GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

SECTION 3

PROJECT DESCRIPTION

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3 PROJECT DESCRIPTION

3.1 INTRODUCTION

3.1.1 Context

The Project Description of the Environmental Impact Statement (EIS) for the Gahcho Kué Project (Project) describes the Project as it is proposed by De Beers Canada Inc. (De Beers). A brief overview of the Project is provided in Section 1, and alternatives considered during development of the Project design are described in Section 2. The impact assessment presented in Sections 7 to 13 assesses the effects of the Project, as described here in the Project Description, on components of the biophysical, cultural, and socio-economic environments.

3.1.2 Purpose and Scope

The purpose of the Project Description is to meet the *Terms of Reference for the Gahcho Kué Environmental Impact Statement* (Terms of Reference) released by the Gahcho Kué Panel on October 5, 2007 (Section 1; Appendix 1.I).

> *". . . the developer is required to provide a comprehensive development description as it is currently proposed. The EIS is intended to be a stand alone document. Sufficient detail must be provided for the Panel to adequately consider the potential impacts of the development and to adequately address the factors to be considered in the impact review ...."* (Gahcho Kué Panel 2007).

Section 3 is intended to be the stand-alone document providing information on the Project Description for the Gahcho Kué Panel and other interested parties. The facility designs, construction methods, and operating practices described in Section 3 are based on preliminary engineering studies. Final designs, construction methods, and operating practices will be developed from detailed engineering undertaken during the development stage, and will benefit from feedback obtained through the Environmental Impact Review (EIR) process. The designs, construction methods, and operating practices described here are considered sufficient to assess potential environmental effects and classify impacts of the Project on the biophysical, cultural, and socio-economic environments. Changes to the Project Description resulting from ongoing engagement and engineering optimization are expected to maintain or enhance environmental performance.

The scope of the development described in this section was defined in Section 2.1 of the Terms of Reference.

> *The scope of the development under review includes the principal development, which is an open pit diamond mine and any activities or structures associated with the principal development, from pre-construction to closure and reclamation*. (Gahcho Kué Panel 2007).

An initial Project scope was presented in an Application Report (De Beers 2005) to the Mackenzie Valley Land and Water Board (MVLWB). This EIS includes alternatives and any other changes to the proposed Project considered since the 2005 submission.

3.1.3 Content

Section 3 provides a comprehensive description of the Project as it is currently proposed. This description is organized according to the following topics:

- Project overview (Section 3.2);
- Project schedule (Section 3.3);
- Gahcho Kué deposit (Section 3.4);
- open pit kimberlite mining (Section 3.5);
- processing of the kimberlite, extraction of the diamonds, and characterization of waste streams from processing (Section 3.6);
- management of mine rock, processed kimberlite, and other solid waste (Sections 3.7 and 3.8);
- water management throughout the Project including dewatering of Kennady Lake, water management during operations, and refilling of Kennady Lake (Section 3.9);
- site infrastructure that will be required, including the proposed airstrip and roads (Section 3.10);
- human resources that will be required for the Project (Section 3.11); and
- closure and reclamation of the site (Section 3.12).

3.2 PROJECT OVERVIEW

The proposed Project is a diamond mine located at Kennady Lake, which is north of the north-eastern arm of Great Slave Lake. The Project is situated in a remote location with limited road access and no utilities. The site is about 280 kilometres (km) northeast of Yellowknife, Northwest Territories (NWT; Figure 3.2-1).

LEGEND

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

NOTES
Base data source: The Atlas of Canada

GAHCHO KUÉ PROJECT

Location of the Gahcho Kué Project

FILE NO. B-Heritage-001-GIS			DATE September 20, 2010
JOB NO. 09-1365-1004	REVISION NO. 0		**Figure 3.2-1**
OFFICE GOLD-CAL	DRAWN CW	CHECK JB	

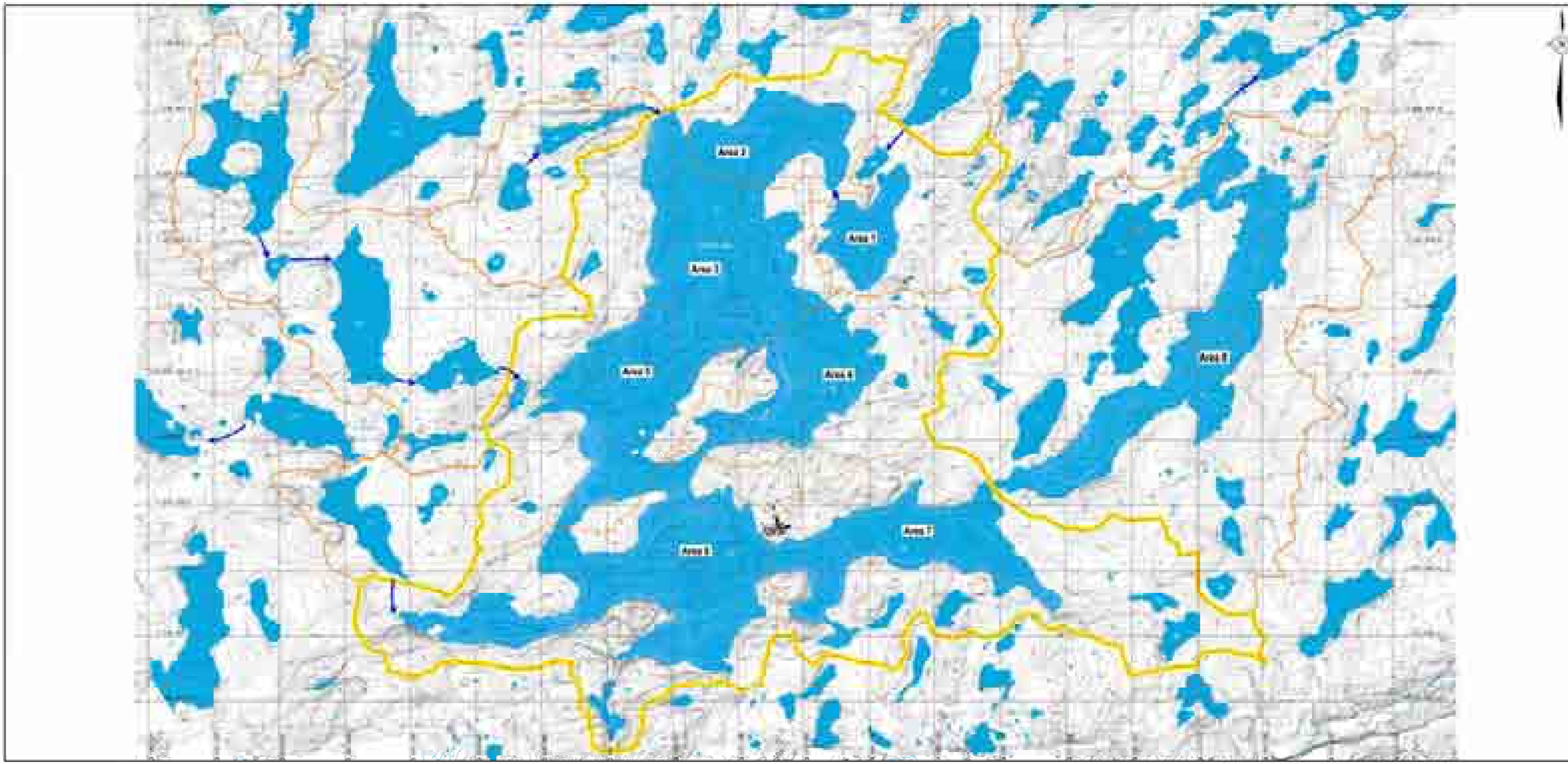
The diamond-bearing kimberlite deposits are vertical pipes generally located beneath Kennady Lake and contain an indicated resource of about 30 million tonnes (Mt) of kimberlite rock in three economic ore bodies, named 5034, Hearne, and Tuzo. The ore extends from near the bottom of Kennady Lake down to more than 300 metres (m) below the lake. It will be extracted by open-pit-mining methods, requiring the alteration of Kennady Lake by dewatering in order to access the ore bodies.

The disturbed areas of the Project site will be isolated from the remainder of the Kennady Lake watershed by a series of dykes so that flows unaffected by the Project will be diverted away from the controlled area. Diverting water away from the controlled area will causes changes to the watershed including flooding of Lakes D2, D3, E1, N14, and A3. Areas 1 through 7 are sub-watersheds located within the controlled area boundary (Figure 3.2-2). The Area 1 sub-watershed includes Lakes A1, A2, and A9. Areas 2, 4, 6, and 7 are individual watersheds, while Areas 3 and 5 comprise one sub-watershed. Water within the controlled area boundary will be isolated from the remainder of the Kennady Lake watershed and managed. The only outflow from the controlled area will be licensed discharges that are monitored.

All disturbance activities for the Project, with minor exceptions, are contained within the controlled area boundary. The exceptions consist of:

- part of the airstrip located in the Area 8 sub-watershed;
- winter access road;
- water pipeline to Lake N11 in the N watershed; and
- two minor site roads that extend into the I Watershed.

Mine rock will be stored in dewatered areas of Kennady Lake and on nearby land. Fine processed kimberlite (PK) will be contained in Areas 1 and 2 within the controlled area boundary. Coarse PK will be stored on land just north of the plant site. Later in the mine life, mine rock and processed kimberlite will also be deposited in two of the mined out pits in Kennady Lake.



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

Bathymetry Contours
5m Index - 1m Intermediate

Controlled Area Boundary

Marsh Area

Scrub

Sub-watershed Boundary

Drainage Flow Direction

NOTES
Base data source: EBA Figure 4.5 - Stage 2 - Water Management During Mine Operation Years 1 to 3 (2015 to 2017)

GAHCHO KUÉ PROJECT

Kennady Lake Sub-watersheds and Controlled Area Boundary

PROJECTION: UTM Zone 12	DATUM: NAD83	
FILE No: P-Other-015-CAD		DATE: December 13, 2010
JOB No: 09-1365-1004	REVISION No: 1	Figure 3.2-2
OFFICE: GOLD - SAS	DRAWN: TAH/AJL	CHECK: PT

3.3 PROJECT SCHEDULE AND GENERAL ACTIVITIES

3.3.1 Introduction

Once De Beers has obtained the necessary environmental assessment approval, permits, and licences, construction will take two years (Year -2 to Year -1; Table 3.3-1). The construction period will include installation of the Project infrastructure and the dewatering of part of Kennady Lake before mining can begin. After the water above the ore bodies has been drained to an acceptable level, pre-stripping of the first open pit and initial production mining will begin. The first year of operations (Year 1) will commence after commissioning is completed in the last quarter of construction (Year -1).

Table 3.3-1 Overview of Project Timeline and General Activities

Year	Calendar Year	Project Phase	General Activities
-2	2013	Construction	Building site infrastructure Initial lake dewatering
-1	2014	Construction	Building Site Infrastructure Pre-stripping of 5034
1 to 3	2015 to 2017	Operations	Mining – 5034
4	2018	Operations	Mining – 5034/Hearne
5	2019	Operations	Mining – 5034/Hearne/Tuzo
6 and 7	2020 and 2021	Operations	Mining – Hearne/Tuzo
8 to 11	2022 to 2025	Operations	Mining – Tuzo
12 and 13	2026 and 2027	Closure and Reclamation	Interim Closure Beginning of lake refilling (about 8 to 16 years total) and monitoring
14 to 19	2028 to 2033	Closure and Reclamation	Continued lake refilling (about 6 to 14 years remaining) and monitoring
20+	2034+	Closure and Reclamation	Site monitoring to meet regulatory requirements

The construction period will be followed by an eleven-year operational period (Year 1 to 11) during which the kimberlite will be mined and processed. Mining is expected to end in Year 11. However, additional economic resource may be identified from kimberlite currently classified as inferred, as the resource becomes better defined during the operations phase. Should economics remain favourable, these inferred resources would constitute an additional one to two years of mine life. Other potential resources that are accessible from the pit may also exist at the Tuzo Pit below the depth of the defined resources.

Where possible, the Project plan calls for progressive decommissioning and reclamation of Project components (e.g., contouring mine rock and PK storage areas) as the mining process advances. Interim closure will occur within two years after the completion of mining (by the end of Year 13, assuming mining is completed by Year 11) and will include removal of most of the site infrastructure and disposal of materials, either on site or off site as appropriate.

Lake refilling and reclamation monitoring will continue from Year 14 onward until the remaining areas of Kennady Lake are refilled. Flooding the pits and returning Kennady Lake to its original lake level by restoring the natural drainage and diverting water from Lake N11 is expected to take approximately eight to sixteen years after the end of operations. Refilling could take less than eight years under unusually wet hydrologic conditions. All remaining site infrastructure (e.g., airstrip and camp) will be removed after the water level in the planned reclamation areas of Kennady Lake have been restored. Monitoring of the Project site will continue after lake refilling until it is shown that the Project site and Kennady Lake meet all regulatory conditions.

The text to follow in Sections 3.3.2 to 3.3.4 provides a more detailed overview of the Project schedule and activities according to phase (i.e., construction, operations, and closure and reclamation). Details on specific topics such as mining method, processing, waste management, water management, and site infrastructure, are found in subsequent sections (i.e., Sections 3.5 to 3.10). Further details on closure and reclamation are provided in Section 3.12.

3.3.2 Construction

The initial construction year (Year -2) will be devoted primarily to:

- initial grading of the plant site;
- construction of core infrastructure items (e.g., accommodations complex, office complex, fuel storage tanks, sewage treatment plant, roads, and airstrip);
- building of minor diversion structures and site roads; and
- construction of Dyke A and initial dewatering of Kennady Lake.

A critical activity during the initial construction will be the creation of a controlled area in which the water is managed by construction of Dyke A at the narrows separating Area 7 and Area 8. Area 8 represents the eastern section of Kennady Lake where no mining activities will occur. Area 8 is outside the controlled area boundary (Figure 3.2-2). To safely mine the ore bodies beneath Kennady Lake, it will be necessary to dewater areas 3, 4, 5, 6, and 7, either completely or substantially. Consequently, the schedule for initial mining activities is largely controlled by the time required to remove the water from the lake. Such dewatering will require the construction of various dykes and berms. It will also require monitoring of the water removed from Kennady Lake. Details on the removal of water from Kennady Lake can be found in Section 3.9.

In the second construction year (Year -1), process plant construction and equipment installations will begin after sufficient site infrastructure is established and the next seasonal winter access road becomes available to allow transport of the equipment to site. The construction of the site infrastructure will be scheduled so that the process facility is ready to receive ore by the end of Year -1. Infrastructure construction activities planned for Year -1 are listed in order of priority as follows:

- major concrete work and erection of maintenance and emulsion buildings;
- construction of process plant building shells, setting of major equipment pieces and large bins; and
- construction and commissioning of the process and service facilities.

Pre-stripping of the 5034 Pit is also planned for Year -1, so that production mining can begin in Year 1.

3.3.3 Operations

Mining of the open pits will begin during the latter part of the construction phase. The 5034 ore body will be the first to be mined followed by the Hearne ore body beginning in Year 4. Area 4, which overlies the Tuzo ore body, will be drained after the Dyke B barrier is in place to provide access to Tuzo. The Tuzo ore body will be mined beginning in Year 5.

The processing plant will begin operations by the beginning of Year 1. During the mine life, the sources of process make-up water for the plant will be from the Water Management Pond (WMP) during Years 1 to 8 and from Tuzo Pit water from Years 8 to 11, supplemented by water from the WMP. The WMP includes Areas 3 and 5 (Figure 3.2-2). Effluent from the Sewage Treatment Plant may also be used as a source of make-up water. Mining of the open pits is tied to the start up and operation of the process facility to limit the need for large kimberlite run-of-mine stockpiles.

With the start of mining and processing operations, mine rock and PK will be placed within areas naturally suited, or designed in the case fine PK, to contain these materials. These materials will be managed and placed so that the work required for the eventual final closure of the site will be minimized. Further details on mine rock and PK management can be found in Section 3.7.

3.3.4 Closure and Reclamation

Progressive reclamation of the areas containing mine rock and PK will begin as soon as practicable, followed by final reclamation and decommissioning as each facility is no longer needed. Progressive reclamation of the Fine Processed Kimberlite Containment (PKC) Facility and the Coarse PK Pile used in the early years of the operations will allow for these portions of the infrastructure to be decommissioned before the completion of mining and processing operations. This includes capping with a final cover and grading the Fine PKC Facility in Areas 1 and 2 and the Coarse PK Pile, as well as final grading of the two mine rock piles (Areas 5 and 6). These progressive reclamation plans are possible because the mined-out Hearne Pit will be used to store fine PK and the 5034 Pit will be used for coarse PK and mine rock disposal during the final years of operations.

After completion of processing operations, most of the infrastructure, buildings and equipment will be removed off site or disposed on site within two years. The only facilities remaining after the two-year interim closure period will be those required to support site monitoring and the return of the planned reclaimed areas of Kennady Lake to suitable fish habitat. Lake refilling is anticipated to continue for about eight years to restore Kennady Lake to its original lake level, although the actual refilling time will vary between eight and sixteen years. Natural drainage from the watershed will be augmented by using water from Lake N11. Refilling time could potentially be less than eight years under unusually wet hydrological conditions. Further details on the closure and reclamation of the Project can be found in Section 3.12.

3.4 GAHCHO KUÉ DEPOSIT

3.4.1 Introduction

The kimberlite cluster at Kennady Lake consists of four groups of vertical kimberlite pipes beneath the southwest portion of Kennady Lake. The three economic kimberlite ore bodies are named 5034, Hearne, and Tuzo. A fourth kimberlite ore body, Tesla, is not viable to mine because of its small size and low diamond grade; therefore, it is not part of the proposed Project. The kimberlite pipes are beneath Kennady Lake except for a part of the 5034 ore body that extends under the peninsula.

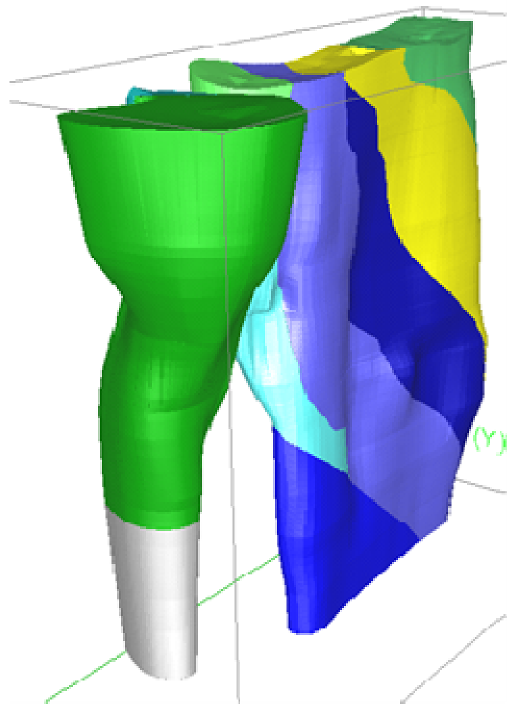
The ore bodies are covered by water ranging from approximately 7 to 16 m in depth, except for part of the 5034 ore body, which is about 45 m below the surface of the main peninsula. The ore bodies under the lake are covered with glacial till, sediment, and granite boulders that must be removed to allow access to the ore.

The ore bodies are complex. An understanding of the shape of their structure will increase over the course of the mine. Different kimberlite pipes containing different grades of diamondiferous material are mixed with each other and with the surrounding rock. The rock around and interspersed within the ore bodies consists generally of granite. Most of this granitic rock contains very little mineralization, but some rock close to the ore is potentially acid generating. Section 3.7.3 provides further information about the characteristics of the mine rock.

3.4.2 Hearne Ore Body

The Hearne ore body is split into two parts: Hearne North and Hearne South (Figure 3.4-1; the colours differentiate different types of kimberlite). The separation between the two parts varies from a minimum of approximately 20 m at the surface to approximately 70 m at depth. Hearne North has an elongated shape with dimensions of about 250 m by 50 m in a north-south direction. Hearne South is about 80 m by 90 m at the surface under the lake.

Figure 3.4-1 Section View of the Hearne Ore Body Looking Northwest



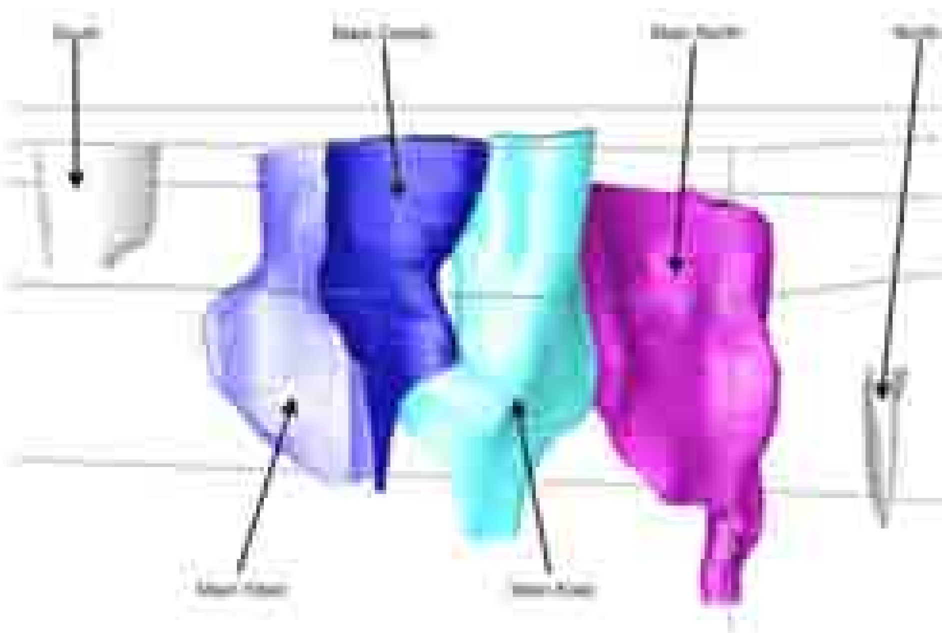
3.4.3 5034 Ore Body

The 5034 ore body is irregularly shaped and consists of six kimberlite pipes; four pipes are joined at surface to form one large kimberlite pipe, and two are outlying satellite kimberlite pipes. The six kimberlite pipes have been named 5034 South, 5034 Main West, 5034 Main Centre, 5034 Main East, 5034 Main North, and 5034 North (Figure 3.4-2).

The part of the ore body consisting of 5034 Main West, 5034 Main Centre, and 5034 Main East lies under the lake. The kimberlite pipes are joined at the surface, but separate at depth. The 5034 Main Centre and 5034 Main East kimberlite pipes separate at a shallow depth, but rejoin again at greater depth leaving a column of mainly granitic rock within the ore body.

The 5034 Main North kimberlite pipe lies below the surface, joining the northern side of the 5034 Main East kimberlite pipe some 45 m below the lakebed. Approximately half of this northern kimberlite pipe is located beneath the peninsula. The 5034 Main North kimberlite pipe extends laterally for about 200 m and varies from approximately 20 m to 80 m in width. The two smaller satellite kimberlite pipes, 5034 North and 5034 South, are totally separate from the main ore body.

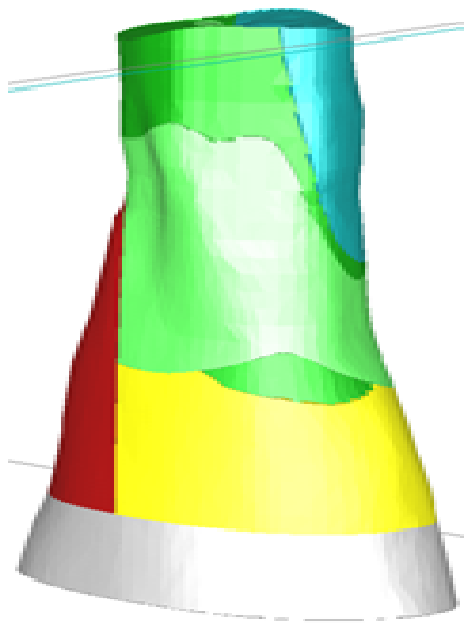
Figure 3.4-2 Section View of the 5034 Ore Body Looking Northwest



3.4.4 Tuzo Ore Body

The Tuzo ore body has an unusual shape for a kimberlite pipe in that the diameter of the ore body increases at depth (Figure 3.4-3). Close to the surface, the ore body is nearly circular in plan view with dimensions of approximately 130 m by 125 m. At depth, the size of the ore body increases to about 250 m by 165 m. As shown in Figure 3.4-3, the composition of this ore body is complex with a number of kimberlite pipes interspersed with each other. The Tuzo ore body is located in the southern portion of Kennady Lake immediately northeast of the 5034 ore body.

Figure 3.4-3 Section View of the Tuzo Ore Body Looking Northwest



3.4.5 Geochemical Characterization of Ore Bodies

The presence of potentially acid generating constituents in the ore bodies and surrounding rock (e.g., sulphides) and potentially acid neutralizing constituents (e.g., carbonates) is of key importance in the design of management facilities. In 2004, an expanded testing plan was implemented for kimberlite and the surrounding rock, primarily granite. Sample collection began during the 2004 winter drilling program and continued through summer 2007. The objective of the geochemical program was to choose representative samples of all the different types of materials that will be excavated or exposed at the Project site.

The geochemical program found that sulphides were present as stringers or fracture infillings in the 5034 ore body near the contact between the kimberlite and granodiorite rock. Kimberlite samples from the interior of the pipe were generally free of sulphides. Calcite was present in the kimberlite as fracture fillings. The rock surrounding the kimberlite body was typically fresh to slightly altered granite and granodiorite (Canamera 1996; Jacques Whitford 2000). No carbonates were observed in the granodiorite (Canamera 1996). Fine-grained, disseminated, and fracture-fill pyrite was visible in portions of the granodiorite (Jacques Whitford 2000).

The Hearne and Tuzo ore bodies differed slightly from the 5034 ore body. Both diatreme and hypabyssal kimberlite (i.e., kimberlite that is present both as large angular fragments in a volcanic vent and as molten rock that has solidified in dykes and sills at shallow depths) made up the Hearne pipe with granite and altered granite comprising the surrounding rock (Jacques Whitford 2000). The Tuzo pipe was dominantly filled with tuffisitic kimberlite breccias (large angular fragments of kimberlite transported by volcanic explosion). The surrounding rock was dominated by granite with lesser amounts of diabase.

3.5 MINING

3.5.1 Introduction

The ore bodies described in Section 3.4 generally lie just below the bottom of Kennady Lake. Mining will proceed by excavating down from the surface with heavy earth-moving machinery, creating a large, open pit around each ore body. The rock extracted from the pits will consist of diamond bearing kimberlite, low grade or non-diamond-bearing (barren) kimberlite, and some of the barren rock around the ore body.

3.5.2 Mine Plan

The ore bodies will be mined in sequence, beginning with 5034, followed by Hearne and then Tuzo. When mining operations in the 5034 and Hearne pits are completed, the pits will be used to store mine rock and PK. Mine rock and coarse PK will be placed into the 5034 Pit, and fine PK and 5034 pit water will be placed into the Hearne Pit.

The current mine plan includes mining of approximately 31.3 Mt of ore, 226.4 Mt of mine rock, and 7.3 Mt of overburden from the three pits during 2013 to 2025 (Year -1 to Year 11). The ore will be processed at an annual rate of 3 Mt beginning in 2015 (Year 1) and extending to 2025 (Year 11).

The ore bodies have been delineated by an extensive drilling program to establish the dimensions of each ore body and the grades of diamondiferous material contained within each of them. Information from the drilling program has been used to calculate the optimum pit design for the safe excavation of the ore bodies. Table 3.5-1 presents the basic parameters of the pit design. The pits will produce about 8 tonnes (t) of mine rock for every tonne of diamondiferous kimberlite (Table 3.5-1).

The open pits will extend over a fairly large area on the surface because of the need to slope the pit walls. The slopes are necessary so that the pit walls do not collapse while the open-pit mines are being excavated. Pit wall stability is a priority safety issue and is the focus of specific geotechnical engineering design requirements. The angle of the pit walls from the horizontal will range between 40 to 60 degrees with the walls generally becoming steeper near the bottom of the pit.

Table 3.5-1 Basic Parameters for Open Pit Design

	5034 Pit	Hearne Pit	Tuzo Pit
Diamonds (carats)	24,900,000	12,300,000	14,900,000
Kimberlite (kilotonnes)	13,200	5,400	12,600
Granite/mine rock (kilotonnes)	103,500	29,300	100,900
Stripping ratio	7.8	5.4	8.0

The pit walls will consist of a series of horizontal steps or benches, blasted into the rock. The vertical height of each bench will be 12 m. The width of the benches will vary between 7 m and 14 m depending on the overall design steepness of the pit walls. The 5034 Pit and Tuzo Pit are expected to be about 300 m deep, while the Hearne Pit is anticipated to be 205 m deep, upon completion of mining.

A road into each pit is required so that heavy equipment can access the pit and the haul trucks can bring the broken rock from the bottom of the pit. The haul road access will consist of a ramp spiralling downwards around the perimeter of the pit, which will be extended deeper into the pit as mining progresses. The design for the pits involves one road only into each pit. The nominal width of the road built into the pit walls will range between 19 m and 30 m. Narrower roads for single lane traffic and/or smaller equipment will be used at depth where the kimberlite ore body narrows.

3.5.3 Procedure for Mining the Open Pits

As construction progresses, the heavy earth-moving equipment required for open pit mining will be brought to the Project over the winter access road. It is projected that the following types of diesel powered, primary equipment will be required for open-pit-mining:

- four drills for drilling vertical holes into the rock to accept the explosive charges;

- three 26-34 cubic metre (m^3) loaders/excavators for loading the broken rock;
- between four to ten 230-t haul trucks and three 100-t haul trucks depending on the amount of hauling required at any particular stage during the Project;
- four tracked dozers;
- three wheeled loaders (12 to 17 m) for loading broken rock;
- two rubber tired dozer; and
- several graders, utility backhoes, smaller tracked dozers, utility loaders, water/sand trucks, and other production support equipment.

Pre-stripping involves the removal of overburden, which is the material that overlies the kimberlite deposits. The pre-stripping of 5034 will begin during the last year of construction, once lake water above the ore body has been pumped out.

When pre-stripping has been completed and the process plant has been commissioned, the production phase open-pit mining of kimberlite will begin. Open-pit mining is performed in the following cycle:

- drilling vertical holes into the bedrock;
- filling the holes with explosives and blasting the rock; and
- loading the broken rock into large haul trucks and removing it from the pit.

After the broken rock has been cleared from that portion of the pit, the entire cycle is repeated.

Blasting in the pits will be carefully planned and controlled to maintain a safe workplace and to avoid mixing the diamondiferous material with the surrounding rock that is not diamond bearing. Generally, this means blasting and hauling away the diamond-bearing kimberlite material separately from the surrounding rock. The ore will be segregated from the barren, non-diamondiferous rock as the haul trucks are loaded with broken rock inside the open pit. Some of the barren, primarily granitic, rock will be used for construction and reclamation. The remaining barren rock will be hauled away for disposal. The diamondiferous kimberlite will be hauled by truck to the process facility.

The mine will produce up to 3.0 Mt of ore per year. This material will be delivered to the process facility. The run-of-mine kimberlite ore stockpile will contain approximately 50,000 t, to allow for uninterrupted plant feed. It will be important to maintain a regular flow of kimberlite out of the pits to the stockpile so that sufficient ore is available to be fed into the processing facility.

3.5.4 Mining Sequence

The 5034 Pit will be mined first. The Hearne Pit will be pre-stripped and the ore exposed and available while 5034 is being mined. Afterwards, the ore in Tuzo will be exposed and available during mining operations at Hearne. The expected time lines for the excavation of the three open pits are presented in Table 3.3-1.

The Project plan considers not just the excavation of ore and mine rock from the open pits, but also the simultaneous disposal of mine rock and PK. This section will clarify the mine plan and the mining sequence by presenting the state of the open pits and the containment facilities at four different points during mining operations (Years 2, 4, and 6, and 8 to 11).

3.5.4.1 Operations Year 2 (2016)

In Year 2 of operations, the site will be fully commissioned and the mine will be operating at full capacity with ore coming from the 5034 Pit. Figure 3.5-1 depicts the mine site and the state of the various mine rock and PK repositories at that time. The initial deposition of the fine PK will be in Area 1 of the Fine PKC Facility. The capacity of Area 1 of the Fine PKC Facility will be expanded by the use of perimeter berms. Construction of the filter dyke (Dyke L) between Areas 2 and 3 will be completed or nearly complete; completion is anticipated to be no later than Year 3. Water decanted from Area 1 will flow via Area 2 through the filter dyke and into Area 3 within the WMP, which will serve as the primary source of process make-up water. Coarse PK will be stored on land in the Coarse PK Pile adjacent to Area 4. Mine rock used to construct the dykes will be non-acid generating (non-AG). Mine rock that is not used for construction purposes will be placed on either the West Mine Rock Pile or South Mine Rock Pile located within and adjacent to Areas 5 and 6, respectively.

3.5.4.2 Operations Year 4 (2018)

In Year 4 of operations, ore will come from the deeper portion of the 5034 Pit and upper portions of the Hearne Pit (Figure 3.5-2). Following Year 4, the fine PK will be placed into Area 2 of the Fine PKC Facility, while coarse PK will continue to be placed in the Coarse PK Pile. Portions of Area 1 of the Fine PKC Facility will begin to be covered with coarse PK and mine rock as part of the progressive reclamation and decommissioning plan. The remaining mine rock will be placed on the South Mine Rock Pile and then the West Mine Rock Pile. Groundwater flowing into the 5034 Pit will be pumped to Area 5 within the WMP or to the process plant. Groundwater pumped to the process plant will be incorporated in the PK slurry and eventually be pumped to Area 1 or Area 2 of the Fine PKC Facility.

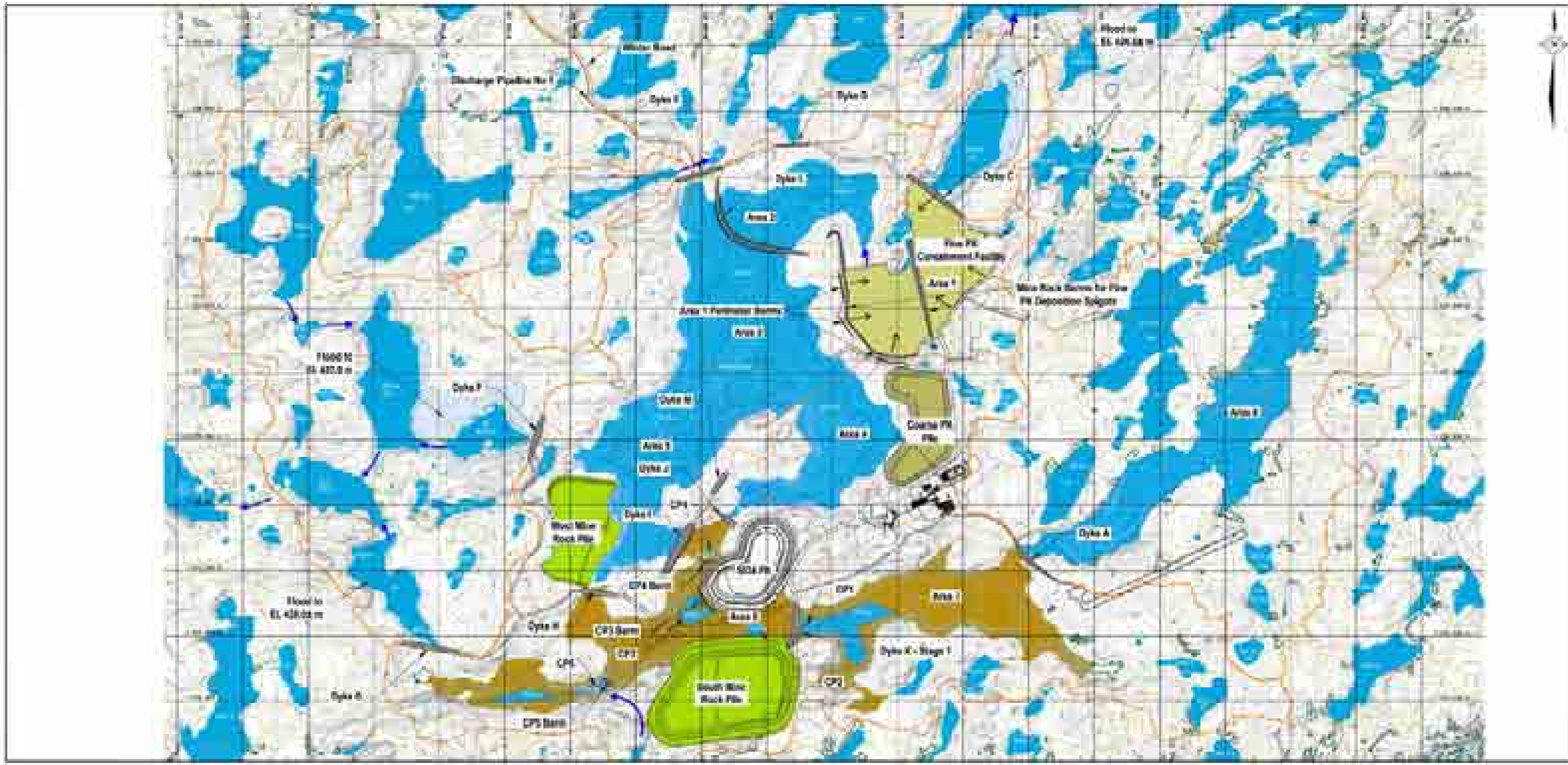
3.5.4.3 Operations Year 6 (2020)

In Year 6 of operations, the 5034 Pit will be completed, and ore will be removed from the Hearne Pit and the upper portions of the Tuzo Pit (Figure 3.5-3). Fine PK will continue to be deposited in Area 2 of the Fine PKC Facility until the Hearne Pit is mined out. Groundwater inflows into the Tuzo Pit and Hearne Pit will either be pumped into Area 5 or be used as process water. Mine rock will be deposited in the mined-out 5034 Pit as it becomes available. Coarse PK will continue to be deposited in the Coarse PK Pile. The coarse PK will also be used as a transitional cover over the Fine PKC Facility prior to covering with non-AG mine rock to provide a base on which the final mine rock cover will be placed. Dyke K, on the west side of Area 7, will be constructed to its final height and Area 7 will be allowed to begin filling naturally.

3.5.4.4 Operations Years 8 to 11 (2022 to 2025)

By Year 8 of operations, the Hearne Pit will be completed and mining will be solely from the Tuzo Pit (Figures 3.5-4 and 3.5-5). As soon as the empty Hearne Pit is available, the fine PK discharge line will be moved to Hearne. Hearne is the preferred location for depositing fine PK given the close proximity of 5034 to the Tuzo open pit operations. Coarse PK will continue to be deposited in the Coarse PK Pile, used as cover on the Fine PKC Facility, and/or deposited into the mined-out 5034 or Hearne pits. The closure of the Fine PKC Facility is expected to be completed by Year 8.

Pit water inflow from Tuzo will be pumped to the Hearne Pit. Dewatering of the 5034 Pit will have been discontinued and any groundwater seeping into this pit will be allowed to accumulate, or pumped to Hearne Pit should the level of water in 5034 Pit affect mining in Tuzo Pit. Portions of Areas 6 and 7 will be allowed to fill with natural runoff in anticipation of mine closure.



LEGEND

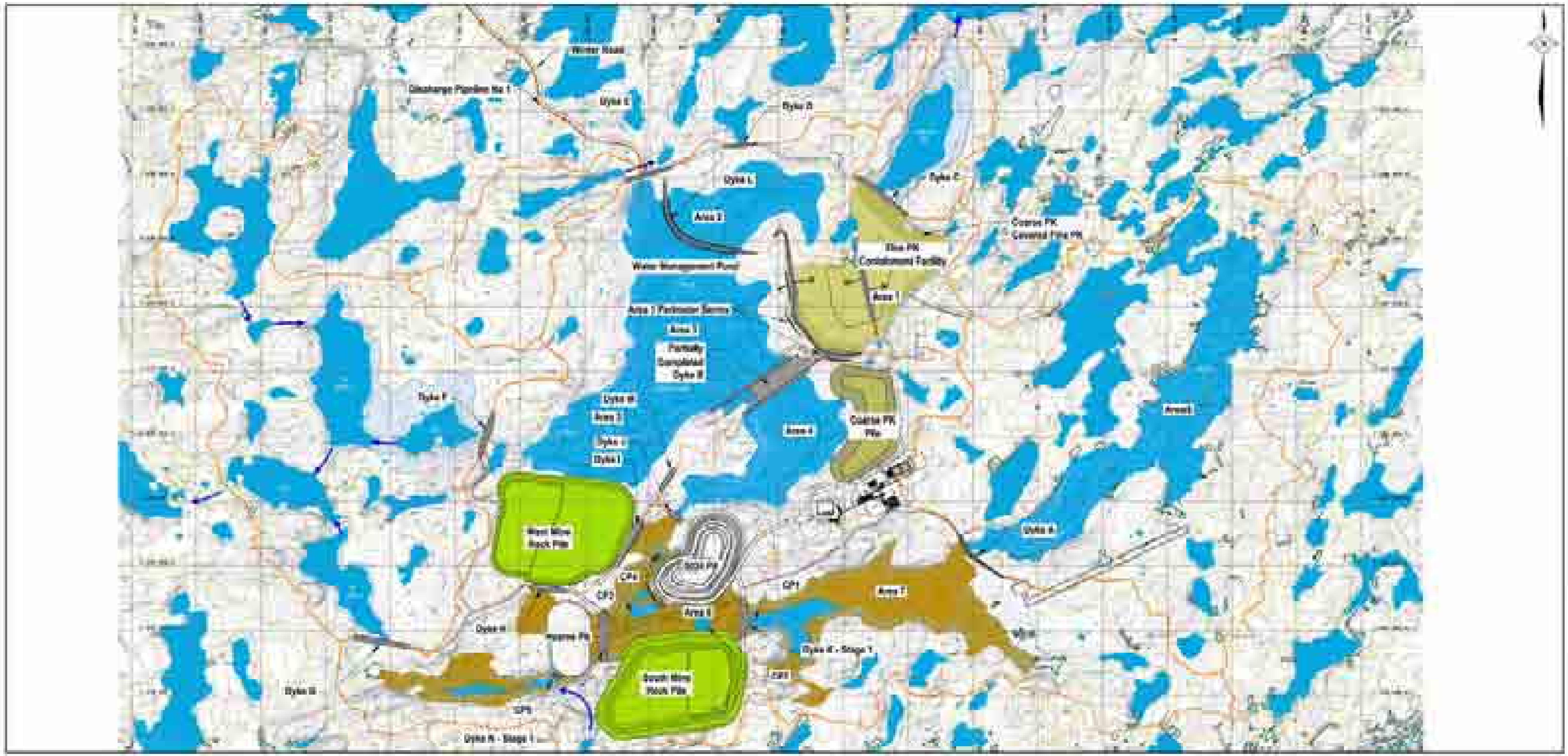
Existing Ground Contours 5m Index + 1m Intermediate
Bathymetry Contours 5m Index + 1m Intermediate
CP Collection Pond
Winter Road
Marsh Area
Scrub
Sub-watershed Boundary
Drainage Flow Direction
Discharge Pipeline
Coarse PK
Drained Area
Fine PK
Flooded Areas
Lake/Pond
Mine Rock

NOTES
Base data source: EBA Figure 4.5 - Stage 2 - Water Management During Mine Operation Years 1 to 3 (2015 to 2017)

GAHCHO KUE PROJECT

Mining Operations Years 1 to 3 (2015 to 2017)

PROJECTION: UTM Zone 12	DATUM: NAD83		
FILE No: P-Other-002-CAD			DATE: October 18, 2010
JOB No: 09-1365-1004	REVISION No: 3		Figure 3.5-1
OFFICE: GOLD - SAS	DRAWN: AJL	CHECK: PT	



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

Bathymetry Contours
5m Index - 1m Intermediate

CP Collection Pond

Winter Roads

Mine Area

Roads

Sub-watershed Boundary

Drainage Flow Direction

Discharge Pipeline

Coarse PK

Disturbed Area

Fine PK

Flooded Areas

Lake/Pond

Mine Rock

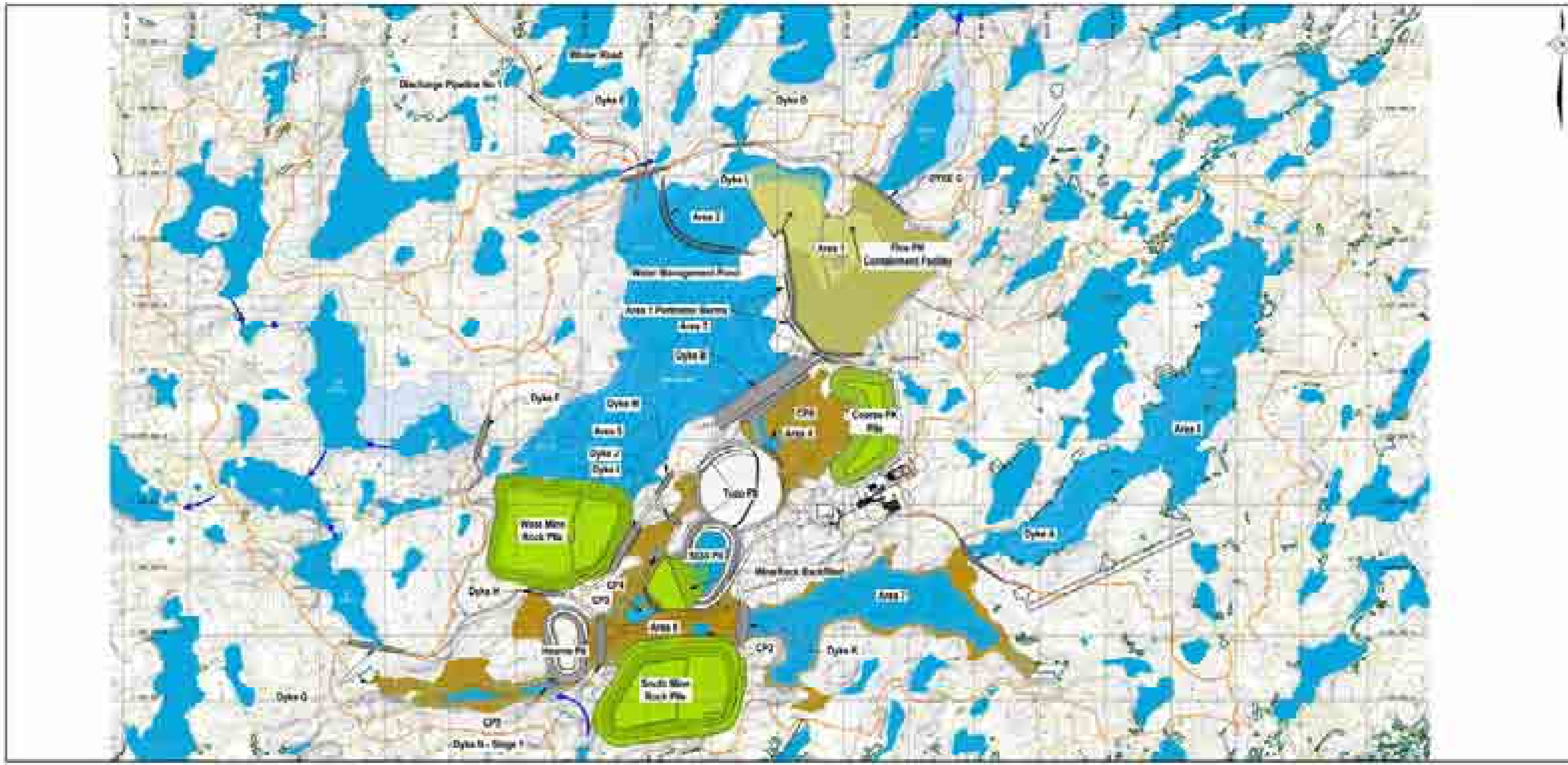
NOTES
Base data source: EBA Figure 4.6 Stage 3 Water Management During Mine Operation Year 4 (2018)

GAHCHO KUE PROJECT

Mining Operations
Year 4 (2018)

PROJECTION: UTM Zone 12	DATUM: NAD83
FILE No: P-Other-003-CAD	DATE: October 18, 2010
JOB No: 09-1365-1004	REVISION No: 3
OFFICE: GOLD - SAS	DRAWN: AJL
CHECK: PT	

Figure 3.5-2



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

Bathymetry Contours
5m Index - 1m Intermediate

CP Collection Pond

Winter Roads

Mine Area

Scrub

Sub-watershed Boundary

Drainage Flow Direction

Discharge Pipeline

Coarse PK

Drained Area

Fine PK

Flooded Areas

Lake/Pond

Mine Rock

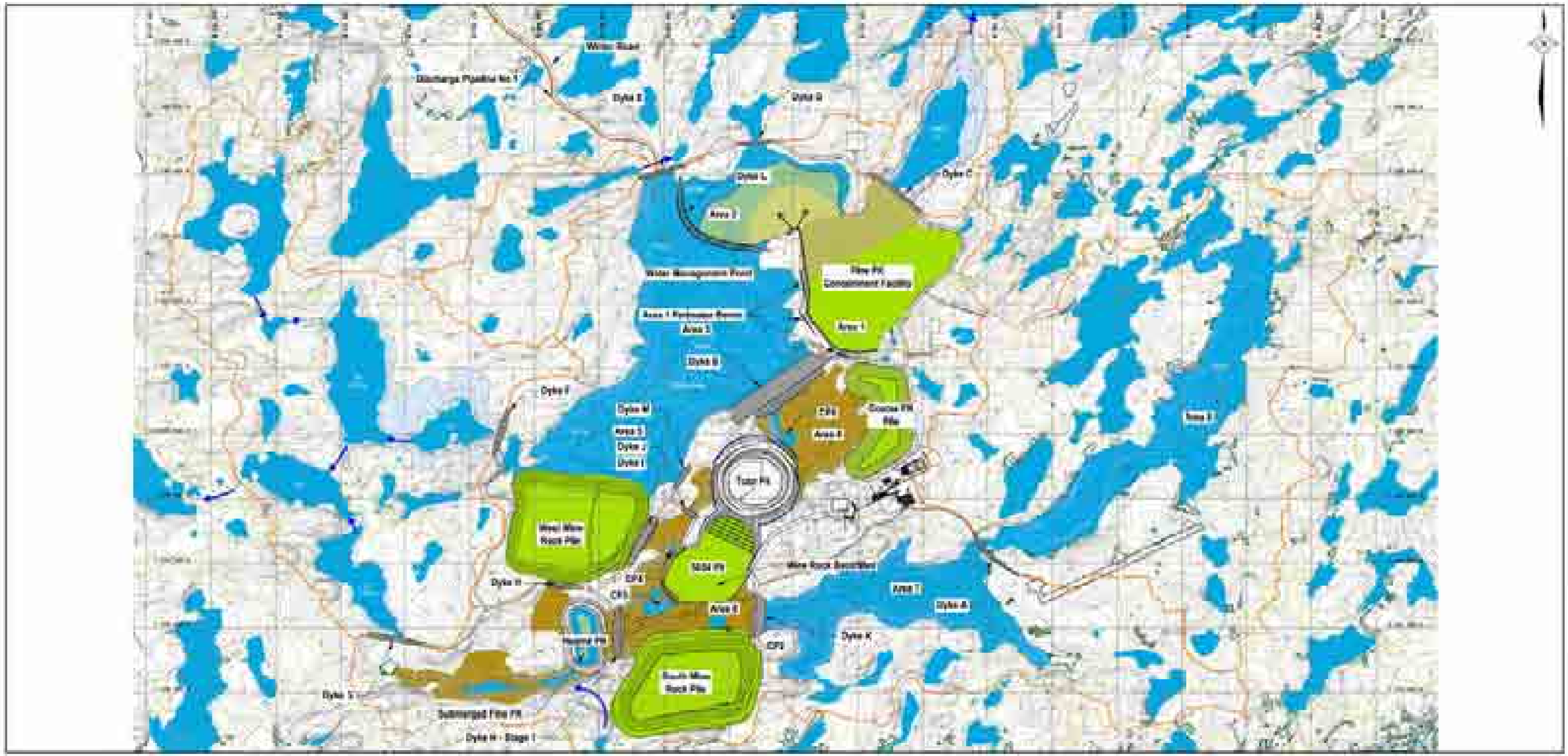
Submerged PK

NOTES
Base data source: EBA Figure 4.8 - Stage 5 - Water Management During Mine Operation Year 6 (2020)

GAHCHO KUE PROJECT

Mining Operations
Year 6 (2020)

PROJECTION: UTM Zone 12	DATUM: NAD83	
FILE No: P-Other-004-CAD		DATE: October 18, 2010
JOB No: 09-1365-1004	REVISION No: 3	Figure 3.5-3
OFFICE: GOLD - SAS	DRAWN: AJL	CHECK: PT



LEGEND

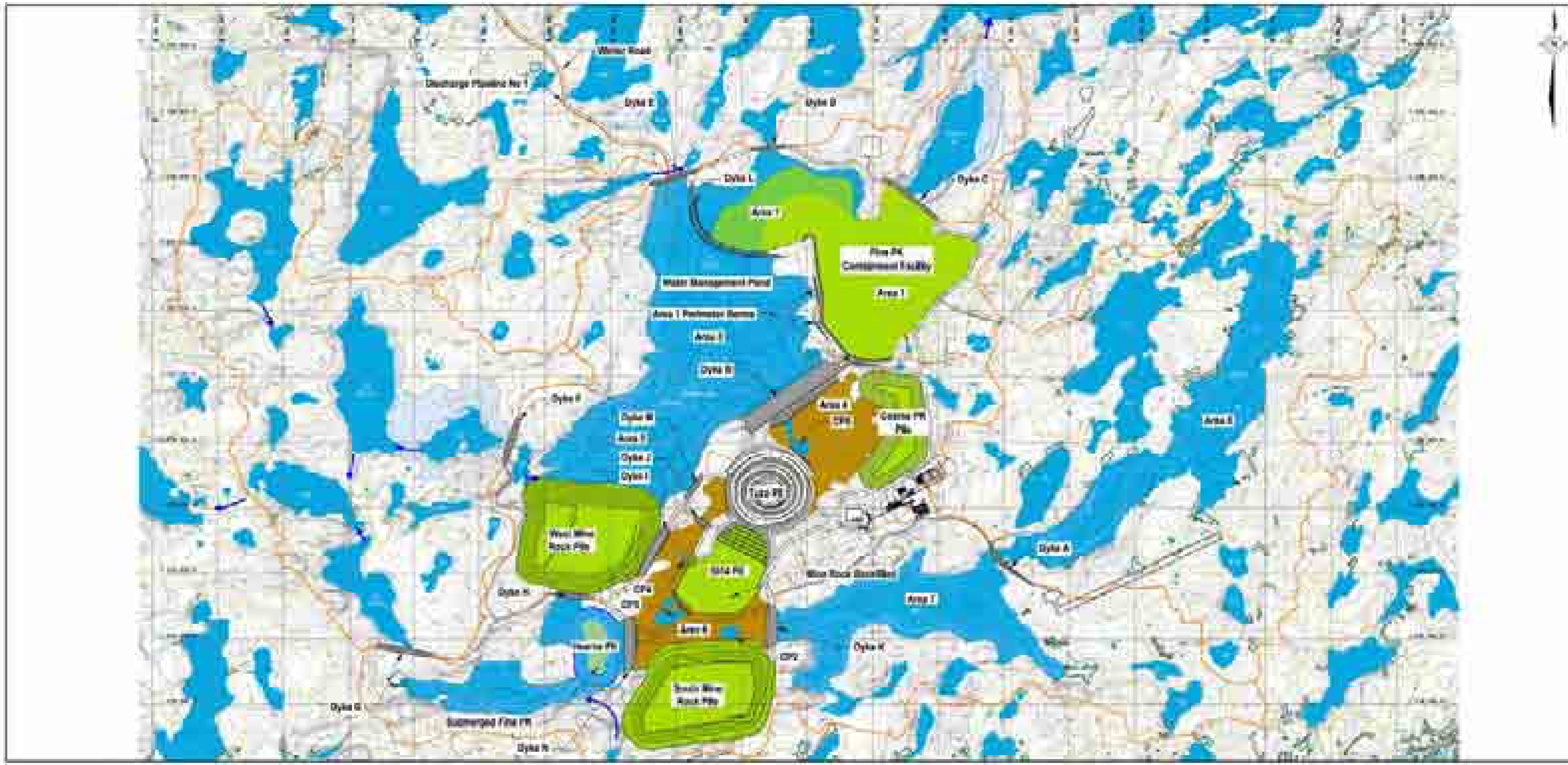
	Existing Ground Contours 5m Index + 1m Intermediate		Marsh Area		Coarse PK
	Bathymetry Contours 5m Index + 1m Intermediate		Scrub		Drained Area
CP	Collection Pond		Sub-watershed Boundary		Fine PK
	Winter Road		Drainage Flow Direction		Flooded Areas
			Discharge Pipeline		Lake/Pond
					Mine Rock
			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

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

GAHCHO KUE PROJECT

Mining Operations Year 8 (2022)

PROJECTION: UTM Zone 12	DATUM: NAD83	
FILE No: P-Other-006-CAD		DATE: October 18, 2010
JOB No: 09-1365-1004	REVISION No: 3	Figure 3.5-4
OFFICE: GOLD - SAS	DRAWN: AJL	CHECK: PT



LEGEND

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

NOTES
Base data source: EBA Figure 4.11 - Stage 8 - Water Management During Mine Operation Years 9 to 11 (2023 to 2025)

GAHCHO KUE PROJECT

Mining Operations Years 9 to 11 (2023 to 2025)

PROJECTION: UTM Zone 12	DATUM: NAD83
FILE No: P-Other-006-CAD	DATE: December 22, 2010
JOB No: 09-1365-1004	REVISION No: 3
OFFICE: GOLD - SAS	DRAWN: TAH/AL
CHECK: PT	

Figure 3.5-5

3.6 PROCESSING

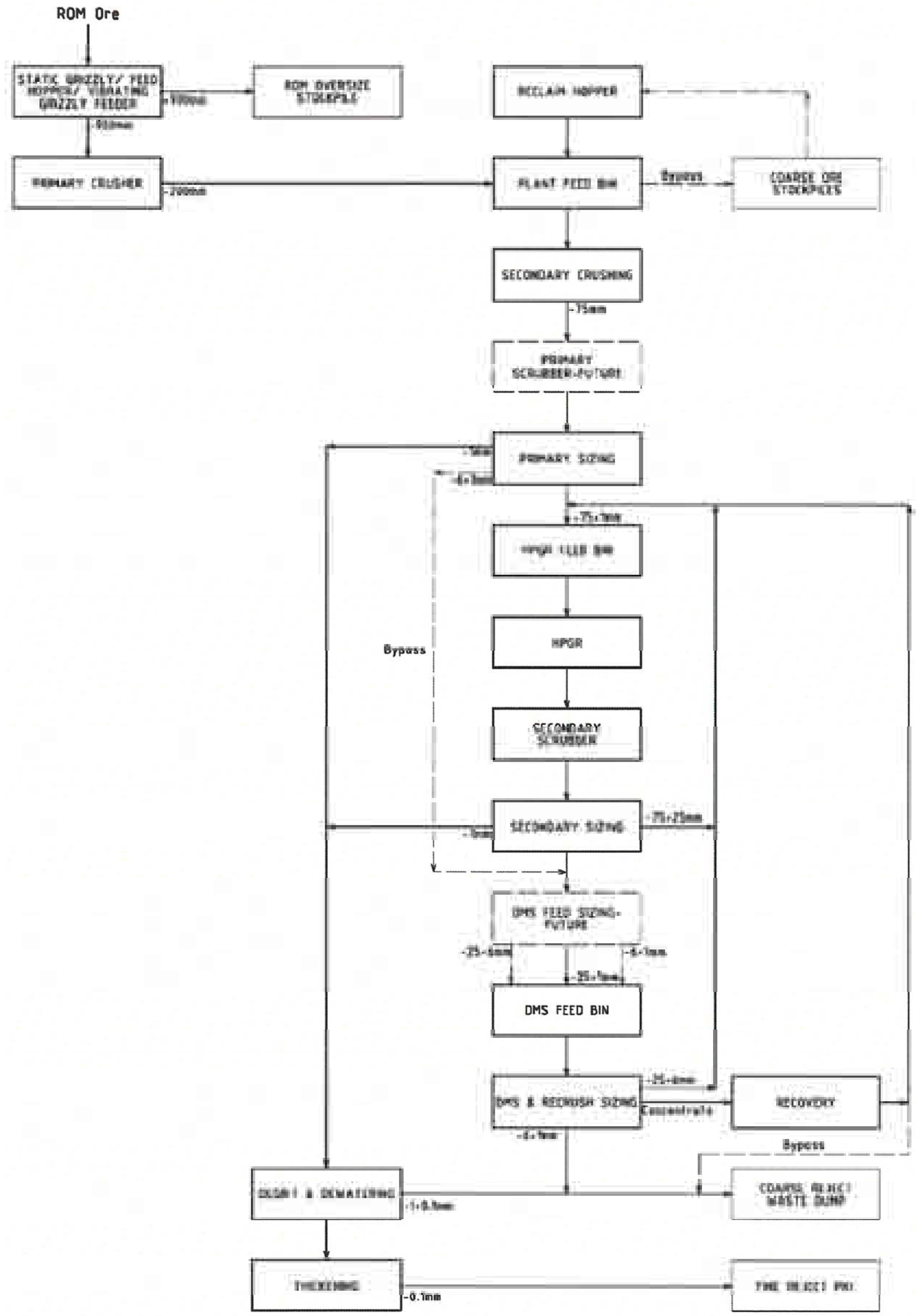
3.6.1 Introduction

The ore processing system will concentrate and recover diamonds in the size range of 28 millimetres (mm) to 1.0 mm. The diamond recovery efficiency of the combined concentration and recovery processes is anticipated to be generally greater than 90% by mass.

Development of the ore processing system was based on De Beers' extensive experience in diamond mining and processing, with assistance from experienced engineering companies. The design takes into consideration the experience of other open pit diamond mines in NWT and Nunavut, as well as De Beers' Snap Lake and Victor mines. Although there are some refinements, it is generally similar to the processing systems at other operating mines in the NWT. Ore processing includes the following steps:

- primary crushing;
- crushed ore conveying and stockpiling;
- secondary crushing;
- further crushing by high pressure grinding roller;
- screening;
- concentration (dense medium separation);
- x-ray and grease diamond recovery and sort house;
- degritting;
- fines thickening; and
- rejects disposal.

A simplified process flow sheet is shown in Figure 3.6-1 and 3.6-2. The major steps in the process, the products used in processing the ore, and waste streams from the processing plant are described below.



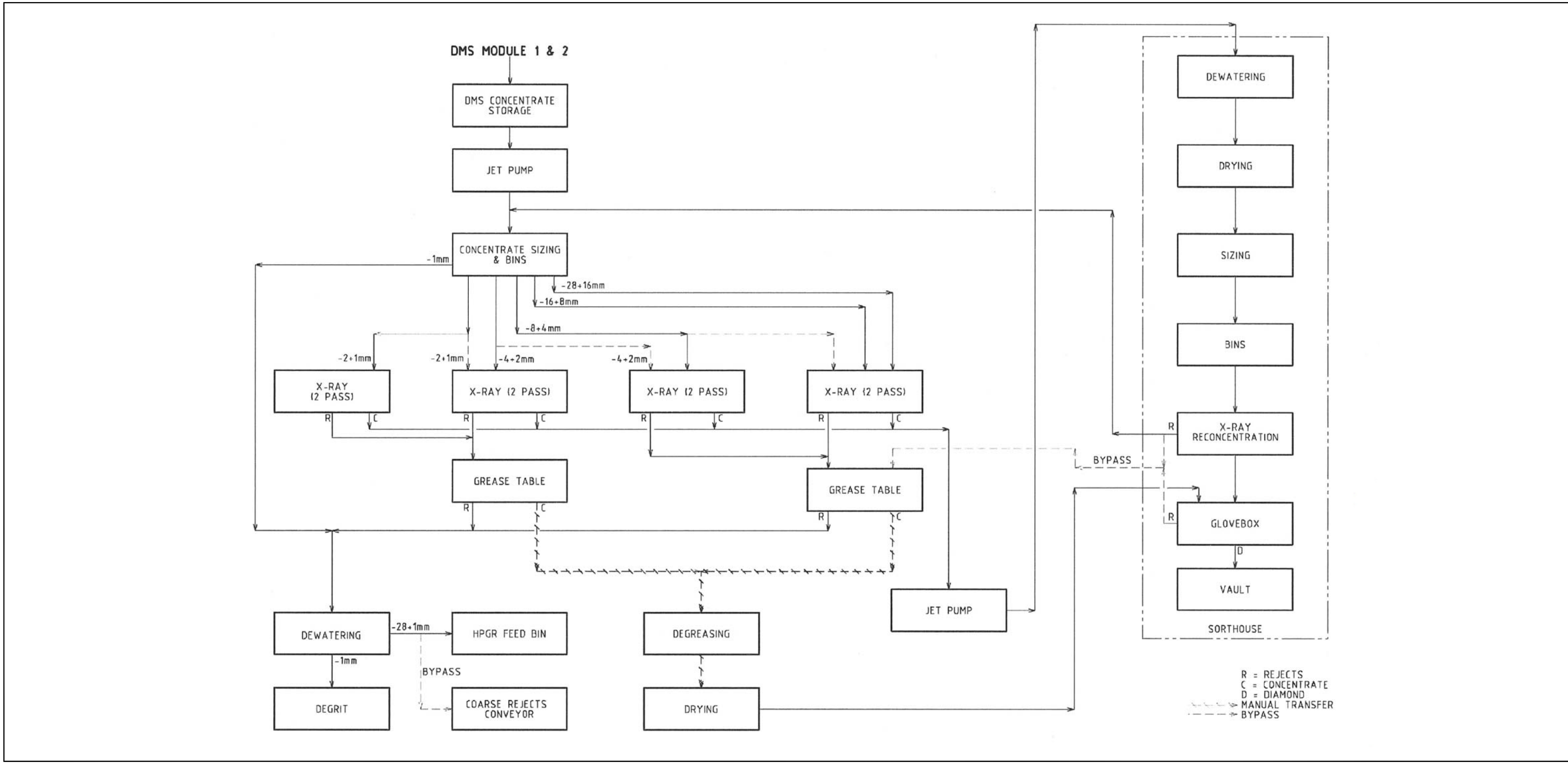
LEGEND

ROM	Run of Mine
HPGR	High Pressure Grinding Rollers
DMS	Dense-Medium Separation

GAHCHO KUÉ PROJECT

Ore Processing Diagram

PROJECTION: N/A	DATUM: N/A		
SCALE: NOT TO SCALE			
FILE No: P-Other-007-CAD			DATE: October 18, 2010
JOB No: 09-1365-1004	REVISION No: 1		Figure 3.6-1
OFFICE: GOLD - SAS	DRAWN: AJL	CHECK: PT	



LEGEND

ROM	Run of Mine
HPGR	High Pressure Grinding Rollers
DMS	Dense-Medium Separation

GAHCHO KUÉ PROJECT

Diamond Recovery Diagram

PROJECTION: N/A	DATUM: N/A
NOT TO SCALE	
FILE No: P-Other-008-CAD	DATE: August 18, 2010
JOB No: 09-1365-1004	REVISION No: X
OFFICE: GOLD - SAS	DRAWN: AJL / CHECK: PT

Figure 3.6-2

3.6.2 Process Description

3.6.2.1 Crushing

Ore from the run-of-mine stockpile will be delivered and screened through a grizzly, which is a heavy-duty steel grating used to remove over-sized pieces. Ore that has passed through the grizzly will be added to a 50 t surge bin above the primary crusher. The primary crusher will be located in an area approximately 200 m from the main processing facility and will be connected to the rest of the process facility by uncovered conveyors.

Depending on the nature of the run-of-mine ore, the flow from the primary crusher circuit may at times exceed the capacity of the process facility. A primary crushed stockpile will receive excess flow from the primary crusher whenever the process facility is unavailable, or when the flow from the primary crusher exceeds the capacity of the process facility.

In addition to the primary crusher, a secondary crusher and a high pressure grinding roller will be in the circuit. The objective is to sequentially crush the ore to liberate diamonds and to eventually reach a particle size ranging between 1.0 mm and 28 mm without damaging the diamonds within the kimberlite.

3.6.2.2 Cleaning and Screening

Crushed ore will pass through screening stages to produce clean and suitably sized ore. Washing action on the screens will help break up the larger conglomerate chunks of ore. Washing the ore will also clean the larger particles and remove the very fine particles from the circuit. As a result of the washing, the majority of the processing is done on wet ore, which will reduce the generation of dust from inside the Process plant.

3.6.2.3 Concentration

The initial separation of the kimberlite from the diamonds will use the difference in density between diamonds and kimberlite host rock. Particles of ore between 1.0 mm and 28 mm will pass to one of two dense-medium separation (DMS) modules (Figure 3.6-1) in the DMS circuit, where they will be mixed with ferrosilicon and water. The ferrosilicon is used to make a dense medium that contributes to the separation and concentration of the diamonds.

Within the DMS module, the dense medium will be separated by centrifugal force using a cyclone. The slurry of ore and ferrosilicon will pass through a cyclone where the heavier, potentially diamond-bearing particles, will be separated from the lighter particles. From the cyclone in the DMS module, the light particles with a size greater than 6 mm will be sent back to a crusher, while the heavier particles will be sent to the diamond recovery plant.

Particles from the cyclone that are smaller than 1.0 mm will pass to the degrit circuit. The degrit module consists of cyclones that separate the fines (less than 0.25 mm) from the grits (greater than 0.25 mm but less than 1.0 mm). The grits will be combined with the rejects (barren rock that is less than 6 mm from the DMS module) and trucked to the Coarse PK Pile or, later, the mined-out 5034 Pit or Hearne Pit. The fines will be thickened with the addition of flocculent and become the fine PK stream.

3.6.2.4 Diamond Recovery

The final recovery of diamonds takes place in the recovery plant where x-ray machines and a grease diamond recovery system in a secure facility will be used to separate the diamonds from the kimberlite rock. The secure recovery facility will recover diamonds from diamondiferous concentrates with an efficiency (for this stage only) that is anticipated to be not less than 97% by value. The diamonds will be collected and shipped to Yellowknife for further value-added processing. Particles greater than 6 mm in size not identified as diamonds will be sent back into the process system for further crushing and another pass through the system. Non-diamond particles greater than 1.0 mm and less than 6 mm in size will pass from the recovery plant back to the crushing circuit or to the coarse PK rejects stockpile.

3.6.3 Processing Materials and Chemicals

Processing of the kimberlite ore will be essentially mechanical, with only minimal use of chemicals. The proposed materials and chemicals along with the estimated annual consumption of each are listed in Table 3.6-1. Fate of these substances is described in Section 3.6.4.

Table 3.6-1 Processing Materials and Chemicals and Estimated Annual Consumption

Chemical	Location	Process Use	Estimated Annual Consumption
Ferrosilicon	site	concentration	525 t to 600 t
Flocculent (Magnafloc 1011)	site	thickening	6 t to 10 t
Grease	site	diamond recovery	2 t to 3 t
Solvent	site	de-greasing	2,000 L to 2,500 L

t = tonne; L = litres, Site = Mine Site.

3.6.4 Waste Streams from the Processing Plant

3.6.4.1 Processed Kimberlite

The purpose of the processing plant is to separate the diamonds from the kimberlite rock by the controlled crushing of the kimberlite and screening of the particles. Hence, the crushed kimberlite rock passing through the process facility constitutes the bulk of the waste from the processing plant. The PK stream consisted of coarse and fine PK. The coarse PK stream ranging in size between 0.25 mm and 6 mm is placed in the Coarse PK Pile. The fine PK will be fed to a thickener to remove excess water and then pumped by pipeline to the Fine PKC Facility.

The other additions to the PK stream will be a small quantity of residual ferrosilicon used during the density separation and minor amounts of grease used in the grease diamond recovery system. Most of the ferrosilicon used in density separation will be recovered and re-used. The treated effluent from the sewage treatment plant will be added to the fine PK stream as it leaves the processing plant unless it is needed for processing.

3.6.4.2 Process Water

The water used in the processing plant will be re-circulated and recycled as much as possible. Additional make-up water will be required continually to replace the water contained in the PK waste streams.

The processing plant will begin operations by the beginning of Year 1. During the mine life, the sources of process make-up water will be from:

- WMP (Areas 3 and 5 in Figure 3.2-2) during Years 1 to 8;
- Tuzo Pit from Years 8 to 11, supplemented by water from the WMP; and
- sewage treatment plant, as required.

Water reclaimed from the process plant thickener, as well as water from the WMP and Tuzo Pit, will be stored in a process raw water tank for distribution throughout the processing plant.

3.6.4.3 Process Materials and Chemicals

3.6.4.3.1 Ferrosilicon

Ferrosilicon is an inert iron/glass powder that, when mixed with water, serves to thicken the water to a dense media or slurry. The ferrosilicon is kept in suspension, together with the particles of ore. When this mixture is fed into a cyclone, the heavier diamond-bearing material will separate from the lighter barren material. The ferrosilicon is recovered using magnets and recycled back into the process. Ferrosilicon not recovered will flow into the PK waste stream. It is anticipated that about 500 t of ferrosilicon will be lost in the process system each year. This ferrosilicon will be deposited with the fine PK in the Fine PKC Facility or the mined-out Hearne or 5034 pits.

3.6.4.3.2 Flocculent

Magnafloc® 1011 is a non-toxic, high molecular weight, anionic polyacrylamide flocculent supplied as granules. It will be used to assist settling and thicken the fine PK waste stream, which will be pumped as a slurry to the Fine PKC Facility or the mined-out Hearne or 5034 pits.

3.6.4.3.3 Grease and Solvent

The grease used in the diamond recovery process on-site will be recycled as much as possible, but it is expected that there will be losses, as indicated in Table 3.6-1, that must be replaced as some grease stays in the solvent. The solvent is used to remove the residual grease from the diamonds. Used solvent will be stored in drums and shipped off-site to appropriate disposal facilities.

3.6.5 Diamonds Removal

The diamonds recovered at the Project site will be weighed, sized, and cleaned at an existing sorting facility in Yellowknife. Caustic soda is used at this facility to clean the diamonds and nitric acid is used to remove the caustic residue after the diamonds are cleaned. Afterwards, the rough diamonds will be sold. De Beers has agreed to make 10% of its rough diamonds, by value, from the Project available to manufacturers approved by the Government of the Northwest Territories and by De Beers. The remainder of the diamonds will be sold internationally.

3.7 MINE WASTE MANAGEMENT

3.7.1 Introduction

The proposed Project will produce the following solid materials:

- overburden from pre-stripping above the ore bodies;
- non-ore mine rock (primarily granite) that has been excavated from the open-pit mines;
- barren (non-diamondiferous) kimberlite rock;
- kimberlite (fine and coarse) that has been processed to remove the diamonds contained within it; and
- general domestic, industrial, and hazardous waste produced as part of normal Project operations.

The design for the mine waste containment facilities provided in this section is based on engineering studies. The final design will be developed from detailed engineering undertaken in the final design phase and will benefit from feedback obtained during the EIR process. The final design will be consistent with the environmental protection outlined in the preliminary design.

The deposition and containment of each of these solid waste streams will be discussed in the following sections, with the exception of general domestic, industrial, and hazardous wastes, which are discussed in Section 3.8.

3.7.2 Overburden

The ore bodies lie beneath a layer of lake-bottom sediment and till. This overburden, which must be removed before mining, will be used on the Project site. The approximate quantities and locations of overburden deposited on the site from pre-stripping in Year -2 to Year 7 are shown in Table 3.7-1.

Overburden will be used in the construction of dykes within the Kennady Lake sub-watershed areas, including intermediate dykes dividing the Kennady Lake areas from one another and dams within the dewatered lakebed. Overburden will be used to regrade the lakebed as required to manage runoff. Overburden, including lakebed sediments, will be used to cover any areas in the core of the mine rock piles where potentially reactive mine rock (if present) is sequestered. The overburden (including sediments), which consists mainly of till, will provide a low permeability barrier that will limit infiltration and encourage water to flow over the surface of the mine rock pile, rather than through it. Excess overburden material will be deposited in designated areas in the mine rock piles.

Table 3.7-1 Deposition of Overburden from Pre-stripping from Year -2 to Year 7

Year	Calendar Year	Overburden Removal (m^3)			Overburden Deposition (m^3)		
		5034	Hearne	Tuzo	Storage	Dyking and Grading	Stockpile for Reclamation
-2	2013	204,000	-	-	-	204,000	-
-1	2014	117,000	-	-	-	117,000	-
1	2015	984,000	-	-	684,000	300,000	-
2	2016	-	-	-	-300,000	300,000	-
3	2017	-	-	-	-384,000	384,000	-
4	2018	-	552,000	-	-	-	552,000
5	2019	-	328,000	827,000	-	328,000	827,000
6	2020	-	-	159,000	-	-	159,000
7	2021	-	-	92,000	-	-	92,000
	Total	**1,305,000**	**880,000**	**1,078,000**	**0**	**1,633,000**	**1,630,000**

m^3 = cubic metre.

3.7.3 Mine Rock

This section provides information on:

- quantity and distribution of mine rock;
- geochemical characteristics of mine rock; and
- characteristics of the mine rock piles.

3.7.3.1 Quantity and Distribution of Mine Rock

Mine rock includes the excavated bed rock surrounding the kimberlite deposits. Most of the mine rock from the excavation of the open pits will be stored in one of the following locations:

- mine rock piles in and adjacent to Area 5 (West Mine Rock Pile) and Area 6 (South Mine Rock Pile); and
- the mined-out 5034 Pit.

A breakdown estimate for the distribution of mine rock by year is provided in Table 3.7-2. About 63% of the mine rock will be deposited on the mine rock piles and about 37% will be deposited in the mined-out 5034 Pit. Near the end of mine life, some mine rock might be placed in the Hearne Pit. The amount is unknown at this time.

Some mine rock from the mine rock piles will be used for construction of roads, dykes, and dams, as well as reclamation. These amounts are included within the quantities of mine rock destined for the mine rock piles shown in Table 3.7.2. The amount used for construction and reclamation will reduce the amount stored in the piles.

The South Mine Rock Pile (Area 6) holds mine rock from the 5034 Pit until Year 3, after which it serves as a storage area for overburden from the Hearne Pit and Tuzo Pit. The mine rock from the 5034 Pit generated in Years 3, 4, and 5 will be hauled to the West Mine Rock Pile (Area 5). At this point, the 5034 Pit will be available for mine rock storage and the mine plan designates 5034 Pit as the primary disposal site for mine rock from the Tuzo Pit. Tuzo mine rock generated after the 5034 Pit is full will be placed in the West Mine Rock Pile. Mine rock from the Hearne Pit will be placed in the West Mine Rock Pile as well. Some mine rock will be diverted before it reaches storage to cover the Fine PKC Facility and the Coarse PK Pile once they are full.

Table 3.7-2 Distribution of Mine Rock by Year

Year	Calendar Year	5034 Mine Rock (Mt)			Hearne Mine Rock (Mt)		Tuzo Mine Rock (Mt)		
		Total Mined	To South Mine Rock Pile	To West Mine Rock Pile	Total Mined	To West Mine Rock Pile	Total Mined	To 5034 Pit	To West Mine Rock Pile
-2	2013	1.6	1.6	-	-	-	-	-	-
-1	2014	16.0	16.0	-	-	-	-	-	-
1	2015	27.2	27.2	-	-	-	-	-	-
2	2016	24.7	24.7	-	-	-	-	-	-
3	2017	17.7	2.2	15.5	-	-	-	-	-
4	2018	10.5	-	10.5	1.9	1.9	-	-	-
5	2019	2.9	-	2.9	10.0	10.0	11.6	11.6	-
6	2020	-	-	-	11.8	11.8	13.3	13.3	-
7	2021	-	-	-	3.6	3.6	27.2	27.2	-
8	2022	-	-	-	-	-	31.5	31.5	-
9	2023	-	-	-	-	-	9.9	-	9.9
10	2024	-	-	-	-	-	4.0	-	4.0
11	2025	-	-	-	-	-	1.0	-	1.0
Total		**100.6**	**71.7**	**28.9**	**27.3**	**27.3**	**98.5**	**83.6**	**14.9**

Mt = million tonnes.

3.7.3.2 Geochemical Characterization of Mine Rock

Geochemical characteristics play a critical role in the mine rock and PK management plans that have been developed for the Project. Geochemical stability can be broadly categorized into ‘acid rock drainage’ (ARD) and ‘metal leaching’. These two aspects are generally related; however, metal leaching can occur independently from acid generation. Detailed environmental geochemical characterization of the waste streams is provided in the Metal Leaching and Acid/alkaline Rock Drainage Report, Appendix 8.II, which is appended to Section 8 of the EIS.

Geochemical testing has been conducted on drill core samples from representative rock types based on visible physical characteristics. Granite (include gneissic granite) is the dominate rock type with lesser amounts of:

- altered granite;
- granodiorite;
- altered granodiorite;
- diabase; and
- diorite.

Results of all the rock types are presented together to reflect their treatment as mine rock. Granite will comprise more than 95% of all mine rock. Testing of mine rock samples indicates that the mine rock generally has the following characteristics:

- neutral to alkaline paste pH values (pH of all samples was 5.5 or greater);
- low concentrations of the potentially acid-forming minerals total sulphur and sulphide sulphur; and
- very little neutralizing mineral present.

Based on median concentrations, granite contains the lowest amounts of total sulphur and sulphide sulphur of all rock types (median concentration of 0.01 percent by weight [wt%]). The altered granite, altered granodiorite, and diorite have median sulphide sulphur concentrations of 0.28 wt%, 0.16 wt%, and 0.16 wt%, respectively. A summary of acid generation potential by rock type, based on the samples tested, is provided in Table 3.7-3.

Table 3.7-3 Summary of Acid Generation Potential for Mine Rock by Rock Type

Rock Type	Number of Samples	Number of Samples with Acid Generation Potential	Percent of Samples with Acid Generation Potential (%)
Granite	1,189	53	4.0
Altered Granite	10	6	60
Granodiorite	6	1	17
Altered Granodiorite	8	2	25
Diabase	7	0	0
Diorite	1	1	100
Total	**1,221**		

% = percent.

Although the ARD classification of samples was based generally on the Indian and Northern Affairs Canada (INAC) criteria presented in *Guidelines for ARD Prediction in the North* (DIAND 1992), adjustments to this classification system were made in cases where there was simply not enough acid forming minerals (sulphide) to produce acidity.

To supplement the classification above, additional longer-term repetitive leaching tests (humidity cell tests) were conducted. These tests are designed to simulate enhanced weathering and provide rates for acid generation, acid neutralization, and metal and major element leaching under laboratory conditions. Of the total of 14 humidity cell tests, the majority had neutral pH leachate with low metal concentrations. In most of the humidity cells, the rate of neutralizing potential consumption was generally greater than the rate of sulphate production (sulphide oxidation), indicating that the rate of acid neutralization was sufficient to buffer acid generation.

Based on the testing completed, some (less than 6%) mine rock extracted through open pit mining will have to be managed as being potentially acid generating (PAG) with metal leaching potential as a precaution, even at very low levels of sulphur. Potential key leachate parameters of pH, aluminum, arsenic, barium, chloride, copper, iron, lead, nickel, selenium, silver, thallium, total dissolved solids, and zinc were identified. The PAG rock will be isolated within the mine rock piles because the potential exists for acidic leachate to occur in some rock to be deposited in the mine rock piles (see also Section 3.7.3.3).

3.7.3.3 Mine Rock Pile Characteristics

Of the approximately 226 Mt of mine rock produced to the end of operations in Year 11, about 143 Mt will be directed to the designed mine rock piles. The remainder will be placed into the mined-out 5034 Pit. A portion of the mine rock will be used in construction and reclamation.

The mine rock will be placed directly on the ground. Detailed stability analyses for typical sections along the mine rock piles have been conducted. Based on the results of the stability analysis, mine rock piles with the following geometric parameters and foundation features will meet the design criteria:

- first bench (bottom) slope: 3H:1V or flatter;
- height of the first bench over the original ground surface: 10 m (from the toe to the crest);
- other slopes above the first bench: 1.33H:1V or flatter;
- height of other benches (slopes) above the first bench: 15 m or less;
- width of each horizontal offset between two adjacent benches: 15 m (from the crest of the lower slope to the toe of the upper slope immediately above);
- maximum height of the mine rock pile: 100 m or less; and
- overall slope of the mine rock pile: 2.4H:1V or flatter.

Slope stability analyses undertaken for the mine rock piles indicate that the margin of stability (factor of safety) is greater than 1.5 at a maximum height of 95 m. The maximum height of the South Mine Rock Pile is currently estimated at 90 m, with the maximum height of the West Mine Rock Pile expected to be about 70 m.

Runoff from the mine rock facilities will be contained in collection ponds and flow to either Area 5 within the WMP or to one of the mined-out pits (i.e., any water running off the mine rock piles will flow through natural drainage channels within the watershed and into the collection ponds).

The mine rock piles will be used from the pre-stripping period through to the end of the mine life. The 5034 Pit will be mined out and will become available for depositing mine rock in Year 5. The sequencing of rock and overburden placement within the South Mine Rock Pile (Area 6) and the West Mine Rock Pile (Area 5) will be in accordance with the following objectives:

- Experience at the Ekati Diamond Mine shows that coarse kimberlite in direct contact with the naturally acidic tundra soils can lead to displacement of low pH bog water, owing to the compression of tundra soils below the pile.
- Any PAG mine rock, as well as any barren kimberlite, will be sequestered within the interior of the mine rock piles in areas that will allow permafrost to develop or will be underwater when Kennady Lake is re-filled. Till from ongoing pit stripping will be used to cover PAG rock placed within the interior of the structure to keep water from penetrating into that portion of the repository. Further, the PAG rock will be enclosed within enough non-AG rock to prevent the active zone (typically 2 m) from extending into the enclosed material. Water runoff will occur on the non-AG rock cover areas. While all the water will not be stopped completely from penetrating a till and non-AG rock envelope, the amounts that may penetrate deeper into the pile are expected to be trapped in void spaces and freeze. Minimal water is expected to penetrate to the PAG rock areas. To confirm that the lower levels remain frozen, temperature monitoring systems will be placed in the mine rock piles as they are being constructed.

From Year 7 onwards, potentially reactive mine rock will be placed within the mined-out 5034 Pit. Closure of the mine rock piles will begin when practical as part of the progressive reclamation program described in Section 3.12.

3.7.4 Processed Kimberlite

The following section provides information on:

- quantity and distribution of PK;
- characteristics of the Coarse PK Pile;
- characteristics of the Fine PKC Facility; and
- geochemical characterization of PK.

3.7.4.1 Quantity and Distribution of Processed Kimberlite

Processed kimberlite is the material that remains after all economically and technically recoverable diamonds have been removed from the kimberlite during processing. The processed kimberlite for the Project will be divided into two streams based on particle size: 1) coarse (including grits) and 2) fines. Coarse and grits are between 0.25 mm and 6 mm, while fines are less than 0.25 mm.

The planned deposition of fine and coarse PK is summarized in Table 3.7-4 and involves the following:

- During the first four years of operation (Years 1 to 4), fine PK will be stored in the Area 1 side of the Fine PKC Facility, located adjacent to the northeast margin of Kennady Lake (Figures 3.5-1 and 3.5-2).
- During Year 6, fine PK will be deposited in the Area 2 side of the Fine PKC Facility (Figure 3.5-3).
- During the course of Year 8 until the end of the mine life, fine PK will be placed in the mined-out Hearne open pit (Figure 3.5-4).
- Coarse PK will be placed on the Coarse PK Pile (Figure 3.5-1). In later years, coarse PK will be used for reclamation of the Fine PKC Facility, and co-disposed with mine rock in the 5034 Pit.
- All PK will be contained within the controlled area of Kennady Lake.

Table 3.7-4 Processed Kimberlite Deposition

Year	Fine Processed Kimberlite (Mt)			Coarse and Grits (Mt)			
	Total	Fine PKC Facility	Hearne Pit	Total	Coarse PK Pile	Reclaim/ Dyke	5034 Pit
1	0.63	0.63	-	1.89	1.89	-	-
2	0.75	0.75	-	2.25	2.25	-	-
3	0.75	0.75	-	2.25	2.25	-	-
4	0.75	0.75	-	2.25	2.15	0.10	-
5	0.75	0.75	-	2.25	1.70	0.55	-
6	0.75	0.75	-	2.25	0.20	0.49	1.56
7	0.75	0.75	-	2.25	-	0.49	1.76
8	0.75	-	0.75	2.25	-	0.49	1.76
9	0.75	-	0.75	2.25	-	0.49	1.76
10	0.75	-	0.75	2.25	-	0.49	1.76
11	0.45	-	0.45	1.35	-	0.49	0.86
Total	**7.83**	**5.13**	**2.70**	**23.49**	**10.44**	**3.59**	**9.46**

Mt = million tonnes; PK = processed kimberlite; PKC = processed kimberlite containment; - = no kimberlite to deposit.

Two alternatives may occur regarding the deposition of PK. Some fine PK may be deposited initially in the mined-out 5034 Pit until the mined-out Hearne Pit is available. Some of the coarse PK may be trucked and placed into both of these mined-out pits.

Fine PK is expected to comprise only 25 percent solids by weight (wt%) of the PK waste streams. PK grits will be dewatered and combined with the coarse PK for a combined weight fraction of 75%. The actual split at any given time will vary due to the variability in the plant feed. It is possible that the upper portion of the ore in the 5034 Pit could be relatively soft at start-up, resulting in fine PK comprising substantially more of the total PK for the first year or more (as was experienced at the Diavik Diamond Mine).

Pumping of fine PK in thickened slurry form (45 to 50 wt%), and dewatering and trucking of the coarse and grits fractions are the optimal means of PK transport for the Project. Coarse and grits PK can be readily dewatered and trucked. However, filtration testing on fine PK samples generated during the ore dressing studies for the Project demonstrated that it could not be effectively dewatered to the extent required to make truck transport and dry stacking of the material feasible. Fine PK must, therefore, be transported by pipeline to the Fine PKC Facility and, later, the mined-out pits as thickened slurry.

3.7.4.2 Coarse Processed Kimberlite Pile

After dewatering, coarse PK will exit the process plant by conveyor and be discharged on the coarse reject stockpile. From here, the coarse PK will be loaded into trucks and hauled to the Coarse PK Pile (Figure 3.5-1). The area adjacent to the planned process facility (Area 4) will be used as the Coarse PK Pile. This pile will be built entirely on land in 5 to 10 m lifts to a maximum height of approximately 30 m. The Coarse PK Pile will have side slopes of 4H:1V and a maximum crest elevation of about 450 metres above sea level (masl).

The design storage capacity of the pile is approximately 5.2 million cubic metres (Mm^3), which is equivalent to the estimated volume of the in-place coarse PK produced up to and including Year 5 of full production. Any excess coarse PK material in later years might be placed in the 5034 and Hearne pits as capacity becomes available.

The Coarse PK Pile will not be designed to have a single point of release for seepage and runoff. Any runoff will flow through natural channels within the controlled area and be retained in the collection pond associated with Area 4, which in later years represents the Tuzo Pit area.

3.7.4.3 Fine Processed Kimberlite Containment Facility

The Area 1 section of the Fine PKC Facility will receive the fine PK slurry produced by the processing plant for the first four years of operation. The design storage capacity for Area 1 will be approximately 3.06 Mt of fine PK.

The density of the fine PK slurry is likely to range from 45% to 50% and could at times be as low as 40% solids by weight. To the extent practical, the slurry will be sub-aerially discharged to maximize the capacity of the Area 1 facility. The facility is designed for substantial ice entrainment.

Area 1 will encompass the lake area that flows into Kennady Lake in the northeast corner, including Lakes A1 and A2. Saddle berms and dykes constructed of overburden till from the 5034 pre-stripping activities will be installed during the construction period to provide platforms for spigot discharge of the fine PK slurry. A saddle dam (Dyke C) will be constructed between Area 1 and Lake A3 to the north. Area 1 will be partially dewatered into Lake A3 after Dyke C is constructed. Dyke C will serve to raise the level of Lake A3 to a point where the Lake A3 outlet will be diverted into Lake N8. Dyke C will also act as the connector to the seasonal winter road to the mine site (Figure 3.5-1).

In Years -1 to 3, mine rock and till overburden from the 5034 Pit pre-stripping will be used to construct Dyke L, a wide mine rock and till causeway across the northern reach of Kennady Lake, effectively separating Area 2 from Area 3. Dyke L will provide filtering capacity reducing the total suspended solids (TSS) concentration of the fine PK decant water into the Area 3 WMP. Overflow water from the Area 1 facility will flow to Area 2 and eventually to the Area 3 WMP through Dyke L.

During operations, the only water to enter the Fine PKC Facility, other than the water contained within the fine PK, will be precipitation. Runoff from the Fine PKC Facility will eventually flow into the WMP through Dyke L.

As Area 1 of the facility is filled, the fine PK slurry pipeline will be extended along discharge berms designed to allow the facility to reach maximum capacity. This will effectively link Areas 1 and 2 into a contiguous facility that is filled sequentially to produce a surface suitable for long-term stability and favourable drainage patterns. The total capacity of both Areas 1 and 2 of the Fine PKC Facility is expected to be 5.5 Mt of fine PK.

While fine PK is being deposited in the mined-out pits (primarily Hearne, but potentially 5034), process water will not be reclaimed from the pits. Instead, the slurry discharge water will be used to accelerate filling of the mined-out pits. This process will facilitate a more rapid re-filling and progressive reclamation of Area 6 within Kennady Lake. Make-up process water will be drawn from site contact water sequestered in the WMP (Area 3) and possibly from mine water inflows to the Tuzo Pit while it is being mined.

3.7.4.4 Geochemical Characterization of Processed Kimberlite

As discussed in Section 3.7.3.2, geochemical characteristics play a critical role in the PK management plans that have been developed for the Project. As with the mine rock, geochemistry of the PK is broadly discussed here in terms of ARD and metal leaching (which can occur independently from acid generation). Detailed environmental geochemistry characterization of the PK waste streams is provided in the Metal Leaching and Acid/alkaline Rock Drainage Report, Appendix 8.II, which is appended to Section 8 of the EIS.

The PK is primarily kimberlite altered to a clay±chlorite±talc±biotite assemblage with lesser inclusions of granitic and basic rock fragments.

Results of the 40 PK samples submitted for geochemical analyses generally have the following characteristics:

- alkaline paste pH values (values of about 8);
- low concentrations of the potentially acid forming minerals total sulphur and sulphide sulphur; and
- substantial excess neutralizing minerals.

For the samples tested, a maximum sulphide concentration of 0.08 wt% sulphide was observed. Based on the DIAND (1992) classification criteria, all of the PK samples are non-acid generating with substantial excess neutralization capacity.

To supplement the classification above, additional longer-term repetitive leaching tests (humidity cell tests) were conducted. These tests are designed to simulate enhanced weathering and provide rates for acid generation, acid neutralization, and metal and major element leaching under laboratory conditions. Based on the eight samples tested, the pH of the PK humidity cell leachate was neutral to alkaline and the samples were not expected to release acidity over time.

Kinetic test results for PK indicated potential key leachate parameters of aluminum, arsenic, barium, chloride, chromium, copper, iron, molybdenum, total dissolved solids, and zinc. Evaluation of the results of supplemental geochemical tests, including process water analysis and submerged column tests, indicates that phosphorous is also a potential key leachate parameter. These parameters were evaluated in the context of the overall site in consideration of proposed mitigation.

3.7.5 In-pit Storage of Mine Rock and Processed Kimberlite

3.7.5.1 Advantages of In-pit Storage

Plans have been developed for disposal of mine rock and PK in the mined-out 5034 Pit and Hearne Pit, respectively. The advantages of backfilling the mined-out pits with PK and mine rock are as follows:

- decreases the on-land Project footprint;
- represents greater physical and geochemical stability compared to on-land storage. Storing unconsolidated material in a container like a pit is much more stable than putting it on the ground because the fine PK and mine rock have fewer migration routes and are easier to contain. Geochemical stability comes from the fact that the material will be deeply submerged;
- reduces the volume of water within the deep pits when Kennady Lake is reclaimed;
- reduces the time required for filling of these portions of Kennady Lake because less water is required to refill the partially backfilled pits; refilling of Kennady Lake during mine operations is, therefore, a form of progressive reclamation; and
- allows for the containment of any poor-quality groundwater flowing into the open pits.

Part of the water management strategy for the Project is to sequester pit inflows in the mined-out pits to the greatest extent practical, while allowing discharge of water from the WMP to Lake N11, provided the water quality is acceptable for release.

3.7.5.2 5034 Pit Backfilling Plan

Backfilling the 5034 Pit should begin sometime during Year 5 by advancing a single-lift mine rock pile southwards from the saddle intersection of the Tuzo pipe, as well as northwards from the south rim of the pit. This will enable haul trucks to begin placing mine rock into the mined out pit. In approximately Year 7, fine PK may be discharged through a pipeline to the pit, prior to being discharged into the Hearne Pit. Coarse PK may also be deposited in the mined out pit beginning in approximately Year 6 (Table 3.7-4).

3.7.5.3 Hearne Pit Backfilling Plan

Backfilling of the Hearne Pit begins in Year 8 as soon as kimberlite mining is completed. The fine PK discharge line will be moved to the Hearne Pit. Hearne is the preferred location for deposition of the fine PK as it avoids the potential for water from the 5034 Pit to infiltrate the Tuzo Pit. The fine PK will be 120 m below the surface of the water once the lake is re-filled.

3.8 SOLID WASTE MANAGEMENT

3.8.1 Introduction

This section describes the management of solid waste other than mine waste at the Project site. Solid waste includes food waste, inert bulk waste, and hazardous waste. Although this section refers to solid waste, specific liquids such as waste oil and glycol are included. This section is divided into two parts:

- waste handling; and
- waste facilities.

3.8.2 Waste Handling

Waste must be sorted at the source before it can be disposed of in, or transported to, specific designated areas for proper disposal. The following are examples of environmental design features and practices that can be used for sorting:

- Separate bins will be located throughout the accommodations complex, service complex, processing plant, shops, and other facilities on-site for immediate sorting of domestic waste.
- Bins and dumpsters will be located at each major facility for the collection of burnable and non-burnable materials and recyclable wastes such as scrap metal, timber, tires, and unsalvageable equipment.

Food wastes will be collected from the food waste bins in the accommodations complex, service complex, and other facilities and immediately placed and sealed in plastic bags. The plastic bags will then be stored in sealed containers at each facility before transport directly to the incinerator storage area for immediate incineration.

Non-toxic, non-food solid wastes will be sorted into four types: combustible, non-combustible, recyclable, and reusable. Combustible items will be burned in the incinerator (if suitable for disposal), while non-combustible items will be placed in the designated landfill area or recycled if practical. Aerosol cans will be punctured and drained prior to disposal. Inert bulk wastes that cannot readily be recycled or re-used, such as general debris or incinerator ash, will be transferred to the landfill.

Toxic materials will be stored in sealed steel or plastic drums in the waste transfer area and shipped off-site for proper disposal. All other hazardous, non-combustible waste and contaminated materials not identified above will be temporarily stored in the waste storage transfer area in sealed, steel, or plastic drums, and shipped off-site for disposal or recycling. Waste oil will be collected and stored in the waste oil storage tank and subsequently incinerated for heat generation (if not shipped off-site for recycling).

Chemicals such as waste oil, glycol, acids, solvents, battery acids, and laboratory agents will be collected in lined trays and drums and stored in suitable sealed containers in the waste transfer area. Chemicals other than waste oil that cannot be incinerated will be shipped off-site for disposal or recycling. Some of the waste will be transferred to the Yellowknife Solid Waste Site. Other recyclable waste such as waste oil, glycol, and batteries will transferred to waste facilities outside the NWT.

3.8.3 Waste Facilities

Five on-site waste management areas will be used to contain and store solid wastes:

- a waste transfer storage area;
- a landfill for inert solid wastes;
- a landfarm for petroleum-contaminated soils (constructed as required);
- incinerators for combustible waste and waste oil; and
- a domestic sewage treatment plant.

Waste Transfer Storage Area: The waste transfer storage area will be established for the handling and temporary storage of wastes. Non-food waste products that are not incinerated or placed in the landfill immediately will be collected, sorted, and placed in designated areas within the storage area. The waste transfer storage area will include a lined and enclosed pad for the collection and subsequent return of hazardous waste to suppliers or to a hazardous waste disposal facility.

The waste transfer storage area is part of the fuel, lube, and glycol storage area. Any waste petroleum products (and glycol) that is not burned in the auxiliary boiler will be stored here for later disposal. This area is bermed and lined. Bulk liquid materials will have dedicated tankage; empty oil and grease drums, lube cubes, and other bulk product containers will also be stored. There will be separate depository bins and/or drums for oil filters and used batteries within the bermed area. Bins for other hazardous materials requiring offsite disposal will be provided. Other than used glycol, filters and grease containers, and batteries, minimal hazardous waste materials requiring offsite disposal are expected. Specialized bins and/or containers may also be used. Use of airfreight backhaul will be used to transport smaller scale items (e.g., drums of used oil filters) offsite on a regular basis.

All inert material of insufficient value including used tires will be placed in the landfill. Inert materials of sufficient salvage value will be stored in laydown areas for return and sale.

Landfill: The active landfill will be located within a small area of the mine rock piles or Fine PKC Facility that will be above the level of the refilled Kennady Lake at closure. As the mine rock piles and Fine PKC Facility advance in height and size, the location of the active landfill will change. The landfill will receive inert bulk waste that cannot be recycled or re-used such as conveyor belts, tires, chute liners, and building debris, as well as incinerator ash from the combustion of kitchen and office waste.

Landfill waste will be buried to minimize exposure to wind and care will be taken to prevent the inclusion of wastes that could attract wildlife. The landfill in the mine rock piles will represent a single landfill in operation at any given time, which likely will be covered and buried from year to year to coincide with the mine rock pile developments.

Landfarm: A landfarm for the bio-remediation of hydrocarbon-contaminated solids from spills may be constructed depending on the need. This dyke bounded cell would be located adjacent to the fuel storage area and would consist of an arctic geo-membrane liner placed under fill material. Hydrocarbon-contaminated soils would be placed in the landfarm and spread during summer months. Any soil that has subsequently reached acceptable levels of hydrocarbon degradation would be removed and reused, or transferred to the landfill.

Arctic conditions when combined with the type of contaminated soil may impede the remediation of contaminated soil through natural microbiological processes. If remediation of hydrocarbon-contaminated soils in the landfarm proves to be ineffective and no other remediation system has proved effective in northern climates, the contaminated soils will be collected and shipped to suitable disposal facilities in Alberta.

Incinerators: Two dual-chamber, diesel-fired incinerators will be provided for the incineration of combustible waste, including kitchen waste. The incinerators can also be used to burn waste oil. Incinerator ash will be collected in sealed, wildlife-resistant containers, and transported to the landfill.

Each modular unit will be pre-assembled and will be housed in a pre-engineered module located near the accommodation complex. The facility will be capable of meeting the demand of the construction workforce housed in the permanent camp.

Domestic Sewage Treatment Plant: A modular sewage treatment system to handle a peak load of 432 people will be provided as part of initial construction. Treated effluent will be discharged to Area 3 of Kennady Lake initially and later, during operations, added to the fine PK slurry pipeline. The sewage sludge will be dewatered and disposed in the landfill on site. If possible, the sludge may be composted or used as a soil treatment.

3.9 WATER MANAGEMENT

3.9.1 Introduction

Water management is a key component of the Project because the diamond bearing kimberlite pipes are mainly located under Kennady Lake. The key water-related activity that will take place during the Project will be the dewatering of Areas 2 to 7 of Kennady Lake and Lake A1, and the subsequent re-filling of Kennady Lake. Isolating water that may come in contact with the disturbed area of the Project site by diverting inflows and damming outflows to create a controlled system that is isolated from the surrounding watersheds except for licensed discharges is also key to the Water Management Plan. The following section provides a summary of the Water Management Plan that has been developed for the Project.

The Water Management Plan will isolate within the controlled area boundary (Figure 3.2-2) eight major sub-watershed areas. Area 1 is located northeast of Kennady Lake and includes Lake A1 and Lake A2, while Areas 2 to 8 are within Kennady Lake (Figure 3.9-1). Area 8 is a sub-watershed of Kennady Lake, but it is outside the controlled area boundary. Construction of perimeter and internal water retention dykes is expected to begin during the construction phase and continue through the operations phase, as required.

The key objectives of the water management plan are to:

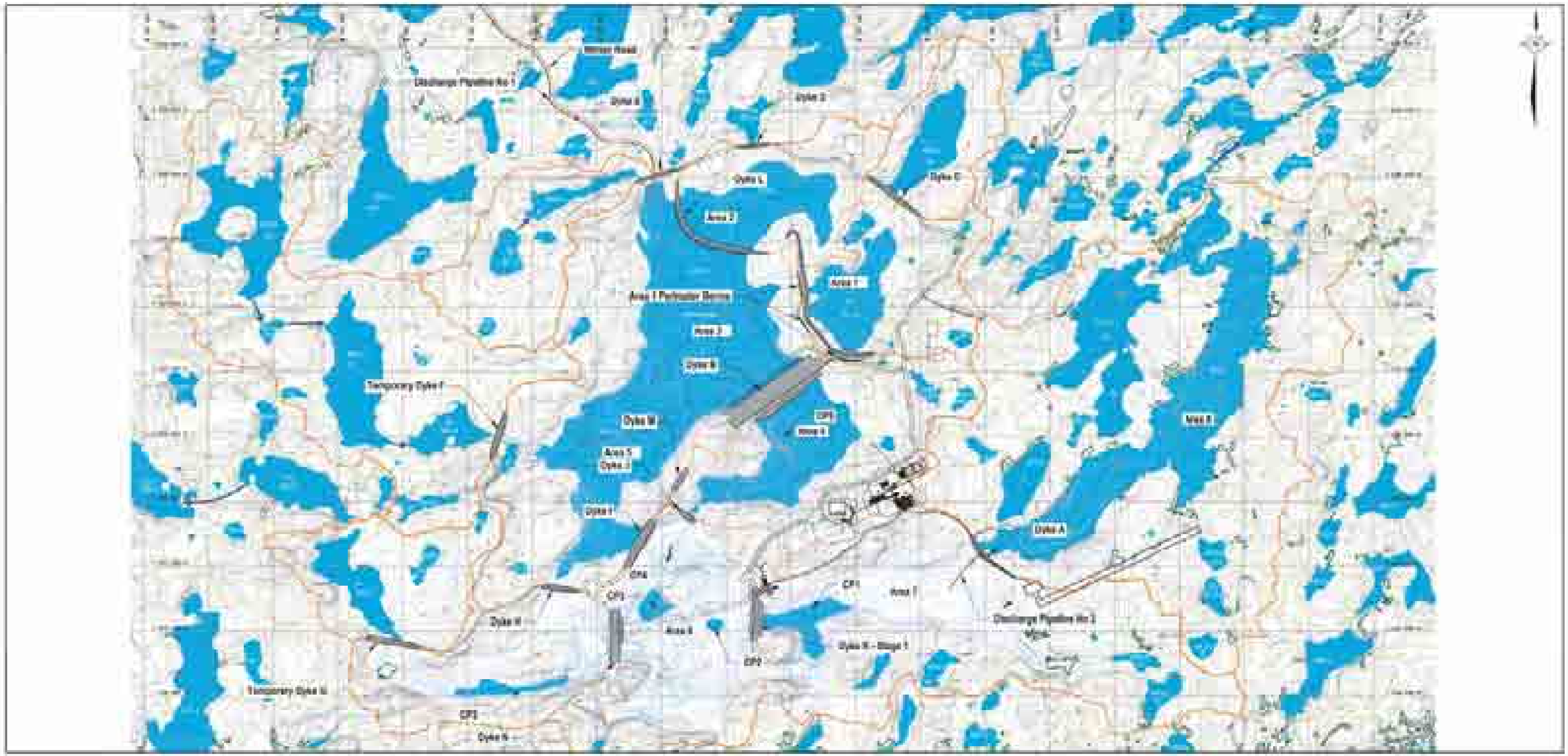
- minimize the amount of water requiring discharge to downstream receptors during the initial dewatering period;
- manage mine water to minimize water quality impacts within the WMP during the closure and post-closure periods; and
- manage waters within the Kennady Lake catchment area until the water quality is suitable for release, marking the transition to the post-closure period.

The Water Management Plan is also discussed in terms of the following time periods:

- Initial dewatering phase – Years -2 to -1 (2013 to 2014) – Kennady Lake is drawn down to increase available capacity and facilitate dyke construction; water is discharged to Lake N11 and Area 8;
- Operational phase – Years 1 to 11 (2015 to 2025) – water is diverted from mine pits and lake areas to the WMP; water is discharged from the WMP to Lake N11, as necessary.
- Closure phase – Years 12 to 20 (2026 to 2034) – water is transferred from the WMP to Tuzo Pit and Kennady Lake is refilled from natural drainage and water pumped from Lake N11; and
- Post-closure – Years 21 (2035) onwards – Kennady Lake receives only natural drainage and releases water to Area 8.

This section is organized chronologically to address water management through construction, operations, and closure (including refilling the remainder of Kennady Lake). Therefore, the following text provides information on:

- diversion of A, B, D, and E watersheds;
- dykes required for water management;
- dewatering of Kennady Lake;
- fresh water supply and distribution;
- water management during operations;
- water management during closure, including re-filling of Kennady Lake; and
- water balance for the Project.



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

Winter Road

Discharge Pipeline

NOTES
Base data source: EBA Figure 4.2 - Stage 1 - Initial Lake Dewatering (June-July, 2013)

GAHCHO KUE PROJECT

Water Management Areas, Dykes, Collection Ponds, and Lakes Associated with the Project

PROJECTION: UTM Zone 12	DATUM: NAD83
P-Other-009-CAD	November 2, 2010
JOB No.: 09-1365-1004	REVISION No.: 3
OFFICE: GOLD - SAS	DRAWN: AJL/TAH · CHECK: AW

Figure 3.9-1

3.9.2 Diversion of A, B, D, and E Watersheds

The Fine PKC Facility will be located in the A watershed and the northeast embayment of Kennady Lake, which are identified as Areas 1 and 2, respectively. Area 1 includes the majority of the A watershed (i.e., Lakes A1 and A2) that drains into Kennady Lake in the northeast corner, but excludes Lake A3. Lake A3 will be isolated from Lakes A1 and A2 through the construction of a permanent saddle dam (Dyke C) between Area 1 and Lake A3 to the north (Figure 3.9-1). Dyke C will serve to raise the level of Lake A3 to a point where the Lake A3 outlet will be permanently diverted into Lake N9. Lake A1 will be partially dewatered into Lake A3 after Dyke C is constructed.

To reduce surface inflows to Kennady Lake, a portion of the Kennady Lake watershed (watersheds B, D, and E on the west side of Kennady Lake) will be isolated or diverted, so that the runoff from these watersheds is directed away from Kennady Lake. The diversion system will rely on temporary, earth-filled dykes that will be placed across the outlets of the B, D, and E watersheds. Runoff from the B, D, and E watersheds will be diverted to lakes in the N watershed. To prevent fish in upstream dyked watersheds from being isolated, access for migration will be provided along natural or modified channels to allow fish movement into other lakes.

3.9.3 Dykes for Water Management

The number of dykes built to isolate water that may come in contact with the disturbed areas of the Project from the surrounding watersheds will ultimately depend on fish habitat requirements. The fish habitat enhancement plan may be able to take advantage of the dykes because the dykes could also be used to create more flooded area outside the controlled area boundary. A “base case” (i.e., the Project without this plan) is presented within this section. An overview of the fish habitat enhancement plan presented in Section 3.12.

For the base case, fourteen dykes will be built to achieve the controlled area boundary for the Project site (Table 3.9-1 and Figure 3.9-1). Perimeter dykes around Areas 1 to 7 will include Dykes A, C, D, E, F, and G. Several of these dykes (e.g., Dykes C, E, F, and G) will be constructed to divert water away from Kennady Lake. The diversions are required to reduce the volume of runoff entering the controlled areas (i.e., Areas 1 to 7) of Kennady Lake. Internal water retention dykes will include Dykes B, H, I, J, K, M, and N. Dyke L will serve as a filter dyke between Areas 2 and 3. Table 3.9-1 provides a summary of the characteristics of each dyke.

Table 3.9-1 Characteristics of the Dykes Required for the Project Base Case

Dyke	Construction Year (approximate)	Dyke Type and Consequences	Characteristics of Dyke	Fate of Dyke
A	Year -2 (2013)	perimeter, retention/diversion dyke separating Area 7 and Area 8	- a soil-bentonite slurry cutoff wall through a till fill zone placed over the overburden and the overburden to the bedrock surface has been adopted as the main seepage control measure - cut-off wall will be protected by a downstream filter zone and a mine rock shell zone - construction material is anticipated to involve either crush rockfill with bentonite (by weight) or sand and gravel with bentonite	- breach in about Year 19 or once the water quality in the restored lake basins in Areas 1 to 7 meets discharge criteria
B	Year 4 and 5 (2018 to early 2019)	internal water retention dyke that separates Areas 3 and 4 allowing dewatering of the southern portion of Area 4 so the Tuzo Pit can be mined	- 850 m long - a wide till core has been selected as the main seepage control design - an upstream mine rock berm and a downstream coarse PK berm will provide confinement to the wide till core materials placed between the two berms - seepage through the dyke will be collected in the water collection pond CP6 and the sumps in Tuzo Pit	- portion of the dyke crest will be excavated down to create a temporary spillway for extra runoff water during early years of mine closure - breach in Year 11
C	Before Year -1 (2014) spring freshet	permanent water diversion dyke to divert runoff water from the catchment area of Lakes A3 and A4 and to allow the dewatering of a portion of Area 1 into Lake A3	- seepage control includes a liner keyed into competent frozen ground (saturated inorganic permafrost) or bedrock	- permanent
D	Before Year 2 (2016) spring freshet	water retention dyke to prevent water in Area 2 from flowing north into Lake N7 during the late stage of mine operation	- seepage control includes a liner keyed into competent frozen ground (saturated inorganic permafrost) or bedrock	- permanent

Table 3.9-1 Characteristics of the Dykes Required for the Project Base Case (continued)

Dyke	Construction Year (approximate)	Dyke Type and Consequences	Characteristics of Dyke	Fate of Dyke
E	Before Year 1 (2015) spring freshet	water diversion dyke initially and then a water retention dyke during the late stage of mine operation; to allow backflow from Lake B1 to Lake N13 in the N watershed	- seepage control includes a liner keyed into competent frozen ground (saturated inorganic permafrost) or bedrock	- breached after Year 11
F	Before Year -1 (2014) spring freshet	temporary diversion dyke to minimally raise the level of Lake D2	- seepage control includes a liner keyed into competent frozen ground (saturated inorganic permafrost) or bedrock	- temporary – structure removed at completion of operations
G	Before Year -1 (2014) spring freshet	temporary water diversion dyke to divert runoff water from the catchment of Lakes E1 to E3	- seepage control includes a liner keyed into competent frozen ground (saturated inorganic permafrost) or bedrock	- temporary – structure removed during closure
H	Stage 1 = Year -2 (2013) Stage 2 = prior to Year 3 (2017)	internal water retention dyke to separate Areas 5 and 6	- Stage 1 construction = placement of fill when water level in Area 6 is lowered to expose lakebeds - Stage 2 construction = additional till added prior to Year 3 - a wide till core has been selected to control seepage - seepage will be collected and pumped back to the source reservoir as required	- permanent
I	Stage 1 = Year -2 (2013) Stage 2 = prior to Year 3 (2017)	internal water retention dyke to separate Areas 5 and 6	- Stage 1 construction = cofferdams constructed underwater followed by placement of fill when water level in Area 6 is lowered to expose lakebeds - Stage 2 construction = additional till added prior to Year 3 - a wide till core has been selected to control seepage - seepage will be collected and pumped back to the source reservoir as required	- permanent
J	Stage 1 = Year -2 (2013) Stage 2 = prior to Year 3 (2017)	internal water retention dyke to separate Areas 4 and 6	- Stage 1 construction = cofferdams constructed underwater followed by placement of fill when water level in Area 6 is lowered to expose lakebeds - Stage 2 construction = additional till added prior to Year 3 - a wide till core has been selected to control seepage - seepage will be collected and pumped back to the source reservoir as required	- dyke will be lowered to limit net fish habitat losses

Table 3.9-1 Characteristics of the Dykes Required for the Project Base Case (continued)

Dyke	Construction Year (approximate)	Dyke Type and Consequences	Characteristics of Dyke	Fate of Dyke
K	Stage 1 = Year -1 (2014) Stage 2 = Year 5 to 6 (2019 to 2020)	internal water retention dyke	- Stage 1 construction will serve as a portion of the haul road from Hearne Pit to the West Mine Rock Pile and will be constructed using overburden materials from Hearne Pit - a wide till core has been selected as the main seepage control design - seepage will be collected and pumped back to the source as required	- portion of the dyke crest will be excavated down to create a temporary spillway for extra runoff water during early years of mine closure - breach in Year 11
L	Stage 1 = Year -1 (2014) Stage 2 = prior to Year 3 (2017)	curved filter dyke to retain the particles of fine PK placed in Areas 1 and 2 while allowing sufficient filtered water to pass through the dyke from Area 2 to Area 3	- 1,070 m long - construction involves a lower portion of fill placed under water and mine rock benches within both side slopes for slope stability - processing from hard, durable, non-acid generating rock will be required to achieve the particle size gradation required for the filter - construction material will be free of roots, organics and other materials not suitable for construction	- a section of dyke crest close to the northwest abutment will be lowered down to create a drainage path across the dyke
M	Prior to Year 3 (2017)	internal water retention dyke	- a wide till core has been selected to control seepage - seepage will be collected and pumped back to the source as required	- permanent
N	Stage 1 = Year 4 (2018) Stage 2 = Year 9 (2023)	internal water retention dyke	- Stage 1 construction will serve as a portion of the haul road from 5034 Pit to the South Mine Rock Pile and will be constructed using overburden materials from 5034 Pit - a wide till core has been selected to control seepage - seepage will be collected and pumped back to the source as required	- portion of the dyke crest will be excavated down to create a temporary spillway for extra runoff water during early years of mine closure - breach in Year 11

A quality assurance program will be implemented during construction of each of the dykes so that design specifications for those parts of the dykes that require engineered materials and/or specialized placement are achieved. The specific requirements and testing frequencies for the quality assurance process will be set out in the construction specifications prepared during final designs.

Performance monitoring is an integral part of the operation of any water retention structure, particularly in an arctic environment. The performance of the dykes will need to be monitored throughout their construction and operating life. Instrumentation together with systematic visual inspection can provide early warning of many conditions that can contribute to dyke failures and incidents. Detailed instrumentation requirements for each dyke and berm will be specified in the final design of the dykes and berms. The types of instruments may include piezometers, thermistors, and survey monitoring markers.

3.9.4 Dewatering of Kennady Lake

The objective of the dewatering program will be to drain Areas 2 to 7 of Kennady Lake to at least 50% of capacity by initial discharge of clean water to designated receiving points. Areas 2 to 5 will be dewatered to the maximum extent possible. After this initial dewatering, Areas 6 and 7 will be isolated and drained completely into Areas 2 to 5. Fish salvage will be conducted to remove fish from Areas 2 to 7 before and during dewatering.

3.9.4.1 Infrastructure Required for Dewatering of Kennady Lake

Before dewatering can take place, various dykes will be built to both divert runoff water from Kennady Lake and later retain water affected by the Project within Areas 1 to 7 (see Section 3.9.2). A critical activity during the initial construction will be the construction of Dyke A at the narrows separating Area 7 and Area 8. Area 8 represents the eastern section of Kennady Lake that will remain at the existing lake elevation (Figure 3.9-1).

Dyke A will be constructed in two stages. Initially, a temporary crossing structure will be placed in the narrows between Area 7 and Area 8 to provide access to the airstrip. The temporary dyke will become part of the permanent Dyke A, forming part of the dyke's shell. The initial dewatering will commence following completion of Dyke A, which will isolate the majority of Kennady Lake from Area 8.

As the level of water in Areas 2 to 7 decreases, the sills separating the northwest portions of the lake (Areas 2 to 5) from the areas above the 5034 and Hearne ore bodies (Areas 6 and 7) will be exposed. Internal water retention dykes will be constructed isolating the northern portion of the lake (Area 2 to 5) from the southern portion of the lake (Areas 6 and 7), effectively splitting the partially dewatered lake into two major sections and allowing the complete drainage of the remaining water from Areas 6 and 7 into the northern part of the basin.

If necessary, water in Areas 6 and 7 will be treated in-line as it is pumped to the WMP (Areas 5 and 3) for flocculation and settling in the WMP before being subsequently discharged to Lake N11. All other site waters, such as dewatering discharge from the Fine PKC Facility (Areas 1 and 2) and Area 4, will report to the WMP to be pumped to Lake N11 during the initial dewatering period.

A pervious dyke may be constructed within Area 5, if required, to assist settling of treated water pumped from Areas 6 and 7. The dyke would consist of the north-eastern edge of the West Mine Rock Pile (toe of the pile) and be constructed of mine rock. The dyke would create a calm area to reduce any impacts of northerly winds in the settling zone for flocculated sediments to settle. More specifically, if the wind direction aligns with the long fetch from Area 3 and causes increased wave heights, the dyke would be constructed to reduce the effect of the wind and limit waves. This settling area would also contain flocculated sediments within the area that will eventually be covered by the West Mine Rock Pile.

3.9.4.2 Quality and Quantity of Water from Kennedy Lake

Initially, the water from Kennady Lake will be discharged without water treatment. Previous experience at Diavik Diamond Mine and Ekati Diamond Mine has shown that water from the upper portion of the lake will meet regulatory requirements for the total suspended solids concentration in the discharged. It is anticipated that more than half the water in Kennady Lake (about 17 Mm^3) can be pumped out without water treatment.

During the first phase of dewatering, the surface water would be pumped via pipeline at the maximum rates to two principal locations simultaneously:

- Area 8 of Kennady Lake, which is the natural outlet for Kennady Lake; and
- Lake N11 in the N watershed (Figure 3.9-1).

The projected maximum water flow to Area 8 will be 114,000 cubic metres per day (m^3/d). The N watershed, located north of the Kennady Lake watershed, is larger and capable of accepting more water than the Kennady Lake watershed.

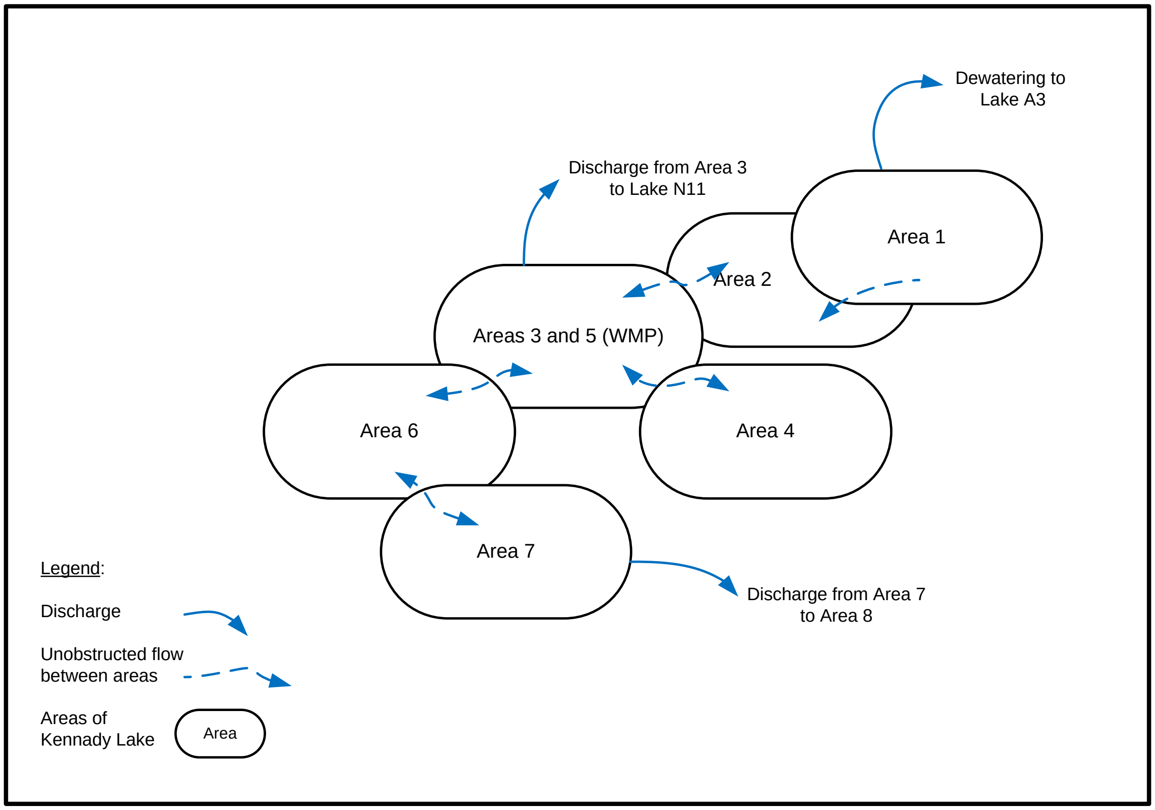
Water can be pumped to Lake N11 at the rate of 500,000 m^3/d, without potential erosion damage to the Lake N11 outlet and downstream watercourses.

The water will be proportioned between Area 8 and the adjoining northern watershed to eliminate erosion concerns and associated effects on fisheries. Discharge flow rates to Area 8 and Lake N11 will be restricted to one-in-two year flood levels, except at outlets where there is sufficient protection. This maximum pumping rate to Lake N11 will depend on the discharge from the N1 outlet (downstream of Lake N11), and will occur only if the discharge from the N1 outlet does not exceed the one-in-two-year peak discharge.

The potential for erosion of lake-bottom sediments in Area 8 and Lake N11 will be reduced during dewatering pumping with the use of diffusers on the discharge pipe outlets. These diffusers will be placed close to the lake surface at the discharge points in Area 8 and Lake N11 to increase the distance between the outfall and the bottom sediments. The discharge point will also be located in relatively deep sections of the receiving waters. Although some sediment may be mobilized despite these measures, the extent of any effect is likely to be limited to the area immediately adjacent to the diffuser. It will quickly diminish with distance from the outfall.

The dewatering of Kennady Lake will continue from Area 7 to Area 8 and from Area 6 into the WMP and then into Lake N11 (Figure 3.9-2) until TSS in the Kennady Lake water increases to a level that no longer meets the regulatory requirement for the discharge quality. As water levels in Kennady Lake decrease, sediment from the lake bottom may become suspended in the water. Once a threshold TSS concentration is reached, discharge from Area 7 to Area 8 will no longer be possible. All the water pumped out of Kennady Lake from this point onwards will be released into Lake N11 at a maximum discharge rate of 500,000 m^3/d.

Figure 3.9-2 Diagram of Initial Dewatering during Construction



WMP = Water Management Pond.

During the second phase, the excess capacity of the partially dewatered northern portion of Kennady Lake (Areas 2 to 5) will be used to settle and/or store water unsuitable for release directly to the natural watershed. Flocculant may be added as required to reduce TSS. More specifically, the water transferred to the south end of Area 5 from Areas 6 and 7 will have in-line flocculation to promote settling of suspended solids in the part of Area 5 that will eventually be covered by the West Mine Rock Pile. In-line flocculation is expected to allow for continued discharge of water from Area 2 to the environment. It is expected that water from Area 2 will contain sufficiently low levels of TSS that pumping to Lake N11 can continue until the region above the 5034 and Hearne ore bodies in Area 6 and 7 is dry and available for mining.

Sediment from the lake bottom can also become suspended due to wave action on the exposed shorelines as the water level in Kennady Lake is lowered. Areas 2, 3, and 5 will be dewatered to the maximum extent possible; however for planning purposes, it is estimated that, at a minimum, a 2 m drawdown can be achieved before suspension of lake-bottom sediments would result in TSS levels in Areas 2, 3, and 5 that are too high to discharge to Lake N11. If possible, the water level will be drawn down further.

3.9.4.3 Water Monitoring During Dewatering

Lake dewatering discharge will be sampled regularly to monitor for compliance with TSS discharge limits specified by the Mackenzie Valley Land and Water Board in the water license, which will be required before the Project can operate. Monitoring data will be used to identify the water level in the lake needed to minimize the suspension of lake-bottom suspended solids.

Any water not meeting the discharge limits will be stored within the controlled area boundary of the Kennady Lake watershed.

3.9.5 Fresh Water Supply and Distribution

Fresh water for potable consumption will be drawn from Area 8. About 60,000 cubic metres per year (m^3/y) of fresh water will be required for potable water during construction. During operations, with a smaller workforce, the potable water required will decrease to about 27,000 m^3/y.

The freshwater intake and pumphouse will be located on the north western shore of Area 8. The intake will consist of vertical filtration wells fitted with vertical turbine pumps that supply water on demand. The intake will be connected to the pumphouse with piping buried under a rockfilled embankment. The embankment will act as a secondary screen to prevent fish from becoming entrained.

Fresh water will be pumped through an overland pipeline to the freshwater storage tank in the accommodations complex, and will be chlorinated before distribution as potable water. The freshwater pipe will be insulated and heat-traced. Potable water will be monitored according to NWT health regulations for total and residual chlorine and microbiological parameters. Treated water will be piped to areas in the process plant and truck shop requiring potable water and to the accommodations and service complexes. Insulated pipes will distribute water through the utilidors between the plant, service complex, and the camp. Potable water will be trucked to washrooms in satellite areas as needed.

Water for additional plant site fire suppression capacity will be pumped from the process plant storage tank through a pressurized system to adjacent areas of the plant, and to the accommodations and service complexes, the power plant and the utilidors. The volume of water and duration of flow in the pressurized system will be standardized to national fire codes. An adequate volume of water will be maintained in the tank for availability in the event of a fire.

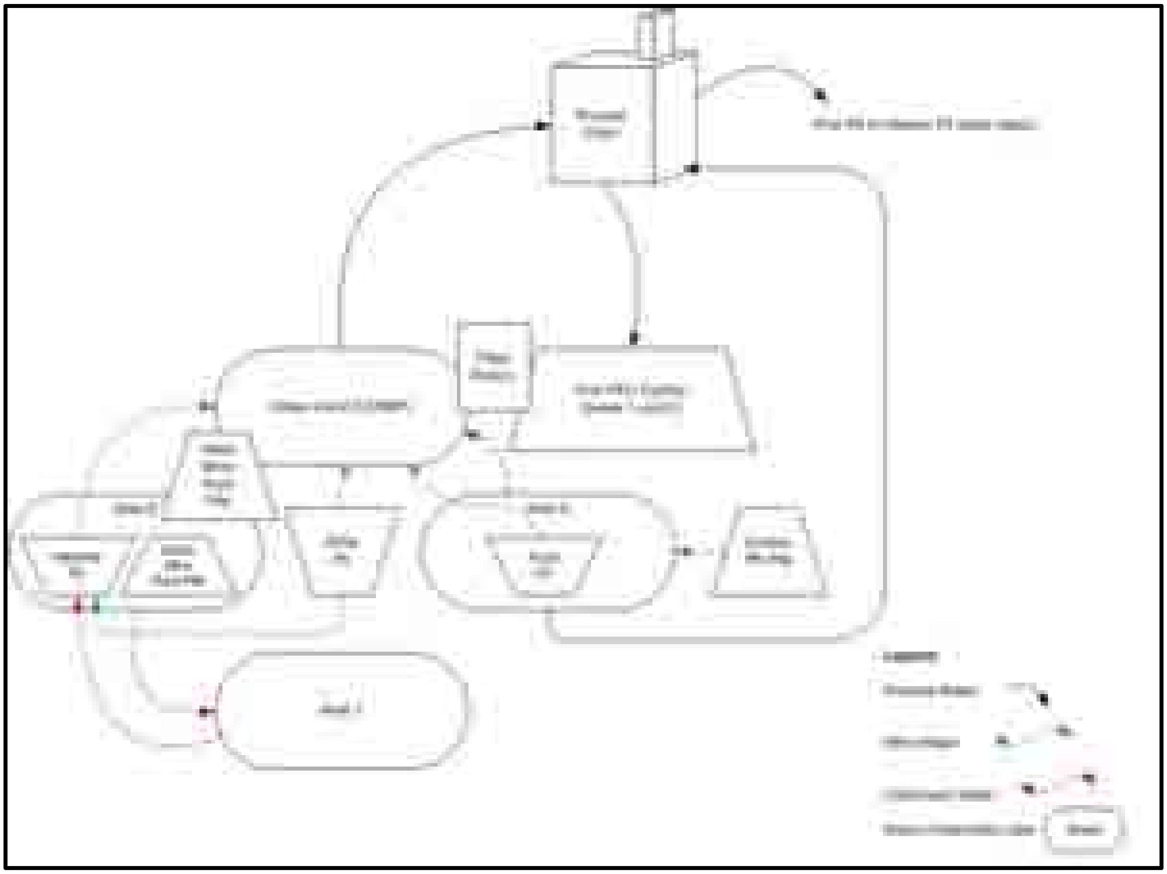
3.9.6 Water Management During Operations

The key objective of the Water Management Plan during operations is to minimize the discharge of site water to downstream receptors by using the mined-out open pits (e.g. 5034, Hearne, and Tuzo pits) for additional mine rock, PK, and mine water storage. As such, the Water Management Plan and associated routing of mine water during the operational period is sequenced to coincide with open pit development. Water management during operations will involve a variety of tasks including:

- recycling water to the processing plant;
- containing and managing runoff and dyke seepage;
- managing groundwater from the open pits; and
- dewatering Kennady Lake above the Tuzo Pit.

These items are described in greater detail in the following sections and water flows are illustrated in Figure 3.9-3.

Figure 3.9-3 Diagram of Water Management in Operations Phase



WMP = Water Management Pond; PKC = processed kimberlite containment; PK = processed kimberlite.

3.9.6.1 Water Management Pond

During construction and operations, a WMP will be developed in Areas 3 and 5 with a maximum storage capacity of 18.8 million cubic metres (Mm^3). The WMP will collect and store water from the following sources during the operational period:

- Fine PKC Facility (Areas 1 and 2) drainage through filter Dyke L;
- runoff and seepage from the West Mine Rock Pile;
- Area 4 open water drainage (including runoff and seepage from the Coarse PK Pile) prior to the construction of Dyke B;
- water pumped from Areas 6 and 7 during dewatering of Kennady Lake, which will include runoff and seepage from the South Mine Rock Pile;
- open pit inflows;
- treated effluent discharge from the sewage treatment plant;

- process water; and
- disturbed and undisturbed site runoff.

The WMP will be the primary reservoir for storage of site water. During mining of the 5034 and Hearne pits, the WMP will supply plant process makeup water to the process plant, which will be pumped to a process water tank located in the plant.

Should water within the WMP meet discharge criteria, excess water in the WMP, including seasonal melt water, will be pumped to Lake N11.

3.9.6.2 Site Runoff Control

Site runoff will flow naturally to the dewatered areas of Kennady Lake that will act as collection ponds for storage of water. Water flows can be managed within these areas. Natural drainage patterns will be used, where practical, to minimize the use of ditches or diversion berms.

3.9.6.2.1 Ponds in Dewatered Lake Bottom

Ponds in dewatered Areas 6 and 7 are shown in Figure 3.9-1. Several natural collection ponds will remain within Areas 6 and 7 following their dewatering. These ponds will collect runoff from natural catchments located along the southern face of the former Area 6 and 7 shorelines. Site runoff from the southern portion of the processing plant area will also flow naturally to these ponds.

Up to Year 6, runoff into the Area 6 and 7 collection ponds will be pumped through an in-line treatment system to Area 5 of the WMP. Starting in Year 6, the runoff from the collection ponds will be pumped to Area 7 until mining is completed in the Hearne Pit. Then, this runoff will flow to the mined out Hearne Pit. The 5034 Pit will capture precipitation and groundwater within its footprint.

3.9.6.2.2 Mine Rock Piles

Mine rock will be stored at two locations during operations: the West Mine Rock Pile and the South Mine Rock Pile. The West Mine Rock Pile will be constructed within the catchment of the WMP at the watershed divide with Area 6. Seepage and runoff from this facility will flow to the WMP. To minimize the amount of seepage flowing to the dewatered Area 6 from the West Mine Rock Pile, Dykes H and I will be constructed along the southern and eastern limits of the facility, respectively.

The proposed footprint of the South Mine Rock Pile is located immediately south of Area 6. All runoff and seepage from this facility will flow to the Area 6 collection pond (CP2), where it will be subsequently pumped to the WMP, Area 7 or the mined out Hearne Pit, depending on the operational year.

Runoff from the mine rock piles will flow and/or be directed as described below:

- Runoff from the eastern face and along the northern perimeter of the West Mine Rock Pile will flow directly to Area 5.
- Runoff from the western perimeter of the West Mine Rock Pile will either flow along the mine rock pile to Area 5 or percolate into the mine rock pile.
- Minor runoff from the southern perimeter of the West Mine Rock Pile will flow into the Hearne Pit, which will have pit sumps that will be pumped out periodically to the process plant.
- Runoff from the South Mine Rock Pile will flow to, and be contained within, the Area 6 dewatered lake bottom collection ponds.

No substantial runoff and seepage from the mine rock piles is expected.

3.9.6.2.3 Coarse Processed Kimberlite Pile

The Coarse PK Pile will be located immediately east of Area 4. The Coarse PK Pile will not be designed to have a single point of release for seepage and runoff. Any runoff and seepage will flow through natural channels to Area 4, where it will initially flow to the WMP when there is an open water connection between Areas 3 and 4 in Kennady Lake. Following the completion of Dyke B and dewatering of Area 4, Coarse PK Pile runoff and seepage will flow to the Area 4 collection pond (CP6) and subsequently be pumped to the WMP.

3.9.6.2.4 Fine Processed Kimberlite Containment Facility

A filter dyke (Dyke L) will be constructed to separate the Fine PKC Facility from Area 3 (Figure 3.9-1). During the initial years of operations, surface runoff, seepage, and liberated process water from fine PK deposited into Area 1 is expected to flow to the WMP via Area 2. As fine PK deposition expands into Area 2, runoff, seepage and liberated process water will flow to Area 3 of the WMP via filter Dyke L. Fine PK deposition will be redirected to the mined out Hearne Pit following the cessation of mining in this pit.

3.9.6.2.5 Airstrip

The airstrip has a total surface area of 150,000 square metres (m^2). Because of the topography, runoff from approximately 50% of the airstrip surface will flow naturally to Area 7 of Kennady Lake. Filter cloth silt fences will be used in the natural drainage courses to remove sediments. These sediment traps will be cleaned out as required. For the remaining 50% of airstrip surface, similar silt fences will be used in natural and enhanced surface drainage courses as runoff will eventually flow to Area 8.

3.9.6.3 Managing Groundwater from Open Pits

During operations, groundwater flowing into the open pits is expected to range from a minimum of about 770,000 cubic metres per year (m^3/y) at the end of construction (Year -1) to about 1,500,000 m^3/y in Year 6 when total inflow to the open pits reaches a maximum. After Year 7, the gradual refilling of the 5034 Pit and Hearne Pit will reduce the hydraulic gradients, resulting in a decreased groundwater inflow to these open pits. The additional groundwater production is expected to require water release from the site during open water seasons until Year 11 of operations.

Table 3.9-2 provides a summary of the estimated rates of passive inflow to the pits during mine operations. These values were used in the water balance presented in Section 3.9.8.

Table 3.9-2 Estimated Annual Rates of Passive Inflow to Pits

Year	Calendar Year	Estimated Passive Inflow to Pit (m^3/d)		
		5034	Hearne	Tuzo
-1	2014	2,100	-	-
1	2015	2,300	-	-
2	2016	2,100	-	-
3	2017	2,400	-	-
4	2018	2,600	400	-
5	2019	2,500	800	600
6	2020	2,200	1,200	800
7	2021	1,200	1,400	1,100
8	2022	1,400	700	1,800
9	2023	1,400	300	2,100
10	2024	1,400	100	2,200
11	2025	1,400	50	2,400

During the operational period, groundwater flowing into the open pits will be pumped to the WMP, where it will be recycled to the process plant, used for dust suppression or pumped to Lake N11. Dewatering of open pits to the WMP will cease when mining is complete in the Hearne Pit in Year 7. Thereafter, the Tuzo Pit will be the only active pit, and water captured in the Tuzo collection pond will be directed to the process plant to supplement process water requirements. It is expected that groundwater may continue to flow into the open pits during the winter. A system of ditches and sumps will be constructed, maintained, and upgraded throughout the operation phase of the Project.

In Year -1, the open pit dewatering system for the 5034 Pit will be installed. Because some limited overburden removal may also occur in Hearne Pit in the next year, a pit dewatering system will be installed prior to the start of full-scale mining. The purpose of the dewatering system is to remove any precipitation and surface runoff that accumulated before the beginning of mining. Pit dewatering of the Hearne Pit between Year 2 and the end of Year 4 will take place on an intermittent basis to prevent excessive water accumulation in the pit prior to the commencement of full-scale continuous mining activities in Year 5. This dewatering system will be expanded as mining takes place to handle groundwater inflows.

Water entering the open pits during mining will be routed by ditches to a series of sumps. Temporary sumps will be developed in working areas that will allow initial settlement of coarse suspended solids from the water. From the temporary sumps, water will be directed through a combination of ditches and pipelines to main sumps equipped with multiple storage areas and pumps. A limited amount of storage capacity will be provided in the open pits to prevent flooding of sumps and working areas.

As required, perimeter dykes will be constructed around the circumference of the open pits to reduce the inflow of surface runoff from the exposed lakebeds. A small amount of seepage may reach the open pits during runoff events, because the perimeter dykes will not be constructed with water-retaining cut-off walls.

To reduce TSS, water will be treated by in-line flocculation in the same way and at the same location as water from Areas 6 and 7 was treated in the initial dewatering phase. Treated groundwater inflows collected in the pit dewatering systems will be discharged to either Area 5 or the process plant. Once the 5034 Pit is mined out in Year 5, discharge of treated groundwater into Area 5 will stop and the groundwater entering the 5034 Pit will be retained in the pit. The dewatering system will be removed and installed in the Tuzo Pit for the anticipated start-up of mining activities in Year 5.

The concentration of total dissolved solids in the pit water from groundwater infiltration is expected to increase with depth and the concentration will determine its destination. At first, pit water can be pumped to Area 5. As the concentration of total dissolved solids increases, the pit water will be pumped to the process plant. Groundwater used as process water will eventually be incorporated in the PKC slurry and discharged to the Fine PKC Facility. From Year 5 onwards, mined-out pits will be available and deep groundwater will be retained in or discharged to the mined-out pits, as necessary.

3.9.6.4 Dewatering Above the Tuzo Ore Body

By mid-year of Year 5, Dyke B will be constructed to separate Areas 3 and 4 of Kennady Lake (Figure 3.9-1) thereby allowing dewatering of Area 4 so the Tuzo Pit can be mined. This dyke will be constructed using overburden till and mine rock from the open pits. Dyke B will be constructed to a crest elevation of 423.5 masl, which is above the maximum projected operating level of the WMP in Area 3. Following the completion of Dyke B, Area 4 will be dewatered. Initially, approximately 3.6 Mm^3 of water will be siphoned to the mined out 5034 Pit to draw down the water level in Area 4. Water captured in the Area 4 collection pond during the remainder of the operational period will be pumped to the WMP.

3.9.7 Water Management for Closure and Reclamation

3.9.7.1 Closure and Post-Closure Phases

This section describes the following key water-related activities that will take place during the closure phase of the Project:

- restoration of Kennady Lake;
- site-wide drainage patterns; and
- linkages to surrounding watersheds.

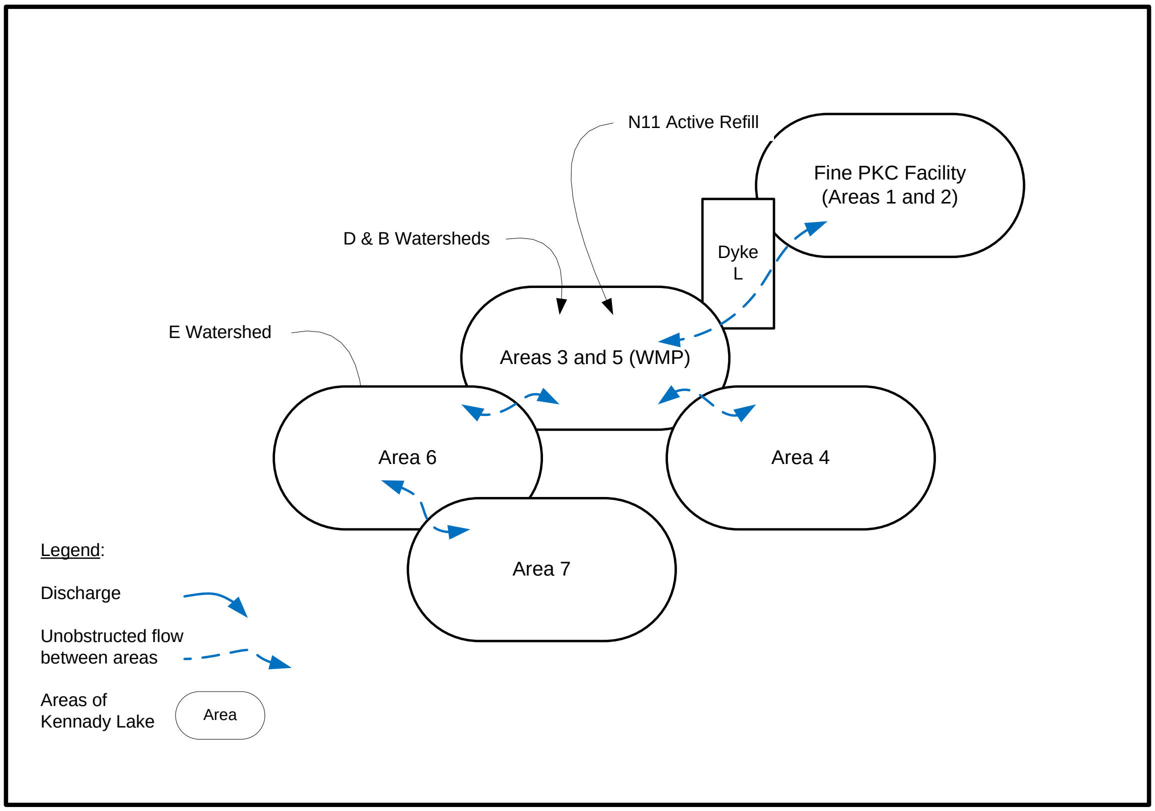
The key water management flows during the closure (refilling) period is presented in Figure 3.9-4.

3.9.7.2 Restoration of Kennady Lake

At the completion of mine operations, the Hearne Pit will have been partially backfilled with fine PK; the 5034 Pit will be partially backfilled with mine rock; while the Tuzo Pit will be open and empty. Area 1 and Area 2 will be filled with fine PK and reclaimed with a coarse PK and mine rock cover. Area 4 will be drained as this area is adjacent to the Tuzo Pit.

The progressive reclamation strategy will be extended to the water management of Kennady Lake, where portions of the lake are isolated and allowed to refill to natural water levels as early as possible. For example, pumping pit water from the Hearne Pit will stop in Year 7, with extra water from the mined-out 5034 Pit being pumped into the Hearne Pit in Year 8. These steps will help fill the Hearne Pit with water prior to Project closure, which will accelerate the refilling of Kennady Lake.

Figure 3.9-4 Diagram of Water Management during Closure



PKC = processed kimberlite containment; WMP = Water Management Pond.

After the planned within-lake reclamation activity has been completed, such as the construction of any fish compensation habitat and the decommissioning of any roads, diversion channels, and pipelines, the refilling process for Area 6 will begin. Area 7 will have been filled during operations with natural recharge near the end of operations.

At the end of operations, in-lake Dykes B, K, and N will be breached to the elevation 417 masl to allow flooding of the Tuzo Pit area. This activity will lower each of these dyke structures to a level below the expected restored lake level. At the same time, the temporary diversion Dykes C, E, F and G will be breached and removed to allow the upper watersheds to resume their flow into Kennady Lake. Natural runoff from these upper watersheds and supplemental pumping from Lake N11 will be used to refill Kennady Lake. It is expected to take approximately eight years to refill the lake to the original water levels. (Lake area and volume will be permanently altered.)

Supplemental water will be pumped from Lake N11 to Area 3 during the early high-water season. Pumping will typically begin in June and end in July, although it may extend into August. In wet years, flow forecasts based on snow pack conditions and seasonal precipitation will be used to estimate annual water yields from Lake N11. Planned pumping sites will be set accordingly to prevent the total annual outflow from Lake N11 from dropping below the one-in-five-year dry condition. During the pumping season, pumping rates will be adjusted as required to meet this objective. In years where the Lake N11 outflow is forecast to naturally fall below the one-in-five-year dry condition, no pumping will occur.

The total annual diversion from Lake N11 will be in the order of 3.7 million cubic metres per year (Mm^3/y), which represents no more than 20% of the normal annual flow to Lake N11. The 20% cut-off will be used to ensure that sufficient water remains in Lake N11 to support downstream aquatic systems in the N watershed. The value of 3.7 Mm^3/y represents the difference between the flow to Lake N11 under median/normal flow conditions, and that which occurs under one-in-five-year dry conditions. Based on a six-week pumping period, the average daily pumping rate will be 88,100 m^3/d. It is anticipated that more water will be withdrawn during wetter years (i.e., up to a maximum of 175,200 Mm^3/d). In drier years, less water will be withdrawn. At no time will the diversion result in an outflow from Lake N11 below that which occurs under a one-in-five-year dry condition.

3.9.7.3 Site-wide Drainage Patterns

At the start of closure, the temporary diversions dykes will be removed to restore the baseline B, D and E watershed boundaries of Kennady Lake. These watersheds will be returned to their natural drainages patterns. During the restoration of Kennady Lake, runoff from the Fine PKC Facility, mine rock and Coarse PK piles, plant site, and airstrip will flow to the lake and be used to assist in refilling. If the water quality of runoff from the mine rock piles to the west and south of Kennady Lake, the Coarse PK Pile, or the Fine PKC Facility is unsuitable for direct discharge into Kennady Lake, this water will be collected and treated to achieve acceptable discharge water quality.

3.9.7.3.1 Linkages to Surrounding Watersheds

Once Areas 3 through 7 are refilled to the same elevation as Area 8, and the water quality within the refilled lake is acceptable, the in-lake portion of Dyke A will be removed. The breaching and removal of Dyke A will be undertaken using heavy machinery, such as long-armed backhoes. Explosives will be used only if necessary. The refilling of Kennady Lake, and its reconnection with the downstream watersheds, will then be completed.

3.9.8 Water Balance for the Project

A water balance model has been developed that provides a prediction of monthly inflows and outflows from the water management system for each phase of the Project. Table 3.9-3 shows a summary of the inflows to and outflows from the water management system (e.g., the Project mechanism to which all elements of site contact and mine contact water, potable and plant water supply, pumped inflows and discharges, and natural inflows and outflows are managed and facilitated) during the construction, operations, and closure phases of the Project. The table was compiled using data for the one-in-two wet year freshet (median values).

Table 3.9-3 Summary of Inflows to and Outflows from the Water Management System

Project Phase	Total Annual Flow (m^3/y)	Proportional Flow (m^3/y)
Construction (Year -2 [2013] to Year -1 [2014])		
Inflows	3,466,300	
Natural surface runoff from watershed A		340,000
Natural surface runoff from watershed B		241,000
Natural surface runoff from watershed C		15,500
Natural surface runoff from watershed D		762,000
Natural surface runoff from watershed E		215,000
Natural surface runoff from watershed F		57,800
Natural surface runoff from watershed G		125,000
Natural surface runoff from watershed K (Area 1 to Area 7)		1,650,000
Fresh water supply from Area 8		60,000
Outflows	21,450,000	
Water Pumped to Area 8 from Area 7		8,550,000
Water pumped to Lake N11		12,900,000

Table 3.9-3 Summary of Inflows to and Outflows from the Water Management System (continued)

Project Phase	Total Annual Flow (m^3/y)	Proportional Flow (m^3/y)
Operations (Year 1 [2015] to Year 11 [2025])		
Inflows	4,205,932 to 5,173,321	
Groundwater inflows entering the open pits		839,500 to 1,533,000
Runoff from Fine PKC Facility		108,470 to 473,737
Runoff from Coarse PK Pile		28,639 to 79,968
Runoff from West Mine Rock Pile		72,135
Runoff from South Mine Rock Pile		81,900 to 163,800
Disturbed area runoff		1,022,272 to 1,358,497
Runoff from the airstrip		118,000
Natural surface runoff from watershed C		15,500
Natural surface runoff from watershed D1		72,800
Natural surface runoff from watershed F		57,800
Natural surface runoff from watershed G		125,000
Natural surface runoff from watershed K (inside)		1,012,892 to 1,707,037
Fresh water supply from Area 8		27,000
Outflows	1,790,000	
Water pumped to Lake N11		1,790,000
Closure to Refilled Kennady Lake (Year 12 [2026] to Year 19 [2033])		
Inflows	6,834,300	
Lake N11		3,270,000
Natural surface runoff from watershed B		241,000
Natural surface runoff from watershed C		15,500
Natural surface runoff from watershed D		762,000
Elevated surface runoff from watersheds D and E (from Operations)		188,000
Natural surface runoff from watershed E		215,000
Natural surface runoff from watershed F		57,800
Natural surface runoff from watershed G		125,000
Natural surface runoff from watershed H		149,000
Natural surface runoff from watershed I		130,000
Natural surface runoff from watershed J		245,000
Natural surface runoff from watershed K (inside)		1,960,000
Natural surface runoff from watershed Ke		628,000
Outflows	0	

Table 3.9-3 Summary of Inflows to and Outflows from the Water Management System (continued)

Project Phase	Total Annual Flow (m^3/y)	Proportional Flow (m^3/y)
Post-Closure (Year 20+ [2034+])		
Inflows	3,376,300	
Natural surface runoff from watershed B		241,000
Natural surface runoff from watershed C		15,500
Natural surface runoff from watershed D		762,000
Natural surface runoff from watershed E		215,000
Natural surface runoff from watershed F		57,800
Natural surface runoff from watershed G		125,000
Natural surface runoff from watershed K (inside)		1,960,000
Outflows	3,428,000	
Natural discharge from Area 7 to Area 8		3,428,000

Note: Surface runoff = total precipitation - snow sublimation loss - lake evaporation – evapotranspiration.
m^3/y = cubic metres per year

3.9.8.1 Inflows

Inflows to the water management system will consist of fresh water drawn from Area 8, groundwater entering the open pits, surface runoff from the Project site, natural surface runoff from adjacent watersheds and drainage from the Fine PKC Facility and the mine rock and coarse PK piles. During closure, additional water will also be pumped from Lake N11 to expedite the refilling of Kennady Lake.

During construction, approximately 60,000 cubic metres per year (m^3/y) (i.e., 163 m^3/d) of fresh water will be taken from Area 8 for potable water needs. During operations, 27,000 m^3/y (i.e., 75 m^3/d) of freshwater will be drawn from Area 8 for potable water needs, in addition to a portion of the make-up water requirements for the processing plant facility, which is estimated to be 740 m^3/d. At the plant site, water will be recycled to reduce the freshwater requirements.

During operations, water volumes entering the open pits from groundwater inflows will range from a minimum of about 839,500 m^3/y (i.e., 2,300 m^3/d) during Year 1 to about 1,533,000 m^3/y (i.e., 4,200 m^3/d) in Year 6, when the size and depth of the open pits reaches a maximum. The average inflow volume during operations (i.e., Years 1 to 11) is estimated to be about 1,190,000 m^3/y. Backfilling activities will gradually add water to the open pits, thereby reducing hydraulic gradients and subsequent groundwater inflows.

Natural inflows to Kennady Lake (i.e., Areas 2 to 7) include watersheds A to G. During operations, inflows from the upstream watersheds will be altered due to the diversion of the A, B, D and E watersheds. Inflows from these upstream watersheds will be reduced (watershed A) or diverted (watersheds B, D and E). Watershed A will be permanently altered as a result of the Project. In the first year of construction (Year -2), a saddle dam (Dyke C) will be constructed between Lakes A1 and A2 (Area 1), and Lake A3 to the north. Inflows from Area 1 will be limited to drainage from Area 1 (i.e., Fine PKC Facility) to Area 2. During operations, natural runoff from watersheds B, D and E will be diverted to lakes in the N watershed. At closure, natural inflows from the B, D and E watersheds will be redirected to Kennady Lake. Altered inflows from watershed A to Kennady Lake will remain during the closure and post-closure periods.

Drainage from the mine rock and coarse PK piles and the Fine PKC Facility will include runoff from direct precipitation. As new material is continuously deposited on these Project facilities between Years 1 and 11, the net annual runoff yield is estimated to increase as their area increases and the storage material becomes saturated[1]. This will result in drainage increasing from about 219,000 m^3/y early in the Project life to about 790,000 m^3/y in 2021. At the end of operations, drainage will be reduced to about 727,000 m^3/y. Drainage from these Project facilities will continue at this rate during closure and post-closure unless reclamation activities substantially change the drainage pattern. There are no plans to cover or vegetate the mine rock piles. The Coarse PK Pile will be covered with a mine rock layer, and the Fine PKC Facility will be covered with coarse PK and mine rock.

3.9.8.2 Outflows

Outflows from the water management system will consist of water pumped to Area 8 and Lake N11 as a result of the dewatering of Kennady Lake during construction and operations. During closure, no outflows are anticipated from the water management system due to the refilling activities of Areas 3 to 7. In post-closure, after the reconnection of Areas 3 to 7 with Area 8, outflows will be associated with natural discharge from Area 7.

3.9.8.3 Area 8

The natural outflow from Area 8 during construction, operations, and closure is assumed to be equal to the volume of inflows (i.e., snow and rain inputs) to Area 8 from watersheds H, I, J, and Ke minus evaporation from the surface of

[1] The estimate of runoff volumes from the mine rock and coarse PK piles and Fine PKC Facility does not consider the degree of saturation of each facility

Area 8. Table 3.9-4 shows a summary of the inflows and outflows from Area 8. This table was compiled using data for the one-in-two wet year freshet (median values). Discharge from the outlet of Area 8 flows into Lake L3.

During construction when Area 8 is isolated from the upstream areas of Kennady Lake, Area 8 will receive pumped discharge from Area 7 as part of the dewatering activities associated with the drawdown of Areas 2 to 7 in Kennady Lake, and natural inflows from watersheds H, I, J, and Ke. During operations and closure, inflows to Area 8 will be limited to natural runoff from watersheds H, I, J, and Ke. In post-closure, after the reconnection of Area 8 with Area 7, the natural outflows from Area 8 will include the flow inputs from the upper areas of Kennady Lake, with natural outflow estimated to be approximately 4,400,000 m^3/y.

Table 3.9-4 Summary of Inflows to and Outflows from Area 8

Project Phase	Total Annual Flow (m^3/y)	Proportional Flow (m^3/y)
Construction (Year -2 [2013] to Year -1 [2014])		
Inflows	9,702,000	
Natural surface runoff from watershed H		149,000
Natural surface runoff from watershed I		130,000
Natural surface runoff from watershed J		245,000
Natural surface runoff from watershed Ke (Area 8)		628,000
Water pumped from Area 7		8,550,000
Outflows	1,150,000	
Freshwater supply to the Water Management System		60,000
Natural Discharge from Area 8		1,090,000
Operations (Year 1 [2015] to Year 11 [2025])		
Inflows	1,152,000	
Natural surface runoff from watershed H		149,000
Natural surface runoff from watershed I		130,000
Natural surface runoff from watershed J		245,000
Natural surface runoff from watershed Ke (Area 8)		628,000
Outflows	1,190,000	
Freshwater supply to the Water Management System		27,000
Natural Discharge from Area 8		1,163,000
Closure to Refilled Kennady Lake (Year 12 [2026] to Year 19 [2033])		
Inflows	1,152,000	
Natural surface runoff from watershed H		149,000
Natural surface runoff from watershed I		130,000
Natural surface runoff from watershed J		245,000

Table 3.9-4 Summary of Inflows to and Outflows from Area 8 (continued)

Project Phase	Total Annual Flow (m^3/y)	Proportional Flow (m^3/y)
Natural surface runoff from watershed Ke (Area 8)		628,000
Outflows	1,152,000	
Natural Discharge from Area 8		1,152,000
Post-Closure (Year 20+ [2034+])		
Inflows	4,528,300	
Natural surface runoff from Areas 3 to 7		3,376,300
Natural surface runoff from watershed H		149,000
Natural surface runoff from watershed I		130,000
Natural surface runoff from watershed J		245,000
Natural surface runoff from watershed Ke (Area 8)		628,000
Outflows	4,400,000	
Natural discharge from Area 8		4,400,000

Note: Surface runoff = total precipitation - snow sublimation loss - lake evaporation – evapotranspiration.
m^3/y = cubic metres per year

3.10 SITE INFRASTRUCTURE

3.10.1 Introduction

No mining services are currently available at the Project site. The necessary mining infrastructure will be established on the site before the start of mining. The following major infrastructure will be required:

- accommodations complex and administrative offices;
- maintenance complex and warehouse;;
- electrical power and heating;
- storage for oil, fuel, and glycol;
- production and storage of explosives;
- winter access road;
- site roads;
- traffic management;
- airstrip; and
- sewage treatment.

3.10.2 Description of Infrastructure

3.10.2.1 Plant Site

The plant site layout is shown in Figure 3.10-1. The general layout of the plant site was based on the following criteria:

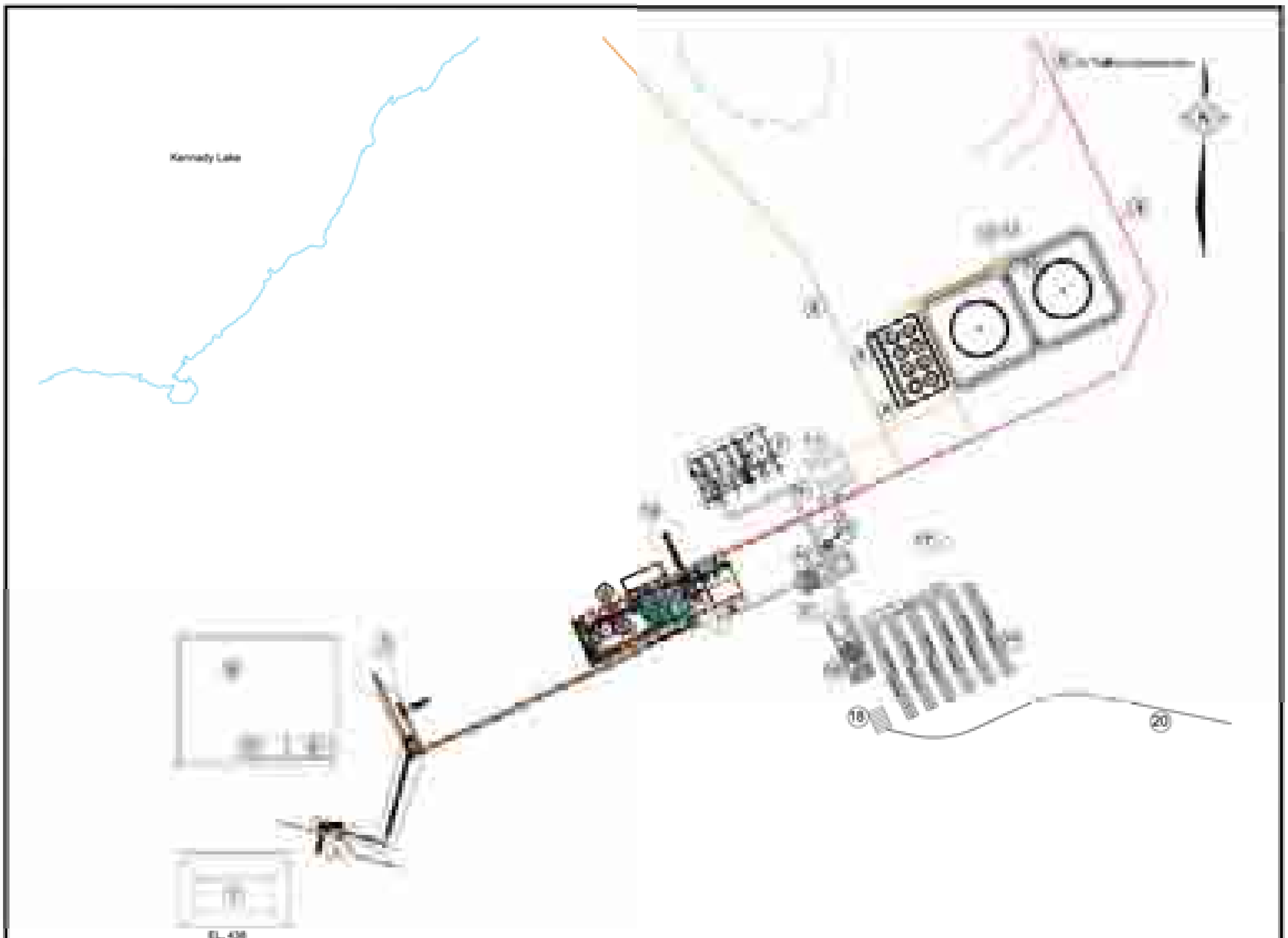
- compact site footprint for minimal land disturbance and maximum site operations efficiency;
- compact building sizes and layout for maximum energy efficiency;
- efficient facility access for personnel and vehicles during construction and operations; and
- minimal impact of winter road truck traffic around the site.

3.10.2.2 Accommodations Complex and Administration Offices

A camp capable of housing 432 workers on a double-occupancy basis (for the construction period) and 216 workers on a single-occupancy basis (for the operations period) will be erected within the first six months of site mobilization. The permanent incinerator, potable water, firewater, and sewage treatment modules will be installed and sized to handle the higher construction occupancy requirements.

The accommodations complex will be of modular construction. It will be a series of single-storey dormitory sections attached to a central core by means of ground level heated and insulated utilidors. Bedrooms will be completely furnished. Washroom and shower facilities will be provided for blocks of rooms. The core complex will have dining, kitchen, food storage, and recreational facilities. A self-serve area will be accessible from the main hallway and adjacent to the dining rooms. The entire complex, including dormitories and central kitchen facilities, will be supported on cribbing placed on a prepared ground surface surrounded by skirting.

The administration offices will form part of the camp complex and be sized to handle all construction office needs from the onset. Included in the administration complex will be the medical clinic, computing and communication network, mudrooms, toilet facilities, and lunch rooms.



Mine Facilities & Buildings

1. Run-of-Mine Stockpile
2. Primary Crusher
3. Coarse Ore Stockpile
4. Truck Shop
5. Lube/Waste Oil Containment
6. Fines Rejects & Reclaim Water Pipes
7. Process Plant
8. Emergency Dump Line
9. Waste Incinerator
10. Fuel Storage
11. Power Plant
12. Fueling Stations
13. Fuel Unloading Station
14. Accommodation Complex
15. Kitchen/Dining Complex/Admin Office
16. Core Complex
17. Sewage Treatment Plant
18. Fire/Fresh Water Storage/Potable Water Treatment
19. Coarse & Grits PK Loadout
20. Fresh Water Pipeline
21. Utilities Electrical Room

Construction Facilities

- (A) Construction Fuel Storage
- (B) Aggregate Crushing and Batch Plant
- (C) Construction Office
- (D) Cold Storage
- (E) Construction Maintenance

NOTES

Base data source: EBA Figure H333420-0000-00-014-0008 - Project Site Layout - Plan View

GAHCHO KUÉ PROJECT

Site Layout

JOB No: 09-1365-1004	REVISION No: 4		Figure 3.10-1
OFFICE: GOLD - SAS	DRAWN: AJL	CHECK: PT	

3.10.2.3 Maintenance Complex and Warehouse

A maintenance complex and warehouse will be erected adjacent to the processing plant. The workshop area of the maintenance complex will be designed to meet the need for servicing and maintaining the mining equipment and the mine and plant support equipment fleet. The warehouse will be connected to the maintenance complex. A utilidor between these buildings and the permanent accommodations complex will provide all-weather access.

3.10.2.4 Electrical Power and Heating

Power will be generated on site by five 2,825 kilowatt (kW(e)) diesel-powered electric generator units with heat recovery, switchgear, and boiler complex. Three of the units will be running during normal operations, with one on standby and one on maintenance. Total power demand for the Project is expected to be seven megawatts (MW), while the total installed capacity of the primary gensets will be 12.5 MW.

The power distribution system is designed to provide a reliable, maintainable, and where essential, emergency power supply to the various facilities. Major utilities including power will be routed through the enclosed utilidors or, for locations without utilidors, power will be routed through armoured cable.

A program of carbon and energy management will be implemented once the generators are commissioned. The program will include the following:

- Generator efficiencies will be constantly monitored and equipment will be tuned for optimum fuel-energy efficiency.
- Load management will allow for optimization of the load factors on the machines.
- Programs will be instituted to review power and heat use to minimize energy use.
- Pumping circuits will be monitored so that no unnecessary pumping takes place and pump efficiencies are optimized.

Recovered heat from the main electrical generators will be used to heat the accommodations complex as well as the central process and maintenance facilities. Heat will be recovered from engine jacket water coolers and engine exhaust gas and distributed around the site by means of a propylene glycol and water (60% glycol) heat transfer fluid. Heat will be transferred by a circulation system loop network through the adjoining plant site buildings. Piping will be insulated for heat conservation and personnel protection. In addition, an auxiliary boiler will be available to supplement the heat from the electrical generators during extreme weather and to provide supplementary heating during lower power demand periods (e.g. extended process plant maintenance periods) when limited heat recovery is available from the power plant.

Electric heating will be used for areas where the use of the piped glycol system is impractical. This includes outlying buildings such as the explosives emulsion plant, temporary construction buildings, and water pumping stations. The camp will be heated by a dual electric/hot water system to allow flexibility during construction. All offices will have backup electric heat.

3.10.2.5 Storage for Oil, Fuel, and Glycol

The estimated diesel fuel demand for a typical year of operations is summarized in Table 3.10-1. This estimated demand formed the basis for the fuel storage design. The total fuel storage capacity on-site is planned to be 40 million L, which provides 15% excess capacity when considering the two month winter road period.

Table 3.10-1 Estimated Diesel Fuel Requirements

Area/Facility	Estimated Average Annual Diesel Fuel Consumption (L)
Mining	25,000,000
Power generation	10,000,000
Surface mobile equipment	5,000,000
Pit dewatering	
Pond dewatering	
Incinerators	
Total diesel fuel demand	**40,000,000**

L = litres.

The main fuel storage facility will consist of eight 500,000 L capacity prefabricated tanks and two 18 million L single-wall welded steel tanks, which will be erected on-site. All the tanks will be designed and constructed according to the American Petroleum Institute 650 standard. The tanks will be placed in a lined and dyked containment area to contain any fuel spills. The design of the containment area will be based on requirements of the Canadian Council of Ministers of the Environment *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (CCME 2003), the National Fire Code of Canada, and any other standards that are required. The containment area will be sized to hold 110% of the volume of the largest storage tank and will include a gravel base with a continuous 60 mil (60 thousandths of an inch) high-density polyethylene liner sheet installed under the tanks and the internal sides of the berm. A fuel unloading pumping module will be installed within a spill containment area adjacent to the fuel storage tank farm.

In addition to the large fuel tanks, a number of smaller tanks will be required. These tanks will be placed inside lined and bermed containment areas designed to contain any spills. The following storage facilities are planned:

- engine oil storage tanks;
- transmission/hydraulic oil storage tank;
- final drive/differential oil storage tank;
- glycol/coolant storage tank;
- two waste oil storage tanks; and
- waste coolant storage tank.

Jet-B aviation fuel will be stored in self-contained, Underwriters Laboratories Canada-rated envirotanks mounted on an elevated pad at the air terminal shelter. This reserve will be for emergency use by aircraft. Jet-B fuel will also be required for helicopter refuelling. This fuel will be stored in sealed drums inside a lined berm at the helipad near the airstrip.

3.10.2.6 Production and Storage of Explosives

Explosive use will be managed with the primary environmental goal of limiting loss of ammonia to mine rock and kimberlite, which could subsequently leach into runoff at the Project site or be processed at the processing plant. Emulsions will be used for wet blasting; ammonium nitrate fuel oil (ANFO) will be used for dry blasting to limit ammonia leaching. Packaged explosives will be kept on-site where required. All runoff from the ammonium nitrate storage areas, mine pits, and mine rock piles will be contained within the controlled area boundary of the Kennady Lake watershed.

The ammonium nitrate storage areas, emulsion plant, and explosives storage magazines are sited north and northeast of the main plant site, with separation distances in accordance with the guidelines set out in the *Quantity-Distance Principles User's Manual* published by the Explosives Regulatory Division of Natural Resources Canada. These facilities include the following:

- three or four explosives magazines for blasting accessories (used to initiate explosions) and various packaged explosives;
- storage pads for ammonium nitrate; and,
- an emulsion plant.

The explosives magazines facilities will be located near the Area 1 section of the Fine PKC Facility sufficiently distanced from other operations as per Natural Resources Canada regulations. The primary ammonium nitrate storage pad will be located north of Area 1. The emulsion plant and operational (smaller) ammonium nitrate storage pad containing less than 2,000 t will be situated southeast of Area 1. Both locations are within the controlled area boundary.

The ammonium nitrate supersacs will be stacked outdoors in rows on two storage pads and covered with tarps as required. About 12,000 t of ammonium nitrate will be required each year during the operation of the mine. This material will be brought in via winter road and stockpiled on the storage pads for use throughout the year

All emulsion materials will be stored at the emulsion plant. Any spills of emulsion materials will be contained within the building. The emulsion plant will use ammonium nitrate to manufacture a water resistant emulsion-type explosive. Bulk ANFO explosives that are not water resistant will be used only under appropriate dry hole conditions.

Licensed contractors will supply all explosives and operate the emulsion plant. The emulsion plant will operate intermittently, and produce only the quantities of finished product required for immediate use so that storage of bulk explosives materials in the plant is not required.

3.10.2.7 Winter Access Road

The winter access road for this Project links with the existing Tibbitt-to-Contwoyto winter road (Figure 3.10-2). More specifically, a 120-km winter access road will be constructed from MacKay Lake each winter to connect the Project site to the Tibbitt-to-Contwoyto winter road at km 271, just north of Lake of the Enemy. The main access to the site from the winter access road during operations will be via a service road connecting the site to Lake N11 (Figure 3.9-2).

LEGEND

- Gahcho Kué Project
- Tibbitt-to-Contwoyto Winter Road
- Winter Access Road
- Watercourse
- Waterbody
- Index Contour (100m interval)
- Intermediate Contour (25m interval)

NOTES
Base data source: National Topographic Base Data (NTDB) 1:250,000

GAHCHO KUÉ PROJECT

Winter Access Road to Project Site

P-Other-045-GIS			October 7, 2010
JOB NO. 09-1365-1004	REVISION NO. 1		**Figure 3.10-2**
OFFICE GOLD-CAL	DRAWN CW	CHECK PT	

3.10.2.8 Site Roads

Site roads will be constructed using compacted granular fill material over general fill. The plant site roads will have 1 m wide shoulders and two lanes, with each lane 4 m wide, for a total road width of 10 m. Some of the service roads to outlying parts of the mine will be single lane, 4 m wide with 0.5 m shoulders, for a total road width of 5 m. Road grades will generally be limited to less than 8%. A water truck on site will be used to water the roads regularly to limit fugitive dust.

In addition to the site service roads, dedicated roads for the large haul trucks and loaders will be used to transport rock out of the open pits and around the Project site. These dedicated roads will be of sufficient width to meet the regulatory requirements for the equipment being used.

3.10.2.9 Traffic Management

The Project will generate two types of road traffic: 1) highway traffic on the winter roads and the road from Edmonton to Yellowknife and 2) mine production traffic. Highway traffic will consist of about 1,500 to 2,000 trucks per year during construction and 1,000 to 1,200 trucks per year during operations traveling over the winter road for a 10-week period every winter (approximately January through March). Fewer trucks (approximately 110 to 200) will be required during closure. Trucks will be hauling B-trains of fuel, loads of ammonium nitrate prills, and loads of miscellaneous freight.

To prevent conflicts between the mine haul trucks and trucks hauling fuel to site over the winter roads, fuel tanks and the unloading station will be installed to keep fuel trucks away from the active mining areas. As much as possible, mine haul trucks carrying ore or waste will be kept to the west side of the site, away from the accommodations complex and potential pedestrian and airstrip traffic. The ammonium nitrate storage area and the fuel tank farm will be constructed in the northern part of the site, allowing for most winter road haul truck traffic to be confined to this area and not interacting with mining operations traffic. Pick-up trucks and light service vehicles will generally access all site areas for operations and maintenance purposes by way of the site service or haul roads.

Personnel arriving at or leaving the site will be transported by bus between the airstrip and the accommodations complex along the access road that crosses over Dyke A. The accommodations complex will be east of the processing plant to minimize the visual and noise impact to residents on site (Figure 3.10-1).

3.10.2.10 Airstrip

Before the permanent airstrip is established, aircraft will land on an ice airstrip located on Kennady Lake. The ice airstrip will be capable of handling all aircraft potentially servicing the site.

The permanent site airstrip will be designed to accommodate a wide range of aircraft, with the largest being the Hercules and Boeing 737. The aircraft requirements will be adjusted to meet the transport demand of the Project; projections are summarized in Table 3.10-2. The airstrip will be constructed in stages to allow smaller aircraft to use a portion of the airstrip under controlled circumstances once sufficient length is built. The airstrip will be about 1 km southeast of the plant site on the opposite side of Kennady Lake and connected to the Project site by a road over Dyke A.

The airstrip will be oriented west-southwest, which aligns with the predominant wind direction, sites the strip on favourable ground, and avoids approach interference from high building structures or mine rock piles. Wind data collected indicated that the predominant wind direction ranged from the northwest to southwest.

The airstrip will be 45 m wide and up to 1,620 m long with graded shoulders 7.5 m wide to allow for navigational lighting and access by emergency and service vehicles. The airstrip will be constructed of general fill with a covering base of -200 mm material. This will be topped by a 300 mm thick levelling course of -50 mm material, and finally, a 150 mm thick compacted surface course of -20 mm crushed granular fill. In areas of muskeg, a minimum of 2 m of general fill will be placed to provide a competent foundation. Roads will be watered as required to reduce fugitive dust. A de-icing area will be constructed although usage is likely to be minimal, based on experience at Snap Lake Mine.

Table 3.10-2 Air Traffic Forecast by Project Phase and Type of Aircraft

Project Phase	Number of Years	Number of Flights per Year			
		Jet	Large Propeller[(a)]	Small Propeller	Helicopter
Construction	2	n/a	500	200	50-75
Operations	11	n/a	150	100	50-75
Closure[(b)]	2	n/a	20	40	50-75

(a) Large propeller defined as more than 32 seats.
(b) Closure refers to time required to remove site remaining infrastructure. Only infrastructure required for lake refilling will remain at the Project site beyond two years. Final site demobilization will occur via a winter ice strip once Kennady Lake has been refilled.
n/a = not available

3.10.2.11 Sewage Treatment Plant

A modular sewage treatment system adequate for 432 workers will be installed as part of the initial construction. The sewage treatment system will be housed in a building adjacent to the accommodations complex. Treated liquid effluent from the sewage treatment system will be discharged to Area 3 of Kennady Lake initially and then in Year 2 directed to the process plant for disposal with the fine PK stream. The sewage sludge will be dewatered for disposal in the landfill on site. If possible, the sludge may be composted or used as a soil treatment.

3.11 HUMAN RESOURCES

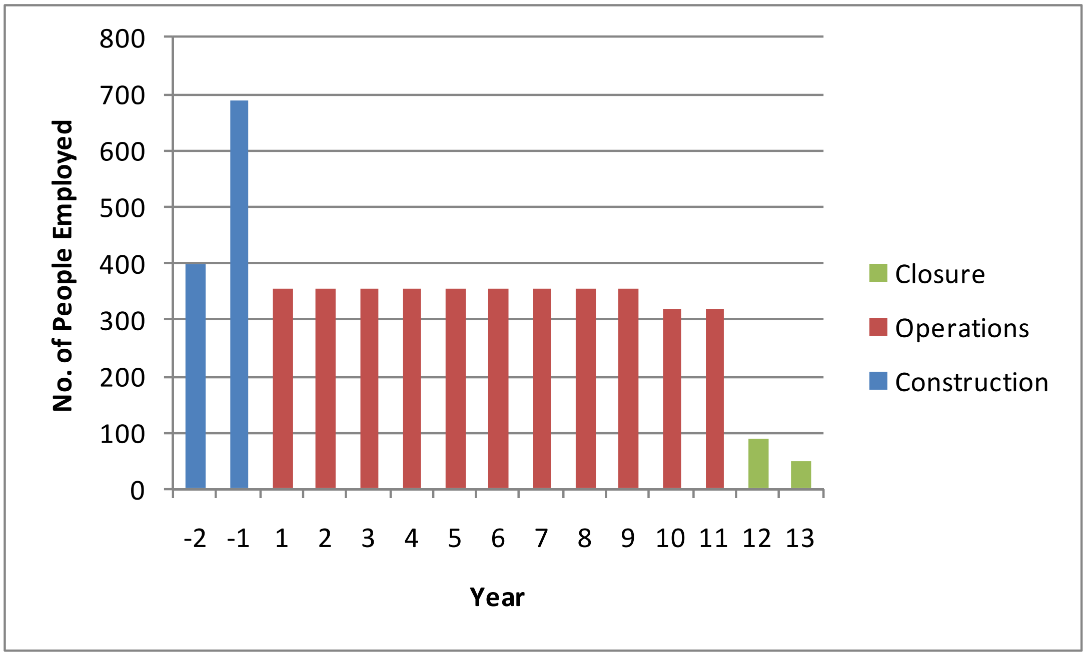
3.11.1 Introduction

This section discusses human resources needs and management required for the various Project phases (i.e., construction, operations, and closure and reclamation). The human resource strategies, policies, plans, and procedures will build upon, and be consistent with, those of the Snap Lake Mine.

3.11.2 Employment

In general, the Project is expected to employ an average of about 360 full-time equivalents (FTEs; one FTE is the number of hours worked that add up to one full-time employee) during the operations phase (Year 1 through Year 11), with peak employment of nearly 700 FTEs during construction Year 1 (Figure 3.11-1). Employment during the closure and reclamation phase is expected to be fewer than 100 FTEs (Figure 3.11-1).

Figure 3.11-1 Total Employment by Year during Construction, Operations, and Closure



3.11.2.1 Construction

The construction workforce will grow from approximately 400 FTEs in Year -2 to a peak of 690 FTEs in the following year. This peak employment includes both on-site and off-site employment, and is not equivalent to the number of on-site personnel at any one time. The number of people on site is limited by the maximum capacity of the camp, which is set at 432 persons. In addition to an average 450 construction FTE positions, about 190 operational FTEs will be coming on-stream over the course of the construction phase to operate all the earthworks equipment for construction and pre-stripping, as well as to prepare for operations.

The nature and description of each job skill level are shown in Table 3.11-1.

Construction workforce estimates by job skill levels for each construction year are shown in Table 3.11-2. The workforce in the year before construction begins will be approximately 10 FTEs.

Table 3.11-1 Jobs Skill Levels and Definitions

Position types	Requirements	Examples
Management	combination of significant work experience at a senior level and a university degree, masters or doctorate	positions at the executive level, managers, and superintendents.
Professional	university degree and related work experience	geologists, engineers, and coordinators
Skilled	college diploma or technical school certification along with related work experience	trades people and technicians
Semi-skilled	high school graduation or General Equivalency Diploma along with a minimum of 3 years work experience in a particular field	equipment operators and apprentices
Unskilled	high school graduation or General Equivalency Diploma along with some work experience[(a)]	labourers and assistants

(a) De Beers does consider the experiences of individuals not meeting minimum education requirements for entry level positions on a **case-by-case basis**.

Table 3.11-2 Construction Workforce Estimates

Skill Level and Type	Year -2	Year -1
Manual Labour:		
Skilled	169	299
Semi-Skilled	77	160
Unskilled	62	92
Non-Manual Labour:		
Management	51	76
Professional	23	35
Skilled	18	28
Grand Total	**400**	**690**

Note: Numbers shown are number of jobs per skill level/type; skill level definitions and examples are found in Table 3.11-1.

3.11.2.2 Operations

The operating mine life is estimated to be 11 years in duration, with commissioning of the process plant at the end of Year -1. Full production is anticipated in Year 1 with production completion in Year 11. The mining operation starts with a pre-stripping fleet in Year -2 and a smaller mining workforce will conduct all earthworks activities from the beginning of construction. By the end of construction, the operations workforce of approximately 160 FTEs will be on-site and will include general and administrative staff, camp housekeeping, catering, mill operators, truck drivers, open pit mining, and surface facilities maintenance crews. The total workforce will average 372 FTEs during operations with less than half this number onsite at one time due to rotational work schedule and some Yellowknife-based employees.

The operations workforce estimates by job skill levels for each year of operation are shown in Table 3.11-3.

Table 3.11-3 Operations Workforce Estimates

Type of Operation	Management	Professional	Skilled	Semi-Skilled	Unskilled	Total
Mining	4	14	43	96	6	163
Process Plant	1	9	20	32	7	69
Surface Operations	0	0	4	22	4	30
Administration: On Site	12	9	27	0	50	98
Administration: Yellowknife	3	0	6	3	0	12
Administration Outside NWT	0	0	0	0	0	0
Total	**20**	**32**	**100**	**153**	**67**	**372**

Note: The above employment distribution estimate is an approximation for the operations period based on average annual employment of 372 FTEs. In any one year, the total number and mix of employees may differ from this estimation.

3.11.2.3 Closure and Reclamation

Progressive reclamation will occur throughout the life of the Project, and most closure work will be completed during the latter years of the operations. For example, reclamation work such as demolition and dyke breaching will occur during the last year of operations. However, much of the mine closure activities are planned for Years 12 and 13 upon cessation of processing operations, at which time interim closure will be achieved. Employment during interim closure is expected to be less than 100 FTEs, with fewer staff required in Year 13 than Year 12 (Figure 3.11-1). Section 3.12 provides further details on closure and reclamation activities.

Much of the interim closure monitoring is planned for the approximately eight year period following end of mining operations when Kennady Lake is being re-filled to original lake levels. The recovery of the aquatic ecosystem in Kennady Lake will also be monitored beyond this period as the remaining activity to achieve final closure. It is expected that fewer than 2 FTEs will be required as activities are limited to the pumping required to accelerate the refilling of the lake and ongoing monitoring requirements. The final year of site activity will be determined based on the results of the monitoring program.

3.11.3 Administration

Management of human resources for the Project will be done from the De Beers Canada Inc. Yellowknife Office using the Northwest Territories (NWT) Projects management and administrative support services. The company will use existing operating systems and administrative procedures that are currently in place for the Snap Lake Mine for administrative support to the Project. It is anticipated that this will increase the number of staff required in the Yellowknife office by approximately 8 to 12 positions for the operations phase of the Project. These positions will be in the disciplines of Human Resources, External and Corporate Affairs, Materials Management, and Finance. The actual number of positions will be refined closer to construction as the transition to operations from construction is detailed and as the company's NWT organizational structure is updated accordingly.

Within External and Corporate Affairs, a Superintendent Community Relations leads and manages the work of two Community Liaison Coordinators, who are employed to work with communities throughout the life of De Beers' NWT Projects. Within these three positions, one is staffed with a Chipewyan speaking employee and the other with an employee who speaks Tlicho. Within the Materials Management department, the Superintendent Materials Management and Business Development is responsible for working with NWT businesses to assist with increasing employment and business opportunities in the NWT.

3.11.4 Workforce Schedule and Mobilization

Before construction begins, the company will determine what rotation schedule is required to attract the skilled labour it needs to complete the construction of the mine. Work rotations and shifts will be planned accordingly.

During operations, most of the workforce will work 12-hour shifts in a two weeks on and two weeks off rotation. Other variations on rotation schedules have been considered for the management and professional positions required for the operations phase (see project alternatives in Section 2). Traditional pursuits of Aboriginal employees will be accommodated within work schedules in balance with the operational requirements of the Project, where practicable and with appropriate notice.

De Beers will provide return air transportation, at its expense, to employees traveling from designated pick-up points in NWT communities and the Project.

The number of flights and the size of the aircrafts will be determined based on the best options regarding the transportation of people and freight to and from the site. From time to time, De Beers will re-evaluate the effectiveness of the pick-up points and make adjustments to support construction and operations labour requirements. These points will be selected by De Beers based on the location of its workforce; requirements to recruit and retain employees; and construction and operations schedules.

3.11.5 On-site Services and Facilities for Workers

During the construction of the Project, the camp will include the necessary facilities to sustain the workforce at the site. The existing exploration camp will serve as the starter and overflow camp for initial construction. Temporary, two-per-room shared accommodation will be provided to crews during the construction phase. For permanent accommodations, staffing levels will allow for individual occupancy rooms.

Eating and sleeping areas will be non-smoking for all workers, including operations personnel. Food services will include country foods when available. Food workers will be trained food handlers.

Recreational facilities in the camp will be available 24 hours a day, seven days a week. Generally, services may include the following:

- exercise facilities;
- lounge with televisions and DVD;
- access to telephone and email for workers to communicate with family;
- computer facilities; and
- a quiet room for studies, library, reading, or religious/cultural practices.

Workers will be encouraged to establish a recreation committee to supplement on-site activities. De Beers may provide reasonable assistance for other types of facilities and services may be provided if there is sufficient workforce interest (e.g., visual arts).

Medical personnel will be stationed at the site and the medical aid personnel will be accessible 24 hours a day, seven days a week. This service will be provided throughout the construction, operations, and closure. Medical emergencies will be evacuated to Yellowknife.

3.11.6 Staffing

The key elements of De Beers' approach to employment include:

- recruiting and training that maximizes employment opportunities available to local residents;
- identifying Aboriginal people who meet the minimum entry-level qualifications for hiring preference;
- working with local employment officers, and advertising in northern newspapers and the company website positions available at the Project. The company already maintains a 1-800 number in the NWT for employment information and job opportunities;
- identifying opportunities for gathering information and addressing barriers to successful employment;
- promoting and encouraging careers in the diamond mining industry with De Beers;
- promoting and encouraging partnerships with NWT schools that enable students to understand career opportunities available as well as training and education required to pursue these opportunities; and
- promoting and encouraging partnerships with Aurora College and other Canadian post-secondary education institutions to establish work experience and job placement programs.

During construction, operations, and closure, De Beers will use its best efforts to hire according to the preference and order indicated below for the entire spectrum of Project-based employment while matching the skills required with the skills available.

- Aboriginal people living in the communities within the Socio-economic Local Study Area;
- Aboriginal people living in the NWT;
- other NWT residents;
- those relocating to the NWT; and
- all others.

Retaining and supporting the development of northern Aboriginals people is important to De Beers. De Beers wants to ensure that these employees have the opportunity to grow, develop, and progress in their jobs and careers. To help with this, a range of training, counselling, family support, mentoring, and performance incentives will be provided for staff.

3.11.6.1 Participation by Women in the Project

De Beers supports and encourages the participation of women on an equal basis with men in all aspects of work related to the Project. The following will be continued or initiated for the Project:

- work through Skills Canada, the Native Women's Association of the Northwest Territories, the Northwest Territories Status of Women Council, Aurora College, Aboriginal communities, and the Government of the Northwest Territories to promote women in trades and mining occupations;
- offer scholarships to female NWT students who are attending college and university programs;
- promote activities in the NWT that target young women for jobs at the Project;
- make female role models available for school programs to promote women working at the Project;
- support "women in trades" programs in partnership with educational institutions and women's groups in selected communities;
- offer scholarships and awards for women who are in an apprenticeship program with the Project;
- offer coaching regarding personal development strategies to women who may not possess all of the requisite skills and knowledge for particular positions; and
- encourage contractors to participate and support De Beer's commitments related to promoting the participation of women in the workforce.

3.11.6.2 Skills and Entry Requirements

The minimum qualifications for entry level (unskilled jobs) for construction and operations will be as follows:

- High school graduation or General Equivalency Diploma. De Beers does consider the experiences of individuals not meeting minimum education requirements for entry level positions on a case-by-case basis.
- All potential employees will be required to undergo a confidential pre-employment medical examination.

- As a standard risk management practice, credit and criminal history checks will be required for positions.
- With the applicant’s permission, reference checks will be undertaken on all prospective employees and will be made prior to any formal offer of employment.

3.11.6.3 Salaries, Benefits, and Performance

A salary and benefits survey will be conducted regularly to ensure that the Project is competitively positioned in the NWT and Canadian marketplace to recruit and retain a skilled labour force. De Beers' will work with its long-term contractors to ensure that salary and benefits for contract employees on site are also positioned competitively.

Employees of the Project will be offered the same comprehensive and competitive benefits package that all De Beers employees receive, which generally includes the following:

- health benefits, including medical travel assistance;
- life insurance;
- dental care;
- optical care;
- comprehensive employee and family assistance programs;
- out-of-province/ out-of-emergency medical treatment;
- long- and short-term disability insurance for sickness and injury income protection;
- vacation;
- sick and bereavement leave;
- supplemental benefits to maternity leave;
- northern relocation benefit;
- miscellaneous payroll deductions including options for retirement;
- employee incentives for safety, attendance, and length of service;
- professional memberships; and
- social/fitness benefits.

Employees will be provided with a job description, roles and responsibilities, and key performance indicators. Annually, performance measures that ensure targets for safety, environmental performance, and production will be set and incentives established for staff to achieve them. Targets will be established, reviewed, and incentive payments approved by management. Workers will also be recognized and rewarded through a recognition program. Incentives may also be provided to employees interested in volunteering their time for social or cultural programs or activities in their home communities.

3.11.7 Training

De Beers has developed the following specific training approach for its northern operations:

- maintaining a human resource office in the NWT;
- working with contractors to achieve the goal of training members of Aboriginal communities and NWT residents;
- linking training strategies to support impact–benefit–agreement implementation with Aboriginal communities;
- establishing a mine orientation program for all new employees;
- establishing a recruitment and training strategy for school students that encourages and promotes the completion of secondary school;
- making best efforts to schedule training so that potential employees who have completed the training will be able to take immediate advantage of employment opportunities with the Project, and encourage contractors to do the same;
- participating in career fairs where appropriate;
- conducting a training needs assessment to identify existing educational and/or skill levels of Aboriginal community members and other NWT residents who apply for positions, so that work can be offered to new recruits and opportunities for advancement can be offered to existing employees; and
- training and offering advancement opportunities to existing employees in accordance with the hiring priorities; subject to each employee’s performance, training, skills, interests, and career plan.

Orientation training will be provided to all new hires. Employees will be given a realistic and accurate description of the job they are to perform, including the positive and negative aspects of camp life, and accepted performance levels. In addition, all workers will receive the following types of orientation training:

- orientation to the job and camp life;
- information benefits, hours of work, rotation schedule, and so forth;
- money management;
- health and safety training (e.g., First Aid/CPR, WHMIS, SHE);
- camp and work site rules and policies; and
- cultural awareness and cross-cultural training for northern Aboriginal and non-Aboriginal workers.

3.11.7.1 Supervisor and Mentor Training

A Supervisory Training Program has been developed for supervisory and management staff, which will be mandatory. The program establishes the roles and responsibilities of foremen and supervisors, including coaching and supporting the training and development of their employees.

A mentoring program will be developed by matching Aboriginal workers with those who have the desire and skill to supervise and mentor junior workers. The aim is to encourage career development and advancement for young Aboriginal employees.

3.11.7.2 On-the-job Training and Advancement of Entry-level Workers

De Beers is committed to promoting from within. The aim is to fill as many of the skilled positions and as many of the semi-skilled positions as possible with northern Aboriginal workers over the life of the Project. Unskilled workers will receive on-the-job training. As vacancies in skilled and semi-skilled positions occur, concerted efforts will be made to fill these positions with northern Aboriginal workers.

A learning centre will be located on-site with equipment and resources which will include computers and a learning centre resource library. On-site literacy programs will be linked to recruitment and employment strategies to permit employees to take advantage of career advancement opportunities.

3.11.7.3 Apprentice Training

Apprentice positions will be developed in accord with the operational requirements of the business and in accord with requirements of the Northwest Territories Apprenticeship, Trade and Occupations Certification Act (ATOCA), and those positions filled in accordance with the hiring preferences outlined above. Opportunities will be provided for workers to obtain the necessary training hours to achieve their trade's certificates on-site, including heavy equipment operator, electrician, and mechanic and mill operators. In support of these, De Beers will do the following:

- establish a training program for qualified NWT Aboriginal residents and other NWT residents employed by De Beers who are pursuing certified occupations or trades occupations;
- provide apprentice positions for NWT Aboriginal residents and other NWT residents who successfully meet trades entrance requirements;
- organize and implement training and apprenticeship programs so that employees completing the training will be able to use the skills acquired and time spent as credit towards certification or status recognized in the NWT under the ATOCA;
- record the details of employment and training according to the requirements of the ATOCA; and
- fill the positions in accordance with hiring priorities commitments, subject to the availability of persons who meet the requirements of the Northwest Territories ATOCA.

3.11.8 Aboriginal Language and Cultural Support

Retaining and supporting northern Aboriginals is important to De Beers. As such, the company strives for a culturally supportive work place. Among the actions that are already supported with plans to continue are:

- providing its core policies in print in English, French, Chipewyan, and Tlicho;
- incorporating Dene culture and traditions into key site celebration activities;
- encouraging the practice of Aboriginal languages at the worksite when it does not compromise health and safety. English will be the general working language for conveying instructions related to operations;
- to the extent operationally possible, assigning entry-level Aboriginal workers to a supervisor who will play a mentoring role;
- collaborating with Aboriginal communities on the development and delivery of training programs based on cultural value systems;
- arranging cultural activities as part of the ongoing recreation activities planned at the site; and

- providing and maintaining space at the mine site for spiritual and cultural pursuits.

3.11.9 Alcohol, Drugs, and Harassment

De Beers will continue to promote a healthy and safe work site, and healthy lifestyles off-site. A key aim of the Project is to protect the safety of its workers and employees, as well as to protect De Beers' investment. Among the focal points is the Dry Site Policy, which establishes that all workplaces will be drug- and alcohol-free. This includes workers in transit who will be required to remain sober and drug-free during their entire transit to and from the mine site. De Beers practices a zero tolerance towards harassment, fighting, or bullying on site.

3.11.10 Firearms, Hunting, and Fishing

Workers will not be allowed to hunt or fish while at the site at any time during the life of the Project. No personal firearms will be allowed on-site at any time during the life of Project.

3.11.11 Smoking

A smoke-free work and living place will be provided at the Project site. Suitable areas for those who do smoke will be designated at the Project site.

3.11.12 Employee and Community Outreach

3.11.12.1 Literacy Programs

Literacy programs will be provided for employees and will continue in selected communities. In both cases, De Beers will work with community agencies to ensure that literacy programs will be directly linked to other kinds of upgrading, education, and training programs, so that participants may further improve their qualifications towards employment.

One initiative that has been implemented in NWT Aboriginal communities in order to foster increased literacy levels is the Books in Homes Literacy Program. With this initiative, De Beers is helping families build home libraries by providing children from preschool to Grade 12 with three free books per year to take home each school year.

3.11.12.2 Health and Wellness

Health and wellness of individuals and families is fundamental to the social, economic, and cultural sustainability of communities. De Beers' employees and their immediate family members may access counselling services through the company health care plan.

3.11.13 Communications and Engagement

De Beers will continue to conduct ongoing communications and engagement activities with community residents and leaders, prospective workers, Aboriginal organizations, and the Federal and Territorial governments. This will be accomplished through the following:

- regular community visits and communications from community liaison coordinators;
- communications with elected leadership;
- occasional visits by managers and professionals to communities for participation in key events;
- participation in local career fairs and recruitment drives;
- visits to the Project site for leaders, elders, youth, and lands and environment committee members;
- clear, accessible, transparent, and up-to-date Project website that provides general information as well as specific details about local jobs and contracts; and
- extensive use of internet, email, and other communication tools.

3.11.13.1 Access to Project Facilities

The Project facilities will not be made available to the general public. The airport and access roads to the Project mine site and airstrip will be operated as private facilities for mine construction and operation purposes, except in emergency situations. Signs will be posted and reasonable efforts will be made to advise the local communities of these restrictions. However, in keeping with De Beers' goal to be a good neighbour to communities in close proximity, community liaison coordinators will coordinate and welcome special visits to the Project facilities with Aboriginal leaders.

3.11.14 Contracting and Procurement

Policies intended to increase business and value-added opportunities for NWT businesses were established for the Snap Lake Mine. Wherever feasible, and consistent with sound procurement management, these will be continued for the Project. Procurement needs will be sourced from NWT businesses as much as practical during construction, operations, and closure. Special emphasis and priority will be placed on contracting businesses in the selected communities. Opportunities will be provided for sourcing procurements in the following order of priority:

- N'Dilo, Detah, Yellowknife, and Łutselk'e;
- Tłı̨chǫ communities;
- NWT businesses, industry, and business associations;
- other Canadian businesses.

All contractors to the Project will be expected to conform to the following general criteria:

- cost competitiveness;
- quality;
- ability to meet the technical specifications of prescribed goods and services;
- ability to supply and deliver the goods and services;
- timely delivery;
- safety, health, and environmental record; and
- degree of northern Aboriginal participation.

De Beers retains the right, at its sole discretion, to make decisions relating to contract performance criteria, qualifications regarding contractors, the assessment of tenders against selection criteria, and the design and implementation all systems for measuring contractor performance.

3.11.14.1 Contracting and Business Support

De Beers is committed to supporting local and regional businesses that deliver products and services that meet the company's specifications and do so in a safe, timely, cost competitive, and efficient manner. While some contracts will be arranged directly, De Beers will provide the following support to northern businesses to help them prepare to bid on contracts and to maximize northern Aboriginal content:

- Sessions will be held in Yellowknife to provide summary information on contracting opportunities.
- Advance notification will be provided for routine procurement opportunities whenever possible. Advance notification will not include procurement that is required for specialized services not available in the NWT or on an as-needed basis (new parts for equipment repair, for example).
- Where possible, De Beers will match contract size and/or adjust contract duration to business capacities and capabilities.
- Where local and regional businesses are contracted to procure goods and/or services, a general notification list will provide detailed information and specifications.
- Upon request, post-award information will be provided to unsuccessful businesses in the interests of improving their competitive and technical capabilities for future tender packages.

3.11.14.2 Business Opportunity Management Initiatives

De Beers has already undertaken the following measures to maximize Project-related business opportunities for Aboriginal and NWT businesses. These will continue for the Project.

- A position will continue to be staffed with the responsibility to act as a liaison between De Beers, Government of the Northwest Territories, Aboriginal groups, and NWT businesses.
- A business development strategy for Aboriginal groups and communication of the scope and scale of business opportunities and Project requirements in a timely and effective manner.
- Identification of project components, at all stages of construction, operations and closure of the Project, that should be targets for a business development strategy.
- Identification of possible opportunities for joint ventures with Aboriginal businesses.
- Maintaining an NWT business policy that supports the objectives and commitments aforementioned.
- Sharing of business-related expertise with its industry contacts to Northwest Territories' mine-related business initiatives.

- Development of a flexible contracting approach by size and scope to match the capacity of Aboriginal businesses and NWT businesses, where feasible.
- Preparation of a business opportunities' forecast to identify foreseeable procurement requirements of the Project, and providing this to Aboriginal businesses and NWT businesses in accordance with the purchasing priorities set out above.

3.12 CLOSURE AND RECLAMATION

3.12.1 Introduction

3.12.1.1 Objectives

Two important concepts for the Project are "progressive reclamation" and "design for closure". Closure and reclamation were considered during the selection of design alternatives. As such, closure and reclamation planning has been considered in all Project phases, including design. Progressive reclamation during operations, and closure and reclamation of the site at the end of mining will be consistent with the objectives outlined by INAC in the *Mine Site Reclamation Guidelines for the NWT* (INAC 2007).

The overall goal of the reclamation plan is to minimize the lasting environmental impacts of operations to the extent practical and allow disturbed areas to return to productive fish and wildlife habitat as quickly as possible.

Short-term reclamation objectives include the following:

- progressively reclaim disturbed areas during operations as soon as they are no longer required;
- minimize the risk of erosion and sediment loss as a result of on-site runoff;
- stabilize slopes on all structures to maintain safe working conditions and facilitate reclamation activities;
- restore natural drainage patterns where possible;
- cover ground to prevent soil drifting and dust production; and
- maintain an environmentally safe site.

Long-term objectives consist of the following:

- restore or replace the natural fish habitat that may have been lost, altered, or disturbed as a result of the Project;
- return the site to a state that is similar to other habitats in the same region and time period that are not affected by the Project; and
- create, to the extent practical, an aesthetically pleasing final landscape.

In line with the above-noted objectives, De Beers has made the following commitments for the Project:

- minimize, to the extent practical, the total amount of area disturbed by Project activities at any one time through the use of progressive reclamation;
- recover as much soil as practical for use in reclamation activities;
- develop a fish compensation plan that meets the “no-net-loss” guiding principle established by Fisheries and Oceans Canada (DFO);
- conduct reclamation trials throughout the life of the Project to determine what prescriptions work most effectively at the Project site; and
- actively liaise with other mine operators in the Canadian Arctic to understand the challenges and successes they have encountered with respect to reclamation.

Although closure and reclamation will be progressive and begin as soon as possible, it will extend years after mine closure. De Beers will use proven technology that is available at the time of reclamation, in accordance with the legal requirements at that time to facilitate reclamation as quickly as possible.

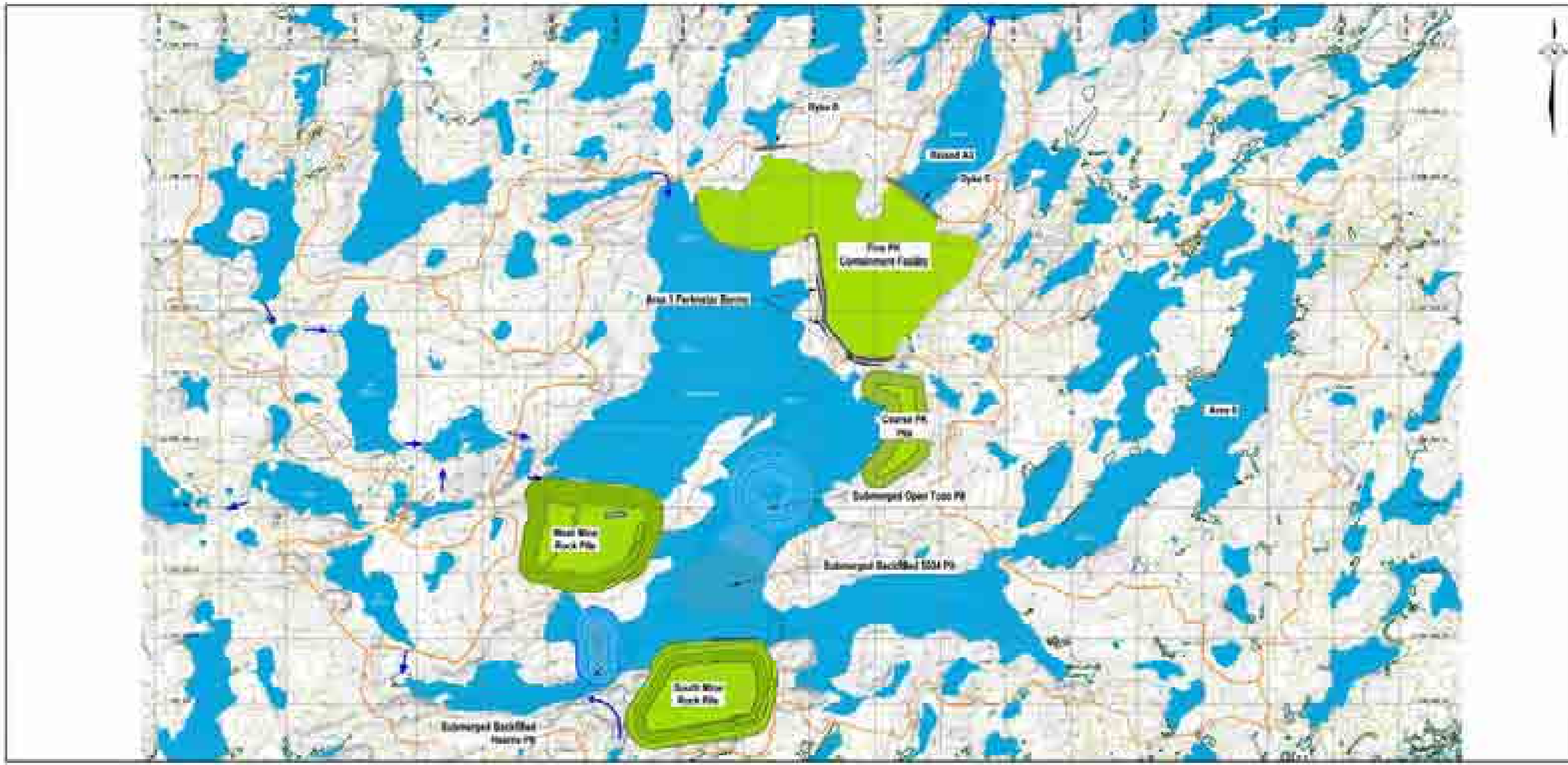
3.12.1.2 Overview of Key Closure and Reclamation Activities

The general components of the reclamation program are summarized briefly as follows:

- Salvage and stockpile soil, overburden, and lakebed sediments, to the extent practical, from areas of disturbance.
- Create new or expanded fish habitat areas during construction and operations phases. Progressively install fish habitat enhancements in Areas 6 and 7 during periods when basins are fully drained.
- Progressively reclaim parts of the Area 1 and Area 2 portions of the Fine PKC Facility.

- Progressively reclaim portions of the South Mine Rock Pile.
- Progressively reclaim portions of the West Mine Rock Pile.
- Progressively backfill the 5034 Pit.
- Progressively backfill the Hearne Pit.
- At the end of operations:
  - Remove all potentially hazardous materials from site.
  - Dismantle and remove or demolish all buildings and related structures.
  - Remove all above-grade (i.e., above ground level) concrete footings and foundations.
  - Construct additional fish compensation habitat near Kennady Lake.
  - Construct additional fish habitat enhancements structures, although most habitat enhancement structures will be constructed during operations.
  - Refill Kennady Lake using natural runoff and supplemental waters drawn from Lake N11.
  - Cut channels in Dykes B, K, and N to begin filling the areas around Tuzo Pit and 5034 Pit and allow for lowering of all dykes below final planned lake elevation.
  - Upon refilling the lake and achieving appropriate water quality, breach and/or partially remove Dyke A to connect the reclaimed portions of Kennady Lake with Area 8.
  - Monitor conditions over time to evaluate the success of the Closure and Reclamation Plan and, using adaptive management and newer proven methods as available, adjust the plan, if necessary.
  - De Beers will comply with the legal requirements for closure and reclamation in effect at the end of operations.

An illustration of the Project site after reclamation is shown in Figure 3.12-1.



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

Marsh Area

Scrub

Sub-watershed Boundary

Drainage Flow Direction

Lake/Pond

Mine Rock

NOTES
Base data source: EBA Figure 8.2 - Final Reclamation

GAHCHO KUE PROJECT

Final Reclamation

PROJECTION: UTM Zone 12	DATUM: NAD83
FILE No: P-Other-012-CAD	DATE: November 1, 2010
JOB No: 09-1365-1004	REVISION No: 4
OFFICE: GOLD - SAS	DRAWN: AJL/AKG
CHECK: PT	

Figure 3.12-1

3.12.1.3 Schedule of Key Activities

The cornerstone of the Project's Closure and Reclamation Plan is progressive reclamation, whereby any disturbed area that is no longer in use is reclaimed as soon as possible and practical. As a result, closure and reclamation activities will occur throughout the 11-year operational life of the Project. Key milestones in the closure and reclamation schedule are outlined in Table 3.12-1.

Table 3.12-1 Key Activities and Milestones in the Conceptual Closure and Reclamation Schedule

Activity / Milestone	Year
Begin progressive reclamation of Fine PKC Facility (Area 1 and 2)	3
Begin progressive reclamation of South Mine Rock Pile	5
Begin progressive reclamation of West Mine Rock Pile	7
Begin progressive reclamation of the 5034 Pit	5
Begin progressive reclamation of the Hearne Pit	7
Begin progressive reclamation of Coarse PK Pile	6
Finish mining in the Tuzo Pit	11
Breach Dykes B, K, and N	11
Decommission explosives storage and manufacturing facilities	11
Complete construction of fish enhancements structures	11
Start to decommission processing plant and service shop	12
Complete decommissioning of processing plant and maintenance complex	12
Decommission main power plant	12
Remove main fuel storage tanks	12
Remove permanent accommodation complex	13
Achieve interim closure status	13
Reclaim site roads not required for reclamation monitoring	13
Breach Dyke A	19+
Complete the refilling of Kennady Lake	19+
Final demobilization from site	19+
Monitor post-closure conditions in Kennady Lake	20+

[a] Assumes mining operations begin in 2015 (Year 1) and end in Year 2025 (Year 11).

3.12.2 Overburden and Soil

During the development of the mine, overburden (including lakebed sediments) will be removed to expose the top of the kimberlite pipes contained within the Hearne, 5034, and Tuzo deposits and to allow surface mining of the deposits to proceed. To the extent possible and practical, these materials will be stockpiled as a portion of the South Mine Rock Pile and used for construction and/or reclamation activities, as part of the overriding “design for closure” philosophy that has been adopted for the Project. For example, overburden (including lakebed sediments) will be used to cover any areas in the core of the mine rock pile where potentially reactive mine rock (if present) is sequestered. The lakebed sediments and overburden, which consist mainly of till, will provide a low permeability barrier that will limit infiltration and encourage water to flow over the surface of the mine rock pile, rather than through it.

In a similar fashion, soils disturbed during the construction of the plant site, airstrip, and other on-land facilities will be, to the extent possible and practical, initially stockpiled in the South Mine Rock Pile. As progressive reclamation occurs, soils will be recovered from the stockpiles and spread over reclaimed areas that would benefit from additional soil.

3.12.3 Mine Rock Piles

Over the mine life, the Project is projected to produce approximately 226 Mt of mine rock. Of this total, approximately 143 Mt of mine rock will be placed in two designated mine rock piles during operations. The South Mine Rock Pile final pile crest will be at a surface elevation of approximately 515 masl, giving the pile a maximum height of about 90 m. The West Mine Rock Pile will have a final crest elevation of 474 masl and a height of 70 m. Both piles will be developed with 2.4H:1V overall side slopes. The angle of the side slopes will provide stability against sliding, with flatter side slopes being constructed when the final slope is exposed to the shoreline. The mine rock piles are expected to be in permafrost conditions at the end of mine life (Year 11) since the piles are constructed in ambient conditions that average -10°C.

Geochemical testwork on the mine rock will be ongoing throughout the operational period, but results to date indicate that any potentially acid-generating rock would comprise only a small proportion of the overall mine rock tonnage. Any potentially reactive rock will be identified by mine geologists and confirmed by blast hole sampling and testing, and will be sequestered within the central zone of the mine rock pile. Only non-reactive mine rock will be placed on the upper and outer surfaces of the mine rock pile. The thickness of the cover layer is predicted to be sufficient so that the active freeze-thaw layer remains within the non-reactive mine rock.

Based on available survey data, the mine rock piles will be constructed in Areas 5 and 6, and designed in such a way to allow both short- and long-term stability. A minimum thickness of 2 m of non-reactive mine rock will be placed prior to placement of any barren kimberlite, or mine rock mixed with barren kimberlite. This procedure will be used because experience at the Ekati Diamond Mine suggests that coarse kimberlite placed in direct contact with tundra soils can lead to low pH drainage due to the acidic nature of the tundra soils. Placing the initial layer of non-reactive mine rock at the bottom of the mine rock piles will separate barren kimberlite from the tundra soils.

Closure of the mine rock piles will involve contouring and re-grading, and will occur progressively, starting as early as Year 5 for the South Mine Rock Pile and Year 7 for the West Mine Rock Pile (Table 3.12-1). The piles will not be covered or vegetated, consistent with the approaches in place at the Ekati Diamond Mine and Diavik Diamond Mine. Thermistors will be installed within the mine rock piles to monitor the progression of permafrost development. The upper portion of the thick cover of clean mine rock over the waste repository will be subject to annual freeze and thaw cycles, but the PK and PAG rock sequestered below are predicted to remain permanently frozen.

3.12.4 Fine Processed Kimberlite Containment Facility

Reclamation of the Fine PKC Facility will be completed during mine operations. As the Area 1 portion of the facility becomes filled during the initial years of operations, it will be covered with a layer of coarse PK to prevent the fine PK from being windblown. This will allow subsequent vehicle traffic and placement of approximately a 1 m to 2 m thick layer of non-AG mine rock. The facility will be graded so that any surface runoff will flow towards Area 3.

The Area 2 portion of the Fine PKC Facility will be reclaimed in a similar fashion. Any remaining water impounded within Area 2 behind Dyke L will be backfilled with coarse PK or mine rock to provide runoff drainage patterns flowing into Area 3. As above, the closure scenario also involves a non-AG mine rock covered terrain. For both Area 1 and Area 2, the final geometry of the cover layer will be graded to limit ponding of water over the mine rock covered areas.

Permafrost development in the Fine PKC Facility and underlying talik is expected to occur over time. Thermistors will be installed in the Fine PKC Facility to monitor the formation of permafrost in the solids. The Fine PKC Facility is anticipated to take an appreciably longer time (i.e., to the end of the reclamation phase) than the mine rock piles to establish permafrost conditions.

3.12.5 Coarse Processed Kimberlite Pile

The Coarse PK Pile is located on land adjacent to Area 4. It will be shaped and covered with a layer of mine rock of a minimum of 1 m to limit surface erosion. Runoff will be directed to Area 4.

3.12.6 Mine Pits

The Project will result in the creation of three mined-out pits: 5034, Hearne, and Tuzo. The closure and reclamation activity planned for each pit is described below.

3.12.6.1 5034 Pit

Mining within the 5034 Pit is scheduled to finish in Year 5 and the pit is expected to be about 305 m deep. Once mining in the pit has ceased, closure and reclamation activities, in the form of backfilling, will begin.

The 5034 Pit will be the primary storage area for mine rock from the Tuzo Pit, although PK might also be stored in the 5034 Pit. The 5034 Pit will be completely backfilled except for the northern quarter where it borders the Tuzo Pit; this shared boundary is lower than the bottom of Kennady Lake. The 5034 Pit will be backfilled to the extent possible with mine rock; the remaining space will be eventually filled with water once mining in the Tuzo Pit is complete.

3.12.6.2 Hearne Pit

Mining within the Hearne Pit is scheduled to finish in Year 7 of operations. Once mining in the pit has ceased, backfilling will begin. Hearne Pit will be the repository for the fine PK stream, which will be released via a pipeline into the pit. Although unlikely, mine rock and coarse PK may also be deposited in the Hearne Pit. Runoff water, pit water, and decant water from the fine PK will cause a water layer above the settled fine PK in the Hearne Pit. The water will be left in place to allow for an accelerated filling schedule. The top of the fine PK in the pit is anticipated to be 120 m deep; in comparison, the total depth of the Hearne Pit is expected to be 205 m.

3.12.6.3 Tuzo Pit

The Tuzo Pit, which is the last pit to be mined, will not be backfilled with material and will be about 305 m deep. The pit will be allowed to flood following the completion of the operations phase. Natural watershed inflows will be supplemented by pumping water from Lake N11. Flooding of the pits and returning Kennady Lake to its original lake level is expected to take about eight years after the end of operations.

3.12.7 Buildings, Machinery, and Other Infrastructure

After mining has ceased, closure and reclamation of the plant site and airstrip will begin. Gradually, all buildings, machinery, equipment, and other infrastructure established as part of the Project will be demolished, removed, or buried.

To support on-site personnel during the initial closure and reclamation phase of the Project, suitable site services, including potable water treatment, sewage treatment, and communications, will be maintained. Once they are no longer needed, they will be decommissioned, dismantled, and disposed of, as appropriate. They will be replaced, as appropriate, with smaller, temporary facilities in support of post-closure monitoring activities.

3.12.7.1 General Demolition and Disposal Procedures

Prior to demolition, buildings and equipment will be inspected so that potentially hazardous materials are correctly identified and flagged for appropriate removal and disposal. All equipment will be drained of fluids and cleaned so that potentially hazardous materials are not placed within the inert materials landfill.

Before beginning these activities, the appropriate authorizations for the non-hazardous waste disposal site will be obtained as required from the relevant regulatory agencies that deal with land leases and water use, such as the MVLWB and INAC.

3.12.7.1.1 Salvageable Materials

Structures, equipment, and materials deemed economically salvageable at the time of demolition will be dismantled and removed from site. Equipment will be cleaned, drained, and degreased as required before off-site transport.

Salvageable equipment is generally expected to include machinery and mobile equipment in working or repairable condition. Hazardous materials are generally expected to consist of waste oil, glycol, lubricants, solvents, paints, batteries, and miscellaneous chemicals. Some of these materials may be suitable for recycling, if appropriate facilities off-site are available.

Salvageable equipment to be shipped off-site will be prepared and stored in one of the site laydown areas. Hazardous materials will be stored in sealed containers and drums in a lined waste transfer area or temporary enclosure. The equipment and materials will be shipped to appropriate disposal, recycling, or salvage facilities (most likely in Edmonton) on the next available winter road.

3.12.7.1.2 Inert Solid Materials

Non-salvageable and non-hazardous components from demolition of the site buildings, structures, and equipment will be dismantled, washed and/or degreased (as necessary), and deposited in the inert materials landfill within the mine rock pile. The landfill will be above the water level of the re-filled Kennady Lake. The deposited materials will then be covered with a layer of non-reactive mine rock.

All above-grade concrete structures will be demolished, and any remaining below-ground footings/foundations covered with till or rock. Demolition concrete will be placed in the inert materials landfill.

3.12.7.1.3 Potentially Contaminated Soil and Hazardous Materials

The potential for ground contamination around the maintenance building and other structures will be assessed. Assessed areas will include the airstrip de-icing area and fuel storage pad, fuel tank farm, processing plant, power plant, accommodations complex, service complex, waste management facilities, and storage facilities. Soils in these areas will be sampled during decommissioning and analyzed for contaminants, such as hydrocarbons and glycol. Any contaminated soils will be excavated and either permanently encapsulated in a secure area, treated on-site to an acceptable standard, or stored in appropriate sealed containers for off-site shipment and disposal.

Hazardous materials will be stored in sealed containers and drums in a lined waste transfer area pending shipment to the appropriate off-site recycling, or disposal facility. Generally, hazardous materials will be retrieved directly by licensed companies specializing in the handling of these materials.

3.12.7.2 Process Facility

At the end of the operational life of the mine, all remaining ore stockpiles will be processed through the plant. The base of the stockpile will be scraped by bulldozers, and the scrapings run through the processing plant. Once all the ore has been processed, the various circuits within the processing plant will be flushed and cleaned.

When the milling circuit has been cleaned out, the interior of the building will be washed. All potentially hazardous materials, such as hydrocarbons, chemicals, and reagents, will be removed and prepared for off-site disposal. The process equipment will be drained of any potentially hazardous materials, such as lubricating oil and glycol. In addition, all utilities and services, including air, glycol, power, and water, will be shut off, de-energized, and drained as necessary to permit demolition.

Buildings and equipment with no salvageable value will be dismantled and buried in the inert materials landfill. Specific materials will be dealt with as follows:

- Concrete foundations and floor slabs will be broken down to original ground level and demolition rubble buried in the inert materials landfill.
- Surface piping will be flushed, if necessary, removed, and buried in the inert materials landfill.
- Buried electrical cables will be cut approximately 1 m below grade at surface terminations and left intact. The remaining above-ground cable will be removed and disposed of in the inert materials landfill.
- All other inert materials not suitable for re-use or salvage, such as metal cladding, wallboard, and insulation, will be buried in the inert materials landfill.

At closure, a 1 m to 2 m cover of mine rock will be placed over the wastes in the inert demolition landfill.

3.12.7.3 Power Plant

One or more of the main generators will remain operational as long as necessary during the reclamation period to provide power. Once they are no longer needed, the generators will be decommissioned. The power plant will then be dismantled and salvaged or otherwise reclaimed using practices similar to those described for the processing plant.

After the power plant has been decommissioned, a small amount of power may still be required for accommodations, site services, and other activities. If such is the case, a small, skid-mounted diesel generator set will remain on-site; it will be demobilized when it is no longer required.

3.12.7.4 Explosives and Related Facilities

All explosives will be removed from the site by qualified contractors and handled only by certified employees in compliance with the federal *Explosives Act* and the *NWT Mine Health and Safety Act and Regulations*. Once the explosives and supporting infrastructure have been removed, the related buildings will be reclaimed as described above for other similar structures.

The remaining inventory of ammonium nitrate left on-site at the end of mining will either be returned to the supplier or transferred to another licensed user. The emulsion plant will be decommissioned, cleaned, and demolished in the same way as other buildings.

The remaining inventory of explosives caps left on-site at the end of mining will either be returned to the supplier or transferred to another licensed user. The cap magazines will then be decommissioned, cleaned and either removed from site for salvage or demolished.

3.12.7.5 Other Buildings

The shop complex will be decommissioned, cleaned, and demolished in a manner similar to the processing plant. The accommodations complex will remain in partial use after mine operations end until it is no longer required. Non-needed portions of the camp will be decommissioned and reclaimed. Upon completion of the reclamation program, the remaining portion of the camp will be removed from site.

3.12.7.6 Transportation Corridors and Airstrip

Site roads not required for post-closure maintenance and monitoring will be decommissioned and reclaimed at the end of the closure phase; the rest will be reclaimed at the end of post-closure monitoring period. Post-closure access to the site will be achieved primarily by aircraft, with minimal vehicle traffic.

The airstrip will be reclaimed near the end of the site closure phase of the Project. It will be preferable to leave the airstrip until the end of monitoring requirements; this would be decided during the site closure phase. Lighting, navigation equipment, and culverts will be removed, and contouring will be done to eliminate potential hazards to wildlife. Reclamation will involve scarifying and loosening the surface to encourage natural re-vegetation. Where erosion or sedimentation is a concern, the surface will be re-contoured. Culverts or stream-crossing structures will be removed, and natural drainage re-established.

3.12.7.7 Fuel Storage Tanks

Before demobilization, the remaining diesel fuel inventory will be assessed for requirements for temporary power generation and construction equipment during the reclamation program. In the event of a shortfall, additional diesel fuel will be delivered to site and stored in the fuel tank farm. Smaller portable envirotanks will be used for fuel storage to allow the permanent tanks to be removed at the end of the closure program.

Before the permanent tanks are dismantled, any remaining inventory will be withdrawn. Steel plate sections and distribution system components will be washed and disposed of in the inert materials landfill, pursuant to regulatory approval. The containment berm and liner materials will be removed, and the area re-graded. Any additional fuel required for power generation and equipment for demobilization activities and post-closure monitoring will be drawn from the envirotanks.

3.12.7.8 Solid Waste Management Areas

The incinerators, waste handling equipment and associated structures will be dismantled. Salvageable equipment and structures will be demobilized from site. Non-salvageable equipment, materials, and structures will be disposed of in the inert materials landfill.

The potential for ground contamination in the immediate area of the incinerator and waste-handling facilities will be assessed, and any required remediation will be undertaken. A cover of non-reactive mine rock will then be placed over the site, and the area will be re-graded to blend with the surrounding topography.

Operation of the landfill will include the regular placement of a 2 m cover of non-reactive mine rock over the deposited wastes. Upon closure of the site, all remaining waste materials will be covered with a layer of non-reactive mine rock.

3.12.7.9 Quarries

The reclamation of any quarries (none currently envisioned) will involve removing all mobile and stationary equipment, and then stabilizing and contouring the surface of the quarries to blend with the surrounding landscape. Quarries will be decommissioned at different times during the operation of the Project. Those used primarily for construction will be reclaimed early in the operation of the Project. The remaining quarries will be reclaimed at the end of operations. For the most part, mine rock will be used as the source of aggregate production minimizing the need for quarries.

3.12.7.1 Conceptual Fish Habitat Compensation Plan

Construction and operation of the Project will cause harmful alteration, disruption, or destruction (HADD) of fish habitat in the Kennady Lake watershed. The affected habitat areas include portions of Kennady Lake and adjacent lakes within the Kennady Lake watershed that will be permanently lost, portions that will be physically altered after dewatering and later submerged in the refilled Kennady Lake, and portions that will be dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake. During Project construction and operations, there will also be alterations of flows within the Kennady Lake watershed and in areas downstream from the Kennady Lake watershed.

Compensation options have been developed and evaluated in step with the evolution of the Project. Additionally, meetings between De Beers and DFO have occurred on several occasions, including site visits by DFO. The Conceptual Compensation Plan (Appendix 3.II) outlines anticipated Project effects on fish habitats, describes the various options considered for providing compensation, and presents a proposed fish habitat conceptual compensation plan to achieve no net loss of fish habitat according to DFO's Fish Habitat Management Policy (DFO 1986, 1998, 2006).

3.12.7.1.1 Proposed Conceptual Compensation Plan

The proposed fish habitat compensation plan consists of a combination of the many compensation options considered (Appendix 3.II). The preferred options for the proposed compensation plan include Options 1b and 1c (raising the water level in lakes to the east of Kennady Lake), Option 2 (raising the level of Lake A3), and Option 10 (widening the top bench of mine pits where they extend onto land. Also included in the proposed compensation plan are Options 3 and 4 (construction of habitat enhancement features in Areas 6, 7, and 8) and Option 8 (the Dyke B habitat structure).

The amount of compensation habitat, in terms of surface area, provided by the proposed compensation plan is summarized in Table 3.12-2. This table also shows the compensation habitat areas and compensation ratios (based on habitat surface area) during operations and after closure with compensation Options 1b, 1c, 2 and 10, and including altered areas of Kennady Lake that will be reclaimed and submerged at closure.

Quantification of habitat gains in terms of habitat units (Hus), and determination of compensation ratios based on HUs, will be completed as part of the development of a detailed compensation plan to be completed in 2011.

Table 3.12-2 Summary of Fish Habitat Compensation Achieved with the Proposed Conceptual Compensation Plan

Compensation Description	Compensation Habitat Area (ha)	
	During Operations	After Closure
Newly Created Habitat		
Option 1b – Construction of Impounding Dykes F, G, E1 and N14 to the west of Kennady Lake to raise the water levels of Lakes D2, D3, E1, and N14 to 428 masl elevation	149.7	–
Option 1c – After closure, further raise the water level in Lakes D2, D3, E1, and N14, and the surrounding area, to 429 masl and reconnect the flooded area to Kennady Lake through Lake D1	–	195.9
Option 2 – Construction of Impounding Dyke C between Area 1 and Lake A3, Dyke A3 to the north of Lake A3, and Dyke N10 between Lakes A3 and N10 to raise Lake A3 to 427.5 masl elevation	31.1	31.1
Option 10 – Widening the top bench of pits (to create shelf areas) where they extend onto land	–	13.7
Altered Areas Reclaimed and Submerged at Closure		
Hearne Pit [(a)]	–	16.0
5034 Pit [(a)]	–	35.0
Tuzo Pit [(a)]	–	35.2
Dykes A, B, J, K, and N	–	23.8
Road in Area 6	–	4.0
Water Collection Pond Berms CP3, CP4, CP5, and CP6	–	1.3
Mine rock areas [(b)]	–	25.3
Total	**180.8**	**381.3**
Compensation Ratios (gains:losses) [(c)]	**0.65**	**1.37**

(a) The areas for these options are the entire pit areas, including habitat features along the edges and the deep-water areas.
(b) The mine rock piles with final surface elevations between 410.0 and 418.0 masl are considered as compensation habitat.
(c) Calculated based on total area of permanently lost habitat and physically altered and re-submerged habitat (277.8 ha; Tables 3.II-2 and 3.II-11).

ha = hectares; masl = metres above sea level.

3.12.7.1.2 Monitoring Effectiveness of Compensation

Habitat created or enhanced to compensate for the loss of fish habitat will be monitored to assess effectiveness of compensation by evaluating the physical and biological characteristics of the habitats, as well as fish use of the habitats. Habitat improvements will be implemented, as part of an adaptive management approach in consultation with regulators, if new or enhanced habitats are not providing the required habitat components for the target fish species.

Monitoring results would be used, if necessary, to adjust mitigation and habitat compensation measures and make design improvements as required. Habitat monitoring will be key to confirming the no net loss objective has been achieved. Details of the compensation monitoring will be included in the detailed compensation plan. The detailed monitoring plan will be designed to meet all fish and fish habitat monitoring requirements included as conditions attached to any regulatory authorizations, approvals or permits that may be issued for development of the Project. Should, for some reason, the existing proposed habitat compensation not be sufficient to achieve no net loss of the productive capacity of fish habitat, additional habitat compensation would be developed in consultation with the appropriate regulators.

3.12.8 Site Stabilization and Re-vegetation

The entire area will be stabilized and contoured. Any remaining overburden will be used for final reclamation.

3.12.8.1 Erosion Control

Erosion will be controlled principally by keeping slope angles of constructed facilities at less than the angle of repose or by rock armouring, as appropriate. Where feasible, long-term sediment control will be achieved by re-vegetation. Rock armouring will be done where re-vegetation is not possible and erosion control is required. The rock will be obtained by screening suitably sized inert material from the mine rock stockpile.

3.12.8.2 Re-vegetation

Re-vegetation in northern areas is challenging because of limitations associated with cool short summers, low precipitation levels, cold winters, permafrost, and other biotic and abiotic influences that are not always readily identifiable or controllable. Other challenging factors include the limited availability of soil, a less-than-comprehensive understanding of indigenous plant phenology and associated succession processes, and the general absence of endemic plant seeds or insufficient quantities for use in large-scale planting or seeding. As a result, growth and establishment of vegetation in northern areas is often slow and unpredictable.

There are few examples of successful and well-documented re-vegetation programs in northern latitudes, especially for larger disturbances, that can provide direction. Emerging technology and empirical studies from southern locales are not directly relevant to northern areas. A re-vegetation management plan that can fulfill the reclamation objectives will need to be flexible and developed through the operational life of the mine to take advantage of key findings obtained at other mine sites. At the Ekati and Diavik mines, active reclamation research has been ongoing for several years with the goal of developing optimum re-vegetation strategies for disturbed northern areas (HMA 2005; Naeth et al. 2005). These research projects have involved the use of various combinations of amendments, soil materials, fertilizers, and vegetative species to maximize re-growth and develop a self-sustaining vegetative cover.

Some key results that will be considered at the Project site include the following:

- Studies at the Ekati Diamond Mine have found that for selective mine units, including a diversion channel, a former exploration topsoil stockpile and a lake sediment stockpile, seedlings and willow cuttings have had some success.
- Similarly, a combination of dwarf birch, fireweed, and bluejoint were successfully established in esker areas at the Ekati Diamond Mine, whereas direct seeding of the tundra has not been successful.
- Care needs to be taken in stockpiling soil materials for reclamation, with free dumping proving to be more effective at maintaining soil physical properties than levelling the piles.
- Site recontouring and landscaping have improved moisture conditions, which in turn have improved re-vegetation success.
- Creating microhabitat, such as small boulder piles and mild depressions to trap moisture, has shown to be effective in enhancing plant growth opportunities, although boulder piles have only worked where vegetation is already established.
- Studies at the Ekati Diamond Mine have found that native plant cultivars applied at a low seeding rate have been the most successful in encouraging native plant recolonization.
- Sewage sludge has had mixed success at the Ekati Diamond Mine, but it has been a key part of plant establishment at the Diavik Diamond Mine (Naeth 2007, pers. comm.).
- Based on experience at the Ekati Diamond Mine, careful control of the application of sludge is required to prevent depressions from over-concentrating sludge and preventing plant establishment.
- Summer planting has not proven successful with seeds failing to germinate or seedlings dying from moisture stress; autumn or spring planting shows the most promise.
- Grazing of newly established vegetation has been problematic at the Ekati Diamond Mine, and some method of discouraging grazers, such as Arctic hares, may be required.
- Salvaged glacial materials mixed with lakebed sediments containing a preponderance of till yield a soil with improved texture that has proved successful in promoting plant growth; however, the inclusion of too much lake sediment has led to soil compaction and the inhibition of plant growth.

Experience gained from closures of the Ekati and Diavik mines will be used at the Project site to develop a re-vegetation management plan to support the successful restoration of the site. The evaluation will consider the physical aspects of re-vegetation, such as re-contouring, erosion control techniques, seedbed preparation, surface roughening, and the use of soil amendments, which collectively promote natural secondary succession. Test plots will be used to assess the effectiveness of various seed mixtures and their application on different growth media. In addition, the feasibility and practicality of collecting seeds from local species will be evaluated.

The overall objective of the re-vegetation management plan will be to create a stable landscape that encourages natural colonization, encroachment, and regeneration of endemic plant species. However, intermediate steps may be required to control soil and slope stability over an appropriate time period. Alternative reclamation methods, such as rock armouring, may also be used to allow for the long-term stability of rock slopes or other site features that may not be suitable for re-vegetation.

3.13 REFERENCES

Canamera. 1996. 1996 Environmental Baseline Studies: Section 6, Acid-Base Accounting. Canamera Geological Ltd., Environmental Resources Division: Vancouver, BC, Canada.

CCME (Canadian Council of Ministers of the Environment). 2003. Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products. Winnipeg, Man.

De Beers (De Beers Canada Inc.). 2005. Gahcho Kué Project: Water License Application Report for the Mackenzie Valley Land and Water Board. November 2005.

DFO (Fisheries and Oceans Canada). 1986. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat. Presented to Parliament by the Minister of Fisheries and Oceans. October 7, 1986.

DFO. 1998. Habitat Conservation and Protection Guidelines Developed from the Policy for the Management of Fish Habitat (1986). Second Edition (1998). Ottawa, Ontario.

DFO. 2006. Practitioners Guide to Habitat Compensation, Developed from the Policy for the Management of Fish Habitat (Habitat Policy) (1986).

DIAND (Department of Indian and Northern Affairs). 1992. Guidelines for Acid Rock Drainage Prediction in the North. Department of Indian Affairs and Northern Development: Yellowknife, NWT, Canada (Prepared by Steffen, Robertson and Kirsten [B.C.] Inc. and B.C. Research and Development).

Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, N.W.T., Canada.

HCI. 2005. Predicted Hydrologic Effects of Developing Gahcho Kue Diamond Project. Prepared for SRK Consulting, Vancouver and prepared by Hydrologic Consultants, Inc. of Colorado, an HCItasca Company, December 2005.

HMA (Harvey Martens & Associates Inc.). 2005. EKATI Diamond Mine Revegetation Research Projects - 2004. Final report prepared for BHP Billiton, Inc., Yellowknife, N.W.T., Canada

INAC (Indian and Northern Affairs Canada). 2007 Mine Site Reclamation Guidelines for the Northwest Territories. Yellowknife, N.W.T. January 2007 Version.

Jacques Whitford (Jacques Whitford Environmental Ltd.). 2000. Project No. BCV 50091: Monopros Ltd. AK Property Acid/Alkaline Rock Drainage Generating Potential Monitoring Plan. Jacques Whitford Environment Ltd,: Burnaby, B.C., Canada.

Naeth, A.M., 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 prepared for Diavik Diamond Mines Inc., Yellowknife, N.W.T.

Naeth, A. 2007. University of Alberta, Professor of Applied Ecology and Land Reclamation. Personal Communication. September 21, 2007.

3.14 ACRONYMS AND GLOSSARY

3.14.1 Abbreviations And Acronyms

ANFO	ammonium nitrate fuel oil
AP	Acid potential
ARD	acid rock drainage
CCME	Canadian Council of Ministers of the Environment
De Beers	De Beers Canada Inc.
DFO	Fisheries and Oceans Canada
DMS	dense-medium separation
EIR	environmental impact review
EIS	environmental impact statement
HPGR	high pressure grinding rollers
INAC	Indian and Northern Affairs Canada
MVLWB	Mackenzie Valley Land and Water Board
non-AG	non-acid generating
NWT	Northwest Territories
PAG	potentially acid generating

PK	processed kimberlite
PKC	processed kimberlite containment
Project	Gahcho Kué Project
TSS	total suspended solids
WMP	Water Management Pond

3.14.2 Units of Measure

<	less than
>	greater than
%	percent
El.	Elevation
kg/hr	kilogram per hour
kg/t	kilogram per tonne
km	kilometre
L	Litre
m^2	square metre
m^3	cubic metre
m^3/y	cubic metre per year
m^3/d	cubic metre per day
m^3/sec	cubic metre per second
m	metre
masl	metres above sea level
mm	millimetre
mg/m^3	milligram per cubic metre
Mm^3/y	million cubic metres per year
Mm^3	million cubic metres
Mt	million tonnes
MW	mega-watt
mg/L	milligram per litre
N	North
pH	concentration of hydrogen ions
t	tonne
t/d	tonne per day
t/hr	tonne per hour
t/m^3	tonne per cubic metre
wt%	percent by weight

3.14.3 Glossary

Abiotic	Non-living factors that influence an ecosystem, such as climate, geology and soil characteristics.
Acid rock drainage	Acidic pH rock drainage due to the oxidation of sulphide minerals that includes natural acidic drainage from rock not related to mining activity; an acidic pH is defined as a value less than 6.0.
Active layer	The layer of ground above the permafrost that thaws seasonally during the summer and refreezes in the fall.
Ammonium nitrate fuel oil	A widely used explosive mixture.
Armouring	Protecting a channel from erosion by covering with protective material.
Backfilling	Using material to refill an excavated area.
Barren kimberlite	Non-diamond bearing kimberlite.
Biophysical	The biological (e.g., plants, animals) and physical (e.g., air, water, soil) components of the natural environment.
Bioremediation	Use of microorganisms or their enzymes to return soil altered by contaminants back to its original condition.
Biotic	Living components of an ecosystem.
Boulder	A large rounded mass of rock lying on the surface of the ground or embedded in the soil.
Breccia	A fragmental rock whose fragments are angular.
Catchment	An area of land where water from precipitation drains into a body of water.
Coarse kimberlite	Coarse kimberlite particles range in size from 1.0 mm to 6 mm.
Degrit	A degrit module consists of cyclones that separate the fine kimberlite (less than 0.25 mm) from the grits (greater than 0.25 mm but less than 1.0 mm).
Diabase	A dark coloured, fine to medium-grained igneous intrusive rock.
Dyke	A tabular body of igneous rock that cuts across the bedding or foliation of the rock it intrudes.
Entrainment	The entrapment of one substance by another substance.
Esker	An esker is a long, winding ridge of stratified sand and gravel believed to form in ice-walled tunnels by streams which flowed within and under glaciers. After the retaining ice walls melt away, stream deposits remain as long winding ridges.
Fetch	An area of a waterbody where waves are generated by a wind having a constant direction and speed (also called Generating Area).
Fine processed kimberlite	Fine processed kimberlite involves particles that are smaller than 0.25 mm.
Fines	Silt and clay particles.
Finger reef	Have asked Gordon and Travis for a definition.
Flocculant	Chemicals that promote flocculation by causing colloids and other suspended particles in liquids to aggregate, forming a floc.
Freeboard	The distance between the water level and the top of a containing structure such as a dyke crest or channel top of bank.

Freshet	Seasonal surface runoff associated with spring melt.
General fill	rock not graded as to size or quality
Glacial till	Unsorted and unstratified glacial drift (generally unconsolidated) deposited directly by a glacier without subsequent reworking by water from the glacier. Consisting of a heterogeneous mixture of clay, silt, sand, gravel and boulders (i.e., drift) varying widely in size and shape.
Granular fill	Screened and sized rock material for earthworks/construction.
Grits	Processed kimberlite particles between 0.25 mm and 1.0 mm in size.
Grizzly	A grating, usually constructed of steel rails to separate coarse material from plant feed.
Groundwater	Water within interconnected pore spaces of the subsurface within the saturated zone below the water table.
Habitat	The place or environment where a plant or animal naturally or normally lives or occurs.
Heat-traced pipes	Piping with electric heating elements to prevent freezing.
Humidity cell	A type of kinetic test in which a small sample (about 1 kg) is placed in an enclosed chamber in a laboratory, alternating cycles of moist and dry air is constantly pumped through the chamber, and once a week the sample is rinsed with water; chemical analysis of rinse water yields concentrations of elements and other parameters used to calculate reaction rates.
Hydraulic gradient	The difference in piezometric level or hydraulic head between two points over a change in distance in the direction, which yields the greatest change in hydraulic head.
Hydrocarbons	Oil based products.
Infrastructure	Basic facilities, such as transportation, communications, power supplies and buildings, which enable an organization, project or community to function.
Landfarm	Facility that contains soil during bioremediation.
Littoral	The shallow, shoreline area of a lake.
Make-up water	The process water required to replace that lost by evaporation or leakage in a closed-circuit, recycle operation.
Mineralization	Diamond bearing material
Muskeg	A soil type comprised primarily of organic matter. Also known as bog peat.
Open-pit mine	A mine where rock or mineral extraction from the earth is done using a pit or borrow open to the surface, rather than using a tunnel into the earth.
Ore body	An accumulation of ore, which is a type of rock that contains minerals with important elements that are typically mined.
Overburden	Materials of any nature, consolidated or unconsolidated, that overlie a deposit of useful materials. In the present situation, overburden refers to the soil and rock strata that overlie kimberlite deposits.
Overwintering	To remain alive over winter.
Permafrost	Permanently frozen subsoil occurring throughout the polar regions.
pH	The degree of acidity (or alkalinity) of soil or solution. The pH scale is generally presented from 1 (most acidic) to 14 (most alkaline). A difference of one pH unit represents a ten-fold change in hydrogen ion concentration.

Pipes/kimberlite pipes	Typically vertical structures of volcanic rock in the Earth's crust that can contain diamonds.
Plant phenology	The study of periodic plant life cycle events and how these are influenced by seasonal and interannual variations in climate.
Potable water	Water that is suitable for drinking.
Potentially acid generating	Rock with a ratio of neutralizing potential to acid potential (NP:AP) of less than 3 as determined by static tests.
Processed kimberlite	The material that remains after all economically and technically recoverable diamonds have been removed from the kimberlite during processing.
Processed kimberlite containment	On-site storage facility for storing processed kimberlite.
Propagules	Root fragments, seeds, and other plant materials that can develop into a plant under the right conditions.
Reagent	A substance or compound that is added to a system to bring about a chemical reaction or is added to see if a reaction occurs.
Runoff	The portion of water from rain and snow that flows over land to streams, ponds or other surface waterbodies. It is the portion of water from precipitation that does not infiltrate into the ground, or evaporate.
Run-of-mine	Not graded according to size or quality.
Sediment	Solid material that is transported by, suspended in, or deposited from water. It originates mostly from disintegrated rocks; it also includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope soil characteristics, land usage and quantity and intensity of precipitation.
Seepage	Slow water movement in subsurface. Flow of water from man-made retaining structures. A spot or zone, where water oozes from the ground, often forming the source of a small spring.
Subject of Note	Issues that require serious attention and substantive analysis (as defined by the Terms of Reference (Gahcho Kué Panel 2007)
Sub-watershed	A smaller portion of a watershed containing a drainage area that is connected to the larger portion by a single channel.
Succession	The progressive replacement of one dominant type of species or community by another in an ecosystem until a stable climax community is established.
Sumps	A well or pit in which liquids collect below floor level.
Talik	A layer of year-round unfrozen ground that lies in permafrost areas.
Thermistors	An instrument used to measure temperature.
Till	Till is an unsorted glacial sediment. Glacial drift is a general term for the coarsely graded and extremely heterogeneous sediments of glacial origin. Glacial till is that part of glacial drift which was deposited directly by the glacier. It may vary from clays to mixtures of clay, sand, gravel, and boulders.
Total dissolved solids	The total concentration of all dissolved materials found in a water sample.
Total suspended solids	A measurement of the concentration of particulate matter found in water.

Tundra	Treeless terrain, with a continuous cover of vegetation, found at both high latitudes and high altitudes. Tundra vegetation comprises lichens, mosses, sedges, grasses, forbs and low shrubs, including heaths, and dwarf willows and birches. The term is used to refer to both the region and the vegetation growing in the region.
Turbidity	The cloudiness or haziness of a fluid caused by individual particles (suspended solids) in water that are generally invisible to the naked eye.
Utilidors	A utility corridor built underground or aboveground to carry utility lines such as electricity, water and sewer.
Mine rock	Excavated bed rock surrounding the kimberlite deposits. Mine rock consists primarily of granitic rock material.
Watershed	The entire catchment area of runoff containing a single outlet.

APPENDIX 3.I

ACCIDENTS AND MALFUNCTIONS

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3.I ACCIDENTS AND MALFUNCTIONS

3.I.1 INTRODUCTION

3.I.1.1 Purpose

The environmental impact statement (EIS) for the Gahcho Kué Project (Project) has been prepared as part of an application by De Beers Canada Inc. (De Beers) to construct and operate a diamond mine at Kennady Lake in the Northwest Territories (NWT). The purpose of Appendix 3.I of the Project Description (Section 3) is to meet the *Terms of Reference for the Gahcho Kué Environmental Impact Statement* (Terms of Reference) released on October 5, 2007 by the Gahcho Kué Panel (2007). Table 7-4 in Section 7, Remaining Issues, in the Terms of Reference identified emergency measures as an issue and required descriptions of the following:

- impact of spills; and
- accidents and malfunctions.

The assessment presented in this appendix also provides information that is required in other parts of the Terms of Reference, specifically Table 7-2 in Section 7, Section 5.2.11, and Section 4.1.2.

3.I.1.2 Scope

This section presents an assessment of possible accidents and malfunctions that could occur at the Project, including all facilities at the Project site, the Tibbitt-to-Contwoyto Winter Road, airstrip and the Winter Access Road that will be used to bring materials to the Project site. The focus is on risks of accidents and malfunctions including their impacts, although risk mitigation and management are summarized for completeness. Management of potential consequences from accidents and malfunctions is discussed in detail in Attachment 3.I.1 to this Appendix, Emergency Response and Contingency Plan.

The following key line of inquiry and subject of note in the EIS also provide responses related to spills, and accidents and malfunctions:

- Key Line of Inquiry: Water Quality and Fish in Kennady Lake (Section 8); and
- Subject of Note: Traffic and Road Issues (Section 11.8).

3.I.1.3 Temporal Framework

The temporal framework for the risk assessment is from Project construction through to the refilling of Kennady Lake. Assuming Project permits are obtained, the timeframe is Year -2 through Year -1 for Project construction, Year 1 through Year 11 for operations, Year 12 through Year 13 for site closure, and Year 14 through Year 19+ for refilling.

3.I.1.4 Spatial Framework

The geographic areas considered for this assessment are:

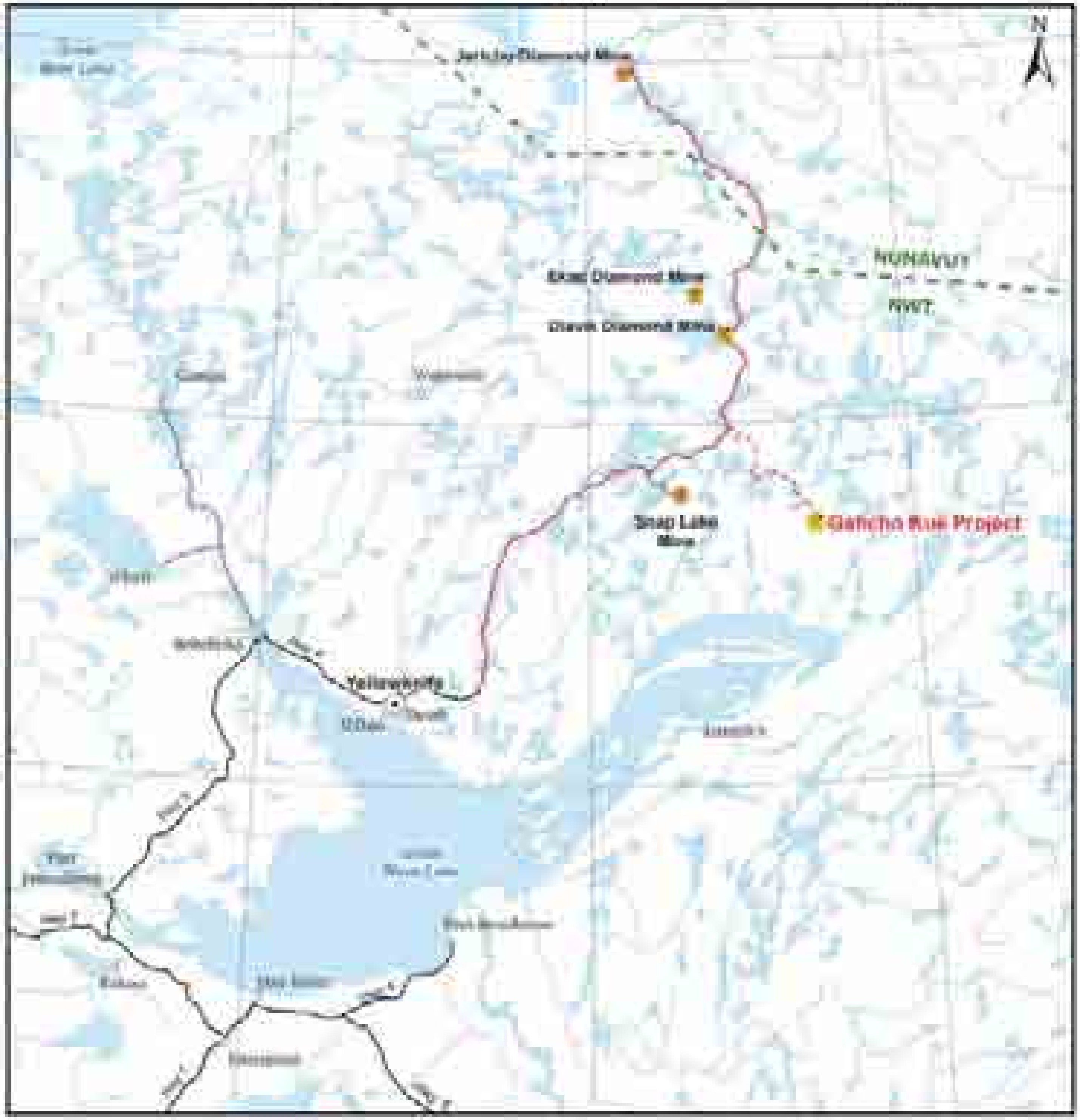
- the Project site;
- the Tibbitt-to-Contwoyto Winter Road to MacKay Lake; and
- the Winter Access Road from MacKay Lake to the Project site.

Figure 3.I-1 provides a map of the location of the Project and the winter roads.

3.I.2 RISK MANAGEMENT

Management of risks, including preparation for the unexpected (emergency response and contingency planning) is integral to De Beers' Sustainable Development Policy. De Beers will ensure that management systems are in place to minimize the risk of accidents affecting people, the environment, and the facilities. Risks will be managed for the Project through the following means:

- prevention of accidents and malfunctions through engineering design, construction and operations training, awareness, education, and equipment maintenance;
- assessment of risks of accidents and malfunctions throughout the Project phases;
- employment of adaptive management to ensure continual appraisal of risks;
- design and implementation of effective emergency response and contingency plans; and
- implementation of a site environmental management plan.



LEGEND

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

NOTES
Base data source: The Atlas of Canada

GAHCHO KUÉ PROJECT

Location of the Gahcho Kué Project

PROJECTION: Canadian Lambert Conf. Conic	DATUM: NAD83		
Scale 1:3,000,000			
FILE NO: B-Heritage-001-GIS			DATE: September 20, 2010
JOB NO: 09-1365-1004	REVISION NO: 8		Figure 3.I-1
OFFICE: GOLD-CAL	DRAWN: CW	CHECK: JB	

Standard operating procedures are a key part of accident prevention and emergency response; Project-specific procedures will be developed before construction of the Project begins. The Snap Lake Mine currently has an International Organization for Standardization (ISO)-14001 certified environmental management system (EMS). This system will be extended to the Gahcho Kué Project before operations start.

Table 3.I-1 lists the environmental design features (i.e., mitigation measures) that will be implemented during the detailed planning and design phase for the Project to address and reduce risk of accidents and malfunctions. With ongoing risk evaluation as the Project develops, risk reduction strategies will be adjusted as required. This will occur primarily through updates to key management plans throughout the life of the Project.

Table 3.I-1 Summary of Environmental Design Features to Reduce Risk

Risk	Risk Reduction Strategy
Petroleum spill	The primary risk reduction strategies will be development of a site-specific spill contingency plan and on-the-job training for fuel handlers. Major fuel handling will be under the direction of experienced site personnel. Large petroleum spills to the environment will be prevented to the extent possible through secondary containment of bulk storage tanks and large fuel caches. Small spills risks will be mitigated through use, where appropriate, of portable berms, bermed areas for large drum caches, spill kits, absorbent pads and containment booms, and routine inspections by site services and environmental personnel.
Ammonium nitrate spill	The primary risk reduction strategies will include development of an explosives management plan and handling of ammonium nitrate restricted to licensed personnel. Ammonium nitrate will be stored in a secured area; any incidental spills will be cleaned up immediately.
Fire	The primary risk reduction strategy will be engineering design to limit the chance for fire to start, a site-specific emergency response plan and training including fire drills held at least annually as required by the *Northwest Territories Mine Health and Safety Act.*
Uncontrolled explosion	The primary risk reduction strategies will be engineering design to limit potential sources of uncontrolled explosion to the greatest extent possible, a site-specific emergency response plan, and training of appropriate staff.
Aircraft accident	Risk of aircraft accidents is reduced primarily through actions of the air charter company operating under regulations set by Transport Canada. Risk at the Project site will be reduced by effective communication between the Project personnel, the air charter company, and pilots through satellite phone and radio. No site vehicles will be allowed on the airstrip when aircraft are in-bound. Large ungulates, such as caribou, will be herded off the strip if required.
Dyke, berm, mine rock pile, and pit wall failures	Risks from dyke, berm, waste rock pile, and pit wall failure will be reduced primarily through engineering design and annual geotechnical inspections coupled with frequent inspections by on-site personnel.

3.I.3 APPROACH

Potential accidents and malfunctions related to the Project were evaluated by a qualitative risk-based process using a method developed by the Manitoba Industrial Accidents Council (MIAC 1996). The method is straightforward and transparent. Arriving at the risk estimates involved reviewing relevant experience at other arctic mining operations and operation of the winter roads (Tibbitt-to-Contwoyto Winter Road and the Project's Winter Access Road).

The risk assessment method involved a three-step process:

- identify the hazards;
- analyze the risks; and
- evaluate the risks.

3.I.3.1 Identification of Hazards

The risk assessment began by creating a list of all of the hazard scenarios that could possibly impact the Project site, and Project-related use of the Tibbitt-to-Contwoyto Winter Road and the Winter Access Road throughout the phases of the Project. Both natural and human-made hazards were included.

3.I.3.2 Analysis of Risks

The second step was to estimate the risk associated with each hazard scenario. Risk is a function of the severity of the consequences and associated frequency (probability) of a hazard's occurrence. Risk was estimated using a project risk matrix defined by a frequency index and an index of the severity of the consequence for the environment.

The severity of consequences resulting from the occurrence of a hazard scenario was evaluated for the consequence that best described the effects of a worst-case mishap after emergency planning and management controls were in place. For example, a large spill of diesel fuel at the fuel farm could have more severe environmental consequences if there were no containment facilities for the fuel tanks, but the containment facilities will be installed. Therefore, the assessment was done on the worst-case mishap that would occur with the containment facilities (i.e., mitigation) in place.

3.I.3.3 Evaluation of Risks

Risk for a hazard scenario was evaluated based on the frequency and consequence severity indices estimated in Step 2, using a project risk matrix. The risk matrix shows the ranking of risk according to four levels from negligible to high.

3.I.4 METHODS

The frequency index was defined in four order-of-magnitude levels as shown in Table 3.I-2.

Table 3.I-2 Frequency Index

Frequency Index	Frequency (Probability)
Highly likely	at least one chance of occurring within a year (100% probability)
Likely	at least one chance of occurring within 10 years, but less than once a year (10% to 100% probability)
Possible	at least one chance of occurring within 100 years, but less than once in 10 years (1% to 10% probability)
Unlikely	less than one chance of occurring in 100 years (less than 1% probability)

% = percent.

Consequences were divided into four severity levels as shown in Table 3.I-3.

Table 3.I-3 Consequence Severity Index

Negligible	Low	Moderate	High
A consequence that is contained, controlled, and/or cleaned up with no measurable impact to the environment.	A consequence that is contained, controlled, and/or and cleaned up, but may negatively affect organisms present at the spill location. The effect would be short-term.	A consequence that is uncontained and results in the loss of communities at the local scale.	A consequence that results in a negative effect of high magnitude (effect at the population level) at the regional scale or over the medium- to long-term.

Risk increases as frequency and consequence severity increase as illustrated in Table 3.I-4.

Table 3.I-4 Project Risk Matrix

Frequency Index	Consequence Severity Index			
	Negligible	Low	Moderate	High
Highly likely				
Likely				
Possible				
Unlikely				

Risk Legend

- **High**
- **Moderate**
- **Low**
- **Negligible**

3.I.5 IDENTIFICATION OF HAZARDS

The assessment is based on hazards found in arctic diamond mines, other northern mines, and general industrial operations. In addition, concerns expressed through community and regulatory engagements were included where they differed from operations experience. Issues associated with accidents and malfunctions are listed in Table 3.I-5 according to the Project facility. All facilities and Project phases were examined.

Table 3.I-5 Accidents and Malfunctions Assessed

Issue	Facility
Petroleum spill	fuel farm
	power generator sets
	explosive storage
	processing plant
	maintenance workshop
	vehicle refuelling stations
	site roads
	airstrip
	Tibbitt-to-Contwoyto Winter Road
	Winter Access Road

Table 3.I-5 Accidents and Malfunctions Assessed (continued)

Issue	Facility
Ammonium nitrate spill	explosive storage
	open pit
	site roads
	Tibbitt-to-Contwoyto Winter Road
	Winter Access Road
Fire	fuel farm
	power generator sets
	processing plant
	accommodation complex
	vehicle refuelling
	Tibbitt-to-Contwoyto Winter Road
	Winter Access Road
Uncontrolled explosion	explosives storage
	accommodation complex
	fuel farm
	airstrip
	vehicle refuelling
Aircraft accident	airstrip
	between community and the Project
Dyke failure	Dyke A
	Dykes C and D
	internal dykes
	watershed diversion dykes
Slope failure	mine rock piles
	coarse PK pile
Pit wall failure	Hearne, 5034, and Tuzo pits

PK = processed kimberlite.

3.I.6 ANALYSIS OF RISKS

The Project will have an EMS and contingency plan in place to prevent accidents and malfunctions and to respond to any accidents that occur. Accidents and malfunctions are system failures or contingencies not accounted for by systems in place. The EMS will be ISO-14001 compliant and based on the De Beers' Snap Lake Mine and Victor Mine EMS's. The contingency plan for the Project is based on North American mining experience and, in particular, Canadian Arctic mining experience over the last 25 years. On this basis, De Beers believes that all credible contingencies are addressed. Thus, there is a very low risk that accidents will occur that are not addressed in the contingency plan or not covered within the framework of the Project EMS.

Accidents and malfunctions are evaluated in this section in the order listed in Table 3.I-4 and the rationale for each accident risk estimate is provided. All areas of the Project site and Project-related use of the Tibbitt-to-Contwoyto Winter Road and the Winter Access Road where an accident could occur are discussed. Risk is estimated in the context of the Project EMS and contingency plan (i.e., the estimated level of risk represents the frequency of the consequence severity from an accident or malfunction with these systems in place and functioning as designed). A summary of the risk evaluation is provided in the following subsections.

3.I.6.1 Petroleum Spill

3.I.6.1.1 Fuel Storage Tank Farm

A petroleum spill at the fuel storage tank farm could result from a leak in tanks or piping inside the dyked area, or from leaking valves on the tanks or piping outside the dyked area. A catastrophic failure of a tank, although very unlikely, could result in the release of all of the petroleum in the tank. All tanks, piping, and valves will meet American Petroleum Institute 650 standard and be installed by experienced contractors. The design of the containment area will be based on requirements of the Canadian Council of Ministers of the Environment *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (CCME 2003), the National Fire Code of Canada, and any other standards that are required. Once the tank farm is constructed, and until tanks are emptied and dismantled, the tank farm will be routinely inspected by Project personnel to ensure no leakage has occurred.

The tank farm will be constructed with a continuous high-density polyethylene liner that covers the floor under the tanks, and continues up the internal sides of the berms surrounding the tank farm. The liner will be approved for arctic conditions. The containment area within the berm will be constructed on a gravel base and have a minimum capacity of 110 percent (%) of the largest tank, and tanks will be placed far enough from the edge of the berm to contain any wave surge that could result from catastrophic failure.

A large petroleum spill due to catastrophic failure of a tank is unlikely, estimated to occur less than once in 100 years. The consequence to the environment is negligible with the proposed engineering safeguards in place. Therefore, based on the estimated frequency and consequences, the risk of a large spill to the environment is negligible.

Routine small leaks are more likely to occur than a catastrophic failure, and are estimated to occur at least once every 10 years but no more than once a year. With the proposed engineering safeguards and spill response in place, the consequences of such spills to the environment are negligible. Therefore, the risk from routine small leaks is negligible to the environment.

3.I.6.1.2 Power Generator Sets

Power for the Project will be supplied from diesel generators that will be fuelled either from dedicated storage tanks or directly from the fuel storage tank farm. In either case, fuel tanks will have provision for spill containment. Fuel will be supplied to generators by steel pipe with shutoff valves at the tank end. Fuel supply tanks will be routinely inspected to ensure no leakage. The tank and all piping will be approved by the American Petroleum Institute and will be installed by experienced contractors.

Large and small spills from the fuel farm are already discussed above, see Section 3.I.6.1.1. Small spills at the power generator sets are possible, estimated at a frequency of at least once in 100 years but less than once in 10 years. With the proposed engineering safeguards and spill response in place, consequences of such a spill to the environment are negligible. The risk of a small spill causing an impact to the environment is therefore negligible.

3.I.6.1.3 Explosives Manufacture and Storage

Propylene glycol will be used at the explosives manufacturing plant. Diesel fuel will be stored in the fuel storage tanks farm; only small working quantities of diesel fuel will be kept in the explosives manufacturing plant. Caps and stick powder storage will be housed in dedicated unheated magazines where no petroleum products are used or stored.

Glycol loss is possible, estimated to occur at least once in 100 years but less than once in 10 years. Any potential loss would be small and contained within the explosives building sump system. Therefore, the consequences of any glycol loss to the environment are negligible and the risk from glycol spills is negligible.

3.I.6.1.4 Processing Plant

Any spills occurring at the processing plant will be from lubricants used to operate the machinery. Such small spills are likely, estimated to occur at least once in 10 years but less than once a year. The consequences to the environment of spills that occur, and are cleaned up, in the plant are negligible. The risk is therefore negligible.

3.I.6.1.5 Maintenance Workshop

Petroleum products stored and used at the workshop in the Maintenance Complex will include hydraulic oil, engine oil, grease, propylene glycol, and solvents such as Varsol™ (or equivalent). These products will be stored in 20-litre (L) pails, or 205-L drums, in an area surrounded by a raised sill and protected from damage from moving vehicles. Solvents, used frequently to degrease parts, will be stored in a solvent container.

The workshop will have a concrete floor that will slope slightly to a drain or drains connected to a sump. Small routine spills will be cleaned up with absorbent and the absorbent removed from the site as hazardous waste. Large spills (up to 205 L) outside of the spilled area would flow to the sump and be pumped back into a waste oil container for shipment off-site during the winter re-supply. A hazardous waste contractor will be engaged before construction of the Project begins.

The frequency of small routine spills is estimated to be more than once a year, or highly likely. Such spills would be completely contained within the workshop; thus, the consequences to the environment are negligible. The associated risks are therefore negligible.

Large spills are unlikely, estimated to occur at a frequency of less than once in 100 years. The consequences of large spills to the environment are low due to the proposed containment system. Therefore the risk due to large spills is negligible.

3.I.6.1.6 Vehicle Refuelling Stations

Two vehicle refuelling stations are planned, one for light service vehicles and another for ore trucks. Crawler equipment such as dozers will be fuelled at the worksite by a fuel truck. Vehicle fuelling stations will be located on a concrete pad sloping toward a drain connected to a sump. Any spills of fuel would flow to the sump, which could be pumped out to a waste oil cube for shipment off-site during the winter re-supply as previously discussed.

Crawler equipment will be fuelled by trained employees in the site services group and the frequency of routine spills will therefore be minimized. Any spills that do occur will be cleaned up immediately and contaminated soils transferred to the land farm for bioremediation. If the land farm proves to be ineffective under site weather conditions, the contaminated soils will be collected and shipped to suitable disposal facilities in Alberta. Contaminated snow will be segregated in a contained drainage area to melt. Any residue remaining will be transferred to the landfarm for bioremediation.

The frequency of routine spills is estimated as greater than once per year or highly likely. The consequences of routine spills to the environment are negligible. The risk from fuel spills is therefore negligible.

3.I.6.1.7 Site Roads

Leaks of fuel or other petroleum fluids from vehicles may occur periodically on site roads or anywhere service or ore trucks frequent, including the open pits, mine rock and coarse processed kimberlite (PK) piles, and the Fine Processed Kimberlite Containment (PKC) Facility. Proper maintenance and awareness training for vehicle drivers are management measures that will be put in place to minimize routine spills.

Most areas where vehicles travel will be within controlled drainage areas. Therefore, if a spill occurred, runoff would be contained, recovered, and transferred to an oil-water separator, before being transferred to the appropriate waste facility in operation at the time. Contaminated soil and snow would be treated similarly.

The frequency of small routine spills along the site roads is estimated to be at least once per year, or highly likely. The consequences of any spills that occur to the environment are negligible for areas inside and outside of contained drainage. Therefore, the risk from small fuel spills on site roads and in site facilities frequented by vehicles is estimated to be negligible.

For large spills, the consequences to the environment depend on the volume of the spill and where it occurs. A worst-case scenario would be a spill of a loaded fuel truck near a waterbody, or muskeg, where the fuel disperses to the waterbody or muskeg. The frequency of this worst-case scenario is unlikely because of aforementioned management controls and because fuel service vehicles will rarely have occasion to travel outside the controlled drainage area. The consequences associated with this worst-case scenario would be moderate; however, the risk to the environment is low because the frequency is unlikely.

3.I.6.1.8 Airstrip

Jet B aviation fuel will be stored in self-contained, Underwriters Laboratories Canada-rated envirotanks mounted on an elevated pad at the air terminal shelter. Jet B fuel required for helicopter refuelling will be stored in sealed drums inside a lined berm at the helipad near the airstrip.

Fuel transfer will be undertaken by the pilots or flight engineers as a requirement of air charter company regulations. Any small spills that occur will be cleaned up by the site services group. The frequency of small spills is estimated to be greater than once per year, or highly likely. However, the consequences of a small spill would be negligible to the environment. Therefore the risk due to small spills is negligible.

The frequency of a large spill is estimated to be less than once in 100 years, or unlikely. The consequences for large spills within the containment area are negligible due to the engineered structures discussed above. Routine inspection of storage tanks will help ensure that potential failures are noted and corrected before a failure occurs. Consequences for the environment outside of the contained area would be moderate. Therefore, the risk to the environment due to large spills is low.

3.I.6.1.9 Tibbitt-to-Contwoyto Winter Road

Accident statistics are kept on the Tibbitt-to-Contwoyto Winter Road by the Government of the Northwest Territories, Department of Environment and Natural Resources (GNWT ENR). All spills from 1983 to the end of March 2001, except one, had been cleaned up by the end of 2001 (EBA 2001). According to these spill records, there have been no substantial spills of petroleum products into any waters along the winter road corridor where fish or other aquatic resources have been affected. Also spill records indicated that the number of spill incidents per year had not increased as a result of higher levels of commercial vehicle traffic since the mid 1990s. A review of the ENR hazardous materials spill database from 2002 to 2010, identified only two additional spills (150 L and 80 L of diesel) on the Tibbitt-to-Contwoyto Winter Road since 2001 (GNWT ENR 2010, internet site).

Small spills on the Tibbitt-to-Contwoyto Winter Road are highly likely, estimated to occur at least once a year. Given that spills on the Tibbitt-to-Contwoyto Winter Road occur under frozen conditions (e.g., above the ice on an ice-covered lake) and are cleaned up, the consequences of a small spill are negligible to the environment. Hence, the risk from small spills is negligible to the environment.

Two large spills of diesel occurred in the first two years of winter road operation (1983 and 1984) when vehicles overturned. Since that time, one large spill (15,000 L) occurred in 2000 when a vehicle overturned. Given the high priority currently placed on diligent traffic management, operations safety, and the strong commitment to continual improvement in winter road operations, this low occurrence of large spills is expected to continue, but it will remain within the "possible" range of the frequency index. In most cases, a large spill would be contained on the ice surface and cleaned up. The consequences of a potential large spill that could not be contained on the ice surface and cleaned up are moderate to the environment. Therefore, the risk from large spills is low to the environment.

3.I.6.1.10 Winter Access Road

No reportable spills occurred on the Winter Access Road when it was open from 1999 to 2002 and 2006. While the record is short, it indicates that a large spill on this road is possible, or occurring at a frequency of at least one chance in 100 years, but less than once in ten years. The consequence of a large spill to the environment that is contained on the ice surface and cleaned up is low; however, if the spilled material cannot be contained, the consequence is moderate. The risk from large spills is low.

Small spills are highly likely, with an estimated frequency of at least once within a year that the winter access road is open. Because spills must be cleaned up by the carriers, the consequences for such spills are negligible to the environment. Thus, the risk due to small spills is negligible to the environment.

3.I.6.2 Ammonium Nitrate Spill

3.I.6.2.1 Explosives Storage

Ammonium nitrate will be delivered in prill (dry pellet) form in tote bags when the Winter Access Road is available. It will be stacked at the storage site on a gravel pad and covered with tarps. Spills (from torn bags) will be cleaned up immediately and reported. All partially full contaminated or ripped bags of prilll and spilled prill will be recovered and used. Used empty bags will be collected and burned on-site.

Small spills from the ammonium nitrate tote bags are highly likely, with an estimated frequency of at least once a year. Nevertheless, the consequences of such small spills are negligible to the environment. Therefore the risk associated with small spills is negligible to the environment.

Large spills are estimated to occur less than once in 100 years, or unlikely. The consequences of large spills are low to the environment because the prill would be cleaned up immediately. Therefore, the risk due to large spills is negligible to the environment.

3.I.6.2.2 Open Pits

Ammonium nitrate will only be handled by trained employees licensed to use explosives. Ammonium nitrate mixed with fuel oil (ANFO) will be delivered down drill holes by an explosives truck.

Small spills are possible, occurring at an estimated frequency of at least once in 100 years but less than once in 10 years. However, as the ANFO would remain on the pit floor and be exploded or burned by the blast, the consequences of a spill to the environment are negligible. Therefore, the risk is negligible.

Further, misfires from blasting will occur periodically, which could result in leaching of ammonia. The estimated frequency of misfires is greater than once per year, or highly likely. If the misfire occurred in mine rock, ammonia could leach off the rock after it is placed on a mine rock pile. However, all runoff from the mine rock piles will be contained in collection ponds and flow to either Area 3 within the Water Management Pond or to one of the mined-out pits (i.e., any water running off a mine rock pile will flow through natural drainage channels within the watershed and into the collection ponds). Runoff will be controlled within the Project footprint and not enter the environment. Some mine rock will be used for construction on the site; runoff from these locations will remain within the Project footprint. Because of the containment, the consequences to the environment are low. Therefore the risk posed by the misfires is also low.

3.I.6.2.3 Site Roads

An accident involving an explosives truck could potentially lead to a spill of ammonium nitrate on the site road between the explosives plant and the open pit. This road is within a controlled area where runoff is collected. Any spilled ammonium nitrate would be cleaned up by employees licensed to handle explosives.

The frequency of a spill of ammonium nitrate from an explosives truck is estimated to be unlikely (i.e., less than once in 10 years, but at least one chance of occurring within 100 years). The consequences of any spill are negligible to the environment. The risk is therefore negligible.

3.I.6.2.4 Tibbitt-to-Contwoyto Winter Road

Any spill of ammonium nitrate that potentially occurs would be cleaned up as soon as possible by personnel licensed to handle explosives. A small residual amount would likely remain. If the spill occurred on a portage, the ammonium nitrate would be absorbed by the soil and act as fertilizer. If the spill occurred on lake ice, the small residual of ammonium nitrate would eventually enter the water at very low concentrations, unless a large spill occurred that could not be contained and recovered.

Two small spills involving ammonium nitrate occurred on the Tibbitt-to-Contwoyto Winter Road in 2001 (EBA 2001) and one small spill also occurred in 2007 (Joint Venture 2008). One large (12,000 L) spill of ammonium nitrate occurred in 2000 (EBA 2001). All spills were cleaned up to the satisfaction of the inspectors. The frequency of a spill, small or large, is estimated to be possible. For small spills, the consequences to the environment are low. The risk to the environment is therefore negligible. For a large spill, the consequences could be moderate to the environment if the spill cannot be adequately contained and recovered. Ammonium nitrate is a fertilizer and a spill could increase aquatic or terrestrial productivity near the spill. Because the consequences could be moderate, the risk to the environment from large spills is low.

3.I.6.2.5 Winter Access Road

Ammonium nitrate has never been spilled on the Winter Access Road, although ammonium nitrate use will increase during construction and operations. The number of vehicles carrying ammonium nitrate will be less than the number of vehicles on the Tibbitt-to-Contwoyto Winter Road. Therefore, the frequency is unlikely and the consequence for this hazard scenario is identical to that for the Tibbitt-to-Contwoyto Winter Road (Section 3.I.6.2.4). The risk to the environment is negligible for small spills and low for large spills.

3.I.6.3 Fire

Any fire has potentially serious consequences to people at the Project site and to the facilities; however, fire at the site has less of an effect on the environment because it would usually occur in a contained area of the Project site. All precautions possible will be taken to prevent fires at the site, because of the difficulty in effectively fighting fires at this remote location, especially during winter. Fire drills will be held regularly to check personnel preparedness. Locations of fire alarms and evacuation routes if not obvious (e.g., only one door) will be posted in all work areas; fire alarms, fire extinguishers, and fire hoses will be clearly marked in an approved manner. Precautionary measures to be taken at facilities with respect to fire control are discussed in the Emergency Response and Contingency Plan (Attachment 3.I.1).

3.I.6.3.1 Fuel Storage Tank Farm

While a large volume of flammable petroleum product will be stored at the fuel farm, all product will be contained. There will also be a strictly enforced policy prohibiting open flames or smoking at the fuel farm.

Fires at the fuel farm are possible, occurring at an estimated frequency of at least once in 100 years but less than once in 10 years. The consequences of a fire at the fuel farm are negligible to the environment and the risk due to fires at the fuel farm is negligible to the environment.

3.I.6.3.2 Power Generator Sets

The power generator sets will be modularized and self-contained, and placed on crushed aggregate. A policy of no open flame and no smoking at the power generator sets will be strictly enforced. Diesel for the generators will be piped in from the fuel farm or from dedicated storage tanks.

Fire at the power generator sets is possible, with at least one chance of occurring in 100 years but less than once in 10 years. The consequences of this hazard are negligible to the environment and the risk is also negligible. A high level of precaution will be exercised because the risk, although negligible for the environment, will be high for the facilities and people.

3.I.6.3.3 Processing Plant

Fires within the processing plant could result from the electrical equipment being used. The estimated frequency for this hazard scenario is less than once in 100 years, or unlikely. The consequences of a fire at the processing plant are negligible to the environment and the risk is also negligible.

3.I.6.3.4 Accommodation Complex

Fire at the accommodation complex could result from flammable liquids spilling on open flames in the cafeteria kitchen, from leaking propane in the kitchen, or from fires accidentally started in the accommodation complex by smoking or the presence of open flame.

Based on experience at other mine sites, the frequency of such fires is possible, with at least one chance of occurring in 100 years but less than once in 10 years. All practical precautions including fire suppression equipment, fire alarms, education, and fire drills will be employed to reduce risks. Although the consequences are high to people and the facilities, the consequences are negligible to the environment. The risk is also estimated to be negligible to the environment.

3.I.6.3.5 Vehicle Refuelling

Fire during vehicle refuelling could only result from open flame or sparks during the process. A policy of no smoking and no open flames present while refuelling equipment will be strictly enforced. As well, all mobile equipment will be diesel powered as the flash point of diesel is much lower than that of gasoline.

The frequency of potential fires from vehicle refuelling is possible, with at least one chance of occurring in 100 years but less than once in 10 years. The consequences are negligible to the environment. Therefore, the risk to the environment is estimated to be negligible.

3.I.6.3.6 Tibbitt-to-Contwoyto Winter Road

The frequency of a fire on the Tibbitt-to-Contwoyto Winter Road is unlikely, or less than one chance in 100 years. The consequence of a fire is low to the environment as use of the road occurs under winter conditions and fire would not spread. Therefore, the risk is estimated to be negligible to the environment.

3.I.6.3.7 Winter Access Road

See Section 3.I.6.3.6 (Tibbitt-to-Contwoyto Winter Road).

3.I.6.4 Uncontrolled Explosion

3.I.6.4.1 Explosives Storage

The risk of uncontrolled explosion at the explosives storage facility is posed by the stored ammonium nitrate as well as the caps and stick powder. While ammonium nitrate is flammable, it will not explode by itself under normal circumstances. Thus, the frequency of explosion at the ammonium nitrate storage facility is unlikely.

Caps and stick powder are required to be stored in separate magazines. Caps may explode, but spontaneous detonations are unlikely. Stick powder may burn but will not explode on its own. Therefore, the frequency of explosion for the caps and stick powder is also unlikely.

The consequences to the environment are low because the explosion may affect organisms near the storage facility. Given the unlikely frequency, the risk is negligible.

3.I.6.4.2 Accommodation Complex

An explosion could occur at the accommodation complex from faulty propane equipment. All such equipment will be inspected regularly and serviced as required.

The frequency for this hazard scenario is unlikely, estimated as less than once in 100 years. The consequence to the environment is low and therefore the risk to the environment is negligible.

3.I.6.4.3 Fuel Storage Tank Farm

A hot fire at the tank farm could potentially result in explosion of highly volatile petroleum products such as Jet B aviation fuel, if stored at the tank farm. Diesel is very unlikely to explode although it would readily burn.

Thus, the frequency of potential explosions at the tank farm is unlikely if volatile petroleum products are stored there, and nonexistent if they are not. The consequence of such potential explosions is low to the environment because the explosion may affect organisms near the tank farm (i.e., the effect may not be entirely limited to the containment area). Therefore, the risk is negligible to the environment. Precautions taken to prevent fires at the tank farm will also serve to prevent explosions.

3.I.6.4.4 Airstrip

A hot fire at the airstrip could potentially result in explosion of Jet B aviation fuel. All practical precautions taken to prevent fires will also be taken to prevent explosions. Therefore, the frequency of potential explosions is estimated to be unlikely, or less than one chance in 100 years. The consequences of such an explosion are low to the environment. Therefore, the risk is negligible to the environment.

3.I.6.4.5 Vehicle Refuelling

A hot fire could potentially result in explosion of fuel tanks on vehicles, although with diesel-powered vehicles the risk is considerably lower than for gasoline-powered vehicles. All practical precautions taken to prevent fires will also be taken to prevent explosions.

An explosion is unlikely, estimated to occur at a frequency of less than once in 100 years. The consequences of this hazard scenario are low to the environment. Therefore, the risk to the environment is negligible.

3.I.6.5 Aircraft Accident

3.I.6.5.1 Airstrip

Accidents at the airstrip could include an aircraft during takeoff or landing, Accidents could also occur between an aircraft and a vehicle if the vehicle is on the airstrip during the aircraft takeoff or landing. The first type of accident is largely beyond the control of the Project personnel. However, prevention of the second is the responsibility of the Project personnel.

The airstrip will be maintained to a safety standard acceptable to the air charter company(ies) flying to the Project site, who operate under the regulations set by Transport Canada. This will include regular grading throughout the year and snow removal in the winter. The airstrip will be equipped with landing lights for nighttime, low visibility landing, and take off. Radio contact will be maintained between the aircraft and the Project personnel for flights to and from the Project site.

Any vehicles operating on the airstrip will be equipped with approved flashing lights and will be equipped with radios to maintain contact with the site air traffic controller. Vehicles will not be allowed on the landing strip when aircraft are landing or taking off. Large ungulates, such as caribou will be herded off the strip if required.

The frequency of both types of accidents, involving only an aircraft and involving an aircraft and a vehicle during takeoff and landing, is estimated to be less than 10 years, but at least one chance of occurring within 100 years (possible).

Although the consequences of such potential accidents to people and facilities are high, the consequences to the environment are low. Thus, the risk is negligible to the environment.

3.I.6.5.2 Between a Community and the Project

An aircraft accident occurring at a location between a community and the Project site is entirely beyond the control of the Project personnel. The frequency of such accidents is possible (i.e., less than once in 10 years, but at least one chance of occurring in 100 years). The consequences to people (including the public) and the facilities could be high in the worst case. The Emergency Response and Contingency Plan (Attachment 3.I.1) provides response actions on the part of the Project personnel in the event of this type of accident. The consequence to the environment is estimated to be low and therefore the risk to the environment is negligible.

3.I.6.6 Dyke Failures

Dykes will be inspected daily by site personnel and annually by a qualified geotechnical engineer. Downstream seepage of external dykes will be monitored continuously during the summer by means of piezometers. Any significant increase in seepage will be cause for corrective action (significance to be determined on-site, but a 20% increase in seepage would normally be considered significant and warrant a prompt investigation by the design engineers).

Earthquakes do not pose a credible risk in the Project area (Natural Resources Canada 2005, internet site).

3.I.6.6.1 Dyke A

Dyke A will be located at the east side of Area 7 between Areas 7 and 8 (Section 3; Figure 3.5-1). A failure of Dyke A during operations when Areas 1 to 7 are dewatered would result in water from Area 8 flowing into Area 7. The loss of water in Area 8 would have potential impacts on fish populations and habitat, both in Area 8 and downstream in the outlet stream. If a rupture occurred at the base of the dyke, water from downstream waterbodies could flow backwards into Area 8 and then through Dyke A into Area 7. The gradient is low and this would occur over several hours to days allowing time for emergency repairs to Dyke A.

Ruptures are unlikely during the approximately 20-year life cycle of the dyke, which will be deliberately breached when the water quality in Area 7 meets regulatory requirements. The consequences of any potential rupture depend on the height above the dyke base that the rupture occurred and the extent of the failure. The consequence of a complete failure of Dyke A would be a loss of fish and aquatic organisms in Area 8 and in the outlet stream, depending on how quickly the flow can be stopped. The consequence would be moderate to the environment. Because the frequency is unlikely and the consequence is considered moderate, the risk to the environment is low.

If Dyke A failed at the beginning of the refilling of Kennady Lake, the consequence would be similar to operations. However, at the end of refilling when water levels in Areas 7 and 8 are similar, the consequence would be the mixing of water from Area 7 that may not have acceptable water quality. Fish also would be able to move into refilled areas west and north of Area 7 (Section 3: Figure 3.5-5). The consequence could be moderate and the risk to the environment is low.

At the end of the Project life when Kennady Lake is refilled and water quality of the lake complies with permit requirements, the in-lake portion of Dyke A will be removed and no further dyke failure risk will be present.

3.I.6.6.2 Dykes C and D

Dyke C is a permanent water diversion dyke located on the northeast side of Area 1, which initially allows the dewatering of a portion of Area 1 into Lake A3. Later, it separates the Fine PKC Facility from Lake A3 (Section 3: Figure 3.5-1). As the facility is filled with fine PK slurry, Dyke C prevents seepage from the Fine PKC Facility from entering Lake A3, which is a fish-bearing lake.

Dyke D is a permanent water retention dyke located on the north edge of Area 2 that prevents water from Area 2 from flowing north into Lake N7 during the late stage of mine operation (Section 3; Figure 3.5-5). It also prevents the submerged fine PK and water released from settled fine PK from flowing into Lake N7. These dykes will not be removed. The frequency of failure of one of these two dykes is considered to be possible (less than once in 10 years but at least one chance of occurring in 100 years). Failure of these dykes would allow an uncontrolled flow of fine PK and/or water containing elevated levels of total suspended solids and total dissolved solids to enter the environment, specifically Lake A3 or Lake A7. The consequence could be moderate and the probability of the event occurring is possible; therefore, the risk to the environment is low (Table 3.I-4).

3.I.6.6.3 Internal Dykes

Dykes will be constructed within the Project footprint (i.e., within the controlled area that is isolated from the surrounding watersheds). The purpose of the internal dykes is to manage water levels and water quality within the footprint.

Dykes B, I, J, K, L, M, and N (Section 3; Table 3.9-2, Figure 3.5-5) are internal water retention dykes.

Failure of one of these dykes could result in water or fine PK slurry (Dyke L) spilling from one controlled area to another. This could have important mining implications (e.g., failure of Dyke B during operations would allow water from Area 3 to flow into Area 4 and the Tuzo Pit). However, no water or slurry would be released to the environment, and therefore would not be considered a spill. Repairs would be affected by Project personnel, and the water or slurry pumped back into the originating area once dyke repairs were completed.

Although dyke crests will be lowered after operations for many of the dykes, Dykes H, I, and M will remain unchanged at closure. The frequency of failure is possible (less than once in 10 years but at least one chance of occurring in 100 years). The consequences to the environment are negligible. The risk is therefore negligible.

3.I.6.6.4 Sub-watershed Diversion Dykes

Dyke E will be a water diversion dyke to allow backflow from Lake B1 to Lake N8 in the N watershed. Temporary water diversion Dykes F and G, will minimally raise the water level of lakes E1, D2 and D3, and divert runoff water from the D and E catchments to Lake N14. These dykes (Section 3: Figure 3.5-1) prevent water unaffected by the Project from entering the Project footprint. Since the water would flow towards the Project footprint, the effect on the water quality of lakes outside the footprint; would be negligible; however, a drop in the water level that had been elevated by the dyke(s) could occur.

The estimated frequency of dyke failure is less than one chance in 10. All of these dykes will be removed or breached after Year 11 (i.e., at closure) of the Project. The consequence to the environment of a potential failure of one of the dykes is moderate and the risk to the environment is low.

3.I.6.7 Slope Failure of the Mine Rock and Coarse Processed Kimberlite Piles

The two mine rock piles will have a very low potential for slope instability. They will be comprised mainly of competent, granitic mine rock that has a relatively high resistance to weathering. They will be constructed to final slopes that are considerably flatter than would be required to achieve typically accepted margins of stability as expressed by a factor of safety. Slope stability analysis that was undertaken for the mine rock piles indicates that the margin for stability is greater than 1.5 at a maximum height of 95 metres (m). The maximum height of the South Mine Rock Pile is currently estimated at 90 m, with the maximum height of the West Mine Rock Pile expected to be about 70 m.

The Coarse PK Pile will be built mostly on land in 5 to 10 m lifts to a maximum height of approximately 30 m. It will have side slopes of 4H:1V. The Coarse PK Pile will be shaped and covered with a layer of mine rock to a minimum of 1 m to limit surface erosion.

The frequency of a potential slope failure is unlikely, or less than one chance in 100 years. Should either of the mine rock piles or the Coarse PK Pile undergo a slope failure, the consequences to the environment could be moderate in the worst case, depending upon debris entering a restored Kennady Lake or disrupting the drainages (and fisheries habitat) or terrestrial habitat. Therefore, the risk is low in all categories.

3.I.6.8 Pit Wall Failure

The pit wall failure risk applies to 5034, Hearne, and Tuzo pits. Failure of the pit wall could destroy multiple pit access ramps and possibly stop production for more than a month. Failure could also cause debris to fall on personnel working below or cause mobile equipment and operators immediately above the failure to fall to lower levels of the pit.

Pit wall slope angles will be determined by geotechnical professionals, benches will be engineered, and pit walls will be monitored by on-site personnel to mitigate the risk of pit failure. Mining methods will include controlled blasting along pit perimeters and using pre-split sidewalls to protect stability.

The frequency of a pit wall failure is unlikely, or less than one chance in 100 years. Although the consequences to people and the facility are high, the consequences to the environment are negligible because debris and damaged equipment would remain within the pit and therefore, be contained. The risk is negligible to the environment.

3.I.7 SUMMARY OF RISK EVALUATION

Table 3.I-6 summarizes the risks of accidents and malfunctions that were identified for the Project. The risks were estimated according to the frequency index and consequence severity index described in Tables 3.I-2 and 3.I-3. In this table, the frequency and the consequence are provided as words and the severity of the risk is shown as a pattern, with the legend provided at the bottom

of the table. For example, a large oil spill on the winter access road is unlikely and the consequence if the spill cannot be cleaned up is moderate. The combination of unlikely and moderate results in a Project risk of low, which is shown by the pattern of vertical lines in Table 3.I-6.

Table 3.I-6 Risk Analysis and Risk Evaluation Results

(Risks are colour-coded to the legend)

Hazard Scenario	Frequency	Consequence Severity
		Environment
Petroleum Spill		
Fuel Storage Tank Farm		
Small	likely	**negligible**
Large	unlikely	**negligible**
Power Generator Sets		
Small	possible	**negligible**
Explosives Manufacture and Storage		
Small	possible	**negligible**
Process Plant		
Small	likely	**negligible**
Maintenance Workshop		
Small	highly likely	**negligible**
Large	unlikely	**low**
Vehicle Refuelling Stations		
Small	highly likely	**negligible**
Site Roads		
Small	highly likely	**negligible**
Large	unlikely	**moderate**
Airstrip (fuel bermed)		
Small	highly likely	**negligible**
Large	unlikely	**moderate**
Tibbitt-to-Contwoyto Winter Road		
Small	highly likely	**negligible**
Large	possible	**moderate**
Winter Access Road		
Small	highly likely	**negligible**
Large	possible	**moderate**
Ammonium Nitrate Spill		
Explosives Storage		
Small	highly likely	**negligible**
Large	unlikely	**low**
Open Pits		
Small	possible	**negligible**
Misfires	highly likely	**low**
Site Roads		
Small	unlikely	**negligible**
Tibbitt-to-Contwoyto Winter Road		
Small	possible	**low**
Large	possible	**moderate**

Table 3.I-6 Risk Analysis and Risk Evaluation Results (continued)
(Risks are colour-coded to the legend)

Hazard Scenario	Frequency	Consequence Severity
		Environment
Winter Access Road		
Small	unlikely	low
Large	unlikely	moderate
Fire		
Fuel Storage Tank Farm	possible	negligible
Power Generator Sets	possible	negligible
Process Plant	unlikely	negligible
Accommodation Complex	possible	negligible
Vehicle Refuelling	possible	negligible
Tibbitt-to-Contwoyto Winter Road	unlikely	low
Winter Access Road	unlikely	low
Uncontrolled Explosion		
Explosives Storage	unlikely	low
Accommodation Complex	unlikely	low
Fuel Storage Tank Farm	unlikely	low
Airstrip	unlikely	low
Vehicle Refuelling	unlikely	low
Aircraft Accident		
Airstrip	possible	low
Between Community and the Project	possible	low
Dyke Failure		
Dyke A	unlikely	moderate
Dyke C and D	possible	moderate
Internal Dykes	possible	negligible
Sub-watershed Diversion Dykes	unlikely	moderate
Slope Failure		
Mine Rock Pile	unlikely	moderate
Coarse PK Pile	unlikely	moderate
Pit Wall Failure		
5034	unlikely	negligible
Hearne	unlikely	negligible
Tuzo	unlikely	negligible

Note: Colour coding in consequence severity column applies to risk assigned to each hazard scenario (as per legend below) while words apply to consequence severity applied to each hazard scenario.

Moderate
Low
Negligible

3.I.8 REFERENCES

EBA (EBA Engineering Consultants Ltd.). 2001. Tibbitt to Contwoyto Winter Road Project Description Report. Prepared by EBA Engineering Consultants Ltd. on behalf of the Tibbitt to Contwoyto Winter Road Joint Venture. Yellowknife, NT. September 2001. Available at: http://www.miningnorth.com/projects/Project_Description_Report/TableContents.pdf . Accessed July 16, 2008.

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

GNWT ENR (Government of the Northwest Territories Environment and Natural Resources). 2010. Hazardous Materials Spill Database. Available at: http://www.enr.gov.nt.ca/_live/pages/wpPages/Hazardous_Materials_Spill_Database.aspx. Accessed: October 1, 2010.

Joint Venture. 2008. Tibbitt-to-Contwoyto Winter Road Joint Venture Website. URL: http://jvtcwinterroad.ca/ Date accessed July 25, 2008.

MIAC (Manitoba Industrial Accidents Council). 1996. Industrial Emergency Response Planning Guide.

Natural Resources Canada. 2005. Seismic Hazard. http://earthquakescanada.nrcan.gc.ca Last Accessed: May 1, 2008.

RWED (Resources, Wildlife and Economic Development). 2001. Hazardous Materials Spill Database. Environmental Protection Service, Yellowknife.

3.I.9 ACRONYMS AND GLOSSARY

3.I.9.1 Acronyms and Abbreviations

ANFO	ammonium nitrate fuel oil
De Beers	De Beers Canada Inc.
EIS	environmental impact statement
EMS	environmental management system
ENR	Environment and Natural Resources
GNWT	Government of the Northwest Territories
ISO	International Organization for Standardization
NWT	Northwest Territories
PK	processed kimberlite
PKC	processed kimberlite containment
Project	Gahcho Kué Project
Terms of Reference	Terms of Reference for the Gahcho Kué Environmental Impact Statement

3.I.9.2 Units of Measure

%	percent
L	litre
m	metre

3.I.9.3 Glossary

ANFO	Explosive formed by ammonium nitrate mixed with fuel oil.
Bioremediation	Use of microorganisms or their enzymes to return soil altered by contaminants back to its original condition.
Caps	A small explosive device generally used to detonate a larger explosive.
Hazard	A hazard is anything that has the potential to cause harm.
Land farm	Facility that contains soil during bioremediation.
Muskeg	A swamp or bog formed by an accumulation of sphagnum moss, leaves, and decayed matter resembling peat.
Permafrost	Permanently frozen ground (subsoil). Permafrost areas are divided into more northern areas in which permafrost is continuous, and those more southern areas in which patches of permafrost alternate with unfrozen ground.
Piezometers	A device (tube or pipe) that allows one to determine the elevation of hydraulic head in an aquifer at a given point.
Prill	Dry pellets of a material.
Risk	Risk is measured in terms of the consequences of an event and their frequency (or probability). It is a function of the consequences (severity) and associated frequency (probability) of a hazard's occurrence.
Risk matrix	A matrix to rank risks according to one index representing the measure of frequency and another index representing the measure of consequence severity. When a hazard scenario is identified, the associated risk is estimated by locating it within the risk matrix.

ATTACHMENT 3.I.1

DRAFT EMERGENCY RESPONSE AND CONTINGENCY PLAN

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3.I.1 DRAFT EMERGENCY RESPONSE AND CONTINGENCY PLAN

3.I.1.1 INTRODUCTION

The Emergency Response and Contingency Plan was developed to establish a guidance document for emergency responses at the Gahcho Kué Project (Project) site.

The plan is driven by the De Beers Canada Inc. (De Beers) policies and in compliance with regulatory requirements. This plan will incorporate experience gained at the Snap Lake Mine experience and comply with the Northwest Territories *Guidelines for Spill Contingency Planning* (INAC 2007), the 2004 Emergency Response Guidebook (Kenneth Barbalace 2004), and the Indian and Northern Affairs Canada *Spill Reporting Protocol for Mining Operations in the Northwest Territories and Nunavut* (2004).

The plan provides:

- a clear chain of command for all emergency activities;
- accountability for the performance of the spill response;
- well-defined task and operational hazards/risk; and
- reporting and record keeping requirements to track program progress.

The plan will be a "living" document and will be updated on a regular basis to address operational changes, as new information comes to light or procedures, permits, and authorizations change.

3.I.1.2 ADMINISTRATION

The Mine Manager will be responsible for administering the Emergency Response and Contingency Plan. The Manager of the Safety, Health and Environment Department will support the manager and will regularly review the plan and update as needed. The plan will also be reviewed periodically by the mine occupational health and safety committee.

3.I.1.2.1 Purpose

The purpose of this document is to act as a general resource for each member of management and all employees to enable them to react to emergencies at the Project site. The Emergency Response and Contingency Plan will act as a guidance tool to ensure immediate and effective handling of any emergency. Prompt, effective, and organized emergency response by the company will ensure safety of the employees, minimize the effect on the environment, and maintain effective communication with the regulatory agencies.

3.I.1.2.2 Prevention

De Beers is committed to a prevention strategy of ongoing maintenance, inventory control, staff training, and vigilance in all aspects of the work. The following will be standard practice on the De Beers site:

- Inventory control: All hazardous materials will be subject to strict inventory control from the time they enter the site. Logs will be kept as required for inspection by the regulatory agencies.
- Storage: All hazardous goods will be stored in a manner that is required for the individual product as set out in the manufacturers' Material Safety Data Sheets.
- Daily inventory balance: All liquid products will be checked daily and a balance sheet of inflow and outflow maintained.
- Disposal: All hazardous materials will be disposed of in strict compliance with the laws and regulations of the Northwest Territories (NWT). If such laws and regulation do not exist, similar regulations for other provinces within Canada (for specific products or conditions) will be used.
- Staff Reminders: Pre-job meetings/safety meetings will contain a component to constantly remind employees to be on the look-out for innovative ways to improve environmental and safety performance.

3.I.1.2.3 Distribution

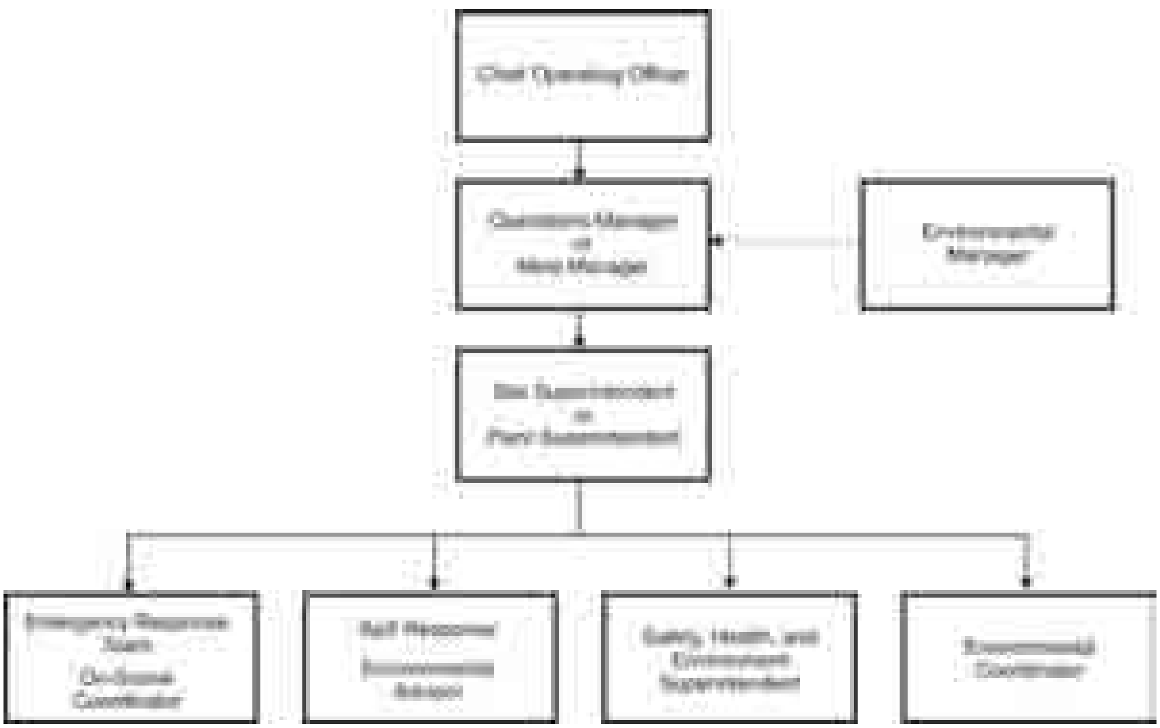
Although a controlled document, the Emergency Response and Contingency Plan will be available, through supervisors, at strategic areas at the Project site to all employees for reference. The senior safety coordinator is responsible for keeping the information current and distributing updates to all participants as required. Copies of this document will be distributed to all stakeholders including Environment Canada, Fisheries and Oceans Canada, Royal Canadian Mounted

Police (RCMP) Yellowknife, and Government of the Northwest Territories Department of Environment and Natural Resources (GNWT ENR).

3.I.1.3 ORGANIZATION AND RESPONSIBILITY

The Mine Manager has overall control of the site and all aspects of the response plan. He/She will be assisted and supported by the Site Superintendent who is responsible for the fuel handling and storage, the powerhouse, and the mechanical shop. The Environmental Manager will also play a supporting role by keeping current with regulations and providing advice during incidents, as well as providing liaison with the regulatory agencies. Figure 3.I.1-1 illustrates the chain of command within De Beers.

Figure 3.I.1-1 Chain of Command



3.I.3.1.1.1 Communications

Senior staff will be in daily contact with senior management on-site, so that decisions can be made in an efficient and timely manner.

The site will be equipped with a satellite receiver and phone system as well as portable radios and a base station at the site office. All front line supervisors will carry a portable radio while working on-site. Independent satellite phones will be available for crews working off-site and for emergency communications if the phone system fails.

3.I.1.4 EMERGENCY RESPONSE

3.I.1.4.1 Natural Incidents

The safety of the individual takes precedence over all else. When a natural disaster, such as flood, earthquake, or severe windstorm sufficient to cause damage occurs, workers are to carry out the following steps immediately:

- sound the alarm by using the radio;
- designate the responsible person;
- evacuate to muster point or shelter as instructed by the responsible person;
- hold a roll call and confirm everyone is accounted for;
- report any missing personnel to the Emergency Response Team; and
- call for outside help as required.

Depending upon the nature of the natural disaster, and whether or not there is any warning, it may or may not be possible to use the designated muster point and shelter. If either or both of the muster point or the shelter are unavailable, then the responsible person shall make alternative plans on the spot, depending upon the circumstances.

3.I.1.4.2 Severe Weather

3.I.1.4.2.1 Severe Cold

All workers will be expected to be familiar with working in the cold weather that is prevalent on-site. Workers will receive orientation and training on the proper methods for working in the cold. However, there will be circumstances when work may be restricted because of extreme cold. Procedures will be established for the various work tasks to protect outside workers.

3.I.1.4.2.2 Whiteout Conditions

If whiteout conditions occur, all outdoor physical work must stop. This is particularly important for persons using equipment or cutting tools, because any person suffering an injury may be unable to either reach the first aid post, or be evacuated to a hospital until the conditions improve. Personnel are to remain within shelter until the emergency has passed. Remote sites will be equipped with emergency rations and a heat source.

People working at these sites will be informed to stop work and to remain inside the shelter until the severe weather has passed. No one will be permitted to operate any vehicle (truck or snowmobile) except in extreme emergencies and only with the consent of the Mine Manager.

3.I.1.4.3 Human-Caused Incidents

3.I.1.4.3.1 Facility Fire

Specific fire-fighting procedures will be developed and special fire teams will be trained to deal with any special conditions that may be present in the processing plant or other processing facilities on-site.

On discovering a fire, personnel must carry out the following steps immediately:

- Small fires that can be safely extinguished should be put out; ensuring there is a safe exit or retreat, and that you fight a fire from fresh air.
- If unable to put the fire out, initiate emergency procedures. Sound the alarm by using the radio.
- Remain calm.
- Report the fire to your Supervisor immediately and provide the following:
  - your full name;
  - your location (where you are calling from);
  - the location and size of the fire; and
  - the muster station you are going to.
- Call out to people in your area to warn them of the danger.
- Evacuate all persons to the muster point.
- Do not pass through smoke.

- Feel all doors before you open them - if they are hot use another route. If no other route is available, return to the closest safe place and close the door.
- Go to the window and open it to get fresh air and call for help.
- Close (but do not lock) all doors behind you, as you leave the area.
- Report to the muster point.
- Hold a roll call and confirm everyone is accounted for.
- Assign/designate a response captain.

If you are able to put the fire out yourself, make sure the fire is completely out before leaving the scene. Use the radio to inform the Mine Manager (or his/her designate) and inform them of the details. If you must leave the scene of the fire, make sure you or someone trained in fire-fighting returns to the fire location to make sure it has not restarted. Maintain a fire watch until there is no chance that the fire will restart.

Once all persons are accounted for, arrange for their temporary shelter if required. The temporary shelter should be in a suitable place of refuge, separate from and away from the facilities involved. The shelter will contain emergency rations, blankets, a method of heating the shelter, sufficient seating for everybody, and a means of communication with emergency services off the Project site.

No one may re-enter a facility evacuated as a result of fire until the Mine Manager, or his/her designate, gives the “all clear” signal. He/she will ensure the building has been checked out to ensure adequate ventilation is restored and the structural integrity of the building has not been compromised.

3.I.1.4.3.2 Ground Fires

Ground fires are an uncommon occurrence in the high arctic. Fire-fighting capability will, however, be on hand in the form of pulaskis (fire break digging tools), and back-pack water fire extinguishers. If a ground fire occurs, the GNWT ENR will be contacted immediately. All available resources at the site will assist in fighting the fire under the direction of the GNWT ENR.

3.I.1.4.3.3 Medical Treatment and Emergencies

During construction and throughout the life of the Project, the site will have a full-time medic with the appropriate level of training for the number of personnel on-site. The medical treatment and emergency procedures will be developed by this staff in consultation with the Mine Manager. All emergency procedures will comply with the NWT Mining Regulations and the Worker's Compensation Board requirements.

3.I.1.4.4 Aircraft

Aircraft will be the mode of transport for all employees in and out of camp as well as lighter cargo and food supplies. Helicopters will also be used occasionally.

3.I.1.4.4.1 Missing or Overdue Aircraft, and Aircraft Accident

Every aircraft transportation company has procedures for tracking overdue and lost aircraft. De Beers will integrate their procedures into this plan and will refer to it in this document. The aircraft company's procedure will be a companion document to this procedure. However, if a particular aircraft company does not have an acceptable procedure, personnel will act as outlined in the following sections.

3.I.1.4.4.2 Helicopters

Fuel loads will restrict helicopters to within approximately two hours of the site. The pilots of helicopters using the site as a base will be required to file a flight plan with the person responsible for aircraft on the site. The following procedure will be followed during helicopter use on-site:

- If the helicopter is making short exploration flights to several areas, then the pilot will radio to camp on a predetermined schedule as this will allow a faster response if an incident occurs.
- If there is no contact from the pilot at the predetermined time, then the site person will attempt to contact the helicopter on the active frequency.
- Radio contact will be attempted every few minutes until 30 minutes have passed.
- If 30 minutes have passed, and no contact has been established, the site person will call the helicopter company base to inform them, and to ascertain whether they have heard from the pilot on another frequency.
- If other aircraft are in the area, they can be asked to attempt to contact the missing aircraft; if the pilot or crew is carrying a satellite phone then this should be used to attempt contact.
- When all attempts at contact are negative and the helicopter has been over-due for more than 30 minutes, the De Beers person responsible will inform the Mine Manager and the helicopter company that a search

should be initiated; the aircraft company will then use its standard operating procedures for overdue aircraft with the full cooperation and resources of De Beers; during this procedure De Beers will continue to attempt contact with the aircraft.

- Information will not be released to unauthorized persons and all queries will be referred to the helicopter company or the authorities.

3.I.1.4.4.3 Fixed-Wing Aircraft

For the most part, the fixed-wing aircraft coming to site will be carrying people or supplies. Most flights will be on prescribed schedules and have a defined flight plan filed with the originating airport. The De Beers person responsible for the landing strip will always know when an aircraft is scheduled to land. This is necessary to make sure that the landing area is free of debris and animals.

The following procedure is to be used for fixed-wing flights that fail to arrive according to their flight plan:

- If a flight is more than 30 minutes past its scheduled arrival time and has not contacted the site, then the De Beers responsible person will contact the aircraft company and the originating airport to advise them that the aircraft is overdue.
- If the site has the correct frequencies, the De Beers person will attempt to contact the overdue aircraft and will continue until the aircraft company initiates their search procedure, or the authorities take over the communications and the search.
- If there are other aircraft available on-site, these will immediately be made available to the organized search.
- Site personnel will be made available to the aircraft company as necessary for the search.
- The De Beers responsible person will inform the Mine Manager as soon as the aircraft is deemed to be overdue.
- Information will not be released to unauthorized persons and all queries will be referred to the aircraft company or the authorities.

3.I.1.4.5 Vehicle Incidents

There will be relatively few vehicles on-site. Vehicle incidents and accidents are, however, possible. For mishaps involving other vehicles or stationary objects company procedures will be followed for insurance purposes. All vehicle incidents including near misses will be reported to the Mine Manager.

Vehicle impacts with wildlife have additional criteria. Wildlife encounters may occur at any time and it is everyone's responsibility to ensure the safety of people and animals on-site. Wildlife has the right-of-way. The following procedures will be followed if there is a collision with any wildlife:

- The driver of the collision vehicle must immediately contact the wildlife response team.
- If the vehicle has killed the animal, remove it from the roadway until it can be picked up.
- If the animal has been badly hurt but not killed it must be dispatched as quickly as possible to avoid the animal suffering any further. Remember that hurt animals can be dangerous, so do not put yourself at risk by attempting to handle a wounded animal.
- The GNWT ENR must be informed immediately and asked direction on proper disposal.
- Refer to the Wildlife Encounter Management Plan which will be developed and made available to all personnel on-site.

3.I.1.4.6 Equipment or People Falling Through Ice

Travel of people and equipment over frozen lakes will occasionally occur at the site. In the unlikely event of accidents, however, the following procedure will be used:

- First, ensure the safety and well-being of personnel involved.
- Note that ice tends to fracture for a considerable distance away from any hole, and a ladder or long plank may be required to spread the weight of any rescuers over a wide area.
- Any person(s) attempting to rescue any other persons who have fallen through the ice must be secured by a rope to a point well removed from the hole, so that they can be hauled to safety if necessary.
- Use a rope to assist anybody in the water to get out; it is difficult to climb onto ice from water in the extreme cold in wet clothes.
- Any persons who have fallen through the ice are to be removed from the ice and water and immediately treated for hypothermia as follows:
  - move them as soon as possible out of the wind;
  - get dry clothes on the person;
  - if dry clothing is not available, remove wet clothing and place the chilled person in a sleeping bag;

  - use a second warm person to provide body heat within the sleeping bag to help warm up the chilled person if necessary; and
  - arrange for medical attention as soon as possible.

- Where equipment has fallen through the ice, if it is still accessible, arrange for it to be lifted or towed out as soon as possible.
- Ensure that leaks of fuel or engine oils are minimized wherever possible by pumping the fuel from tanks into other containers where this can be safely done without danger of a spill.
- Where a vehicle has gone completely through the ice and is submerged, contact the appropriate government spills hot line and ask for advice; where possible, also contact a specialist contractor to assist or to undertake the recovery of the submerged vehicle.

3.I.1.5 SPILL RESPONSE PLAN

3.I.1.5.1 Introduction

The roles and responsibilities of the Project personnel, contractors, and government if a spill occurs are described. Response and reporting procedures are also outlined.

3.I.1.5.2 Purpose

Recognizing that spills or leaks of petroleum products and chemical substances have the potential of posing a variety of hazards and can endanger both short or long-term public health and the environment, De Beers has implemented this Spill Response Plan to address accidental releases of hazardous substances. Hazards that may exist at the Project site include the release of toxic vapours, fire, spills, and explosions.

3.I.5.2.1.1 Objectives

Principal objectives of the Spill Response Plan are:

- to provide information to cleanup crews, employees, contractors, and government agencies if a spill occurs;
- to promote the safe and effective recovery or disposal of spilled materials;
- to comply with the De Beers Sustainable Development Policy;

- to comply with federal and territorial regulations pertaining to the preparation of contingency plans and reporting requirements; and
- to minimize the negative impacts of spills on the receiving environment (water/ice and/or land).

3.I.1.5.3 Scope

This plan addresses the organization of the Project spill response and related emergency measures. Alerting and notification procedures and cleanup strategies are outlined along with the duties and responsibilities of key spill response personnel.

The petroleum-derived materials included in this plan can generally be divided into two categories:

- flammable immiscible liquids (i.e., liquids that will not mix with water); and
- flammable compressed gases.

3.I.1.5.3.1 Flammable Immiscible Liquids

These substances are all hydrocarbon-based and will ignite under certain conditions. Gasoline and aviation fuel pose the greatest fire (and safety) hazard and usually cannot be recovered when spilled on water. The remaining materials generally do not pose a hazard at ambient temperatures. They are all insoluble, float unless mixed into the water column, and can be recovered when safety allows. They are:

- gasoline;
- Jet A aviation fuel;
- Jet B aviation fuel;
- diesel fuel;
- waste oil; and
- lube oil high flash point.

3.I.1.5.3.2 Flammable Compressed Gases

- usually highly explosive;

- may be heavier than air and therefore may concentrate in low-lying locations; and
- may be lighter than air and highly noxious or toxic.

Propane, acetylene, and oxygen are the flammable gases most likely to be on-site.

3.I.1.5.3.3 Other Products

Because of the nature of the milling process, chemicals and reagents are needed for use in the diamond abstraction process. These products include:

- grease;
- degreasing solvent;
- ferrosilicon;
- flocculants; and
- chlorine (sodium hypochlorite).

Specific response procedures with the Material Safety Data Sheets will be available on-site and available to the regulatory agencies.

3.I.1.5.3.4 Process Byproducts

Operations at the Project will create the following byproducts:

- domestic sewage; and
- processing plant wastes.

Response procedures for these materials will be available on-site and available to the regulatory agencies.

3.I.1.5.4 Spill Response

3.I.1.5.4.1 Responsibilities

During training, site personnel will learn their roles in a spill incident. The following are the roles for the De Beers and on-site contractor personnel:

First Responders

- Assess the situation for worker safety (does anyone need help? If so, call for help).
- Evacuate the area if necessary.
- Initiate spill response actions, immediately contact and work with On-Scene Coordinator/Site Superintendent and Environmental Coordinator.
- Provides basic spill response actions (stop and contain the leak, only if safe to do so).

On-Scene Coordinator (Site Services Supervisor)

- Controls the spill scene and directs the clean-up personnel.
- Reports the spill to the Mine Manager.
- Reports the spill to the NWT 24-hour spill report line at (867) 920-8130.
- Evaluates the initial situation and assesses the magnitude of the problem.
- Activates the response plan and calls out the key personnel in the response team, as deemed appropriate, to handle the situation.
- Calls the Environmental Advisor, if required, providing an overview of the situation and requests specific advice on environmental actions to be taken such as sampling and monitoring
- Develops the overall plan of action for containment and clean-up of the specific incident as well as directs and implements the plan.
- Ensures assigned responsibilities are carried out and coordination exists between supervisory team members.
- Assesses the requirements for people, equipment, materials, and tools to contain the spill in light of what resources are immediately available. The urgency will depend on the nature of the spill.
- Ensures that all spill response personnel receive adequate training to fulfill their responsibilities as part of the spill response team.
- Prepares the incident report and reviews with Team Members and Management.

Environmental Coordinator

- If on-site, acts as an alternate for the On-Scene Coordinator.
- Coordinates the sampling and monitoring program for the collection and analysis of samples to identify and monitor possible containment levels
- Reports on the effectiveness of clean-up and remediation activities

- Reviews the draft incident report and provides comments as necessary
- Follows up with regulatory / licensing reporting requirements.

Environmental Advisor (External)

- Supports the Environmental Coordinator
- Advises on the effectiveness of various containment, recovery, and disposal options, suggesting the most appropriate approach.
- Develops and/or recommends the sampling program to identify and monitor possible contaminant levels; suggests potential sample collections points and analytical requirements
- Monitors the effectiveness of the clean-up operation and recommends further work, if necessary.
- Provides technical advice on what the anticipated environmental impacts of the spill will likely be.
- Reviews the incident report and recommends suggestions to improve the response actions taken

Mine Manager

- Provides liaison with De Beers administrative/management team and keeps them informed of clean-up activities.
- Assists in obtaining any additional resource not available on-site for spill response and clean-up.
- Coordinates external resources and support activities with the On-Scene team.
- Reviews the incident report

Site Superintendent

- Acts as an alternate for the Mine Manager
- Is advised of the spill situation
- Advises the Chief Operating Officer of the spill
- Reviews the Incident Report

Permitting Coordinator

- Provides follow-up with regulatory/licensing reporting requirements

Chief Operating Officer

- Is advised of the spill situation, determines if additional corporate support is needed.
- In the event of a major spill, will advise other Corporate Officers of the clean-up activities.
- Reviews the incident report
- If required, will act as the spokesperson for media/stakeholders

3.I.1.5.4.2 Emergency Contacts

- The Mine Manager or designate is responsible to: (i) contact the regulatory authorities by phone within 24 hours of a reported major spill; (ii) fax in the NWT spill report form.

  Notification - The Mine Manager (using the NT-NU Spill Report Form) will be responsible to notify the NWT Spill Report Line at (867) 920-8130 if the volume spilled requires mandatory reporting as specified in Schedule B from the Regulation R-068-93 Spill Contingency Planning and Reporting Regulation (July 22, 1993) Consolidation Issued July 15, 1998.

- Log of Contacts - The Mine Manager or designate will maintain a log of all external contacts made which will include the date, time and organization contacted, essence of the notice or information transmitted/received, and whenever possible the name and title of individuals receiving or issuing notification or instructions.

  Communications - The Mine Manager will maintain a standby position at the site office, or designate some other competent person, to maintain spill-related communications.

- Depending on the severity of the spill, any outside help if required is the responsibility of the Mine Manager.

3.I.1.5.5 Discovery and Response

3.I.1.5.5.1 Discovery

- Any employee noticing an environmentally hazardous spill is required to notify immediately their supervisor or the Mine Manager or the spill response coordinator.
- The person reporting will try to ascertain whether there is a danger to life and if it is safe to attempt to stop the spill.

3.I.1.5.5.2 Response

3.I.1.5.6 Disposal

The disposal of spilled material and/or contaminated soil is governed under the *Waste Management Act* and its regulations. A copy of the Act and the Special Waste Regulation and the Contaminated Sites Regulation will be maintained on-site for reference.

Petroleum-contaminated topsoil will be removed and placed in the land treatment areas for treatment. In situations where these facilities have reached maximum capacity, contaminated topsoil will be in 205-L drums and transported off-site to approved facilities in Yellowknife for disposal purposes.

The spill response coordinator and Mine Manager will investigate the most appropriate disposal options for the spilled material. Disposal may include burning, disposal in waste areas, or recycling.

3.I.1.5.7 Documentation and Reporting

The spill response coordinator, or a designate, will be responsible for attending the scene of any spilled materials or contaminated soils to photograph and measure the affected area. They will be required to engage properly qualified personnel to collect samples of the materials or soils. No person should sample or handle spilled hazardous materials unless the person has received adequate training in safe sampling procedures, use/selections of protective clothing and identification of the hazards associated with the respective spilled material.

The Mine Manager will submit a detailed report to the appropriate agencies within thirty (30) days starting from the day of the spill. Progressive reports are submitted regularly until the completion of remedial activities. The report will include but not be limited to:

- reporting person’s name and telephone number;
- name and telephone number of the person/company who caused the spill;
- location and time of the spill;
- type and quantity of the substance spilled;
- cause and effect of the spill;
- details of action taken or proposed;
- description of the spill location and of the area surrounding the spill;
- details of further action contemplated or required;
- names of agencies on the scene;
- names of other persons or agencies advised concerning the spill;
- chronological sequence of events including internal and external notifications;
- copies of analytical results from external laboratories; and
- analysis of the events leading up to the spill, and a critique of the internal response and handling of the incident.

3.I.1.5.8 Spill Equipment

Spill kits will be placed in the following locations:

- tank farm;
- refuelling station;
- incinerator;
- powerhouse;
- water intake;
- reagent storage area;
- landing dock;
- fuel delivery truck;
- workshop;
- airstrip, helipad;
- mine; and
- drill sites.

Each spill kit will contain a minimum of:

- 1 roll absorbent;
- 2 plug and dyke kits;
- 1 (one) 3 x 4 m tarpaulin;
- 2 Tyvek suits;
- 4 mini booms;
- 25 spill pads;
- 2 pairs of neoprene gloves; and
- 2 splash-proof goggles.

Earth moving equipment, such as loaders and backhoes, is also available for constructing dykes and moving contaminated material. The fuel delivery truck will carry a spill response kit containing absorbent pads and material as well as large disposal bags for small spills.

3.I.1.6 WILDLIFE ENCOUNTERS

Wildlife on and surrounding the site will be an important consideration during construction and operations. Project roads are of particular concern.

The airstrip will average five to seven flights per week during the construction phase and between two and four flights per week during operation phase.

Vehicle traffic on these roads, and aircraft landing and taking off from the airstrip are potential sources of accidental wildlife mortality due to vehicle/wildlife collisions. Vehicle and aircraft traffic may also cause a disturbance to wildlife near the Project site.

A wildlife encounter procedure will be developed and distributed to personnel on-site. Response to wildlife encounters will be detailed in the Project Wildlife Management Plan developed for construction and operation phases.

3.I.1.7 ARCHAEOLOGICAL AND HISTORICAL DISCOVERIES

Archaeological investigations have been conducted at the Project area annually. The work was done by qualified archaeologists holding valid NWT archaeological permits. The primary focus of these investigations was on the discovery of archaeological sites. Site locations must be identified in order to determine whether or not avoidance, the preferred management option, is feasible. A secondary focus was on the archaeological assessment of sites that will be affected so that suitable management options to mitigate the effects can be determined.

These archaeological inventory and assessment studies were completed for the Project footprint and winter access road, and suitable management options have been identified for sites that cannot be avoided. Site-specific management options will be completed before construction begins. Because archaeological site mitigation can be destructive, whenever possible these activities are not undertaken until finalized development plans are available.

Although intensive archaeological inventory has been undertaken in the Project area, it is possible that unanticipated sites may be encountered. Suitable management options have been identified for encounters with unanticipated archaeological sites. These procedures for handling unknown or accidentally encountered archaeological sites will be identified in an Archaeological Management Plan. Procedures to assist in the protection of archaeological sites will be developed and included in this plan. The proposed plan will also include techniques that may assist in limiting indirect impacts. Archaeological sites are protected by legislation and De Beers will ensure that all archaeological requirements are met, all archaeological sites are properly documented, and adequate levels of investigation are conducted during all phases of development.

3.I.1.8 DYKE SAFETY

3.I.1.8.1 Dyke Types On-site

The Project requires dykes for water management as well as processed kimberlite containment. Details of these facilities are provided in Section 3.9.2 of the Project Description (Section 3).

3.I.1.8.2 Definitions

Emergency
Any condition that develops naturally or unexpectedly, endangers the integrity of the dyke, upstream or downstream property, or life, and requires immediate action.

Emergency Action Plan
Document that contains procedures for preparing for and responding to emergencies at the dyke, or associated equipment. The emergency action plan includes notification process and inundation maps.

Dyke Failure
Failure of the dykes to act as they were designed. In terms of structural integrity, the uncontrolled release of the contents of a reservoir through collapse of the dyke or part of it.

Risk
Measure of the probability and severity of an adverse effect to health, property, or the environment. Risk is estimated by the mathematical expectation of the consequences of an adverse event (i.e., the product of the probability of occurrence and the consequences).

Levels of Risk
Three levels of warning signs or emergency conditions have been assumed for the Project dykes:

- high level – observations and conditions representing an obvious emergency and failure and/or catastrophic collapse is imminent or has occurred;
- moderate level – observations and conditions that represent a potential emergency if allowed to continue and exacerbate, but catastrophic collapse is not imminent; and
- low level – observations and conditions are noted as being unusual and likely requiring intensified monitoring, supplemented with prompt investigation, assessment, and resolution.

3.I.1.8.3 Subplans

Emergency action plans consist of four components called subplans. The four subplans are:

- emergency identification;
- emergency operations and repair;
- notification; and
- evacuation.

3.I.1.8.4 Emergency Action Plans for Dykes at the Gahcho Kué Project

There are usually two cases identified for which an Emergency Action Plan should be developed:

- discharges in sufficiently large volume to cause flooding outside the impoundment; and
- dyke failure.

3.I.1.8.4.1 Emergency Identification

Potential causes of dyke failure have been identified as:

- embankment instability;
- deformation due to earthquake;
- excess seepage;
- piping;

- high pool conditions;
- high pore pressure;
- increasing of ground temperature;
- cracking;
- failure of discharge facilities; and
- extreme climatic events.

A continuous monitoring system will be instituted by the Plant Superintendent and regular daily inspections by the shift supervisor will be established as soon as the impoundment is in place.

3.I.1.8.4.2 Operations Emergency

As the design of the dyke structure is finalized, an operational plan will be developed and the final emergency plan will follow a set of emergency criteria that will be designated by the design engineer. These criteria will set out tolerance parameters for dyke movement, deformation, seepage discharge, and internal core temperatures. Each of the parameters if exceeded will have a response. In most cases of potential emergencies, the main and immediate action will be reduction of water level through release. In addition, mobilization of earth moving equipment, resources, and required materials may be needed.

If or when there is a need to reduce the level of water contained by the dyke, the following approach will be taken:

- notify regulatory authorities;
- develop a Water Sampling Plan for before, during, and after excess water release; and
- submit a written report to the regulatory authorities within 30 days of the completed task.

3.I.1.8.4.3 Emergency Identification Criteria

3.I.8.4.3.1 Inspection Procedures

Dykes will be inspected daily to weekly (depending on the stage of dyke construction) by mine personnel and annually by an independent geotechnical engineer. The mine inspections will be logged and made available to government inspectors upon request. .

3.I.8.4.3.2 Documenting Observations

When a potential emergency is recognized, the first action is to initiate the chain of communication as instructed in the notification subplan. In documenting a potential emergency, the observer should accurately and properly record the appropriate factual information including:

- when the observation was made;
- what was observed; and
- location of the observations.

Photographs of the observation should be taken to aid in documentation of the potential emergency. The photographs should include something for scale and the time and date that the photo is taken.

3.I.1.8.4.4 Equipment that may be Needed for Emergency Operation and Repair

The open pit mine will be active 24 hours a day and 7 days a week; therefore equipment required for dyke repair will be available on an immediate basis. The following equipment will be available:

- dozer or plow for snow clearing and/ or road access to the site of the problem;
- hydraulic excavator for excavation and placement of materials;
- loader;
- haul truck to transport materials as required;
- compactor; and
- machine operators.

3.I.1.8.4.5 Notification

If during inspection, or at any time, one of the established emergency criteria is met, the Site Superintendent, Environmental Manager, and Mine Manager will be notified as shown in the internal notification process below. Each emergency condition will be immediately assessed and the appropriate response will be initiated. The Mine Manager will contact the geotechnical engineer or environmental consultant, if warranted.

3.I.1.9 REFERENCES

Indian and Northern Affairs Canada (INAC). 2007. Northwest Territories *Guidelines for Spill Contingency Planning* (April 2007) *Available at:* http://www.mvlwb.ca/Library/INAC%20-%20Guidelines%20for%20Spill%20Contingency%20Planning-%20April07.pdf (accessed December 13, 2010)

Kenneth Barbalace. 2004. ERG (Emergency Response Guidebook). EnvironmentalChemistry.com. 1995 - 2010. *Available at:* http://EnvironmentalChemistry.com/yogi/hazmat/erg/ (Accessed: December 13, 2010)

INAC (Indian and Northern Affairs Canada). 2004. *Spill Reporting Protocol for Mining Operations in the Northwest Territories and Nunavut.*

3.I.1.10 ACRONYMS AND ABBREVIATIONS

De Beers	De Beers Canada Inc.
GNWT ENR	Government of the Northwest Territories, Environment and Natural Resources
NWT	Northwest Territories
Project	Gahcho Kué Project
RCMP	Royal Canadian Mounted Police

APPENDIX 3.II

CONCEPTUAL COMPENSATION PLAN

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LIST OF TABLES

LIST OF FIGURES

3.II.1 INTRODUCTION

De Beers Canada Inc. (De Beers) is proposing to construct and operate a diamond mine, the Gahcho Kué Project (the Project), located at Kennady Lake, Northwest Territories (NWT), approximately 280 kilometres (km) northeast of Yellowknife. The purpose of the development is to extract diamond-bearing kimberlite deposits from three vertical pipes located beneath and adjacent to Kennady Lake. The three ore bodies, named 5034, Hearne, and Tuzo, will be mined using open pit methods down to a depth of approximately 300 metres (m). Open-pit mining methods will require dewatering of some areas of Kennady Lake and the physical disturbance of others.

The Project is expected to begin with two years of construction during 2013 and 2014 (Year -2 and Year -1). Kimberlite will be mined and processed during an 11-year (2015 to 2025) operational period. Dewatering of Kennady Lake will begin at the start of construction to establish a controlled basin and allow access to the lakebed above the 5034 ore body. Mining operations will commence in 2015 (Year 1), with mining of the 5034 ore body. Mining of the Hearne ore body is scheduled to begin in 2018 (Year 4), followed by mining of the Tuzo ore body in 2019 (Year 5). Progressive reclamation will occur during operations, with final closure anticipated to occur in year 14 (2028).

Construction and operation of the mine will cause harmful alteration, disruption, or destruction (HADD) of fish habitat in the Kennady Lake watershed. The affected habitat areas include portions of Kennady Lake and adjacent lakes within the Kennady Lake watershed that will be permanently lost, portions that will be physically altered after dewatering and later submerged in the refilled Kennady Lake, and portions that will be dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake. During Project construction and operations, there will also be some alterations of flows within the Kennady Lake watershed and in areas downstream from the Kennady Lake watershed.

Compensation options have been developed and evaluated in step with the evolution of the Project. Additionally, meetings between De Beers and Fisheries and Oceans Canada (DFO) have occurred on several occasions, including site visits by DFO. This Conceptual Compensation Plan (CCP) outlines anticipated Project effects on fish habitats, describes the various options considered for providing compensation, and presents a proposed fish habitat conceptual compensation plan to achieve no net loss of fish habitat according to DFO’s Fish Habitat Management Policy (DFO 1986, 1998, 2006).

3.II.2 PROJECT EFFECTS ON SURFACE WATERS

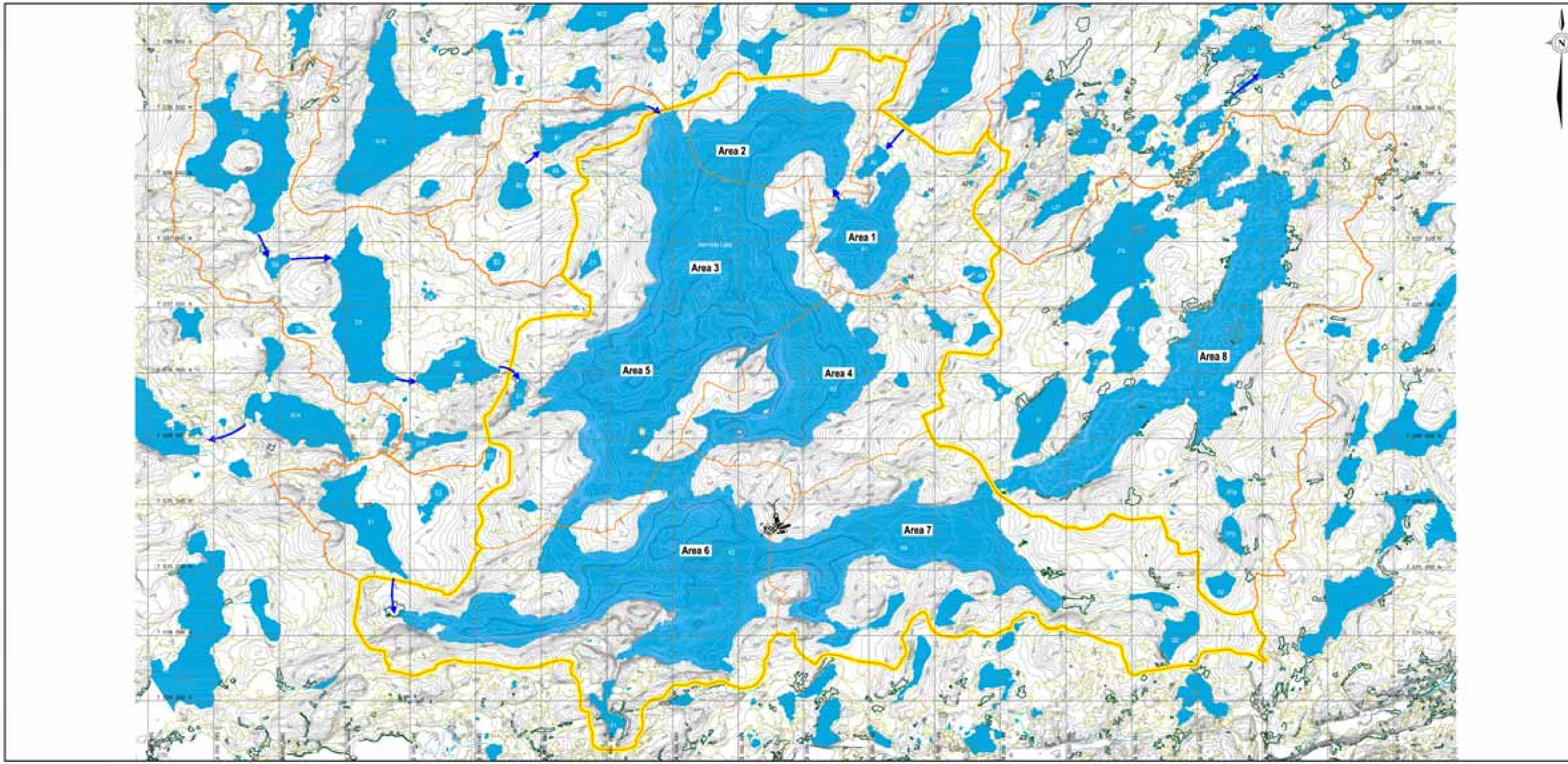
Project effects on surface waters include effects directly attributable to construction and mining operation activities (i.e., the base-case Project) as well as some effects attributable to development of fish habitat compensation works in conjunction with Project development. These effects are described separately in the following sections.

3.II.2.1 DIRECT PROJECT EFFECTS

The areas of the Kennady Lake watershed to be directly affected by Project development include Kennady Lake and several adjacent lakes that drain to Kennady Lake. The Kennady Lake sub-watersheds and the Project footprint are shown in Figure 3.II-1. Eight areas within the Kennady Lake watershed are identified in Figure 3.II-1. Area 1 includes Lake A1, Areas 2, 3, 4 and 5 include the northern portion of Kennady Lake, Areas 6 and 7 include the southern portion of Kennady Lake, and Area 8 includes the eastern basin of Kennady Lake. Outflow from Kennady Lake is through Area 8, discharging to the L watershed, In addition to these eight areas, some lakes in the A, D and E watersheds (which are sub-watersheds of the Kennady Lake watershed) will be affected by Project development

The controlled watershed created by the Water Management Plan for the Project consists of Areas 1 through 8 of the Kennady Lake watershed (Figure 3.II-2). Figure 3.II-2 illustrates how the Project development alone (i.e., without implementation of specific fish habitat compensation measures) would affect Kennady Lake and adjacent areas. The dewatering program required for developing and operating the mine includes dewatering of Areas 4, 6, and 7, and partial dewatering of Areas 3 and 5. Area 2 will be dewatered as part of the initial partial dewatering of Areas 3 and 5, and will become part of the Fine Processed Kimberlite Containment (PKC) Facility. Isolating and dewatering portions of Kennady Lake will begin in Year 2 of construction, so that removal of overburden from above the 5034 kimberlite deposit can begin in a timely fashion.

Fourteen dykes will be built to achieve the defined area for the controlled watershed (Figure 3.II-2). Perimeter dykes around Areas 1 to 7 will include Dykes A, C, D, E, F, and G. Several of these dykes (e.g., Dykes C, E, F, and G) will be constructed to divert water away from Kennady Lake. The diversions are required to reduce the volume of runoff entering the controlled areas (i.e., Areas 1 to 7) of Kennady Lake. Internal water retention dykes will include Dykes B, H, I, J, K, M, and N. Dyke L will serve as a filter dyke between Areas 2 and 3.



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

Bathymetry Contours
5m Index - 1m Intermediate

Controlled Area Boundary

Marsh Area

Scrub

Sub-watershed Boundary

Drainage Flow Direction

Lake/Pond

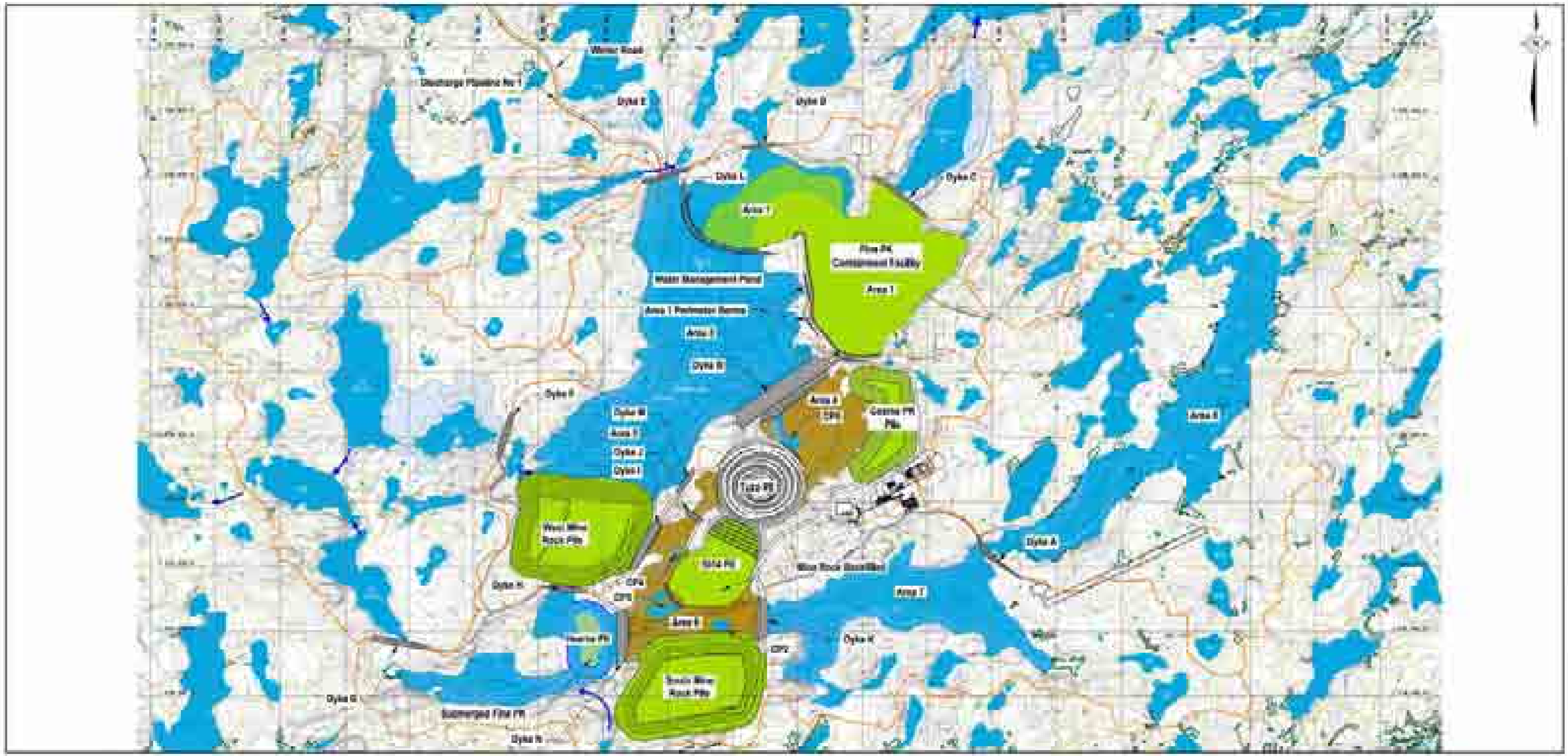
NOTES
Base data source: EBA Figure 4.5 - Stage 2 - Water Management During Mine Operation Years 1 to 3 (2015 to 2017)

GAHCHO KUÉ PROJECT

Kennady Lake Sub-watersheds and Controlled Area Boundary

PROJECTION: UTM Zone 12	DATUM: NAD83
SCALE 500 0 500 METRES	De Beers CANADA
FILE No: E-Fish-006-CAD	DATE: December 13, 2010
JOB No: 09-1365-1004	REVISION No: 1
OFFICE: GOLD - SAS	DRAWN: TAH/AJL CHECK: GW

Figure 3.II-1



NOTES
Base data source: EBA Figure 4.11 - Stage 8 - Water Management During Mine Operation

GAHCHO KUE PROJECT

Project Footprint at End of Operations (Years 9 to 11)

PROJECTION: UTM Zone 12	DATUM: NAD83	
FILE No: E-Fish-001-CAD		DATE: November 24, 2010
JOB No: 09-1365-1004	REVISION No: 0	Figure 3.II-2
OFFICE: GOLD - SAS	DRAWN: TAH/AG	CHECK: GW

3.II.2.1.1 Dewatering of Kennady Lake

The dewatering program will require initial construction of a water-retaining dyke (Dyke A) between Area 7 and Area 8, effectively isolating Areas 1 through 7 from Area 8, which is the primary lake outlet. Once Dyke A is completed, water will be discharged out of Kennady Lake by pumping to Area 8 and to Lake N11.

As the level of water in Areas 2 to 7 decreases, the sills separating the northwest portions of the lake (Areas 2 to 5) from the areas above the 5034 and Hearne ore bodies (Areas 6 and 7) will be exposed.

Internal water retention dykes will be constructed isolating the northern portion of the lake (Area 2 to 5) from the southern portion of the lake (Areas 6 and 7), effectively splitting the partially dewatered lake into two major sections and allowing the complete drainage of the remaining water from Areas 6 and 7 into the northern part of the basin. Areas 2 through 5 will be partially dewatered. Area 2 will be isolated from Areas 3 and 5 by Dyke L, and will become part of the Fine PKC Facility. Areas 3 and 5 comprise the Water Management Pond. By the middle of Year 5, Dyke B will be constructed to separate Areas 3 and 4 of Kennady Lake (Figure 3.II-2). This activity will allow for the dewatering of the southern portion of Area 4, so that the Tuzo ore body can be mined.

3.II.2.1.2 Closure Water Management

A progressive reclamation strategy will be used, where portions of the lake are isolated and allowed to refill to natural water levels as early as possible. The closure water management plan requires controlled pumping of water from Lake N11 to Area 3 to reduce the time required to refill Kennady Lake. The required filling time is estimated to be approximately eight years of both pumping from Lake N11 and natural runoff accumulation.

Major steps for the closure water management plan include the following:

- Lower the water elevations in all water storage areas within Areas 1 through 7 to 417.0 metres above sea level (masl) by siphoning the water from Areas 3 and 5, west of Area 6, and Area 7 to the mined-out Tuzo Pit after the end of mine life.
- Lower sections of Dykes B, N, and K to an elevation of 417.0 m, flatten the downstream slope, and place 1 m thick erosion protection material over the excavated dyke crests and flattened downstream slopes.

- Place erosion protection materials over the downstream natural channels (or engineered channel when required) to limit erosion along the flow paths to the mined-out Tuzo Pit.
- Breach a section of Dyke E to allow the runoff water from the catchment area of Lakes B1 to B4 to flow into Area 3.
- Allow the extra runoff water from Areas 3 and 5, west of Area 6, and Area 7 to flow over the breached sections of Dykes B, N, and K.
- Pump water from Lake N11 to Area 3 for eight consecutive years.
- Raise the water elevation in the entire basin to the original lake elevation of 420.7 masl in eight years after end of the mine operation.
- Breach Dykes F and G, and re-establish connections of the D and E watersheds to Kennady Lake
- Breach Dyke A to connect the refilled areas to Area 8, when the water quality meets criteria that allows Kennady Lake to be reconnected to the downstream watersheds.

3.II.2.1.3 Fish Habitat Loss and Alteration

The proposed mine development will affect all areas of Kennady Lake with the exception of Area 8 (which will experience reduced flow during mine operation). The affected habitat areas during mining include portions of Kennady Lake and adjacent lakes within the Kennady Lake watershed that will be permanently lost, portions that will be physically altered after dewatering and later submerged in the refilled Kennady Lake, and portions that will be dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake. The permanently lost or altered fish habitat areas are shown in Figure 3.II-3. The permanently lost areas are those affected by the following:

- The Fine PKC Facility (Areas 1 and 2, Lake A1, Lake A2, Lake A5, Lake A6, Lake A7);
- The Coarse PK Pile (Area 4 and Lake Kb4);
- West Mine Rock Pile (Area 5 and Lake Ka1);
- South Mine Rock Pile (Area 6); and
- Dykes C, D, H, I and L.

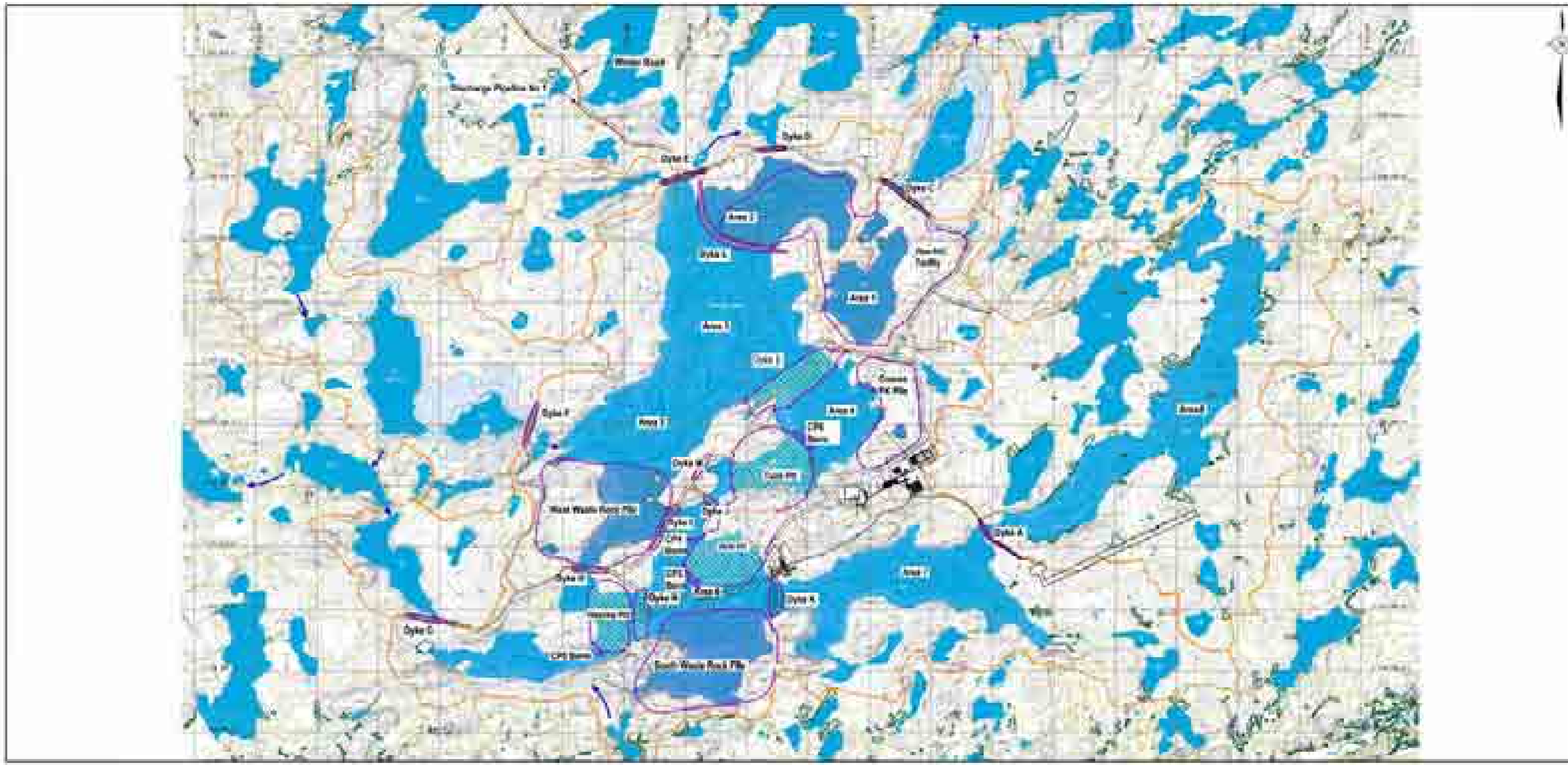
The areas that will be physically altered, but will be submerged in the refilled Kennady Lake after reclamation include areas of Kennady Lake affected by the following:

- The Hearne, Tuzo, and 5034 pits;
- Dykes A, B, J, K and N;
- The road through Area 6, between the Hearne Pit and Dyke K; and
- Water Collection Pond Berms CP3, CP4, CP5 and CP6.

The areas that will be dewatered (or partially dewatered) include those portions of Areas 3 through 7 that are not either permanently lost or physically altered before being submerged in the refilled Kennady Lake, as shown in Figure 3.II-3. Lake D1 will also be dewatered during operations, but will not be otherwise altered, and will be refilled at closure.

In addition to the affected areas noted above, several lakes will have increased water levels during mine operations. These include Lakes A3, D2, D3 and E1. Lake D1 will be affected due to the normal flow from D2 to D1 being blocked by Dyke F. Short sections of small watercourses will also be affected by Dykes F and G. Water levels in the raised lakes will be sufficient to divert their flows to the N watershed. Lake A3 will be permanently raised and diverted to the N watershed. Flows in areas downstream from the Kennady Lake watershed will be altered during construction and operations.

Proposed mine developments will affect large areas of Kennady Lake and, as such, will affect multiple life stages of species of fish known to inhabit the lake, including lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), burbot (*Lota lota*), lake chub (*Couesius plumbeus*), slimy sculpin (*Cottus cognatus*), and ninespine stickleback (*Pungitius pungitius*). In northern lakes, habitat quality (during ice-free periods) is typically higher in littoral (shallow shoreline) areas. Littoral areas are more productive with respect to aquatic vegetation and insects and, therefore, offer increased foraging opportunities, cover, and spawning habitat for fish. Additionally, lake margins share habitat with inlet streams; these areas are important for fish that use streams for key life processes, such as rearing or spawning (e.g., Arctic grayling).



LEGEND

Existing Ground Contours 5m Index - 1m Intermediate

Bathymetry Contours 5m Index - 1m Intermediate

CP Collection Pond

Winter Road

New Dyke

Marsh Area

Subwatershed Boundary

Drainage Flow Direction

Discharge Pipeline

Altered Fish Habitat Submerged at Closure

Permanently Lost Fish Habitat

Lake/Pond

Flooded Area

Mine Rock/Dyke

NOTES

Base data source: EBA Figure 4.5 - Stage 2 - Water Management During Mine Operation Years 1 to 3 (2015 to 2017)

GAHCHO KUE PROJECT

Permanently Lost or Altered Fish Habitat Areas

PROJECTION: UTM Zone 12	DATUM: NAD83		
FILE No: E-Fish-002-CAD			DATE: December 20, 2010
JOB No: 09-1365-1004	REVISION No: 0		Figure 3.II-3
OFFICE: GOLD - SAS	DRAWN: TAH/AG	CHECK: GW	

In winter, these areas offer little to no habitat, as ice can form to depths of up to 2 m. Therefore, habitat in Kennady Lake in the 2 to 4 m range becomes important from an overwintering perspective. In addition to remaining ice-free, these areas are influenced by wave-generated currents during open water periods and therefore contain substrates relatively free of organics and fines. Therefore, these areas offer important winter refugia and foraging opportunities for fish as well as providing suitable spawning substrates for several species. Lake habitats deeper that 4 m are typically used by large-bodied fish for holding, foraging and overwintering, and may provide spawning habitat for species (e.g., lake trout) that can spawn in deep areas where substrates are suitable.

With regard to specific developments in Kennady Lake, the majority of habitat that will be permanently lost or altered is within the greater than 4 m depth category (see Section 3.II.5). However, substantial amounts of habitat will be affected in the 0 to 2 m and 2 to 4 m depth categories, where higher quality fish habitat is more prevalent. Given the species assemblage in the lake, permanently lost or altered habitat in the 0 to 4 m range will affect rearing, holding, feeding, and spawning habitat for all species (with the exception of Arctic grayling, which spawn in streams). Given the distribution of clean, coarse substrates in Kennady Lake, all proposed developments (with the exception of some dykes) will affect un-embedded gravel, cobble, and boulder to some extent. Specifically, habitat with the potential to support spawning lake trout exists in areas proposed for the Fine PKC Facility, the West and South Mine Rock piles, Hearne, Tuzo, and 5034 pits, Dykes B, I, K, and L, and the road through Area 6. Additionally, habitats in the 2 to 4 m depth category are important to all species during the winter months.

3.II.2.2 COMPENSATION HABITAT DEVELOPMENT

Fish habitat compensation options that have been considered are described in Section 3.II.7.2. The compensation options described have the potential to affect several lakes and associated watercourses adjacent to Kennady Lake. One option involves raising the water levels (using dykes) in the area to the west of Kennady Lake. This would affect Lakes D2, D3, E1, N14, D4, D5, D6, D10, E2, an unnamed lake between D10 and N14, and an unnamed lake between N14 and D5, as well as their associated watercourses, as they would all be contained within the area of elevated water level. Another option would alter Lake A3 by raising the water level (over what would be required for the Project development alone) to provide additional compensation habitat. One compensation option considered involves raising the water level in Area 8 (and all of the refilled Kennady Lake after closure). In addition to altering Area 8, this option would also affect Lakes L2, L3, and L13 and their associated watercourses.

3.II.2.3 SUMMARY OF AFFECTED FISH HABITATS

3.II.2.3.1 Permanently Lost Areas

Fish habitats that will be permanently lost due to Project development are shown in Figure 3.II-3. These include:

- Lake A1 (affected by Fine PKC Facility)
- Lake A2 (affected by Fine PKC Facility)
- Part of Lake A3 (affected by Dyke C)
- Lake A5 (affected by Fine PKC Facility)
- Part of Lake A6 (affected by Fine PKC Facility)
- Lake A7 (affected by Fine PKC Facility)
- Lake Ka1 (affected by West Mine Rock Pile)
- Lake Kb4 (affected by Coarse PK Pile
- Part of Lake N7 (affected by Dyke D)
- Kennady Lake Area 2 (affected by Fine PKC Facility and Dyke L)
- Part of Kennady Lake Area 4 (affected by Coarse PK Pile)
- Part of Kennady Lake Area 5 (affected by West Mine Rock Pile, Dyke I and Dyke H
- Part of Kennady Lake Area 6 (affected by South Mine Rock Pile)
- Stream A1 (affected by Fine PKC Facility)
- Stream A2 (affected by Fine PKC Facility)
- Stream A3 (affected by Fine PKC Facility and Dyke C)
- Stream A5 (affected by Fine PKC Facility)
- Stream A6 (affected by Fine PKC Facility)
- Stream A7 (affected by Fine PKC Facility)
- Stream F1 (affected by South Mine Rock Pile)
- Stream Ka1 (affected by West Mine Rock Pile)
- Stream Kb4 (affected by Coarse PK Pile)

These permanently lost habitat areas will be compensated for by the proposed fish habitat compensation works.

3.II.2.3.2 Physically Altered and Re-submerged Areas

Fish habitats that will be physically altered during operations and then submerged in the refilled Kennady Lake at closure are shown in Figure 3.II-3. These include:

- Part of Kennady Lake Area 3 (affected by Dyke B).
- Part of Kennady Lake Area 4 (affected by Tuzo Pit, Dyke B, Dyke J, and CP6 Berm).
- Part of Kennady Lake Area 6 (affected by Hearne Pit, 5034 Pit, Dyke K, Dyke N, Road between Hearne Pit and Dyke K, CP3 Berm, CP4 Berm, and CP5 Berm).
- Part of Kennady Lake Area 7 (affected by Dyke A and Dyke K).

These physically altered and re-submerged areas will be compensated for by the proposed fish habitat compensation works. As all of these areas will provide some type of habitat after being re-submerged, their surface areas have been include in the total compensation habitat area, as described in Section 3.II.7.3.

3.II.2.3.3 Dewatered and Re-submerged Areas

The areas that will be dewatered (or partially dewatered) but not otherwise altered before being re-submerged are shown in Figure 3.II-3. These include:

- Portions of Kennady Lake Areas 3 through 7 (those parts that are not either permanently lost or physically altered).
- Lake D1.
- Streams D1, D2 and E1.

The proposed compensation works are not intended to compensate for these areas. The dewatered, but otherwise physically unaltered areas that will be re-submerged will provide habitats after closure that will have the same physical characteristics as those areas had prior to Project development.

3.II.3 DESCRIPTION OF POTENTIALLY AFFECTED WATERBODIES AND WATERCOURSE SEGMENTS

This section includes descriptions of existing conditions in waterbodies and watercourses that would be affected by Project development or that could be affected by one of the fish habitat compensation options described in Section 3.II.7.2

3.II.3.1 KENNADY LAKE

Kennady Lake (63° 26' N; 109° 12' W) is a small (815 hectares [ha]) headwater lake of the Lockhart River watershed with a mean depth of 5 m and a maximum depth of 20 m. It is located approximately 280 km northeast of Yellowknife and about 140 km northeast of the Dene community of Łutselk'e on the eastern arm of Great Slave Lake. A low divide separates Kennady Lake from a series of small headwater lakes and streams to the immediate north. Discharge from Kennady Lake flows north to Lake 410 (approximately 12 km downstream from Kennady Lake) then through a series of small lakes and streams into Kirk Lake and eventually into Aylmer Lake on the mainstem drainage of the Lockhart River. The Lockhart River system drains into the northeastern arm of Great Slave Lake.

In general, habitat in Kennady Lake can be classified into three types:

- shallow, nearshore littoral habitat within the zone of freezing and ice scour (i.e., less than 2 m deep);
- nearshore habitat deeper than the zone of ice scour but subject to wave action that prevents excessive accumulation of sediments (i.e., greater than 2 m but less than 4 m); and
- deep, offshore habitat with substrate usually consisting of a uniform layer of loose, thick organic material and fine sediment (i.e., greater than 4 m).

Nearshore habitats (i.e., less than 4 m) comprise approximately 48 percent (%) (393 ha) of the total area of Kennady Lake. Most of this nearshore habitat (greater than 57%) has a low gradient extending from the wetted edge to deeper, greater than 4 m habitat. Two other general nearshore habitat morphologies are also present in the lake but are less common. They include low gradient shorelines extending from the wetted edge to approximately the 2 m depth contour and then increasing in gradient to depths below 4 m, and high gradient shorelines extending immediately from the wetted edge to deeper greater than 4 m offshore habitat.

Twelve substrate categories, based on particle size standards for British Columbia (BC MELP 1998), have been identified in Kennady Lake (Annex J, Fisheries and Aquatic Resources Baseline). Habitat can also be classified into one of three gradient categories (i.e., slope from shoreline towards centre of lake) and one of three depth categories. Depth categories were differentiated by the typical annual ice depth (2 m) in Kennady Lake and the average depth of wind-generated currents (4 m). At depths less than 4 m, these wind-generated currents generally keep substrates clean by preventing the accumulation of silt and algae. Below 4 m depth, the effectiveness of these wind-generated currents is diminished, and substrates are typically embedded and/or algae covered.

Five sport fish species (i.e., Arctic grayling, burbot, northern pike, round whitefish and lake trout) have been recorded within Kennady Lake. Arctic grayling is the most abundant fish species (EBA and Jacques Whitford 2001). Lake chub, slimy sculpin and ninespine stickleback have also been recorded in Kennady Lake (Annex J). A single longnose sucker (*Castostomus catostomus*) was observed in the spring of 2000 near the lake outlet (Annex J). It is believed this single fish was a stray from downstream habitats and that Kennady Lake does not support a population of longnose sucker (Annex J).

Area 8 is the easternmost basin of Kennady Lake and is just upstream of the L watershed. As Area 8 will not be dewatered, it is the only part of Kennady Lake that has some potential for sustaining fish populations during the operational period. There is also potential for enhancement of habitat conditions in Area 8. The basin is long (approximately 4 km), narrow (typically less than 500 m wide), and generally less than 4 m deep (mean depth of 3 m). Two deep (greater than 8 m) holes exist in Area 8, and the maximum depth is 10.5 m, but deep-water habitats represent only 14.8% of the total Area 8 basin area (142.2 ha). Nearshore habitats are more diverse than in other basins of Kennady Lake. Ninety-eight percent of all nearshore habitats less than 2 m deep have shallow gradients. Within this nearshore zone, ten different substrate categories are present; however, most substrates are clean boulder/cobbles. Fines/organics are the most abundant substrate type at depths greater than 2 m. Aquatic vegetation is present in littoral areas of Area 8 and is typically found in shallow embayments along the southern shoreline and near the Kennady Lake outlet.

Area 8 has been identified as having high quality spawning habitat for Arctic grayling (EBA and Jacques Whitford 2001, 2002). Similar to Arctic grayling, northern pike have been captured moving into the Kennady Lake outlet area using Area 8.

3.II.3.2 UNNAMED LAKES IN THE A WATERSHED

3.II.3.2.1 Lake A1

Lake A1 has a surface area of 34.5 ha and a maximum recorded depth of 7.6 m (Jacques Whitford 2003). Lake A1 is dominated by low gradient, shallow habitat and fine substrates. The substrates in the northern embayment of the lake consist of mainly fines. The eastern and southern shores of the lake are composed of boulder and cobble substrates that have been scoured by wave and ice action. Shoals in these areas consist of fines with pockets of emergent vegetation. The western shoreline has two embayment areas with substrates composed mainly of fines. Sedges have been found along the edges of these areas. Outside the embayment areas, substrates consist of boulders and cobbles, similar to the eastern areas. Fish species that have been recorded in Lake A1 include Arctic grayling, burbot, and round whitefish (Annex J, Addendum JJ, Additional Fish and Aquatic Resources Baseline Information).

3.II.3.2.2 Lake A2

Lake A2 has a surface area of 3.07 ha and a maximum depth of 1.1 m. The lake is dominated by low gradient, shallow habitat. Boulders comprise more than 40% of the substrate and are highly embedded with a layer of fine sediments. No fish have been captured in Lake A2; however, it is assumed to be fish bearing, since fish have been captured in upstream habitats (Annex J).

3.II.3.2.3 Lake A3

Lake A3 has a surface area of 23.8 ha and is the deepest of the small lakes and ponds within the Kennady Lake watershed. It has a recorded maximum depth of 12.2 m. Shoreline substrates along the steep west side consist of scoured boulders lying near the surface and up to the high-water mark. Below this area is a zone of inorganic fines. The northern inflow and southern outflow ends of the lake are shallow with organic fines and dense sedge (*Carex* sp.) populations. The shoreline along the eastern side of the lake has a shallow gradient, and is fringed with emergent vegetation over a boulder substrate. Fish species recorded in Lake A3 include Arctic grayling, burbot, lake trout, and northern pike (Annex J, Addendum JJ).

3.II.3.3 UNNAMED LAKES IN THE D WATERSHED

3.II.3.3.1 Lake D1

Lake D1 has a surface area of 1.87 ha and a maximum depth of 3.8 m. The lake is dominated by low gradient, shallow habitat with substrate composed of more than 40% boulder that is highly embedded boulders overlain with a layer of fine sediment. Fish species recorded in Lake D1 include burbot and northern pike (Annex J).

3.II.3.3.2 Lake D2

Lake D2 is shallow with a maximum depth of 1 m. It has a surface area of 12.5 ha. Substrate throughout the lake is mainly boulder with an overlying 0.30 m thick layer of organic sediments. There are also boulder substrates adjacent to the shore with a thin layer of sediments. A zone of sedges is located at the east end of the lake. Surrounding the entire lake is a 25 to 100 m zone of sedges that would be expected to be inundated during high water. Northern pike have been captured in Lake D2 (Annex J, Addendum JJ).

3.II.3.3.3 Lake D3

Lake D3 has a surface area of 38.4 ha. This lake is shallow with a maximum depth of 2.5 m. Shoreline substrates are primarily ice scoured boulder and cobble with inorganic silt patches. The shoreline is of low gradient with a 0.5 to 1 m fringe of sedges found along the majority of the lake. The north and south ends of the lake are particularly shallow. The central deeper portion of the lake has a substrate consisting of boulders with an overlying layer of organic fines. Fish species that have been recorded in the lake include burbot, lake trout, and northern pike (Annex J, Addendum JJ).

3.II.3.3.4 Lake D4

The outlet of Lake D4 is characterized by a wide wetland area of emergent sedge vegetation. Substrate is 100% organics. The lake outlet is controlled by very large boulders. No fish have been captured in Lake D4; however, it is assumed to be fish bearing, since fish have been captured in upstream habitats (Annex J).

3.II.3.3.5 Lake D5

Lake D5 is a non-fish bearing lake for which no habitat data are available (Annex J).

3.II.3.3.6 Lake D10

Lake D10 has a surface area of 4.40 ha. This lake has a maximum depth of 1.7 m. The dominant shallow habitat is composed of highly embedded boulders overlain with a layer of fine sediments. Boulders make up more than 40% of the substrate composition. Lake D10 is a non-fish bearing lake (Annex J).

3.II.3.4 UNNAMED LAKES IN THE E WATERSHED

3.II.3.4.1 Lake E1

Lake E1 has a surface area of 20.2 ha and is comprised of three basins separated by shoals. The northern basin has a maximum depth of 2.2 m and a moderately steep shoreline composed of bedrock/boulder and cobbles. The central basin has a maximum depth of 3.4 m. The southernmost basin has a maximum depth of 3 m. The shoals separating the basins are 0.75 m deep and are composed of ice scoured boulders and cobbles. The western shoreline of the central basin is moderately steep and composed of a boulder and cobble substrate. The eastern shoreline of the central basin has a shallow gradient, with shoreline characteristics similar to the western shoreline. Shoreline areas have a fringe of emergent vegetation and overhanging vegetation around the perimeter of the lake. Fish species recorded in Lake E1 include northern pike and slimy sculpin (Annex J, Addendum JJ).

3.II.3.4.2 Lake E2

Lake E2 is a very shallow lake with no discernable outflow channel. The lake has a surface area of 3.02 ha and has a maximum measured depth of 0.4 m. The shoreline is composed primarily of boulders, with organic fines present. The shoreline is surrounded by a fringe of sedges about 0.5 m to 1.0 m wide. The substrate in the southernmost basin has fewer fines and is mostly comprised of clean boulder substrate with no sedges. The substrate in the main waterbody, excluding the shoreline, is composed of boulders with an overlying layer of organic silt (0.30 m thick). Lake E2 is a non-fish bearing lake (Annex J).

3.II.3.5 UNNAMED LAKES IN THE KA WATERSHED

3.II.3.5.1 Lake Ka1

Lake Ka1 is a small, one hectare lake with a maximum observed depth of 1 m (Annex J). The substrate in Lake Ka1 consists of boulders overlain with organic fines. There is emergent vegetation along the shoreline of the lake, with some areas of exposed boulders also present.

3.II.3.6 UNNAMED LAKES IN THE KB WATERSHED

3.II.3.6.1 Lake Kb4

Lake Kb4 is a small, one hectare lake with substrate composed of mostly organics with some intermittent boulders. There is emergent vegetation along the lake shoreline. The lake bottom deepens quickly away from the shoreline.

3.II.3.7 UNNAMED LAKES IN THE N WATERSHED

3.II.3.7.1 Lake N2

Lake N2 is a 27.1 ha lake with a maximum depth of 5.5 m. The shoreline is dominated by shallow and steep gradient areas with boulder and fine substrates interspersed with areas dominated by boulders and cobbles. Along the northwest and northeast shoreline, two small pockets of bedrock are present. The lake interior is a deep zone dominated by organic and fine sediments. However, in the eastern portion of the basin and along the adjacent shoreline, large boulders are present. Accessibility of fish habitat downstream of the outlet is restricted in summer and fall due to limited surface flow over boulders. Arctic grayling, lake trout, round whitefish, lake chub, slimy sculpin, and ninespine stickleback have been captured in Lake N2 (Annex J, Addendum JJ).

3.II.3.7.2 Lake N3

Lake N3 is 12.2 ha in size and has a maximum recorded depth of 5.5 m. The shoreline is dominated by boulder and fine substrates, with shallow and steep gradients interspersed. At the northeast end of the lake, a pocket of cobbles and fine substrates is present, and a pocket of emergent vegetation mixed with fine substrates is present along the northwest shoreline. The lake basin interior is dominated by organic and fine sediments up to the maximum depth. Fish habitat downstream of the outlet is passable to fish during all seasons. Arctic grayling, round whitefish, burbot, and lake chub have been captured in Lake N3 (Annex J, Addendum JJ).

3.II.3.7.3 Lake N4

Lake N4 is a small, shallow lake with substrate dominated by boulders and fine sediments. A small pocket of emergent vegetation with organic substrate is present along the southwest shoreline, and a larger pocket at the north end of the lake shoreline. In addition, an area with boulder and cobble substrates is present along the northwest portion of the lake. The central portion of the lake is dominated by fine and organic substrates. Bedrock and boulders restrict access to fish habitat downstream of the lake outlet during low flow periods. Arctic grayling and lake chub have been captured in Lake N4 (Annex J, Addendum JJ).

3.II.3.7.4 Lake N5

Lake N5 has a total surface area of 52.4 ha and has a maximum depth of 12.8 m. The shoreline of the lake is dominated by boulder and fine substrates, with both shallow and steep gradients represented. Along the northeast portion of the shoreline, boulders are present. The interior of the lake is dominated by organic and fine sediments; however, in the northern portion of the basin, a large area with boulders is present. During low flow periods, a boulder garden provides a barrier to fish passage downstream of the outlet area. Arctic grayling, lake trout, round whitefish, lake chub, slimy sculpin, and ninespine stickleback have been captured in Lake N5 (Annex J, Addendum JJ).

3.II.3.7.5 Lake N6

Lake N6 is composed of two basins: N6a and N6b. Together, the two basins are 81.4 ha in size and have a maximum recorded depth of 4.0 m. The shoreline is dominated by boulder and fine substrates, with steep gradients interspersed with shallow areas. Along the southwest arm of the lake, an area with boulders is present. The interior of the lake is dominated by organic and fine sediments, with a large boulders present in the central portion. Fish habitat downstream of the outlet is accessible to fish in all seasons. High quality northern pike habitat is present in the downstream tributary. Arctic grayling, burbot, lake trout, round whitefish, lake chub, and ninespine stickleback have been captured in Lake N6 (Annex J, Addendum JJ).

3.II.3.7.6 Lake N12

Lake N12 has a surface area of 100.8 ha and a maximum depth of 5.8 m. Fish captured in Lake N12 include Arctic grayling, burbot, lake trout, longnose sucker, lake chub, slimy sculpin, and ninespine stickleback (Annex J, Addendum JJ).

3.II.3.7.7 Lake N13

Lake N13 is a small, shallow lake with a shoreline dominated by boulder and cobble substrates. Pockets of emergent vegetation and organics are present along the northwest, northeast, western, and southern portions of the lake shoreline. A patch of boulder and fine substrates is present along the southwest shoreline. The lake interior is dominated by organic and fine sediments. This lake is perched, and no outlet stream has so far been identified during. Fish have not been captured in Lake N13 (Annex J, Addendum JJ).

3.II.3.7.8 Lake N14

Lake N14 is a shallow lake dominated by boulder and fine substrates along the shoreline. Some steeper gradient habitats were identified during surveys. The central portion of the lake is dominated by organic and fine substrates and the basin has a maximum recorded depth of 2.8 m. Upstream access to the lake by fish in the tributary is limited due to the presence of a plunge pool located near the outlet of the lake. Arctic grayling, lake trout, longnose sucker, and lake chub have been captured in Lake N14 (Annex J).

3.II.3.8 UNNAMED LAKES IN THE L WATERSHED

3.II.3.8.1 Lake L2

Lake L2 has a surface area of 12.6 ha and a maximum recorded depth of 3.4 m. Lake L2 is dominated by a shoreline consisting of boulders and fines. Boulders constitute more than 40% of the substrate. In the more central portions, fines and organics are the dominant substrates. Along the southwest shoreline, a small pocket of bedrock is present. The lake bed generally has a low gradient. Moderate quality fish habitat is located downstream of the outlet, and is passable to fish during all seasons. Fish captured in Lake L2 include Arctic grayling and northern pike (Annex J, Addendum JJ).

3.II.3.8.2 Lake L3

This small lake has a shallow basin, with a surface area of 4.4 ha and a maximum recorded depth of 1.0 m. The substrate is dominated by boulder and fines with a small area of organic and fine sediments present in the central portion of the lake. A small patch of bedrock is located along the northern shoreline of the lake. Access to suitable Arctic grayling habitat downstream of the outlet is unavailable after spring freshet. Northern pike have been captured in Lake L3 (Addendum JJ).

3.II.3.8.3 Lake L13

Lake L13 is a small, shallow lake with a surface area of 3.3 ha and a maximum depth of 1.3 m. Lake substrates are dominated by fines, with some boulder/cobble areas also present (Addendum JJ). Burbot have been captured in Lake L13 (Annex J).

3.II.3.9 WATERCOURSE SEGMENTS

3.II.3.9.1 Streams in the A Watershed

Detailed habitat descriptions are not available for streams in the A watershed.

3.II.3.9.2 Streams in the D Watershed

3.II.3.9.2.1 Streams D1, D2, D3

Stream D1 is 118 m long, Stream D2 is 228 m long, and Stream D3 is 97 m long. Together with Stream D4, streams D1, D2, and D3 provide low to moderate northern pike spawning habitat and provide access to upstream lakes of catchment D; particularly lakes D2 and D3, where emergent and submergent vegetation used by northern pike for spawning and rearing are abundant.

3.II.3.9.2.2 Stream D4

Stream D4 is 428 m in length with an overall gradient of 0.5%. The stream is characterized by a well defined channel through a depression in the tundra. Mean bankfull height is 0.9 m, and the average width of this gully is 2.6 m. The habitat composition in Stream D4 is a series of glide and pool units. The channel is heavily vegetated with sedges, willows (*Salix* sp.), and dwarf birch (*Betula nana*). Substrate is dominated by fines, with small components of gravel, cobble and boulder habitat. At Lake D4, the stream widens into a braided channel; mean width is 3.1 m, with a floodplain width of 10.1 m.

Stream D4 provides low to moderate northern pike spawning ground that exists in association with wetlands at the head waters of Stream D4. Small areas of potential spawning habitat for Arctic grayling are available, but use is considered unlikely. In addition, Stream D4 provides access to upstream lakes of catchment D (Annex J).

3.II.3.9.2.3 Stream D6

Stream D6 consists of an area of periodically wetted tundra. No channel is present, no fish habitat exists, and no upstream passage is possible at this location (Annex J).

3.II.3.9.2.4 Stream D7

Stream D7 is 206 m in length, and consists of a narrow channel flowing through a shallow depression in the tundra. Overall gradient is 1.7%. Riparian habitats are characterized by thick growth sedges, as well as willow and dwarf birch overhanging the stream channel. The first 20.8 m of stream downstream of Lake D7 consists of a channel averaging 11.7 m in width, with a floodplain 21.6 m wide. Substrates are predominantly fines, and depth averages 0.27 m. The outlet of the lake is controlled by a shallow boulder riffle. Thereafter, the stream channel is fairly uniform, consisting of a series of glides and pools separated by small boulder riffles. Habitats of this type continue for 139 m downstream. The stream banks are generally well defined, with a low flow channel averaging 1.3 m in width, and a floodplain averaging 4.3 m in width. The channel is occasionally braided, with a maximum floodplain width of 10.5 m. Depth averages 0.24 m, and substrates are primarily organic, with small areas of cobble, gravel, and boulder. At the confluence with Lake D4, the channel spreads into a wetland area.

The segment provides limited spawning habitat for northern pike, particularly at the outlet of Lake D7 and at Lake D4. A small fragment of potential Arctic grayling spawning habitat exists near Lake D7, but it is not known whether Arctic grayling are present in this lake. The stream provides fish passage between Lakes D7 and D4, so fish passage between Kennady Lake and Lake D7 is possible. The stream maintains some flow in summer, providing limited rearing habitat. Slimy sculpin have been captured in this stream (Annex J).

3.II.3.9.2.5 Stream D8

Lake D8 is seasonally connected by Stream D8 to Lake D7 by way of sheet flow through a wetland area. Total distance between the two lakes is 169 m, and overall gradient is 2%. During an investigation on August 6, 2004, no visible channel was present, and no fish habitat existed. Fish passage is not possible. The wetland area is characterized by sedge vegetation (Annex J).

3.II.3.9.2.6 Stream D9

Lake D9 is connected to Lake D7 by a watercourse (Stream D9) consisting of a poorly defined wetland for 85 m and a more well-defined stream section 103 m in length. Overall length of the section is 188 m, and overall gradient is 2%. Fish passage through Stream D9 appears impossible, because flow is subsurface at the confluence with Lake D7.

The wetland area at the outlet of Lake D9 has an average depth of 0.2 m. Spring flows likely cover an extent averaging 17.1 m wide. Habitat is largely boulders embedded in fine organic sediments, and the area is completely covered by emergent sedge vegetation. Scattered pool habitat also exists in this area, with depths to 0.5 m. No fish have been caught in these habitats, and it is not known whether any fish are present in Lake D9.

Downstream of the wetland, a more confined channel is present, characterized by fine and boulder substrates. Flow is subterranean for the last 9.3 m at the confluence with Lake D7. There is no defined channel, and fish passage is unlikely at any time (Annex J).

3.II.3.9.3 Streams in the E Watershed

3.II.3.9.3.1 Stream E2

The total channel length of Stream E2 is 290 m, with an overall gradient of 1.6%. The stream channel connects Lakes E2 and E1. A braided, poorly defined channel is present for 81 m downstream of Lake E2, characterized by heavy willow vegetation and fine substrates. Floodplain width averages 11.7 m. Flow also seeps out of Lake E2 north of this location. Thereafter, the channel is generally poorly defined, with predominantly fine substrates, and flows through an area of spruce (*Picea* sp.) and willow trees. Short sections of braided defined channel are present, characterized by boulder substrates. Flow is subterranean at many locations, and no fish passage is possible. The final 77 m of the stream section is a wetland area 48.4 m in width. Although short sections of braided, defined channel are present, fish passage is not possible, because flow is subterranean beneath boulders near Lake E1 (Annex J).

3.II.3.9.4 Stream K5

Stream K5 is the outlet to Kennady Lake, located at the end of Area 8. Stream K5 is 110.6 m long, and flows northwest into Lake L3. The overall gradient is 0.1%. The substrate in Stream K5 is primarily angular boulders.

This stream provides high quality spawning and rearing habitat for both northern pike and for Arctic grayling, as both a large sedge wetland and appropriately sized, clean spawning gravels are present. Arctic grayling prefer to spawn in small gravel or rocky-bottomed streams (Scott and Crossman 1973) with current velocities less than 1.4 metres per second (m/s) (Evans et al. 2002). However, gravels and smaller cobbles are abundant in Stream K5; combined with the riffle and pool habitat that exists in spring, this stream likely provides better spawning habitat for Arctic grayling than most streams in the Project area. High numbers of young-of-the-year Arctic grayling have previously been captured in Stream K5. This suggests that Stream K5 provides spawning and rearing habitat for Arctic grayling. Limited riparian cover is present, with vegetation comprised largely of sedges and grasses (Annex J).

3.II.3.9.5 Streams in the Ka Watershed

3.II.3.9.5.1 Stream Ka1

A detailed habitat description is not available for Stream Ka1.

3.II.3.9.6 Streams in the Kb Watershed

3.II.3.9.6.1 Stream Kb4

A detailed habitat description is not available for Stream Kb4.

3.II.3.9.7 Streams in the L Watershed

3.II.3.9.7.1 Stream L1a

Stream L1a is a complex watercourse section providing diverse fish habitats for both spawning and rearing. The stream is confined within a defined depression. At the upstream end, several channels leave Lake L1a, providing inundated vegetation habitat as well as suitable spawning gravels in riffle and glide habitats.

The main channel is divided into several braids separated by vegetated islands. Substrates are primarily large angular boulders. A wide pool is present in the central portion of the section. In the lower portion, the right bank is defined by a steep bedrock wall, and a cascade is present, which is unique among streams in the outlet drainage. However, the left bank at this location consists of willow vegetation, with extensive low gradient off-channel habitat. Although velocities along the confined right bank may constrain fish migration at very high flows, fish passage through vegetated channels along the left bank remains possible. An area of inundated vegetation is present near the centre of the stream section, but use by spawning northern pike has not been observed. Tall willow vegetation throughout this stream section provides overstream cover and habitat complexity that is uncommon amongst the stream sections in the outlet drainage. Overall section length is 346 m, with a gradient of 1.3% (Annex J).

3.II.3.9.7.2 Stream L1b

This stream is a short, highly braided riffle comprised of a wide channel separated by numerous vegetated islands. The right bank is well defined, but the left bank consists of many small channels and, during the spring, inundated tundra vegetation. Riparian vegetation includes low shrubs and sedges among tundra hummocks. Islands are sparsely vegetated but have little influence on aquatic habitat quality. Overall length of aquatic habitat is 104 m, with a gradient of 0.8%. Floodplain width averages 47.5 m. The defined channel averages 41.5 m in width (Annex J).

3.II.3.9.7.3 Stream L1c

Stream L1c is a small, wide stream segment is composed of riffle type habitat over its entire 94.5 m length, with intermittent pocket pools. The stream is wide and unconfined in comparison to Section L2 immediately upstream. Riparian habitat is comprised of low shrub vegetation with little influence on habitat character or quality within the section. Overall gradient is 0.5% (Annex J).

3.II.3.9.7.4 Stream L2

Stream L2 is composed of two channels, with the left channel carrying most of the flow and being accessible to fish. The right channel is likely of glacial origin and is dominated by large boulders with flows during spring through interstitial spaces in the substrate. Overall length of this stream segment is approximately 80 m with an overall gradient of 0.5%. Banks are well defined, with riparian cover comprised of willow and dwarf birch shrubs.

3.II.3.9.7.4.1 Left Channel

The first 14 m of the left channel of Stream L2 is comprised of glide habitat with cobble, boulder and gravel substrates. This area is essentially a narrowing in Lake L2; channel width is 22.7 m, with a wetted width of 31.7 m. This area is different than the habitat at Lake L2 due to the presence of an area of inundated sedge wetland along the right bank of the stream. Mean depth is 0.3 m, and mean velocity is 0.25 m/s. The channel is then constrained in a riffle 3.3 m wide and 24.5 m in length. Depth and substrates remain similar to the upstream reach, but flow velocities increase to 0.96 m/s. A small pool below the riffle area is 0.5 m deep, with average flows of 0.56 m/s (38.5 to 41 m). The riffle downstream of this pool braids at 57.4 m; substrates are predominantly boulders, with 30% cobbles also present. The combined wetted width of the braided channels is equivalent to an active channel width of 9.9 m. The left bank of this section of channel is bedrock controlled. Mean depths and velocities are relatively high in comparison to other stream segments in the outlet drainage (0.3 m and 0.96 m/s). Channels join at a small pool present between 67.8 and 72.7 m (4.5 m wide, max depth 0.6 m). Substrate in the pool is predominantly gravel (70%). Between 72.7 m and the confluence with Lake L1c at 80 m, the stream is characterized by a single channel, comprised of riffle habitat with large boulder substrate.

Although areas of suitable spawning gravel for Arctic grayling are more limited in this stream segment than in Stream L3, the gravel substrates present likely represent important habitat for this species. However, rearing habitat for juvenile fish is limited during the spring, as a result of relatively high current velocities in this constrained channel (Annex J).

3.II.3.9.7.4.2 Right Channel

The right channel of Stream L2 is dominated by angular boulder substrate that are likely glacial in origin. Fish habitat is poor or nonexistent in this channel, and fish passage is not possible at the flows observed during field surveys (Annex J).

3.II.3.9.7.5 Stream L3

Stream L3 is a complex stream with an overall length of 463 m and gradient of 0.3%. The stream flows east, and is characterized by in-stream islands, old glacial channels, oxbows, and inundated off-channel habitats and pools. Pockets of small cobbles and gravel provide high quality spawning habitat for Arctic grayling. The high diversity of habitats also affords high quality rearing habitat for juvenile fish. Riparian cover is more complex than in the upstream section, with shrub birch and willow cover on vegetated islands and along the boulder channel on the left bank (Annex J).

3.II.4 APPROACH FOR HABITAT ASSESSMENTS

3.II.4.1 PERMANENTLY LOST, PHYSICALLY ALTERED OR DEWATERED HABITATS

3.II.4.1.1 Habitat Area Determination

The areal quantity of fish habitat permanently lost, physically altered or dewatered as a result of the Project was determined using a Geographic Information System (GIS) to overlay the Project footprint over habitat classification maps of the affected waterbodies. Habitat was classified into categories of substrate type (e.g., boulder/cobble), gradient (i.e., shallow or steep), and depth (i.e., less than 2 m, between 2 and 4 m, greater than 4 m) (Annex J, Addendum JJ). The area (A_k) of each habitat category, k, within the Project footprint was digitized using GIS for each waterbody and quantified in hectares.

The length of watercourse segments permanently lost, physically altered or dewatered by the Project was determined using GIS. Kennady Lake tributary streams are generally small and less than 3 m wide (Annex J). For the purposes of estimating the quantity of watercourse habitat lost, the area of the watercourse affected was determined by multiplying the length of each watercourse segment by an assumed width of 3 m.

3.II.4.1.2 Habitat Suitability Determination

The suitability of fish habitat permanently lost, physically altered or dewatered by the Project was quantified using a modified Habitat Evaluation Procedure (HEP). The HEP method was developed by the US Fish and Wildlife Service (USFWS 1980, 1981) and has been used to quantify habitat losses and gains at other mining projects in the NWT and Nunavut, including the Lac De Gras (Diavik 1998), Snap Lake (De Beers 2002), Jericho (Mainstream Aquatics 2004), Doris North (Golder 2005) and Meadowbank (Cumberland Resources 2005) mines.

With a HEP approach, habitat suitability is assigned to discrete habitat types using Habitat Suitability Index (HSI) models developed for fish species known or assumed to be present in affected areas. The HSI models are developed from available literature and professional judgement regarding the habitat preferences and life-history requirements of different fish species. Specifically, updated versions of the HSI models developed for northern fish populations by Diavik (1998) were used to quantify habitat suitability for areas affected by the Project.

Models were updated with more recently published information (Richardson et al. 2001; Evans et al. 2002; Stewart et al. 2007) and with modifications made in more recent fish habitat compensation plans (De Beers 2002; Mainstream Aquatics 2004; Golder 2005; Cumberland Resources 2005).

The HSI models were used to quantify the suitability of habitat categories for various life-history stages, and for each fish species present on a scale of 0 (unsuitable) to 1 (optimal). The habitat suitability values assigned by the models are based on the following rating system:

- unsuitable: 0.00;
- below average: 0.25;
- average: 0.50;
- above average: 0.75; and
- optimal: 1.00.

The HSI models were used to determine habitat suitability for the following life-history stages of species present:

- spawning/nursery stage, considering the suitability of habitat used by fish for spawning and embryo development;
- rearing stage, considering the suitability habitat used by young-of-the-year and juveniles for foraging and refuge from predators;
- foraging stage, considering the suitability of habitat used by adult fish for feeding; and
- overwintering stage, considering the suitability of habitat used by all fish during the winter.

Habitat suitability indices were determined for all permanently lost, physically altered or dewatered waterbodies and for the eight fish species known to occur in the Project area, which include lake trout, round whitefish, Arctic grayling, northern pike, burbot, lake chub, slimy sculpin, and ninespine stickleback. For Kennady Lake, suitability indices were determined for all eight species. For lakes in the A watershed, suitability indices were not determined for lake chub, since it has not been documented in that watershed. For lakes in the N watershed, suitability indices were not determined for northern pike, since it has not been documented in that watershed. While a single longnose sucker has been observed near the outlet of Kennady Lake, it is believed this single fish was a stray from downstream habitats and that Kennady Lake does not support a population of longnose sucker (Section 3.II.3.1, Annex J). Because of this, longnose sucker were not included in the calculations of habitat suitability.

HSI models have not yet been developed for the Project for watercourse segments. Development of these models will be completed in 2011, and the assessment of losses associated with affected watercourses will be included in the detailed compensation plan that will be developed for the Project.

3.II.4.1.3 Calculation of Habitat Units

The area and suitability of fish habitat permanently lost, physically altered or dewatered by the Project was integrated into a single, dimensionless unit called a Habitat Unit (HU). For each species, permanently lost or altered HUs were calculated as the product of the area lost for each habitat category and the suitability of that habitat category for each life-history stage. For each permanently lost or altered waterbody, the HUs are then summed across all habitat categories and species life-history stages to calculate the total HUs lost for a species in a given waterbody. The calculation of HUs for a species in a given waterbody can be formally stated by the following equation:

$$HU_i = \sum_{j=1}^{n} \sum_{k=1}^{n} A_k \times S_{j,k}$$

where: $S_{j,k}$ = the suitability of habitat category *k* for life-history stage *j;*

A_k = the area of fish habitat permanently lost or altered (in hectares) of habitat category *k;* and,

HU_i = the habitat units permanently lost or altered for species *i*.

3.II.4.2 COMPENSATION HABITATS

3.II.4.2.1 Preliminary Habitat Quantification

Preliminary estimates of habitat gains potentially achieved from the compensation options under consideration were quantified using GIS. The footprint of each compensation option was overlaid on maps of the project area that include bathymetry of lakes in the Project area. Lake area by depth class was measured for habitat to be created by each option for areas that would otherwise not be expected to provide fish habitat, such as flooded terrestrial area and reclaimed submerged mine pits.

3.II.4.2.2 Planned Detailed Habitat Quantification

Detailed quantification of habitat gains potentially achieved by the selected compensation options will be included in the detailed compensation plan that is to be completed in 2011. The general strategy for quantification is equivalent to the approach taken for quantifying permanently lost, physically altered or dewatered habitats (Section 3.II.4.1).

3.II.5 ASSESSMENT OF PERMANENTLY LOST OR OTHERWISE ALTERED HABITATS

3.II.5.1 PERMANENTLY LOST AREAS

3.II.5.1.1 Surface area

The Project will result in the permanent loss of 194.56 ha of lake area (Table 3.II-1). The majority of the losses will occur in Kennady Lake (154.61 ha). They represent about 19% of the total pre-development Kennady Lake area of 813.57 ha. The remainder of the permanently lost areas include the complete loss of Lakes A1, A2, A5, A7, Ka1 and Kb4, and partial losses of small portions of Lakes A3, A6, and N7 (Table 3.II-1). The largest category of habitat that will be permanently lost is deep lake bed covered by fine substrate (79.41 ha) (Table 3.II-2), with an additional 31.65 ha of habitat loss occurring in other areas dominated by fine substrates (which is typically of relatively low quality fish habitat). A considerable proportion of the remaining permanent losses (66.74 ha) will occur in areas dominated by boulder (Table 3.II-2), which is typically of relatively high quality fish habitat. The Project will also result in the permanent loss of 0.51 ha of watercourse area in tributaries to Kennady Lake (Table 3.II-3).

Table 3.II-1 Lake Areas Permanently Lost as a Result of the Gahcho Kué Project

Mine Infrastructure	Area Permanently Lost (ha)										
	Kennady Lake	A1	A2	A3	A5	A6	A7	Ka1	Kb4	N7	Total[(a)]
Fine PKC Facility	59.24	34.45	3.07	-	0.14	0.07	0.12	-	-	-	97.09
Coarse PK Pile	1.05	-	-	-	-	-	-	-	1.03	-	2.08
West Mine Rock Pile	34.08	-	-	-	-	-	-	0.94	-	-	35.03
South Mine Rock Pile	52.71	-	-	-	-	-	-	-	-	-	52.71
Dyke C	-	-	-	0.09	-	-	-	-	-	-	0.09
Dyke D	-	-	-	-	-	-	-	-	-	0.04	0.04
Dyke H	0.62	-	-	-	-	-	-	-	-	-	0.62
Dyke I	2.25	-	-	-	-	-	-	-	-	-	2.25
Dyke L	4.67	-	-	-	-	-	-	-	-	-	4.67
Total	**154.61**	**34.45**	**3.07**	**0.09**	**0.14**	**0.07**	**0.12**	**0.94**	**1.03**	**0.04**	**194.56**

[(a)] Totals may not be exact due to rounding errors.

ha = hectares; PKC = Processed Kimberlite Containment; PK = processed kimberlite

Table 3.II-2 Areas Permanently Lost (ha) as a Result of the Gahcho Kué Project, listed by Substrate Category, Gradient Class, and Depth Class

Substrate Category[(a)]	Gradient class[(b)]	Depth class[(c)]	Kennady Lake	A1	A2	A3	A5	A6	A7	Ka1	Kb4	N7	Total[(d)]
F	Unknown	Deep	79.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.41
F	Unknown	unknown	0.00	21.34	0.00	0.00	0.00	0.04	0.12	0.00	0.00	0.00	21.50
Bo/Co	Low	Shallow	14.84	2.01	0.44	0.09	0.00	0.00	0.00	0.00	0.00	0.00	17.39
Bo/F	Low	Shallow	12.70	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.02	0.00	14.46
Bo/Co	Low	Moderate	13.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.71
Bo/F	Low	Moderate	10.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.12
F	Low	Shallow	0.00	8.16	0.00	0.00	0.13	0.00	0.00	0.80	0.96	0.00	10.05
Bo	Low	Shallow	5.48	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.00	5.57
Veg/Bo	Low	Shallow	2.30	1.99	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.04	4.99
Co/F	Low	Moderate	4.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.29
Bo/Co	High	Moderate	3.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.22
Co/F	Low	Shallow	3.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.07
Bd	Low	Shallow	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	1.20
Veg/Org	Low	Shallow	0.00	0.77	0.17	0.00	0.01	0.01	0.00	0.02	0.06	0.00	1.04
Bd/Bo	Low	Shallow	0.77	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
Bd	High	Moderate	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52
Bo/Co	High	Shallow	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
Bd	High	Shallow	0.46	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.48
Bo/F	High	Moderate	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46
Bo	High	Moderate	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44
Bo	High	Shallow	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43
Bd/Bo	Low	Moderate	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
Bd/Bo	High	Moderate	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26
Bd	Low	Moderate	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Bo/Co	High	Deep	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
F	High	Shallow	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10

(a) Bo: boulder, Co: cobble, Bd: bedrock, Gr: gravel, F: fines/organics, Veg: vegetation, Org: organics.

(b) Low: less than or equal to 10 degrees, High: greater than 10 degrees.

(c) Shallow: up to 2 m, Moderate: between 2 to 4 m, Deep: greater than 4 m.

(d) Totals may not be exact due to rounding errors.

Table 3.II-3 Watercourse Areas Permanently Lost as a Result of the Project

Stream	Length (m)	Assumed Width (m)	Area (m^2)
A1	100	3	300
A2	20	3	60
A3	294	3	882
A5	115	3	345
A6	371	3	1113
A7	31	3	213
B1	94	3	282
F1	168	3	504
Ka1	170	3	510
Kb4	309	3	927
		Total Area (m^2)	**5136**
		Total Area (ha)	**0.51**

m = metres; m^2 = square metres; ha = hectares.

3.II.5.1.2 HSI and HU determinations

Lakes A5, A6, A7, Ka1, and Kb4 were determined to be non-fish bearing in the baseline assessment (Annex J, Addendum JJ) and were not considered further in the calculation of habitat units permanently lost. Fish bearing lakes that are expected to be affected include A1, A2, A3, N7, and Kennady Lake.

Lake A1 has a total of 110.34 HUs (Table 3.II-4), all of which will be permanently lost due to the Project. Most of the habitat units in Lake A1 are for lake trout (22.36 HUs), Arctic grayling (21.15 HUs), and burbot (20.34 HUs). Lake A1 also provides habitat suitable for round whitefish, northern pike, slimy sculpin, and ninespine stickleback (Table 3.II-4). The majority of the approximately 110 HUs being permanently lost in Lake A1 are foraging (52.85 HUs) and rearing (38.73 HUs) habitat. Losses of wintering habitat and spawning habitat in Lake A1 are small.

Table 3.II-4 Habitat Units Permanently Lost in Lake A1, Listed by Species and Life-history Stage

Species	Spawning	Rearing	Foraging	Wintering	Total[(a)]
lake trout	0.71	9.68	9.96	2.02	**22.36**
round whitefish	0.71	4.20	10.40	1.67	**16.98**
Arctic grayling	0.00	9.93	9.56	1.67	**21.15**
lake chub	species has not been recorded in A watershed				
northern pike	1.58	1.58	3.08	1.67	**7.90**
burbot	1.06	8.92	8.69	1.67	**20.34**
slimy sculpin	2.18	2.35	9.09	0.87	**14.50**
ninespine stickleback	2.08	2.08	2.08	0.87	**7.10**
Total [(a)]	**8.33**	**38.73**	**52.85**	**10.43**	**110.34**

[(a)] Totals may not be exact due to rounding errors.

Lake A2 has a total of 15.74 HUs (Table 3.II-5), all of which will be permanently lost due to the Project. The largest amounts of habitat units in Lake A2 are for slimy sculpin (3.09 HUs), lake trout (2.84 HUs), and Arctic grayling (2.59 HUs). Lake A2 also provides habitat suitable for round whitefish, northern pike, burbot, and ninespine stickleback (Table 3.II-5). The majority of the approximately 16 HUs being permanently lost in Lake A2 correspond to foraging (6.05 HUs) and rearing (5.53 HUs) habitat. Losses of spawning habitat in Lake A2 are 1.09 HUs.

Table 3.II-5 Habitat Units Permanently Lost in Lake A2, Listed by Species and Life-history Stage

Species	Spawning	Rearing	Foraging	Wintering	Total[(a)]
Lake trout	0.00	0.98	1.43	0.44	**2.84**
Round whitefish	0.00	0.85	1.10	0.44	**2.39**
Arctic grayling	0.00	1.21	0.94	0.44	**2.59**
Lake chub	species has not been recorded in A watershed				
Northern pike	0.25	0.25	0.36	0.44	**1.29**
Burbot	0.00	0.97	0.86	0.44	**2.26**
Slimy sculpin	0.56	1.00	1.09	0.44	**3.09**
Ninespine stickleback	0.28	0.28	0.28	0.44	**1.29**
Total [(a)]	**1.09**	**5.53**	**6.05**	**3.06**	**15.74**

[(a)] Totals may not be exact due to rounding errors.

A total of 0.90 HUs will be permanently lost in Lake A3 due to the Project (Table 3.II-6). The largest amounts of habitat units lost in Lake A3 will be for slimy sculpin (0.28 HUs). Losses in Lake A3 will also include a small amount of habitat suitable for lake trout, round whitefish, Arctic grayling, northern pike and burbot (Table 3.II-6). The majority of the approximately HUs being permanently lost in Lake A3 correspond to foraging (0.42 HUs) and rearing (0.39 HUs) habitat. Losses in Lake A3 do not include wintering habitat, and losses of spawning habitat in the lake are very small.

Table 3.II-6 Habitat Units Permanently Lost in Lake A3, Listed by Species and Life-history Stage

Species	Spawning	Rearing	Foraging	Wintering	Total[a]
Lake trout	0.00	0.07	0.07	0.00	**0.14**
Round whitefish	0.00	0.05	0.09	0.00	**0.14**
Arctic grayling	0.00	0.09	0.07	0.00	**0.16**
Lake chub	species has not been recorded in A watershed				
Northern pike	0.00	0.00	0.02	0.00	**0.02**
Burbot	0.00	0.09	0.07	0.00	**0.16**
Slimy sculpin	0.09	0.09	0.09	0.00	**0.28**
Ninespine stickleback	0.00	0.00	0.00	0.00	**0.00**
Total [a]	**0.09**	**0.39**	**0.42**	**0.00**	**0.90**

[a] Totals may not be exact due to rounding errors.

A total of 0.08 HUs will be permanently lost in Lake N7 due to the Project (Table 3.II-7). The largest amounts of habitat units in Lake N7 are for lake trout (0.02 HUs), Arctic grayling, and burbot (0.02 HUs). The losses in Lake N7 also include a small amount of habitat suitable for round whitefish, lake chub, and slimy sculpin (Table 3.II-7). Losses in Lake N7 will not include wintering habitat, and the losses of habitat units for other life-history stages is very small.

Table 3.II-7 Habitat units Permanently Lost in Lake N7, Listed by Species and Life-history Stage

Species	Spawning	Rearing	Foraging	Wintering	Total[a]
Lake trout	0.00	0.01	0.01	0.00	**0.02**
Round whitefish	0.00	0.00	0.01	0.00	**0.01**
Arctic grayling	0.00	0.01	0.01	0.00	**0.02**
Lake chub	0.01	0.00	0.00	0.00	**0.01**
Northern pike	0.00	0.00	0.00	0.00	**0.00**
Burbot	0.00	0.01	0.01	0.00	**0.02**
Slimy sculpin	0.00	0.00	0.01	0.00	**0.01**
Ninespine stickleback	0.00	0.00	0.00	0.00	**0.00**
Total [a]	**0.01**	**0.03**	**0.05**	**0.00**	**0.08**

[a] Totals may not be exact due to rounding errors.

Kennady Lake has a total of 5,826 HUs before considering the potential impacts of mining activities (Table 3.II-8). Total habitat units are highest for lake chub (1,034 HUs), lake trout (924 HUs), round whitefish (829 HUs), Arctic grayling (810 HUs), burbot (849 HUs) and slimy sculpin (899 HUs), and lowest for northern pike (279 HUs) and ninespine stickleback (202 HUs). The majority of the 5,826 HUs present in Kennady Lake are foraging (2,046 HUs) and rearing (1,809 HUs) habitat. Considerable amounts of spawning (657 HUs) and wintering (1,314 HUs) habitat are also present in Kennady Lake (Table 3.II-8).

Table 3.II-8 Habitat Units by Species and Life-history Stage Existing in Kennady Lake Under Existing Conditions

Species	Spawning	Rearing	Foraging	Wintering	Total[a]
Lake trout	35.26	305.00	410.38	173.53	**924.18**
Round whitefish	37.16	285.97	345.49	159.77	**828.39**
Arctic grayling	0.00	338.96	311.44	159.77	**810.17**
Lake chub	339.12	267.81	267.81	159.60	**1034.34**
Northern pike	6.77	6.77	90.03	175.34	**278.91**
Burbot	66.31	327.15	296.03	159.60	**849.09**
Slimy sculpin	163.38	268.35	315.88	151.00	**898.60**
Ninespine stickleback	8.97	8.97	8.97	174.95	**201.87**
Total [a]	**656.98**	**1808.99**	**2046.03**	**1313.55**	**5825.55**

[a] Totals may not be exact due to rounding errors.

Permanent habitat losses in Kennady Lake will total 1,157 HUs (Table 3.II-9), which represents about 20% of the HUs currently in Kennady Lake (Table 3.II-10). The species most affected by the lost habitat include lake chub (206 HUs), lake trout (185 HUs), slimy sculpin (171 HUs), and burbot (170 HUs). Permanent losses will consist of mostly foraging, rearing, and wintering habitat with smaller amount of losses for spawning habitat. The largest relative permanent losses in Kennady Lake will be to lake trout spawning (loss of 27.6%) and burbot spawning (loss of 26.8%) habitat (Table 3.II-10). By life-history stage, the largest relative permanent losses will be to wintering (20.7%) and spawning (20.5%) habitat.

Table 3.II-9 Habitat Units Permanently Lost by Species and Life-History Stage in Kennady Lake

Species	Spawning	Rearing	Foraging	Wintering	Total[a]
Lake trout	9.74	58.91	79.04	36.97	**184.67**
Round whitefish	9.68	55.43	67.70	32.63	**165.44**
Arctic grayling	0.00	63.07	61.80	32.63	**157.50**
Lake chub	62.92	55.46	55.46	32.60	**206.45**
Northern pike	1.72	1.72	19.04	36.32	**58.81**
Burbot	17.77	62.18	57.10	32.60	**169.66**
Slimy sculpin	30.31	50.17	58.40	32.36	**171.25**
Ninespine stickleback	2.30	2.30	2.30	36.03	**42.93**
Total [a]	**134.45**	**349.25**	**400.84**	**272.16**	**1156.70**

[a] Totals may not be exact due to rounding errors.

Table 3.II-10 Percentage of Habitat Units Permanently Lost by Species and Life-History Stage in Kennady Lake

Species	Spawning	Rearing	Foraging	Wintering	Total[a]
Lake trout	27.6%	19.3%	19.3%	21.3%	**20.0%**
Round whitefish	26.0%	19.4%	19.6%	20.4%	**20.0%**
Arctic grayling	0.0%	18.6%	19.8%	20.4%	**19.4%**
Lake chub	18.6%	20.7%	20.7%	20.4%	**20.0%**
Northern pike	25.5%	25.5%	21.1%	20.7%	**21.1%**
Burbot	26.8%	19.0%	19.3%	20.4%	**20.0%**
Slimy sculpin	18.6%	18.7%	18.5%	21.4%	**19.1%**
Ninespine stickleback	25.6%	25.6%	25.6%	20.6%	**21.3%**
Total [a]	**20.5%**	**19.3%**	**19.6%**	**20.7%**	**19.9%**

[a] Totals may not be exact due to rounding errors.

3.II.5.2 PHYSICALLY ALTERED AND RE-SUBMERGED AREAS

3.II.5.2.1 Surface Areas

The Project will result in 83.32 ha of lake area being physically altered and re-submerged at closure. All of this area will be located in Kennady Lake (Table 3.II-11), and it represents about 10% of the total pre-mine Kennady Lake area. The largest category of habitat that will be physically altered and re-submerged is deep lake bed covered by fine substrate (56.68 ha) (Table 3.II-12). Almost 70% of the habitats to be physically altered and re-submerged (56.81 ha) will occur in areas dominated by fine substrates (Table 3.II-12), which is typically of relatively low quality fish habitat. A considerable proportion of the remaining affected area (19.91 ha) will occur in areas dominated by boulder (Table 3.II-12), which is typically of relatively high quality fish habitat.

Table 3.II-11 Areas in Kennady Lake that are Physically Altered and then Re-Submerged at Closure

Mine Infrastructure	Area Physically Altered and Re-Submerged (ha)
Hearne Pit	13.87
Tuzo Pit	20.81
5034 Pit	19.8
Dyke A	0.35
Dyke B	16.13
Dyke J	0.41
Dyke K	2.89
Dyke N	3.99
Roads	3.96
Water Collection Pond Berms	1.12
Total[(a)]	**83.32**

[(a)] Totals may not be exact due to rounding errors.

Table 3.II-12 Areas in Kennady Lake that are Physically Altered and then Re-Submerged at Closure, listed by Substrate Category, Gradient Class and Depth Class

Substrate Category[(a)]	Gradient class[(b)]	Depth class[(c)]	Kennady Lake
F	unknown	Deep	56.68
Bo/Co	Low	Shallow	6.55
Bo/Co	High	Moderate	4.23
Bo	Low	Shallow	3.24
Bo/Co	Low	Moderate	2.23
Co/F	Low	Moderate	1.87
Bo/F	Low	Shallow	1.5
Co/Gr	High	Moderate	1.43
Co/Gr	High	Shallow	0.92
Co/F	Low	Shallow	0.89
Bo/F	High	Moderate	0.68
Bo/Co	High	Deep	0.56
Veg/Bo	Low	Shallow	0.44
Bo	High	Moderate	0.39
Co/F	High	Moderate	0.35
Co/Gr	High	Deep	0.32
Bo/Co	High	Shallow	0.27
Bd	High	Shallow	0.25
Bo/F	Low	Moderate	0.23
F	Low	Shallow	0.12
Bd	High	Moderate	0.07
Bd	Low	Shallow	0.07
Bo	High	Shallow	0.02
F	Low	Moderate	0.01

[(a)] Bo: boulder, Co: cobble, Bd: bedrock, Gr: gravel, F: fines/organics, Veg: vegetation, Org: organics.

[(b)] Low: less than or equal to 10 degrees, High: greater than 10 degrees

[(c)] Shallow: up to 2 m, Moderate: greater than 2 m to 4 m, Deep: greater than 4 m.

3.II.5.2.2 Habitat Suitability Index and Habitat Units Determinations

As detailed in Section 3.II.5.1.2, Kennady Lake has a total of 5,826 HUs under existing conditions (Table 3.II-8). Most of the HUs are accounted for by lake chub, lake trout, round whitefish, Arctic grayling, burbot, and slimy sculpin. There are low amounts of habitat units for northern pike and ninespine stickleback. The majority of the habitat units present in Kennady Lake are foraging and rearing habitat, but there is also a considerable amount of spawning and wintering habitat present (Section 3.II.5.1.2).

Habitat losses in Kennady Lake from areas that will be physically altered and re-submerged at closure will total 610 HUs (Table 3.II-13), which represents about 11% of the HUs currently in Kennady Lake (Table 3.II-14). The amounts of habitat units lost will be highest for lake trout (104 HUs) and lake chub (97 HUs). Physically altered and re-submerged habitat losses will be mostly foraging, rearing, and wintering habitat with smaller losses for spawning habitat. The largest relative losses of physically altered and re-submerged habitat in Kennady Lake will be to round whitefish spawning (loss of 18.2%), lake trout spawning (15.4%), and burbot spawning (13.5%) habitat (Table 3.II-14). Relative losses to northern pike spawning (4.8%) and rearing (4.8%) habitat will be low (Table 3.II-14). By life-history stage, the largest relative physically altered and re-submerged habitat losses will be to wintering (12.2%) and spawning (10.5%) habitat.

Table 3.II-13 Habitat Units Physically Altered and then Re-Submerged at Closure in Kennady Lake

Species	Spawning	Rearing	Foraging	Wintering	Total[(a)]
Lake trout	5.44	31.59	45.78	21.41	**104.23**
Round whitefish	6.76	28.23	34.62	19.70	**89.30**
Arctic grayling	0.00	32.53	31.86	19.70	**84.08**
Lake chub	31.98	22.70	22.70	19.56	**96.94**
Northern pike	0.33	0.33	6.53	20.34	**27.52**
Burbot	8.95	32.45	30.01	19.56	**90.97**
Slimy sculpin	15.35	29.52	31.04	19.90	**95.81**
Ninespine stickleback	0.44	0.44	0.44	20.32	**21.63**
Total [(a)]	**69.24**	**177.79**	**202.97**	**160.47**	**610.47**

[(a)] Totals may not be exact due to rounding errors.

Table 3.II-14 Percentage of Habitat Units Physically Altered and then Re-Submerged at Closure in Kennady Lake

Species	Spawning	Rearing	Foraging	Wintering	Total[(a)]
Lake trout	15.4%	10.4%	11.2%	12.3%	**11.3%**
Round whitefish	18.2%	9.9%	10.0%	12.3%	**10.8%**
Arctic grayling	0.0%	9.6%	10.2%	12.3%	**10.4%**
Lake chub	9.4%	8.5%	8.5%	12.3%	**9.4%**
Northern pike	4.8%	4.8%	7.3%	11.6%	**9.9%**
Burbot	13.5%	9.9%	10.1%	12.3%	**10.7%**
Slimy sculpin	9.4%	11.0%	9.8%	13.2%	**10.7%**
Ninespine stickleback	4.9%	4.9%	4.9%	11.6%	**10.7%**
Total [(a)]	**10.5%**	**9.8%**	**9.9%**	**12.2%**	**10.5%**

Note: Total column shows the percentage of total species habitat lost, the percentages in the other columns are specific to the types of habitat.

[(a)] Totals may not be exact due to rounding errors.

% = percent

3.II.5.3 DEWATERED AND RE-SUBMERGED AREAS

3.II.5.3.1 Surface Areas

The Project will result in approximately 435.90 ha of lake area being dewatered and re-submerged at closure but that will remain otherwise unaltered. This area includes 434.06 ha in Kennady Lake (Figure 3.II-1), which represents about 53% of the total pre-mine Kennady Lake area, and 1.87 ha in Lake D1. The largest category of habitat that will be physically altered and re-submerged is deep lake bed covered by fine substrate (46.96 ha) (Table 3.II-15). Almost 60% of the habitats that will be dewatered and re-submerged, but otherwise unaltered is deep lake bed covered by fine substrate (262.66 ha) (Table 3.II-15). Approximately 63% of the habitats that will be unaltered but dewatered and re-submerged (276.01 ha) will occur in areas dominated by fine substrates (Table 3.II-15), which is typically of relatively low quality. A considerable proportion of the remaining affected area (117.73 ha) will occur in areas dominated by boulder (Table 3.II-15), which is typically of relatively high quality. The Project will also result in 0.23 ha watercourse area in tributaries to Kennady Lake (Streams D1, D2, and E1) being dewatered and re-submerged at closure, but that will remain otherwise unaltered.

Table 3.II-15 Areas in Kennady Lake and Lake D1 that will be Dewatered and then Re-Submerged at Closure, but will Remain Otherwise Unaltered, Listed by Substrate Category, Gradient Class, and Depth Class

Substrate Category[(a)]	Gradient class[(b)]	Depth class[(c)]	Kennady Lake	D1	Total[(d)]
F	Unknown	Deep	262.63	0.00	262.63
Bo/Co	Low	Shallow	32.96	0.18	33.13
Bo	Low	Shallow	21.22	0.00	21.22
Co/F	Low	Moderate	18.13	0.00	18.13
Co/F	Low	Shallow	15.65	0.00	15.65
F	Low	Moderate	12.70	0.00	12.70
Bo/Co	High	Moderate	12.33	0.00	12.33
Bo/F	Low	Shallow	11.17	0.60	11.77
Bo/F	Low	Moderate	10.13	0.44	10.57
Bo/Co	Low	Moderate	10.35	0.00	10.35
Bo/F	High	Moderate	7.32	0.00	7.32
Veg/Bo	Low	Shallow	4.08	0.32	4.40
Bo	Low	Moderate	2.69	0.00	2.69
Bo	High	Shallow	2.63	0.00	2.63
Bo	High	Moderate	1.55	0.00	1.55
Bo/Co	High	Shallow	1.24	0.26	1.50
Bo/Gr	High	Moderate	1.34	0.00	1.34
Bo/Gr	High	Shallow	1.32	0.00	1.32
Bd	Low	Shallow	1.03	0.00	1.03
Co/Gr	Low	Moderate	0.71	0.00	0.71
Bd	High	Shallow	0.69	0.00	0.69
F	Low	Shallow	0.57	0.00	0.57
Bd/Bo	Low	Shallow	0.40	0.00	0.40
Co/F	High	Moderate	0.28	0.00	0.28
Co/Gr	High	Moderate	0.23	0.00	0.23
Co/F	High	Shallow	0.21	0.00	0.21
Veg/Org	Low	Shallow	0.16	0.00	0.16
Bd/Bo	High	Shallow	0.15	0.00	0.15
F/Org	Low	Moderate	0.00	0.08	0.08
Bd	High	Moderate	0.06	0.00	0.06
Bd/Bo	High	Moderate	0.05	0.00	0.05
F	High	Deep	0.03	0.00	0.03

[(a)] Bo: boulder, Co: cobble, Bd: bedrock, Gr: gravel, F: fines/organics, Veg: vegetation, Org: organics.
[(b)] Low: less than or equal to 10 degrees, High: greater than 10 degrees.
[(c)] Shallow: up to 2 m, Moderate: between 2 to 4 m, Deep: greater than 4 m.
[(d)] Totals may not be exact due to rounding errors.

3.II.5.3.2 Habitat Suitability Index and Habitat Units Determinations

The number of habitat units in Kennady Lake from areas that will be dewatered and then re-submerged at closure, but will remain otherwise unaltered, will total about 3011 HUs (Table 3.II-16), which represents about 52% of the HUs currently in Kennady Lake (Table 3.II-17). The amount of habitat units lost will be highest for lake chub (502 HUs) and lake trout (495 HUs). Habitat that will be dewatered and then re-submerged at closure, but will be otherwise unaltered, will be mostly foraging, rearing, and wintering habitat with a smaller amount of losses of spawning habitat. The largest relative amount of HUs that will be dewatered but otherwise unaltered in Kennady Lake will be to slimy sculpin wintering habitat (59.1%) (Table 3.II-17). By life-history stage, the largest amount of habitat that will be dewatered and then re-submerged at closure, but will be otherwise unaltered, is wintering (57.9%) habitat.

Table 3.II-16 Habitat Units that will be Dewatered and then Re-Submerged at Closure, but will be Otherwise Unaltered, in Kennady Lake

Species	Spawning	Rearing	Foraging	Wintering	Total[(a)]l
Lake trout	17.85	156.07	221.66	99.17	**494.75**
Round whitefish	18.55	146.25	173.13	92.44	**430.37**
Arctic grayling	0.00	169.29	158.14	92.44	**419.87**
Lake chub	167.37	120.92	120.92	92.44	**501.65**
Northern pike	3.22	3.22	41.08	101.41	**148.93**
Burbot	34.17	164.84	151.29	92.44	**442.74**
Slimy sculpin	72.79	138.46	158.56	89.24	**459.04**
Ninespine stickleback	4.24	4.24	4.24	101.38	**114.09**
Total[(a)]	**318.18**	**903.28**	**1,029.02**	**760.95**	**3,011.43**

[(a)] Totals may not be exact due to rounding errors.

Table 3.II-17 Percentage of Habitat Units that will be Dewatered and then Re-Submerged at Closure, but will be Otherwise Unaltered, in Kennady Lake

Species	Spawning	Rearing	Foraging	Wintering	Total[(a)]
Lake trout	50.6%	51.2%	54.0%	57.1%	**53.5%**
Round whitefish	49.9%	51.1%	50.1%	57.9%	**52.0%**
Arctic grayling	0.0%	49.9%	50.8%	57.9%	**51.8%**
Lake chub	49.4%	45.2%	45.2%	57.9%	**48.5%**
Northern pike	47.5%	47.5%	45.6%	57.8%	**53.4%**
Burbot	51.5%	50.4%	51.1%	57.9%	**52.1%**
Slimy sculpin	44.6%	51.6%	50.2%	59.1%	**51.1%**
Ninespine stickleback	47.2%	47.2%	47.2%	57.9%	**56.5%**
Total[(a)]	**48.4%**	**49.9%**	**50.3%**	**57.9%**	**51.7%**

[(a)] Totals may not be exact due to rounding errors.

Note: Total column shows the percentage of total species habitat lost, the percentages in the other columns are specific to the types of habitat.

Lake D1 has a total of 4.61 HUs (Table 3.II-18), all of which will be unaltered but dewatered and then re-submerged at closure. The largest amounts of habitat units in Lake D1 are for burbot (1.65 HUs). Lake D1 also provides habitat suitable for Arctic grayling and northern pike (Table 3.II-18). The majority of the approximately HUs being dewatered in Lake D1 correspond to foraging (1.98 HUs) and rearing (1.78 HUs) habitat.

Table 3.II-18 Habitat Units that will be Dewatered and then Re-Submerged at Closure, but will be Otherwise Unaltered, in Lake D1

Species	Spawning	Rearing	Foraging	Wintering	Total [(a)]
Lake trout	species has not been recorded in D watershed				
Round whitefish	species has not been recorded in D watershed				
Arctic grayling	0.00	0.81	0.69	0.13	**1.63**
Lake chub	species has not been recorded in D watershed				
Northern pike	0.24	0.24	0.61	0.24	**1.33**
Burbot	0.11	0.73	0.69	0.13	**1.65**
Slimy sculpin	species has not been recorded in D watershed				
Ninespine stickleback	species has not been recorded in D watershed				
Total [(a)]	**0.35**	**1.78**	**1.98**	**0.50**	**4.61**

[(a)] Totals may not be exact due to rounding errors.

3.II.6 ASSESSMENT OF DOWNSTREAM FLOW ALTERATIONS

Mitigation measures will implemented by periodically pumping water to Area 8 during operations and closure to offset any project impacts in downstream habitats due to flow reductions. With consideration of the proposed mitigation measures, it is anticipated that there will be no HADD in streams downstream of Kennady Lake, and therefore no compensation is planned. Additional analysis will be completed in consultation with DFO to define the appropriate mitigation flow (i.e., frequency, timing and magnitude) and monitoring will be conducted to determine the effectiveness of the mitigation.

3.II.7 COMPENSATION HABITATS

3.II.7.1 HABITAT COMPENSATION APPROACH

The selection of the habitat compensation approach included consideration of the hierarchy of compensation preferences as outlined in the DFO *Policy for Management of Fish Habitat* (DFO 1986), *Habitat Conservation and Protection Guidelines* (DFO 1998), and *Practitioner's Guide to Habitat Compensation* (DFO 2006). These preferences for habitat compensation are summarized in the following points, in declining order of priority:

1. Create similar habitat at or near the development site within the same ecological unit; that is, replace natural habitat with the same type of habitat at or near the site.

2. Create similar habitat in a different ecological unit that supports the same stock or species.

3. Increase the productive capacity of existing habitat at or near the development site and within the same ecological unit.

4. Increase the productive capacity of a different ecological unit that supports the same stock or species.

5. Increase the productive capacity of existing habitat for a different species of fish either on or off site.

6. Where it is not technically feasible to compensate for the habitat itself, use artificial production techniques, such as maintaining a stock of fish, deferring compensation, or restoring chemically contaminated sites.

The compensation options considered in this assessment conform to Item 1 in the above list. As the proposed project activities will result in permanent loss or alteration of primarily lacustrine habitats, the compensation options considered, and the proposed compensation plan, involve creating additional lacustrine habitat and habitat enhancement features in existing lacustrine habitats.

3.II.7.2 COMPENSATION OPTIONS

To compensate for habitat permanently lost or altered due to proposed mine development, De Beers intends to construct fish habitat using a like-for-like approach, as per DFO's hierarchy of preferred compensation options. This approach will be accomplished, at least in part, by constructing and/or improving habitat within the same ecological units as those lost or altered during mine development. Several of the identified compensation options focus on the construction of habitat structures (e.g., finger reefs) within specific areas of Kennady Lake. Others focus on opportunities for habitat compensation in adjacent areas.

Compensation features will be permanent structures designed to provide habitat for the fish community that will be re-established in the Kennady Lake watershed after closure. The purpose of the compensation features is to provide spawning, rearing, and foraging habitat for fish species expected to inhabit the Kennady Lake watershed. It is thought that compensation features constructed below a water depth of 4 m (below 6 m in exposed areas) would eventually become covered with silt and fine organic material, thereby decreasing the quality of the habitat. Compensation habitat structures will therefore be designed and constructed to maximize the amount of habitat created in the 0 to 4 m depth range, as this is where the majority of the high quality fish habitat in the lake currently exists. It is anticipated that structures built above a 4 m depth (above 6 m in exposed areas) would be kept clean of silt and fine organic debris by wave-generated currents. Descriptions of the compensation options that have been identified by De Beers are included in the following sections.

3.II.7.2.1 Option 1a

Option 1a would raise the water level of some lakes to the west of Kennady Lake (in the D watershed) to a level greater than what would be required only for development of the Project. This option involves construction of Impounding Dykes F and G, and an additional dyke (D3) between Lakes D3 and N14, to raise Lakes D2 and D3 to an elevation of 428 masl (as shown in Figure 3.II-4). This change would redirect outflow from Lake D3 to the north, to Lake N18. The maximum depth of Lake D2 would increase by 3.8 m, from 1.0 m to 4.8 m. The maximum depth of Lake D3 would increase by 2.6 m, from 2.5 m to 5.1 m. Northern pike have been captured in Lake D2, and northern pike, lake trout, and burbot have been captured in Lake D3.

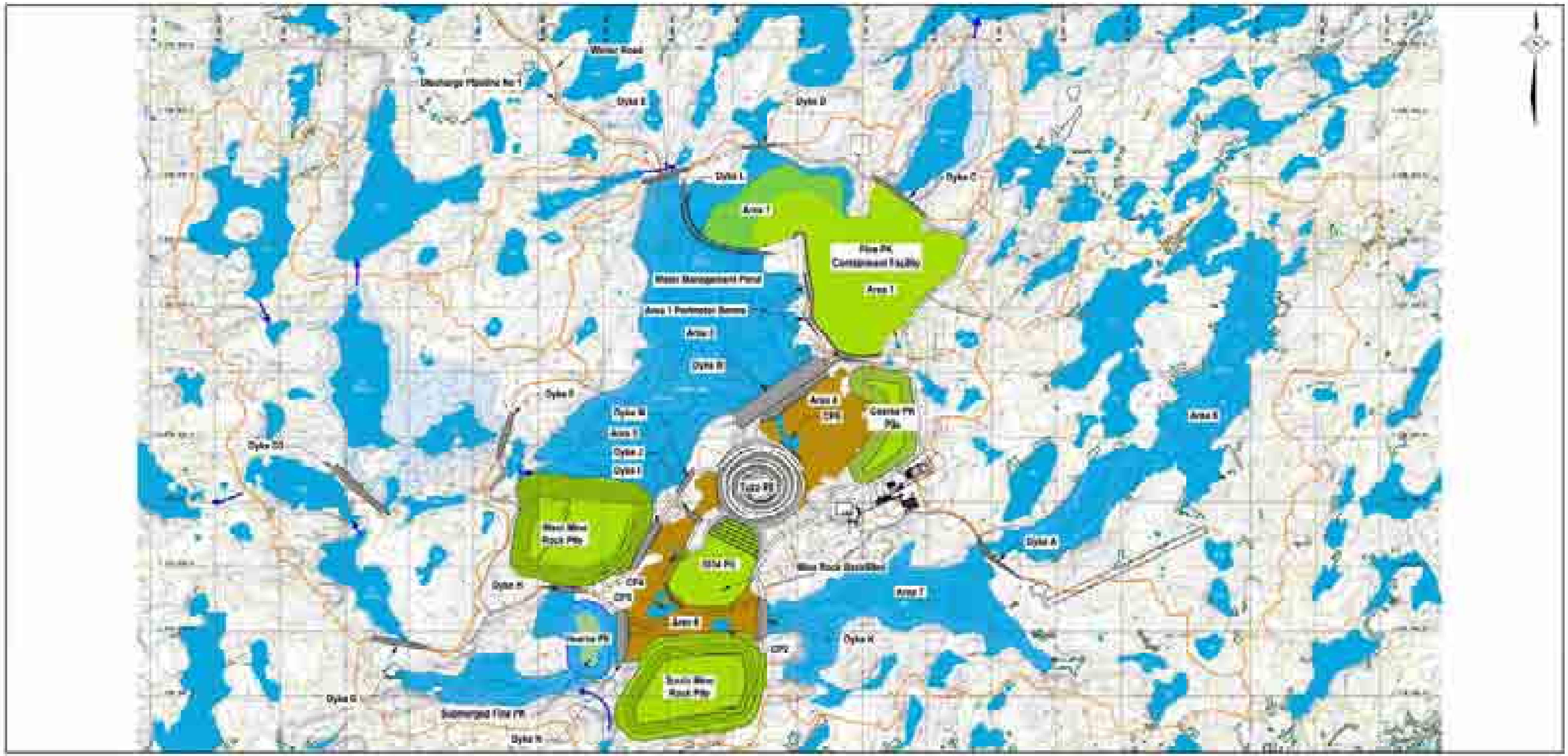
The sizes of the existing Lakes D2 and D3 are 12.5 ha and 38.4 ha, respectively. The additional habitat area (compared to existing conditions) would be 90.0 ha.

At the elevation of 428 masl, Lakes D5, D6, D10, an unnamed lake between Lake D10 and Lake N14, and an unnamed lake between Lake N14 and Lake D5 would all be within the flooded area and connected to Lakes D2 and D3. Lakes D5, D6, and D10 have been reported to be non-fish-bearing (Annex J), and the total area of those three lakes (6.2 ha) has therefore been considered as compensation habitat, due to the new connection to fish-bearing waters. The total compensation habitat provided by this option is 96.2 ha, including 90.0 ha of newly flooded area and 6.2 ha of the three non-fish-bearing lakes. The fish-bearing status of the two unnamed lakes has not been determined, and their areas have not been considered as compensation habitat.

3.II.7.2.2 Option 1b

Option 1b would raise the water level of some lakes to the west of Kennady Lake (in the D E and N watersheds) to the same level as in Option 1a, but would create more habitat than Option 1a by involving more lakes and land area. This option involves construction of Impounding Dykes F, G, E1, and N14 to the West of Kennady Lake to raise Lakes D2, D3, E1, and N14 to an elevation of 428 masl (as shown in Figure 3.II-5). This activity would redirect outflow from Lake D3 to the north, to Lake N18. The maximum depth of Lake D2 would increase by 3.8 m, from 1.0 m to 4.8 m. The maximum depth of Lake D3 would increase by 2.6 m, from 2.5 m to 5.1 m. The maximum depth of Lake E1 would increase by 2.8 m, from 3.4 m to 6.2 m. The maximum depth of Lake N14 would increase by 2.7 m, from 2.8 m to 5.5 m. Northern pike have been captured from Lake D2 and Lake E1, while northern pike, lake trout and burbot have been captured from Lake D3. Arctic grayling, lake trout, and lake chub have been captured from Lake N14.

The sizes of the existing Lakes D2, D3, and E1 are 12.5 ha, 38.4 ha and 20.2 ha, respectively. The size of the existing Lake N14 plus the small lake to the north that would also be included within the flooded area is 24.8 ha. The additional habitat area (compared to existing conditions) would be 143.5 ha. At the elevation of 428 masl, Lakes D5, D6, D10, an unnamed lake between D10 and N14, and an unnamed lake between N14 and D5 would all be within the flooded area and connected to Lakes D2, D3, E1, and N14. Lakes D5, D6, and D10 have been reported to be non-fish-bearing (Annex J), and the total area of those three lakes (6.2 ha) has therefore been considered as compensation habitat, due to the new connection to fish-bearing waters. The total compensation habitat provided by this option is 149.7 ha, including 143.5 ha of newly flooded area and 6.2 ha of the three non-fish-bearing lakes. The fish-bearing status of the two unnamed lakes has not been determined, and their areas have not been considered as compensation habitat.



LEGEND

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

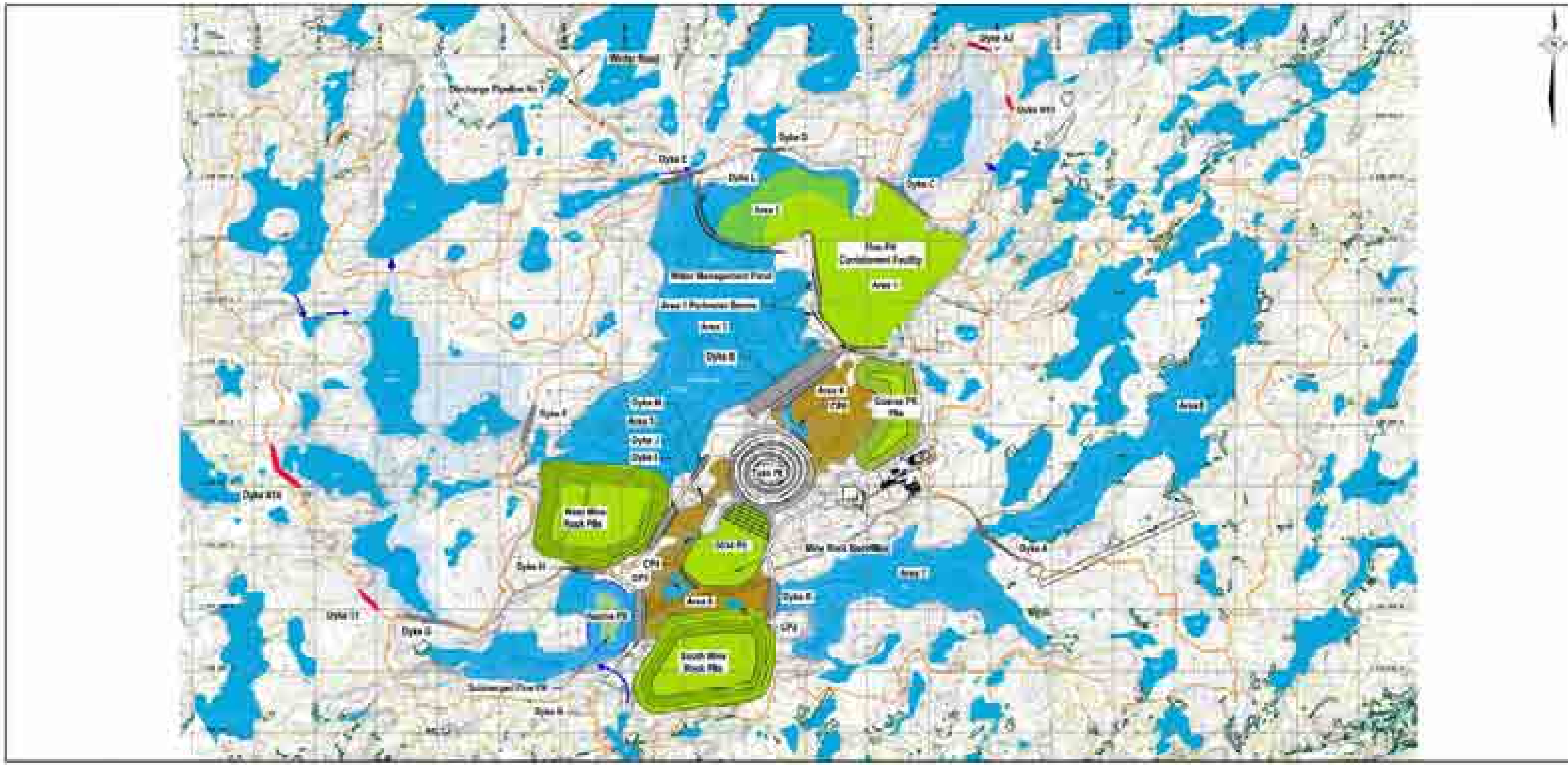
NOTES

Base data source: EBA Figure 4.11 - Stage 8 - Water Management During Mine Operation Years 9 to 11

GAHCHO KUE PROJECT

Project Footprint at End of Operations (Years 9 to 11) Showing Compensation Option 1a

PROJECTION: UTM Zone 12	DATUM: NAD83	
FILE No: E-Fish-007-CAD		DATE: December 20, 2010
JOB No: 09-1365-1004	REVISION No: 3	Figure 3.II-4
OFFICE: GOLD - SAS	DRAWN: TAH/AL	CHECK: GW



LEGEND

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

GAHCHO KUE PROJECT

Project Footprint at End of Operations (Years 9 to 11) Showing Compensation Options 1b and 2

PROJECTION: UTM Zone 12	DATUM: NAD83	
FILE No: E-Fish-003-CAD		DATE: November 24, 2010
JOB No: 09-1365-1004	REVISION No: 0	Figure 3.II-5
OFFICE: GOLD - SAS	DRAWN: TAH/AG	CHECK: GW

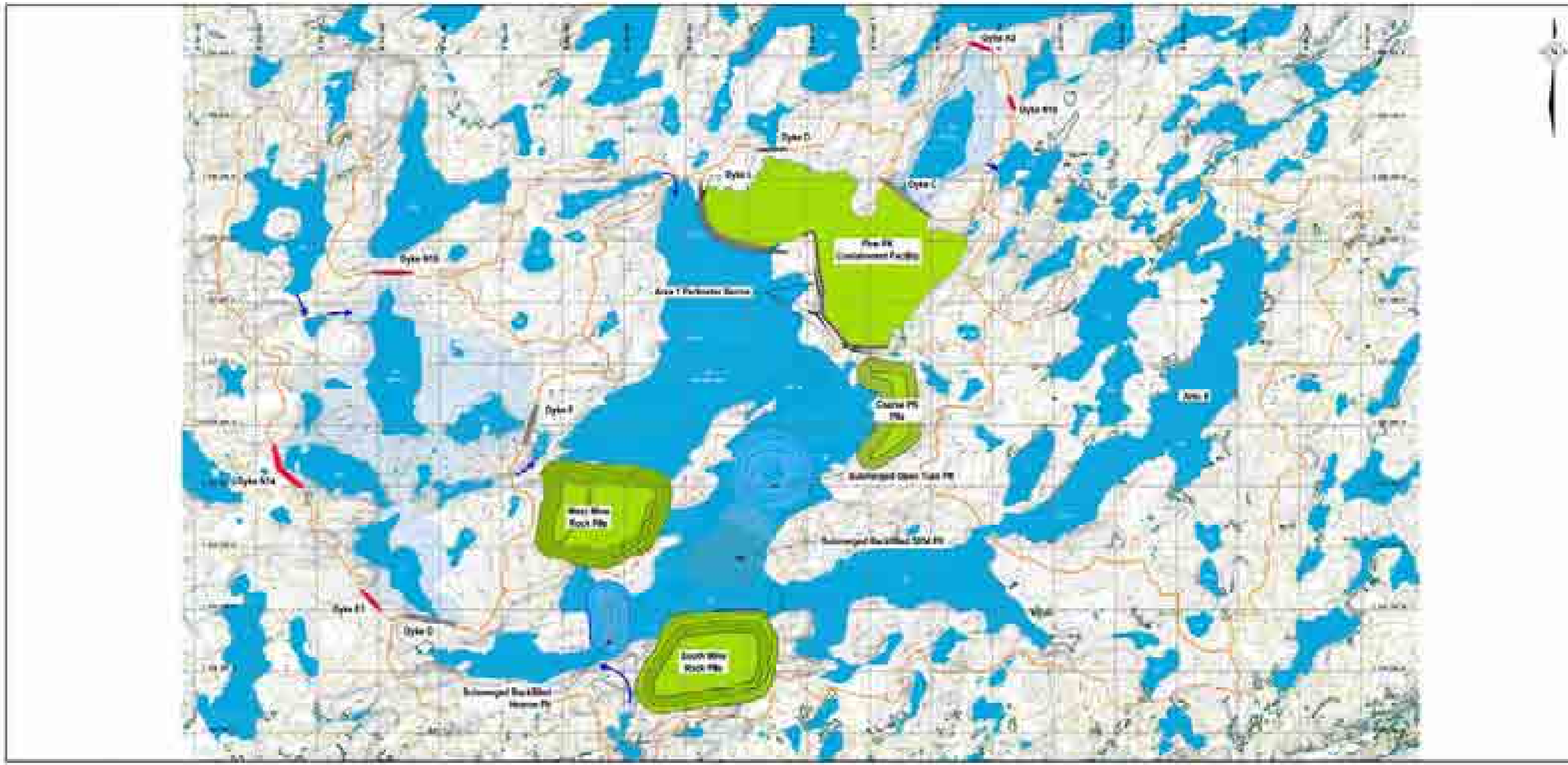
3.II.7.2.3 Option 1c

Option 1c involves additional raising, after mine closure, of the water level in the flooded area created by Option 1b. It would include increasing the height of Dykes F, G, E1, and N14, and construction of Dyke N18, to increase the water level in Lakes D2, D3, E1, and N14, and the surrounding area, to 429 masl and reconnect the flooded area to Kennady Lake through Lake D1 (as shown in Figure 3.II-6). The additional habitat area (compared to existing conditions) would be 186.7 ha. As the habitats created by Option 1c would be connected to Kennady Lake after closure, they would provide a source of spawning and rearing habitat for species, such as northern pike, that the re-established fish population in Kennedy Lake could access.

At the elevation of 429 masl, Lakes D4, D5, D6, D10, E2, an unnamed lake between D10 and N14, and an unnamed lake between N14 and D5 would all be within the flooded area and connected to Lakes D2, D3, E1 and N14, and to Kennady Lake. Lakes D5, D6, D10 and E2 have been reported to be non-fish-bearing (De Beers 2008b), and the total area of those four lakes (9.2 ha) has therefore been considered as compensation habitat, due to the new connection to fish-bearing waters. The total compensation habitat provided by this option is 195.9 ha, including 186.7 ha of newly flooded area and 9.2 ha of the four non-fish-bearing lakes. The fish-bearing status of the two unnamed lakes has not been determined, and their areas have not been considered as compensation habitat.

3.II.7.2.4 Option 2

Option 2 involves raising Lake A3 to a greater elevation than would be the case only for development of the Project. It would include construction of Impounding Dyke C between Area 1 and Lake A3, Dyke A3 to the north of Lake A3 and Dyke N10 between Lakes A3 and N10 to raise Lake A3 to an elevation of 427.5 masl (as shown in Figure 3.II-5). The outflow from Lake A3 would be to the L watershed (to Lake L18). The maximum depth of Lake A3 would be increased by 4.5 m, from 12.2 m to 16.7 m. Burbot, Arctic grayling, lake trout, and northern pike have been captured from Lake A3. The additional habitat area created would be 31.1 ha.



LEGEND

Existing Ground Contours 5m Index - 1m Intermediate	
New Dyke	
Marsh Area	Lake/Pond
Scrub	Mine Rock
Sub-watershed Boundary	Flooded Area
Drainage Flow Direction	

NOTES
Base data source: EBA Figure 8.2 - Final Reclamation

GAHCHO KUE PROJECT

Final Reclamation Showing Compensation Options 1c and 2

PROJECTION: UTM Zone 12	DATUM: NAD83		
E-Fish-004-CAD			December 20, 2010
JOB No: 09-1365-1004	REVISION No: 0		Figure 3.II-6
OFFICE: GOLD - SAS	DRAWN: TAH/AG	CHECK: GW	

3.II.7.2.5 Option 3

Option 3 includes construction of finger reefs placed in Areas 6 and 7 during the dewatered period. Appropriately-sized mine rock could be placed in Area 6 and Area 7 to create finger reefs. The reefs would extend to within 2 m of the normal refilled lake level, be aligned to maximize exposure to wind-generated waves, and be designed to provide rocky reef habitats suitable for fish species expected to inhabit the refilled Kennady Lake.

3.II.7.2.6 Option 4

Option 4 includes development of habitat enhancement structures in Area 8. These structures would be reef structures, similar to what was described above for Option 3, and would be designed to provide rocky reef habitats suitable for fish species expected to inhabit the refilled Kennady Lake.

3.II.7.2.7 Option 5

Option 5 involves construction of shallow littoral and reef habitat structures on the shallow portions of the backfilled Hearne Pit within Kennady Lake. However, at the present time, there is some uncertainty about the extent of the backfilling that will occur and the final depth of the pit at closure. The amount of backfilling and the characteristics of the pit at closure may not be known until some time into the operational period. If the final depth is suitable, the types of habitat structures described above could be developed; otherwise, the Hearne Pit may provide primarily deep water habitat. The total surface area within the Hearne Pit in the refilled Kennady Lake will be 16.0 ha.

3.II.7.2.8 Option 6

Option 6 involves construction of shallow littoral and reef habitat structures on the shallow portions of the backfilled 5034 Pit within Kennady Lake. However, the same uncertainties that were described for Option 5, regarding the amount of backfilling and the characteristics of the pit at closure, also apply to this option. The total surface area within the 5034 Pit in the refilled Kennady Lake will be 35.0 ha.

3.II.7.2.9 Option 7

Option 7 involves developing some shallow habitat structures within Kennady Lake around the rim of the Tuzo Pit, constructed by backfilling the upper bench of the Tuzo Pit rim. The majority of the Tuzo Pit would remain deep water habitat.

The total surface area within the Tuzo Pit in the refilled Kennady Lake will be 35.2 ha.

3.II.7.2.10 Option 8

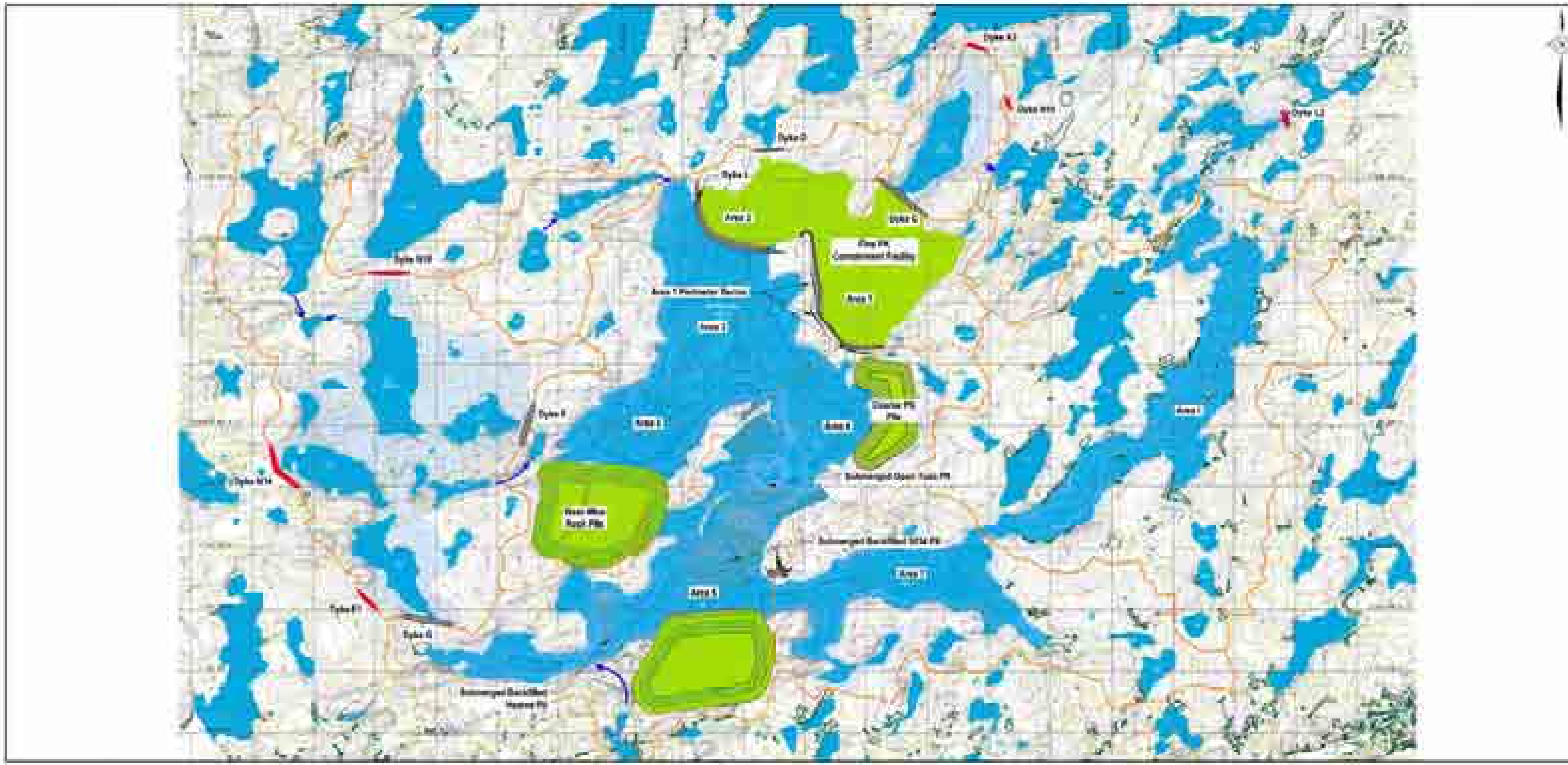
Option 8 is the development of a Dyke B habitat structure within Kennady Lake after closure. It would involve placement of boulder and cobble mine rock to maximize its suitability as rocky reef habitat suitable for fish species expected to inhabit the refilled Kennady Lake. After the end of operations, Dyke B will be lowered to a level below the expected restored lake level. The reef area that would be provided by this option is 16.0 ha.

3.II.7.2.11 Option 9

Option 9 consists of construction of Impounding Dyke L2 at the Lake L2 east outlet and Dyke Area 7 to the south of Area 7 to raise Area 8 and Lakes L2, L3 and L13 to 422 masl (as shown in Figure 3.II-7). This change would also raise water levels in the remaining portions of Kennady Lake at closure (i.e., in Areas 2 through 7). The maximum depth of Lake L2 would increase by 3 m, from 3.4 m to 6.4 m. The maximum depth of Lake L3 would increase by 1.3 m, from 1.0 m to 2.3 m. The maximum depth of Area 8 would increase by 1.3 m, from 10.5 m to 11.8 m. Arctic grayling have been captured from Lake L2.

With this option, the raised water level would also provide improved connectivity of Lake J1 (at the south end of Lake J1a) and Lake I1 to Area 8, but the elevations of these lakes would be minimally affected. Lake J1a has a maximum depth of 2.2 m, and J1b has a maximum depth of 4.3 m. Arctic grayling have been captured from J1a, and burbot has been captured from J1b. Lake I1 has a maximum depth of 11.0 m, and Arctic grayling, lake trout, ninespine stickleback, and slimy sculpin have been captured from I1. There is, at present, limited seasonal fish access between Area 8 and Lakes J1a and I1. The improved connectivity to Lakes J1a and I1 would make these areas accessible to fish from Area 8 on a more continuous basis.

The existing sizes of Lakes L2, L3, and L13 are 1.7 ha, 4.8 ha, and 3.4 ha, respectively. The area of the existing Area 8 basin is 164.2 ha. The total additional habitat area would be 124.4 ha, including 69.3 ha in Area 8 and Lakes L2, L3 and l13, as well as 55.1 ha in Kennady Lake Areas 2 to 7.



LEGEND

Existing Ground Contours
5m Index - 1m Intermediate

New Dyke

Marsh Area

Scrub

Sub-watershed Boundary

Drainage Flow Direction

Lake/Pond

Flooded Area

Mine Rock

NOTES
Base data source: EBA Figure 4.5 - Stage 2 - Water Management During Mine Operation Years 1 to 3 (2015 to 2017)

GAHCHO KUE PROJECT

Potential Compensation Habitat With Options 1c, 2 and 9 After Closure

PROJECTION: UTM Zone 12	DATUM: NAD83
FILE No: E-Fish-005-CAD	DATE: December 20, 2010
JOB No: 09-1365-1004	REVISION No: 0
OFFICE: GOLD - SAS	DRAWN: TAH/AG
CHECK: GW	

Figure 3.II-7

3.II.7.2.12 Option 10

Option 10 consists of widening the top bench of the Tuzo and 5034 pits to create shelf areas where they extend onto land. It would involve alterations to the southeast edge of Tuzo/5034 joined pit edge, the north end of Tuzo Pit and the northwest edge of 5034 Pit. These alterations would provide an additional 13.7 ha of lake area.

3.II.7.2.13 Summary of Compensation Options

A summary of the area of habitat potentially created through the 14 compensation options outlined above is included in Table 3.II-19. An evaluation of compensation options, including consideration of size, environmental viability and engineering/cost viability is provided in Table 3.II-20. Key factors affecting environmental viability and engineering/cost viability are included in Table 3.II-20 for each compensation option. These factors were the basis for determination of the Environmental Rank and Engineering and Cost Rank assigned to each compensation option and included in Table 3.II-20. The option ranks were determined in a workshop setting by consensus of participating biologists and engineers

Table 3.II-19 Summary of Fish Habitat Areas Gained by the Identified Fish Habitat Compensation Options

Option Number	Compensation Option	Newly Created Habitat Area (ha)				Total Compensation Habitat Area (ha)
		Depth I (0-2 m)	Depth II (2-4 m)	Depth III (>4 m)	All Depths	All Depths
1a	Raising Lakes D2 and D3 to 428 masl	63.4	26.6	0.0	90.0	96.2 [d]
1b	Raising Lakes D2, D3, E1 and N14 to 428 masl	103.6	39.9	0.0	143.5	149.7 [d]
1c	Raising Lakes D2, D3, E1 and N14, and surrounding area, to 429 masl and reconnect to Kennady Lake after closure	98.6	81.6	6.5	186.7	195.9 [e]
2	Raising Lake A3 to 427.5 m	18.9	12.2	0.0	31.1	31.1
3	Finger Reefs in Areas 6 & 7 [a]	n/d	n/d	n/d	n/d	n/d
4	Habitat enhancement structures in Area 8 [a]	n/d	n/d	n/d	n/d	n/d
5	Hearne Pit Habitat Structure [b]	n/d	n/d	n/d	16.0	16.0
6	5034 Pit Habitat Structure [b]	n/d	n/d	n/d	35.0	35.0
7	Tuzo Pit Habitat Structure [b]	n/d	n/d	n/d	35.2	35.2
8	Dyke B Habitat Structure [c]	n/d	n/d	n/d	16.0	16.0
9	Raising Area 8 and Lakes L2, L3 and L13 to 422 m	124.4	0.0	0.0	124.4	124.4
10	Widening the top benches of Tuzo and 5034 pits where they extend onto land	n/d	n/d	n/d	13.7	13.7

[a] These options would enhance rather than create habitat.
[b] The areas for these options are the entire pit areas, including habitat features along the edges and the deep-water areas.
[c] The area estimated for the Dyke B habitat structure was based on lowering the section of Dyke B over the original lake surface to an elevation of 418.0 masl
[d] These areas include the areas of Lakes D5, D6 and D10, which are currently non-fish-bearing and would become connected to fish-bearing waters.
[e] This area includes the areas of Lakes D5, D6, D10 and E2, which are currently non-fish-bearing and would become connected to fish-bearing waters.
ha = hectare; m = metre; > = greater than; masl = metres above sea level; n/d = not yet determined.

Table 3.II-20 Evaluation of Potential Compensation Options

Option Number	Compensation Option	Habitat Area (ha)	Factors Affecting Environmental Viability	Factors Affecting Engineering and Cost Viability	General Comments	Environmental Rank [(a)]	Engineering and Cost Rank [(a)]
1a	Raising Lakes D2 and D3 to 428 masl	96.2	▪ Value of habitats dependent upon nature of habitat in newly flooded areas. ▪ Ecological effectiveness dependent upon nature of new habitats and effect on existing habitats. ▪ Potential effect of dykes on fish access (Lake D2 and Lake E1 connections to Kennady Lake lost, and downstream connectivity to the N watershed established by outflow to Lake N18). ▪ Three non-fish-bearing lakes (Lakes D5, D6 and D10) totaling 6.2 ha in area would become connected to fish-bearing waters.	▪ Relatively low cost as the access and source of construction materials is already established. ▪ Improving and enlarging structures that were built as a part of the mine development which would then remain permanent. ▪ Structures are still relatively low and stable.	▪ Could be constructed early in the Project development. ▪ Potential for developing habitat enhancement features in newly flooded areas.	2	1.5
1b	Raising Lakes D2, D3, E1 and N14 to 428 masl	149.7	▪ Value of habitats dependent upon nature of habitat in newly flooded areas. ▪ Ecological effectiveness dependent upon nature of new habitats and effect on existing habitats. ▪ Potential effect of dykes on fish access (Lakes D2 and E1 connections to Kennady Lake lost, and downstream connectivity to the N watershed established by outflow to N18). ▪ Three non-fish-bearing lakes (Lakes D5, D6 and D10) totaling 6.2 ha in area would become connected to fish-bearing waters.	▪ Additional cost compared to Option 1a in that additional dykes and access roads would have to be constructed. ▪ Relatively low cost because of the proximity of construction material and locations of structures close to existing mine development.	▪ Could be constructed early in the Project development. ▪ Potential for developing habitat enhancement features in newly flooded areas.	2	2
1c	Raising Lakes D2, D3, E1 and N14, and surrounding area, to 429 masl and reconnect to Kennady Lake after closure	195.9	▪ Value of habitats dependent upon nature of habitat in newly flooded areas. ▪ Ecological effectiveness dependent upon nature of new habitats and effect on existing habitats. ▪ Connectivity to Kennady Lake would be re-established after closure. ▪ Four non-fish-bearing lakes (Lakes D5, D6, D10 and E2) totaling 9.2 ha in area would become connected to fish-bearing waters.	▪ Very low incremental cost following from Option 1b, for a relatively large gain of 45 ha. ▪ Addition to existing structures and the construction of a spillway to reestablish flow into Kennady Lake. ▪ The source of construction materials is nearby and access is already established.	▪ Would not be constructed until after closure. ▪ Potential for developing habitat enhancement features in newly flooded areas. ▪ Option 1b would operate for 15 years before Option 1c would be developed.	1	2
2	Raising Lakes D2 and D3 to 427.5 masl	31.1	▪ Value of habitats dependent upon nature of habitat in newly flooded areas. ▪ Ecological effectiveness dependent upon nature of new habitats and effect on existing habitats. ▪ Potential for adverse water quality effects. ▪ Potential effect of dyke (and Fine PKC Facility) on fish access (Lake A3 connection to Kennady Lake lost and downstream connectivity established to the L watershed (by outflow to Lake L18). ▪ Outflow to the L watershed would partially mitigate the flow reductions downstream of Area 8.	▪ Relatively low cost of construction due to short road access and proximity to construction materials. ▪ Construction cost of Dyke C is part of the mine plan.	▪ Would be constructed early in the Project development. ▪ Potential for developing habitat enhancement features in newly flooded areas.	2	1.5
3	Finger Reefs in Areas 6 and 7	Not Determined	▪ Ecological effectiveness of finger reefs dependent upon the extent to which reef habitats are presently limiting to fish production (or would be in the altered and refilled Kennady Lake).	▪ Material will be readily available and the construction would be very low cost with little disturbance considering that the work will be done when the lakes are dry.	▪ To be constructed during the dry period. ▪ Would not be functional until after closure. ▪ Determination of potential habitat area provided by finger reefs requires further design work.	2	1
4	Habitat Enhancement Structures in Area 8	Not Determined	▪ Ecological effectiveness dependent upon nature of habitat enhancement structures and effect on existing habitats. ▪ Ecological effectiveness dependent upon the extent to which the types of habitats that would be provided by enhancement structures are presently limiting to fish production.	▪ Higher cost relative to Option 3, because of longer haul distance and the need to build access roads (Ice roads or gravel).	▪ Could be constructed early in the Project development. ▪ Determination of types of habitat structures and potential habitat area requires further design work.	2	3 (or 2 if using an ice road)
5	Hearne Pit Habitat Structure	16.0	▪ Habitat would include deep-water areas, with shallow areas limited to portions along the edges of the pit. ▪ Ecological effectiveness is uncertain; dependent upon the extent to which similar habitats are presently limiting to fish production (or would be in the altered and refilled Kennady Lake).	▪ Low relative cost and can likely be accommodated within existing mine production schedule.	▪ Would not be constructed until after closure.	2	1

Table 3.II-20 Evaluation of Potential Compensation Options (continued)

Option Number	Compensation Option	Habitat Area (ha)	Factors Affecting Environmental Viability	Factors Affecting Engineering and Cost Viability	General Comments	Environmental Rank [(a)]	Engineering and Cost Rank [(a)]
6	5034 Pit Habitat Structure	35.0	▪ Habitat would include deep-water areas, with shallow areas limited to portions along the edges of the pit. ▪ Ecological effectiveness is uncertain; dependent upon the extent to which similar habitats are presently limiting to fish production (or would be in the altered and refilled Kennady Lake).	▪ Low relative cost and can likely be accommodated within existing mine production schedule.	▪ Would not be constructed until after closure.	2	1
7	Tuzo Pit Habitat Structure	35.2	▪ Habitat would include deep-water areas, with shallow areas limited to portions along the edges of the pit. ▪ Ecological effectiveness is uncertain; dependent upon the extent to which similar habitats are presently limiting to fish production (or would be in the altered and refilled Kennady Lake).	▪ Low relative cost and can likely be accommodated within existing mine production schedule.	▪ Would not be constructed until after closure.	2	1
8	Dyke B Habitat Structure	16.0	▪ Ecological effectiveness dependent upon the extent to which similar habitats are presently limiting to fish production (or would be in the altered and refilled Kennady Lake).	▪ Low relative cost and can likely be accommodated within existing mine production schedule.	▪ Would not be constructed until after closure.	2	2
9	Raising Area 8 and Lakes L2, L3 and L13 to 422 m	69.3 in Area 8 and Lakes L2, L3, and L13 55.1 in Kennady Lake Areas 2 to 7 Total: 124.4	▪ Value of habitats dependent upon nature of habitat in newly flooded areas. ▪ Ecological effectiveness dependent upon nature of new habitats and effect on existing habitats. ▪ Outflow from Lake L2 redirected through a natural drainage path to Lake L9 (north of Lake L2) so downstream connectivity to the L watershed would be maintained. ▪ Some Arctic grayling spawning habitat would be lost immediately downstream from Area 8. ▪ Connections between Area 8 and Lakes I1 and J1a (which both have deep water habitat) would be improved and maintained on a more continuous basis. ▪ Increasing the area of Area 8 and improving overwintering capability increases the chances of maintaining viable populations in Area 8 and facilitate re-colonization of Kennady Lake after closure. ▪ During operations, there will be reduced inflows to Area 8 and reduced outflows from Area 8, which may limit the value of the compensation habitat in the operational period.	▪ Higher cost due to the distance of structures from the mine area and the location of fill materials. ▪ The construction of these structures on untouched stream channels is not a part of the mine plan and would be a separate task. ▪ Would enlarge the area of disturbance and the area of monitoring.	▪ Could be constructed early in the Project development. ▪ Will have reduced flows through Area 8 until after closure. ▪ Potential for developing habitat enhancement features in newly flooded areas.	2	3
10	Widening the top benches of Tuzo and 5034 mine pits where they extend onto land	13.7	▪ Ecological effectiveness of shelf areas dependent upon the extent to which reef habitats are presently limiting to fish production (or would be in the altered and refilled Kennady Lake).	▪ Additional material would have to be drilled and blasted which is not a trivial cost; however, the location within the influence of the mine area makes the cost relatively low. ▪ Relatively easy way to make more lake and control the bathymetry of the shoreline.	▪ Would not be constructed until after closure, but before refilling of Kennady Lake.	1	2

[(a)] Rank 1 is the highest preference.

ha = hectares

3.II.7.3 PROPOSED HABITAT COMPENSATION PLAN

The proposed fish habitat compensation plan consists of a combination of the compensation options described in Section 3.II.7.2. The preferred options for the proposed compensation plan include Options 1b and 1c (raising the water level in lakes to the east of Kennady Lake), Option 2 (raising the level of Lake A3), and Option 10 (widening the top bench of mine pits where they extend onto land. Also included in the proposed compensation plan are Options 3 and 4 (construction of habitat enhancement features in Areas 6, 7 and 8) and Option 8 (the Dyke B habitat structure).

The amount of compensation habitat, in terms of surface area, provided by the proposed compensation plan is summarized in Table 3.II-21. Table 3.II-21 also shows the compensation habitat areas and compensation ratios (based on habitat surface area) during operations and after closure with compensation Options 1b, 1c, 2 and 10, and including altered areas of Kennady Lake that will be reclaimed and submerged at closure.

Quantification of habitat gains in terms of HUs, and determination of compensation ratios based on HUs, will be completed as part of the development of a detailed compensation plan to be completed in 2011.

Table 3.II-21 Summary of Fish Habitat Compensation Achieved with the Proposed Conceptual Compensation Plan

Compensation Description	Compensation Habitat Area (ha)	
	During Operations	After Closure
Newly Created Habitat		
Option 1b – Construction of Impounding Dykes F, G, E1 and N14 to the west of Kennady Lake to raise Lakes D2, D3, E1 and N14 to 428 masl elevation	149.7	–
Option 1c – After closure, further raise the water level in Lakes D2, D3, E1 and N14, and the surrounding area, to 429 masl and reconnect the flooded area to Kennady Lake through Lake D1	–	195.9
Option 2 – Construction of Impounding Dyke C between Area 1 and Lake A3, Dyke A3 to the north of Lake A3, and Dyke N10 between Lakes A3 and N10 to raise Lake A3 to 427.5 masl elevation	31.1	31.1
Option 10 – Widening the top bench of pits (to create shelf areas) where they extend onto land	–	13.7
Altered Areas Reclaimed and Submerged at Closure		
Hearne Pit [(a)]	–	16.0
5034 Pit [(a)]	–	35.0
Tuzo Pit [(a)]	–	35.2
Dykes A, B, J, K and N	–	23.8
Road in Area 6	–	4.0
Water Collection Pond Berms CP3, CP4, CP5 and CP6	–	1.3
Mine rock areas [(b)]	–	25.3
Total	**180.8**	**381.3**
Compensation Ratios (gains:losses) [(c)]	**0.65**	**1.37**

(a) The areas for these options are the entire pit areas, including habitat features along the edges and the deep-water areas.
(b) The mine rock piles with final surface elevations between 410.0 and 418.0 masl are considered as compensation habitat.
(c) Calculated based on total area of permanently lost habitat and physically altered and re-submerged habitat (277.8 ha; Tables 3.II-2 and 3.II-11).

ha = hectares; masl = metres above sea level.

3.II.7.4 MONITORING EFFECTIVENESS OF COMPENSATION

Habitat created or enhanced to compensate for the loss of fish habitat will be monitored to assess effectiveness of compensation by evaluating the physical and biological characteristics of the habitats, as well as fish use of the habitats. Habitat improvements will be implemented, as part of an adaptive management approach in consultation with regulators, if new or enhanced habitats are not providing the required habitat components for the target fish species.

Monitoring results would be used, if necessary, to adjust mitigation and habitat compensation measures and make design improvements as required. Habitat monitoring will be key to confirming the no net loss objective has been achieved.

Details of the compensation monitoring will be included in the detailed compensation plan. The detailed monitoring plan will be designed to meet all fish and fish habitat monitoring requirements included as conditions attached to any regulatory authorizations, approvals or permits that may be issued for development of the Project. Should, for some reason, the existing proposed habitat compensation not be sufficient to achieve no net loss of the productive capacity of fish habitat, additional habitat compensation would be developed in consultation with the appropriate regulators.

3.II.8 REFERENCES

BC MELP (BC Ministry of Environment, Lands and Parks). 1998. British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials. Province of British Columbia.

Cumberland Resources Ltd. 2005. Aquatic Ecosystem/Fish Habitat Impact Assessment. Prepared for the Meadowbank Gold Project.

De Beers (De Beers Canada Mining Inc.). 2002. Snap Lake Diamond Project Environmental Assessment Report. Prepared for De Beers Canada Mining Inc. by Golder Associates Ltd. Yellowknife, N.W.T. February 2002.

DFO (Fisheries and Oceans Canada). 1986. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat. Presented to Parliament by the Minister of Fisheries and Oceans. October 7, 1986.

DFO. 1998. Habitat Conservation and Protection Guidelines Developed from the Policy for the Management of Fish Habitat (1986). Second Edition (1998). Ottawa, Ontario.

DFO. 2006. Practitioners Guide to Habitat Compensation, Developed from the Policy for the Management of Fish Habitat (Habitat Policy) (1986).

Diavik (Diavik Diamond Mines Inc.). 1998. Environmental Assessment Report. Diavik Diamond Mines Inc. Yellowknife, NT.

EBA Engineering Consultants Ltd. (EBA), and Jacques Whitford Environment Ltd. 2001. Gahcho Kué (Kennady Lake) Environmental Baseline Investigations (2000). Submitted to De Beers Canada Exploration Limited, Yellowknife, NT.

EBA, and Jacques Whitford Environment Ltd. 2002. De Beers Canada Exploration Gahcho Kué Fisheries Studies (2001). Submitted to De Beers Canada Exploration Limited, Yellowknife, NT.

Evans, C.L., J.D. Reist, and C.K. Minns. 2002. Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Riverine Habitat Requirements. Can. Manu. Rep. Fish. Aquat. Sci. 2614: xiii + 169 pp.

Golder. 2005. Doris North Project "No Net Loss" Plan, Revision 4. A report prepared for Miramar Hope Bay Ltd by Golder Associates Ltd, Edmonton, AB. 66 pp. + appendices

Jacques Whitford. 2003. Gahcho Kué (Kennady Lake) Limnological Survey of Potentially Affected Bodies of Water (2002). Project No. NTY71008. Final Report Submitted to De Beers Canada Exploration Inc., Yellowknife, NT.

Mainstream Aquatics (Mainstream Aquatics Ltd.) 2004. Revised fish habitat no net loss plan for the Jericho Diamond Project. Prepared for Tahera Diamond Corporation. Report No. 04006BF: 63 pp. + appendices.

Richardson, E.S., J.D. Reist, and C.K. Minns. 2001. Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Lake Habitat Requirements. *Can. Manu. Rep. Fish. Aquat. Sci*. 2569.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184. 966 pp.

Stewart, D.B., N.J. Mochnacz, J.D. Reist, T.J. Carmichael, and C.D. Sawatzky. 2007. Fish Life History and Habitat Use in the Northwest Territories: Arctic Grayling (*Thymallus arcticus*). *Can. Manu. Rep. Fish. Aquat. Sci*. 2797.

USFWS (United States Fish and Wildlife Service). 1980. Habitat Evaluation Procedures (HEP). USDI Fish and Wildlife Service. Division of Ecological Services. ESM 102.

USFWS. 1981. Standards for the development of habitat suitability index models. USDI Fish and Wildlife Service. Division of Ecological Services. ESM 103.

3.II.9 ACRONYMS AND ABBREVIATIONS

3.II.9.1 ACRONYMS AND ABBREVIATIONS

CCP	Conceptual Compensation Plan
De Beers	De Beers Canada Inc.
DFO	Fisheries and Oceans Canada
GIS	Geographic Information System
ha	hectares
HADD	harmful alteration, disruption, or destruction
HEP.	Habitat Evaluation Procedure
HSI	Habitat Suitability Index
HU.	Habitat Unit
PKC	Processed Kimberlite Containment
Project	Gahcho Kué Project
USFWS	US Fish and Wildlife Service

3.II.9.2 UNITS OF MEASURE

%	percent
>	greater than
km	kilometres
m	metres
m/s	metres per second
masl	metres above sea level