Figure 1-2). All mining, diamond recovery, support activities and infrastructure will be limited to East Island.

Overall, DDMI and ADM have a mineral claim to an area that includes portions of Lac de Gras, the East and West islands, and portions of the mainland to the southeast and northwest. Lac de Gras is about 100 km north of the treeline in the central barren ground tundra of the Northwest Territories, at the headwaters of the Coppermine River. This river, which flows north to the Arctic Ocean east of Kugluktuk, is 520 km long and has a drainage area of approximately 50,800 km^2.

The community of Wekweti lies approximately 187 km to the West South West of the mine site. Lutsel K'e is 230 km to the South, Bathurst Inlet is about 275 km to the Northeast, and the Lupin mine site is about 125 km to the north. The BHP Billiton Diamonds Incorporated Ekati Mine is located roughly 25 km to the north (Figure 1-1).

1.2 Project History

Aber Resources Ltd. began staking mineral claims in the Lac de Gras area of the Mackenzie Mining District, NWT, in November 1991. Through an option agreement dated June 1, 1992, Kennecott Canada Inc. ("Kennecott") acquired the right to earn a 60% Joint Venture interest in the Diavik claim blocks of Aber Resources Ltd. Kennecott exercised its rights under the option agreement following the discovery of the four diamond bearing kimberlite pipes just off the eastern shore of East Island. The Joint Venture was consummated on March 23, 1995 with Kennecott initially appointed as

Manager. Kennecott assigned its rights and interests to DDMI on November 29, 1996. Aber Resources Ltd. assigned its rights and interests to ADM on January 30, 1998.

On the basis of a Feasibility Study completed in July 1999, DDMI and ADM began actively proceeding with implementation of the project. The Diavik Diamonds Project Environmental Assessment documents were formally submitted to the Federal Government in September 1998, and in early November 1999 the Federal Minister of the Environment approved the Diavik Diamonds Project for permitting and licensing. On March 8 2000, an Environmental Agreement was signed and the Department of Indian Affairs and Northern Development (DIAND), now Indian and Northern Affairs Canada (INAC), issued permits to allow DDMI to commence with construction activities.

The Diavik Diamond Mine commenced production in January 2003 producing approximately 3.8 million carats in 2003. Full production began in 2004 with a production target of 7 to 8 million carats. It is expected that the mine will produce approximately 107 million carats of diamonds over a 16 to 22 year mine life.

A historical summary of project milestones is provided in Table 1-1 below.

Table 1-1: Project Milestones

Date	Milestone
1991-1992	Aber stakes mineral claims
Mar 1992	Exploration begins
Jun 1992	Aber Resources forms joint venture with Kennecott Canada Exploration
1994-1995	Pipes A21, A154North, A154South and A418 discovered
Feb 1996	75-person exploration camp erected on-site
Jul 1996	5,900 metric tonne bulk sampling of A418 and A154S pipes completed
Nov 1996	Diavik Diamond Mines Inc. created, with head office in Yellowknife
Mar 1997	Bulk sample transported over the winter road to Yellowknife for processing. Approximately 21,000 carats of diamonds discovered
Jun 1997	Environmental baseline studies completed
Sep 1997	Pre-feasibility study completed
Mar 1998	Project description submitted to Federal Government triggering formal environmental assessment review under Canadian Environmental Assessment Act
Sep 1998	Environmental Assessment Report submitted and Comprehensive Public Involvement Plan initiated
Nov 1999	Federal Government approves project for permitting and licensing

Date	Milestone
Sep 2000	All necessary permits and licenses to bring mine into production received
Dec 2000	Investor approvals to build the mine received
Jan 2001	Mine construction begins
Oct 2001	Earthworks for the A154 dike completed
Jul 2002	A154 dike complete and dewatering commences
Dec 2002	Mine infrastructure construction virtually complete
Jan 2003	Start of diamond production
Jul 2003	Diavik Diamond Mine Official opening ceremony
Oct 2005	Earthworks for A418 dike completed

1.3 Permits and Authorizations

The Diavik Diamond Mine received ministerial approval under the Canadian Environmental Assessment Act in November 1999. On March 3, 2000, DDMI signed an Environmental Agreement with parties including the Federal Government, the Government of the Northwest Territories, and First Nations, and on March 31, 2000, the Federal Government issued DDMI 30 year land leases for the mine site (all expire 29 March, 2030) under the *Territorial Lands Act*. In August 2000, a Class "A" Water Licence (expires August 31, 2007) was granted under the *Mackenzie Valley Resource Management Act*, various fisheries authorizations were granted under the *Fisheries Act*, and a Navigable Waters Permit (expires August 3, 2030) was issued under the *Navigable Water Protection Act*. Energy, Mines, and Resources Canada issued an Explosive Permit (renewed annually with no expiry) in December 1999.

1.3.1 Water Licence Requirements

The water license for the Diavik Diamond Mine (Class "A" Water Licence N7L2-1645) sets out several conditions with respect to DDMI's right to alter, divert or otherwise use water for the purpose of mining. Specifically, Part L: Conditions Applying to Abandonment and Restoration of the Water License specifies that DDMI shall submit to the Board for approval…an Interim Abandonment and Restoration Plan (herein referred to as an Interim Closure and Reclamation Plan) in accordance with the Board's "Guidelines for Mines in the Northwest Territories" (September 1980, or subsequent edition) and the Canadian Dam Safety Guidelines.

The plan is to include specific closure and reclamation objectives and an evaluation of alternatives for the closure of each mine component. A summary of the specific requirements listed within the water license are provided Table 1-2.

In addition to the Interim Closure and Reclamation Plan, Part L of the Water License specifies that:

- DDMI shall annually submit to the Board, an updated estimate of the anticipated mine restoration liability at the end of the upcoming year (submitted under separate cover);
- DDMI shall submit to the Board a Restoration Research Plan describing planned, initiated and completed restoration research DDMI will undertake to address the objectives identified in Part L, Item 1 a) (submitted under separate cover); and
- DDMI shall submit to the Board a restoration monitoring program to evaluate the effectiveness of all progressive reclamation and to identify any modifications required to facilitate landscape restoration (Chapter 10 of this document).

Table 1-2: Concordance Table with Class "A" Water Licence N7L2-1645 Requirements. Part L, Conditions Applying to the Interim Closure and Reclamation Plan

Water License Item #	Requirement(s) of the Interim Closure and Reclamation Plan	September 2006 Interim Mine Closure and Reclamation Plan
1 a)	Specific abandonment and restoration objectives and an evaluation of alternatives for the closure of each mine component, including, but not limited to: i) open pits, water retention dikes, and related structures; ii) underground workings; iii) Processed Kimberlite Containment Facility, including the placement of coarse kimberlite material over PKC slimes, and water handling during placement; iv) Waste Rock Storage Facilities and the Drainage Control and Collection System; v) water management structures (dams, intake and delivery systems, treatment plants); vi) Dredged Sediment Containment Facility; vii) North Inlet Facility including, sediment containment, and water management; viii) borrow pits, ore storage stockpiles, and other disturbed areas; ix) surface infrastructure (Process Plant, camp, roads, and airstrip); x) all petroleum and chemical storage areas; xi) any other areas potentially contaminated with hazardous materials; xii) any facilities or areas, which may have been affected by development such that a potential pollution problem exists; xiii) contingencies for pit water treatment during closure; xiv) dike breach locations and sizes; and xv) restoration of aquatic habitat in all areas.	Ch. 3, Ch. 5 to 8

Water License Item #	Requirement(s) of the Interim Closure and Reclamation Plan	September 2006 Interim Mine Closure and Reclamation Plan
1 b)	A description of the detailed plans for reclamation, measures required, or actions to be taken, to achieve the objectives stated in the Board's Guidelines and Part L, Item 1 a) for each mine component.	Ch. 6 to 8, Ch. 10, Ch. 11
1 c)	A detailed description, including maps and other visual representation, of the pre-disturbance conditions for each site, accompanied by a detailed description of the proposed final landscape, with emphasis on the restoration of surface drainage over the restored units.	Ch. 4, Ch. 9
1 d)	A comprehensive assessment of materials suitability, including geochemical and physical characterization, and schedule of availability for restoration needs, with attention to top-dressing materials, including maps where appropriate, showing sources and stockpile locations of all reclamation construction materials.	Ch. 5, Ch. 6
1 e)	A description of the procedure to be employed for progressive reclamation, including details of restoration scheduling and procedures for coordinating restoration activities within the overall mining sequence and materials balance.	Ch. 7
1 f)	A description of any post-closure treatment that may be required for drainage water that is not acceptable for discharge from any of the reclaimed mine components including a description for handling and disposing of post-closure treatment facility sludges.	Sec. 8.8, Sec. 10.4
1 g)	A description of the plan to assess and monitor any ground water contamination during post-closure.	Sec. 4.1, Ch. 5 to 7, Ch. 10
1 h)	An evaluation of the potential to re-vegetate disturbed sites that includes the identification of criteria to be used to determine technical feasibility and alternative restoration options.	Sec. 10.3
1 i)	An identification of the research needs for restoration.	Ch. 7
1 j)	A description of how progressive reclamation will be monitored throughout the life of the mine, including an evaluation of the effectiveness of any reclaimed areas.	Sec. 10.3
1 k)	Details of closure measures proposed in the event of a premature or temporary shutdown at any time throughout	Ch. 6

Water License Item #	Requirement(s) of the Interim Closure and Reclamation Plan	September 2006 Interim Mine Closure and Reclamation Plan
	mine life.	
1 l)	A description of proposed means to provide long term maintenance of collection system and treatment plant.	Sec. 10.4
8	A restoration monitoring program to evaluate the effectiveness of all progressive reclamation and to identify any modifications required to facilitate landscape restoration.	Ch.10

1.3.2 DFO Authorization Requirements

The Diavik Diamond Mine is subject to the Authorization for Works or Undertakings Affecting Fish Habitat File No SC98001 ("Fisheries Authorization") issued by Fisheries and Oceans Canada (DFO August 2000). The Fisheries Authorization outlines reporting requirements and approvals, compensation requirements for the harmful alteration, disruption or destruction (HADD) of fish habitat, and requirements for compensation plans. DDMI must also produce monitoring plans to determine the effectiveness of all fish habitat enhancement and development efforts.

The Fisheries Authorization also stipulates that DDMI must meet the following specific requirements prior to final closure and reclamation of the enclosure dikes and open pits:

- DDMI shall provide updated estimates of pit water quality for each dike area a minimum of three months prior to anticipated date of commencement of habitat compensation works within each dike area;

- DDMI shall demonstrate that water quality will be acceptable to DFO prior to any dike breaching;

- If water quality within the diked area is unacceptable, DDMI shall submit a revised Compensation Plan (within six months of the unacceptable water quality results) for habitat compensation within the A21 area of Lac de Gras prior to implementing compensation efforts within the dike;

- Upon demonstration of acceptable water quality, DDMI shall commence with the Compensation Plan for each of the diked areas provided that the locations and sizes of dike breaches are as specified within the Navigable Waters Permit (DFO Canadian Coast Guard August 2000);

- DDMI shall ensure that habitat features within the dike areas upon completion of mining in each open pit (including depth, substrate type, size and configuration), are modelled after those features found in other productive areas of the lake, as well as incorporating traditional knowledge where applicable;

- DDMI shall submit a report on the habitat compensation efforts (a final calculations of actual habitat losses and habitat gains expressed as habitat units for each of the dikes) including and follow-up monitoring within one year of breaching of each dike; and

- DDMI shall maintain all habitat compensation as required, and monitor, verify and report on the effectiveness of the compensation efforts that will be outlined in Compensation and Monitoring Plans as approved by DFO.

1.3.3 Navigable Waters Permit Requirements

In accordance with the Navigable Waters Permit, DDMI must meet the following requirements prior to final closure and reclamation of the enclosure dikes and open pits:

- all internal fish habitat reefs shall be placed a minimum 2 m depth from lower water; and

- Dike breaches shall be 30 m width and minimum 2 m depth from low water.

1.3.4 Explosives Permit Requirements

In accordance with Explosives Permit requirements, DDMI must remove all explosives and ammonia nitrate off site prior to final closure and reclamation.

2. INTERIM CLOSURE AND RECLAMATION PLAN

2.1 Closure and Reclamation Plan Development Approach

In accordance with Mackenzie Valley Land and Water Board (MVLWB) Class "A" Water License N7L2-1645 and the Mine Site Reclamation Guidelines for the Northwest Territories (DIAND 2006), DDMI has prepared a Closure and Reclamation Plan (CRP) describing all the studies and plans related to the closure and reclamation of the mine site and all related mine facilities.

The CRP is required to be developed in three phases, as follows:

- Preliminary CRP: required in support of initial mine planning and permitting;
- Interim CRP(s): required within one year of granting the initial water license, and when there is a significant change to the mine plan, or at key milestones in the mine life; and
- Final CRP: required at least three years prior to anticipated final closure, or immediately following an unplanned closure.

The CRP aims to reduce exposure to environmental and third party liabilities during operations and beyond closure after the site has been abandoned.

A Preliminary CRP for the project was submitted in August of 1999 in support DDMI's application for the water license (DDMI August 1999). Based upon feasibility-level information, the Preliminary CRP was a statement of commitment by DDMI to fulfill specified environmental management requirements before the project is shut down and finally abandoned after approximately 20 years of mining.

Following granting of the initial water license, the Preliminary CRP was updated with the submission of the first Interim CRP in October 2001 (DDMI October 2001). The October 2001 report, which was submitted under the title "Interim Abandonment and Restoration Plan", presented a revised closure and reclamation plan based on detailed engineering design and mine construction completed to that point. This report in turn, updates the October 2001 submission based on current mine planning, and information and experience gathered from operations and ongoing restoration research and development.

This Interim CRP remains consistent with the previous CRP submissions. It is based on the concept that the overall mining project is designed and operated with final closure and reclamation in mind. Moreover, it integrates environmental and mine planning and adopts progressive reclamation throughout the project life cycle, where practically possible.

The Interim CRP includes the main components of the mine development and presents concepts for the closure and reclamation of each significant project component. Details on interim shutdown and progressive closure strategies aimed at minimizing final closure, abandonment and restoration requirements are also provided together with a reclamation monitoring and maintenance program to evaluate whether closure objectives are being achieved.

As with the previous CRP submissions, this Interim CRP is considered to be a dynamic document. At key times throughout the course of operations it will be revised and improved based on results of future environmental studies, performance monitoring data and operational changes. For this reason, the Interim CRP was designed to be flexible in order to accommodate latest technology, operational changes and new innovative ideas as they develop.

2.2 Guidelines and Regulations

This Interim CRP follows applicable regulatory guidelines, the principles of which are described in:

- Indian and Northern Affairs Canada Mine Site Reclamation Guidelines for the Northwest Territories (DIAND 2006); and

- Indian and Northern Affairs Canada Mine Site Reclamation Policy for the Northwest Territories (DIAND 2002).

This Interim CRP is also subject to several Federal and Territorial Acts and Regulations, which are listed in Table 2-1.

The overall approach to closure and reclamation planning for the Diavik Diamonds Project conforms to both corporate and established international guidelines for mine closure. Selected aspects of closure and reclamation planning completed for other mining operations in the Northwest Territories have been reviewed in the development of this plan.

Table 2-1: Relevant Federal and Territorial Acts and Regulations

Federal Acts and Regulations	Territorial Acts and Regulations
Arctic Waters Pollution Prevention Act and Regulations	*Commissioner's Lands Act* and Regulations
Canadian Environmental Assessment Act and Regulations	*Environmental Protection Act* and Regulations
Canadian Environmental Protection Act and Regulations	*Environmental Rights Act* and Regulations
Fisheries Act and Regulations	*Mine Health and Safety Act* and Regulations
Mackenzie Valley Resource Management Act and Regulations	*Science Act* and Regulations
Navigable Water Protection Act and Regulations	
Northwest Territories Waters Act and Regulations	
Territorial Lands Act and Regulations	
Transportation of Dangerous Goods Act and Regulations	

2.3 Closure and Reclamation Planning Team

DDMI has established an internal Closure and Reclamation Planning Team to assist with closure and reclamation planning for the mine. A schematic of the Team is presented in Figure 2-1 together with a general list of the roles and responsibilities of each team member in the design, review and implementation of the CRP.

2.4 Background Documentation

Project specific details and information contained in this Interim CRP have been sourced from a number of project related reports. As necessary, the reader is referred to the following reports for additional background information:

- Department of Fisheries and Oceans, 2000. *Authorization for Works or Undertaking Affecting Fish Habitat*. DFO File No. SC98001. August, 2000.

- Department of Fisheries and Oceans Canadian Coast Guard, 2000. *Project Approval under Navigable Waters Protection Act, Part 1 Section 5(1)*. August 3, 2000.

- Diavik Diamond Mines Inc., 1998. *Diavik Diamonds Project "No Net Loss" Plan*. August 1998.

- Diavik Diamond Mines Inc., 1999. *Diavik Diamonds Project Addendum to the "No Net Loss" Plan*. April 1999.

- Diavik Diamond Mines Inc., 1999. *Initial Abandonment and Restoration Plan – Version 1*. August 1999.
- Diavik Diamond Mines Inc., 2001. *PKC Facility Operation Plan*. June 2001.
- Diavik Diamond Mines Inc., 2001. *Cost Estimates for Interim and Final Restoration Plan*. August 2001.
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- Diavik Diamond Mines Inc., 2004. *Water Management Plan – Version 3*. March 2004.
- Diavik Diamond Mines Inc., 2004. *Rock Management Plan – Version 3*. September 2004.
- Diavik Diamond Mines Inc., 2006. *2005 Wildlife Monitoring Report*. March 2006.
- Diavik Diamond Mines Inc., 2006. *DDMI Site Water Balance – Submitted as Part of the Type A Water License Annual Report*. April 2006.
- Dillon Consulting, 2004. *Stream Habitat Design for the West Island Stream at the Diavik Diamond Mine*. March 2004.
- Golder Associates Ltd. 1998. *Integrated Environmental and Socio-Economic Baseline Report for Diavik Diamond Mines Inc*. March 1998.
- Golder Associates Ltd., 2003. *Report on Fish Habitat Design for the Pit Shelf Areas at the Diavik Diamond Mine*. March 2003.
- Golder Associates Ltd., 2005. *2005 PKC Investigation Update October 2005*. October 2005.
- Mackenzie Valley Land and Water Board Water License N7L2-1645 – Diavik Diamond Mines Inc. Effective August 2002, Revised and Amended May 2004.
- Neath, M.A., S.R. Wilkinson and B.L. Kwiatkowski, 2005. *Mine Reclamation at Diavik Diamond Mine, NWT – Substrates, Soil Amendments and Native Plant Community Development 2005 Annual Report*. December 2005.

- NISHI-KHON / SNC•LAVALIN, 1999. *Water Retention Dikes Final Design Report – Volume 1*. July 1999.

- NISHI-KHON / SNC•LAVALIN, 1999. *Diavik Diamonds Project – Drainage Ditches and Collection Ponds Design Report*. August 1999.

- NISHI-KHON/SNC•LAVALIN, 2001. *Processed Kimberlite Containment Facility Updated Design Report.* April 2001.

- NISHI-KHON/SNC•LAVALIN, 2001. *Country Rock & Till Storage Updated Design Report*. August 2001.

2.5 Glossary of Terms

The following terminology is utilized in this document following the definitions provided in the Mine Site Reclamation Guidelines for the Northwest Territories (DIAND 2006) and the DDMI Class “A” Water License (License Number: N7L2-1645):

Abandonment: The permanent dismantlement of a facility so it is permanently incapable of its intended use. This includes the removal of associated equipment and structures.

Acid rock drainage: acidic leachate, seepage or drainage from underground workings, pits, ore piles, waste rock, tailings, and overburden.

Alkalinity: A measure of the buffering capacity of water, or the capacity of bases to neutralize acids.

Backfill: Material excavated from a site and reused for filling the surface or underground void created by mining.

Baseline: A surveyed condition and reference used for future surveys.

Berm: A mound of rock or soil used to retain substances or to prevent substances from entering an area.

Biodiversity: The variety of plants and animals that live in a specific area.

Bioremediation: The use of micro organisms or vegetation to reduce contaminant levels in soil or water.

Biotite schist: A metamorphic rock containing a significant proportion of biotite (black) mica flakes, which are aligned in one main direction.

Board: The Mackenzie Valley Land and Water Board established under Part 4 of the Mackenzie Valley Resource Management Act.

Carat: A unit weight for precious stones: 1 carat = 200 mg.

Care and maintenance: A term to describe the status of a mine when it undergoes a temporary shutdown.

Closure: When a mine ceases operations without the intent to resume mining activities in the future.

Conductivity: A measure of the ability of water to pass an electrical current, which is affected by the presence of inorganic dissolved solids and organic compounds.

Construction: Activities undertaken to construct or build any components of, or associated with, the development of the Diavik Diamond Mine.

Contaminant: Any physical, chemical, biological or radiological substance in the air, soil or water that has an adverse effect. Any chemical substance with a concentration that exceeds background levels or which is not naturally occurring in the environment.

Contouring: The process of shaping the land surface to fit the form of the surrounding land.

County rock: The rock surrounding an intrusive igneous rock such as kimberlite.

Criteria: Detail to set precise measures of when an objective has been satisfied.

Cryosols: An order of mineral or organic soils that generally have permafrost within 1 m of the ground surface and soil layers that are frequently disrupted by freezing.

Cryoturbation: Mixing of soil due to freezing and thawing.

Decommission: The process of permanently closing a site and removing equipment, buildings and structures. Reclamation and plans for future maintenance of affected land and water are also included.

Dewatering: The removal or draw down of water from any water body or from ground water table by pumping or draining.

Diabase: A dark-gray to black, fine-textured igneous rock composed mainly of feldspar and pyroxene.

Dike: Temporary water-retaining structure designed for water control to enable safe open-pit and underground mining.

Dike cutoff wall: Seepage barrier constructed within a dike.

Dike seepage: Any water which passes through a dike.

Discharge: The release of any water or waste to the receiving environment.

Disposal: The placement, containment, treatment or processing of unwanted materials. This may involve the removal of contaminants or their conversion to less harmful forms.

Drainage: Excess surface or ground water runoff from land.

Dredging: Excavating and moving lake-bottom sediments and glacial till below the high watermark and from the bottom of Lac de Gras in the area of the footprints of the dikes.

Ecodistrict: A subdivision of an ecoregion which is characterized by distinctive assemblages of relief, geology, landforms, soils, vegetation, water and fauna.

Ecoregion: A subdivision of an ecozone which is characterized by distinctive regional ecological factors, including physiography, climate, soil, vegetation, water and wildlife.

Ecosystem: An ecological unit consisting of both biotic (living) and abiotic (nonliving) environment that interacts within a defined physical location.

Ecozone: An area at the earth's surface representative of large and very generalized ecological units characterized by various abiotic (nonliving) and biotic (living) factors.

Effluent: Treated or untreated liquid waste material that is discharged into the environment from a treatment plant.

Environment: The components of the Earth, and includes: land, water and air, including all layers of the atmosphere; all organic and inorganic matter and living organisms; and the interacting natural systems that include the aforementioned components.

Environmental Assessment (EA): An assessment of the environmental effects of a project that is conducted in accordance with the *Canadian Environmental Assessment Act* and its regulations.

Environmental Management System (EMS): A management system that incorporates environmentally and socially responsible practices into project operations.

Erosion: The wearing away of rock, soil or other surface material by water, rain, waves, wind or ice.

Esker: Glaciofluvial landform that occurs when meltwater deposits are left behind after glacier melts, resulting in long winding ridges of sediment.

Extensometer: An instrument used to monitor ground displacements.

Fish habitat: Areas used by fish for spawning, nursery, rearing, foraging and overwintering.

Freeboard: The vertical distance between the water line and the effective water containment crest on a dam's or dike's upstream slope.

Freshet: An increase in surface water flow during the late winter or spring as the result of rainfall, and snow and ice melt.

Geotechnical Engineer: A professional engineer registered with the Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories and whose principal field of specialization is the design and construction of earthworks in a permafrost environment.

Geothermal analysis: The analysis of temperature conditions below the ground surface.

Glacial till: Unsorted and unlayered rock debris deposited by a glacier.

Glaciofluvial deposits: Material moved by glaciers and subsequently sorted and deposited by flowing glacial meltwater. Consist primarily of course to medium grained sands, gravels, cobbles, and boulders.

Glaciolacustrine deposits: Material moved by glaciers and deposited in glacial lakes. Consist primarily of fine sands, silts and clay.

Groundwater: All subsurface water that occurs in rocks, soil and other geologic formations that are fully saturated.

Habitat: The place where an animal or plant naturally lives and grows.

Hummock: A bulging mound of soil having a silty of clay core that often develops in wet and/or permafrost conditions and shows evidence of movement due to regular frost action.

Hydraulic conductivity: Measure of the capacity of an aquifer to transmit water.

Igneous rock: Rock formed when molten rock cools and solidifies.

Inclinometer: A tilt sensor used to monitor the angle of an object with respect to gravity.

In-situ: A method of managing, treating or disposing of material "in place" in a manner that does not require the material to be physically removed or excavated from where it is located.

Kame: An irregularly shaped hill or mound composed chiefly of poorly sorted sand and gravel deposited by a sub-glacial stream as an alluvial fan or delta.

Kimberlite: A type of ancient rock that travelled up to the earth’s surface where it formed mini-volcanoes.

Kimberlite pipes: Volcanic deposits contained in steep-walled, cone-shaped cylinders.

Landfill: An engineered waste management facility at which waste is disposed of by placing it on or in land in a manner that minimizes adverse human health and environmental effects.

Lifts: A layer of rock placed to raise the height of a large rock pile.

Metal leaching: The mobilization and migration of metals from underground workings, pitwalls, ore piles, waste rock, tailings, and overburden.

Metal migration: The movement of dissolved metals in flowing water or vapour.

Mine plan: The plan for development of the mine, including the sequencing of the development.

Mine water: Any water that accumulates in any underground working or open pits.

Mitigation: The process of rectifying an impact by repairing, rehabilitating or restoring, the affected environment, or the process of compensating for the impact by replacing or providing substitute resources or environments.

Monitoring: Observing the change in geophysical, hydrogeological or geochemical measurements over time.

No Net Loss: A term found in Canada’s Fisheries Act. It is based on the fundamental principle of balancing unavoidable losses of fish habitat with habitat replacement on a project-by-project basis in order to prevent depletion of Canada’s fisheries resources.

Objectives: Objectives describe what select activities are aiming to achieve.

Pegmatite: A very coarse-grained igneous rock that has a grain size of 20 mm or more;

Permafrost: Ground that remains at or below zero degrees Celsius for a minimum of two consecutive years.

Permeability: The ease with which gases or liquids penetrate or pass through a soil or cover layer.

pH: A measure of the alkalinity or acidy of a solution, related to hydrogen ion concentration; a pH of 7.0 being neutral.

Piezometer: An instrument used to monitor pore water pressure.

Pit water: Water that seeps into and/or is collected within the pit.

Pore water pressure: The pressure of groundwater held within the spaces between sediment particles.

Pore water: The groundwater present within the spaces between sediment particles.

Post-closure: The period of time after closure of the mine.

Processed Kimberlite (PK): Processed material rejected from the process plant after the recoverable minerals have been extracted.

Processed Kimberlite Containment (PKC): A storage area for the kimberlite remaining after diamonds have been removed during processing.

Progressive reclamation: Actions that can be taken during mining operations before permanent closure, to take advantage of cost and operating efficiencies by using the resources available from mine operations to reduce the overall reclamation costs incurred. Progressive reclamation enhances environmental protection and shortens the timeframe for achieving the reclamation objectives and goals.

Project: The Diavik Diamonds Project, a joint venture between Aber Resources Inc. and Diavik Diamond Mines Inc.

Quaternary glaciation: Glaciation that occurred during Quaternary period or the geologic time period from the end of the Pliocene Epoch roughly 1.8-1.6 million years ago to the present.

Reclamation: The process of returning a disturbed site to a condition consistent with the original natural state or one for other productive uses that minimizes any adverse effects on the environment or threats to human health and safety.

Rehabilitation: Activities to ensure that the land will be returned to a form and productivity in conformity with a prior land use plan, including a stable ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values.

Remediation: The removal, reduction, or neutralization of substances, wastes or hazardous material from a site in order to minimize any adverse effects on the environment and public safety now or in the future.

Restoration: The renewing, repairing, cleaning-up, remediation or other management of soil, groundwater or sediment so that its functions and qualities are comparable to those of its original, unaltered state.

Revegetation: Replacing original ground cover following a disturbance to the land.

Riparian: Refers to streams, channels, banks and the habitats associated with them.

Risk assessment: Reviewing risk analysis and options for a given site, component or condition. Risk assessments consider factors such as risk acceptability, public perception of risk, socio-economic impacts, benefits, and technical feasibility. It forms the basis for risk management.

Runoff: Water that is not absorbed by soil and drains off the land into bodies of water.

Scarification: Preparation of a site to make it more amenable to plant growth.

Sediment: Solid material, both mineral and organic, that has been moved by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

Sewage: All toilet wastes and greywater.

Shoals: A shallow but submerged area isolated from the shorelines of a body of water.

Shoreline habitat: Area extending from the high water mark to the low water mark of a given water body.

Slurry: A mixture of fine rock and water that can be pumped.

Solifluction: The slow creeping of soil down a slope promoted by the presence of permafrost and caused by a combination of frost creep and the downslope movement of wet, unfrozen soil.

Spawning habitat: A particular type of area where a fish species chooses to produce and deposit its eggs.

Spillway: An engineered structure to facilitate the release of water from a water retention facility, often in an emergency. The spillway elevation is the elevation at which water begins to flow through the spillway structure.

Substrate: The material that comprises the bottom of a water body.

Surficial material: Deposits on/at the earth's surface.

Sump: A catch basin where water accumulates before being pumped elsewhere for storage, treatment or release.

Surface waters: Natural water bodies such as rivers, streams, brooks, ponds and lakes, as well as artificial watercourses, such as drainage ditches and collection ponds.

Sustainable development: The design, development, operation and closure of all mining activities so as to ensure the optimisation of post closure outcomes in terms of social, environmental and economic development needs and expectations.

Taliks: Unfrozen zones that can exist within, below, or above permafrost layers. They are usually located below deep water bodies.

Temporary shutdown: The cessation of mining and diamond recovery for a finite period due to economic or other operational reasons, with the intent to resume operations under more favourable conditions.

Thermistor: An instrument used to monitor temperature change.

Total dissolved solids (TDS): A measure of the amount of dissolved substances in a waterbody:

Total suspended solids (TSS): A measure of the particulate matter suspended in the water column.

Traditional knowledge: A cumulative, collective body of knowledge, experience, and values built up by a group of people through generations of living in close contact with nature. It builds upon the historic experiences of a people and adapts to social, economic, environmental, spiritual and political change.

Turbidity: The degree of clarity in the water column typically reflected as the amount of suspended particulate matter in a waterbody.

Waste Rock: All unprocessed rock materials produced as a result of mining operations that have no economic value.

Water equivalent: Depth of water contained within accumulated snow and ice.

Watershed: A region or area bordered by ridges of higher ground that drains into a particular watercourse or body of water.

Wetland: A swamp. Marsh, bog, fen or other land that is covered by water during at least three consecutive months of the year.

2.6 List of Abbreviations

ADM	Aber Diamond Mines Ltd.
AEMP	Aquatics Effects Monitoring Program
CCME	Canadian Council of Ministers of the Environment
CLAR	Clarification Pond
CLR	Clean Rock Cell
CRP	Closure and Reclamation Plan
DIAND	Department of Indian Affairs and Northern Development (Indian and Northern Affairs Canada)
DDMI	Diavik Diamond Mine Inc.
DFO	Department of Fisheries and Oceans (Fisheries and Oceans Canada)
EA	Environmental Assessment
EMP	Environmental Management Plans
EMS	Environmental Management System
HADD	Harmful alteration, disruption or destruction (of fish habitat)
INAC	Indian and Northern Affairs Canada
ISO	International Standards Organization
LOM	Life of Mine
MVLWB	Mackenzie Valley Land and Water Board
NCRTS	North Country Rock and Till Storage

NI	North Inlet
NIWTP	North Inlet Water Treatment Plant
NNLP	No-Net-Loss Plan
NWR	Northwest Rock cell
NWT	Northwest Territories
OLDSSF	Old Sediment Storage Facility
PIMS	Project Information Management System
PK	Processed Kimberlite
PKC	Processed Kimberlite Containment
QUAR	Quarry Cell
ROM	Run of Mine
SCRTS	South Country Rock and Till Storage
SED	Sediment Pond
SNP	Surveillance Network Program
SSTP	South Sewage Treatment Plant
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UCAF	Underhand cut and fill
WMP	Wildlife Monitoring Program
WTA	Waste Transfer Area
WWF	World Wildlife Fund

2.7 List of Units and Symbols

BTUs	British thermal unit
°C	degrees Celsius
° ’	Degrees, minutes
FeSi	Ferro-silicon
H : V	Horizontal to vertical
HP	Horsepower
ha	Hectare
km	Kilometre
km^2	Square kilometre
km/hr	Kilometres per hour

kV	Kilovolts
L	Litre
m	Metre
masl	Metres above sea level
m^3	Cubic metre
m^3/day	Cubic metres per day
m/s	Metres per second
mg/L	Milligrams per litre
ML	Million litres
mm	Millimetre
Mm^3	Million cubic m
Mt	Million tonnes (1 tonne = 1,000 kilogram)
Mt/yr	Million tonnes per year
MW	Million watts
NTU	Nephelometric turbidity units
%	Percent
v	Zonal velocity ratio (seismicity)
Z_a	Acceleration related seismic zone
Z_v	Velocity related seismic zone

3. CLOSURE AND RECLAMATION STANDARDS

3.1 Mine Closure and Site Abandonment

The continuing aim of closure and reclamation planning for the Diavik Mine site is to develop and implement responsible progressive reclamation strategies for cost effective closure of facilities and final site abandonment. This has been achieved through integrated mine and environmental planning, design for closure, and progressive closure. The objective is to minimize disturbance throughout the project life cycle, protect terrestrial and aquatic resources to the greatest extent practical, and include closure-oriented work during operations, thereby reducing mitigation requirements and the capital cost of ultimate closure.

From the outset, mine and environmental planning for the project has progressed as a series of iterative engineering and environmental investigations. Preliminary decisions on optimal facilities location and feasibility-level designs were resolved on a multidisciplinary basis. The final project designs were completed with the aim of minimizing environmental impact throughout the project life cycle. This has been achieved by applying the principles of designing for closure and use of practices suited to environmental management under northern conditions.

To date, DDMI has completed several integrated environmental and facilities design studies. These studies have assisted in the development of minimum impact and low maintenance systems for the protection of surface waters and aquatic resources and, to the extent possible, the maintenance of primary wildlife habitat function on East Island.

Development of final closure plans will continue to be based upon results of future studies, monitoring, and environmental and engineering performance assessments. For several project components, this involves a continuous process of re-appraisal and refinement before final implementation. These components are outlined in this report.

The following criteria will be considered in the selection process for final closure alternatives:

- environmental effectiveness;
- environmental impact of construction or installation;
- operational and maintenance requirements; and
- practicality and cost of construction or installation.

DDMI's CRP summary objectives are:

1) for the mine site and each of its facilities to be physically and geochemically stable over the long term;

2) for the mine site and each of its facilities to be safe for human and wildlife use over the long term;

3) for runoff from the mine site and each of its facilities to be of sufficient quality to be safe for the aquatic ecosystem of Lac de Gras; and

4) to have a final surface condition over all mine infrastructure and roads that will support and, if practical, enhance natural revegetation.

3.2 Ecological Restoration

The majority of the closure effort will be focused on Objective #1 – Physical and Geochemical Stability. This objective must be achieved in order to succeed in the others.

The complete restoration of pre-development terrestrial ecological characteristics is not possible. Published studies of plant succession following glacial retreat have indicated that natural soil and plant community development from early plant colonization to a stable climax may take several decades to achieve at transitional tundra latitudes (Crocker and Major, 1955). Therefore, the objective of the terrestrial ecological restoration plan for the Diavik Diamond Mine site is to rehabilitate selected targeted areas of disturbance to allow for longer term, natural soil development and plant community succession with possible assisted vegetation establishment. Other areas, such as Country Rock and PKC will remain barren and provide boulder field type wildlife habitat.

Ecological restoration of aquatic habitats is driven by two objectives:

(a) return and enhancement of habitat lost from Lac de Gras; and

(b) enhancement and habitat creation to replace aquatic habitat permanently lost on East Island.

3.2.1 Terrestrial Habitat Reclamation Strategies

The terrestrial habitat reclamation strategy aims to re-create several different terrestrial habitats within the project footprint by adopting a landscape unit design. The landscape unit design will focus on target wildlife species, and will include a diversity of landscapes including boulder fields and partially vegetated land.

If vegetation establishment is proven to be technically feasible, three alternative strategies for the re-introduction of pioneer and more advanced native vegetation on disturbed surfaces may be appropriate. These are summarized as:

- **The topsoil strategy**, which requires placement of topsoil or an alternative "cultivable" material, followed by a conventional approach to establishing indigenous vegetation;
- **The ameliorative strategy**, which does not require topsoil to be placed, but rather promotes the establishment of stress-resistant native species directly into an infertile substrate. Usually, the substrates require some chemical and/or physical improvement to create a soil-like condition; and
- **The adaptive strategy**, which also establishes native species directly into the substrate, but with less requirement for chemical and physical amendment of the material. This more cost-effective strategy uses varieties of native species, which have adapted to physical and chemical disturbances that may prevail at certain locations. It is particularly suited to the establishment of plants directly into mineralized substrates. Normal, non-adapted varieties would be severely compromised under such conditions.

The proposed strategy is to establish native vegetation in local topsoil or other cultivable media, which would be placed in random pockets over targeted areas scheduled for reclamation. DDMI's intention is to create pockets of growth in designated areas as opposed to complete revegetation. The areas targeted for revegetation are the south plant area, ammonium nitrate storage areas, the north camp area, and selected roadway sites.

3.2.2 Aquatic Habitat Restoration Strategy

As discussed in Chapter 1, one of the regulatory permits granted to DDMI was a DFO Fisheries Authorization. This Authorization allows DDMI to alter and or destroy fish habitat during the construction and operation phases of the mine.

The Authorization contains several conditions that need to be adhered to, including the development of detailed designs, specifications, and implementation plans that describe how DDMI plans to recreate fish habitat units (habitat) that may be lost from the development. This fish habitat creation/modification is to be in accordance with the No Net-loss Plan submitted to DFO in August 1998 (DDMI August 1998).

At the time of writing this Interim CRP, DDMI has partially implemented the approved fish habitat designs for the A154 pit area and is in the process of defining the detailed design and compensation work plan for the remainder of the fish habitat compensation program through consultation with communities and DFO science experts for ultimate submission and approval by DFO. Sections included later in this plan discuss specific design plans that DDMI is currently proposing. It should be noted that these plans may change pending approval by the DFO. Any changes will be reflected in subsequent revisions to this Interim Plan.

4. ENVIRONMENTAL CONDITIONS

This portion of the CRP describes the environmental conditions in the region and project area based on environmental baseline information collected during field sampling programs conducted in 1994/95, 1996 and 1997 (Golder March 1998).

4.1 Physical Environment

The Diavik Mine is located at Lac de Gras, about 300 km northeast of Yellowknife in the Northwest Territories (64^o 31’ North, 110^o 20’ West) (Figure 1-1). The project site is approximately 100 km north of the treeline, at the headwaters of the Coppermine River. This river, which flows north to the Arctic Ocean east of Kugluktuk, is 520 km long and has a drainage area of roughly 50,800 km^2.

The Lac de Gras area is characteristic of the north-western Canadian Shield physiographic region, with rolling hills and relief limited to approximately 50 m in elevation. The terrain in this area 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.

4.1.1 Climate Conditions

The project area lies within the Arctic Climatic Region where daylight reaches a minimum of 4 hours per day in winter and a maximum of 20 hours in summer. The climate is extreme, with long cold winters and very short cool summers. Temperatures are cool, with an average temperature in July of 10°C and -31°C in January. The mean annual air temperature at the site is approximately -10°C.

Winds are moderate to strong and generally from the west. Average wind speeds are about 20 km/hr with an estimated 100-year hourly wind speed of 128 km/hr out of the northwest.

The average annual precipitation is 373 mm; of this, approximately 40% occurs as rainfall (144 mm) and 60% occurs as snowfall (229 mm, water equivalent). Snow falls in every month, although rain generally only occurs between May and October. The net annual average runoff (precipitation minus evapotranspiration) is 171 mm.

4.1.2 Topography

The regional study area is part of the Slave Geological Province, which is located in the north-western portion of the Canadian Shield and within the continuous permafrost zone. Major elements of the landscape were shaped in pre-Quaternary times (i.e., before

1.64 million years ago); however, many details of the terrain are products of Quaternary glaciation (Fulton 1989).

The growth and decay of the Laurentide ice sheet of the Wisconsin ice age (about 9,500 years ago), have had the most significant effect on the terrain of this region (Fulton 1989), with eskers, boulder fields, and large exposed bedrock outcrops being major landscape features. The glacial deposits have been and continue to be modified by geomorphological processes, especially those associated with the annual freeze-thaw of the active layer of permafrost. Hence, the present landscape results from the interaction between the bedrock geology of the area, historical glacial activity and current geomorphological processes.

The terrain on East Island is characterized by steep sided bedrock ridges, undulating to strongly rolling slopes consisting of glacial till, ridged eskers and level to depressional glaciolacustrine and organic deposits. The topographical relief is low to moderate, with elevations ranging from 415 m above sea level at the shoreline of Lac de Gras to 445 m inland. Most of the terrain features are controlled by shallow bedrock and boulders are present on all portions of the island.

4.1.3 Surficial Geology

Soil development on East Island is restricted to pocketed areas within bedrock and till blankets, and in depressions and rock cervices where organic matter has accumulated. Maximum soil depths are typically less than 0.5 m thick and up to 2.0 m where organic matter has accumulated (Figures 4-1a and 4-1b).

Glacial till is the dominant surficial material on East Island, and overlies most of the bedrock. Glaciofluvial deposits are in the form of eskers and kames, and are most common on the north end of the island. Glaciolacustrine deposits occur mainly in lowland areas, while organic deposits typically overlie glaciolacustrine deposits near the lake shore. Shallow (< 1 m) organic deposits typically have large stones exposed at the surface.

All of the soils that have developed on East Island are Cryosols which have been influenced by varying degrees of cryoturbation. There are also numerous solifluction lobes on East Island. These lobes typically occur on slopes ranging from 10% to 25%, although they may occur on slopes as shallow as 2%.

Lakebed sediments are underlain by a layer of organic-rich lake bottom sediments overlying bouldery glacial till. The lake bottom sediments primarily consist of organic silts and clays and vary in thickness from 5 m to 8 m. The underlying till may reach a thickness of between 20 m and 30 m.

4.1.4 Bedrock Geology

The Lac de Gras regional study area is located in the central part of the Slave Geological Province of the Precambrian Shield. This province is 190 000 km^2 and lies in the middle of the Northwest Territories, bordered to the south by Great Slave Lake and to the north by the Coronation Gulf (Goodwin 1991) (Figures 4-2 and 4-3). One-third of the Slave Province is underlain by metasedimentary rocks of Archean age (dated at 3.96 billion years old) (EMPR 1995). The remainder is primarily underlain by intrusive igneous rock of granitic composition (2.3 to 2.6 billion years old) (Douglas 1970).

The surface expression of East Island is controlled by bedrock, with bedrock outcropping occurring over about 40 percent of the surface of the island. The bedrock geology of the island is dominated by granitic rock, with volcanic rocks such as diabase present in small proportions.

The Diavik diamond deposits occur in kimberlite pipes intruding in the granitoid country rock located under Lac de Gras adjacent to East Island. Material within the kimberlite pipes comprises three broad classes: hypabyssal kimberlite, volcanic and epiclastic kimberlite and xenoliths. Volumetrically the kimberlite pipes are dominated by volcaniclastic and epiclastic material, often with a significant xenolithic component. The hypabyssal phases are volumetrically less significant, occurring as feeders to the pipes at deeper levels and as contact intrusions along the pipe margins.

4.1.5 Geological Hazards and Seismicity

The site is situated in a region of low seismicity: Acceleration Related Seismic Zone $Z_a = 0$, Velocity Related Seismic Zone $Z_v = 1$, and Zonal Velocity Ratio v = 0.05.

4.1.6 Permafrost Conditions

The Diavik Diamond Mine site is located just north of the diffuse boundary between the widespread discontinuous and continuous permafrost, which generally coincides with the northern extent of trees (Heginbottom 1989; Johnston 1981).

Based on deep thermistor installation measurements, the permafrost has been confirmed to a depth of 150 m in the Lac de Gras area; however temperature projections from these thermistor installations also suggest that the permafrost may extend up to a depth of 240 m. The seasonal active layer in the vicinity of the mine site is about 1.5 m to 2.0 m deep in till deposits, 2.0 m to 3.0 m deep in well-drained granular deposits (eskers) and about 5 m in bedrock. In poorly drained areas including bogs, with thicker vegetation cover, the active layer is less than 1 m in depth.

The depth of the permafrost decreases towards Lac de Gras, and permafrost is absent beneath the lake itself. Other smaller lakes and very small islands in the region may also be underlain by unfrozen materials referred to as “taliks”.

4.1.7 Hydrogeology

In the Arctic, the relatively low amount of precipitation (<400 mm in Lac de Gras area) restricts the amount of water available to recharge aquifers. Permafrost in the Arctic terrain can act to reduce the movement of groundwater. Aquitards may be continuously present in ground that is frozen year-round (Prowse and Ommanney 1990).

Groundwater at the Diavik Diamond Mine site is contained within surface and lakebed sediments, and fractures contained within the country rock and kimberlite pipes. Currently, groundwater at the Diavik project site appears to have essentially no regional groundwater flow. This is likely the result of the combined effects of 1) the presence of Lac de Gras that acts as a boundary for water movement, 2) the low topographic relief, and 3) the presence of permafrost beneath the islands and the mainland.

The hydraulic conductivity of the lakebed sediments is estimated to be approximately 1×10^{-5} m/s. The hydraulic conductivity of the competent country rock is estimated to be approximately 5×10^{-8} m/s. Weathered and fractured zones of the country rock are considerably more permeable, with hydraulic conductivities of approximately 1×10^{-5} m/s and 1×10^{-6} m/s, respectively. The kimberlite pipes are more permeable than the competent country rock, with an estimated hydraulic conductivity of 1×10^{-6} m/s.

The hydraulic conductivity of the permafrost zone is very low (essentially zero). The hydraulic conductivity of the surface sediments has not been characterized, but is expected to vary in accordance with local lithology. Groundwater flow occurs in warmer seasons through the thin (0.5 m to 1.5 m thick) active layer near surface, but these flows are considered relatively small.

Groundwater sampled from boreholes and active seeps on the faces of declines in the vicinity of the A154 and A418 pipes in 1996 and 1997 indicated a slightly alkaline (pH near 8), moderate total dissolved solids (TDS; generally < 500 mg/L), Na-Mg-Ca – HCO3-(Cl) water. This general chemistry is consistent with water that has had a long residence time in a granitic terrain. The stable isotope geochemistry indicates that the groundwater recharged under a cold climate. The stable isotope and tritium signatures of ground water are distinct from those of water in Lac de Gras. Metals in the groundwater are low to very low, and radionuclides are very close to detection limits in all samples. There is a general trend of increasing concentration of most major species with depth.

4.1.8 Surface Water Hydrology

The Lac de Gras watershed is approximately 4,000 km^2 in area. Lac de Gras itself has a surface area of 572 km^2 and a capacity of roughly 6.7 billion m^3. The lake is about 60 km long, averages 16 km wide, and has a shoreline length of about 740 km. The average depth is 12 m, with a maximum depth of 56 m.

Although over 200 streams discharge to Lac de Gras, the principal inflow is through a narrow channel from Lac du Savage to the northeast. Most precipitation in the project area accumulates during winter as snow, which melts and runs off rapidly in early June. Stream flows peak during the spring snowmelt period. However, once the accumulated snow has melted, a vast majority of the streams dry up due to the small contributions of summer precipitation, which usually occurs as rain.

On average, Lac de Gras is covered by ice for about 240 days, typically from October 21 to June 26. The mean date of the first occurrence of permanent ice on East Island is October 9. The earliest and latest recorded occurrences are September 28 and October 27, respectively. The mean date for the lake to be clear of ice is June 26. The earliest and latest recorded occurrences are June 9 and July 14, respectively. The mean maximum ice thickness is 1.5 m; however, ice thickness can vary significantly over the lake due to currents and other factors.

The greatest outflow from the lake typically occurs in September, and lowest in March. The yearly average evaporative water loss from the lake is approximately 300 mm. The water level of the lake normally fluctuates between level 415.5 m and 416.0 m on an annual basis. The estimated maximum normal water level of the lake (2 year return period) is 415.85 m and the maximum 10,000 year water level is 416.70 m. The estimated maximum instantaneous water level at the project site is 420.5 m.

Lac de Gras has little or no sediment washed into it from the surrounding basin; annual sediment yield to Lac de Gras is 0.0003 mm.

4.1.9 Surface Water Quality

Lowland lakes, such as Lac de Gras, are oligotrophic and have low aquatic productivity. This is the natural result of relatively low concentrations of nutrients, low light levels during winter months, extended periods of ice cover and low water temperatures. The water quality is nearly that of distilled water.

The water of Lac de Gras contains low levels of dissolved substances. The water is very clear and contains low concentrations of nutrients such as phosphorous and nitrogen. Somewhat higher concentrations of nitrate can be found between the East and West Island compared to other areas in the lake. The pH generally ranges from 6.0 to 6.7. Usually metal concentrations are low but occasionally are greater than Canadian water quality guidelines for the protection of aquatic life. Lac de Gras does not appear to stratify, meaning that water temperatures do not vary significantly from the surface to the bottom. However, winter concentrations of dissolved oxygen on the east side of East island as well as between the East and West Islands decrease with depth to the point where there is not enough oxygen in the water at the bottom to support fish.

Water quality of the inland lakes is similar to water quality in the larger Lac de Gras, except that concentrations of some elements may be higher in inland lakes. In particular, winter concentrations of dissolved parameters in the inland lakes are greater than concentrations in Lac de Gras. This is likely because the effect of freeze out is more extreme in the smaller inland lakes due to the smaller volume of water available for dilution under the ice cover. Other noted elements that have been seen to be higher are both zinc and aluminium which may be due to the local geology around some of the inland lakes.

4.2 Biological Environment

The project area is located within the Southern Arctic Ecozone, as defined by Environment Canada and Agriculture Canada (ESWG 1995) (Figure 4-4). An ecozone is an area at the earth's surface representative of large and very generalized ecological units characterized by various abiotic (climate, geology, soil) and biotic (plants, animals) factors. There are 15 terrestrial ecozones in Canada.

Hudson Bay splits the Southern Arctic Ecozone into east and west portions, with over 80% of the land area in the western portion. It covers northern mainland Canada from the Richardson Mountains in the Yukon to Ungava Bay in northern Quebec. It has the most extensive vegetation cover and highest diversity of species of the three arctic ecozones identified by the Ecological Stratification Working Group.

Each ecozone is subdivided into ecoregions, which are characterized by distinctive regional ecological factors, including physiography, climate, soil, vegetation, water and wildlife (ESWG 1995). There are 217 terrestrial ecoregions in Canada. Lac de Gras and the Diavik Mine site are within the Takijuq Lake Upland Ecoregion of the Southern Arctic Ecozone.

Within the ecoregions are ecodistricts, which are characterized by distinctive assemblages of relief, geology, landforms, soils, vegetation, water and fauna. There are 1,030 terrestrial ecodistricts in Canada (ESWG 1995). The Diavik Mine falls within Ecodistrict 168 of the Takijuq Lake Upland Ecoregion.

4.2.1 Vegetation

The Diavik Project is located in the tundra biome of the central Canadian Arctic, in an area described as the Low Arctic. This is the transition zone between taiga and upper arctic tundra. The short growing season, with cool soil and subsoil temperatures has limited soil development that in turn has limited the establishment of either productive or diverse plant communities. Plant community types vary between dwarf tree/shrub wetlands and wet sedge meadows, to drier, raised hummock grassland associations, and non-vascular (moss-lichen) plant communities associated with rock outcrops.

The Heath Tundra plant community is the dominant plant community and represents the climax vegetation stage in the tundra biome. It covers most of the dry upland area at Lac de Gras. Sedge associations (sedge meadows) less than 20 m in diameter are also very common in the Lac de Gras area. These develop on nearly level slopes or in shallow depressions in areas where water accumulates on silty or organic soil. These little sedge meadows occur throughout the heath tundra, among boulder associations, or in depressions in bedrock outcrops, anywhere water collects on organic soil.

All exposed (not flooded) boulders in the area are about 80% covered with lichens, while lichen coverage on exposed bedrock ranges from 5% on smooth rock that is highly exposed to the wind to 80% on protected faces. Crests of many of the islands and peninsulas are covered with an additional association termed lichen veneer. This occurs mostly on gravelly surfaces where the snow layer is very thin in winter, and where exposure creates an extremely harsh microclimate.

Shoreline vegetation varies depending on the soil or bedrock material in the area, water depth and slope of shore. Most of the shoreline of Lac de Gras is covered by boulders. Little emergent or submergent vegetation grows along these shores. Similarly, cobble to gravel shores do not support much vegetation since wave action and unstable substrates make it difficult for plants to survive. Silt and sand shores, which occur in sheltered areas with gradual slopes, support emergent vegetation such as sedges. Riparian shoreline shrub communities are found along the shores of islands or peninsulas extending out into Lac de Gras and sporadically along all shorelines of Lac de Gras. Shoreline shrub communities consist of dwarf birches and willows growing in slumped areas near the water's edge. Other less common vegetation communities associated with Lac de Gras shorelines are grass ridges, sedge meadows and heath tundra.

Specific vegetation communities on East Island include esker complexes, heath tundra, sedge associations, riparian associations, boulder associations and lichen veneer. Island riparian associations contain dwarf birches and willow, but do not contain alder and spruce which are present on the mainland. As well, the understory is slightly less diverse than on the mainland, likely due to the slightly harsher climate.

In the immediate vicinity of the mine site, heath tundra is the most common association, followed by sedge associations, boulder associations, esker complexes, bedrock associations, riparian associations, and lichen veneer.

No rare plant species are reported in the literature for past collections in the Lac de Gras area, as summarized in McJannet et al. (1995). In addition, no rare plant species were found in any of the sites examined during the baseline study.

4.2.2 Freshwater Biota and Habitat

Based on nutrient levels in lake water, Lac de Gras is classified as ultra-oligotrophic. A small, isolated area between the East and West Island together with the unique, riverine habitat between Lac de Gras and Lac du Sauvage (referred to as the Narrows) are the main areas where aquatic plants can be found. Generally, Lac de Gras only supports marginal growth of aquatic plants.

Most of the energy required by aquatic organisms in the lake must come from algal production. Phytoplankton growth is highly seasonal, depending on light availability, nutrient levels and grazing by zooplankton. In the spring, algae begin to multiply under the ice and typically undergo dramatic changes in standing stock through the short Arctic summer. Phytoplankton production is essentially zero during the winter, when the light level under the thick ice cover of Arctic lakes is too low to support algal growth.

The phytoplankton community in Lac de Gras is typical of other oligotrophic lakes at northern latitudes. The species of algae present are largely motile, nanoplanktonic (i.e., very small) forms. The community is dominated by relatively few taxa, compared to more southern waterbodies, and includes members of the families Chrysophyceae (golden-brown algae) and Chlorophyceae (green algae), and the Cyanobacteria (blue-green algae).

Lac de Gras supports a zooplankton community that is also typical of northern lakes in that it is dominated by several key species. Members of the Phylum Rotifera (rotifers) are dominant in terms of abundance over all other zooplankton species; the crustacean Suborder Cladocera and Class Copepoda are present in roughly equal numbers but are secondary. Benthic invertebrates are small animals such as insect larvae, worms, clams and crustaceans that live on the bottom of lakes. These organisms feed on a variety of materials, including algae growing on rocks, decaying algae and zooplankton that sink to the bottom, and other benthic invertebrates. Benthic invertebrate abundance can also vary considerably among seasons. The abundance of these organisms is controlled by a number of factors such as food availability, feeding by fish and life cycle processes. In arctic lakes, the dominant members of this group (chironomid midges) emerge from the lake as winged adults once their larval life stage is complete.

The benthic community of Lac de Gras is characterized by low density and few species. This reflects low nutrient levels and water temperature, a short season of primary production and the lack of a well-developed littoral zone, which limit primary production in the lake. Invertebrate density varies considerably among different areas of the lake, suggesting a patchy distribution on the lake’s bottom. The benthic community is dominated by chironomid midge larvae, which are represented largely by five common genera (Corynocera, Procladius, Stictochironomus, Tanytarsus, Micropsectra) and small larvae that could not be identified to a lower level in the Subfamily Orthocladiinae. Other common invertebrates include nematode worms, small clams in the Family Sphaeriidae, oligochaete worms, ostracods and aquatic mites.

The fish community in Lac de Gras consists of nine species which are present in variable abundance. These species include lake trout (*Salvelinus namaycush*), cisco (*Coregonus artedii*), round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), slimy sculpin (*Cottus cognatus*), longnose sucker (*Catostomus catostomus*) and northern pike (*Esox lucius*). The community in general is stable and slow growing, and is characteristic of the cold, ultra-oligotrophic status of Lac de Gras. Despite the low productivity of the lake, the biomass of fish is high. This is due largely to the long life of the species present. It is important to note that the presence of a substantial fish community under nutrient poor conditions is representative of the incremental accumulation of low annual production over many years.

Shorelines of Lac de Gras are covered by boulders which make the shorelines vary from unsuitable to moderately suitable for fish spawning, nursery/rearing, and foraging. The bottom of Lac de Gras is very uneven and shallow shoals (1 m – 10 m deep) are prevalent throughout open areas of the lake. Shoals in Lac de Gras provide fair to good quality spawning habitat for lake trout and cisco.

The shorelines of the inland lakes are also dominated by boulders. Fish species found in the inland lakes on the east island include lake trout, round whitefish, cisco, lake whitefish, lake chub and longnose sucker. Of the 11 inland lakes surveyed on the east island, one is of high importance, two are of moderate importance, and five are of low importance to inland lake fisheries.

No sentinel fish species have been observed in any of the streams originating from the east island. This is likely due to the ephemeral nature of the streams on the island. Even during spring melt, the flow in streams of the east island is dispersed through sedge meadows with no distinct channel.

4.2.3 Terrestrial Wildlife and Habitat

The predominant natural land use in the Lac de Gras region is wildlife habitat. Mammals that reside in the area year-round are generally denning animals such as wolverines, grizzly bears, foxes, ground squirrels and ermine that are able seek shelter from the harsh winter conditions. Caribou feed and calve in the tundra but generally move to the taiga during the winter since the trees provide shelter and food. Predators such as wolves follow the caribou to the treeline.

Large waterbodies such as Lac de Gras have an influence on local caribou migration patterns. Spring migration movements across the ice on Lac de Gras tend to be towards nearest points of land including East Island and West Island. In the fall, when return movements from the north are often blocked by Lac de Gras, the caribou seek the easiest route to by-pass the lake. Occasionally this takes caribou onto East Island and West Island before they return to the north mainland and are deflected either east or west around Lac de Gras.

Ground squirrels and lemmings are widely distributed on the islands and on the mainland. In contrast, Arctic hare abundance is significantly greater on the islands than on the mainland. Grizzly bear, wolverine and wolves regularly travel, hunt and forage on the East and West Islands and east mainland. Foxes den on the islands and are often sighted near the Diavik site.

To protect caribou migrating near the Diavik Diamond Mine, caribou advisory signs are posted on all haul roads. Caribou, and other wildlife, have the right of way. DDMI's environmental team also conducts routine caribou monitoring with the assistance of elders from local Aboriginal communities.

4.2.4 Birds and Habitat

Only two bird species (ptarmigan and raven) reside year round in the project area due to the scarcity of food during the long winter. However, many bird species migrate into the Lac de Gras area to take advantage of the productive, yet brief warm summer.

Water birds such as loons and terns forage on the fish in Lac de Gras. Some types of birds such as herring gulls, red-throated loons, yellow-billed loons, arctic terns and snow bunting typically nest on small islands in the lake. The shallow bays on the east side of East Island provide an early spring staging area for waterfowl and shorebirds.

The islands are relatively poor raptor habitat, with only one active peregrine falcon nest site identified on East Island in 1997 (Golder March 1998).

4.3 Social Environment

Land usage in the region includes very limited hunting and fishing by northern communities, natural resource exploration and development (mostly diamond and gold recovery, with some base metal exploration) and recreation (several outfitting camps are now located in the area).

4.3.1 Land Use

Aboriginal people have used the Lac de Gras area for many centuries. First use of the area may have been by the Taltheili Tradition, ancestors of the modern Dene, about 2,500 years ago. In recent times, the Yellowknives Dene, Dogrib Dene and the Inuit have used the lands surrounding the project area primarily in the spring and fall to hunt caribou and trap for furs.

The Slave Geological Province is an area of increased mineral exploration and development. In 1996, there were approximately 65 exploration activities in the Slave Province (EMPR 1995). Most of the past and present gold operations in the NWT are also located within this area (e.g., Lupin, Colomac, Giant, Con, Ptarmigan). Major exploration and development projects in the Central Arctic are shown in Figure 4-3.

The Lupin winter road, extending from Tibbett Lake to Contwoyto Lake, is the primary winter (ice) road that traverses the regional study area. Echo Bay Mines originally established this road in 1983 to provide transportation to the Lupin Mine at Contwoyto Lake. The road is typically open between January and March with an average of 70 “open” days during that period. The primary consideration that determines dates of road opening and closure is ice thickness. In addition to DDMI, Echo Bay Mines Ltd., BHP Billiton, and DeBeers Mining Canada Inc. use the road to transport equipment and supplies. Other exploration companies, outfitters and resident hunters also use the road to access the Lac de Gras area.

Several outfitting operations conduct seasonal sport hunting, fishing and wildlife observation excursions within and around the Lac de Gras area. Sports hunting outfitters have camps located on north east shore of Lac de Gras, and nearby on Contwoyto, Point, Courageous, Clinton-Colden, Desteffany, Jolly and MacKay lakes. Licensed canoeing/rafting outfitters offer trips of varying length and duration on the Coppermine River system. Most trips start at points downstream from Lac de Gras, but some start at the west end of the lake and cover the entire river system.

4.3.2 Protected and Heritage Areas

Eleven proposed protected areas or significant conservation-sites have been identified within the Slave Geological Province. These consist of one tribal park (proposed by the Yellowknives Dene First Nation), three International Biological Program sites, and 10 areas identified by World Wildlife Fund (WWF). The Diavik Mine site is near the proposed tribal park, a corridor extending south-westward from the MacKay Lake area to the Gordon Lake area. The Diavik Mine site is also within an area identified by the WWF as having high conservation interest. The proposed tribal park and the WWF site overlap. Important biological features include main and subwatershed divides, and forest-tundra transition areas (WWF Canada 1996).

One hundred and thirty-four heritage resource sites have been identified on East Island and West Island combined. Of these, 61% are located where exposed quartz veins were battered to obtain material for tool manufacture. They occur almost exclusively on elevated areas in the central and southern portion of East Island. 32% of the sites are either scatters of stone tool manufacturing debris or isolated artefacts where a single episode of tool manufacture or use took place. Generally, these manufacturing sites are concentrated around the central valley and near interior lakes on East Island, or on elevated landforms around the central wetland on the west island. The remaining 7% comprise more unique sites, including eight campsites, two with hearth structures, and a stone trap marker. Of these only the two sites with hearths are considered significant enough to warrant avoidance and would be considered special.

5. MINE SITE DESCRIPTION

5.1 Introduction

A summary of the project description is provided here to establish an overview of the various facilities for closure and reclamation planning.

Kimberlite ore is found in four pipes located under Lac de Gras just offshore of East Island; A154N and A154S (collectively identified as “A154”), A418, and A21 (Figure 1-2). The kimberlite pipes are the roots of relatively young volcanoes dated at approximately 55 million years old. The host rocks are ancient Precambrian granites and metamorphosed sedimentary rocks that are approximately 2 billion years old. The A154 and A418 kimberlite pipes have a total reserve of 29.8 Mt.

Diavik will process up to 2.5 Mt of ore annually. Diamond ore processing uses gravity-based methods, which rely on the diamonds' heavier weight to separate them from much of the waste kimberlite.

The overburden and country rock from open pit mining will be transported and placed in permanent storage piles on East Island where all processing facilities and infrastructure are located. The processed kimberlite from the plant will also be stored permanently on the island.

The main on-land facilities are surrounded by a perimeter road incorporating drainage ditches and collection ponds for the collection of all surface and groundwater drainage. The collected water is tested against effluent discharge criteria. Collected water not meeting discharge criteria is used to help satisfy process water demand, or is temporarily stored prior treatment in the North Inlet Water Treatment Plant.

The area of East Island is about 17 km^2 or 1,700 ha. The mine layout design is based on minimizing the environmental impact on the island by abutting all overburden stripping materials, country rock and processed kimberlite into one footprint area. The footprint area contained within the mine perimeter road is about 850 ha, or about one half of East Island. To the end of 2005, the existing development had a footprint of approximately 800 ha. The ultimate mine footprint is predicted to be 983 ha including the open pits.

5.2 Open Pits

The current mine plan utilizes three open pits to access the four kimberlite pipes: A154, A418 and A21. A21 pit is currently in the conceptual phase and all discussions regarding A21 throughout this plan are general; details will be incorporated in subsequent CRPs as design progresses from concept. A154 pit is currently being mined and A418 will commence in 2007 upon completion of the A418 dikes (see Chapter 11).

The mineralized kimberlite pipes in the current mine plan are located near the shoreline of East Island and are surrounded by granitic country rock. The pipes are overlain by an upper horizon of 1 m to 2 m of soft lake sediments, and about 5 to 10 m of dense silty sand till containing cobbles and boulders. The average lake water depth above the pipes is 12 m. The proximity of the pipes to the surface allows for economic ore extraction by open pit mining. At depths greater than about 200 to 250 m the ore will be mined by underground mining methods, subject to economics. Refer to Figure 5-1 for conceptual layout of open pits and underground mine workings.

Open pit mining will involve drilling and blasting and will be carried out with conventional truck and shovel methods. The open pit excavations will be separated from the toe of the enclosure dikes by an 80 m to 100 m wide perimeter shelf.

Open pit mining requires the construction of temporary water retention dikes to isolate the pits from Lac de Gras (see Section 5.4). A water collection and pumping system will collect water from precipitation and dike and pit wall seepage and pump it to the North Inlet.

Geotechnical and hydrogeological investigations have been initiated with the objectives of further defining the A154 pit groundwater flow characteristics and evaluating methods of reducing or capturing the groundwater flow.

Groundwater inflow and runoff estimates for the future A418 and A21 pits, as well as underground mining operations, are given in the 2006 Site Water Balance Report (DDMI April 2006). These estimated flow rates will be reviewed and updated as required based on findings of field technical investigations.

The key objectives for management of pit inflows are:

- Direct and contain water within a designated sump area;
- Transfer pit inflows to North Inlet and maintain pit water sump level below maximum capacity;
- Minimize ammonia entrainment within pit inflows; and
- Manage water pressures in the pit walls so they remain within the ranges assumed in design studies.

Pit inflows are directed to a single collection sump located within a sinking cut on the floor of each open pit. Where surface flows are significant, trenching is utilized within the pit for directing water flows toward the sump.

Water collected within the pit sump is transferred to the North Inlet for subsequent treatment through the NIWTP. Independent transfer systems will be developed for each pit, consisting of submersible pumps located within the pit sump, and portable in-line booster pumps located at intermediate points within a pipeline to the North Inlet. Piping located outside of the pit area is insulated and heat traced. Piping located within the pit area is sloped to permit free draining to the pit sump in case of system shutdown. As pit depth increases, system capacity will be increased to accommodate increased flow rates.

Pit flows are measured and reported in the Project Information Management Systems (PIMS) Site Services Report. Sump levels and other components of the pit dewatering system are monitored on an ongoing basis by the dewatering crew.

5.3 Underground Mine Workings

The current mine plan utilizes underground mining methods to mine the kimberlite pipes under the A154 and A418 pits. The underground mining plan is currently in the conceptual phase and all discussions are general; details will be incorporated in subsequent CRPs as design progresses from concept. Underground mining is scheduled to occur concurrently with open pit mining (see Chapter 11).

Underground mining plans are currently based on using underhand cut and fill (UCAF) methods at A418 pipe and A154 south pipe and a combination of UCAF and blast hole stoping in the A154 north pipe. Mined stopes will be back filled to enhance physical stability during operations and beyond closure.

The underground workings below A418 open pit are currently in a feasibility design phase and will likely move to a design phase in 2007. The current plan is that the A418 underground workings will be connected to the underground workings below the A154 pit. Access to the underground workings will be from a main decline (Figure 5-1) that is currently being designed as part of the feasibility design study. Construction of an exploration decline began in 2005. Underground operations will use existing surface infrastructure and support services as well as some new facilities specific to the underground operation. In addition to the vehicle access portal, two ventilation raises will be situated on the island, adjacent to an existing, abandoned decline driven during site exploration.

Underground facilities will likely include maintenance shops and storage areas for fuels and lubricants. Primary underground equipment could include electric powered tunneling machines, "load-haul-dump" vehicles, and drills. Present planning is for kimberlite to be transported to the diamond recovery plant by truck, thereby eliminating the need for underground conveyors.

Groundwater inflow estimates for the underground workings are given in the 2006 Site Water Balance Report (DDMI April 2006). These estimated flow rates will be reviewed and updated as required based on findings of field technical investigations. Inflows will be collected mainly in drainage holes and directed to sumps located throughout the underground workings. Water collected within the sumps will be transferred to the North Inlet for subsequent treatment through the NIWTP.

Underground flows will be measured and reported in the PIMS Site Services Report. Sump levels and other components of the dewatering system will be monitored on an ongoing basis by the dewatering crew.

5.4 Enclosure Dikes

The current mine plan requires dikes (the east dike and the west dike) to be constructed around the North Inlet to provide adequate holding capacity for collected water prior to treatment. The mine plan also requires the construction of temporary water retention dikes to isolate the open pits from Lac de Gras.

To allow open pit mining, three water retaining diversion dikes will be constructed: A154 dike; A418 dike; and the A21 dike. DDMI completed the first dike, which encircles the A154North and A154South pipes, in 2002. Construction of the second dike which encircles the A418North pipe began in spring 2005 and will be completed in 2006.

Dike designs for the A154 and A418 pits prescribe a rock-fill structure comprising a central zone of crushed granite. A concrete cut-off wall centered within the crushed granite zone will control movement of water through the dike. Seepage beneath the dike into the pits will be minimized by a grout curtain that will extend into bedrock beneath the cut-off wall. The A21 dike is in the conceptual phase; dike design details will be incorporated in subsequent CRPs as design progresses from concept.

The Al54 rock dike contains about 6 Mt of rock, of three different size fractions. The lake side of the dike is large, run-of-quarry sized rock. The central part of the dike is 56 mm minus sieve sized material and the pit side of the dike is 200 mm minus sieve sized material.

The water barrier is made up of three components, a plastic concrete cut-off-wall, overlapping jet-grout columns (between the base of the cut-off-wall and bedrock}, and pressure-grouted bedrock that lies underneath the cut-off-wall. The massive rock dike provides the strength to support the cutoff-wall. A downstream water collection system manages the small amounts of seepage expected through the dike.

The Al54 dike was made watertight in July 2002. Draining of the water in the mining area began shortly after and was completed three months later. Pre-stripping of the lakebed sediment and glacial fill began as the water level was lowered. The A154 dike is:

- 3.9 km long;

- 3.2 km offshore of Lac de Gras at its furthest point;
- an average of 10 m high; and
- 28 m high at its deepest point.

The outside of the A154 dike has been designed as fish habitat. In addition, Diavik has built fish habitat in the form of rock shoals between the dike toe and the open pit rim. At mine closure, the area will be flooded and the dikes will then be breached to create islands in Lac de Gras.

Dike seepage during operations will be managed with the following objectives:

- Monitor and analyze dike seepage trends; and
- Collect and transfer both dike seepage and surface runoff before entry into the pit.

The dike seepage collection system recovers water flows from the following sources:

- Lake water seepage through the dike;
- Lake water seepage resurging within the area between the open pit and the toe of the dike; and
- Surface runoff within the area between the open pit and the toe of the dike.

Trends and changes in dike seepage pumping station flow rates are analyzed in conjunction with geotechnical monitoring data to determine seepage rates and dike cutoff wall performance.

The A154 dike seepage collection system consists of four dike pumping stations located along the inside toe of the dike and connected to piping that transfers water to the North Inlet Water Treatment Plant. Seepage water is collected within each pumping station via a drain system along the dike toe. Surface runoff is collected through drains that are strategically located at low points in the ground between the dike toe and the pit. Each station contains an operating and standby pump located within a heated sump. Pump operation is activated automatically by level controls within the sump. Dike seepage water received at the North Inlet Water Treatment Plant can be directed to Lac de Gras or to the North Inlet.

The geotechnical monitoring of the dikes incorporates several hundred sensors that are used to monitor the integrity of the dike throughout its life. The sensors measure temperature (thermistors), pressure (piezometers), and movement {inclinometers, extensometers, survey pins). In addition, thermosyphons (refrigeration systems) are installed where the dike crosses islands in the lake in order to keep the permafrost frozen. They operate in passive mode in winter, and are switched to active refrigeration mode in summer.

5.4.1 Dike Design

A variety of engineering analyses were undertaken to predict the performance of the present dike design under various loading conditions and to ensure achievement of the design objectives and compliance with the design as laid out in such documents as the Canadian Dam Safety Guidelines (NKSL July 1999).

A154 Dike

The A154 dike consists of a central crushed stone Zone 1 material (0-56 mm) supported both by a downstream crushed stone shell Zone 2 material (0-200 mm) underlain by a filter blanket of crushed stone Zone 1A material (0-56 mm), and an upstream quarried rock Zone 3 shell material (0-900 mm). The larger Zone 3 rock fragments are pushed toward the upstream slope to provide riprap protection.

Table 5-4 summarizes the A154 Dike design parameters. A plan drawing of the dike is provided in Figure 5-2.

Table 5-1: Dike A154 Characteristics[a]

Characteristic	Value
Crest width (m)	16.0
Crest elevation (m)	421.0
Max. normal Lac de Gras water elevation (m)	415.85
Extreme Lac de Gras water elevation (m)	416.7
Outer slopes	upstream 1.6 - 3.0H: 1.0V downstream 1.7 - 3.0H:1.0V
Top elevation of central Zone 1 (m)	419.0
Boundary of Zones 1 / 2 & 1 / 3	0.75H: 1.0V
Depth of toe drainage trench (m)	1.5 (min) or bedrock level
Cutoff wall	plastic concrete diaphragm wall extended with jet grouting

[a]Source: **NKSL (July 1999)**

The crest width of 16.0 m was selected to meet the criteria defined for safety, roadway and construction requirements.

For land areas between elevation 417 m and 421 m, a freeboard dike with an impervious geomembrane was installed to:

- preclude seepage in pervious layers present in the active layer;
- provide protection from wave run-up; and
- provide protection against permafrost degradation.

North Inlet Dikes

The North Inlet was initially closed through the construction of a dike at the east end of the inlet. A dike will be constructed at the west end of the facility to allow water levels within the North Inlet to increase above those in Lac de Gras. This work is planned for 2007.

The typical cross-section of the East Dike (Table 5-2) consists of double outer groins constructed using quarry run Zone 3 (0-900 mm) material, with a central crushed stone Zone 1 core (0-56 mm) and an intermediate Zone 2 (0-200 m) transition.

Table 5-2: North Inlet East Dike Characteristics[a]

Characteristic	Value
Crest width (m)	variable
Crest elevation - final (m)	422.5
Max. normal North Inlet water elevation (m)	418.0
Extreme North Inlet water elevation (m)	421.0
Outer slopes	upstream 1.5: 1.0V downstream 1.5H:1.0V
Boundary of zones 1 / 2 (in the wet)	1.5H: 1.0 V
Boundary of zones 1 / 3 (in the dry)	0.75H: 1.0V
Cutoff wall	jet grouting

[a]Source: **NKSL (July 1999)**

The West Dike (Table 5-3) will be located on a boulder field adjacent to the airport access road. The cross-section consists of a Zone 1 (0-56 mm) material supported by the Zone 3 (0-900 mm) material making up the access road. The imperviousness will be obtained by the use of geomembrane resting on a geotextile.

Table 5-3: North Inlet West Dike Characteristics[a]

Characteristic	Value
Crest width (m)	12.0 + roadway
Crest elevation (m)	422.5
Max. normal North Inlet water elevation (m)	418.0
Extreme North Inlet water elevation (m)	421.0
Outer slopes	upstream 2.0H: 1.0V
Cutoff wall	geomembrane

[a]Source: **NKSL (July 1999)**

5.5 Country Rock and Till Storage

The country rock associated with the mine development is generally granitic in nature with small amounts of pegmatite, diabase and biotite schist lithologies. The granite, pegmatite and diabase rocks which account for approximately 80% to 90% of the total rock mass are generally non-reactive with very low sulphur levels and adequate alkalinity to neutralize any potential reaction. The biotite schist, which accounts for approximately 10% to 20% of the rock mass, is potentially acid generating. The average sulphur level in the biotite schist is relatively low; however, the alkalinity is also very low, thereby increasing the potential for acid generation.

The geological and geochemical database of the mining area was developed by DDMI over a four-year period prior to production mining. The database provided an essential source of information to formulate a preliminary plan to manage the small portion of country rock that is reactive. Following collection of additional operational information during the first 18 months of mining in the A154 open-pit, refinements were made to this plan. Information continues to be collected and assessed and further refinements will be made as required.

Country rock from the A154 and A418 open pits is placed within the North Country Rock and Till Storage (NCRTS) area, while country rock from the A21 open pit will be placed within the South Country Rock and Till Storage (SCRTS) area. The estimated volumes of the country rock and till that will be produced by the A154 and A418 open pits are given in Table 5-4.

Table 5-4: A154 and A418 Open Pit Till and Country Rock Production[a]

Year	Till (Mm^3)	Type I (Mm^3)	Type II (Mm^3)	Type III (Mm^3)	Total Volume (Mm^3)
2002	2.56	0.44	0.05	0.41	3.46
2003	2.13	2.55	0.85	4.10	9.63
2004	0.48	3.64	1.57	5.63	11.3
2005	0	4.45	0.88	4.82	10.2
2006	0.17	4.07	1.16	5.41	10.8
2007	3.50	3.46	0.99	6.40	14.4
2008	2.34	5.05	1.44	7.57	16.4
2009	0	3.79	1.08	6.34	11.2
2010	0	1.13	0.32	1.69	3.15
2011	0	0.05	0.02	0.17	0.23
Totals	**11.2**	**28.6**	**8.36**	**42.6**	**90.7**

[a]2006 to 2011 volumes are estimated totals

Removal of country rock and overburden began in October 2002. The annual amount of country rock removed was 1.8 Mt in 2002, 15.2 Mt in 2003, 22.0 Mt in 2004, and 20.6 Mt in 2005. No country rock or overburden was removed during baseline studies or during most of the initial construction period.

Given the updated Life of Mine (LOM) plan, an estimated 184 Mt of country rock will be hauled to the NCRTS area which is estimated to cover 3.5 km^2. Use of the SCRTS area is pending evaluation of A21.

The expected maximum elevation for the north pile is 520 masl for the updated LOM plan. It is recognized that the Country Rock and Till Storage areas could present a movement barrier to wildlife, particularly caribou. Expected movement routes and critical points have been identified by wildlife biologists. At these locations, ramps with maximum slopes of 4:1 will be constructed as the Country Rock and Till Storage area develops.

5.5.1 Rock Classification

Excavated country rock is segregated into three types according to potential for acid generation (Type I, II, and III). The country rock will be stored in separate cells with different seepage collection designs based on the rock type.

Geochemical criteria have been established to segregate country rock from the A154 and A418 mine areas (Table 5-5). The sulphur level established for each rock type is a relative target based on geochemistry baseline data and the NCRTS design criteria of a maximum 40% of actual segregated rock to be Type III.

Table 5-5 Waste Rock Classification

Rock Classification	% Total Sulphur	Description
Type I	< 0.04	Considered clean rock.
Type II	0.04 – 0.08	Considered intermediate rock, minimal to no potential for acid generation.
Type III	> 0.08	Considered potentially acid generating rock.

During initial operations, conservative total sulphur criteria were used to define the three rock types. In the first 18 months of operation, 27% of the drill hole sulphur results were classified as Type III, but 53% of the waste rock was handled as Type III. After gaining 18 months of operating experience, DDMI had a much better understanding of the actual efficiency of the segregation method, and refined the segregation criteria to better balance the actual distribution of segregated rock. This fine tuning is expected to continue through the life of the mine.

5.5.2 Country Rock and Till Storage Plan

The excavated materials from A154 and A418 will be placed in six cells within the NCRTS area based on rock classification. The six cells into which the pit stripping materials will be placed are shown Figure 5-3, and listed in Table 5-6.

Different reclamation concepts will be applied to the cells depending on the type of rock they contain. The country rock with elevated sulphur, i.e. high in biotite schist, will be segregated and placed in isolated cells within the storage area.

The plan to classify, segregate and encapsulate the potentially reactive rock addresses the best management practices proposed during the environmental assessment and the water license permitting process.

Till Cell

Till from overburden stripping of mines A154 and A418 that is not used in construction will be stored in the North Till Storage Area. Till from stripping of mine A21 that is not used in construction will be placed in the South Till Storage Area.

The North Till Storage area is bounded by the perimeter ring road and the east end of the NCRTS. The silty sand till will be used directly from the pit, whenever possible, for purposes such as dam construction or for progressive reclamation. The remaining till will be stored in the till cell. Some of this till may be used for reclamation of the site at closure and will be available for progressive reclamation in case of unforeseen premature closure of the mine. If the quantity of till is higher than planned due to the unavoidable mixing with rock during mining, or if there is no stable location on any particular day, the till could be stored in the Clarification Pond area.

Table 5-6: Pit Stripping Storage Cells

Cell Designation	Material to be Stored	Description	Area (ha)
Till	Till	Till storage area located at east of the North Rock Storage Area.	33
QUAR	Type III Rock (Biotite Schist)	Quarry - A depression that was formed to produce crushed stone for site and dike construction prior to 2003. The depression was enlarged towards the east and north-west by constructing perimeter berms.	38
CLR	Type I Rock (Clean Rock)	Clean rock to be stored within a defined watershed located between the quarry, sediment pond and PKC storage area.	24
OLDSSF - SED	Sediments & Type III Rock	Sediment Pond where sediments from the A154 dike footprint and pit stripping have been stored and will be covered with Type III Rock in the future.	38
OLDSSF – CLAR	Sediments & Type I and Type III Rock (Biotite Schist)	Clarification Pond constructed to contain water from dike dredging and pumping of pit pool water. Will later store sediments from Pit A418 and Type III Rock.	43
NWR	Type II Rock	Northwest area to store Type II Rock.	51
		Total Area	**227.0**

Quarry (QUAR) Cell

The quarry cell is formed by the North Quarry, which was developed in the 2000 - 2002 construction period to produce crushed materials for infrastructure, on-land dams and the A154 dike. The capacity of this cell was enlarged to store additional Type III rock. The cell was expanded eastward by constructing a perimeter berm, and by raising the northwest corner with a similar berm. The average depth of the quarry is estimated to be about 25 m. Type III rock from Pit A154 will be stored in this cell until it reaches its final height in year 2008.

Clean Rock (CLR) Cell

This cell is located within the east end of a natural east-west trending depression bounded to the west by the East Dam of the Sediment Pond. The ground slopes towards collection Pond 1. Type I clean rock will be placed within this cell. This cell may also be used for the storage of till and dike construction materials from the development of Pit A154.

The first infilling will be of low permeable till and will include a Type II rock berm placed against the East Dam. This berm will provide the buttress that is required to increase the stability of the East Dam when placing Type II Rock over the sediments

Old Sediment Storage Facility (OLDSSF)

The OLDSSF comprises two intermediate cells: the Sediment Pond (SED) and the Clarification Pond (CLAR).

The OLDSSF was constructed to store settled sediments from dredging of the A154 Dike footprint, and A154 pool water that didn't meet discharge criteria. The east area of the OLDSSF (i.e., the SED cell) has since been filled with Type III country rock as the Country Rock and Till Storage within the NCRTS area has advanced. A thick wedge of till was placed on the downstream face of the pervious dam located between the CLAR and SED cells to limit seepage from the clarification pond into the placed country rock.

As operations have progressed, the OLDSSF has been used as a multipurpose water management facility for the temporary storage of water from the dredging of the A154 dike/pit, dewatering of the A154 pit and short term storage of mine water from the North Inlet. Changes in the mine plan enabled placement of dredged sediments from the A418 dike construction in the CLAR cell rather than the North Inlet, and the CLAR cell will also be used for the temporary storage of pool water from A418.

Water collected within the CLAR cell is pumped to Lac de Gras providing it meets discharge water quality criteria. Excess water not meeting these criteria is sent to the North Inlet for treatment.

In the future, the CLAR cell will be used to store country rock from Pits A154 and A418. Type III Rock will be placed in the CLAR cell after the QUAR Cell is filled in Year 2008. The storage will start from the SED cell and progress towards the west. As rock advances from the east end, sediment overburden from Pit A418 stripping will be placed over the base of the CLAR cell, which in turn will be overlaid with Type III rock. The CLAR cell can store all the Type III rock from pit A418 with a 20% contingency based on the total estimated Type III volume.

Dredged sediments from A21 development will likely be pumped directly to the North Inlet.

Northwest Rock (NWR) Cell

Placement of Type II rock started within the NWR Cell progressing from east to west. This area drains towards the west into Collection Pond 2. The water quality of drainage from the Type II Rock will be monitored, and providing it meets discharge criteria, will be discharged to Lac de Gras. Otherwise, it will be pumped to the PKC Pond.

South Country Rock and Till Storage Area

No special placement procedures are anticipated in the SCRTS area for the rock from the A21 open pit due to its expected non-acid generating characteristics.

5.5.3 Drainage

The drainage collection system for the NCRTS includes Ponds 1, 2 and 3. Pond 1 is located downstream of the Type I Country Rock and Till Storage area, while Pond 2 is located downstream of the Type II Country Rock and Till Storage area. Pond 3, which is currently the west end of the clarification pond, is scheduled for construction within the updated LOM plan for use beginning in approximately 2008.

5.5.4 Closure Measures

The country rock and till storage areas will be closed by covering them with low permeability material and Type I rock. The EA project description states that restoration of soils and vegetation at closure would involve establishment of pioneer island communities; this plan was first to be tested in field experiments during operations. However, given current mine and updated LOM conditions, re-vegetation will be limited to roads and plant-site areas only, and the reclaimed rock storage areas will be left as boulder field type habitat.

5.6 Processed Kimberlite Containment (PKC)

The diamonds represent approximately one part per million of the host kimberlite rock. Once this small fraction of diamonds is removed, the remaining kimberlite is placed in the Processed Kimberlite Containment (PKC) area (Figure 5-4). Constructed in a natural valley in the centre of East Island, the PKC area is bounded by dams at each end.

Processed kimberlite (PK) is stored in an engineered containment area designed for 25.6 Mt. However, the design incorporates provisions for this facility to be enlarged within the same footprint area to store up to 38 Mt of PK. This design therefore provides a large storage contingency. At the completion of mining, the PKC area will be approximately 1 km long by 1.3 km wide and contain up to a 40 metre thickness of processed kimberlite.

The key objectives of the PKC facility and process water management at the facility are to:

- Provide storage of processed kimberlite;
- Provide an equalization reservoir for supernatant water and runoff water for Process Plant re-use; and
- Minimize use of raw water.

There are two PK materials: a coarse PK fraction (10 mm to 1 mm particle sizes) and a fine PK fraction (minus 1 mm particle sizes). The disposal concept is to pump the fine PK into the center of the PKC facility through insulated pipelines and surround the central pond with coarse PK transported by truck to either the North or South Coarse PK Cells. Internal north and south spigot pads will separate the fine and coarse PK storage areas. Containment of the entire PKC area will be provided primarily by perimeter dams. In addition to the impermeable elements in the dams, the cold arctic temperatures will result in long term freezing of the fine and coarse PK, with limited seepage expected. The dam designs assume frozen conditions, but the dams would also be stable in unfrozen conditions.

The Process Plant is the primary consumers and suppliers of product to the PKC facility, consuming reclaim water and generating both coarse and fine PK. The volume of PK slurry is highly dependent upon the ore characteristics. The PKC facility was originally designed to store 67% fine PK and 33% coarse PK. However, since 2003 the percentage of fine PK has typically varied between 80% and 90% of the total PK. The proportion of fine PK is expected to decrease as ore is mined from greater depth within pit A154; however, current planning for the PKC pond is based on an allowance for up to 90% fine PK.

The PKC pond functions as an equalization reservoir for inflows from four sources:

- PK slurry from the Process Plant;
- Treated and disinfected sewage effluent;
- Surface runoff from PKC watershed; and
- Surface runoff transferred from the collection ponds.

The PKC facility includes a pond that is designed to accommodate a normal operating water volume of between 500,000 m^3 and 1.4 Mm^3, while leaving sufficient freeboard to contain a 1 in 500-year runoff event. PK slurry deposition beaches currently exist around the full perimeter of the fine PKC facility with the pond in the middle.

A floating barge is located within the PKC pond for reclaim of water, which is pumped via an insulated pipeline to the process and recovery plants. Piping will be installed to permit transfer of PKC reclaim water to the North Inlet in 2006, if necessary.

The concentration of dissolved metals within the PKC water is anticipated to increase over time, due to recycling of water exposed to processed kimberlite and introduction of surface runoff exposed to the country rock piles. Actual dissolved metals concentrations are monitored and the trends are used to make long term predictions on water quality in order to evaluate the need for additional water treatment capabilities.

Management of PKC Water

PKC operations are managed by the Process group, with technical support provided by DDMI's geotechnical engineer. Operation of the facility is in accordance with the PKC operations plan, which is reviewed annually.

Water levels within the PKC pond are controlled within design parameters. Development of the area involves progressive dam raises using country rock to a final elevation of 460 m. As of 2005, the dams had been raised to an elevation of 440 m with a planned raise of 5 m in 2006. The dams will continue to be raised as required to maintain normal freeboard. If excess water builds up in the PKC pond, it will be transferred to the North Inlet for treatment.

The sequence of deposition of fine PK around the facility is used to maintain the pond in a central location. A deposition plan is produced each year that sets out the sequence of spigot operation.

PKC reclaim pump operation is controlled and monitored by the Process Plant control room operator. Pumps, pipelines and PK discharge spigots are inspected regularly by the PKC operator. Water levels are regularly monitored and minimum and maximum water control levels are established as appropriate.

PK slurry, reclaim water, and raw water flow rates are monitored continuously, and daily volumes are reported in the PIMS Process Plant and Site Services reports.

Collection ponds have been constructed downstream of the two main dams to collect seepage, should it occur.

5.7 Water Management Facilities

Water management is the collection, storage, recycling and treatment of water in a safe, efficient and compliant manner. The Water Management Plan (DDMI March 2004) discusses the water collection system constructed around East Island. Through a system of sumps, piping, storage ponds and reservoirs, Diavik collects runoff water and groundwater seepage which can be used in the Process Plant or is treated in the North Inlet Water Treatment Plant before being released to Lac de Gras.

The 2006 Site Water Balance report (DDMI April 2006) summarizes the inflow and outflow of water from the project site over time. The inflows of water are divided into two areas as shown in Figure 5-5:

- North Inlet Subsystem; and
- PKC Subsystem.

The water inflows reporting to the North Inlet are:

- Pit seepage inflows – A154 pit (from 2003), A418 pit (from 2008) and A21 pit (from 2012);
- Seepage collected at toe of enclosure dikes – A154 dike (from 2003), A418 dike (from 2007) and A21 dike (from 2012);
- Underground seepage inflows from construction and mining – A418 pipe (from 2005), A418 exploration decline (from 2006), A154 pipes (from 2005) and A154 exploration declines (from 2006);
- Water from dredging for dike construction – A418 (from 2005) via Clarification Pond and A21 (from 2011);
- Pool water from the dewatering of pits – A418 pit (from 2006) via the Clarification Pond and A21 (from 2012);
- Runoff from the NCRTS and the North Inlet watershed (from 2003); and
- Water used during crusher operation and collected in Pond 14.

The water sources reporting to the PKC pond include:

- Fine PK transport water (PK Slurry);
- Pumped surface runoff from collection ponds on-site;
- Surface runoff within the footprint of the PKC facility;
- Raw water from Lac de Gras as required;

- Treated and disinfected effluent from the South Sewage Treatment Plant; and
- A21 exploration decline water.

Water outflows include treated effluent and treated water to Lac de Gras, surface runoff, seepage and evaporation.

Freshwater will be drawn from Lac de Gras. Freshwater volume requirements will reduce as reclaim water is utilized in kimberlite processing. The following are uses of freshwater:

- Potable water;
- Process Plant makeup water as required;
- Fire suppression;
- Dust suppression; and
- Drill water for underground drilling if necessary.

The seepage associated with the open pits, underground and dikes are described in Sections 5.2, 5.3 and 5.4 respectively. Seepage associated with the PKC pond is described in Section 5.6. Potable water is described in Section 5.9.8. The following components of the water management plan are discussed below:

- North Inlet;
- North Inlet Water Treatment Plant; and
- Surface runoff collection system (ponds and ditches).

5.7.1 North Inlet

The North Inlet (NI) is located between the NCRTS and the airstrip. The NI is a natural water body that has been modified for water management purposes (see Section 5.4 and Figure 5-6). The objectives of the NI are to:

- Provide a water surge pond to accommodate temporary flow increases or temporary treatment plant shutdown;
- Provide flow equalization; and

- Enable gravity settling of suspended solids.

The NI water storage reservoir currently has a holding capacity of 1.5 million m^3. This volume will be increased when the east dike is raised and the west dike is constructed. The NI is the main repository for all mine water. The North Inlet Water Treatment Plant is coupled to the NI since all sources of water to be treated by the NIWTP first got to the inlet.

North Inlet Spillway

In general the water from the NI can only be discharged to Lac de Gras after treatment by the NIWTP. However, as part of the contingency measures, the NI will have a spillway at elevation 421 m in the East Dike to discharge flows in excess of the design criteria to Lac de Gras.

5.7.2 North Inlet Water Treatment Plant

The North Inlet Water Treatment Plant (NIWTP) was constructed at the northeast end of the North Inlet to treat pool water or mine water to meet compliance requirements prior to discharge to the environment.

Water reporting to the NI is pumped to the NIWTP for treatment. Pit inflows and dike seepage are essentially continuous flows to the NI, while the other flows described above are intermittent. At the end of 2005, the maximum treatment capacity of the NIWTP was 29,500 m^3/day; however, an upgrade to increase the treatment capacity up to a maximum of 45,000 m^3/day is scheduled for completion in 2006.

The NIWTP is designed for removal of fine solids and dissolved phosphorus in cold water conditions. Major system components include coagulant and flocculant preparation equipment, two high capacity clarifiers, and four deep bed sand filters. Metals treatment is not currently anticipated, but water quality of inflows to the NI, particularly PKC water, will continue to be monitored to establish trends in dissolved metals concentrations. A pH control system was added to the NIWTP in 2005.

Sludge from the NIWTP is deposited within the NI, while treated effluent is discharged into Lac de Gras via a submerged outfall and diffusers located 200 m offshore at a depth of 20 m. A test program is currently underway to evaluate whether sludge from the NIWTP can be used to enhance the revegetation process in disturbed areas.

The NIWTP is operated through DDMI’s Distributed Control System as described in the March 2004 DDMI Water Management Plan. Treatment flow rates are continuously monitored, and are reported in the PIMS Site Services Report. Influent and treated effluent quality values of pH, turbidity, and conductivity are monitored continuously and alarmed if outside acceptable limits. Equipment faults and pH levels at points within the circuit are also monitored and alarmed. Effluent is physically tested by the operator for turbidity, pH, conductivity, and alkalinity four times daily.

North Inlet water levels are regularly monitored and maintained within allowable limits.

5.7.3 Ponds and Ditches

The surface runoff collection system consists of a network of ponds and drainage ditches that collect runoff from the NCRTS, South Plant Site, and the PKC dam toes, as shown in Figure 5-7. As described in the Water Management Plan (DDMI March 2004), the objectives of the surface runoff water management plan are to:

- Collect and contain potentially contaminated surface runoff within catchment ponds;
- Transfer collected water to the PKC facility; and
- Allow uncontaminated surface runoff to follow natural drainage patterns.

Surface runoff from the following areas is not collected:

- North side of airstrip; and
- Roads to ammonium nitrate storage and emulsion plant facilities.

Runoff from these areas is allowed to follow natural drainage patterns and silt fences are installed as required to control sediment transport. Aircraft fuelling and de-icing is performed on the airport apron, which is sloped toward the North Inlet. Any fuel or de-icing spills will be contained within the North Inlet.

Surface runoff typically occurs over a 5 month period from May to September. Runoff volumes are dependent upon climate conditions, and DDMI has selected 1 in 100-year return conditions for sizing of surface runoff collection systems. Climate conditions are discussed in Section 4.1.1.

Storage ponds are sized to hold, without discharge to the environment, 100% of the 1 in 100-year return period freshet occurring over an 8-day period. As pond watershed surface areas will change over the life of the mine, the maximum watershed area was considered for design purposes.

Drainage patterns within each watershed are controlled through drainage ditches that direct flow to the ponds. Un-insulated pipelines are permanently installed to permit transfer of water from the collection ponds to the PKC facility. Portable diesel powered pumps are used for the pumping of pond water.

Table 5-7 summarizes the characteristics of the runoff collection ponds on-site. Pond 2, located west of the NCRTS, was constructed in 2005 and 2006 in advance of extending the rock storage piles into the associated watershed. In advance of development of the SCRTS area, two new catchment ponds (Ponds 6 and 7) and associated ditches will be installed to contain runoff from the area. Pond 14 was constructed to temporarily manage water from the crusher plant. The pond will be removed in 2007 during the pre-stripping phase of the A418 open pit.

Table 5-7: Runoff Collection Ponds

Drainage Area	Pond No.	Status
North Country Rock Pile	1	Installed
	2	Physically completed. Reaming upstream riprap to be placed in early 2006
	3	Installed (forms part of clarification pond)
PKC dam toes	4	Installed
	5	Installed
South Country Rock Pile	6	Future installation – year 2010
	7	Future installation – year 2010
Plant Site Area	10	Installed
	11	Installed
	12	Installed
North Site office area	13	Constructed the in spring of 2006
	14	Constructed in December 2005 and will be removed early 2007 during A418 pre-stripping

Site Services manages surface water runoff and collection within the ponds, while the Environmental Group monitors pond water quality. Pond levels are monitored regularly and the ponds are emptied as required during the spring freshet period. In addition, the ponds are pumped substantially dry by October each year to provide additional storage capacity for the following spring freshet.

Geochemical analysis results have indicated the potential for elevated levels of some dissolved metals within surface runoff of country rock piles (NKSL 1998). Accordingly, the pond water collection system was designed to transfer pond water to the PKC facility as opposed to discharging directly to Lac de Gras. If collected runoff water meets the discharge water quality criteria specified in the Water License however, it can be redirected to Lac de Gras.

5.8 Plant Site, Accommodation Complex and Fuel Storage

The physical plant site was essentially completed in 2002. The physical plant is located on East Island and includes a Kimberlite Process Plant, a permanent accommodation complex, a maintenance complex, four 18 ML diesel fuel storage tanks, a power plant, and a boiler house (Figure 5-8). Elevated Arctic Corridors carry services and provide enclosed walkways that connect all major buildings.

5.8.1 Process Plant

The Process Plant complex is located in the southern part of East Island. The entire area is surrounded by a series of collection ditches draining to three ponds.

Three modules make up the Process Plant - a small run-of-mine building; the main dense media separation plant; and a smaller recovery building that removes the diamonds from the host kimberlite rock. The Process Plant has dimensions of 35 m high (11 stories), 40 m wide, and 152 m long.

The diamond-bearing kimberlite ore is trucked to a stockpile area located outside the Process Plant. A loader places the ore into the run of mine building where it is crushed before entering the Process Plant. There it is mixed with water and further crushed to less than 25 mm in size. The ore is then conveyed to the dense media separation circuit where a fine grained, heavy and magnetic ferro-silicon (FeSi) sand is added to the crushed ore and water mixture. The FeSi magnifies the gravity effect and enhances diamond and other heavy mineral separation. A large magnet recovers the FeSi, which is recycled.

The less dense waste kimberlite fraction is directed to the PKC area for permanent storage. The heavy mineral concentrate (containing diamonds, garnet, diopside, olivine and spinel) is conveyed to the recovery circuit.

The diamonds are separated from the waste heavy minerals in the recovery building using X-rays. Diamonds glow under this kind of light and photo-electric sensors direct strategically placed air blasts to blow the diamonds off the conveyor belt into diamond collection receptacles. The diamonds are then shipped to Yellowknife to be cleaned and sized. Waste minerals are re-crushed or directed to the PKC.

The Process Plant is designed to maximize the use of water reclaimed from the PKC pond. Reclaim water is used for essentially all process services in the Process Plant. A portion of reclaim water is filtered to allow use in clean services including pump gland water. The recovery process uses reclaim water for most services, but does use raw water for critical services including X-ray sorter cooling water and grease table water. Raw water is also used in case of shortages of reclaim water.

The kimberlite processing rate in the current mine plan is an average of 1.5 Mt/yr with a maximum of 2.5 Mt/yr. The rates were 1.2 Mt/yr and 1.8 Mt/yr in 2003 and 2004, respectively.

5.8.2 Accommodation Complex

The permanent accommodations complex was built in several stages. The dormitory units were prefabricated in Alberta as a training program under a northern Aboriginal joint venture. A total of 156 modules were constructed and trucked to site, where they were placed into four wings. Each wing has 3 floors and each floor has 22 rooms, creating a total of 264 dormitory rooms. Each floor has a separate lounge area and laundry facility. The accommodations core complex was built on-site under a separate northern contract. It houses security offices, cafeteria, and recreational faculties including a gymnasium with running track, and a squash court.

Contractors Facilities

Numerous contractors and subcontractors were mobilized to site in 2000 for construction of the project. The contractors' personnel were housed in the North and South Construction Camps. These camps also included offices, maintenance facilities, temporary fuel storage and large laydown areas for equipment and construction materials and supplies.

The North Construction Camp has been moved from the north side of East Island and has been placed adjacent to the South Construction Camp. About two thirds of the South Construction Camp has been disassembled with some units transported off site during the 2003 to 2005 winter road seasons. The remaining third of the South Construction Camp was retained and is used for overflow accommodations, a secondary dining area, and offices at various locations around the mine site.

5.8.3 Maintenance Complex

The Maintenance Complex is 25 m high, 127 m long and 60 m wide. Equipment service bays (10 in total), maintenance shops, warehousing and are located on the main floor, while operations support facilities, utility rooms, and additional warehouse space are on the second floor. The third floor houses the Diavik Mine Planning and Administration Offices. The height of the building allows the large haul trucks to raise their boxes for maintenance.

The Emergency Response Vehicle garage is located in a separate building off of the accommodation complex.

5.8.4 Fuel Storage

Diesel fuel is the primary fuel for the site. There are four 18 ML diesel fuel tanks located at the South Tank Farm which provide fuel for mobile equipment, diesel power generators, and heating. The fourth tank was constructed in 2005.

Gasoline storage is also provided for smaller equipment, boats, snowmobiles and gas-powered tools. Jet fuel is stored near the airstrip for helicopters and fixed wing aircraft.

All fuel tanks are housed within secondary containment facilities that include berms, release prevention barriers and impervious liners.

5.8.5 Power Plant

The power plant building is 25 m high, 60 m long and 36 m wide. It houses five Caterpillar diesel engines capable of producing 4.2 megawatts each, in addition to four 1.25 megawatt generator sets. Three engines run at any one time with one held in reserve and one on maintenance.

Waste heat is recovered and is used to heat the plant site buildings. This raises the total energy efficiency of the power system to over 80%.

Power is carried throughout the plant site through the Arctic Corridors, and elsewhere on the site along 13.8 kV lines supported by over 200 wooden poles.

Average winter demand under existing conditions is 8.6 MW; average summer demand ranges from 5.5 MW to 6.7 MW.

5.8.6 Boiler Plant

The boiler plant houses three boilers, each capable of producing 23,000 BTUs per hour. The boilers are held in reserve and, in the event of a failure within the main power plant, can be used to keep the buildings from freezing.

The boilers use a 60:40 glycol/water mix which is pumped through the system at a rate of 84 litres per second. The temperature of the glycol mix leaving the plant is 90°C and it returns at 70°C.

5.9 Infrastructure

The project is supported by a variety of infrastructure including:

- Plant yard;
- Arctic Corridors, which carry services and provide enclosed walkways between major buildings;
- Communication system;

- Ammonium Nitrate Storage, Explosive Mixing Plant and Caps Magazine Storage;
- Batch Plant;
- Crusher Plant;
- Airstrip with Helicopter Pad and Fuel Storage;
- Roads, which form a perimeter containment for most of the facilities;
- Water pipelines;
- Raw water intake and potable water treatment plant;
- Sewage treatment plant with treated sewage outfall;
- Hazardous wastes storage facility;
- Waste transfer area and inert landfill; and
- Miscellaneous administration, storage, repair shops and laydown areas.

5.9.1 Plant Yard

The plant yard area was developed as a level platform formed by blasting into bedrock. It is contained within a bermed area formed by a perimeter road and ditches. Surface water runoff is directed to collection ponds where it is pumped to the PKC pond.

5.9.2 Arctic Corridors

Twenty prefabricated metal modules have been connected to join the major buildings. These "arctic" corridors carry all utilities including drinking and heating water, a separate water sprinkler line, sewage, power, and communications. The corridors also provide heated, well-lit walkways for workers going to and from work at the plant site.

5.9.3 Communication System

Voice and data communication at site is conducted with Internet protocol technology and is connected by satellite to Yellowknife.

The telephone system uses Voice Over IP protocols (VPOP) and is based on equipment that also supports the data network. Network connections between buildings are through optical fibre cabling, while wiring within each building uses Cat 5e copper cabling for computers and telephones.

5.9.4 Explosive Management

Explosives on-site are managed and stored at three separate facilities: the Ammonia Nitrate Storage; the Caps/Explosive Storage; and the Emulsion Plant. These facilities are located southwest of the PKC area, away from the south camp and plant site.

Explosives are used to produce blasted rock for site development and dike construction, in the stripping of country rock, and in the mining of ore. Water-resistant ANFO based emulsion explosives are used as the blast holes tend to be wet. The required emulsion blends are manufactured in the Emulsion Plant and are delivered to the blast holes in bulk delivery trucks.

5.9.5 Batch and Crusher Plants

Temporary Batch and Crusher Plants are located in the northern portion of East Island near the A154 and A418 pits (Figure 5-9). These are construction specific facilities that will be demobilized following construction.

Water for the batch plant is obtained from the NIWTP for reuse in the formation of concrete and shotcrete.

5.9.6 Airstrip and Roads

The transportation facilities for the project include:

- Airstrip with Helicopter Pad and Fuel Storage; and
- Roads, which form a perimeter containment for most of the facilities.

The airstrip is 1,600 m long and has a 45 m wide granular surface. It is capable of accepting Boeing 737 jet and Hercules transport aircraft. A host of smaller aircraft also bring freight and workers to and from a number of northern communities. Adjacent to the airstrip are a terminal building, helicopter pad, fuel storage and navigational aids.

Approximately 25 km of construction haulage and service roads will be used during operations. The roads will be constructed above grade from quarried crushed rock and esker sand material located on East Island. Road widths range from 12 m for service roads, to 40 m to 42 m for main haul roads. Access roads vary between 20 m and 22 m in width. Typical granular thickness ranges from 1.0 to 1.4 m, with roadbed thickness increased locally over ice-rich soils depending on performance.

Many of the roads serve as the perimeter surface water collection system, hence are an integral part of the closure and reclamation plan. Where applicable, the roads are lined with till blankets on the contained and up-slope side, and have ditches to direct water to collection ponds.

5.9.7 Water Pipelines

The site will have some 35 km of pipelines to convey water between various locations. Approximately 21 km (60%) of all the pipelines are related to collection of seepage and runoff water from the open pits and dikes, and transport to the North Inlet area and to the NIWTP. Some 3.5 km of pipe (10%) will be used for the transport of fine PK slurry, and the remainder (30%) of the pipelines are utilities service pipelines in the Process Plant area. These include above ground lines for treated sewage, fire protection, potable water, and raw makeup process water.

5.9.8 Potable Water Treatment Plant

The objective for the potable water system is to ensure safe drinking water for the site. Raw water is pumped from Lac de Gras to a potable water treatment plant consisting of deep bed multi media filters, polishing filters (carbon), and chlorine dosing. Pressurized water pipelines located within the Arctic Corridors deliver potable water from the plant to the major buildings on-site, while a water truck is used to deliver potable to the Air Terminal Building, NIWTP and Explosives Handling Facilities and other support facilities on the mine site.

Potable water is tested for chorine residual three times daily. Chlorine dosing is controlled proportionally based on actual flow. Potable water quality is tested by an independent laboratory at 13 or more different locations around the site on a quarterly basis. Monthly biological tests are conducted at several key areas around the site.

The potable water plant is sized to accommodate 800 persons.

5.9.9 Sewage Treatment

The South Sewage Treatment Plant (SSTP) is an activated sludge system with tertiary filtration to remove phosphorus when required. The treated effluent is also disinfected with chlorine when treated water is directed to the Process Plant for reuse within the plant. If treated water is directed to Lac de Gras, the chlorine system is turned off and the UV disinfection and phosphorous system is activated.

The plant is designed to permit discharge to the lake; however, treated effluent from the SSTP is directed to the PKC via the Process Plant. The treated effluent is tested on a daily basis for turbidity, pH, and chlorine residual, and the flow rate is monitored and recorded.

Sludge from the sewage treatment process is segregated and stored within the DDMI Waste Transfer Area (WTA). A test program is currently underway to evaluate whether sludge from the SSTP can be used to enhance the revegetation process in disturbed areas.

The SSTP services the south plant site including operating facilities, construction camp, and permanent accommodations. The sewage from the main plant site buildings is pumped to the treatment plant via force mains located in the Arctic Corridors. Local holding tanks are used to collect and store sewage originating from remote facilities such as the Air Terminal Building, NIWTP, and Explosive Handling Facilities. Sewage collected in local tanks is transported to the SSTP for treatment via a sewage collection tanker truck.

The sewage treatment capacity is designed to accommodate 800 persons at a design flow rate of 300 L/person/day.

5.9.10 Hazardous Waste Management

Hazardous wastes are classified, labelled and temporarily stored within the hazardous waste storage facility prior to being transported off-site for recycle, treatment or disposal in a licensed waste disposal facility. Located adjacent to the maintenance shop, the hazardous waste storage facility is fully bermed and lined with an impervious liner to contain any spill or release of materials. The storage site is secured and weather protected. All transfers, drains, and loading /unloading operations are performed in the lined area of the facility to avoid soil contamination. In addition, leak proof devices, overfilling warnings or indicators, and above ground pipes and transferring hoses are used to avoid/reduce spills.

Hydrocarbon contaminated soils from spills or other releases are land-treated in a designated cell within the Waste Transfer Area. The cell is bermed and lined with a geomembrane. The hydrocarbon contaminated soil is placed within the cell and spread during the summer months to allow for remediation to acceptable levels by using natural micro-biological processes (bio-remediation). Fertilizers such as ammonium nitrate are applied to enhance the bio-remediation process and improve the efficiency of the landfarm.

5.9.11 Solid Waste Management

The main disposal methods for solid wastes generated on-site include incineration of all food wastes, categorical segregation of all non-food waste for storage and subsequent removal from site, and the on-site disposal of non-burnable inert wastes.

Incineration, segregation and storage of waste takes place at the DDMI Waste Transfer Area (WTA) which was established to ensure proper handling and storage of waste on-site. The permanent facility is located on the south side of the Processed Kimberlite Containment Area. The WTA is approximately 130 m x 130 m, and is surrounded by a gated, 3 m high chain link fence erected to control wind transportation of any litter and minimize wildlife intrusion. The WTA includes the following: two incinerators for food waste; a burn pit for non-toxic/non-food contaminated burnable material; a contaminated soils containment area; a treated sewage containment area; and sea cans, sheds, and storage areas for drums, crates, bins and totes. The majority of wastes are inventoried and stored at the WTA while awaiting backhaul on the winter ice road. Hazardous wastes are not incinerated on-site.

On-site disposal of non-burnable wastes such as steel, plastics and glass currently occurs at the inert landfill located within the Type III waste rock pile. These materials are covered with waste rock on a regular basis to prevent wildlife attraction.

The inert landfill will remain operational within the NCRTS area until progressive closure of the Type III waste rock pile begins. At this time, the inert landfill will be moved to one of the coarse PK storage areas.

The WTA and inert landfill are operated by trained personnel. Regular inspections and monitoring are conducted to ensure all waste segregation, storage and disposal procedures set out in the DDMI Waste Management Plan are being followed, thereby preventing the attraction of wildlife and protecting environmental integrity.

5.9.12 Miscellaneous Infrastructure

Several office and storage buildings, laydown areas and repair shops are located near the process complex and in the northern portion of East Island near to the A154 and A418 pits. Some of these facilities are buildings reclaimed from the South Construction Camp.

6. INTERIM SHUTDOWN MEASURES

6.1 Introduction

In addition to planning for final closure, abandonment and restoration, DDMI has prepared initial plans for interim shutdown scenarios. In accordance with the requirements of the Class “A” Water License and the Mine Site Reclamation Guidelines for the Northwest Territories (DIAND 2006), the interim closure and reclamation scenarios include temporary and premature shutdown.

6.2 Temporary Shutdown Strategies

Temporary shutdown is defined as the cessation of mining and diamond recovery for a finite period due to economic or other operational reasons, with the intent to resume operations under more favourable conditions.

As temporary shutdown is commonly an uncertain condition, the schedule would be necessarily progressive as each week, month, season or year passes.

6.2.1 Short-Term Shutdown

During periods of short-term shutdown (usually less than one year), mining activities other than maintenance, monitoring, intermittent testing, periodic operation of equipment and appropriate facilities, would generally cease together with all administrative duties required for compliance with permit and license agreements. A sufficient number of care and maintenance staff would be present on-site, and an appropriate level of security would be implemented at selected facilities. Activities related to ensuring public and wildlife safety would be a priority. Such activities would focus upon maintenance and monitoring of all facilities, equipment and stores to maintain physical and chemical stability. Access to temporarily inactive facilities would be restricted to authorized personnel. Fences and signposts to deny access would be erected as appropriate (e.g. underground portal).

Dewatering would continue at the open pit and underground workings to maintain stability. Underground areas would continue to be ventilated. Site-wide surface water, sediment and seepage control systems would be inspected regularly and would be maintained. Access to the PKC area would be restricted. Routine geotechnical stability monitoring and maintenance of the NCRTS and SCRTS piles, other material stockpiles, the PKC and other mine water impoundment structures would continue.

All facilities and infrastructure would be inspected regularly. Infrastructure, equipment, tools and utilities would remain in serviceable and safe condition. Non-emergency and non-essential vehicles would be parked in a secured common area, and when necessary, winterized. Non-essential buildings would be locked, and non-essential power lines would be discharged and locked open. All equipment would be maintained in a no-load condition. If necessary, selected equipment would be drained and stored. All tank levels, including fuel tanks, would be recorded and monitored, and inventories of chemical reagents, explosive materials and solvents would be undertaken.

6.2.2 Long-Term Shutdown

A long-term shutdown would be an opportunity to complete items of progressive closure and reclamation, as scheduled in the CRP. Selected facilities would be completely closed and related areas of disturbance permanently reclaimed. Mining areas no longer in service may be flooded and secured in accordance with the CRP. Areas of the PKC facility and Country Rock and Till Storage areas not intended for further use would be closed and reclaimed to provide long term stability and safety. All non-essential infrastructure and utilities would be decommissioned and closed securely, pending scheduled demolition, removal and final reclamation. Non-essential equipment and materials would be disposed of in accordance with the CRP. Partially closed sites would be secured against access, and would be maintained in physically and chemically stable conditions. Site-wide surface water, sediment and seepage controls would be maintained, but subject to gradual removal and replacement with natural drainage courses.

Throughout the long-term shutdown period, all facilities, materials and equipment necessary for ongoing exploration and further development of natural resources would be maintained in operational condition. During this period, necessary geotechnical and environmental monitoring and maintenance would continue, as would ongoing scheduled reclamation and closure activities. All buildings, utilities and equipment necessary for residual operations and environmental services would be maintained until final and complete closure.

6.3 Premature Shutdown Strategies

If operations cease for economic or other reasons, and/or involve longer-term inactivity, partial closure and abandonment and sale or transfer of selected equipment could occur. This normally occurs when all planned reserves have been recovered and/or further mining is not economic to maintain a full suite of operations. Some facilities could also be used to support exploration.

As is the case for a long-term temporary shutdown, all necessary geotechnical and environmental monitoring and maintenance would continue, as would ongoing scheduled reclamation and closure activities. All buildings, utilities and equipment necessary for residual operations and environmental services would be maintained until final and complete closure.

6.4 Open Pits

The open pits will not be flooded until final closure. The extent to which the procedures listed below are implemented would depend on the anticipated length of the closure and the seasonal limitations on overland transport if any materials or equipment had to be removed from the site in the case of an extended shutdown.

- Dewatering of the open pits would continue as conducted during operations since flooding and subsequent dewatering may adversely impact stability of the pit walls and underground workings.

- Surface water and seepage control systems would continue as conducted during operations. Refer to water management facilities Section 6.9.

- Block open pit access routes with boulder fences and/or berms.

- Post warning signs and fences or berms around pit perimeters.

- Routine geotechnical stability monitoring and maintenance would continue at a reduced rate compared to that conducted during operations (see Chapter 10). The open pit areas would be inspected routinely to check for rockfalls, changes to groundwater inflows and overall integrity.

- All mobile equipment except for small service equipment required for open pit inspections would be removed and prepared for on-site storage.

- Fuel, lubricants and hydraulic fluids would be removed from the open pit area and stored in designated areas.

6.5 Underground Mine Workings

The underground mine workings will not be flooded until final closure. The current mine workings design is conceptual; thus the following is for general purposes. Details will be provided in subsequent CRPs as the underground mine design progresses. The current conceptual underground mining plan involves the integral use of backfill. Therefore, only very limited excavations will be open at any one time within the kimberlite pipes and long term stability of the pipes is assured independent of the timing of a shutdown.

The extent to which the procedures listed below are implemented would depend on the anticipated length of the closure and the seasonal limitations on overland transport if any materials or equipment had to be removed from the site in the case of an extended shutdown.

- Dewatering of the open pits would continue as conducted during operations to maintain stability of the pit walls and underground workings. The underground workings are located below Pits A154 and A418 and therefore are influenced by open pit conditions.

- Dewatering of the underground facilities would continue as conducted during operations to maintain stability.

- Surface water and seepage control systems would continue as conducted during operations. Refer to water management facilities Section 6.9.

- Operation of the primary fans, dewatering pumps and drainage sumps would be maintained.

- Airflow through the mine ventilations systems would be maintained. The raises would remain open and primary intake/exhaust fans would continue to operate in conjunction with underground ventilation controls (doors and seals), to ensure air flow through areas requiring ventilation, including sump and dewatering pump stations; the air would be heated during winter months.

- Underground electric power distribution system would be maintained.

- Underground access to main decline would be blocked with boulder fences and/or berms, subject to leaving access for maintenance.

- Warning signs and fences or berms would be placed around perimeters of any access or surface opening for the underground workings.

- Routine geotechnical stability monitoring and maintenance would continue as conducted during operations (see Chapter 10). All underground facilities would be inspected routinely to check for rockfalls, changes to groundwater inflows and overall integrity.

- All mobile equipment except for small service equipment required for underground inspections would be removed to surface and prepared for on-site storage.

- Fuel, lubricants and hydraulic fluids would be removed from all underground locations and stored in designated on-surface areas.

- Explosives and accessories would be removed from the underground storage magazines to the surface magazines.

6.6 Enclosure Dikes

The dikes will enclose each of the three open pits. The dikes will not be breached until final closure to ensure that the open pits and the underground workings are not flooded. If there was an interim closure the following would be completed for the dikes:

- The dike seepage collection systems at the downstream toe of the dikes would remain active as in operations.

- If the dikes are partially built at the time of an interim closure then the progressing face of the dikes would be stabilized against erosion and slope stability by the addition of riprap on the face.

- Access to dike roads would be blocked with boulder fences and/or berms.

- Warning signs and fences or berms would be placed around the perimeters of the accesses to the dikes.

- Routine geotechnical stability monitoring and maintenance would continue as conducted during operations (see Chapter 10). Dikes would be inspected routinely to check for slope stability, changes to inflows and overall integrity.

6.7 Country Rock and Till Storage Areas

Reclamation of the NCRTS areas for an interim closure condition would require a supply of till and clean Type I rock. The main requirement would be for covering the cells containing Type II and Type III rock.

Till would be available from the North Till Storage area. Type I rock is stored in the CLR cell of the NCRTS Area. This stockpile would provide a clean rock supply in case of an interim closure. If Pit A21 is developed, additional clean rock would also be available from the SCRTS area.

Table 6-1 indicates for each year (commencing in 2007), the quantities of cover materials that would be required for the Type II and III rock cells of the NCRTS area.

Table 6-1: Required Quantities of Cover Materials for NCRTS Closure[a]

Year	Area	Cover Material Requirements (m^3)	
		Till (1.5 m thickness over Type III rock)	Type I Rock (3 m thickness over till; 4 m without till)
2007	SED	142,500	285,000
	QUAR	142,500	285,000
2008	SED	142,500	285,000
	QUAR	142,500	285,000
2009	SED	142,500	285,000
	QUAR	142,500	285,000
2010	SED	142,500	285,000
	QUAR	142,500	285,000
2016	CLAR	161,250	322,500
	NWR	-	510,000
2017	CLAR	161,250	322,500
	NWR	-	510,000
2018	CLAR	161,250	322,500
	NWR	-	510,000
2019	CLAR	161,250	322,500
	NWR	-	510,000

[a] it is assumed that progressive reclamation would occur in equal annual stages over a four year period

The availability of Till and clean Type I rock is presented in Tables 6-2 and 6-3, respectively. The tables show the estimated quantity of Till and Type I rock that will be produced, the quantities of Till and Type I rock that will be used, the quantity of accumulated stored till and rock, and the quantity of till and rock that would be required to cover the NCRTS and PKC Storage areas should the mine have to close before the planned date. The analyses were completed to Year 2011 only because Pit A21 was assumed to be developed in 2012 which would produce large quantities of Till and Type I rock.

Table 6-2 shows that there will be adequate supplies of till to cover the NCRTS pile and PKC areas in the event of premature mine shutdown prior to 2012. However, Table 6-3 indicates a potential shortfall in Type I rock for premature NCRTS and PKC closure in 2006, 2007 and 2008 providing all proposed development proceeds as planned.

Table 6-2: Till Production and Uses (Mm^3)

Year	Till Produced	Mine Development[a]	Cumulative Stored	NCRTS Cover[b]	PKC Cover[b]
2002	2.56	-	2.56	-	-
2003	2.13	1.65	3.04	-	-
2004	0.48	0.48	3.04	-	-
2005	-	-	3.04	-	-
2006	0.17	0.05	3.16	1.14	0.37
2007	3.5	0.58	6.08	0.86	0.42
2008	2.34	0.48	7.94	0.65	0.45
2009	-	0.48	7.47	0.45	0.47
2010	-	0.29	7.18	0.24	0.48
2011	-	-	7.18	0.32	0.48

[a]volume required on an annual basis for planned dams raises, road construction, foundations, and progressive closure.
[b]volume required for final closure and reclamation should mine close in given year

Table 6-3: Clean Type I Rock Production and Uses (Cumulative in millions m^3)

Year	Type I Produced	Mine Development[a]	Cumulative Stored	NCRTS Cover[b]	PKC Cover[b]
2002	0.44	-	0.44	-	-
2003	2.55	2.55	0.44	-	-
2004	3.64	3.43	0.65	-	-
2005	4.45	4.45	0.65	-	-
2006	4.07	0.85	3.87	2.91	2.20
2007	3.46	4.55	2.78	2.49	2.50
2008	5.05	3.35	4.48	2.24	2.69
2009	3.79	3.33	4.93	1.99	2.81
2010	1.13	0.91	5.15	1.74	2.86
2011	0.05	-	5.20	2.06	2.90

[a]volume required on an annual basis for planned dams raises, road construction, foundations, and progressive closure.
[b]volume required for closure and reclamation should mine close prematurely in a given year

6.8 PKC Area

During a shut down the following would be completed at the PKC facility:

- Fine PK pipe distribution system would be purged, flushed, and drained;
- Providing water quality is sufficient to be treated by the NIWTP, the barge would be operated periodically to pump excess water to the North Inlet as needed to maintain design flood storage criteria within the PKC pond; and

- Geotechnical instrumentation would continue to be read.

Reclamation of the PKC facility for a long term closure would require a supply of till and clean Type I rock. Type I rock would be available from the CLR cell of the NCRTS area. Additional clean rock would also be available from the SCRTS area should the A21 Pit be developed. Till would be available from the North Till Storage area.

6.9 Water Management Facilities

The water management plan would not change during an interim temporary shut down. However, the inflow from the PKC pond would decrease since the plant would not be processing kimberlite. The following procedures would be followed:

- Water from the ponds, and the North Inlet would continue to be pumped to the North Inlet Water Treatment plant as conducted during operations;

- Collection sumps and ditches around the site would be maintained to manage runoff from the PKC facility, the NCRTS and SCRTS piles and the general site;

- The North Inlet Water Treatment Plant would remain in operation to treat water pumped from the North Inlet, pits, underground workings and from the collection ponds;

- Continuous operational daily monitoring of the water quality would be performed at the inlet of the treatment plant with regulatory sampling continuing on a six day frequency and at the outfall monthly. Continuous monitoring would include flow rates, pH, turbidity, conductivity, ammonia, and temperature. Regulated sampling would continue as per the Water License. Refer to Section 10 for further details on monitoring.

If the short-term shutdown progresses into indefinite shutdown, then the runoff water from the site and the PKC pond would be redirected to the North Inlet. The NIWTP would remain in operation to treat excess water from the North Inlet prior to discharge to Lac de Gras.

6.10 Plant Site, Accommodation Complex and Fuel Storage

6.10.1 Process Plant

Any stockpiled kimberlite ore remaining on surface at the commencement of a temporary shutdown would be processed before plant operations cease. The plant would then be shut down in a planned and sequential manner in order to prevent damage to equipment, piping and instrumentation.

The following preparatory measures would be taken prior to plant shutdown:

- All rough diamonds would be removed from the diamond collection receptacles and shipped to Yellowknife;
- Remaining coarse PK fractions would be transported by truck to either the North or South Coarse PK Cells; and
- The fine PK slurry pipelines would be flushed of solids using reclaim water pumped from the PKC facility.

Short-term shutdown strategies for the Process Plant include:

- Minimal heating would be maintained to the Process Plant to prevent equipment freezing;
- The raw water supply to the Process Plant would be turned off;
- Power and process air supplies to the Process Plant would be maintained;
- An inventory of all chemical reagents would be undertaken and maintained;
- All tank levels would be recorded and monitored;
- All major equipment would be run periodically to ensure lubrication and integrity of the rotating parts; and
- FeSi would be periodically re-circulated to prevent setting up in the circulating medium tanks.

In addition to the above short-term shutdown strategies, the following measures would be taken in the case of long-term shutdown of the Process Plant:

- Equipment and gearboxes would be drained of lubricants and coolants, which would be stored in sealed drums in the maintenance complex, or removed from site;
- All tanks would be drained, and remaining FeSi would be transferred to the NCRTS area for storage;
- All reclaim water and Fine PK slurry pipelines would be flushed and drained;

- Sensitive electronic devices such as instrumentation control cards, PLCs and control system computers would be removed from the site or warehoused within the Maintenance Complex;

- All chemical reagents would be inventoried and transferred to warehouse storage within the Maintenance Complex, or would be removed from site;

- Heavy rotating equipment would be lifted off bearings and safely supported;

- All heating and power would be turned off, and power lines to the Process Plant would be discharged and left open; and

- The entire Process Plant would be winterized and locked up with emergency access restricted to authorized personnel only.

6.10.2 Accommodation Complex

With the exception of accommodation facilities required for care-and-maintenance personnel, wings, common areas and offices within the Accommodation Complex would be closed off to reduce power, heating and ventilation requirements during temporary shutdown.

All care-and–maintenance personnel would be housed within one wing of the complex and would be serviced by a single cafeteria, common area and laundry room. Recreational facilities located within the gymnasium would also remain available to on-site personnel during the shutdown periods.

Any hazardous materials located within closed off areas of the accommodation complex would be collected, inventoried and stored in the maintenance complex warehouse. All closed off areas would be securely locked with access restricted to authorized care-and-maintenance personnel only.

6.10.3 Administration/Maintenance Complex

Non-essential areas and offices within the Administration/Maintenance Complex would be closed off during temporary shutdown so that heating and ventilation can be reduced to minimum levels. All necessary support facilities and services for care-and-maintenance personnel would remain in operation, including work shops, the Emergency Response Vehicle garage, and the warehouse.

Any hazardous materials located within closed off areas would be collected, inventoried and stored in the warehouse. All closed off areas would be securely locked with access restricted to authorized care-and-maintenance personnel only.

6.10.4 Fuel Storage

The fuel storage areas would remain functional during short-term and long-term shutdown periods in support of care-and-maintenance activities. All tank levels would be monitored throughout the shutdown period, and the tanks would be regularly inspected for potential fuel leaks.

6.10.5 Power Plant

The power plant and waste heat recovery would remain functional during temporary shutdown periods in order to supply power and heating requirements for care-and-maintenance personnel. All non-essential power lines would be discharged and left open during long-term shutdown when power and heating supplies to non-critical plant and infrastructure would be turned off. The power plant would be configured to operate at maximum efficiency under the reduced loading condition.

6.10.6 Boiler Plant

The boiler plant would remain functional during short-term and long-term shutdown periods in order to supply minimal heating requirements in the event of a failure within the main power plant. All non-essential glycol lines would be flushed and drained during long-term shutdown when heating supplies to non-critical plant and infrastructure would be turned off. Excess glycol would be placed in sealed drums, which would be stored in the Boiler Plant or sent to warehousing within the Maintenance Complex.

6.11 Infrastructure

During temporary shutdown, the site infrastructure would be placed into a care-and-maintenance mode to minimize operating costs and ensure environmental stability while maintaining conditions that would permit the safe mechanical resumption of operations at reasonable cost and schedule.

Temporary shutdown strategies for the site infrastructure include:

- All support infrastructures necessary for care-and-maintenance activities would remain in operation during shutdown periods. This would include select Arctic Corridors, the communication system, the airstrip and roads, the raw water intake, the potable water treatment plant, the sewage treatment plant, the waste transfer area and inert landfill.

- Minimal heating to critical facilities would be maintained to prevent equipment freezing.

- Water supplies would be turned off in specific areas that are not in use or are at the lower risk of fire.

- All non-critical facilities and equipment requiring power and/or heating would be shut down. Computing facilities including networks and databases will be backed-up. Equipment and gearboxes would be drained of lubricants and coolants, which would be stored in sealed drums in the maintenance complex, or removed from site. Heavy rotating equipment would be lifted off bearings and safely supported. All heating and power would be turned off, and power lines to the plants would be discharged and left open.

- Remaining equipment would be adjusted or modified to operate at lower capacity and consume less power. All major equipment would be run periodically to ensure lubrication and integrity of the rotating parts.

- Excess chemical reagents and hazardous materials stored within the site buildings would be collected, inventoried and warehoused within designated areas, or transferred off site.

- All non-essential tanks would be drained, and remaining materials would be transferred to the NCRTS area for storage. All remaining tank levels would be recorded and monitored.

- Explosive materials would be inventoried and stored within the Ammonia Nitrate Storage or Caps/Explosives Storage, or transferred off site.

- The Ammonia Nitrate Storage, Caps/Explosive Storage and Emulsion Plants, and the Batch and Crusher plants would be locked up securely with emergency access restricted to authorized care-and-maintenance personnel only.

- Most surface mobile equipment would be relocated to a secured, common parking area and inspected for any potential oil or other fluid leaks. Emergency response vehicles would be kept in the garage located within the Maintenance Complex, available for use as required.

7. PROGRESSIVE RECLAMATION MEASURES

7.1 Introduction

DDMI's sustainable development policy seeks to influence the design, development, operation and closure of all mining activities so as to ensure the optimisation of post closure outcomes in terms of social, environmental and economic development needs and expectations. This Interim CRP is consistent with this objective as it integrates environmental and mine planning and adopts, where practical, progressive reclamation throughout the mine project life cycle.

7.2 Progressive Reclamation Strategies

The Mine Site Reclamation Guidelines for the Northwest Territories (DIAND 2006) define progressive reclamation as reclamation actions that can be undertaken during mining operations before permanent closure, to take advantage of cost and operating efficiencies and reduce overall reclamations costs.

By adopting progressive reclamation throughout the mine life, DDMI will prepare the site for eventual closure. Progressive reclamation reduces DDMI's exposure to environmental liability and maximizes the benefit of operational resources throughout the mine life to achieve final closure objectives. It will not only enable natural flora and fauna to establish early on in the project life but will allow for adaptive management through use of several years of monitoring data collected prior to planned shutdown. During operations, when a variety of professional scientific and engineering personnel are typically on-site, a sound research program should evolve; one which would include site specific solutions to problem areas. Of final significance is the expected annual reduction in bonding costs realized as credit for reclamation progressively achieved.

7.3 Open Pits

The open pits will not be flooded until final closure. Progressive reclamation of the open pits will be limited to fish habitat restoration. Based on the "No-Net-Loss Plan" (NNLP) developed by DDMI (DDMI August 1998) and the conceptual fish habitat plan prepared by Golder Associates Ltd. (Golder March 2003), the objective of fish habitat creation at the Diavik Mine Site is to return the closed pit areas to productive fish habitat wherever possible, and to create fish habitat within the dikes that is similar to the nursery and rearing habitat lost in the North Inlet as the result of mine operations. In doing so, the conservation goal of achieving No-Net-Loss of the productive capacity of fish habitat will be maintained. This objective adheres to the Federal Policy for the Management of Fish Habitat (Dept. Fisheries and Oceans, 1986).

The Fisheries Authorization identified the requirements for achieving no-net-loss of habitat for all aspects of the DDMI Diamond Project. Design parameters for the fish habitat creation works were developed in the NNLP and conceptual fish habitat plan considering fish habitat, surface water runoff, and geotechnical issues. Design details with respect to surface water handling, material selection, and construction of the fish habitat is being managed by DDMI in order to achieve the desired habitat compensation prior to re-flooding of the diked areas.

7.3.1 Overview of NNLP Related to Open Pits

The fish habitat design described in the NNLP and conceptual fish habitat plan applies to each pit; however, only the A154 fish habitat works have been constructed to date. The A418 fish habitat works are scheduled for construction in approximately 2007, with A21 currently scheduled for about 2013. Since completion of the water retention dike (dike) locations and pit layouts for A418 and A21 have not been finalized, some of the design details may be modified for these two pits. It is intended that the design details (particularly setback distances and slope angles) be reviewed prior to construction of fish habitat compensation measures for A418 and A21, to incorporate knowledge gained from the construction and performance of A154.

Specific requirements for the inside of all three open pit areas included:

- the development of shallow rearing habitat and shoreline habitat; and
- ensuring that the habitat features within the dikes areas are modeled after those features found in other productive areas of Lac de Gras, including depth, substrate type, size, and configuration.

Before breaching the enclosure dike walls, mined country rock and finer sediment materials will be placed creating a long narrow reef in the area between the inside toe of the dike and the pit crest. These reefs would be built in areas where the water depth is 5 m and would be approximately 2 m to 3 m high. Areas of granular and soft substrates between reefs would be based on the conditions that existed in the North Inlet. Disturbance of the shoreline may require modification in areas to establish conditions similar to pre-development. This may require the placement of boulders in water depths up to about 5m. Breaching of the dikes (about 2 m to 3 m depth from low water) would create entrances that deter movement of larger fish. Overall, this will present an opportunity for the creation of shallow water fish-rearing habitat for species such as whitefish. Earthworks associated with habitat creation within the dikes will take place progressively during mining; however, the actual habitat will not be created until the dikes are breached.

As discussed in the NNLP, the primary focus for habitat creation inside of all dikes is based on maximizing rearing habitat value. Target species include lake trout (*Salvelinus namaycush*), arctic grayling (*Thymallus arcticus*), burbot (*Lota Lota*), longnose sucker (*Catostomus catostomus*), round whitefish (*Prosopium cylindraceum*), cisco (*Coregonus artedi*), lake whitefish (*Coregonus clupeaformis*), and slimy sculpin (*Cottus cognatus*).

Four key zones of habitat were identified in the NNLP (Diavik August 1998) for the area found inside the constructed dikes during the post closure phase. These included:

- Inside edge of the dike - the area of water depths from 0 m to 2 m along constructed sections of the dike representing new shoreline habitat;
- Reclaimed shorelines - areas of pre-existing shorelines;
- The pit shelf - the area between the inside edge of the dike, the shorelines, and the pit crest; and
- Deep water - the pit itself, which will have a depth of approximately 250 m.

The NNLP provided habitat unit calculations based on the available design information for the dikes and pits at the time. Some modifications to the dike design and pit dimensions were made subsequent to the submission of the NNLP. The habitat units calculated as part of the NNLP Addendum (DDMI April 1999), along with re-calculated values based on this updated information are presented in the Golder report on Fish Habitat Design for the Pit Shelf areas at Diavik Diamond Mine (Golder March 2003).

Inside Edges of Dike

The inside edge of the dike is intended to provide new shoreline features for foraging, rearing and spawning. The dike itself will resemble existing shoreline and reef habitat and is expected to provide a rocky (boulder/cobble) area of moderate slope, with low to moderate wind and wave action. The NNLP habitat evaluation completed for the inside edge of the dikes treated this area as shoreline habitat. Table 7-1 summarizes the amount of shoreline habitat predicted in the NNLP (DDMI August 1998) and the current estimate based on the final constructed dike configuration (Golder March 2003).

Table 7-1: Inside Edge Shoreline Habitat Areas

Dike	NNLP Predicted Area (ha)	Current Predicted Area[a] (ha)
A154	1.37	3.41
A418	0.48	n/a
A21	1.07	n/a

[a]Based on final constructed configuration of dikes, where available; n/a = not available (Golder March 2003).

Reclaimed Shorelines

The reclamation objectives for the pre-existing shoreline along the edge of the diked area, and around any islands within diked areas, are to:

- minimize change to existing substrates or other features; and
- re-configure disturbed portions to pre-development conditions as much as possible.

This will allow the shoreline areas to be restored to pre-existing conditions once the dikes are breached. Any areas of disturbed shoreline will be re-configured to provide new fish habitat resembling habitat that was temporarily lost during the project. Table 7-2 summarizes the amount of reclaimed shoreline habitat predicted in the NNLP (DDMI August 1998) and the current estimate based on the final constructed dike configuration (Golder March 2003).

Table 7-2: Reclaimed Shoreline Habitat Areas

Dike	NNLP Predicted Area (ha)	Current Predicted Area[a] (ha)
A154	0.52	2.36
A418	0.61	n/a
A21	0.82	n/a

[a]Based on final constructed configuration of dikes, where available; n/a = not available (Golder March 2003).

Pit Shelf

The pit shelf area extends from the lower inside edges of the dike to the edges of the pit. The reclaimed pit shelf area is intended to provide shallow foraging and rearing habitat for most species of fish present in Lac de Gras. Material excavated from the pit will be used to fill in deeper portions of the pit shelf area. The area of the pit shelf will be covered by water that ranges from 3 m to 5 m deep. As per the Navigable Waters Permit for the project (DFO Canadian Coast Guard August 2000), no dike breach or constructed shoal features will be less than 2 m depth from the expected low water level in Lac de Gras.

Table 7-3 summarizes the amount of pit shelf habitat predicted in the NNLP (DDMI August 1998) and the current estimate based on the final constructed dike configuration (Golder March 2003).

Table 7-3: Pit Shelf Habitat Areas

Dike	NNLP Predicted Area (ha)	Current Predicted Area[a] (ha)
A154	59.89	61.35
A418	8.68	n/a
A21	54.13	n/a

[a]Based on final constructed configuration of dikes, where available; n/a = not available (Golder March 2003).

Deep Water (Pit Area)

The deep water habitat created by the project will be located in each of the mine pits near the center of the diked area. The deep water will provide a cooler environment for fishes and was considered a pelagic zone in the NNLP. This area will likely be used by pelagic feeding fish such as cisco and may provide other benefits. The maximum depth of the pit areas is anticipated to be 250 m. Table 7-4 summarizes the amount of deep water habitat predicted in the NNLP (DDMI August 1998) and the current estimate based on the final constructed dike configuration (Golder March 2003).

Table 7-4: Deep Water Habitat Areas

Dike	No Net Loss Predicted Area (ha)	Current Predicted Area[a] (ha)
A154	55.21	52.3
A418	41.94	n/a
A21	29.29	n/a

[a]Based on final constructed configuration of dikes, where available; n/a = not available (Golder March 2003).

7.3.2 Stability of Fish Habitat Fills

Slope stability analyses were carried out to determine the stability of the face of the fish habitat fills, and the required setback from the pit crest. The impact of the placed material on the stability of the pit was also checked.

Stability analyses were carried out using the computer program XSTABL and SLOPE/W. Factors of safety were calculated on the principle of limit equilibrium against potential sliding along a failure surface for each of the selected cross-sections. Factors of safety were computed using both Spencer's method and the Morgenstern-Price method, which satisfy both force and moment equilibrium. Based on the type of soil and the configuration of the habitat, both circular and wedge failure mechanisms were assessed.

Based on this analysis, the recommended setback for the fish habitat fills from the pit crest (i.e., top of the in-situ till slope to the toe of the fish habitat fill) is 4 times the height of the fill (taken as the difference between the ultimate top of the fill and the elevation of the pit crest), with a minimum of 15 m. The slope of the faces of the fish habitat fill facing the pit and the interior of the dikes should be 3H:1V or flatter. These design parameters may be modified as mining progresses and further data and observations on fill stability are collected.

7.4 Underground Mine Workings

The underground workings will not be flooded until final closure. The current conceptual underground mining plan involves the integral use of backfill. Therefore, the underground workings will be progressively reclaimed as they are backfilled. Only very limited excavations will be open at any one time within the kimberlite pipes and long term stability of the pipes is assured independent of the timing of a shutdown.

7.5 Enclosure Dikes

At closure the underground workings and the opens pits will be flooded and then the dikes will be breached. Therefore, the only progressive reclamation planned for the enclosure dikes is fish habitat creation.

In addition to the fish habitat creation inside the closure dikes as discussed in Section 7.3 above, the rock grade placed around the exterior of the dikes during construction is expected to create additional fish habitat; specifically, spawning habitat for lake trout.

7.6 Country Rock and Till Storage Areas

Country rock from A154 and A418 will be placed in the NCRTS area and if developed, the country rock from A21 would be placed in the SCRTS area. The estimated volumes of the country rock and till that will be produced from A154 and A418 are given in Table 5-4. Further details regarding the design for the NCRTS can be found in the design report (NKSL August 2001).

7.6.1 Closure Factors

Iterative and thorough design analyses were completed to develop a competent closure design for the Country Rock and Till Storage areas. The major factors addressed in the closure plan are:

- Physical Stability
  - Short term and long term stability of large rock piles on ice rich soil in some areas.
  - Surface erosion and sediment yield.
- Chemical Stability
  - Acid rock drainage potential.
  - Metal mobilization and migration.
- Permafrost Development
  - Maintaining permafrost at the pile perimeter for physical and chemical stability.
  - Development of permanent permafrost within the rock pile.

- Environmental Aspects
  - Caribou migration across the piles.

7.6.2 Progressive Closure Strategy

The closure strategy is an integration of country rock management, placement design and scheduling, design of containment areas, and progressive reclamation. The closure plan started from the first placement of country rock within the NCRTS areas. The closure plan has concentrated on the NCRTS Area for the following reasons:

- It will store some Type III country rock, which may be potentially acid generating; and

- The footprint of the storage area has some sections located over ice rich soil.

The SCRTS area will receive only rock from pit A21, if A21 is developed. The country rock for the A21 pit is granite that has no acid generating potential. Furthermore, the footprint of this area has limited ice rich soil deposits to affect the stability of the rock pile.

The closure strategy for the country rock and till storage areas is as follows:

- Segregate the country rock in the pit into three types based on acid generating potential and store the most concentrated acid generating rock in secure containment areas with closure covers. (Refer to Section 5.5 for details regarding country rock classification and segregation).

- Place the country rock into several cells that will allow progressive reclamation.

- Surround the country rock cells with a perimeter road with ditches and collection ponds so that all surface and seepage water can be collected and checked for water quality. Water meeting Lac de Gras discharge criteria, will be discharged into Lac de Gras during operations. Water that does not meet these criteria will be pumped to the PKC Pond or North Inlet.

- Provide the storage area with shallow gradient ramps at final closure to allow caribou migration.

- The placement schedule for till at the North Till Storage Area has been planned to prevent pile instability. The plan is to place the first layer of unfrozen till over ice poor soil during warmer periods and over ice rich soil in later winter when the till is sufficiently cold to prevent thawing of the ice rich soil foundation. The South Till

Storage Area has either a foundation of bedrock or ice poor soil with only minor concentrations of ice rich soil; therefore, stability is not a concern.

- During operation, sediment control will be provided by collection ponds adjacent to the country rock piles. Before release of water from these ponds, water quality will be tested to confirm that it meets Lac de Gras discharge objectives. When water has to be released from the collection ponds because of a capacity concern and at the same time does not meet discharge criteria, it is pumped into the PKC Pond.

7.6.3 Country Rock and Till Storage Plan

As discussed in Section 5.5, the excavated materials from A154 and A418 will be placed in six cells within the North Rock Storage Area. These cells represent distinct watersheds that will allow the materials to be segregated and to be progressively rehabilitated. Deposition and reclamation will commence from the east end of the North Rock Storage Area and progress towards the west.

The principal feature of the storage concept is to place the Type III Rock, into two 'tub' cells, cover them with a low permeability cover and allow the piles to freeze. The Type I and II rock materials will also be placed in separate cells by material type. This will allow monitoring of the seepage volume and water quality from each type of material.

The rock is placed in 10-20 m thick lifts. When possible, grading of the outer slope of each lift will be undertaken to produce a stable final slope.

There are different reclamation plans for each of the rock types stored in the NCRTS and SCRTS areas. As the NCRTS area cells are filled to capacity they will be reclaimed progressively as suitable cover materials become available. No seepage will be released directly to the environment from any cell unless it is proven that the water meets Water License quality criteria. All country rock from A21 is expected to be non acid generating and is not expected to require any special segregation and storage provision.

Each open pit has glacial till overburden, which needs to be stripped before excavation of the country rock and kimberlite ore can proceed. The till is dense, silty sand containing gravel, cobbles and boulders. It will be used in construction of the PKC dams, to construct covers over Type III stockpiled material and the PKC area, and to provide low permeability material for ditch or pond linings where needed. An estimated 14 to 16 million m^3 of till will be removed during stripping for the three open pits, of which the majority, 11.2 million m^3, will come from the A154 and A418 pits. The surplus till not needed for reclamation and construction will be stored in the North or South Till Storage Areas.

7.6.4 Progressive Closure Method

The different reclamation design plans for the different rock types reflect the anticipated potential for metal leaching from the various Country Rock types.

Type III Rock

Type III rock has a higher percentage of biotite schist rock, which has the most potential for acid generation. Final reclamation will consist of a till cover layer protected with clean rock to prevent seepage and oxygen infiltration. The covers will be placed as areas of the pile reach final elevation and suitable cover materials become available.

Once the Type III cell is raised to its design elevation, the Type III rock will be covered with 1.5 m of till followed by 3 m of clean rock. Cover design thickness will be assessed in a Country Rock Test Pile Study that is under construction (see Section 10.3.2). The design analysis indicated that 3 m of rock over 1.5 m of till will prevent the active layer from extending through the till, thereby ensuring the till is permanently frozen. Once the cover is in place and the till freezes the following year, the cover will inhibit the penetration of water and oxygen into the Type III rock. The rock cover also provides erosion protection.

The following assumptions have been made:

- After the cover is placed, minimal additional water will penetrate into the rock cell; because the till cover has a low permeability and will also become permanently frozen after one year.
- The oxidation of the biotite schist will be very slow because the temperatures within the pile will be at or below 0°C, and will be decreasing with time.
- Freezing of infiltration water from operations will start immediately upwards from the base of the quarry (QUAR) and clarification (CLAR) cells. This upward freezing process will be slow as most heat is extracted at the surface.
- All Type III rock will be completely encapsulated by a layer of frozen materials and will become permafrost in about 25 years.

<u>Quarry Area (QUAR)</u>

The quarry, QUAR, is a receiver of Type III rock. The quarry will be filled in about 5 years and covered with a 1.5 m thick layer of till and then 3 m of clean Type I rock. Thereafter, the rock will cool and be encased in permafrost.

Clarification Pond (CLAR)

The Clarification Pond contains ponded water from dredging for the A154 pit and the A418 dike. Type III rock will be placed in the Clarification Pond starting in 2009. The rock will be placed starting from the Sedimentation Pond and progressing west. All of the rock will be placed by 2013. A 1.5 m till and 3 m clean rock cover will be progressively placed over the Type III rock progressively such that by 2013 almost the entire cover has been constructed.

Type II (mixed) Rock

Type II rock has a very low potential to leach metals in an arctic environment. This rock will be placed in separate watersheds from the other rock Types so that the final cover design can be confirmed from seepage observations made during cell filling and from the Country Rock Test Pile study (see Section 10.3.2). On the basis of present assessment, it is anticipated that a till cover will not be required for the Type II rock. The treatment of Type II rock will consist of placing 4 m of clean rock (Type I) over the Type II to keep the active layer completely within the clean rock. A permanently frozen zone will be developed at the surface of the cell during the first year after the cover is placed and it will increase in depth with time.

Northwest Rock (NWR)

Type II rock will be placed in the NWR cell progressing from east to west. Progressive placement of the Type I rock closure cover will be completed from 2010 to 2013 as areas of the NWR are filled to final elevation and reclamation materials become available.

South Country Rock and Till Storage Area

The rock will be placed in 10-20 m thick lifts. When possible, grading of the outer slope of each lift will be undertaken to produce a stable final slope.

Country rock from Pit A21 consists almost entirely of non-metal leaching rock; therefore no special cover is planned for the SCRTS area. Some of the rock from this pit will be used to cover the final portion of the NCRTS area if needed. The main usage of this country rock will be for the final reclamation of the PKC Storage area after closure. Since the rock is not expected to produce any impacted seepage water, ditches and collection ponds will not be installed around the pile unless water quality monitoring indicates the need for them.

Seepage and Groundwater Control

The NCRTS area is contained by high ground to the north and the PKC facility to the south. The till storage pile is confined by the perimeter road to the east and ditches and collection ponds on the rock storage side.

All surface and groundwater from the North Country Rock Pile will be collected in Ponds 1, 2 and 3 during operations. The groundwater will not be able to seep below the road embankment because the base of the active layer will be elevated by the road fills. The water quality will be checked at the collection ponds before being discharged to Lac de Gras.

7.6.5 Fish Habitat Replacement

There were a number of small lakes that were or will be lost during construction of the NCRTS, SCRTS, and PKC areas. DDMI as part of the NNLP (DDMI August 1998) will re-create similar habitats to compensate for these losses. Plans for compensation are under consideration with Department of Fisheries and Oceans.

7.6.6 Progressive Closure Monitoring

See Section 10 for information regarding monitoring of the country rock and till storage areas.

7.7 PKC Area

The PKC stores coarse and fine PK as described in Section 5.6. Progressive reclamation will not be possible for the PK beaches until about the last 3 years when production will decrease considerably. It will not be possible to plan early reclamation for the PKC pond because of the continued fine PK deposition. No early permafrost development will occur beneath the pond because of the water, but frozen conditions will develop in the exposed beaches. Progressive closure will be possible for the coarse PK areas and is described in this section.

Based on the current mine plan, the Process Plant will produce up to 6 million m^3 of coarse PK during the estimated 20-year plant operation. The material will be stored in cells north and south of the PKC pond, as shown on Figure 5-4. These cells are located on the upland of an east-wet running valley that is used to store the fine PK. The coarse PK will be contained by perimeter dams and rock spigot pads that separate the fine and coarse PK. Large sections of these cells are in turn confined by either the NCRTS or SCRTS piles. The North and South Coarse PK Cells have approximate areas of 19 and 30 ha respectively.

Coarse PK will be trucked to the area of deposition via north and south perimeter roads, and via rockfill finger roads, as required, where the PK will be end-dumped and spread.

7.7.1 Closure Factors

Coarse PK will begin to freeze during the year following placement. However, surface runoff during the summer months could transport metals making the water unacceptable for direct discharge to Lac de Gras. Therefore the closure strategy considered in design was to prevent surface water from being contaminated by coarse PK.

7.7.2 Closure Strategy

The closure strategy for the coarse PK is to provide a sufficiently thick cover to keep the coarse PK permanently frozen and prevent wind erosion.

7.7.3 Proposed Closure Method

The potential leaching of metals, along with surface runoff and wind erosion, require that a cover be placed on the PK surface. The design and thickness of the cover were specified to control leaching of the PK material, resulting in a cover that will be thicker than required to control erosion.

Metal leaching will be minimized as the coarse PK will be covered with 0.5 m of low permeable sandy silt till and 3 m of clean rock and keeping the PK frozen.

The coarse PK cells will be graded so that all the runoff is directed to the PKC Pond.

Coarse PK will be progressively reclaimed as portions of the storage area reach final elevation and cover materials become available. Deposition and progressive reclamation will begin at the North Coarse PK Cell, and when the north cell is full, deposition will start in the South Coarse PK Cell, followed shortly by progressive reclamation.

7.7.4 Fish Habitat Replacement

Fish habitat compensation for the PKC area is being undertaken because a small lake (“Lake e10”) and associated stream connection to Lac de Gras was lost during construction of this facility. The proposed design is to improve in-stream habitat and provide fish passage at a small west island stream (Dillon March 2004). This will consist of the installation of in-stream deflector berms, stream channelization, a step-pool sequence to allow fish passage, and the development of in-stream spawning habitats. Due to the nature of the proposed construction, the work will be conducted during non-frozen conditions, although fill could be stockpiled in the vicinity during the winter to reduce the disruption to the ground surface.

7.7.5 Progressive Closure Monitoring

See Section 10 for information regarding monitoring of the PKC Storage area.

7.8 Water Management Facilities

Progressive reclamation does not apply to the water management facilities. The ponds and ditches will collect and transfer runoff to the North Inlet. Groundwater seepage from the pits and underground workings will be continuously pumped to the North inlet. Therefore, the North Inlet and the associated water treatment plant can not be progressively reclaimed.

7.9 Plant Site, Accommodation Complex and Fuel Storage

No progressive reclamation of the process, power and boiler plants, the accommodation complex, and fuel storage areas is anticipated or planned during mining operations. However, if portions of these areas are deactivated prior to the completion of mining operations, they will be isolated and progressively reclaimed where possible to ensure they do not become a source of contamination, or pose a safety hazard to wildlife and humans.

As indicated above, about two thirds of the South Construction Camp has been dismantled with some being transported off site during the 2003 to 2005 winter road seasons. The remaining third of the South Construction Camp was retained and is used elsewhere on-site.

7.10 Infrastructure

No progressive reclamation of mine infrastructure is planned during mining operations. However, any non-essential infrastructure (or portions thereof) that are deactivated prior to the completion of mining operations will be isolated, and progressively reclaimed where possible to ensure that is does not become a source of contamination, or pose a safety hazard to wildlife and humans.

8. PERMANENT CLOSURE AND RECLAMATION MEASURES

8.1 Introduction

In terms of closure and reclamation planning, site-wide closure is defined as the closure of all of the main and ancillary structures, equipment and service utilities on East Island. The intent is to ensure that DDMI managed active areas are left in a condition which minimises adverse impacts on the human and natural environment.

8.2 Permanent Closure and Reclamation Strategies

Closure is a key element of the mine plan and will be refined continually throughout the life of the project. Reclamation will be ongoing and will be refined with field testing during operations. In this context, “reclamation” refers to re-grading of disturbed land, placement of engineered covers and, in targeted areas where technically feasible, the establishment of initial pockets of indigenous vegetation.

For interim planning purposes, it is assumed most of the serviceable equipment will be transported off-site for reuse or recycling. Non-hazardous materials and equipment, which have limited or zero value, are planned to be disposed of by alternative methods on-site, such as burning or burial, subject to regulatory approval. This Interim CRP is based on developing comprehensive disposal options throughout operations and finalizing then before decommissioning and closure. The following closure disposal options are under consideration:

- Demolition of the major buildings to near ground level and covering with rock and till;
- Demolition/dismantling for off-site disposal or recycling;
- Demolition/dismantling of most inert material for disposal either *in-situ* or in an engineered landfill area;
- Sale of intact items to northern and southern-based enterprises;
- Donation of intact items for regional development;
- Sale or donation (asset and liability transfer) to demolition and reclamation contractors; and
- Maintenance by DDMI or others of selected intact buildings, utilities and equipment for local exploration and mine development, or as emergency facilities.

Methods for the management of materials and equipment at closure will be finalized during operations, and described in the Final CRP. Methods will be selected based on an environmentally focused cost-benefit analysis and risk assessment.

8.3 Open Pit Workings

Closure of the A154 and A418 pits will commence once underground mining operations have ceased in this area, followed by closure of A21 once mining has ceased there. All mine infrastructure and equipment will be removed from each pit area and prepared for removal off site.

8.3.1 Closure Factors

Factors which influence the development of closure methods relate to the potential for release of sediment and possible trace quantities of unwanted materials (metals, ammonium nitrate and phosphorous) into Lac de Gras during pit infilling. Secondary factors relate to breaching of the dikes to create stable surfaces suitable for fish and wildlife habitats, which will remain after closure.

8.3.2 Closure Strategy

The closure strategy for the open pit areas focuses upon controlled flooding of the workings and the creation of a stable configuration of dike remnants to provide fish and shore bird habitats and navigation.

As the pit areas will be flooded at closure (eliminating oxidation), potential acid rock drainage and mobilization of metals from pit walls are not considered to be closure concerns. It is anticipated that any minor amounts of chemicals dissolved in pit seepage water, such as residual ammonium nitrate or trace metals, will be considerably diluted upon pit flooding. Significant hydrocarbon residues will be removed before flooding. Flooding will increase the stability of the pit walls.

8.3.3 Closure Plan

The decommissioning work will consist of:

- Removal of mining equipment;
- Checking for contaminated material, and if present, on-site treatment;
- Removal of seepage wells;
- Removal of thermosyphons and instruments mounted on the top of the dike;

- Removal of pit dewatering system; and

- Introducing water by controlled siphons with discharge pipe ends located in such a way as to minimize surface erosion and reduce the creation of suspended solids in the pool water.

The quality of pit water will be monitored during the gradual introduction of lake water into each pit. If water quality objectives are met, the retention dike will be breached when the pit water level equals that of Lac de Gras.

8.3.4 Closure Monitoring

Geotechnical and environmental monitoring associated with final closure of the open pits is described in Section 10.

8.4 Underground Workings

The current mine workings design is conceptual; thus the following is for general purposes. Details will be provided in subsequent CRPs as the underground mine design progresses.

8.4.1 Closure Factors

The main factor influencing the closure strategy is potential public and wildlife access to flooded underground areas from portals situated on East Island.

8.4.2 Closure Strategy

The strategy for closing and abandoning underground operations requires the physical and chemical stabilization of underground workings and access routes. Surface facilities used to support underground operations will be decommissioned and cleared areas will be re-graded and possibly locally reclaimed for long-term soil development and restoration of vegetated land.

8.4.3 Closure Plan

The underground mine workings will be progressively backfilled during operations; therefore, at closure limited areas will be open prior to flooding. The following specific actions are proposed for the closure of the underground workings at Lac de Gras:

- The access decline will be flooded at closure;

- Ventilation raises will be capped with reinforced concrete fitted with ventilation pipes and then covered with granular material and re-graded;

- The main decline access on East Island will be closed by constructing a concrete plug and removing ground supports from the portal to prevent public and wildlife access. This will be performed in accordance with the Mine Site Reclamation Guidelines for the NWT (DIAND January 2006);

- Unused ammonium nitrate and areas with excessive hydrocarbon contamination will be removed or cleaned as necessary;

- Metal mobilization will be suppressed by flooding of underground workings to seal off oxygen after all salvageable equipment has been removed;

- Fixed equipment such as piping and wiring that cannot be salvaged will be cleaned and left in place;

- All mobile equipment will be removed to surface and prepared for storage or for transport off-site;

- Fuel, lubricants and hydraulic fluids will be removed from all underground locations and shipped off-site; and

- Explosives and accessories will be removed from the underground storage magazines to off-site locations.

8.4.4 Closure Monitoring

Geotechnical and environmental monitoring associated with final closure of the underground workings is described in Section 10.

8.5 Enclosure Dikes

Closure actions associated with the enclosure dikes around the North Inlet are described in Section 8.8.1 below. The following discusses closure action related to the pit water retention dikes.

8.5.1 Closure Factors

The main closure factors are to allow fish migration and restore small craft navigation between the main lake and the flooded mine, and to provide fish habitat. The enclosure pit dikes have been constructed such that physical stability of dike walls, erosion, and sediment yield will not be a concern during closure and post closure.

Dike wall stability will increase as the dike enclosure is flooded. Long term sediment load from the dike embankments is not a concern since the lake sides of the dikes will have been exposed to wave action and the mine side of the dikes will have been washed by precipitation for approximately 10 to 20 years. Chemical stability of residual ammonium nitrate from blasting is also not considered a concern during closure and post closure due to rinsing of the pit walls and floors by precipitation and seepage water over a 10 to 15 year period.

8.5.2 Closure Strategy

The closure strategy is to breach the pit dikes after the mine workings are flooded by siphoning water from Lac de Gras into the pits until the water levels are balanced and when the water quality objectives within the enclosure are confirmed.

8.5.3 Closure Plan

The dike breaches will be localized, and will be managed to achieve the desired water circulation and navigation. The water retention dikes will be breached in a manner that enables the restoration of navigation on Lac de Gras that is acceptable to Navigable Waters Protection Division (DFO August 2000). The exact breached locations will be finalized in subsequent revisions to this plan once circulation patterns around the dikes can be monitored.

The following breaches are planned but may be changed as the design progresses:

- A154 - 2 breaches on the north side, 2 breaches on the east;
- A418 - 2 breaches on the south side and 1 breach connecting A154 and A418; and
- A21 - 3 breaches on the south and east sides and 1 breach on the west side.

The following is a summary of closure actions:

- Remove the pumping system at the toe of the dikes; and
- After water levels between Lac de Gras and the open pits are equalized and it is determined that the water quality is acceptable, breach the dikes at several locations and trim the dike crest edges to produce a sloping surface towards the water.

Breaching will consist of approximately 30 m wide slots with a minimum water depth of 2 m. The breaching will involve:

- Excavating a maximum of 8m of granular fill;

- Breaking and excavating concrete wall installation guides; and

- Breaking and excavating upper portions of the plastic concrete wall.

8.5.4 Reclamation Plan

After multiple breaching, residual portions of the dikes will remain above the lake's surface. These structures will be graded and partially reclaimed to provide low, relatively flat islands, with some shallow-water shoreline. In doing so, habitats suited to aquatic bird nesting (Arctic tern and yellow-billed loon) will be created.

Geotechnical and environmental monitoring associated with final closure of the water retention pit dikes are described in Section 10.

8.6 Country Rock and Till Storage Areas

The majority of the closure of the NCRTS area will be completed progressively over the mine life (see Section 7.6). The remaining closure requirements at the end of the mine life are discussed in this section. Figures 8-1 and 8-2 depict the final closure conditions for the NCRTS.

8.6.1 Proposed Closure Method

As part of the final closure plan, further flattening and contouring of the outer slopes of the NCRTS and SCRTS areas will be completed as required. Any areas requiring cover construction that remain at final closure will be completed following the same method described in Section 7.6.

The till storage area will be contoured and surface water erosion protection applied. This will consist of flow breaks and rock lined ditches where required. The adjacent collection ponds will be converted to sediment settling ponds, by reducing the water storage volume and converting the emergency spillways into discharge channels.

8.6.2 Reclamation Plan

Some wildlife habitat reconstruction will be considered for selected areas of the upper surfaces of the northern rock stockpile. Upper surfaces and slopes may also be re-graded to provide talus areas for wolverine habitat, and islands of well-drained, granular materials, suited to the construction of denning habitats.

In addition it is planned that at one location along the south side of the NCRTS area and one location on the north side, caribou ramps will be constructed. The north ramp will be approximately 40 meters wide at a slope of 4 horizontal to 1 vertical. The south ramp will be approximately 80 m wide at the top and 40 m wide at the bottom at a slope of

10 horizontal to 1 vertical. These flatter slopes will allow any caribou climbing the pile to safely get down.

8.7 PKC Area

Closure reclamation of the PKC facility is required for the following reasons:

- To prevent surface runoff erosion;
- To prevent wind erosion; and
- To ensure acceptable water quality.

The potential for leaching of metals, surface erosion, and wind erosion require that a cover be placed on the PK surface. The design and thickness of the cover are determined by controlling the leaching of the PK material which results in a more demanding cover than the erosion phenomena.

Leaching of the PK was addressed during the design phase for the PKC facility and is discussed in more detail in Section 10.3.1. It was observed that leaching could be eliminated by keeping the PK frozen which would require a 3 m thick rock cover. However, even if the PK remains frozen, there is some uncertainty created by the water percolating through the rock cover and then flowing across the frozen PK surface that could pick up some heavy metals. Because of this uncertainty, it is proposed to add 0.5 m of sandy silt till on top of the PK before the 3 m rock cover is placed. This thickness is increased to 1 m over the PK slimes which will experience consolidation settlement and pore water expulsion following closure.

Thermal analyses have shown that the 3 m rock cover underlain by 0.5 m of till will keep the active layer within the till layer.

Data from the Country Rock Test Pile study (see Section 10.3.2) will be used to evaluate the active layer within the PKC facility along with the thermal properties of the Type I rock and till covers. The test pile data will also be evaluated to determine whether additional test plots will be required to investigate specific PKC cover properties.

The closure of the PKC is discussed under the following headings:

- Coarse PK storage;
- Fine PK beaches;
- Fine PK pond; and

- Closure surface water management.

Figures 8-1 and 8-2 depict the final closure conditions for the PKC area.

8.7.1 Coarse PK Storage

The majority of the coarse PK areas will be progressively closed over the mine life. At final closure the last area requiring closure cover will be completed, following the plan described in Section 7.7.

The South Coarse PK Cell will contain a landfill facility surrounded by coarse PK. At project completion, the landfill is planned to be covered with coarse PK that will in turn receive an additional coarse PK cover.

The coarse PK cells will be graded so that all the runoff is directed to the PKC Pond. Upon closure of the pond, all surface water will exit the PKC area through a channel constructed in the southeast part of the PKC facility.

8.7.2 Fine PK Beaches

Fine PK will be discharged as slurry from the perimeter of the PKC pond to form wide beaches against the dams and spigot pads. The coarser particles of the fine PK will settle out to form 80 to 100 m wide beaches. Since the beach elevation will rise less than 2 m per year after about 3 to 4 years of operation, the fine PK in the beaches will develop permafrost during the early stages of operation.

Closure Strategy

The closure strategy for the fine PK beaches is to cover the fine PK material with a sufficiently thick cover to keep the fine PK permanently frozen and to prevent wind erosion.

Proposed Closure Method

The closure method for the fine PK beaches will be the same as for the coarse PK with the exception that progressive reclamation will not be possible until about the last 3 years when production will decrease considerably. The closure design is based on placing 0.5 m thick till over the fine PK followed by 3 m of clean rock.

8.7.3 Fine PKC Pond

The central part of the fine PKC area will contain a pond with an area of about 20 ha or more with a water depth averaging about 4 m. The base of the pond will be underlain by unfrozen soft fine PK material (slimes). The slimes will consolidate constantly under the continual addition of fine PK material. It will not be possible to plan early reclamation because of the continued fine PK deposition. No early permafrost development will occur because of the 4 m deep water cover.

Closure Factors

The major factor to consider in reclamation of the PKC pond is the soft unfrozen nature of the slimes, and their continual consolidation over a long period of time after the facility is closed. Thermal analyses have shown that permafrost development will be slow, taking more than 100 years for complete freezing to occur.

During the 50 to 100 years following closure, the slimes will be consolidating and the excess water will be expelled to the surface. If the expelled water were to escape, it may not meet discharge criteria. The consolidation may also result in cracks in the surface cover.

Proposed Closure Method

Reclamation of the PKC pond will start once the rate of processed kimberlite deposition will have been reduced to about a third. Under the current mine plan, final reclamation of the whole site will be performed starting in 2023 and will be essentially completed at the closure of the winter road in 2025.

It is proposed to fill the pond depression with coarse PK and/or fine PK beach material and then pre-load the pond slimes to cause the majority of the slime consolidation to occur over a 2-year period during closure construction.

The closure method will consist of the following:

- To minimize the material quantities to fill in the pond depression at closure, it is planned to reduce the volume of the pond during the last 3 years of operation by partially filling it in with coarse PK. This can be done because the Process Plant production decreases to about 1/3 of its normal operating rate. This results in a reduced volume of reclaim water that is pumped out of the PK Pond. During this time it is proposed to reduce the pond size from the west side to about half its normal operating volume. This will decrease the quantity of fill that will be required to fill in the depression at the closure of the plant.

- Pump out most of the pond water for treatment to the modified NIWTP. Leave sufficient water to allow the following step.

- The central water pond will be filled with coarser PK by hydraulic method. This will consist of putting the existing coarser PK into a slurry, pumping to the pond and discharging to fill in the depression.

- A minimum 5 m thick rock spacer will be placed over the coarser PK to load the underlying slimes and enhance early consolidation. Consolidation will occur for about a one year period before the final cover is placed. It is estimated that with the coarser PK fill and rock cover the PK slimes may settle about 4 m. This 4 m settlement is taken into consideration in the design of the closure cover, including the 5 m thick rock spacer immediately above the coarse PK fill.

- Collect all emitted water from consolidation and pump it to the NIWTP. The slimes within the pond will be about 80% consolidated at the time of closure. It is estimated that an additional 1.5 to 2 m of settlement will occur after closure. This will occur over some 50 years but at an ever decreasing rate

- Place a final cover of 1 m till and 3 m of clean rock over the rock spacer dome. Allow water to escape from the rock spacer and for freezing of the stored material to commence.

- After two to three years, the remaining pore spaces within the rock spacer will be able to store the remaining consolidation seepage water.

Figures 8-1 and 8-2 illustrate the grading, outflow and cross sectional geometry of the PKC closure plan.

8.7.4 Closure Surface Water Management

The PKC area will produce a considerable volume of runoff water since it covers an area of about 152 ha. Presently the surface water runoff within the PKC watershed is collected in the pond and recycled to the plant for processing and slurry transport. The PKC pond has an annual water balance deficit because of a large volume of water that is stored permanently in the fine and coarse PK pore space. This loss of water will discontinue once the PK material is covered.

The runoff from the PK cover at the end of the project will be directed to the perimeter of the facility and discharged through a wide erosion protected channel constructed at the southeast corner of the PKC facility, as shown on Figure 8-2. This channel will ultimately join natural drainage routes to Lac de Gras.

Proposed Surface Water Closure Method

All the coarse and fine PK surfaces will be graded to allow surface drainage to be directed into one channel for water discharge under controlled conditions. The construction steps will be as follows:

- Grade all PK surfaces to provide complete surface drainage.

- Place appropriate covers on the graded PK.

- Continue collection and treatment of surface water until the water meets closure discharge targets.

- Complete construction of the discharge channel with appropriate designed rip-rap and flow control steps to prevent erosion.

8.7.5 Reclamation Plan

At final closure the PKC area will be reclaimed by covering any remaining PK with a till and rock cover to maintain the PK completely frozen and prevent wind and water erosion. All surface water will be discharged under controlled conditions.

Permafrost plays an important role in the natural restoration process for both the PKC and the Country Rock and Till Storage areas, as it will slowly aggrade into the massive piles from the surface downward during and after the period of reclamation and abandonment. The permafrost development will create a natural physically and chemically stable condition for the PK and rock piles, thus preventing metal leaching and mass transportation (erosion) as desired from long term environmental protection perspectives.

Geothermal analysis results support the prediction of permafrost development with time.

8.8 Water Management Facilities

The closure objective is to design and manage each area of the project to enable the site to be left without long term water treatment requirements. Specific closure activities will be required to achieve this objective:

- Minimize disturbance to aquatic habitat;

- Minimize erosion;

- Develop sustainable closure drainage; and

- Develop land forms and armouring processes which replicate natural landscape and drainage systems.

Additionally, runoff and seepage water quality will require collection and monitoring to verify the effectiveness of the closure strategies.

During closure, surface disturbances caused by demolition of buildings and/or facilities will present a potential for sediment-laden runoff. Sediment releases from demolition-sites will be persistent, unless remedial designs are implemented to stabilize disturbed surfaces before final abandonment. Sediment discharges to Lac de Gras may also be generated by closure activities at the open pits. Additionally, surface runoff has the potential to transport soil surface contaminants such as hydrocarbons, from operations and storage areas.

Surface water impacts may also arise as a result of temporary seepage from the PKC, NCRTS and SCRTS areas, and other materials storage facilities. The discharge from these areas will require monitoring and may result in changes to the NIWTP. Table 8-1 describes potential elevated chemicals and metals that may occur during closure and decommissioning.

Table 8-1: Possible Elevated Levels in Discharges from Project Area

Project Area	Possible Discharges
Open pit & underground sections	Sediment, ammonium nitrate, hydrocarbons, trace phosphates
Dikes	Sediment
Country rock and till storage areas	Sediment, mineral seepage
PKC area	Sediment, mineral seepage
SSTP	Nitrates, phosphates, organic acids
Airstrip and support facilities	Sediment, hydrocarbons
Maintenance shops	Hydrocarbons, solvents
Fuel/solvent/lubricant storage areas	Hydrocarbons, organic solvents
Process Plant/Accommodation complex	Sediment, hydrocarbons, solvents, reagents

Closure of the following water management facilities is discussed below:

- North Inlet;
- North Inlet Water Treatment Plant; and
- Ponds and ditches.

8.8.1 North Inlet

The North Inlet will be modified for closure when it is no longer required as part of the water management system. Once discharge water quality criteria are meet with the North Inlet, the East Dike will breached to allow fish passage and water circulation. If quality of sediment collected within the North Inlet over the mine life is not appropriate for aquatic life, a section of the East Dike will be excavated and replaced with run of mine rock. This rock will act as a permeable barrier allowing movement of water; however, fish migration into, and sediment transport out of the North Inlet would be precluded.

8.8.2 North Inlet Water Treatment Plant

NIWTP closure activities relate to the following:

- Modifications to the NIWTP to treat, if required, remaining water from the PKC Pond upon its closure; and
- Dismantling the facility.

At closure there may be an excess of water in the PKC pond. Water treatment may be required in the last year of the mine operation in order to empty the PKC facility prior to reclamation. To achieve this, the NIWTP may need to be modified to treat metal-bearing PKC water. The modified water treatment plant will provide for:

- pH adjustment;
- Metals precipitation; and
- Filtration.

The NIWTP will be dismantled after the PKC pond water and the majority of the water produced by the consolidation of the PKC slimes has been pumped out and treated. The NIWTP is currently anticipated to be dismantled 2 years following cover placement on the PKC pond.

8.8.3 Ponds and Ditches

The site will have five collection ponds along the perimeter of the NCRTS area and the PKC Storage Area, two along the SCRTS and five along the perimeter of the plant site at closure. The purpose of the ponds is to collect surface and possible seepage water from the country rock piles and dams and check its water quality before a decision is made whether to discharge directly or to first treat.

The collection ponds around the Process Plant site will be used to trap contaminants and sediments during dismantling of the plant structures and site reclamation. The existing water management facilities may need to be augmented by localized, temporary structures, such as berms, ditches and silt fences, if required. The closure and reclamation plan is to restore the surface drainage to a condition that will ultimately allow direct water discharge into Lac de Gras. During reclamation these ponds will be used as sediment settling ponds. After confirmation that the surface water reporting to these ponds meets the Lac de Gras discharge criteria, discharge channels will be excavated through the collection pond dams to leave shallow ponds to act as sediment settling basins. If discharge quality targets are not met, collected water will be diverted to the water treatment plant

In places, post-closure water management may be assisted by natural attenuation processes achieved by channelizing the flows through natural wetland depressions or existing ponds, using natural drainage patterns. Outflows from existing ponds or wetlands will be discharged to Lac de Gras, or will be treated, according to quality. In the longer term, any seepage from facilities is likely to be limited by permafrost development. Persistent poor quality seepage and runoff will continue to be treated until discharge water quality targets are met.

8.9 Plant Site, Accommodation Complex and Fuel Storage

8.9.1 Facilities to be Closed

The Diavik site has a variety of major structures in the Process Plant Complex in the southern part of the island. These facilities include the kimberlite Process Plant, permanent accommodation complex, maintenance complex, four 18-million litre diesel fuel storage tanks, power plant, and boiler house. All of these structures were constructed to last the duration of the project.

8.9.2 Closure Factors

The main factor influencing closure methods is to prevent sediment release from demolition areas, particularly during the breakage and removal of foundations.

8.9.3 Closure Strategies

The current facilities closure strategy comprises the complete dismantling and removal of all equipment, facilities and infrastructure. This strategy applies to all surface facilities and structures. Remaining areas of disturbance will be rehabilitated, with selected locations being reclaimed for ecological restoration (including revegetation), if technically feasible.

Selected buildings, storage units, equipment and utilities may be maintained on East Island after operations cease, according to requirements. Several essential units could remain to support the monitoring and maintenance work during the post-closure period. Otherwise, all structures and equipment will be dismantled and hauled off-site for disposal or salvage, or may be disposed of by other, environmentally sound methods such as burying or burning, subject to regulatory approval.

Any sediments and contaminants produced during equipment removal, or structure dismantling and demolition will be collected and treated.

8.9.4 Proposed Closure Methods

The proposed general closure methods for the plant site, accommodation complex and fuel storage areas include:

- A temporary camp and fuel storage facility will be set up using some of the equipment remaining from the South Construction Camp.
- Hazardous materials will be packed and shipped offsite for recycle, sale or disposal. During the planned reduced operation of the plant in the last few years, the majority of the hazardous material will have been used up. Waste hydrocarbons will be back-hauled offsite annually, over the winter road for recycling or disposal.
- Equipment and furnishings within the buildings will be dismantled and shipped offsite for sale. Before shipping, the equipment will be drained and degreased if required. Non salvageable scrap material will be hauled to the landfill site for disposal.
- Buildings will be dismantled and shipped offsite for re-use. Inert structural material not suitable for re-use will be placed in the landfill then covered with coarse PK followed by till and rock. This material will include metal cladding, insulation, floor tiles and other inert clean material.
- Concrete walls will be demolished to foundation level. Footings will be left in place and covered with granite country rock.
- Any contaminated soil will be placed in the landfill within the coarse PK containment area and covered with coarse PK followed by the PK cover design.
- Concrete slabs will be covered with a layer of granite country rock up to a nominal 1.5 m thickness.

All utilities will be switched off and supply and distribution networks removed before demolition commences. Buildings will be systematically dismantled for materials re-use, scrap or disposal. Combustible structural materials may be selectively burned on-site, depending upon chemical properties and approval by appropriate regulatory bodies. Remaining structural metalwork may be cut and sold as scrap or disposed of by other approved means, (i.e. disposed in depression area and covered with rock)

Broken and crushed concrete foundations could have functional use in capping, rip-rap, and reclamation. Disposal of concrete within the PKC facility or Country Rock and Till Storage areas, are options. Unconsolidated surfaces after foundation demolition will be physically stabilized and rehabilitated to the extent possible.

Cleared sites will be re-graded to reinstate natural drainage patterns. If any areas of exposed, ice-rich permafrost are created by foundation demolition, they will be insulated with crushed rock. Active layer materials will be replaced and in targeted areas covered with till if vegetation is to be established. Previously salvaged overburden material that has been stored, may also be spread as a top dressing over engineered covers at the plant site.

8.10 Infrastructure

8.10.1 Facilities to be Closed

The Diavik site has a variety of supporting infrastructure located at various concentrated locations around East Island. These facilities include:

- Plant yard;
- Artic corridors, which carry services and provide enclosed walkways between major buildings;
- Communication system;
- Ammonium Nitrate Storage, Explosive Mixing Plant and Caps Magazine Storage;
- Batch plant;
- Crusher plant;
- Airstrip with Helicopter Pad and Fuel Storage;
- Roads, which form a perimeter containment for most of the facilities;
- Water pipelines;
- Raw water intake and potable water treatment plant;
- Sewage treatment plant with treated sewage outfall;
- Hazardous wastes storage facility;
- Fuel Tank Farms (North and South);

- Solid waste incinerator and landfill; and

- Miscellaneous administration, storage, repair shops and laydown areas.

The majority of these facilities were constructed to last the duration of the project.

8.10.2 Closure Factors

The main closure factor influencing the closure and reclamation of infrastructure on East Island is the same as that for the plant complex; namely, minimize the potential for sediment release from demolition areas, particularly during the breakage and removal of foundations.

8.10.3 Closure Strategies

The current facilities closure strategy comprises the complete dismantling and removal of all equipment, facilities and infrastructure. This strategy applies to all surface facilities and structures. Remaining areas of disturbance will be rehabilitated, with selected locations being reclaimed for ecological restoration (including revegetation), if technically feasible.

Depending upon condition, market value and demand, infrastructure materials and equipment will be listed for sale, scrap or approved disposal. Selected assets would be sold to local, northern companies or communities, wherever possible.

Obsolete, unserviceable or surplus fuel, electricity and water distribution systems will be dismantled and removed from site. Pipes, cables and pylons will be cut for approved disposal.

Selected buildings, storage units, equipment and utilities may be maintained on East Island after operations cease, according to requirements. For example, the sewage treatment unit would be kept operating during the decommissioning period in order to accommodate the remaining personnel still on-site at that time. Other essential units required to support the monitoring and maintenance work during the post-closure period would also remain. Otherwise, all structures and equipment will be dismantled and hauled off-site for disposal or salvage, or may be disposed of by other, environmentally sound methods such as burying or burning, subject to regulatory approval.

Any sediments and contaminants produced during equipment removal, or structure dismantling and demolition will be collected and treated.

8.10.4 Proposed Closure Methods

The proposed general closure methods for the site infrastructure include:

- A temporary camp and fuel storage facility will be set up using some of the equipment remaining from the South Construction Camp.

- Hazardous materials will be packed and shipped offsite for sale or disposal. During the planned reduced operation of the plant in the last few years, the majority of the hazardous material will have been used up. Waste hydrocarbons will be back-hauled offsite annually, over the winter road for recycling or disposal.

- Above ground piping, electrical wires and utilidors will be dismantled. The small amount of underground piping on-site will remain below ground.

- Equipment and furnishings within the buildings will be dismantled and shipped offsite for sale. Before shipping, the equipment will be drained and degreased if required. Non salvageable scrap material will be hauled to the landfill site for disposal.

- Buildings will be dismantled and shipped offsite for re-use. Inert structural material not suitable for re-use will be placed in the landfill then covered with coarse PK followed by till and rock. This material will include metal cladding, insulation, floor tiles and other inert clean material.

- Concrete walls will be demolished to foundation level. Footings will be left in place and covered with granite country rock.

- Any contaminated soil and sludges will be placed in the landfill within the coarse PK containment area and covered with coarse PK followed by the PK cover design.

- Concrete slabs will be covered with a layer of granite country rock up to a nominal 1.5 m thickness.

- All of the mobile/support equipment will be cleaned and decontaminated before being removed from the site.

During final reclamation, the terminal building and navigation system will be removed and fuel storage reduced. The airstrip will be maintained until the end of post-closure water treatment operation. At this stage, the remaining fuel storage area will be removed, the airstrip will be breached at three natural drainage locations, and its surface will be scarified.

The roads will be reclaimed as the need for them ends. Other work items for closure will be the removal of culverts, re-establishing drainage courses and scarifying the road surface. Additional reclamation of targeted roadway areas will include the re-establishment of indigenous vegetation. Previously salvaged overburden material that has been stored, may also be spread as a top dressing over the targeted areas.

Areas used to store chemical and petroleum products will be monitored regularly during operations to ensure proper storage and handling as well as immediate clean up of spilled materials. Therefore, at closure minimal contamination will exist; however, if areas have been identified that contain contaminated soil, a site assessment will be conducted to determine the extent of the contamination and appropriate remediation measures will be taken.

All structures for the storage and containment of oils, fuels, glycols and hydraulic fluids will be removed. Liners will be cleaned and disposed of off-site, or by *in-situ* burial at an approved location. Surplus consumable materials may be transported off-site for use at nearby operations, other northern communities, or Yellowknife. Spent hydrocarbon liquids may be sent off-site for recycling or disposal. All surplus reagents from the plant will be removed from site for re-use or sale.

All the bulk fuel tank farms on site are housed within bermed areas, and typically, on impervious liners. At closure, it is expected that all fuel will be used up during decommissioning. The empty tanks will be removed from site. The fuel tanks will be disposed of in accordance with government regulatory requirements. Bottom sludge will either be back hauled off-site to a licensed waste disposal facility, or if feasible, landfarmed on-site. Hydrocarbon-impacted soils from fuel depots, storage areas and occasional locations with soils impacted by spills or leakage may be removed for off-site disposal, or degraded by bioremediation at a land-farm within the PKC area. Seasonal biodegradation of hydrocarbons within a high latitude climate is thought to be feasible, but requires further investigation. If used, land-farm facilities will be dismantled and rehabilitated when remedial work is complete.

Decontamination of certain structural and equipment surfaces by washing or steam cleaning will create wastewater, which may require active treatment before discharge. Sludge generated from decontamination may be disposed of in the PKC facility, or off-site in a managed facility. During demolition of pipelines etc. some spills may occur. In the event that hydrocarbons leak or are spilled, initial efforts will be directed at cleaning up and/or containing the spill. Clean-up efforts will include the use of absorbent pads and sandbags and other containment structures. Any soil still contaminated after clean-up will be transported to an area designated for bioremediation.

The closure and reclamation of the WTA and inert landfill will follow applicable CCME and NWT Guidelines. The current and future areas of the inert landfill will be covered with Type I rock, while a layer of coarse PK followed by till and rock will be placed over the WTA. Both areas will be contoured to promote drainage and to match the surrounding topography.

9. PROJECTED POST-CLOSURE ENVIRONMENT

As indicated above, the objective of progressive closure and reclamation planning at the Diavik Diamond Mine is to develop a post-closure environment that is sustainable in the long term, requires little or no maintenance after a period of monitoring and management, and supports ecological productivity.

This section of the Interim CRP provides a description of the projected physical and biological environment in the vicinity of the mine site following permanent closure and reclamation.

9.1 Physical Environment

At permanent closure and reclamation, the physical characteristics of East Island will have been altered from pre-development conditions as a result of mining activities. Specifically, select inland lakes would have been filled, the relief increased, and surficial characteristics changed with the creation of boulder fields and partially vegetated land in target areas.

The anticipated physical post-closure conditions at the Mine site are illustrated on Figure 9-1. As indicated, the PKC area and the NCRTS and SCRTS Piles will be visible after closure because of their footprint and elevation. Other reclaimed areas will likely remain visible for some time following permanent closure until a sustainable native vegetation community is re-established.

All reclaimed areas will have been contoured where necessary to provide surface drainage, stability and wildlife egress. Depending upon the results of the ongoing re-vegetation studies, indigenous vegetation will have been re-established in target areas (south plant area, ammonium nitrate storage areas, the north camp area, and selected roadway sites). Remaining areas will have been scarified and/or covered with clean Type I rock.

Natural drainage patterns to Lac de Gras will have been reinstated where possible, and remaining surface water collection ponds converted to sediment settling ponds with suitably armoured outlets. The dikes will be breached to allow fish passage and water circulation once water quality objectives are confirmed within the enclosed areas.

9.2 Biological Environment

As indicated previously, the complete restoration of pre-development terrestrial ecological characteristics within the mine footprint will not be possible. The closure design will increase the relief of select areas of the island, and there will be loss of vegetation and a minor loss of biodiversity at the level of groups of plant communities. Once the vegetation on East Island is disturbed, it may take generations for revegetation to occur. Therefore, all traces of use and occupation of East Island would be evident for many years after closure.

As similar habitat is common throughout the area surrounding the Diavik mine site (DDMI 1998), the loss of habitat as the result of mine related development and operations is expected to have relatively minor impact on wildlife and birds. The objective is therefore to focus terrestrial habitat rehabilitation on select targeted areas of disturbance to allow for longer term, natural soil development and plant community succession with possible assisted vegetation establishment. Other areas, such as the Country Rock piles and the PKC will remain barren and provide a boulder field type wildlife habitat.

The PKC area and country rock piles will be contoured and access ramps will be constructed to allow caribou to safely move through the area. Additional wildlife habitat reconstruction will also be considered for selected areas of the upper surfaces of the country rock piles including re-grading of upper surfaces and slopes to provide talus areas for wolverine habitat, and the placement of well-drained, granular materials, suited to the construction of denning habitats.

Through the creation and/or enhancement of new fish habitat in the open pit areas, and at other sites in the surrounding project area, the loss of aquatic habitat during operations will be mitigated during post-closure. Overall, there will be No-Net-Loss of fish habitat as a result of the mine operations, and there is the potential for a net gain of habitat in the newly created or enhanced water bodies.

The release of greenhouse gases, dust and noise from Diavik mine related facilities, infrastructure and operations will cease following permanent closure and reclamation of the mine.

10. RECLAMATION MONITORING AND MAINTENANCE

Monitoring and maintenance programs will be implemented to reduce environmental degradation and measure the performance of reclamation and closure activities at the Diavik Mine site. All closure and reclamation activities will be monitored and maintained during interim closure, final closure and post closure. The monitoring data collected will be used to plan and, if necessary, modify activities and procedures through the progressive reclamation period, closure and post-closure.

Three types of monitoring programs are proposed for closure activities: interim monitoring; progressive monitoring; and closure and post closure monitoring. Interim monitoring applies to closure activities during interim closure and is the same as monitoring during operations. Progressive monitoring applies to research studies and activities used to facilitate the development of closure methods. Closure and post closure monitoring applies to progressively reclaimed areas during operations and reclaimed areas in closure. Based on current mine planning, closure will occur between 2022 and 2024, with post-closure activities extending 5 years thereafter (i.e., to 2029).

The following sections discuss the monitoring programs currently underway of proposed for operations, as well as the monitoring programs related to closure and reclamation.

10.1 Operational Monitoring Programs

Monitoring and maintenance activities during closure will be similar to activities performed during operations. The following programs specific to operations at the Diavik Diamond Mine will also influence closure:

- Environmental Management System (EMS);
- Surveillance Network Program (SNP);
- Aquatic Effects Monitoring Program (AEMP);
- Wildlife Monitoring Program (WMP);
- Geotechnical Monitoring Program; and
- Fisheries Authorization Monitoring Programs.

10.1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

The Diavik Environmental Management System (EMS) is a mechanism for the achievement of continual environmental improvement. It is intended that the EMS, through a systematic approach to environmental management, will enable DDMI to achieve and systematically control an improved level of environmental, health and safety performance. EMS defines management plans and emergency plans for all key areas of the environment during construction, operations, and closure.

The objectives of the EMS are intended to demonstrate that Diavik is committed to conducting its operations in an effective manner whilst achieving a high standard of environmental quality and protection. Diavik appreciates that it is temporarily utilizing the land to recover mineral resources and will do so in a manner which will protect and respect the unique northern environment. The EMS is based on the ISO 14001:2004 standard for environmental management systems and is designed to:

- Manage activities to protect the environment;
- Ensure employees are properly trained;
- Anticipate and avoid environmental problems;
- Monitor and measure performance;
- Ensure regulatory compliance and due diligence; and
- Ensure consistency with corporate Sustainable Development policy.

The Environment Management Plans (EMP) is a component of the EMS and includes information on monitoring for the Diavik mine site. The following is a list of EMPs discussed in the EMS:

- Waste Management Plan;
- Water Management Plan;
- Hazardous Materials Management Plan;
- Blasting Management Plan;
- Explosives Management Plan;
- Quarry Management Plan (old plan; currently not in use);
- Processed Kimberlite Management Plan;
- Country Rock and Till Storage Management Plan; and

- Dredged Lakebed Sediment Management Plan.

10.1.2 Surveillance Network Program (SNP)

The Surveillance Network Program (SNP), approved by the Mackenzie Valley Land and Water Board in August 2000 as part of the original Class "A" Water Licence (N7L2-1645), includes requirements for water quality and quantity monitoring for mine-related activities. The SNP provides descriptions of location, parameters and frequency of monitoring requirements for the Water Licence. The following monitoring programs are referenced in the SNP:

- Monitoring of the quantity and quality of NITWP discharges to Lac de Gras at the discharge outfall;

- Monitoring at three stations in Lac de Gras located 60 m from the NIWTP discharge outfall; and

- Monitoring of total suspended solids (TSS) levels at eight stations in Lac de Gras during dike construction.

10.1.3 Aquatics Effects Monitoring Program (AEMP)

A proposed Aquatic Effects Monitoring Program (AEMP) was originally submitted in conjunction with the EA in 1998. In the spring of 2001, DDMI submitted a revised AEMP that was subsequently approved by the Mackenzie Valley Land and Water Board. The AEMP was designed to:

- Determine and evaluate the short and long term effects of the mine on the water environment;

- Identify additional mitigation measures to reduce or eliminate environmental effects; and

- Enable stakeholders and regulators to evaluate compliance with environmental regulations.

The AEMP includes water quality monitoring of physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients, metals and vertical profiles of dissolved oxygen and temperature at an additional ten stations in Lac de Gras.

Results from the AEMP will also be used, in conjunction with other information, to verify closure plans.

10.1.4 Wildlife Monitoring Program (WMP)

As a requirement of the Environmental Agreement signed in 2000, DDMI developed a Wildlife Monitoring Program (WMP) to monitor and manage wildlife issues of concern identified by communities and regulatory agencies. The primary objectives of the monitoring program are to:

- Collect information that will assist DDMI in determining if there are effects on wildlife and if these effects were accurately predicted in the Environmental Assessment (EA);
- Assist in determining the effectiveness of mitigation measures intended to minimize project-related effects on wildlife and whether or not these measures require enhancements; and
- Determine if new effects are found that were not predicted in the Environmental Assessment.

A total of seven issues of concern were identified and make-up the core of the WMP:

- Vegetation/Wildlife Habitat;
- Caribou;
- Grizzly Bear;
- Wolverine;
- Waste Management;
- Raptors; and
- Waterfowl.

Data concerning each of these issues will be tracked and reported on an annual basis over the life of the mine. Based on technical experience gained throughout the baseline period and the ongoing monitoring program, key recommendations will be made and incorporated into the Wildlife Monitoring Program for subsequent years. As such, the Diavik WMP will be an evolving program that will reflect recommendations during previous years, as well as advances in project development.

Results from the Wildlife Monitoring Program will be used, in conjunction with other information, to confirm closure plans related to wildlife.

10.2 Interim Closure Monitoring

In general, the monitoring during interim closure will be similar to the monitoring procedures carried out during operations as described in the EMS, SNP, AEMP and WMP.

10.2.1 Open Pits

Geotechnical and water quality monitoring of the open pits during interim closure will occur as in operations. The geotechnical instrumentation installed throughout the open pit includes:

- Piezometers;
- Thermistors;
- Inclinometers;
- Extensometers;
- Survey Pins; and
- Seismographs.

Visual inspections will also be conducted on a routine basis to check for signs of instability, rockfall and overall integrity.

Water quality samples of pit sump water located at the base of the open pits will be obtained at approved locations in accordance with the Water License SNP. The samples will be tested for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients, oil and grease, and metals. In addition, the flows will be measured using flowmeters installed at the NIWTP.

10.2.2 Underground Mine Workings

Geotechnical and water quality monitoring of the underground mine workings during interim closure will occur as in operations. The geotechnical instrumentation proposed for the underground workings will be integrated with the open-pit monitoring and may include:

- Piezometers;

- Thermistors;
- Extensometers; and
- Survey pins.

Water quality samples will be obtained from water pumped from the underground workings in accordance with the Water License SNP. The samples will be tested for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients and metals. In addition, flows to the underground workings will be measured using flowmeters installed at designated locations.

10.2.3 Enclosure Dikes

Geotechnical and water quality monitoring of the enclosure dikes during interim closure will occur as in operations. The geotechnical instrumentation installed within the dikes and in proximity to the fish habitat areas include:

- Piezometers;
- Thermistors;
- Inclinometers;
- Extensometers; and
- Survey Pins.

Visual inspections will also be conducted to check for signs of instability, including bulging, slumping or the development of tension cracks.

Water quality samples will be obtained from the dike seepage collection system located between the dike toe and the open pit rim in accordance to the Water License SNP. The samples will be tested for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients and metals. In addition, the flows will be measured using flowmeters installed at the NIWTP.

10.2.4 Country Rock and Till Storage Areas

Geotechnical monitoring of the NCRTS and SCRTS areas during interim closure will occur as in operations. The geotechnical instrumentation may include the following:

- Piezometers;
- Thermistors; and
- Survey pins.

Visual inspections will also be conducted to check for signs of instability.

Water quality and quantity monitoring within the NCRTS and SCRTS areas will occur as in operations as defined in the Water License. Water quality samples will be taken directly from the collection ponds. The water quality samples will be tested for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients and metals.

The water collected in the collection ponds will be monitored (quantity and quality) and discharged to Lac de Gras if the quality meets Water License effluent criteria. If the discharge criteria are not satisfied, the water will be pumped to the PKC Facility.

10.2.5 PKC Area

Geotechnical monitoring within the PKC area during interim closure will occur as in operations. The geotechnical instrumentation may include the following:

- Piezometers;
- Thermistors;
- Inclinometers; and
- Survey pins.

Visual inspections will also be conducted to check for signs of instability.

Water quality and quantity monitoring of the PKC pond will occur as in operations but at a reduced frequency since the plant will not be processing kimberlite. Inflow to the ponds will be reduced to surface flow and limited treated water from the SSTP. Pond water volume will be monitored by changes in water elevation. Water quality samples taken from the pond will be tested for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients and metals. Actual dissolved metals concentrations will be monitored and trended in order to evaluate the need for additional water treatment.

Excess water collected within the PKC pond will be pumped to the North Inlet for treatment at the NIWTP.

10.2.6 Water Management Facilities

Operational monitoring protocols and procedures will continue at the water management facilities during interim closure. Monitoring of the water quality will be performed at the inlet of the NIWTP and at the outfall as per the SNP requirements. Monitoring will include tests for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients and metals. Samples will also be obtained and tested per the Water License.

In addition to monitoring at the NIWTP, water quality samples will be taken from locations indicated in the SNP.

10.2.7 Plant Site, Accommodation Complex and Fuel Storage

The plant site, accommodation complex and fuel storage areas will be inspected and maintained on a regular basis during interim closure. In addition, monitoring of all tank levels, including fuel tanks, will be conducted as in operations.

10.2.8 Infrastructure

All infrastructure will be inspected and maintained on a regular basis during interim closure.

10.3 Progressive Closure Monitoring

Progressive closure monitoring of the mine facility includes research studies that will be used to identify and facilitate development of closure activities. The monitoring associated with the studies may continue into post closure to verify predictions used to determine the closure design criteria. Ongoing research and monitoring include the following studies:

- PKC Area;
- Country Rock and Till Storage Areas;
- Re-vegetation; and
- Fish habitat.

10.3.1 PKC Area

Geochemical, thermal and stability analyses were completed to provide input into the PKC facility design (NKSL April 2001). Monitoring of these design aspects will be carried through into post closure to verify the design assumptions and analyses predictions.

Current Monitoring

The following is a summary of the progressive monitoring that is currently being conducted or is planned for the PKC area:

- Thermistors in the beaches to monitor freezing;
- Thermistors in the dam fills and foundations to monitor foundation and rockfill thermal conditions;
- Piezometers in the pond slimes to track consolidation (excess pore water pressures);
- Inclinometers in the East Dam (to be added during 2006 construction) to monitor creep rate movements in the ice rich foundation;
- Sampling of the fine PK material to measure hydraulic and thermal conductivity, and unfrozen water content; and
- Bathymetric studies and beach mapping to monitor deposition geometry.

Previous Analyses

The analyses completed as part of the design of the PKC are summarized in the following sections. Results of progressive monitoring will be compared to the analyses and modeling results to assess how well the operating conditions match with those predicted.

<u>Geochemical Analyses</u>

Geochemical studies were conducted for the PK to assess the quality of runoff from the PKC facility. Modeling and calculations of concentrations of runoff from the PKC after closure are based on the detailed geochemical data from the baseline report (Sala and Geochimica 1997, 1998), with modifications to account for the proposed closure design and anticipated temperature conditions in the deposited PK. The concentrations of metals in runoff from the PKC facility that were calculated from the modeling were compared to water quality guidelines to identify possible exceedences of metals of potential concern.

The geochemical studies conducted as part of the Environmental Baseline investigation did not address the water quality issues related to the final closure plan for the PKC facility. The studies completed in 2001 were intended to evaluate the water quality from the PKC facility in the longer term and into post closure.

The following conclusions were made based on the geothermal modeling results described in the baseline report:

- Metal leaching rates correlate to rates of sulphide oxidation;
- PK material is generally less reactive than fresh kimberlite ore (probably because a significant amount of sulphide is consumed in the milling process), resulting in comparatively smaller oxidation and metal leaching rates;
- Oxidation rates for sulphide (as indicated by sulphate "leach" rates) are highest initially and decrease significantly over periods of weeks to months; and
- Sulphate and metals concentrations in leach water and sulphide oxidation rates were generally lower for underwater tests (subaqueous) than in those exposed to air (subareal).

While the PK material contains sulphide minerals (mainly as pyrite), it is not expected to generate acid because of the abundant neutralization potential available in this material. However, it was recognized that metal leaching may be of concern under certain conditions. Due to these concerns, two additional modeling scenarios were conducted to review the water quality predictions presented in the baseline report, and to assess the metal concentrations in runoff from the PK if thawed and frozen.

In the first scenario, the top of the PK was assumed to be located within an active layer with 0.5 m of thaw, and was therefore subject to oxidation and metal leaching during the unfrozen period each year. The second scenario assumed that the top of the PK remained frozen and infiltration through the rock cover reported to, and flowed over the PK surface. In this latter scenario, the immediate surface of the PK (estimated to be 0.02 m in depth) was assumed to oxidize and leach during the melt or heavy precipitation periods.

The model results suggest that an active layer of 0.5 m or greater in the upper layer of the PK would likely produce runoff that exceeds water quality guidelines. The modelled results for frozen PK with a 0.02 m thick thawed layer also indicated an exceedence for cadmium, but all other metals of concern were at or below guideline levels. However, the calculated exceedence for cadmium is likely an artefact of the analytical difficulties experienced for this constituent as exhibited in several of the leach test results reported in the baseline report. Therefore, drainage over the frozen PK is anticipated not to exceed surface water quality guidelines.

The placement of a till layer during closure will effectively reduce infiltration to the PK material and the overall cover thickness will ensure that the PK remains frozen, thereby avoiding oxidation and leach reactions. Piezometers will be installed in the PKC facility to monitor the pore water pressures during operations and closure. The piezometers will also be used to monitor the effectiveness of the till in reducing water infiltration.

Thermal Analyses

Thermal analyses of the PKC facility were carried out as part of the design of the PKC facility (NKSL April 2001). Two climate conditions were considered:

(i) Average Monthly Temperatures; and

(ii) Climate Change.

Average Monthly Temperatures

The thermal analyses indicated that the dams will remain stable over the long term. Temperatures within the Fine PK at the East Dam decreased such that 50 years after the completion of deposition, all of the Fine PK and Dam fill deeper than 5 m below the surface had a temperature of less than -4°C. Little change in the temperature distribution was indicated for the Dam, PK and foundation at the West Dam 50 years following deposition. The thawed foundation was predicted to persist, with temperatures in the West Dam remaining less than -4°C.

The thickness of the frozen zone at the top of the pond was shown to increase over time with the temperature in the PKC Pond reduced to about 0°C after 50 years. The freezing of the entire pond will be a slow process because of the latent heat of fusion of high water content slimes and the low thermal gradient.

Climate Change

Climate change was considered in the design phase of the PKC facility assuming an estimated increase in air temperature of 3.2°C per century (Nixon Geotech Ltd. August 1998; and AES February 1998).

Noticeable changes in the thermal regime were observed at the dam locations; however, a temperature increase of less than 1°C was predicted after 50 years. With the exception of the upstream talik foundation area, the dams and foundations remained frozen under the climate warming conditions evaluated, while the increased air temperatures showed little effect on the thermal regime of the PKC Pond.

Overall, the dams were shown to remain stable under climate warming conditions. Thermistors recently installed in the PKC pond and facility will be used to monitor temperature changes during operation into closure and post closure. The results will be used to verify the changes in temperature predicted by the analyses and to update the closure cover design if required.

Stability Analyses

Dam stability was analyzed for anticipated frozen conditions, as well as the hypothetical scenarios of partially thawed and completely thawed conditions. Static and pseudostatic conditions on the dam structures were assessed for the following foundation conditions:

- Case A: Ice-rich soil, with foundation frozen;
- Case B: Ice-rich soil, partially thawed condition at the dam toe and in the dam slope; and
- Case C: Ice-rich soil, completely thawed foundation condition.

The stability analyses were conducted only on the downstream side of the dams as the upstream sides of the dams will always be buttressed with fine PK beach.

The stability analyses were conducted with the dam section initially located on ice rich soil under frozen conditions. This section was then modified in the analyses to include a partially thawed condition at the toe of the dam to assess the factor of safety under warmer conditions. For the hypothetical case of thawed conditions, the dam foundation was assumed to be completely thawed.

A preliminary evaluation was carried out to evaluate whether the thawing of ice rich soils would generate pore pressures that could affect the stability of the dam structures. It was determined that the thawing rate would be significantly slower than the pore pressure dissipation rate; therefore excess pressures would not be generated.

The results from all cases analyzed indicate that adequate factors of safety can be attained during summer and winter conditions under both static and pseudo static loading conditions. Also the dam will be stable even under the hypothetical completely thawed condition.

10.3.2 Country Rock and Till Storage Areas

Thermal and stability analyses were completed to provide input into the rock storage area design (DDMI August 2001). Thermal and Stability monitoring will also be carried out as a component of the planned Country Rock Test Pile study (see below) to verify the assumptions and predictions of the design analyses as the Country Rock and Till Storage Areas are developed.

Water quality will also be monitored within the ponds that collect runoff and seepage from the Country Rock and Till Storage areas. The samples from the ponds will be taken at regular intervals and tested for physical parameters (i.e., pH, TDS, TSS and conductivity), major ions, nutrients and metals. The results of this study will influence the facility design, treatment measures and monitoring for closure and post-closure.

Country Rock Test Pile Study

The objective of the Country Rock Test Pile study is to better understand the physical and geochemical processes occurring within the country rock and to confirm the closure cover design. As such, DDMI is constructing three country rock test piles containing eight different types of instrumentation that will monitor and collect, geochemical, thermal and stability data. The construction of the test piles should by completed by the end of 2006. Results of the monitoring will influence closure activities for the NCTRS areas. The test pile program is described in greater detail in the report titled *Country Rock Test Pile Study Program – 2004* (D. Blowes et al. 2004).

Thermal Analyses

Comprehensive analyses were carried out in the design phase (2001) prior to start of construction to:

- Determine the ground conditions in areas of ice-rich soil for the purpose of stability analyses;
- Assess the closure cover designs; and
- Assess the internal thermal conditions of the Type III rock storage cells.

The following is a summary of the results for different regions of the PKC area.

<u>Foundations</u>

The NCRTS area is located on ice-rich soil. Thermal analyses were carried out to determine the impact of the rock piles on the temperature of the foundation for stability analyses. The analyses indicated that the foundations would remain frozen during and after construction.

<u>Type II Rock Storage cells</u>

Thermal analyses conducted on the Type II closure cover showed that the rock within the Type II cells will remain near 0°C during operations and would develop permafrost within about 25 years after the clean Type I rock is placed over the cell. The underlying Type II rock will become completely frozen with time.

Type III Rock Storage cells

Thermal analyses conducted on the Type III closure cover showed that the till zone of the cover will remain permanently frozen after the first year of application. The rock at the base of the cell will start freezing at the start of filling because of the cold foundation.

The thermal analyses indicate that at the time when the cover is placed over the QUAR cell (see Section 5.5.2), the internal part of the pile will be 0°C and the frozen zone extends down about 20 m from the surface. With time, the depth of the upper frozen zone increases. The saturated zone at the base of the rock freezes within 20 years after cover application, although a 10 m deep isolated unfrozen zone exists above it.

The thermal analyses for the CLAR cell (see Section 5.5.2) showed that the internal pile starts freezing when the cover is placed. A frozen zone forms above the 0°C internal section of the pile. The warm rock has a slight warming effect on the foundation, and the eventual re-cooling of the foundation is slow.

Stability Analyses

Slope stability analyses were carried out as part of the design of the Country Rock and Till Storage areas. Three sections were evaluated, taking into consideration the advancement of the possible thaw front in the foundation soils as indicated by thermal modeling.

The country rock and till piles are designed as frozen piles founded on existing frozen foundations. As a hypothetical case, the physical stability of the piles was also assessed in partial and complete unfrozen (thawed) states for both static and pseudo-static conditions with minimum factors of safety of 1.3 and 1.1, respectively.

The analyses completed correspond to the end of country rock and till disposal operations when the piles reach the critical and maximum height. The results showed that the design of the country rock and till piles met or exceeded the minimum geotechnical requirements for slope stability under the various conditions analyzed.

DDMI is currently considering the installation of additional instruments in the Type III rock pile in order to monitor geochemical, thermal and stability conditions within the pile during progressive reclamation.

10.3.3 Re-vegetation Study

The objective of the re-vegetation study is to determine the most effective and economical methods for establishing self-sustaining native vegetation cover on the targeted areas of disturbance (Naeth et al. 2005). The results of the study will influence the closure activities for proposed re-vegetation areas.

The specific objectives of this research are:

- To determine which substrates are most effective for plant establishment and growth;
- To determine which soil amendments are most effective at enhancing substrate properties and plant establishment; and
- To determine which groups and individual native plant species are able to establish and survive on a variety of substrates.

Two major substrates are currently being considered to support re-vegetation efforts at the Diavik Diamond Mine: processed kimberlite and glacial till. The till will be removed as part of pit development. Both substrates are scheduled to be stored or stockpiled on-site as part of the mine development plan.

Five substrate treatments and four soil amendments were selected for the study together with a suite of vegetation species that are dominant in the adjacent tundra, representing the main plant groups and sources. The substrate treatments considered include glacial till, processed kimberlite (PK), 50% PK and 50% till mix, 25% PK and 75% till mix, and no substrate addition. The soil amendments include salvaged top soil, inorganic fertilizers, sewage sludge, and sludge from the NIWTP.

The research plots were established in 2004. Seeding of the plots commenced in September 2004, and was completed by September 2005. Preliminary observations completed in 2005 (Naeth et al. 2005) indicate that fall seeded fertilizer plots had the greatest plant establishment, and grasses established more readily than forbes. In addition, seeds that were sheltered by rocks and soil clumps within the substrate appeared to germinate and establish more readily than those more exposed.

10.3.4 Fish Habitat Study

The fish habitat studies are required as part of the Fisheries Authorization and will be developed in conjunction with the specific habitat enhancement or creation program. While the specific designs for the studies have not yet been completed, the general objectives will be to determine if the intended physical habitat was created and to assess the biological use of the created or modified habitat.

The programs will be designed with input from communities. Communities will also be involved in the implementation. Some modifications to the physical habitat maybe required as a result of the monitoring programs.

10.4 Closure and Post-Closure Monitoring

The level of monitoring required during closure and post-closure will ultimately be a function of environmental and physical performance on-site. Based on the current mine plan, the mine site will transition from operations into closure in 2022 to 2024. Monitoring and maintenance during this period will be managed adaptively and developed in consultation with communities and regulators as the mine advances and site specific knowledge increases. It is anticipated that operational environmental monitoring described in the AEMP and SNP, would continue on a scaled down basis during closure as there will be no mining activity and no significant full-time human presence at site.

The current mine plan also assumes environmental post-closure monitoring will continue for 5 years following closure. During this time, monitoring will be conducted by DDMI (verified by regulators as appropriate) with respect to the effectiveness of the mitigative measures completed, the accuracy of the environmental assessment and any unforeseen environmental impacts. The duration of the required monitoring phase will be reviewed and confirmed at the time of closure and will depend on the risks associated with the potential impacts on the environment. During this period, DDMI will continue to be responsible for the site, including remediation of any additional environmental complications which develop. If necessary, the monitoring period may be extended to ensure remedial measures are met.

The final monitoring plan for closure and post-closure will be submitted in detail with the final closure and reclamation plan. The following information is provided for general information.

10.4.1 Open Pits

The open pits will be flooded during closure initially by siphon from Lac de Gras. Table 10-1 summarizes the geotechnical monitoring to be conducted at the open pits during closure prior to flooding. Geotechnical monitoring will not occur once the pits are flooded.

The geotechnical monitoring will not continue into post closure since the flooding will increase the stability of the pit walls and make most instruments unreachable. Water quality of the pit water will be monitored as the pits are flooded and into post closure. The dikes will be breached once water within the dikes meets water quality objectives. The water quality objectives will be based on studies of the area, monitoring data of Lac de Gras water quality and input from stakeholders.

Table 10-1: Geotechnical Monitoring of Open Pits

Instrumentation	Measurement Frequency
Piezometers (Standpipe and Vibrating wire) to measure pore water distribution changes	Weekly
Thermistors to measure ground temperatures changes	Weekly
Inclinometers to measure changes in rate of horizontal deformations	Weekly
Extensometers to measure magnitude of vertical compression and/or uplift deformations	Weekly

10.4.2 Underground Mine Workings

The underground mine workings will be flooded during closure. Geotechnical monitoring of the underground workings will not be required in closure or post closure.

Water quality will be monitored during flooding but would cease once the plug has been installed in the main decline closing off the mine access.

10.4.3 Enclosure Dikes

The enclosure dikes will be breached once water quality objectives are met following pit flooding. Fish habitat will be monitored to determine use of the reclaimed habitat areas. Specifics of this monitoring program will be developed in consultation with communities and the Department of Fisheries and Oceans.

10.4.4 Country Rock and Till Storage Areas

The operational monitoring for the Country Rock and Till Storage areas will continue from operations into closure and post closure. Physical changes in the NCRTS and SCRTS areas will be monitored by instrumentation and visual inspections beginning at operations to establish baseline information and continuing through the remaining years of operation into post closure. Table 10-2 summarizes the geotechnical monitoring to be completed at the Country Rock and Till Storage areas during closure.

Water quality of the ponds associated with runoff and seepage from the Country Rock and Till Storage areas will be monitored as per the operational SNP.

Table 10-2: Geotechnical Monitoring of Country Rock and Till Storage Areas

Instrumentation	Measurement Frequency

Piezometers (Standpipe and Vibrating wire) to measure pore water distribution changes until frozen conditions occur	Monthly
Thermistors to measure ground temperatures changes	Monthly

10.4.5 PKC Area

The PKC facility will be covered in closure and will be monitored for physical stability and water quality. Physical changes in the PKC area will be monitored for approximately three years after closure by geotechnical instrumentation and visual inspections. This will likely include a ground truthing program similar to that for the Country Rock and Till Storage areas. Table 10-3 summarizes the geotechnical monitoring to be completed at the PKC area during closure.

Table 10-3: Geotechnical Monitoring of the PKC Area

Instrumentation	Measurement Frequency
Piezometers (Standpipe and Vibrating wire) to measure pore water distribution changes	Monthly
Thermistors to measure ground temperatures changes	Monthly
Inclinometers to measure changes in rate of horizontal deformations	Monthly

Water quality testing of both surface runoff and seepage drainage for metals content will occur on a weekly basis during closure.

10.4.6 Water Management Facilities

Water management facilities will continue to operate during the transition from mine operations into closure and possibly into the post closure phase. The following will influence the extent of management and monitoring required during closure:

- Amount of dewatering of open pits and underground mine workings required until pits are flooded;
- Collection and treatment requirements for runoff and seepage from PKC facility and collection ponds; and
- Continuation of the SNP and AEMP.

DDMI will be required to maintain a valid water use license during closure to cover these activities. The current closure monitoring requirements in the water licence are described in the SNP and AEMP and will be similar to monitoring conducted during operations:

- Continued monitoring of applicable SNP stations (except at PKC facility since flow is only generated during operations);
- Monitoring of water quality in Lac de Gras;
- Monitoring of shallow groundwater flow;
- Monitoring of pit and underground seepage;
- Monitoring of North Inlet water quality;
- Aquatic effects monitoring, including water, sediment, benthos and fisheries; and
- Annual inspection by qualified professional geotechnical engineer of all containment dikes retaining soil, waste or water.

The amount of monitoring required is expected to decline once project facilities have been fully decommissioned, dismantled and removed and the site has been reclaimed. A smaller plant may be required to process water in North Inlet depending on quality. Reduction in monitoring effort will depend upon whether reclamation work has achieved certain "endpoints" agreed upon in water license. For example, seepage from the PKC facility is anticipated to reach acceptable discharge standards without ongoing water treatment within the 5-year reclamation period based on predictive modelling. However, if water quality discharge standards are not met at that time, the seepage will continue to be collected and treated prior to discharge. It is anticipated that results of the operational monitoring will help to refine the estimated time required to reach acceptable discharge standards post-closure.

The North Inlet dikes will be breached only after water quality standards are met in the North Inlet. If the water quality does not meet the water quality objectives during closure, continued monitoring will occur into post closure and additional procedures will be implemented in consultation with stakeholders to address water quality concerns.

10.4.7 Plant Site, Accommodation Complex and Fuel Storage

Physical changes of reclaimed sites within the plant site, accommodation complex and fuel storage areas will be monitored beginning at the completion of closure to establish baseline information, and continuing through the remaining years of post-closure. Monitoring will involve "ground-truthing" to evaluate:

- Effectiveness of surface re-grading to reinstate natural drainage patterns;
- Surface water ponding and runoff;
- Surface erosion and /or depositions of sediment; and
- In re-vegetated areas:
    - Changes in the vegetative layer thickness;
    - Changes in the vegetative cover and penetration depth of its root system; and
    - Excessive vegetation stress or poorly established areas.

Sediment runoff will also be monitored as building areas are reclaimed and re-graded during closure. Reclaimed areas will also be inspected periodically during post closure to establish if buried materials are being pushed to the surface as a result of frost heaving. In addition, periodic inspections of areas remediated during closure due to the presence of contaminated soils will be conducted to evaluate the success of the remediation measures selected.

Although preliminary at this early stage, it is intended that the monitoring effort within the plant site, accommodation complex and fuel storage areas will likely be carried out during the late spring and early fall seasons throughout closure and post-closure.

10.4.8 Infrastructure

Closure and post-closure monitoring of reclaimed infrastructure areas will be the same as for the plant site, accommodation complex and fuel storage areas. Also during post closure, periodic inspections of the inert landfill cover will be conducted to observe performance and to check if permafrost has aggraded into the landfill and if the seasonal active layer remains within the cover. Inspections will also check for cracking and slumping of the cover and for underlying waste material pushing its way up through the cover.

10.5 Post Closure Maintenance

The closure and reclamation activities are designed to reduce future care and maintenance. Surface facilities are graded to prevent surface ponding and to promote drainage by channels with appropriate erosion protection. No buildings will be left on-site, eliminating maintenance requirements associated with structures. All pumping systems will be removed and natural drainage established wherever practical. The pits will be flooded and the enclosure dikes will be breached. All construction equipment and material, temporary structures and parts thereof will be completely removed from navigable waters based on requirements of the Navigable Waters Protection Act. Any mine related debris or material accumulating on the bed or surface of waters will be removed.

Accordingly, the interim CRP includes no planned or scheduled post closure maintenance activities other than the closure and reclamation of remaining water control and collection systems. Specifically, once runoff water quality has reached acceptable discharge standards, ditches, swales, sumps and ponds will be decommissioned and reclaimed. This would involve the removal of all liner materials and re-contouring of underlying base and berm materials. In addition, a cover of Type I rock will be placed over the bottom of ponds to prevent erosion of any deposited sediment, and pond outlets will be re-contoured to re-establish drainage patterns and minimize the potential for erosion.

11. CLOSURE SCHEDULE

11.1 Introduction

The following section provides a description of the interim closure work schedule, including completed and future closure work.

Project construction at Diavik began in 2000 and ore processing commenced in early 2003. At present, open pit mining of the A154 N/S pipe is occurring, with underground mining planned for 2008 under the updated LOM plan (Table 11-1; Figure 11-1). Construction of the dike surrounding the A418 pipe has begun, with open pit mining scheduled to begin in 2007. Development of the A21 pipe is currently under re-evaluation by DDMI, but for this report it has been assumed that A21 will be constructed to coincide with the end of the A418 open pit mine life and will be completed in approximately 2015. Open-pit and underground mining will occur concurrently for both the A154 and A418 deposits.

Table 11-1: Approximate Mining Schedule

Mine	Type	Start	Complete
A154 (both N and S)	Open Pit	2003	2009
	Underground	2008	2021
A418	Open Pit	2007	2012
	Underground	2008	2021
A21	Open pit	2012	2015
	Underground	N/A[a]	N/A[a]

[a]not applicable

11.2 Closure and Reclamation Schedule

The schedule for major activities and reclamation is summarized in Table 11-2 and Figure 11-1. Detailed descriptions of the closure plans for each area are provided in earlier report sections.

Table 11-2: Major Operational and Closure Activities

Year	Major Activities
2002	• Plant and infrastructure construction completed • Water retention dike for A154 pit completed • Sediments from dredging the A154 dike footprint pumped to the Sediment Pond (SED).
2003 to 2006	• Deposition in country rock, till and PKC facilities in 2003

Year	Major Activities
	• Till placed inside toe of the A154 dike and the A154 Open pit in 2003, creating future fish habitat • North Construction Camp moved to South Camp in 2003 • Part of South Construction Camp demobilized in 2003 to 2005 • Dredged material placed in the Clarification Pond from the A418 dike footprint. • Sediment Pond drained and deposition of Type III rock commenced
2006-07	• Water retention dike A418 complete, overburden stripping begins • Type III rock Quarry cell completed • Sedimentation Pond filled with Type III rock • Start filling of Clarification Pond with Type III rock and northwest rock cell with Type II rock
2009	• Open pit mining of Pit A154 complete
2010	• Commence construction of A21 water retention dike • Finalize cover plan/schedule for North Country Rock area • Finalize cover plan/schedule for north coarse PK area
2012	• Open Pit mining of A418 complete • If A21 progresses from concept, A21 water retention dike completed and overburden stripping starts • Placement starts in South Coarse PK area
2015	• North Country Rock cover complete • North coarse PK area cover complete
2022	• Shut down of Process Plant and start final cover of PKC facility and site wide closure
2023	• Final closure of PKC facility complete
2024	• Final closure complete
2029	• Monitoring and maintenance complete

11.3 Progressive Reclamation Schedule

Where possible, and subject to the availability of reclamation materials, progressive reclamation and closure will proceed throughout the mine life. As discussed above, the primary progressive reclamation efforts will focus on the reclamation of the Country Rock and Coarse PK storage areas, fish habitat creation, and continuation of ongoing progressive monitoring studies.

11.3.1 Fish Habitat Restoration

Compensation requirements for HADD of fish habitat in the streams and small lakes of the East Island were specified in the DFO Fisheries Authorization (DFO August 2000). DDMI is working toward fulfilling these requirements.

The fish habitat restoration work on the inside of the A154 dike has been completed to the extent practical. Final contouring of the works will be completed immediately prior to flooding of the A154 Pit. The fish habitat restoration work for A418 is scheduled to commence in 2007/2008.

As detailed in the “No Net Loss Plan” for fish habitat (DDMI August 1998; DDMI April 1999) the conceptual schedule for fish habitat compensation included construction of habitat in two inland lakes (named “e14” and “e17”) during the periods of 2003-2004 and 2006-2007. Due to ongoing discussions with the stakeholders regarding the final design and location of the fish habitat restoration projects, the work schedule has been delayed from the conceptual schedule estimate. Once a final design and location concept is approved, DDMI will commence habitat construction in Lake e14.

A fish habitat design for West Island stream (named “WS1”) has also been developed (Dillon Consulting March 2004) and is currently under review with DFO.

Any additional post-closure fish habitat restoration efforts, and subsequent monitoring activities relating to the effectiveness of those efforts, will be finalized prior to closure.

11.4 Schedule for Temporary or Long term Closure

In the event of a short-term shutdown (usually less than one year), the requirement for closure work would be assessed, but it is unlikely that it would be required.

A long-term shutdown will be an opportunity to complete items of progressive closure and reclamation, as described in the CRP. Selected facilities may be completely closed and related areas of disturbance permanently reclaimed.

In the event of a premature shutdown, the requirement for revisions to the interim CRP schedule would be assessed and detailed in a Final CRP.

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