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REVIEW BOARD

28 February 2003

Mackenzie Valley Environmental Impact Review Board (MVEIRB)
Box 938, 5102 – 50th Avenue
Yellowknife, NT X1A 2N7

Attention: Glenda Fratton, Environmental Assessment Coordinator

Dear: Glenda

SUBJECT: Preliminary Mine Closure and Reclamation Plan

Please accept the attached technical memo titled "Preliminary Mine Closure and Reclamation Plan" for submission to the Public Registry. This memo was compiled in response to issues raised by the Department of Indian and Northern Affairs Canada (INAC) during the MVEIRB Technical Sessions.

Additionally, information contained within this memo should address the outstanding concerns identified by INAC in their Request for Ruling to the Board dated 22 January 2003.

Should you have any questions, please feel free to contact the undersigned.

Sincerely,
SNAP LAKE DIAMOND PROJECT

Robin Johnstone
Senior Environmental Manager

cc: Bob Wooley, Executive Director, MVLWB
Buddy Williams, Land Specialist, INAC

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SNAP LAKE
DIAMOND PROJECT
DE BEERS

PRELIMINARY
MINE CLOSURE & RECLAMATION PLAN

SNAP LAKE DIAMOND PROJECT

Submitted to: De Beers Canada Mining Inc.

Prepared by: AMEC E&C Services

FEBRUARY 2003

IMPORTANT NOTICE

This report was prepared exclusively for De Beers Canada Mining Inc. (De Beers) by AMEC E&C Services (AMEC). The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by De Beers only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

CONTENTS

List of Tables

List of Figures

Appendices

GLOSSARY

AEP	Advanced Exploration Program
AMEC	AMEC E&C Services Inc.
ARD	acid rock drainage
CCME	Canadian Council of Ministers of the Environment
°C	degrees Celsius
DIAND	Department of Indian and Northern Affairs Canada
DMS	dense medium separation
EA	Environmental Assessment
EMS	Environmental Management System
FeSi	Ferrosilicon
ha	hectare
ISO	International Standards Organization
kg	kilogram
km	kilometre
L	litre
LSA	local study area (project footprint, surrounded by 500 m buffer)
m	metre
m/s	metres per second
m^2	square metre
m^3	cubic metre
masl	metres above sea level
ML	million litres
Mt	million tonnes
MTVC	metavolcanic
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
NWT	Northwest Territories
PAG	potentially acid generating
PK	processed kimberlite
PKC	processed kimberlite containment
ppm	parts per million
RSA	regional study area (31 km radius from project site)
SHE	safety, health and environmental
t	tonne (1,000 kg)
t/d	tonnes per day
TDS	total dissolved solids
t/m^3	tonnes per cubic metre
TSS	total suspended solids
TSP	total suspended particulates
$\mu g/m^3$	micrograms per cubic metre
WMP	water management pond

SECTION 1 • BACKGROUND

De Beers Canada Mining Inc. (De Beers), owner and operator of the Snap Lake Diamond Project (the project), is proposing to develop an underground diamond mine at Snap Lake, Northwest Territories, about 220 km northeast of Yellowknife. In February 2001, De Beers initiated a screening of the project under the *Mackenzie Valley Resource Management Act*. The screening was reviewed by the Mackenzie Valley Land and Water Board (MVLWB), which in May 2001 referred the project to the next stage of review – an environmental assessment. De Beers conducted the environmental assessment under the direction of the Mackenzie Valley Environmental Impact Review Board (MVEIRB) and subsequently submitted an Environmental Assessment (EA) report in February of 2002.

Assuming the project receives approval at the completion of the environmental assessment process, it will enter a second licensing phase under the authorization of the MVLWB. As part of this licensing process, De Beers must prepare and submit a Mine Closure and Reclamation Plan for the project.

In 2002 the Department of Indian and Northern Affairs Canada (DIAND) published a *Mine Site Reclamation Policy for the Northwest Territories – A policy for the protection of the environment and disposition of liability relating to mine closures in the Northwest Territories* (Reclamation Policy). This policy sets out the principles and objectives that will guide DIAND in applying its authority in matters relating to the management of environmental and liability issues arising from mine closure and reclamation in the Northwest Territories. The policy attempts to explain to the mining industry what is expected of project components, and what proponents can expect from decision makers. As such, it aims to establish general, consistent criteria for mine closure and reclamation objectives, thereby reducing ad hoc, case-by-case interpretation.

In August 2002, the Water Resources Division of DIAND released *Mine Reclamation Guidelines for the Northwest Territories and Nunavut* in draft form for comment. These guidelines are intended to update the 1990 NWT Water Board publication *Guidelines for Abandonment and Restoration Planning for Mining in the Northwest Territories*. The new guidelines are aimed at assisting proponents of mining projects in understanding DIAND expectations for closure and reclamation planning in the Northwest Territories and Nunavut. The guidelines acknowledge that land owners and other agencies, such as First Nations, Environment Canada, Fisheries and Oceans Canada, Natural Resources Canada, Government of the Northwest Territories and various co-management boards, also play a role in the reclamation of lands and waters affected by mining activities.

The DIAND Reclamation Policy states that all mines in the Northwest Territories should be planned, operated, closed and reclaimed in an environmentally sound manner in accordance with current mine closure and reclamation practices. These practices include:

- submission of a mine closure and reclamation plan to regulators and landowners, approval of the plan before the commencement of mine production, regular plan updates and annual progress reclamation reports

- progressive mine reclamation, consistent with the approved plans and current mine reclamation practices
- financial assurance that fully covers the outstanding liabilities at any period of the mine operations
- sites that are reclaimed and monitored at the financial expense of the mining company.

Mining is considered to be a temporary use of the land. At closure, the mine site and the land affected by the mining operations are to be reclaimed to achieve the following objectives (listed in order of priority):

- protect public health and safety through the use of safe and responsible reclamation practices
- reduce or eliminate environmental effects once the mine ceases operation
- re-establish conditions that permit the land to return to a similar pre-mining land use
- reduce the need for long-term monitoring and maintenance by establishing physical and chemical stability of disturbed areas.

De Beers has incorporated, where applicable, the principles, objectives and standards set out in the DIAND Reclamation Policy and Guidelines in the preparation of this Preliminary Mine Closure and Reclamation Plan for the project. Accordingly, De Beers' plan will comply with the conditions of mining permits, regulations, and industry standards. The following principles have been established to guide the development of the overall plan:

- plan and implement procedures in accordance with all applicable regulations
- apply cost-effective and appropriate closure and reclamation practices to reduce environmental risks and allow traditional use of the land
- conduct studies to predict post-closure environmental effects
- maintain a program of progressive closure and reclamation as an integral part of project operations
- incorporate new reclamation methods and procedures.

De Beers is committed to reducing residual environmental effects at the site upon closure. Reclamation work will form an integral part of the mine plan and will be carried out progressively during the life of the project. The mining and water management plans have been developed to facilitate progressive reclamation. All surface facilities have been designed to minimize reclamation requirements following mine closure and to enhance the natural recovery of the areas affected by mining. It is anticipated that a significant portion of the proposed reclamation will be carried out during the operational phase of the project. Progressive reclamation will provide an opportunity to reduce the extent of disturbed land over the life of the project.

This report provides a description of the anticipated closure and reclamation activities on cessation of mine operations. It describes the areas of disturbance that will require reclamation, summarizes the proposed strategy and schedule for closure and reclamation of each area, and outlines the work to be carried out.

This report was prepared prior to De Beers obtaining land use and water licenses for construction and operation of the project. Therefore, it is considered preliminary since some elements of the plan, such as post-closure monitoring requirements and associated cost estimates, may require revision upon project approval. Further, the specific details of the Mine Closure and Reclamation Plan will evolve as mining progresses, and so the plan will be updated periodically during the mine life. The final plan will be generated several years before mine closure.

The key closure and reclamation issues for the project are as follows:

- Potential acid rock drainage (ARD) will be minimized by placing a thick cap of processed kimberlite (PK) over any potentially acid generating (PAG) mine rock deposited in the north pile. The successful implementation of this strategy will minimize the requirement for long-term post-closure surface water and groundwater monitoring. In addition, this strategy will minimize the requirement for non-PAG rock as cover material.
- Underground disposal of PK will be maximized using a cemented PK paste for underground backfill. Approximately half of the PK produced will be used for this purpose. This will minimize the requirement for surface containment and subsequent reclamation of these materials.
- To minimize the requirement for construction (and subsequent reclamation) of surface water storage facilities, the remaining 50% of PK will be disposed of on surface as an uncemented paste, permitting maximum water recycle to the process plant.

SECTION 2 • PREDEVELOPMENT ENVIRONMENTAL BASELINE

This section provides a description of predevelopment environmental conditions and land use in the project area. The information is taken from the environmental baseline sections of the EA submitted to the MVEIRB in February 2002 (Golder Associates Ltd., Environmental Assessment (EA) Report for the Snap Lake Project, 26 February 2002). The assessment covers a defined local study area (LSA) and regional study area (RSA), where applicable.

2.1 PHYSICAL ENVIRONMENT

2.1.1 Location

The project site is in a remote area about 220 km northeast of Yellowknife in the Northwest Territories. The only means of road access to the site is the Tibbitt-to-Contwoyto winter road, typically open only during the months of January through March or early April. Otherwise the mine site must be accessed by plane. The location of the project is shown in Figure 2.1.

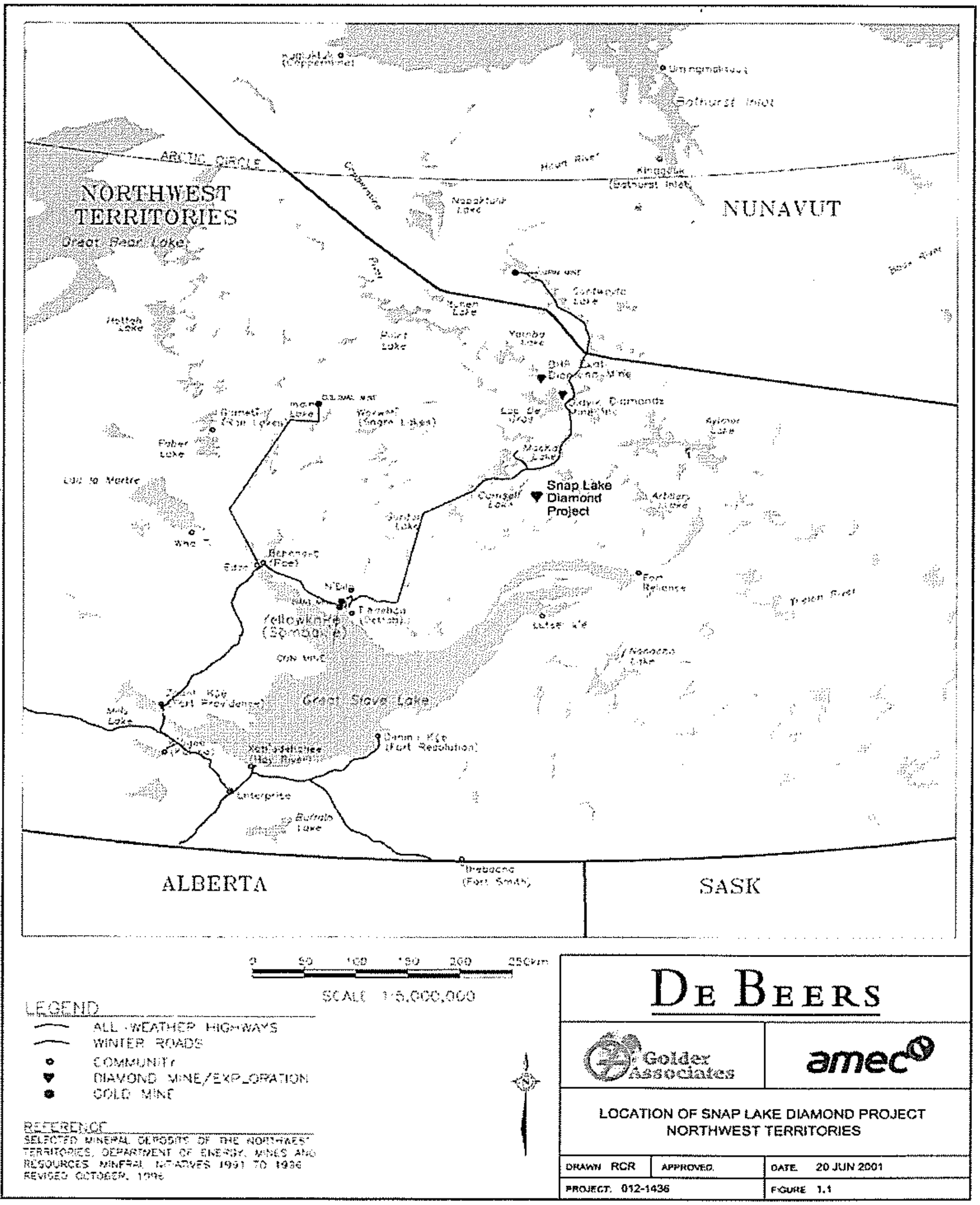
2.1.2 Climate and Air Quality

Meteorological data were collected at an on-site weather monitoring station from February 1998 to January 2001. The gentle topography has a negligible effect on wind direction. Wind frequencies are slightly higher from the east to east-southeast, possibly resulting from onshore breezes from Snap Lake during the warmer, ice-free months. The most common wind speeds are in the range of 6 to 19 km/h, averaging 13.6 km/h over the year. The highest average wind speeds are in the late summer and early fall, the lowest in January.

The climate is characterized by short, cool summers and very cold winters. The average annual temperature is approximately -7.5°C. The mean summer temperature is 9°C and the mean winter temperature is -24.5°C. Mean annual precipitation ranges from 200 to 300 mm. Average monthly temperatures at Snap Lake are below freezing from October through April. Minimum temperatures drop below 0°C in every month except July and August, while maximum temperatures are above freezing from March through October. The average temperatures observed at the Snap Lake weather station were consistent with the 30-year climate normal data for the Yellowknife Airport.

To determine the current air quality at Snap Lake, De Beers initiated a monitoring program in April of 2000. The initial program focused on establishing total suspended particulate (TSP) matter concentrations at three stations, two (A, B) near the advanced exploration program (AEP) activities and one (C) in a more remote area near the former Snap Lake exploration camp. Over the period of record, 24-hour TSP concentrations ranged from 1 to 148 μg/m^3. Average 24-hour TSP concentrations at monitoring stations A, B and C were 39 μg/m^3 16 μg/m^3, and 7 μg/m^3, respectively.

Figure 2.1 – Site Location



2.1.3 Topography

The project site is approximately 70 km north of the east arm of Great Slave Lake in the Slave Geological Province of the Sub-Arctic Canadian Shield, within the barren lands of the NWT. The area is characterized by rolling terrain, rocky hills of limited relief, numerous lakes and rock-strewn surfaces harbouring sporadic, low-growing vegetation; low trees and shrub patches are found in topographic depressions and along shorelines.

As shown in Figure 2.2 (drawing U638A-210-C-001), most of the proposed development will be on the northwest peninsula of Snap Lake. The topography of the peninsula can be described as gently sloping with occasional bedrock knolls. Some areas of peat and organic soils are found on the northern part of the peninsula. Large scattered boulders and frost-shattered rocks dominate the ground. Surface elevations vary from just less than 445 m masl at the Snap Lake lakeshore to approximately 482 m masl on a knoll immediately southwest of the water management pond (WMP).

The terrestrial shoreline of Snap Lake is dominated by open tundra (78%), with limited coniferous forest (9%), sedge wetlands (<2%) and marsh (<1%). The slope of the terrain surrounding the lake varies from shallow to steep.

2.1.4 Surficial Geology

In this environment, soil development and vegetative cover are generally sparse over bedrock or glacially deposited materials except in specific areas near active watercourses or where wind and erosion have been prevalent.

Soils in the project area are typically less than 2 m thick. Dystric brunisols are the dominant soil type. At permafrost sites, the soils consist of turbic cryosols and organic cryosols. Discontinuous permafrost features with low ice content and scattered ice wedges occur in poorly drained, thicker peat-filled depressions throughout the LSA.

2.1.5 Bedrock Geology

The regional bedrock geology consists of Archean-aged granitic rocks overlain locally by relatively small bodies of metavolcanic rocks cut by diabase (dark fine-grained rock) dykes and sills of Proterozoic age. The major structures in the area are two east-west-trending, roughly vertically oriented faults: the Snap Fault and the Crackle Fault. The surface expression of these faults is characterized by quartz-hematite veining. Drill core through these faults is intermittently broken. Intersecting the Snap Fault is an unnamed north-south-trending fault that divides a granodiorite granite assemblage to the west and metavolcanic rocks to the east. Interpretations of magnetically defined lineaments in the area indicate that bedrock fracture sets occur in three or four different orientations.

Figure 2.2 – Site Plan (Drawing U638A-210-C-001)

2.1.6 Permafrost Conditions

Information published by the International Permafrost Association (1997) indicates that the project site lies just north of the border between the zones of discontinuous and continuous permafrost. Accordingly, the depth of permafrost is expected to be approximately 200 m at locations away from the influence of water. A talik zone (unfrozen zone within continuous permafrost) exists beneath Snap Lake; taliks are to be expected under most of the major waterbodies in the area. Permafrost becomes thicker with distance from Snap Lake. It appears to be at least 100 m thick under the surface of much of the northwest peninsula and the ground between Snap Lake and other nearby lakes. The "thaw" or "active" zone beneath the project site has been observed to be up to 8 m thick and extends to the underlying bedrock. (The active zone is the layer of permafrost closest to the surface that melts during the summer.) Except in low-lying areas with peat deposits, the soils contain only seasonal ice. No zones of massive ground ice were encountered during subsurface investigations.

Although part of Dam 1 at the south end of the WMP will be within the talik zone, most of the proposed site development facilities will be located on continuous permafrost. There will be two frozen/unfrozen interfaces in the mine. The surface portal will be in the active layer, from which the access ramp will continue downwards through permafrost to the second interface near the shoreline of Snap Lake. From the shore onwards, the mine will be in the talik zone under the lake.

2.1.7 Geological Hazards and Seismicity

No geological hazards were identified in the LSA. Geological hazards include landslides, mudflows, debris flows, rock slides and earthquakes. No earthquakes have been recorded near the project area. The largest and closest earthquake was magnitude 6 to 8, centred approximately 1,000 km west of the site. No seismic events have been recorded within 500 km of the site over the last five years.

Based on information obtained from the Pacific Geoscience Centre, the peak horizontal ground acceleration for the project area for an event having a risk of exceedance of 10% in 50 years (equivalent to a 475-year return period) is 0.013 g. The corresponding peak horizontal ground velocity for this event is 0.039 m/s.

The effect of an earthquake is also related to rock types. Since the geotechnical investigation program identified the native rock types at the site as meta-volcanic and granitic, little or no ground deformations and rock displacements are anticipated. Based on the 1995 National Building Code of Canada, the area is located in the acceleration zone Za=0 and in velocity zone Zv=0 with a zonal velocity ratio (Za/Zv) of zero.

2.1.8 Groundwater Conditions and Quality

There are two main groundwater flow regimes at the project site: a shallow regime within the active layer above permafrost, and a deep regime beneath the permafrost and within the taliks of large waterbodies. The presence of thick permafrost with low permeability results in little to no hydraulic connection between the two regimes.

The hydraulic conductivity of the frost-shattered and/or weathered rock underlying the till in the location of the boreholes was found to be approximately 1 x 10^{-5} m/s. This is underlain at approximately 8 m depth by competent bedrock with a measured hydraulic conductivity of less than 3 x 10^{-8} m/s. The water level was found to be at depths of less than 1 m below ground surface.

In areas of continuous permafrost, recharge to the deep groundwater flow regime is predominantly limited to the talik areas beneath the larger lakes; the water level within these lakes represents the hydraulic head of the groundwater flow regime. Snap Lake is a headwater lake with the highest water level of any lake in the regional study area. The water elevations of lakes near Snap Lake and the inferred deep groundwater flow directions are presented in EA Figure 9.2-3 (contained in Appendix A). Groundwater is expected to flow radially away from Snap Lake at the inferred hydraulic gradient of approximately 0.002 m/m. The average hydraulic conductivity for fractured rock zones was found to be approximately 5 x 10^{-5} m/s.

Groundwater quality was assessed as part of the 2001 hydrogeology and geochemistry. In general, the groundwater samples showed weak to moderate mineralization with total dissolved solids (TDS) ranging from 5 mg/L to 1,630 mg/L. Mineralization is weakest in the upper metavolcanic units and increases with depth in the metavolcanics and with transition to granitic material. Within the granite the groundwater TDS values show a high degree of variability. The data indicate that calcium and chloride are dominant in the granite groundwater, whereas bicarbonate, calcium and magnesium are predominant in the kimberlite and metavolcanics. The predominance of calcium and chloride in granite groundwater is consistent with previous observations (Pearson, F.J. 1987, Models of Mineral Controls on the Composition of Saline Groundwaters of the Canadian Shield) with regard to deep groundwater of the Canadian Shield.

With the exception of cadmium, cobalt, mercury and zinc, trace metal concentrations in the groundwater samples were generally 10 to 20 times those measured in Snap Lake. In some of the samples, iron, manganese, chloride and TDS exceeded drinking water guidelines (CCME 1999, with 2000 updates) of 300 µg/L, 50 µg/L, 250 mg/L and 500 mg/L, respectively.

2.1.9 Surface Water Hydrology

The project is located in the Sub-Arctic Precambrian Shield hydrologic region, which extends in a narrow band across the northeast end of Great Slave Lake and trends northwest to and including Great Bear Lake. Rugged landscapes consisting of frequent rock outcrops, glacial features and lakes characterize this hydrologic region. The extent and depth of soil is limited, and forest and tundra vegetation coverage is sparse. Snap Lake is a headwater lake with a drainage area of 67.5 km^2 in the Lockhart River system, which discharges into Great Slave Lake. Drainages within the Snap Lake area are not well defined, with runoff often passing downslope through a series of muskegs and ponded areas.

Precipitation determines basin moisture input. Six climate stations were selected for the regional precipitation analysis. The recorded mean annual rainfall in the study region ranges from about 120 mm to about 210 mm. The mean annual water-equivalent snowfall, without undercatch correction, ranges from about 100 mm to 135 mm. The mean annual precipitation without undercatch correction ranges from about 210 mm to 340 mm. The precipitation estimates shown in Table 2.1 are based on isographs and an interpolation between values at Yellowknife Airport and "Lupin Extended" (combined data from climatic stations at Lupin and Contwoyto Lake). A snowfall undercatch correction factor of 1.7 was applied to the recorded snowfall to estimate the actual snowfall on the ground.

Table 2.1 – Derived Long-Term Mean Annual Rainfall, Snowfall and Precipitation at Snap Lake

	Estimated Annual Value (mm)	
Parameter	**No Correction to Snowfall Undercatch**	**With Correction to Snowfall Undercatch**
Rainfall	149	149
Snowfall	122	207
Precipitation	217	356

Table 2.2 lists the extreme seasonal and annual precipitation estimates for 10-year and 100-year return periods. Since extreme values for annual rainfall, annual snowfall and annual precipitation are determined individually, they are not necessarily coincident in the same year. Thus, extreme rainfall and snowfall are not summed to equal precipitation in Table 2.2.

Table 2.2 – Derived Mean and Extreme Annual Rainfall, Snowfall and Precipitation at Snap Lake

	Annual Value[1] (mm)				
Parameter	**100-Year Dry Condition**	**10-Year Dry Condition**	**Mean**	**10-Year Wet Condition**	**100-Year Wet Condition**
Annual Rainfall	68	89	147	204	266
Annual Snowfall	89	148	225	310	373
Annual Precipitation	201	274	372	483	585

1. Snowfall under-catch correction factor of 1.7 applied to derive these estimates.

No direct measurements of evaporation are available for the project site or nearby climate stations. However, several analytical models can be used to estimate lake evaporation and basin evapotranspiration. A mean annual lake evaporation rate of 300 mm was adopted for Snap Lake and other smaller lakes in the region. A water balance analysis and literature review were undertaken to derive basin evapotranspiration rates and snowfall under catch. The adopted mean annual water balance parameters, including evapotranspiration and snowfall undercatch, are summarized in Table 2.3.

Table 2.3 – Mean Annual Water Balance Parameters

Parameter	Adopted Value (mm)
Precipitation	
Rainfall	148
Snowfall based on 1.7 adjustment for undercatch	187
Total precipitation	335
Water loss	
Lake evaporation	300
Upland evapotranspiration	150
Wetland evapotranspiration	240
Total evapotranspiration upstream of Snap Lake	156
Total evapotranspiration at Snap Lake	192

Snap Lake is covered by ice for approximately eight months of the year. The mean date of freeze-over in the area is 11 October and the mean date of ice-melt is 6 June. The mean number of ice-covered days is 224. Ice thickens gradually over the winter, with the mean maximum ice thickness of 1.6 m typically occurring in April.

2.1.10 Surface Water Quality

Snap Lake is a relatively clear, soft water lake, with a neutral to slightly acidic pH. Samples collected from stations in Snap Lake in 1999 and from site AS1 in 2001 (see EA Figure 9.4-2 in Appendix A) had pH values that were occasionally lower than the minimum Canadian Water Quality Guideline (CWQG) of 6.5. Median TDS concentrations were very low, typically near laboratory detection limits. Turbidity was higher than the CWQG at sampling station WQ1 in July 1999 and at AS1 in April 2001. Most metals in Snap Lake were present in low concentrations, with medians below CWQG; individual samples were occasionally above CWQG for cadmium, copper, iron, lead, silver and zinc.

The alkalinity of water can be used to gauge the sensitivity of lakes to acid deposition. Because of its low alkalinity (median = 6 mg/L), Snap Lake is susceptible to acidification, as are many lakes in the Canadian Shield.

Some lakes will stratify into two non-mixing layers in the summer: a layer of warmer, less-dense water lying on a cooler, denser layer, with a thin transitional layer between. The reverse can happen in the winter, with very cold (<4°C), less-dense water overlying warmer, denser water (approximately 4°C). However, Snap Lake does not become stratified in summer or winter. It is relatively well mixed in the summer with no vertical gradients of temperature, dissolved oxygen or pH. Snap Lake is relatively shallow (mean depth 5.2 m), and wind-driven circulation of bottom and surface waters results in a well-mixed system. During the winter, temperatures increase and dissolved oxygen levels decrease with depth. The decline in oxygen is likely due to consumption resulting from bacterial decomposition of lake-bottom organic matter. Dissolved oxygen concentrations remain above CWQG at the surface, indicating adequate oxygen levels for aquatic life. In March 1999, dissolved oxygen concentrations were slightly below minimum CWQG aquatic life levels at the lowest depth at site WQ2. Low dissolved oxygen concentrations are common in lakes in winter owing to oxygen consumption and lack of mixing.

More detailed data on the water quality of Snap Lake are available in Section 9.4 of the EA report.

2.1.11 Sediments

Fine lake-bottom sediments were collected in 1999 from four sites in Snap Lake and from a reference lake. Sediments were analyzed for metals, carbon and particle size. Sediment quality in both lakes was very similar and consisted predominantly of sand and silt with very little clay. Sediment metal concentrations were also very similar in Snap Lake and the reference lake. Concentrations of several metals (cadmium, chromium, copper and zinc) were above Canadian Interim Sediment Quality Guidelines (CISQG) levels. Detailed results are available in Section 9.4 of the EA report.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 Vegetation

The RSA is situated within the Taiga Shield Ecozone in the High Sub-Arctic Ecoclimatic Region. Throughout the taiga, cool air temperatures, a short growing season, geology and recent glaciation have resulted in lower biological productivity and diversity than in the more southerly parts of Canada. The few plant species that thrive have adapted to the harsh climate and poor soils. Because of the cold conditions, vegetation does not decompose rapidly into soil but rather is preserved in the form of peat, which covers most low-lying areas.

The taiga forms the transition between forested lands to the south and open tundra (barren lands) to the north. The predominant vegetation of the taiga consists of open, very stunted stands of black spruce and tamarack with secondary white spruce and a ground cover of dwarf birch, willow, ericaceous shrubs, cotton grass, lichen and moss. Poorly drained sites usually support tussocks of sedge, cotton grass and sphagnum moss. Low shrub tundra, consisting of dwarf birch and willow, are also common. The peak flowering period for most plants in this ecozone ranges from 1 July to 31 July.

2.2.2 Freshwater Biota and Habitat

Snap Lake is a headwater lake that receives inflows from a number of small tributaries around its entire periphery. The lake has an average depth of 5 m and two particularly deep areas, one at the extreme west end of the lake (45 m) and the other at southeast tip of the northwest peninsula (24 m). The shoreline is generally a mixture of boulder, exposed bedrock and intermittent cobble; on-shore organic matter is found in bays and sheltered areas. Most near-shore areas have steep gradients leading to deeper water. Deep water substrates consist of a thick layer of loose organic matter. The division between shoreline and substrates occurs at 3 m to 4 m depth. The lake has numerous islands, rocky outcrops and shoals. Boulder cobble substrate is the most common shoreline aquatic habitat.

Sampling for aquatic organisms and habitat in Snap Lake was conducted in 1999. Details of the sampling results are provided in Section 9.5 of the EA. Phytoplankton, chlorophyl *a* and nutrient concentrations in Snap Lake were found to be moderately low. This is typical of an oligo-mesotrophic lake characterized by low to moderate productivity with total phosphorous concentrations of 0.005 to 0.010 mg/L. The results for Snap Lake are consistent with those for similar lakes in the Slave Geological Province. Chlorophyl *a* ranged from 0.44 to 1.15 µg/L in July, with average concentrations ranging from 0.72 µg/L (September) to 0.93 µg/L (July).

The zooplankton community structure varied monthly, with average maximum biomass recorded in July. Also, zooplankton ash-free dry weight ranged from 0.5 to 27.5 g/m^2. Overall, the ash-free dry weight increased over the open water season and reached a maximum in September at all three sampling sites in Snap Lake.

Benthic invertebrates were collected at four sites in Snap Lake during the fall sampling program in 1999. Mean total benthic invertebrate abundance in the lake varied between 5,000 and 7,400 organisms/m^2. Total taxonomic richness (the number of taxa at the lowest level of identification) varied little among sites. The total number of taxa found (calculated by pooling all the replicate samples at a site) was between 27 and 30. The invertebrate community in Snap Lake was dominated by dipterans and nematodes

In 1999, seven species of fish were captured in Snap Lake, including longnose sucker (*Catostomus catostomus*), burbot (*Lota lota*), lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus)*, lake chub (*Couesius plumbeus*) and slimy sculpin (*Cottus cognatus*). The preferred spawning habitat for lake trout is boulder bedrock shoals near deep water, at depths of 2 m to 6 m, fully exposed to wind and wave action. The most active spawning ground identified in 1999 was near the centre of Snap Lake.

2.2.3 Terrestrial Wildlife and Habitat

The potential impacts of mining activities were not studied for all wildlife species, instead wildlife studies focussed on a group of valued ecosystem components (VECs) that were selected based on the ecological, social, cultural and economic aspects of the ecosystem. Eight wildlife VECs were selected for study in the project EA:

- Bathurst caribou herd
- barren-ground grizzly bears
- wolves
- foxes
- wolverines
- upland breeding birds (passerines, shorebirds, ptarmigan)
- raptors (peregrine falcon, gyrfalcon)
- waterfowl.

The Bathurst caribou herd spend the winter south of the treeline, usually concentrated in areas to the southeast and northwest of the eastern arm of Great Slave Lake. The herd gathers in spring in preparation for a very quick and direct northern migration to the calving grounds west of Bathurst Inlet. After calving is completed, caribou begin a much less direct migration south to the wintering grounds.

Aerial surveys for caribou were conducted in the regional study area between 1999 and 2002; details are provided in Section 10.4 of the EA, and in Wildlife Monitoring Reports (De Beers 2002, 2003).

From 1999 through 2002, 668 caribou groups were observed in the study area during aerial surveys. Most of these groups (92%) were made up of 50 or less caribou. The number of caribou observed during each of the migration periods has varied greatly. For example, less than 1,500 caribou were estimated to be within the study area during the northern migration period in both 1999 and 2001. In contrast, there were approximately 15,000 animals in the study area during the northern migrations of 2000 and 2002, and about 27,000 caribou in the study area during the post-calving migration in 1999.

The combined aerial survey information on caribou group size and location suggests that caribou generally moved through the northern and western half of the study area during northern migrations. Few caribou were observed in the eastern part of the study area during the northern migration. A large number of caribou observations were recorded between Camsell Lake and MacKay Lake. Although the distribution of caribou was more uniform during the southern migrations, again, the western portion of the study area appeared to contain more caribou.

Caribou behaviour during the northern migrations has been similar among years while behaviour during the post-calving migrations has varied from year to year. For both migration periods however, behaviour has varied among habitats. During the northern migrations, caribou groups on frozen lakes were more likely to be moving than groups in heath tundra habitat. During the post-calving migrations, caribou were more likely to be feeding and resting in spruce forest and sedge wetland habitats than they were in all other habitat types.

The number of nursery (with calves) and non-nursery (without calves) groups has been very different from year to year. In 2002, 20% of the caribou groups observed contained calves, while in 2001, approximately 3% of caribou groups contained calves.

Traditional knowledge indicates that eskers provide important travel routes for many mammal species such as caribou, muskox and furbearers, and den sites for carnivores, especially wolves. The locations of all active wolf and fox dens along eskers were recorded during esker surveys in 1999 and 2000. The number of active wolf dens in the study area has ranged from 2 – 5 from 1999 through 2002. Annual surveys to document wolf pup production were initiated in 2001 and in 2002, three pups were observed at one wolf den in the study area. No active grizzly bear dens have been located within the study area. However, grizzly bear sign was observed in seasonally preferred habitat in the study area in 2001 and 2002. An average of 48% of plots in sedge wetland habitat and 45% in riparian habitat, contained fresh grizzly bear sign in 2001 and 2002. Although not a VEC, black bears were observed incidentally on several occasions.

Snow track surveys indicated the presence of wolverine in the study area and incidental sightings of wolverine have been made every year from 1999 through 2002. Estimates of wolverine track density from 1999 through 2002 encompassed the range observed during studies for the Ekati Diamond Mine^{TM}.

A total of 39 species of passerines (small perching birds), shorebirds, gulls, ravens and ptarmigan were observed within the study area from 1999 through 2001. Of these, 23 upland breeding species (passerines, ptarmigan and shorebirds) were identified as breeding within the study area. Average annual density from 1999 through 2001 ranged from 0.3 individuals/0.25 km^2 on control sites for lesser yellowlegs to 40.1 individuals/0.25 km^2 on mine sites for Lapland longspurs. Although estimates of species richness and diversity were highly variable among years, they were similar on control and mine plots each year from 1999 through 2001.

Eight species of raptors (birds of prey) were observed in the regional study area during the 1999 and 2000 baseline surveys, but only two (peregrine falcon and gyrfalcon) were confirmed as breeders. Since 1999, 12 falcon nest sites have been located in the study area. Productivity has ranged from 1.0 – 3.0 chicks per productive nest for Gyrfalcons and 1.5 – 2.5 chicks per productive nest for peregrine falcons from 2000 through 2002. Both the density and productivity of falcon nests in the regional study area are consistent with other Arctic data.

Eighteen lakes in the study area were surveyed for waterfowl in 1999 and 2000. In each case, the entire lake was surveyed and observations were standardized by length of shoreline. Average densities of 2.2 and 2.4 individuals per 1,000 m of shoreline (N = 18 lakes) were recorded in June of 1999 and 2000, respectively. Low primary productivity in lakes and marginal nesting habitat may be associated with low waterfowl density.

Wildlife habitat in the study area primarily consists of heath tundra/boulder habitat interspersed with lakes. Heath tundra/bedrock and heath tundra/boulder associations dominate the southeastern half of the study area while the northwestern half largely consists of heath tundra, heath tundra/boulder, and spruce forest stands. A coniferous forest is located along the east side of Camsell Lake, approximately 5 to 10 km to the west of Snap Lake. Vegetation includes sedges and grasses, and heath mat with low shrubs such as dwarf birch, willow, Labrador tea, crowberry, bog cranberry, and bearberry.

The environmental assessment for the Snap Lake Diamond Project predicted that the loss of any habitat type due to the mine footprint would be less than 1% of the study area. Those predictions indicate that heath/boulder, esker complex, heath tundra, open spruce forest, birch seep, tussock-hummock, sedge wetland, and deep water habitats will be lost. The majority (67%) of the total predicted habitat lost is made up of heath/boulder habitat.

2.2.4 Birds and Habitat

A total of 38 species of passerines (small perching birds), shorebirds, gulls, ravens and ptarmigan were observed within the RSA in 1999 and 2000. Of these, 22 upland breeding species (passerines, ptarmigan and shorebirds) were identified as breeding within the RSA. Average density for 1999 and 2000 ranged from 0.5 individuals/0.25 km^2 for lesser yellowlegs to 39.2 individuals/0.25 km^2 for Lapland longspurs

Eight species of raptors (birds of prey) were observed in the RSA during the 1999 and 2000 surveys, but only two (peregrine falcon and gyrfalcon) were confirmed as breeders. Four peregrine falcon and five gyrfalcon nests were found in the RSA in 1999, compared to five active peregrine falcon nests and one active gyrfalcon nest in 2000. The low density of falcon nests in the regional study area is typical of Arctic tundra ecosystems. Estimates of breeding pairs in the regional study area are consistent with other Arctic data.

Eighteen lakes in the RSA were surveyed for waterfowl. In each case, the entire lake was surveyed and observations were standardized by length of shoreline. Average densities of 2.2 and 2.4 individuals per 1,000 m of shoreline (N = 18 lakes) were recorded in June of 1999 and 2000, respectively. Low primary productivity in lakes and marginal nesting habitat may be associated with low waterfowl density.

2.3 LAND USE

2.3.1 Hunting and Fishing

The RSA is not intensely used for traditional First Nations purposes. Little current fishing activity and no existing traplines were identified, although the area has been used for trapping in the past and people have travelled through the area to hunt wolves. No recent hunting for caribou, permanent or seasonal camps or traditionally significant areas were documented within the RSA.

A no-hunting and no-fishing policy has been and will continue to be enforced for De Beers' employees and contractors at the project. Therefore, the workforce for the project does not represent a land-use factor in terms of resource harvesting.

There are two tourist lodges and one outpost camp in the vicinity of Snap Lake. These facilities are used as bases for sport fishing in summer and big game hunting in the fall.

2.3.2 Protected Areas and Archaeology

The project is situated within the Coppermine River Upland Ecoregion of the Taiga Shield Ecozone. There are no protected areas, national historic sites or heritage rivers within this ecoregion. Some protected areas are proposed (see EA for further detail).

The nearest protected area is the Thelon Wildlife Sanctuary, approximately 250 km to the east. Thelon River has been designated a heritage river. Other environmentally important areas include Wood Buffalo National Park, approximately 350 km to the southwest, and Hidden Lake Natural Environment Park, near Yellowknife. These protected areas are all well beyond the RSA.

A total of 53 archaeological sites were recorded and investigated during the heritage resource investigations for the project. Section 6.2 of the EA describes these sites, their type and topographic associations, actions taken during the study, potential impacts and recommendations.

SECTION 3 • PROJECT DESCRIPTION

3.1 INTRODUCTION

The project is being developed to mine a diamond-bearing kimberlite dyke averaging 2.5 m thick and dipping between 11° and 15° to the northeast under Snap Lake. The dyke has been delineated approximately 2,500 m east/west and 2,000 m north/south.

The kimberlite dyke will be mined by underground mining methods at an average rate of approximately 3,000 t/d. Underground development will be started while the on-site process plant and surface facilities are being constructed. A small amount of the underground mining will be done beneath the northwest peninsula adjacent to the lake, but most of the orebody extends beneath Snap Lake.

Kimberlite extracted from the mine will be processed by means of crushing, washing, screening, conveying, pumping and cycloning. The diamonds and other heavy minerals will be concentrated through a dense medium separation (DMS) circuit based on differences in specific gravity. The DMS concentrate will be passed through X-ray sorters to recover the diamonds.

The tailings from the processing plant (processed kimberlite, or PK) will be partially dewatered to form a fill of a toothpaste-like consistency. Approximately half of the PK will be mixed with cement to produce paste backfill for the mine. The backfill will be pumped from a plant on surface through a pipeline distribution system to underground pour sites to fill the voids left from ore and pillar extraction. The kimberlite pillars may be left in place or recovered by replacing them with high-strength concrete pillars. In this case, concrete will be prepared in a batch plant on surface and trucked underground for placement. The other half of the PK will be pumped via surface pipeline to the surface containment facility (north pile).

Supporting infrastructure on site will include an airstrip, service complex, accommodations complex, diesel generation power plant, diesel fuel storage tanks, water treatment plant and outfall, potable water treatment plant, sewage treatment plant, explosives manufacturing and storage equipment, and general storage facilities. Year-round access to the site is available by aircraft from Yellowknife. Surface access will be possible in winter only by constructing a 35 km extension to site from kilometre 222 of the Tibbitt-to-Contwoyto winter road.

The underground mine will reach its average planned production rate of approximately 3,000 t/d between 9 and 12 months after start-up of the process plant. This production rate will be sustained for most of the estimated 22-year life of the operation, decreasing as the available mining area becomes more limited near the end of operations.

The overall schedule for project development is summarized in the Table 3.1. Where referenced in this document, Year 0 refers to 2007, or the first year of planned operations.

Table 3.1 – Overall Project Schedule

Activity	Time Frame
Permits received	Q1 2004
Set up and commission temporary water treatment plant	Q1 2004
Set up north pile containment	Q3 2004
Begin underground pre-production development	Q3 2004
Begin pre-construction	Q1 2005
Mobilize construction crews, equipment and materials to site	Q1 2006
Set up and commission permanent water treatment plant	Q1 2006
Process plant commissioning	Q4 2007
Construction completed	Q4 2007
Underground mining operation	Q4 2007 – 2029
Processed kimberlite placement – north pile	2007 – 2029
Processing plant – full operation	2008 – 2029
North pile and facilities closure	2030-2031
Water seepage and runoff collection pond closure	2031
Water management pond closure	2031

3.2 UNDERGROUND MINE

The underground mine will include the following major components:

- single access portal, approximately 5 m wide x 5 m high, on the northwest peninsula about 200 m east of the processing plant
- two fresh air intake fans installed on surface, complete with diesel-fired air-heating units, enclosed in steel structures on concrete foundations
- two exhaust raises on the north shore of Snap Lake (approximately 300 m from the plant site), with the exhaust fans installed underground near the bottom of the raises and steel-reinforced concrete collars placed at the surface
- underground primary crushing station, comprising a jaw crusher, apron feeder and associated equipment and structures
- underground incline belt conveyor approximately 1,700 m long, which will convey crushed ore from the underground primary crushing plant to the process plant on surface
- electrical substations, cabling and switchgear
- air, water and paste piping
- sumps and pumping stations
- ventilation ductwork, booster fans and bulkheads
- maintenance shop facility.

3.3 PROCESS FACILITIES

The process facilities will include the following major components:

- enclosed steel building structure on concrete foundations housing the crushing, washing, screening, conveying, pumping, cycloning, DMS and recovery equipment
- pastefill plant within the process plant building
- coarse ore storage and reclaim facility, consisting of a cladded steel A-frame structure, belt conveyors and ore reclaim equipment, all supported on concrete foundations
- existing pilot plant facilities, originally erected in 2000 under the advanced exploration program (AEP).

3.4 SURFACE INFRASTRUCTURE

Surface infrastructure will include the following major components:

- 1,900 m x 45 m airstrip constructed of compacted fill and equipped with navigation and lighting equipment
- site roads, laydown and freight storage areas constructed of compacted fill
- bulk emulsion plant and explosives storage
- aggregate crushing and stockpiling equipment
- service complex/mine dry building: enclosed steel structure on concrete foundations housing offices and administration facilities, repair shops, changerooms, laboratory, first aid facilities and warehouse
- power plant: enclosed steel structure on concrete foundations housing a battery of diesel generators, heat recovery equipment and electrical distribution equipment
- accommodations complex: enclosed steel and wooden structure on piled footings housing dormitory rooms and common facilities such as kitchen and eating areas, food storage and recreation facilities
- diesel fuel storage facility comprising three 12.5 million litre (ML) and eight 330,000 L welded steel tanks, along with associated fuel transfer and dispensing systems
- sewage treatment plant housed within the water treatment plant building
- oil-fired incinerators
- potable water treatment plant housed within the water treatment plant building
- glycol boilers, housed within the water treatment plant building, and associated glycol distribution equipment and piping
- surface mobile equipment.

3.5 MINE WASTE AND PK CONTAINMENT (NORTH PILE)

Approximately 1.8 million tonnes (Mt) of waste rock and 23 Mt of PK will be produced over the mine life. This includes dilution, estimated at approximately 32% of the total ore tonnage. Mine waste rock and approximately half of the processed kimberlite will be disposed of within the north pile facility. The other half of the total PK will be used for underground paste backfill.

The north pile will be developed over the mine life; its development sequence is summarized in Table 3.2 and in EA Figures III.1-1 through III.1-7, contained in Appendix A. The pile will consist of three cells, as described below.

Starter Cell

A starter containment cell will be developed in the southeast part of the north pile, approximately 500 m from Snap Lake, with the capacity to store approximately two years' production of PK. Part of the storage capacity will be provided by quarrying and removing granite rock for general site construction use. The embankment around the perimeter of the starter cell will be constructed primarily from predevelopment mine rock and materials. Soils obtained locally from site grading cuts for ditches, the base of the perimeter shell and quarry stripping will be placed along the inside of the rockfill embankments to serve as a filter zone. Localized deposits of organic soils, if found, will be excavated and stockpiled for future reclamation uses.

East Cell

Construction of the embankment, or shell, along the ultimate outside toe of the facility will begin during the first summer of full-scale mining and production. This embankment will be constructed of combined coarse and grits PK, which will be trucked, spread and compacted using conventional equipment. The rest of the PK will be discharged by pipe into the starter cell. The east cell will be used for PK containment between approximately Years 3 and 12, after the starter cell is filled. Quarrying for rockfill for site-wide construction will deepen part of the interior of the east cell.

An external system of interception drainage ditches, sumps and ponds will be constructed along the perimeter of the east cell as it expands progressively to the west.

West Cell

Between Years 6 and 10, as the east cell is being filled, a quarry will be developed in the area immediately to the west. Material from the quarry will be used to progressively cap the east cell as areas become completed. In about Year 10, work will commence to form the first stage of a perimeter containment embankment for the west cell, which will be used for PK containment between Years 13 and 22. Similar to the east cell, the system of perimeter drainage collection will be extended around the west cell.

The PK will be conveyed by pipeline around the perimeter of the pile and along temporary embankments within the three cells for discharge through lateral pipes into multiple locations. In winter the slope of the tailings may become quite steep, of the order of about 15°. The quantity deposited from each spigot point will be maximized by using temporary spigot towers to achieve the highest slopes and volumes.

In addition to PK and waste rock, the north pile facility will incorporate a landfill for inert solid waste and a land farm for the bioremediation of hydrocarbon-contaminated soils.

Table 3.2 – North Pile Development Schedule

Year End	Approximate Quantity PK Stored (m^3)	Description of Activities
0	0	Starter cell containment shell and interception ditches complete. Quarry development in starter cell and east cell for airstrip and plant site construction.
Start of Production	600,000	Place PK materials in starter cell. Commence construction of north containment shell and interception ditches for east cell. Raise south containment shell for starter cell. Discharge contact water from starter cell sedimentation pond to temporary collection pond.
2	1,000,000	Complete placement of PK materials in starter cell. Commence placement of PK in east cell. Progressively raise east cell containment shell.
6	2,700,000	PK placement in east cell approximately 50% complete. Continue to progressively raise east cell containment shell. Commence quarry development in west cell. Commence surface reclamation of completed portion of east cell using quarried rockfill from west cell.
10	4,400,000	PK placement in east cell approximately 90% complete. Commence construction of containment shells and interception ditches for west cell.
12	4,900,000	PK placement and surface reclamation in east cell complete. Initial containment shells for west cell complete. Commence PK placement in west cell.
17	7,100,000	PK placement in west cell approximately 50% complete. Commence surface reclamation of completed portion of west cell using quarried rockfill from outside west cell, or previously stockpiled from in-pile quarries.
22	8,800,000	PK placement and surface reclamation in east cell complete.

3.6 WATER MANAGEMENT FACILITIES

The site water management and treatment facilities will include the following major components:

- a system of perimeter ditches, sumps and collection ponds to collect and direct water to the water treatment plant and to provide surge capacity for north pile runoff during events such as spring freshets and heavy rainfall events
- water management pond (WMP) to provide additional surge capacity for events such as spring freshets, heavy rainfall events and temporary storage capacity for water treatment plant failure or higher-than-predicted mine water inflows (note: the existing processed kimberlite containment (PKC) constructed in the AEP will be re-named WMP upon construction of the project)
- water treatment plant, comprising a thickener, multi-media pressure filter units, reagent addition systems and associated tanks, pumps, piping, controls and electrical equipment, all enclosed in a steel structure on concrete foundations
- insulated, heat-traced HDPE pipeline on surface and underwater diffuser to discharge treated effluent from the water treatment plant into Snap Lake
- fresh water intake, comprising a rockfill embankment constructed near shore at a water depth of about 7 m, projecting approximately 20 m out into Snap Lake. The embankment will surround a vertical filtration well consisting of three 1.0 m diameter x 7.0 m long perforated steel pipe wells. Pumps will be enclosed in a fabricated steel pumphouse.

SECTION 4 • INTERIM RECLAMATION MEASURES

Interim reclamation planning has been developed for two scenarios: (1) temporary shutdown, and (2) indefinite shutdown. Both scenarios are based on the full intention of resuming operations once the source or reason for the shutdown has been removed.

4.1 TEMPORARY SHUTDOWN

For the purposes of reclamation planning, a temporary shutdown is defined as a cessation of mining and processing operations for a finite period, generally three to twelve months, with the intention of resuming operations as soon as possible after the reason for the shutdown has been resolved. Possible causes for such a shutdown could be a major mechanical equipment failure, late delivery of critical equipment or supplies, or labour conflict.

4.1.1 Underground Mine

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

- All mobile equipment will be removed to surface and prepared for on-site storage. Some small service equipment will be maintained in full operating condition for use during underground inspection tours.
- Fuel, lubricants and hydraulic fluids will be removed from all underground locations, including storage areas and maintenance shops, and stored on surface.
- Explosives and accessories will be removed from the short-term underground storage magazines to the surface magazines. The manufacture of explosives in the surface plant will cease. The plant, to be owned and operated by a contractor, will be placed on a care-and-maintenance basis.
- Airflow through the mine ventilation system will be reduced. The two underground exhaust fans will be turned off. One of the two intake fans on surface will continue to operate, in conjunction with the underground ventilation controls (doors and seals), to ensure air flow through areas requiring ventilation, including sump and dewatering pump stations; the air will be heated during the winter months. The ventilating air will be exhausted through one or both of the exhaust raises. All primary fans will be operated periodically to ensure lubrication and integrity of the rotating parts. Secondary ventilation fans will be removed to centralized storage areas underground.
- The underground electric power distribution system will be maintained. Low levels of heating will be provided to the mine power substations, secondary fan storage areas, maintenance shops, primary exhaust fan locations and main dewatering pump stations.
- Pastefill distribution pipelines will be flushed, cleaned and drained.

- The full dewatering pumping capability will be maintained.
- The operation of the primary fans, dewatering pumps and drainage sumps will be monitored continuously from the surface control room.
- The primary crusher and the conveyor system to surface will be operated periodically to ensure lubrication and integrity of the rotating parts.
- The underground facilities will be inspected daily as required to check for rockfalls, changes in groundwater inflows and overall integrity.

4.1.2 Process Facilities

Any remaining kimberlite stockpiled on surface will be processed before operations are halted. The plant will then be shut down in a planned and orderly sequence to prevent damage to equipment, piping and instrumentation. The following preparatory measures will be taken:

- The plant will be purged of all diamondiferous materials.
- All diamonds will be removed from the site.
- All solids will be purged from the thickeners.
- All slurry lines will be flushed of solids.

Procedures during the shutdown will be as follows:

- Minimal heating to the process building will be maintained to prevent equipment freezing.
- Power supply to the building will be maintained.
- Process air supply to the process plant will be maintained.
- All major equipment will be run periodically to ensure lubrication and integrity of the rotating parts. For example, conveyors would be run for one hour every other day and slurry pumps operated with water for 30 minutes once per week.
- Ferrosilicon (FeSi) will be recirculated once per day to prevent setting up in the circulating medium tanks.

4.1.3 Surface Infrastructure

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

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

- All non-critical equipment requiring power and/or heating will be shut down.
- All necessary support facilities and services for care-and-maintenance personnel will remain in operation. This will include the freshwater intake, potable water treatment plant, sewage treatment plant, power plant, waste heat recovery and glycol heating system, diesel fuel storage and distribution, and some areas of the accommodations complex (one dormitory wing, kitchen, eating area) and the service complex (shops and warehouse). Some equipment within these facilities may be adjusted or modified to operate at lower capacity and consume less power. All major equipment will be run periodically to maintain operability.
- Wings, common areas and offices in the accommodations and service complexes, except those required by care-and-maintenance personnel, will be closed off so that heating and ventilation can be reduced to minimum levels.
- Any hazardous materials stored within site facilities will be collected and stored in the service complex warehouse.
- Most surface mobile equipment will be relocated to a secured, common parking area and inspected for any potential oil or other fluid leaks. Emergency response vehicles will be kept in the service complex truck bays, available for use as required.
- The power plant will be configured to operate at maximum efficiency under the reduced loading condition. This will involve operating the diesel generators in various combinations to ensure operation at a minimum of 80% of rated output.

4.1.4 Mine Waste and PK Containment (North Pile)

Procedures during temporary shutdown will be as follows:

- PK deposition piping will be purged, flushed and drained.
- The water collection system and dust control operations will be maintained.
- Earthmoving equipment will be removed from the facility and parked in the secured plant area.

4.1.5 Water Management Facilities

Procedures during temporary shutdown will be as follows:

- Collection sumps and ditches around the site will be maintained to manage runoff from the north pile and general site.
- The WMP will be maintained to provide surge capacity in the event of heavy precipitation or failure of the water treatment plant.

- The water treatment plant will remain in operation to treat water pumped from the mine and from surface collection ponds.

4.2 INDEFINITE SHUTDOWN

For the purposes of reclamation planning, an indefinite shutdown is defined as a cessation of mining and processing operations for an indefinite period with the intention of resuming operations in the future. In this scenario, the site must be placed into a mode of minimal operating expense while maintaining safety and environmental stability. Possible causes for such a shutdown could be prolonged adverse economic conditions or extended labour disputes.

4.2.1 Underground Mine

Procedures during indefinite shutdown will be as follows:

- Mobile and some semi-mobile and fixed equipment will be removed from underground and stored on surface. This will include all mobile equipment; electric motors from the primary ventilation exhaust fans, crusher and conveyor; secondary ventilation fans; portable dewatering pumps; and electrical substations. All other non-degradable and non-hazardous materials will be left underground.
- All fuel, lubricants, hydraulic fluids, hazardous materials and degradable material will be removed from the underground maintenance shop and secondary storage areas to surface, where they will be placed in appropriate containers and stored in the shops and warehouse.
- Fixed dewatering installations, including pumps, power cables and pipelines, will be left in place. The power to the pumps will be switched off on surface and the mine allowed to flood. The water level will subsequently rise to about the level of Snap Lake, or some 10 m to 15 m below the ground surface elevation at the portals and raise collars. There will be no natural subterranean airflow between these surface openings.
- The explosives plant will be shut down and the explosives magazines emptied. All explosives supplies and accessories will be moved off-site.
- The two portals and the surface collars of the three raises will be barricaded with secured steel structures, and warning signs will be posted.

4.2.2 Process Facilities

The same measures taken for temporary shutdown of the plant (Section 4.1.2) will be taken for indefinite closure, with the following additional activities:

- Equipment and gearboxes will be drained of lubricants, which will be stored in sealed drums in the shops and warehouse.

- Tanks will be drained.
- Remaining FeSi will be pumped to the north pile.
- All water, glycol and slurry lines will be flushed and drained. Glycol will be stored in sealed drums.
- Sensitive electronic devices such as instrumentation control cards, PLCs and control system computers will be removed from the site or stored in a heated, access-controlled location on site.
- Reagents will be removed from the site.
- Heavy rotating equipment such as HPRC rolls and scrubber shells will be lifted off bearings and safely supported.
- The entire process plant will be locked and all heating and power supply turned off. No site staff will be required during this period.

4.2.3 Surface Infrastructure

As in the case of a temporary shutdown, the site infrastructure will be placed into a care-and-maintenance mode of operation. The same measures taken for temporary shutdown (Section 4.1.3) will be taken for indefinite closure.

4.2.4 Mine Waste and PK Containment (North Pile)

Procedures during indefinite shutdown will be as follows:

- PK deposition piping will be purged, flushed and drained.
- The water collection system and dust control operations will be maintained.
- Pile deposition slopes will be regraded to provide good stability and drainage conditions. A temporary, 0.5 m (nominal) thick cover of non-PAG rock will be placed on the pile.
- Earthmoving equipment will be removed from the north pile facility and parked in the secured plant area.
- Pile containment structures, drainage ditching and distribution system will be maintained.

4.2.5 Water Management Facilities

During an indefinite shutdown, runoff water from the site and the north pile will report to the WMP. When the pond nears its maximum operating level, water will be pumped to the water treatment plant, which will be operated temporarily for this emergency service. The treated water will then be discharged to Snap Lake.

SECTION 5 • PROGRESSIVE AND FINAL RECLAMATION MEASURES

5.1 PROGRESSIVE RECLAMATION MEASURES

5.1.1 Construction Phase

All borrow pits, quarries, equipment and storage areas utilized during construction but not required during mine operations will be closed out and reclaimed at the end of the construction phase of the project.

5.1.2 Operations Phase

The only facilities that will be subject to physical change once operations commence are the underground mine and the north pile. The mine development will proceed according to the mine plan design, with no planned progressive reclamation during the mine life. However, the north pile, as described in Section 3, will be constructed in three stages – the starter cell, east cell and west cell – allowing progressive reclamation and closure as each cell reaches the design capacity.

The deposited PK materials in the north pile could be susceptible to wind and water erosion. Therefore, each area being reclaimed will be covered with a capping layer, at least 0.5 m thick, of minus 250 mm granitic, non-acid generating rock. The capping layer will be placed and graded as part of regular operations using bulldozers, front-end loaders and haul trucks. The final surface will be graded to produce localized mounds consistent with the surrounding topography and will incorporate surface drainage paths.

Reclamation of the north pile is discussed in more detail in Section 5.2.5.

5.1.3 Closure and Reclamation Phase

Relatively little construction work will be required to complete the closure and reclamation of the north pile and the surface water management facilities. Most work will be associated with the removal of infrastructure and associated facilities such as roads and storage areas. This phase will also involve decommissioning of the seepage and runoff collection ponds, the water treatment plant, and the WMP. During closure and reclamation activities, control of surface water drainage will likely be required to prevent suspended solids from entering nearby watercourses; temporary sedimentation ponds will be constructed as required.

5.2 FINAL RECLAMATION MEASURES

Final closure and reclamation will generally commence with the mobilization of contractor forces and equipment on the next available winter road following permanent shutdown of site operations. A detailed implementation plan, including schedule and costs, is provided in Section 8.

5.2.1 General

Inert Solid Materials

An estimated 80,000 m^3 of non-salvageable and non-hazardous components, structures and equipment (i.e. inert solids) will be dismantled, washed (if necessary) and buried in the north pile. These materials will be placed in a depression within the north pile west cell, and covered with a layer of non-PAG granitic rock. This is further described in Section 5.2.5.

Materials destined for burial in the north pile will be dismantled as safely and efficiently as possible and stacked in a stockpile within the plant site area. The materials will then be cut by flame or saw into manageable sizes for safe transport and placement in the north pile. A temporary sprung-type structure will be erected to cover this area to permit work in inclement weather.

Prior to commencing closure and reclamation activities, it will be necessary to obtain appropriate authorization for a non-hazardous waste disposal site through the regulatory agencies dealing with land leases and water use (MVLWB, DIAND).

Hazardous and Salvageable Materials

Structures, equipment and materials deemed salvageable or potentially hazardous will be dismantled and demobilized from site. Equipment will be cleaned, drained and degreased as required before disposal or off-site transport. Prior to demolition of any equipment or facility, any hazardous materials stored within them will be removed and prepared for off-site shipment.

Salvageable equipment is generally expected to include most machinery and mobile equipment in working or repairable condition. Hazardous materials are generally expected to comprise waste oil, glycol, lubricants, solvents, paint, batteries and other miscellaneous chemicals. Some of these materials may be suitable for recycling if appropriate facilities are available within reasonable proximity (e.g. Alberta) at the time of mine closure and if recycling can be done at a reasonable cost.

Salvageable equipment and hazardous materials to be shipped off-site will be prepared and stored in the lined waste transfer area, located in one of the laydown areas. Hazardous materials will be stored in sealed containers and drums, and housed in a temporary enclosure. During the next available winter road period, they will be loaded on trucks and transported to appropriate disposal, recycling or salvage facilities, most likely in Edmonton. Most salvageable equipment would be transported to auctioneers or used equipment dealers. For most hazardous materials, companies specializing in the handling and disposal or recycling of hazardous waste materials will retrieve the materials from site with their trucks and transport them to their respective facilities.

5.2.2 Underground Mine

All major structures, and fixed and mobile equipment will be removed from underground and stored on surface for cleaning, where necessary, and subsequent burial in the north pile or off-site shipment. Any equipment or materials potentially contaminated with hydrocarbons or other hazardous materials will be removed from underground and prepared for off-site shipment. All fuel, lubricants, hydraulic fluids, hazardous materials and degradable material will be removed from the underground maintenance shop and secondary storage areas to surface, where they will be stored in appropriate containers and prepared for off-site shipment.

The surface explosives plant will be shut down and the explosives magazines emptied; all explosives supplies and accessories will be moved off-site.

The only items that will be left underground will typically be non-degradable, constructed of steel or concrete, or associated with utility lines, as follows:

- floors and walls of material storage areas and refuge stations
- concrete foundations
- power and communication cables
- water, air and paste pipelines and supports
- ventilation ducting and supports
- ore pass and dump grizzlies, chutework and associated support steel
- rock support structures
- bulkheads
- vent and egress raise ladders

The mine raises and portals that surface on the northwest peninsula, north of Snap Lake, will be closed off and sealed permanently. The collars for the two ventilation raises and the emergency egress raise will be capped with reinforced concrete and low-profile warning signs installed at each location. The intake fans and mine air heating equipment at the ventilation raises will be removed, dismantled and buried in the north pile or shipped off-site. The two surface portals (one for the access ramp and one for the crushed ore conveyor) will be dismantled and sealed with reinforced concrete walls. Surface cuts at the portals will be backfilled to the general ground contour with surface-quarried waste rock.

5.2.3 Process Facilities

Before dismantling, the building structures for the coarse ore storage facility, process plant, paste backfill plant and bulk sample plant will be washed thoroughly with high-pressure water hoses, and all hazardous materials such as hydrocarbons, chemicals and reagents will be removed. In addition, all utilities and services, including air, glycol, power and water, will be shut off to permit demolition to proceed safely and without compromising services to other areas in use.

Dismantling and reclamation of the process plant facilities will generally follow the measures described in Section 5.2.1 above.

5.2.4 Surface Infrastructure

General

Specific materials will be dealt with as follows:

- Concrete foundations and floor slabs will be broken down to nominally 1 m below original grade level and demolition rubble buried in the north pile.
- With the exception of fuel and glycol piping, all buried piping will be removed to just below grade and ends will be capped. Buried fuel and glycol lines will be flushed with water, removed and buried in the north pile. Surface piping will be flushed, if necessary, removed and buried in the north pile.
- Buried electrical cables will be cut approximately 1 m below grade at surface terminations and left intact. The remaining cable will be removed and buried in the north pile.
- All other inert materials not suitable for reuse or salvage, such as metal cladding, wallboard, insulation and other inert clean materials, will be buried in the north pile.

The potential for ground contamination at facility sites will be assessed. This will include the airstrip de-icing area and fuel storage pad, fuel tanks, process 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 stored in appropriate sealed containers for off-site shipment and disposal.

Roads and Airstrip

All site roads not required for post-closure maintenance and monitoring will be decommissioned and reclaimed at the end of the closure and reclamation period. The rest will be reclaimed at the conclusion of the post-closure monitoring program. Most access in the post-closure period will be by aircraft, with minimal travel across the site roads.

The airstrip will be reclaimed near the end of the reclamation program. Lighting, navigation equipment and culverts will be removed to eliminate potential hazards to wildlife. Reclamation will involve scarifying and loosening the top surface to facilitate natural revegetation. Where erosion or sedimentation is a concern, the surface will be recontoured. Culverts and other stream-crossing structures will be removed to permit natural drainage to become re-established.

Quarries

Reclamation of quarries will involve the removal of all mobile and stationary equipment followed by slope stabilization and contouring as required. On-site stockpiles of rock and esker material will be depleted during the last years of operation. Remaining material will be spread and contoured to blend with the surrounding landscape.

The north pile will be developed on top of the three granite quarries at different times during operations. The quarries will therefore be progressively reclaimed at different times as part of the overall north pile reclamation plan. The first two quarries will be used primarily during the construction phase and will be filled early in the operations phase. The last quarry will be filled at the end of operations as the north pile is completed.

Fuel Storage Tanks

Any remaining diesel fuel inventory at site will be assessed against predicted requirements for temporary power generation and construction equipment during the reclamation program. In the event of a shortfall, an additional supply will be delivered to site and stored in the eight 330,000 L tanks. Portable, double-walled “envirotanks” will also be mobilized to site to store any fuel remaining in the permanent tanks at the end of the reclamation program.

During the reclamation period, fuel requirements will initially be met from the remaining inventory in the main 12.5 ML storage tanks; these tanks will then be dismantled. Steel plate sections and distribution system components will be washed and buried in the north pile. The containment berm and liner materials will be removed and the area regraded. Liner materials will be cut into smaller strips and buried in the north pile. Fuel will be then drawn from the 330,000 L tanks for the balance of the first year of the reclamation program. Once these smaller tanks and storage facilities have been decommissioned, as described above, any additional fuel requirement for demobilization activities and post-closure monitoring will be drawn from the envirotanks.

Power Plant

The main power plant will remain in use during the reclamation period as long as the power demand for mine water pumping, water treatment, lighting and heating is great enough for efficient operation of one or more of the main generators. This period of extended use will end, however, when the power plant must be decommissioned to maintain the overall reclamation program schedule. At this time, the power plant will be shut down, decommissioned and dismantled using the general measures described in Section 5.2.1.

A small, skid-mounted diesel generator set will remain on site to provide power for accommodations, site services and water treatment during the second year of reclamation, after the main power plant has been shut down. The diesel genset will be demobilized the following year.

Accommodations Complex

The permanent facility will be used as long as enough personnel are on site to ensure efficient operation, but no longer than required to maintain the overall reclamation program schedule. Construction crews will then relocate to a temporary camp mobilized to site earlier over the winter road. The permanent facility will be decommissioned and dismantled using the general measures described in Section 5.2.1. The temporary camp will be removed from site via the winter road on completion of the reclamation program.

Site Support Facilities

Potable water treatment, sewage treatment and communications systems will be maintained to support construction personnel throughout the reclamation program. These systems will then be decommissioned, dismantled, disposed of and replaced with smaller, temporary facilities to support post-closure monitoring activities.

Solid Waste Management Facilities

The incinerators, waste-handling equipment and associated structures will be dismantled and all salvageable materials demobilized from site. Non-salvageable materials will be buried in the north pile. Above-grade concrete foundations will be removed and the demolition rubble buried in the north pile.

The potential for contamination of the ground in the immediate area of the incinerator and waste handling facilities will be assessed. Any required remediation will be carried out, and a cover of clean granular material or crushed non-PAG rock will then be placed over the site. The area will be regraded to blend with the surrounding topography.

Solid wastes disposed of in the landfill at the north pile will be covered regularly with PK during operations. On closure, a thick layer of PK will be placed over all remaining waste materials, followed by a 0.5 m thick cap of non-PAG rock to minimize the potential for PK erosion.

Any contaminated materials stored in the land farm will be subjected to biological treatment. When treatment results in levels meeting approved limits, materials will be covered with PK. A final 0.5 m thick cap of non-PAG granite will be placed on top to minimize the potential for weathering and erosion of the PK.

5.2.5 Mine Waste and PK Containment (North Pile)

Issues to be considered for final closure of the north pile are discussed below.

Berm Stability

The overall stability of the berm must be maintained under a range of climatic conditions, including freeze-thaw cycles. Because the shell will be constructed of coarse-grained, free-draining materials, problems associated with freeze-thaw loss of strength in fine-grained materials are not expected to affect the stability of the north pile. In addition, the selected 3H:1V design slopes of the pile do not rely on frozen conditions for strength or stability and should be stable in the long term regardless of ground temperature. Earthworks such as regrading are not required to ensure stability after closure.

Erosion of PK Material

Design measures will ensure minimal removal and transportation of PK particles under the action of wind or water. Both wind and water erosion will be controlled by placing a 250 mm layer of quarried non-PAG granite rock over the PK surface; the required gradation of the cover will be assessed during detailed design. Once a stable surface has developed, the suspended solids content of runoff is expected to reduce significantly. The runoff will continue to be directed towards the existing small lakes that form part of the water management system, where remaining suspended solids will settle out before the water reaches Snap Lake. After acceptable water quality is confirmed, the outlets of the lakes will be restored to their pre-construction conditions, so that water can discharge to Snap Lake along the previous natural drainage paths.

Drainage of Surface Water

Initial closure works will direct surface waters towards the existing water management system. After closure, surface runoff will be directed to collection areas outside the PK footprint, preventing runoff from pooling on top of the pile. Depending on pile development at the time of closure, partial or complete removal of some external berms may be necessary to permit drainage and minimize pumping requirements. The materials removed would be incorporated into the north pile. Once water quality is deemed acceptable for discharge to Snap Lake, the pre-development drainage patterns would be re-established.

Encapsulation of PAG Mine Rock

The potential for generation of acid rock drainage will be minimized by burying all PAG materials. It is possible that parts of the north and central starter cell berms will contain PAG rock, but these materials will be buried by PK beyond about Year 3 of operations. If the north pile must be closed within this time period, the external berms constructed ahead of PK deposition will be excavated and placed over the PAG materials, and the PK will be regraded to provide additional cover thickness. Depending on the extent of PAG material exposed, it may be necessary to move some of the PAG to low points such as the quarries for burial. Granite capping material will then be placed as required.

Visual Impact of Post-Closure Topography

The north pile will not exceed the height of the surrounding land and will be shaped and contoured to blend with the surrounding landforms. The final surface of PK will be regraded to produce localized mounds consistent with the surrounding topography.

Final Reclamation of North Pile

The north pile will be progressively reclaimed over the life of the mine, such that minimal reclamation will be required during the final years of operation and post closure. A cover of non-PAG granite rock obtained from quarries developed within the footprint of the north pile will be placed progressively over the deposited PK over the life of the mine operation. Placement of this cover rock may result in some surface settlement. The top of the pile will therefore be graded and contoured as required during operations to prevent water from ponding on the surface.

As part of closure activities, the PK paste distribution system, including all piping, will be removed. Once the quality of surface runoff and seepage from the facility reaches acceptable discharge standards, the sump pumps, associated piping and infrastructure will be removed from the perimeter of the pile. Salvageable materials will be demobilized from the site and non-salvageable materials buried in the north pile.

The final surface will be graded to produce localized mounds consistent with the surrounding topography and to ensure that precipitation runoff water drains freely off the pile. A stockpile of non-PAG granite will be provided for contouring and other maintenance purposes during the closure period. Any material not required for maintenance will be contoured into the surrounding topography at the end of the closure phase.

Activities and quantities associated with progressive and final reclamation of the north pile are summarized in Table 5.1. Figures 5.1 through 5.8 show the reclamation requirements for selected years of operation (including year 22).

Burial of Inert Solids in the North Pile

Upon mine closure, dismantled, inert solids will be placed on the north pile, buried with PK and capped with a layer of non-PAG granitic rock, of sufficient thickness to prevent erosion of PK and to hold the underlying material in inert form. .

Should the mine be closed prematurely, the waste materials would then be deposited and buried with PK and non-PAG rock cap in an available area of the north pile. Depending on the year of premature closure, it may be necessary to quarry additional non-PAG rock for capping.

Burial of inert materials may alter the thermal regime of the north pile only in the immediate area of the buried material; this is not expected to adversely affect thermal or structural stability of the pile. Given that the buried materials will be inert, the seepage water quality in the area of buried materials should be similar to that of the rest of the north pile.

5.2.6 Water Management Facilities

Sedimentation Ponds, Sumps and Ditches

Once the north pile has been successfully reclaimed and runoff water quality has reached acceptable discharge standards, ditches, sumps and sedimentation ponds no longer required will be decommissioned and reclaimed. This will involve the removal of all liner materials and recontouring of the underlying base and berm materials. Liner materials will be cut into smaller strip and buried in the north pile or removed from site. A cover non-PAG rock will be placed over the bottom of the ponds to prevent erosion of any deposited sediment. Recontouring will be done to re-establish natural drainage patterns and minimize the potential for erosion.

Water Management Pond (WMP)

The WMP will be drained and a layer of non-PAG rock placed over the bottom to prevent erosion of any fine sediment accumulated during operations. The pond will then be allowed to refill. After the water quality in the WMP has been shown to meet discharge criteria, the two dams will be breached. Liner materials from the upstream face of each structure will be removed, cut into smaller strips and buried in the north pile or removed from site. Dam fill materials will be recontoured to blend with the natural topography and minimize the potential for erosion. The edges of the pond will be contoured to provide for the re-establishment of riparian vegetation.

Water Supply and Distribution

The fresh water intake wells, piping and pumphouse will be removed, and the embankment left in place and contoured to maximize shoreline habitat. Water discharge facilities will also be removed. It is anticipated that all pumping equipment, including piping, control systems and wiring, will be salvaged. Emergency power supplies associated with heat-tracing equipment will also be salvaged.

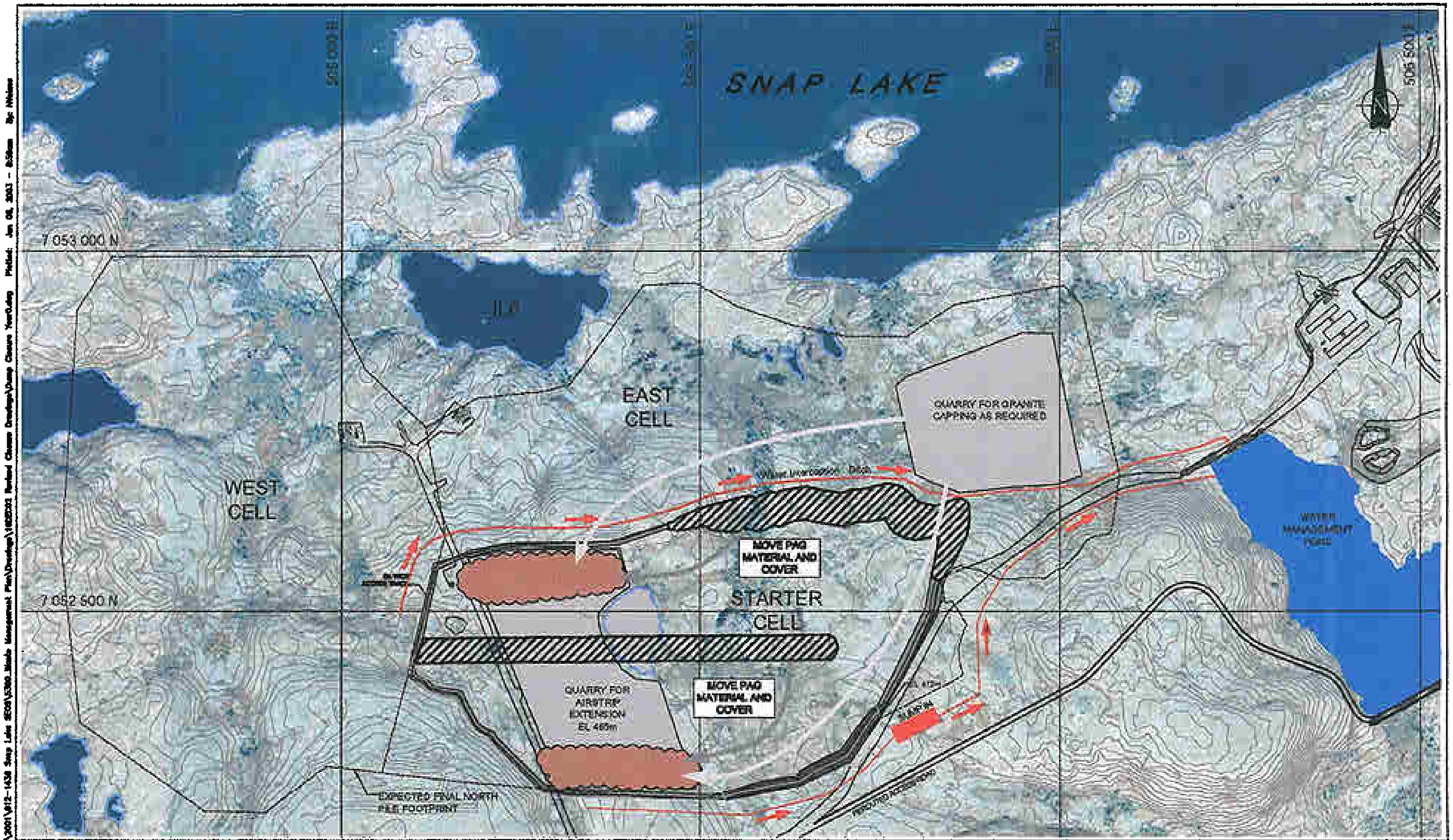
Table 5.1 – Annual Progressive and Final Reclamation Requirements and Quantities for North Pile

Table 5.1 - Annual Progressive and Final Reclamation Requirements and Quantities for North Pile

Year	Activities Required for Final Reclamation In Year Shown	Cumulative Volume of PK Stored	Cumulative Area Developed	Current Active Area	Area Capped In Each Year	Cumulative Area Capped	Area to be Capped at Closure	Volume of Capping Required at Closure	Volume of External Berm Constructed In Each Year	Volume of Berm to be Incorporated Into North Pile	Quantity of Pipe to be Removedat Closure
		(m^3)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^3)	(m^3)	(m^3)	(m)
1	Remove berms near Sump #1 and place over PAG rock. Remove PK distribution pipes. Regrade PK and construct new spillway Place capping over exposed PK. Relocate Sump #1 & #2 pumps to quarry	600,000	247,000	211,000	0	0	211,000	243,000	42,000	42,000	4,000
2	Remove berms near Sump #1 and place over PAG rock. Remove PK distribution pipes. Regrade PK and construct new spillway Place capping over exposed PK. Relocate Sump #1 & #2 pumps to quarry	1,000,000	247,000	130,000	117,000	117,000	13,000	15,000	40,000	82,000	4,000
3	Remove berms near Sump #1 and place over PAG rock. Remove PK distribution pipes. Place capping over exposed PK.	1,400,000	519,000	389,000	130,000	247,000	142,000	164,000	0	82,000	4,000
4	Remove berms near Sump #1. Remove PK distribution pipes. Place capping over exposed PK.	1,800,000	519,000	519,000	0	247,000	272,000	313,000	0	82,000	2,000
5	Remove berms near Sump #1. Remove PK distribution pipes. Place capping over exposed PK.	2,200,000	519,000	519,000	0	247,000	272,000	313,000	0	82,000	2,000
6	Remove berms near Sump #1. Remove PK distribution pipes. Regrade PK Place capping over exposed PK.	2,700,000	519,000	519,000	0	247,000	272,000	313,000	0	40,000	2,000
7	Remove PK distribution pipes. Regrade PK Place capping over exposed PK.	3,125,000	519,000	471,000	48,000	295,000	176,000	202,000	0	40,000	3,000
8	Remove PK distribution pipes. Regrade PK Place capping over exposed PK.	3,550,000	519,000	471,000	48,000	343,000	128,000	147,000	0	0	3,000
9	Remove PK distribution pipes. Regrade PK Place capping over exposed PK.	3,975,000	519,000	471,000	48,000	391,000	80,000	91,000	0	0	3,000
10	Remove Sump #3 Remove portions of berms from West Cell to allow drainage to WCP #1. Remove PK distribution pipes. Regrade PK Place capping over exposed PK.	4,400,000	519,000	471,000	48,000	439,000	31,000	36,000	32,000	32,000	3,000
11	Remove PK distribution pipes. Remove portions of berms from West Cell to allow drainage to WCP #1. Regrade PK Place capping over exposed PK.	4,650,000	867,000	516,000	40,000	479,000	37,000	43,000	18,000	51,000	5,000
12	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	4,900,000	867,000	562,000	40,000	519,000	43,000	50,000	18,000	69,000	5,000
13	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	5,340,000	867,000	867,000	0	519,000	348,000	400,000	0	55,000	5,000
14	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	5,780,000	867,000	867,000	0	519,000	348,000	400,000	0	41,000	5,000
15	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	6,220,000	867,000	867,000	0	519,000	348,000	400,000	0	28,000	5,000
16	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	6,660,000	867,000	867,000	0	519,000	348,000	400,000	0	14,000	5,000
17	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	7,100,000	867,000	867,000	54,000	573,000	294,000	338,000	0	0	5,000
18	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	7,440,000	867,000	867,000	49,000	622,000	245,000	282,000	0	0	5,000
19	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	7,780,000	867,000	867,000	49,000	671,000	196,000	225,000	0	0	5,000
20	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	8,120,000	867,000	867,000	49,000	720,000	147,000	169,000	0	0	5,000
21	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	8,460,000	867,000	867,000	49,000	769,000	98,000	113,000	0	0	5,000
22	Remove PK distribution pipes. External berms to be removed Regrade PK Place capping over exposed PK.	8,800,000	867,000	867,000	49,000	818,000	49,000	56,000	0	0	5,000

Notes:
Area Developed : Total Area within containment berms. May include area not covered or impacted by PK.
Active Area : Area covered or impacted by PK.
Area Capped : Area capped within each year.
Cumulative Area Capped : Total area of capping placed to the end of the year shown.
Area to be Capped at Closure : Difference between Active Area and the Cumulative Area Capped
Volume of Capping Required : Neat volume assuming 1 m thickness of capping, based on plan area to be capped; includes 15% additional volume for undulations and sloping capping surfaces.
Volume of External Berm Constructed : Annual quantity of berms that have been constructed in advance of PK deposition, and not required to contain the PK .
Volume of Berm to be Incorporated into North Pile : Cumulative volume of the above.
Quantity of Pipe to be Removed : Excludes lengths of pipe between Plant and North Pile.

Figure 5.1 – North Pile Closure Plan – Year 0



LEGEND:

- PK DISTRIBUTION LINE TO BE REMOVED
- CONTACT WATER INTERCEPTION DITCH
- PUMPED FLOW
- NON-CONTACT WATER DIVERSION
- ▨ BERM TO BE REMOVED / REGRADED
- 🟥 PAG STOCKPILE TO BE BURIED
- ▩ QUARRY

0 50 100 150 200 250
Scale in Meters

Golder Associates

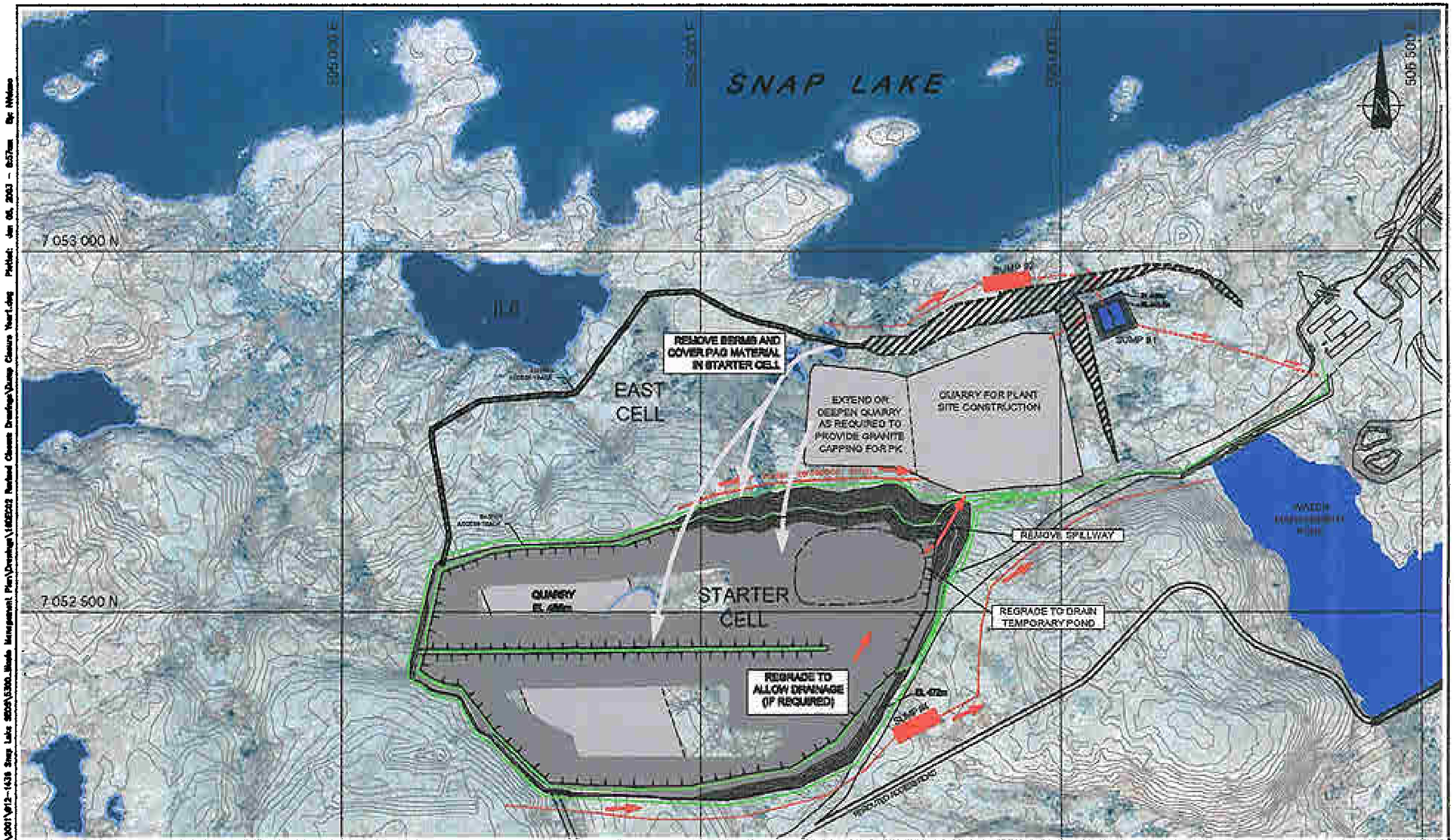
SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 6

Drawn: NV	App'd: AH	Date: Jan 08, 03	Figure: 5-1

Project No.: 012-1436
Revision No.:

Drawing: Q:\Active\1400\2001\012-1436 Snap Lake 9200\5200_Waste Management Plan\Drawings\1\02202 Revised Closure Drawings\Dump Closure Year6.dwg Plotted: Jan 08, 2003 - 8:56am By: Nkleine

Figure 5.2 – North Pile Closure Plan – Year 1



LEGEND:

- PK DISTRIBUTION LINE TO BE REMOVED
- CONTACT WATER INTERCEPTION DITCH
- PUMPED TO SUMP #1
- NON-CONTACT WATER DIVERSION

▨ BERM TO BE REMOVED / REGRADED

■ AREA OF PK REQUIRING CAPPING

▩ QUARRY

Golder Associates

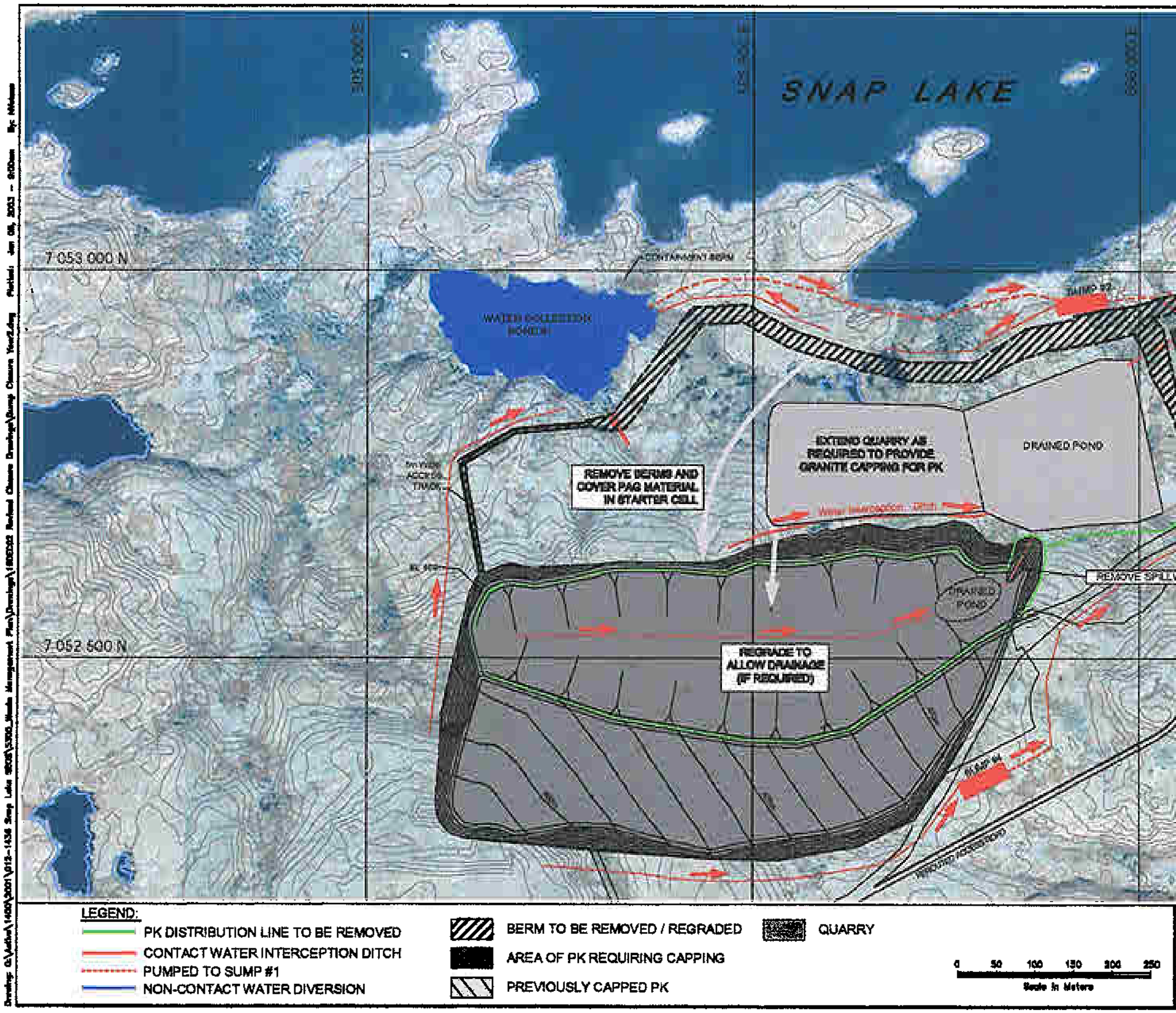
SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 1

Drawn: NV	App'd: AH	Date: Jan 08, 03	Figure: 5-2

Project No.: 012-1436

Revision No.:

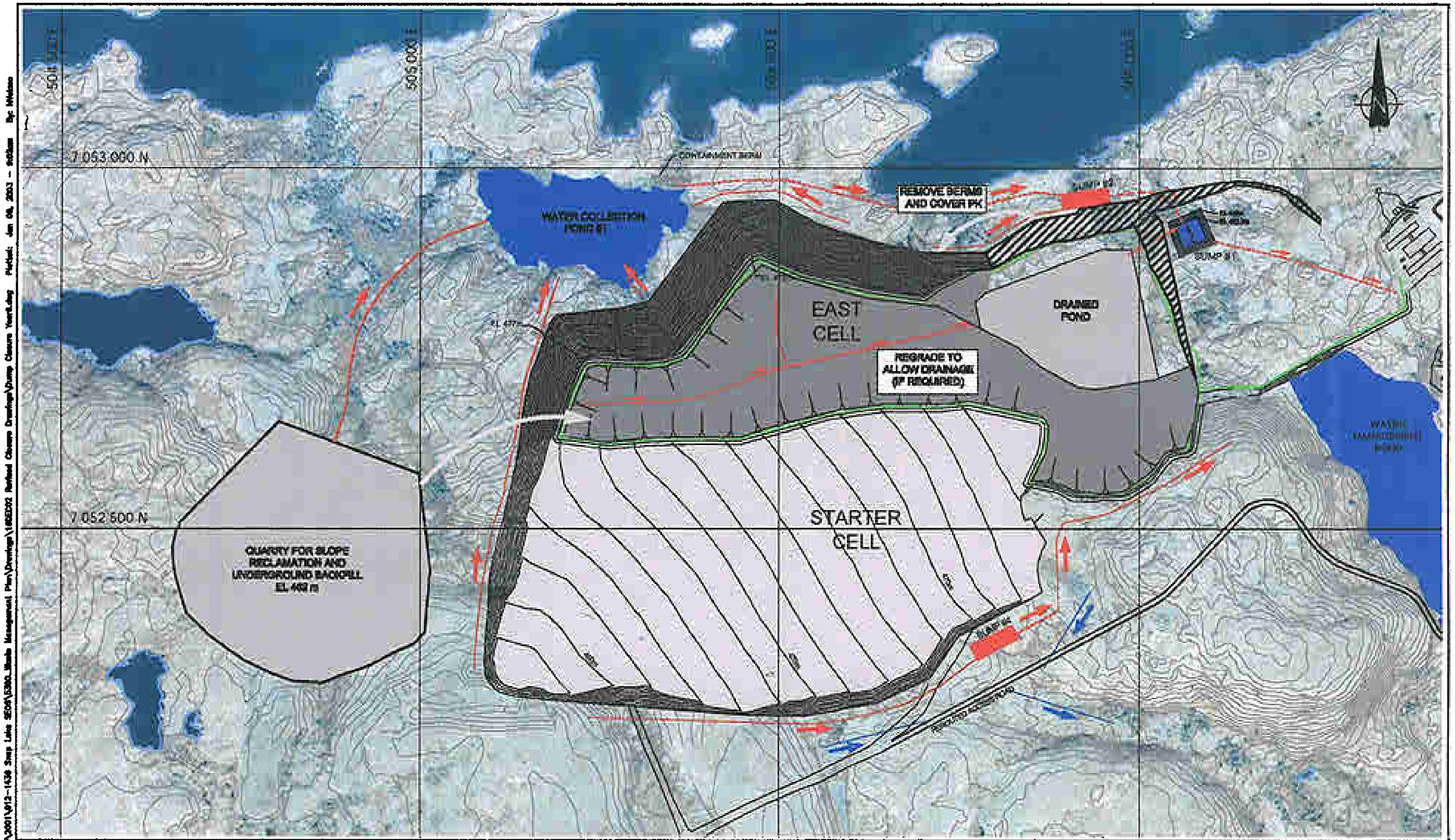
Figure 5.3 – North Pile Closure Plan – Year 2



SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 2

Drawn: NV
App'd: AH
Date: Jan 08, 03
Figure 5-3
Project No.: 012-1436
Revision No.:

Figure 5.4 – North Pile Closure Plan – Year 6



LEGEND:

- PK DISTRIBUTION LINE TO BE REMOVED
- CONTACT WATER INTERCEPTION DITCH
- PUMPED TO SUMP #1
- NON-CONTACT WATER DIVERSION
- ▨ BERM TO BE REMOVED / REGRADED
- ■ AREA OF PK REQUIRING CAPPING
- ▧ PREVIOUSLY CAPPED PK
- ▩ QUARRY

0 50 100 150 200 250

Scale in Meters

Golder Associates

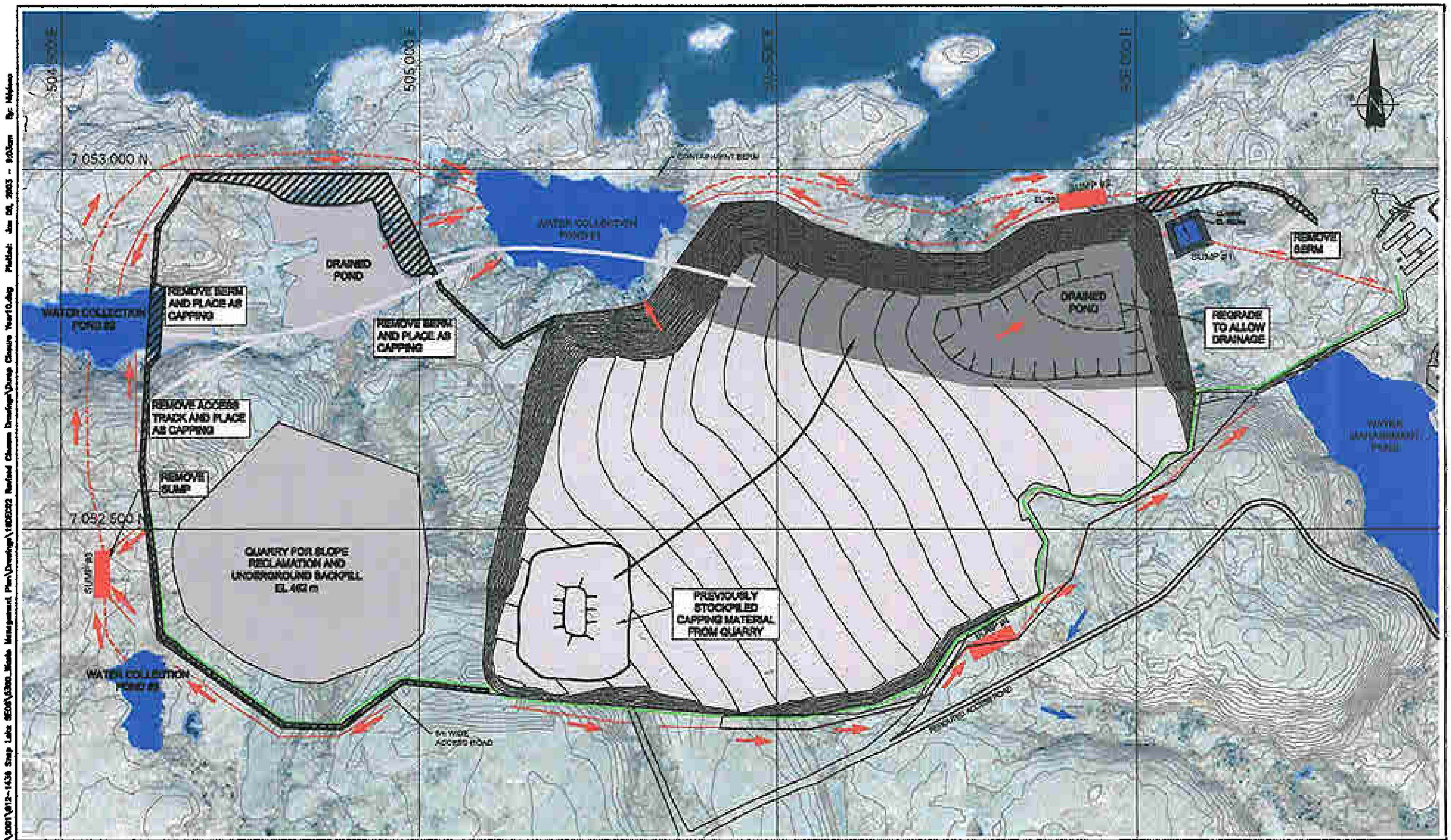
SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 6

Drawn: NV	App'd: AH	Date: Jan 08, 03	Figure: 5-4

Project No.: 012-1436

Revision No.:

Figure 5.5 – North Pile Closure Plan – Year 10



LEGEND:

- 🟩 PK DISTRIBUTION LINE TO BE REMOVED
- 🟥 CONTACT WATER INTERCEPTION DITCH
- PUMPED TO SUMP #1
- NON-CONTACT WATER DIVERSION
- ▨ BERM TO BE REMOVED / REGRADED
- ■ AREA OF PK REQUIRING CAPPING
- ▨ PREVIOUSLY CAPPED PK
- ▩ QUARRY

0 50 100 150 200 250

Scale in Meters

Golder Associates

SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 10

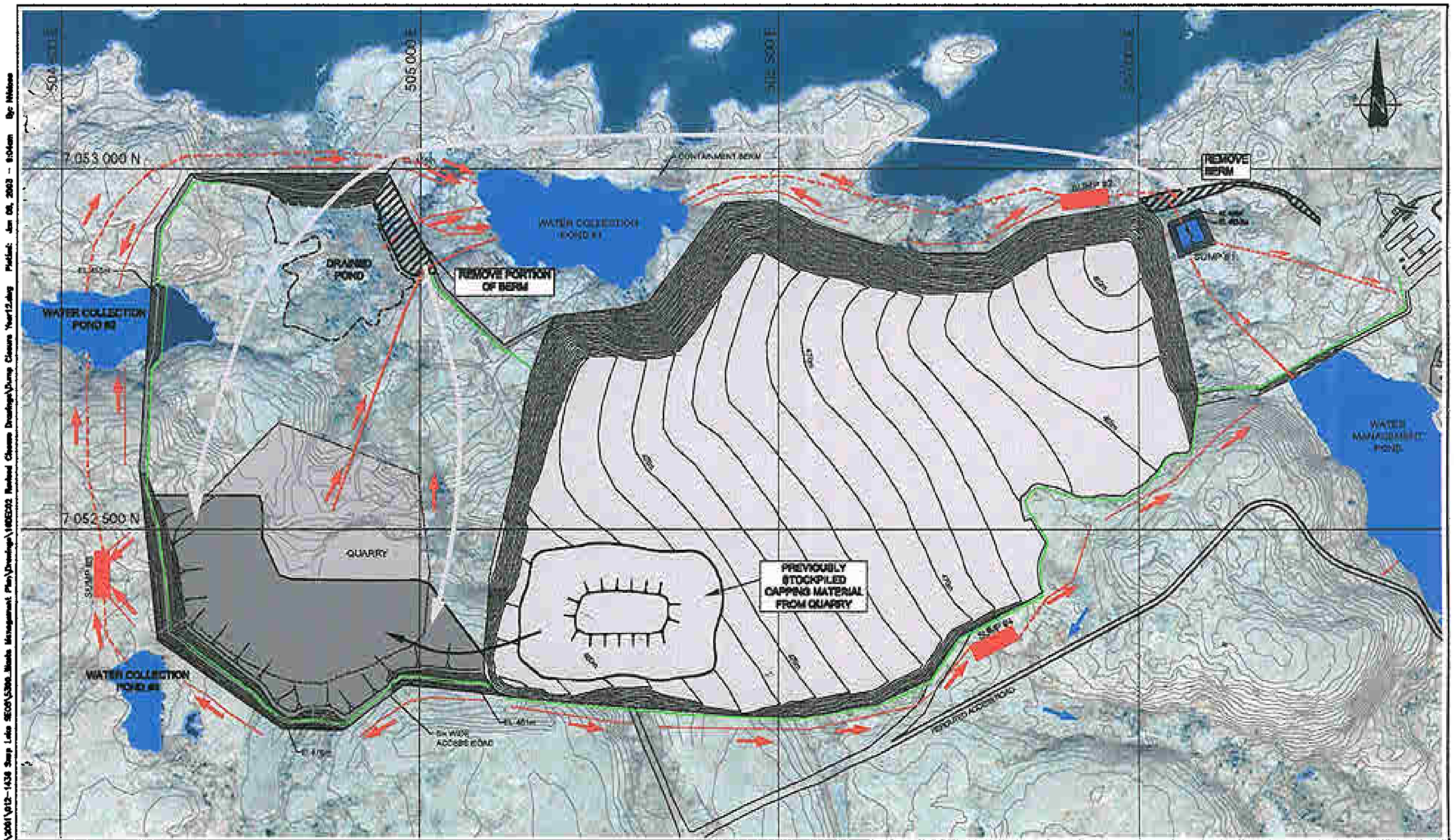
Drawn: NV	App'd: AH	Date: Jan 08, 03	Figure: 5-5

Project No.: 012-1436

Revision No.:

Drawing: G:\Active\1400\2001\012-1436 Snap Lake SEIS\5380_Waste Management Plan\Drawings\1603202 Revised Closure Drawings\Dump Closure Year10.dwg Plotted: Jan 08, 2003 - 9:03am By: NVelasco

Figure 5.6 – North Pile Closure Plan – Year 12



LEGEND:

- PK DISTRIBUTION LINE
- CONTACT WATER INTERCEPTION DITCH
- PUMPED TO SEDIMENTATION POND #1
- NON-CONTACT WATER DIVERSION

▨ BERM TO BE REMOVED / REGRADED

■ AREA OF PK REQUIRING CAPPING

▧ PREVIOUSLY CAPPED PK

▩ QUARRY

0 50 100 150 200 250
Scale in Meters

Golder Associates

SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 12

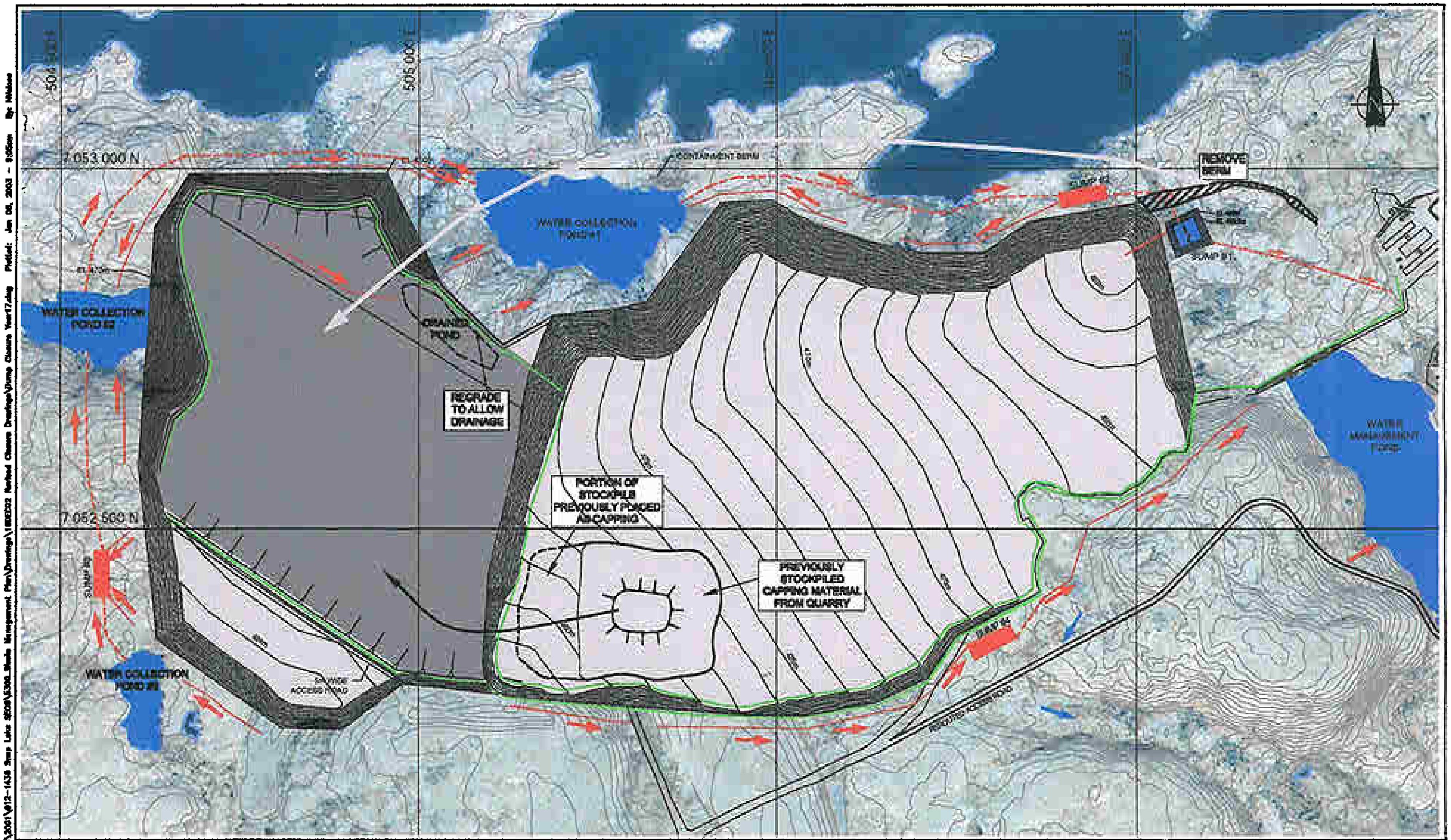
Drawn: NV | App'd: AH | Date: Jan 08, 03 | Figure: 5-6

Project No.: 012-1436

Revision No.:

Drawing: G:\Active\1400\2001\012-1436 Snap Lake SEC05\5300_Waste Management Plan\Drawings\19SE02 Revised Closure Drawings\Dump Closure Year12.dwg Plotted: Jan 08, 2003 - 9:04am By: Nvidese

Figure 5.7 – North Pile Closure Plan – Year 17



LEGEND:

🟩	PK DISTRIBUTION LINE
🟥	CONTACT WATER INTERCEPTION DITCH
----	PUMPED TO SEDIMENTATION POND #1
🟦	NON-CONTACT WATER DIVERSION
▨	BERM TO BE REMOVED / REGRADED
■	AREA OF PK REQUIRING CAPPING
▧	PREVIOUSLY CAPPED PK
▩	QUARRY

0 50 100 150 200 250
Scale in Meters

Golder Associates

SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 17

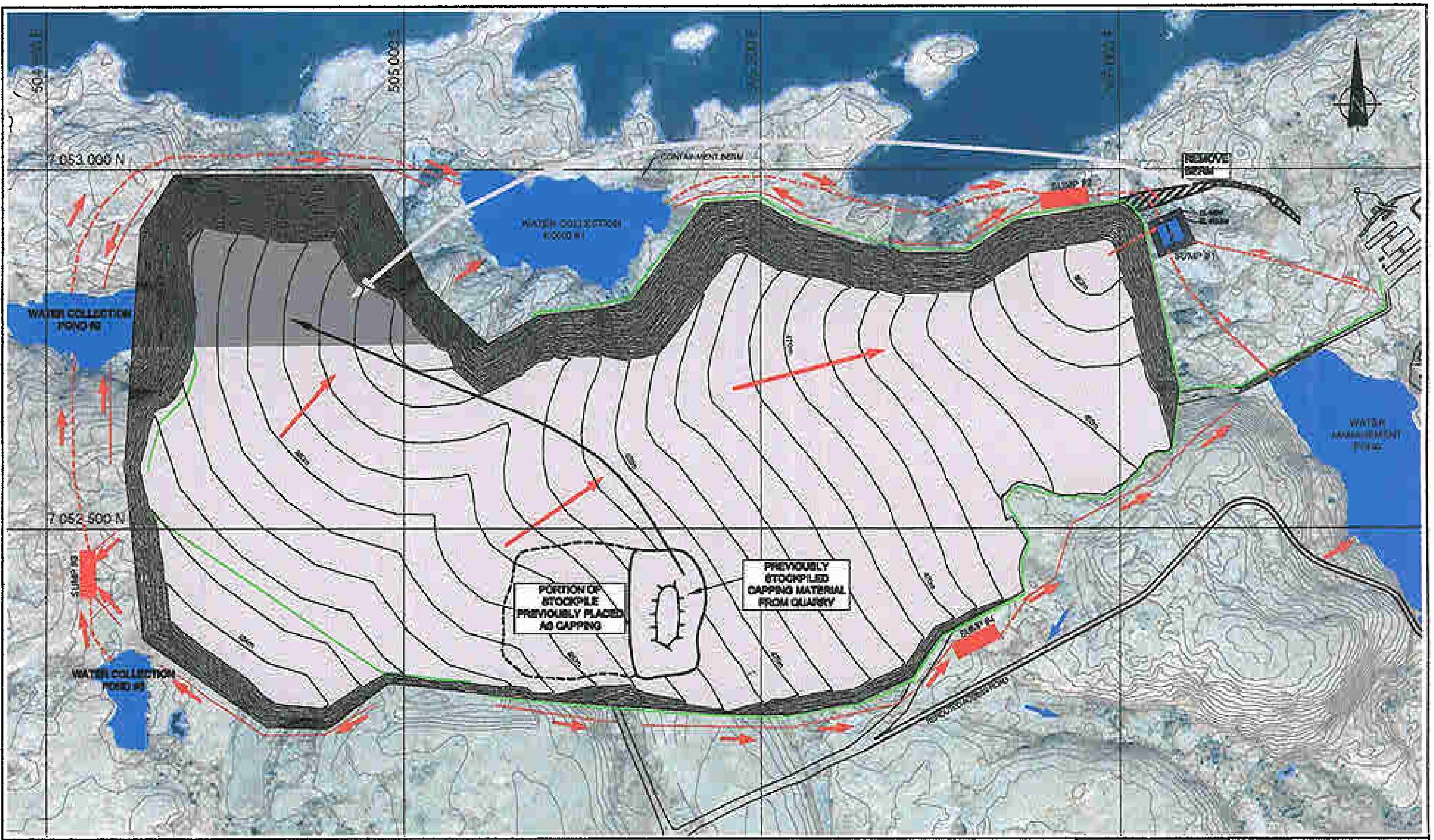
Drawn: NV	App'd: AH	Date: Jan 08, 03	Figure: 5-7

Project No.: 012-1436
Revision No.:

Drawing: O:\Active\1400\2001\012-1436 Snap Lake 3000\5300_Waste Management Plan\Drawings\18DEC02 Revised Closure Drawings\Dump Closure Year17.dwg Plotted: Jan 08, 2003 - 9:05am By: NWatson

Figure 5.8 – North Pile Closure Plan – Year 22

Drawing: G:\Active\1400\2001\012-1436 Snap Lake SEOS\5300_Waste Management Plan\Drawings\1002? Revised Closure Drawings\Dump Closure Year22.dwg Plotted: Jan 08, 2003 - 9:07am By: NValdes



LEGEND:

🟩	PK DISTRIBUTION LINE
🟥	CONTACT WATER INTERCEPTION DITCH
┅	PUMPED TO SEDIMENTATION POND #1
🟦	NON-CONTACT WATER DIVERSION
▨	BERM TO BE REMOVED / REGRADED
■	AREA OF PK REQUIRING CAPPING
▧	PREVIOUSLY CAPPED PK

0 50 100 150 200 250

Scale in Meters

Golder Associates

SNAP LAKE PROJECT
NORTH PILE
CLOSURE PLAN
YEAR 22

Drawn: NV	App'd: AH	Date: Jan 08, 03	Figure: 5-8

Project No.: 012-1436

Revision No.:

Water Treatment Plant

The full capacity of the water treatment plant will no longer be required once the mine dewatering pumps are turned off. However, a smaller plant may continue to be necessary to process water in the WMP, depending on the quality of runoff collected from site and the north pile after closure.

In this event, one filter bank and associated piping and control systems will be retained in operation to treat water that requires discharge from the WMP. The thickener and the rest of the filters and equipment will be decommissioned and dismantled. All salvageable equipment and materials will be demobilized from the site. All non-salvageable equipment and materials will be buried in the north pile.. Once WMP water quality is deemed acceptable for untreated discharge, the remaining equipment will be decommissioned and disposed as described above.

5.2.7 Alternative Disposal Methods

Northern mines are often remote, making off-site transport and disposal of non-hazardous demolition debris cost-prohibitive. Furthermore, materials and equipment removed from Northern mines through the reclamation process that would normally have salvage value in southern Canada have little or no salvage value as the cost of transportation most often exceeds the salvage value. Consequently, reclamation at Northern mines normally involves disposal of non-hazardous materials on site. The most accepted practice in mine reclamation is to create a landfill area in a suitable on-site location, typically within an existing waste disposal site such as a tailings impoundment, waste rock dump, site landfill or in an area disturbed by mining such as a quarry or pit in which the demolition debris can be contained, compressed, buried and readily monitored.

As presented in detail in the preceding sections, the general disposal method that forms the basis of the overall closure and reclamation plan, implementation schedule and cost estimates (see Section 8) is burial of all non-salvageable, inert solids in the north pile, and off-site shipment of salvageable and hazardous materials. This general method was selected as the base case for the overall closure and reclamation plan for the following reasons:

- While underground disposal of inert solids was initially proposed as the primary disposal method by De Beers in the Project Description and EA, De Beers' subsequent consultation with regulators and First Nations groups indicates that this method is not preferred, mainly due to concerns about the potential for leaching of contaminants into the groundwater once the mine is flooded.
- Burial of inert solids in the north pile can generally be performed in a safer manner than underground disposal, due to an inherently safer working environment.
- Burial of inert solids in the north pile is expected to be the least expensive disposal method, compared to underground disposal or off-site shipment.

For purposes of comparing closure and reclamation methods and costs, two alternative disposal methods were considered:

- Underground disposal of inert solids, as initially proposed by De Beers in the Project Description and EA. Salvageable and hazardous materials would still be shipped off-site.
- 100% off-site shipment of all non-salvageable inert solid materials, most likely to landfill facilities in Alberta. Salvageable and hazardous materials would also be shipped off-site.

Alternative: Underground Disposal

In order to dispose inert solid materials underground, most materials will require further size reduction, relative to that required for burial in the north pile, to allow transport through the underground workings. In this case, dismantled materials would be stockpiled near the portal for sizing (i.e. by flame and saw cutting) and loading on underground transport trucks. A temporary sprung-type structure would be erected to allow this operation to continue in inclement weather.

In order to dispose of inert materials in the underground mine, the mine development must have advanced sufficiently to provide the volume required for material transport and placement. Clearly, this volume will increase with time, but it is also necessary to ensure space availability in the case of premature mine closure. The calculated volume available for underground disposal at the end of each year of the mine life, based on the current mine plan, is summarized in Table 5.2. The volumes shown include only these areas accessible with a 5 m x 5 m heading (tunnel).

Table 5.2 – Summary of Available Mine Volume by Year

.Year	Cumulative Mine Development Volume (m^3)
2007	216,000
2008	362,000
2009	404,000
2010	417,000
2011	526,000
2012	630,000
2013	723,000
2014	751,000
2015	848,000
2016	862,000
2017	944,000
2018	978,000
2019	1,015,000
2020	1,090,000
2021	1,147,000
2022	1,183,000

.Year	Cumulative Mine Development Volume (m^3)
2023	1,335,000
2024	1,390,000
2025	1,427,000
2026	1,442,000
2027	1,474,000
2028	1,549,000
2029	1,602,000

Since the materials will consist primarily of dismantled buildings and equipment from the process plant and surface infrastructure facilities, the total volume for disposal would therefore be relatively constant (estimated at 80,000 m^3). Given the calculated mine volumes shown in Table 5.2, it can be concluded that sufficient disposal space will be available at all times.

Alternative: 100% Off-site Disposal

In addition to salvageable and hazardous materials, and with the exception of those materials left underground, as identified in Section 5.2.2, and other materials such as sub-grade concrete, cables and piping, all inert solids would be shipped off-site, most likely to landfill facilities in Alberta. Some of this material, such as scrap steel, tires, conveyor belting, etc. may be suitable for recycling if appropriate facilities are available within reasonable proximity (e.g. Alberta) at the time of mine closure and if recycling can be done at a reasonable cost.

SECTION 6 • ENVIRONMENTAL IMPACT ASSESSMENT

6.1 ASSUMPTIONS

This section provides an assessment of the predicted environmental conditions in the area surrounding the project in the post-closure time period. The assessment assumes that the following physical reclamation activities have been completed:

- All major equipment and structures, and hazardous materials have been removed from the underground mine; the mine dewatering system has been turned off; the openings into the mine have been physically sealed; and natural groundwater has flooded the underground workings so that the water level in the mine has equalized with the water level in Snap Lake.
- All hazardous materials have been removed from the surface kimberlite processing facilities; the plant has been cleaned out; the equipment and structure have been demolished;

salvageable demolition debris has been removed from site and non-salvageable material disposed of in the north pile; above-grade concrete foundations have been demolished and the rubble buried in the north pile; and at-grade concrete foundations have been covered with broken rock or other suitable cover material.

- The north pile has been resloped to allow all drainage to flow to the east towards the water management pond; the processed kimberlite has been covered with broken rock to mitigate future erosion; drainage and runoff have been collected and treated through the water treatment plant until water quality has met acceptable discharge standards; and a permanent drainage system has been created allowing natural drainage to flow from the north pile into Snap Lake.
- All remaining hazardous materials, chemicals, reagents, hydrocarbons, etc., have been removed or disposed of in a manner approved by the appropriate regulatory agencies; and the facilities used to store these materials have been decontaminated, demolished and either removed or disposed of in the north pile.
- All hazardous materials have been removed from the remaining surface infrastructure (accommodations complex, power plant, maintenance shops, explosives plant, water treatment plant, process and paste backfill plant, etc.); the facilities have been cleaned out, the equipment and structures demolished; salvageable demolition debris has been removed from site and non-salvageable material disposed of in the north pile; the above-grade concrete foundations have been demolished and the rubble buried in the north pile; and the at-grade concrete foundations have been covered with contoured broken rock or other suitable cover material.
- The site roads and the airstrip have been decommissioned; all associated buildings, light stands, signs and drainage culverts have been removed; natural drainage across the roads and airstrip has been restored, with adequate erosion protection provided; and the roads and airstrip have been graded to shed surface runoff and scarified to promote in-growth of natural vegetation.
- All other surface infrastructure including above-ground piping and power distribution lines has been demolished and disposed of; all building pads, parking areas, laydown areas, etc., have been regraded and scarified; and all contaminated soils have been removed and treated.

6.2 UNDERGROUND MINE

The underground mine workings will flood with natural inflows from both surface and groundwater sources. The rate of flooding will be determined by the amount of water that can enter the mine through the natural fractures in the rock and the relative difference in hydraulic head between Snap Lake and the mine workings. There is no plan to accelerate the rate of natural flooding by pumping or other means. The rate of inflow will diminish as the difference in hydraulic head decreases. Ultimately the water level within the mine will reach equilibrium with the water level in Snap Lake and the predevelopment groundwater flow regime should become re-established.

All sources of man-made hazardous materials (hydrocarbons, chemical, reagents), along with major equipment and structures, will be removed from the underground mine workings before the mine is allowed to flood. All underground openings will have been sealed. This will significantly reduce any oxidation of sulphide minerals exposed in wall rock.

During post-closure, groundwater in contact with the flooded and backfilled underground workings is expected to equilibrate (in chemistry) with the cemented paste in the backfill. Based on the repetitive leach (kinetic) test data, the affected groundwater is predicted to have a pH ranging 9 to 11. Concentrations of aluminum, chromium and molybdenum will be elevated relative to the baseline groundwater conditions; however, the values expected based on the kinetic test results data are lower than those used in the EA. These levels are anticipated to further reduce to levels below which any environmental impact is anticipated during the time that groundwater follows the flow path before eventually discharging to the unnamed lakes to the north.

6.3 PROCESS FACILITIES

The land surface altered by construction of the kimberlite processing facilities will be covered with rock and graded to enhance drainage runoff and prevent water from ponding. The graded gravel pads will present a visual impact until indigenous vegetation becomes re-established over several years. No other post-closure impacts are anticipated with regard to the kimberlite processing facilities.

6.4 SURFACE INFRASTRUCTURE

The proposed removal and reclamation of the site infrastructure facilities will eliminate any requirement for long-term maintenance, and no substantive adverse impacts are expected in the post-closure period. The infrastructure in this category includes the airstrip, site roads, quarries, waste management facilities and other site support facilities.

6.5 MINE WASTE AND PK CONTAINMENT (NORTH PILE)

The north pile will permanently alter the local topography and will remain visible from a distance after closure. However, the pile will be shaped with irregular contours and capped with granite similar to the surrounding rock to help it blend with the natural landscape at the mine site. The granite cap over the pile will result in minimal dust generation, and no post-closure effects on regional air quality are expected.

A small volume of seepage will emanate from the north pile, affecting groundwater quality in the active layer in the immediate area. The impacts will be localized to the northwest peninsula.

During operations, most if not all of the seepage from the north pile will be collected and pumped to the water treatment plant. The seepage chemistry will include higher-than-background concentrations of nickel, cobalt and cadmium, as well as major ions and TDS. Associated with exposed kimberlite, the changes will be greatest during operations, decreasing after closure once the granite cap over the north pile is complete. Concentrations below acceptable discharge standards are anticipated within one year after closure. The seepage collection system and water treatment plant will continue to be operated until such time as the quality of the seepage and runoff water is confirmed to be suitable for direct untreated discharge. At that time, the ditches will be regraded and a drainage pattern established to carry flow to Snap Lake.

(There may be opportunities on the eastern extent of the north pile where water quality, potentially having achieved background levels after progressive reclamation in that area, may permit recontouring to allow natural drainage to resume before final mine closure. Therefore, only parts of the seepage collection system may be required until final closure.)

The north pile will be developed in three cells during the life of the project. The granite cap will be placed as each section of the pile is raised to the final grade. Since some sections of the cap will be completed in the third year of mine operations, the performance of the pile and the cap will be monitored for nearly two decades during the mine operation and adjustments will be made to the thickness of the cap and to the grain-size distribution of the rockfill to ensure that TSS concentrations in the runoff from the pile post-closure will have no effect on the surface water quality.

While the north pile will take decades to reach thermal equilibrium, the PK below the active layer will cool to temperatures below 0°C within about two years of the end of PK deposition. The starter and east cells will be completed and rehabilitated during the 10 year operating period for the west cell, leaving only the top of the northern end of the west cell to cool below 0°C after operations cease.

The reclamation plan will encourage a natural succession of indigenous plant species within disturbed areas, but re-establishment of vegetation can be expected to take several decades. The predevelopment vegetation in this area was thin and spotty because much of the surface was covered with rock outcrops. Therefore, although the entire footprint of the north pile will have an impact in terms of loss of vegetation, this loss will be relatively minor in a regional context. The resultant impact to terrestrial wildlife and bird habitat associated with the reclaimed north pile will also be relatively minor in a regional context, given the vast surrounding area of land and water providing suitable alternatives for wildlife species.

Given the difficult growth conditions and lack of soil in the project area, active revegetation of the north pile, once the granite capping is complete, may or may not prove successful. A preliminary revegetation plan has been developed (Appendix C); however, it is not included in the environmental impact assessment, cost estimates and implementation schedule for the closure and reclamation plan.

6.6 WATER MANAGEMENT FACILITIES

The reclamation plan for the water management facilities is intended to minimize any requirement for long-term maintenance and to re-establish natural drainage flows as soon as water quality allows. Sediment captured in the facilities over the operating life of the mine will be stabilized under a cover of sand or non-PAG granite to prevent erosion. No substantive adverse impacts are expected in the post-closure time period with regard to these reclaimed facilities.

6.7 BIOPHYSICAL ENVIRONMENT

6.7.1 Air Quality

All stationary and vehicle exhaust emissions (sulphur dioxide, oxides of nitrogen, greenhouse gases) associated with the project will cease following the closure and reclamation of the site facilities. The only emissions in the post-closure period will be those associated with periodic trips into the site for the purpose of environmental monitoring and maintenance. These will be minimal and should have little to no adverse impact.

Dust emissions associated with the project will also decrease substantially after closure and reclamation. Cessation of road and air traffic, removal of all site buildings and facilities and capping of the north pile will eliminate or substantially reduce potential dust sources. Because it will take several decades for natural in-growth of indigenous vegetation after reclamation, some dusting could occur in areas of exposed rockfill on the north pile and building sites during periods of strong winds. The only other dust emissions in the post-closure period will be those associated with periodic trips into the site for environmental monitoring. These dust sources are expected to be minimal and have little to no adverse impact.

6.7.2 Noise and Light

Noise and light impacts associated with the project will cease with the completion of closure and reclamation. No operating equipment or power sources will be left on site in the post-closure period. Some minor noise will be associated with post-closure environmental monitoring trips to the site, but this is expected to be minimal and have no adverse impact.

6.7.3 Terrain

Boulder fields and heath terrain cover most of the area that will be occupied by the project. During operations, any area used for project activities that becomes unnecessary will be recontoured to suit the natural terrain. Because of the extremely harsh growing conditions and lack of soil, re-establishment of natural vegetation will take many years.

The north pile will remain visible after closure. Covering approximately 92 ha and ranging up to 34 m in height, the pile will be among the highest landforms in the area. It will be capped with quarried granite to help it blend with the surrounding landscape in terms of colour and texture.

6.7.4 Wildlife

Areas used for project facilities, including the esker quarry, will essentially be lost to wildlife for the duration of the mine life and for several decades after closure before natural vegetation becomes re-established. Although the impact is expected to be relatively minor because of the extent of similar habitat throughout the region, the size of the project footprint has been restricted, and use of the esker quarry site will be minimized.

Little to no effect on wildlife abundance and use is expected in the post-closure period. The potential for human-wildlife interactions will greatly diminish, and the risks of contact with equipment, vehicles and aircraft will cease when closure and reclamation activities are complete.

6.7.5 Aquatic Resources

Computer models were used to predict how the project would affect lake water levels. Flows during operation are predicted to increase at the outlet from Snap Lake but to decrease at the outlet from the lake north of Snap Lake. This alteration of flow would be within the range of natural variation for the lake, however, and flows would restabilize at predevelopment norms once the mine is flooded. Consequently, this impact will be eliminated in the post-closure period.

Sediment loading to Snap Lake from post-closure runoff is not expected to differ from natural concentrations. No adverse impact to the overall aquatic community in the lake is anticipated.

In summary, the immediate area of the project will be physically altered due to project development, and changes will remain evident in the areas of the north pile or plant site, site roads and airstrip after reclamation. However, the reclamation work will help blend these sites into the surrounding landforms over the long term. The re-establishment of natural vegetation will be slow. The reclaimed project will have minimal impact on the biodiversity and sustainability of the natural renewable resources of the region and have no lasting effect on traditional and non-traditional land use activities in the area.

SECTION 7 • POST-CLOSURE MONITORING AND MAINTENANCE

De Beers is committed to minimizing the residual environmental effects associated with project development. The closure and reclamation plan has been developed in conjunction with the mine plan so that closure considerations can be incorporated into the mine design. Surface facilities have also been designed with closure in mind to facilitate, wherever practical, reclamation requirements and the enhancement of natural recovery of areas affected by the project. In line with this objective, reclamation will be carried out progressively during operations whenever possible, notably at the north pile facility for PK and waste rock.

The closure and reclamation phase of the project will commence once the economic ore reserves within the deposit have been exhausted and mining and processing operations have ceased. Based on current planning, it is anticipated that underground mining at the project will commence in 2007 and continue until 2029. Mine closure and reclamation are expected to take place in 2030 and 2031. The post-closure period would commence in 2032.

Monitoring and maintenance programs will be implemented during the closure and post-closure phases of the mine to prevent environmental degradation and measure the performance of the closure and reclamation procedures. The data collected through post-closure monitoring will allow the planned procedures and activities to be adjusted and/or modified as necessary to ensure optimal environmental protection. The monitoring and maintenance programs discussed in this section are inherently generic at this stage of planning and will be developed in more detail in consultation with communities and regulators, and as project design advances.

7.1 ENVIRONMENTAL MANAGEMENT AND AQUATIC EFFECTS MONITORING

De Beers has developed an environmental management system (EMS) for the present AEP site that has received ISO 14001 certification. This will be updated and re-certified for the construction and operation phases of the project. An EMS is a defined system or process of measuring and documenting compliance with environmental standards and for seeking continuous improvement at a facility such as the project. An EMS utilizes training, environmental monitoring, audits, inspections and other tools to measure and manage actual environmental performance against established objectives.

The EMS will set out how the project will be managed to minimize its impact on the biophysical and socio-economic environment, and to continually improve its environmental performance. It will set out the management plans and the emergency plans for all key areas of the environment during construction, operations and closure. De Beers will develop, in consultation with stakeholders, a program to monitor not only the effectiveness of the management system but also the effects of the project on the environment.

This monitoring program will consist of a number of features, including:

- monitoring for regulatory compliance
- monitoring for project-related regional socio-economic and environmental effects
- identifying circumstances under which additional mitigation should be undertaken if impact predictions were incorrect or impacts were underestimated.

De Beers is committed to monitoring water quality in Snap Lake during construction, operations and closure. The Aquatic Effects Monitoring Program (AEMP) would include both biological and water chemistry sampling. It is anticipated that a detailed AEMP will be developed for Snap Lake as a condition of the water license for the project.

7.1.1 Current Water Quality Monitoring

Under the current water use license for the AEP, De Beers has been conducting a program of environmental monitoring based on sampling activities required under the Surveillance Network Program (SNP) contained within the license. Current sampling stations and frequency are summarized in Table 7.1.

It is anticipated that the current SNP will form the basis for a new SNP to be included in the water use license for the project. This naturally assumes that the project will ultimately receive approval to proceed to the permitting phase following environmental assessment under the MVEIRB, and that the MVLWB will issue a water use license for the project.

7.1.2 Environmental Monitoring During Operation Period

A work plan for the design of the operational AEMP has been submitted to the public registry. In it, the regulations that must be considered in the design of the AEMP and the proposed elements of the AEMP are identified. The development of the AEMP will occur during the water license permitting process. De Beers plans to consult with regulators and communities on the elements and design specifications of the AEMP. Specific monitoring plans cannot be provided at this time.

7.1.3 Environmental Monitoring During Closure and Reclamation Period

Adaptive management will be used to refine the operational AEMP during the 22 year life of the mine. By the time the mine is ready for closure and reclamation, the program may have been refined several times to focus monitoring programs on the key issues at that time. Consequently, the details of the AEMP during the closure and reclamation period cannot be provided at this time. However, given the mine design and known monitoring requirements, a generic discussion of the AEMP can be provided.

During the transition from mine operations to closure and reclamation, water management operations will continue, including:

- dewatering of the underground mine workings and subsequent treatment of the mine water until the mine has been cleared of all hazardous materials (fuels, reagents), and equipment and structures
- collection and treatment of runoff and seepage from the north pile until no further treatment is required to meet acceptable water discharge standards
- continuation of the AEMP.

The project will need to maintain a valid water use license to cover the activities to be carried out during the closure and reclamation phase. These activities will include regular water quality monitoring, in accordance with the SNP set out in the water use license, and the continuation of the AEMP.

Table 7.1 – Current SNP Water Quality Sampling Stations and Frequency

SNP Station	Description	Frequency	Sampling Timeline	Water Quality Analysis
1735-1[1]	Snap Lake AEP freshwater intake	Monthly	Sample monthly when camp or advanced exploration activities in progress, commencing April 2000.	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals)
1735-2	Drawdown intake at IL-1	Daily	Sample only when pumping from IL-1 (March - April 2000).	TSS, turbidity, pH
1735-3	Mine water pumped from U/G mine portal	Weekly/Monthly	Sample only when there is water flow from underground; monitor once a week and monthly thereafter. April - October.	TSS, pH, oil/grease, total ammonia, ICP total and dissolved metal scan (23 metals), oxidation reduction potential (Eh), alkalinity
1735-4	PKC Dam #1 seepage	Monthly	Sample only if seepage is present in collection ditch. Possibility of occurrence limited to non-frozen conditions (May - October).	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals), alkalinity
1735-5	PKC Dam #2 seepage	Monthly	Sample only if seepage is present in collection ditch. Possibility of occurrence limited to non-frozen conditions (May - October).	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals), alkalinity

SNP Station	Description	Frequency	Sampling Timeline	Water Quality Analysis
1735-6	PKC Dam #1 seepage near shoreline of Snap Lake	Monthly	Sample only if seepage is present. Possibility of occurrence limited to non-frozen conditions (May - October).	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals), alkalinity
1735-7	Waste rock runoff	Monthly	Runoff and subsequent sampling would occur only under non-frozen conditions (May - October).	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals), alkalinity
1735-8	Ore stockpile runoff	Monthly	Runoff and subsequent sampling would occur only under non-frozen conditions (May - October).	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals), alkalinity
1735-9[1]	Processed kimberlite (PK) at discharge to PKC	Monthly	Sample discharge into PKC if any present. Would occur only under non-frozen conditions during operation (August - September).	TSS, pH, oil/grease, ICP total and dissolved metal scan (23 metals), alkalinity
1735-10	Discharge from AEP sewage disposal facility	Monthly	During camp operation (estimated April - October).	TSS, pH, oil/grease, BOD, fecal coliform
1735-11	Sewage effluent after wetlands treatment and prior to entry to Snap Lake	Monthly	During camp operation (estimated April - October).	TSS, pH, oil/grease, BOD, fecal coliform

Notes:
TSS = total suspended solid
BOD = biological oxygen demand
ICP = inductively coupled plasma

Dissolved metal analysis and alkalinity were not requested in the water license, but were added to the program in the Acid-Rock Drainage Plan submitted to the MVLWB to facilitate the modelling of site water quality for future impact analysis.

[1] *Parameters and frequency of analysis for SNP stations 1 and 9 were not detailed in the water license. The information listed here is based on comments from D. Milburn, Department of Indian and Northern Affairs, Water Resources.*

The amount of environmental monitoring required is expected to decline once the project facilities have been fully decommissioned, dismantled and removed and the site has been reclaimed. The timing for such reduction in monitoring effort will be a function of environmental performance, i.e., until it can be demonstrated that the reclamation work has achieved the endpoints agreed upon in the water license. In meeting the endpoints, the reclamation work will have met the objective of preventing degradation of the receiving environment and demonstrating that the reclaimed site is not, and will not in the future, adversely affect the aquatic and terrestrial resources in the project area. The assumptions made about the amount, frequency and duration of environmental monitoring for the purposes of this Mine Closure and Reclamation Plan are based on the anticipated performance of the reclamation works. The plan will be modified accordingly to suit actual conditions at the time of decommissioning.

It is expected that issuance of the water license for the project will require a more extensive AEMP than currently associated with the AEP license; however, this is currently under development. Therefore, for the purposes of preparing this Preliminary Closure and Reclamation Plan, primarily for cost estimating, the current SNP was used as the basis for the new SNP. The plan and estimated associated costs will be finalized once the water license is issued and the AEMP requirements established.

A full-time, site-based person is expected to be required for environmental monitoring early in the closure and reclamation phase. Post-closure, this requirement will reduce to periodic site visits on an as-needed basis.

It has been assumed that the operational AEMP to be followed during the two-year-long closure and reclamation period would be similar to that maintained during the operating period.

The main elements of the program would be as follows:

- continued monitoring of the applicable SNP stations (as indicated above, this is based on the current SNP for the purposes of cost estimating only). Some stations, such as the point of PK discharge to the north pile, would no longer be valid because flow is generated only during operations.
- monitoring of water quality in Snap Lake.
- monitoring of the North Lake and a reference lake on the applicable operations period schedule.
- monitoring of shallow groundwater flow. In permafrost areas, only localized monitoring of summertime flow in the active zone would be implemented, if necessary.
- program of aquatic effects monitoring, including water, sediment, benthos and fisheries studies consistent with the operations AEMP
- annual inspection by a qualified professional geotechnical engineer of all containment dykes retaining soil, waste or water.

It is anticipated that post-closure, the AEMP will be reduced in its scope and intensity as reclamation goals and endpoints are achieved. Clear identification of the endpoints (e.g. water quality parameters in any discharge to Snap Lake that must be achieved in order to receive clearance to discontinue monitoring) will be key to the development and implementation of the AEMP after closure and reclamation.

7.1.4 Post-Closure Monitoring

Closure and reclamation of the project facilities is expected to be complete by the end of the second year after the cessation of mining and processing. The project will then enter the post-closure phase. There will be no activity and no full-time human presence at site during this time. Environmental monitoring would continue, but on a scaled-down schedule, most likely during short site visits of generally one day's duration.

The level of monitoring required will be a function of environmental performance at the site. For the purpose of this Mine Closure and Reclamation Plan, it has been assumed that post-closure environmental monitoring will continue for 20 years, with lesser degrees of effort required in each of three sub-periods: Years 1 through 3; Years 4 through 10; and Years 11 through 20. Monitoring activities during these periods are summarized below:

Post-Closure Monitoring Years 1 through 3

- water quality monitoring of the applicable SNP stations. Many of the SNP stations will become superfluous because the flows being monitored will no longer exist, e.g., sewage treatment discharge.
- monitoring of water quality in Snap Lake, North Lake and the reference lake
- monitoring of shallow groundwater flow. In permafrost areas, only localized monitoring of summertime flow in the active zone would be implemented, if necessary.
- program of aquatic effects monitoring, including sediment, benthos and fisheries studies to assess cumulative effects of the project on the aquatic environment
- annual inspection by a qualified professional geotechnical engineer of all containment dykes retaining soil, waste or water.

Post-Closure Monitoring Years 4 through 10

It is anticipated that water quality and other data will demonstrate that environmental conditions have essentially stabilized by the end of Year 3 and that a further reduction in frequency of environmental monitoring can be justified. The assumed changes for Years 4 through 10 are summarized as follows:

- sampling of remaining applicable SNP stations, with the sampling visits scheduled for June and August to catch the periods of spring freshet and summer flow
- monitoring of shallow groundwater flow, with the sampling visit scheduled for August to catch the period of summer flow

Post-Closure Monitoring Years 11 through 20

Stabilization of environmental conditions by the end of year 10 is assumed to be sufficient to further reduce monitoring requirements. However, these will be developed as a function of environmental performance at that time.

7.2 POST-CLOSURE MAINTENANCE

7.2.1 General

The closure design for the surface facilities incorporates features to minimize requirements for future care and maintenance. For example, all sites will be graded to prevent surface ponding, and drainage channels will be designed and constructed with wide cross-sections and appropriate erosion protection to accommodate extreme precipitation events. No buildings will be left, eliminating maintenance requirements associated with structures. All pumping systems will be removed and natural drainage established wherever practical. Other than the environmental monitoring and inspection activities covered in the previous sections, the Mine Closure and Reclamation Plan includes no planned or scheduled post-closure maintenance activities.

De Beers recognizes, however, that some unexpected post-closure issues could arise, such as the need to construct new drainage channel(s) or sediment control pond(s). Any such works would likely be small in size, able to be constructed in a cost-effective manner using resources brought to site by aircraft. An allowance has been included in the post-closure monitoring cost estimate for this type of unspecified maintenance activity.

7.2.2 Revegetation Considerations

The predevelopment terrain at the project site is dominated by exposed bedrock. The site is generally barren of vegetation except for some isolated areas of low trees in topographic depressions along the Snap Lake shoreline. Dwarf shrubs are also found in isolated patches.

Given the limitations associated with cool, short summers, low precipitation levels, cold winters and permafrost, the re-establishment of vegetation in disturbed areas will be difficult. De Beers plans to prepare and evaluate revegetation test plots and other environmental studies during operations to identify stable landforms, suitable plant growth media and possible plant types and species that could most successful during reclamation. Details of this program are included in Appendix C. Because the program will involve studies and experimental activities, its implementation schedule and associated costs cannot be defined at this time, and are therefore not included.

The reclamation plan will be designed to encourage a natural succession of indigenous plant species within disturbed site areas. Where appropriate, grading and contouring will be done to control soil stability and promote revegetation. Where rock slopes or other site features preclude revegetation, a layer of capping rock will be employed to ensure long-term stability.

7.3 ESTIMATED POST-CLOSURE MONITORING & MAINTENANCE COST

For the purposes of this Preliminary Closure and Reclamation Plan, a preliminary estimate of $3.5 million has been made for the total cost of environmental monitoring and maintenance during both closure and post-closure. Of this total, about $1 million is allocated to the two-year closure and reclamation period, and is included in the closure and reclamation cost estimates provided in Section 8. Costs by year are shown in Table 7.7; details of the estimate are included in Appendix B.

Key assumptions and considerations used in the preparation of this estimate are as follows:

- A site-based environmental person will be retained on the project during the two-year closure and reclamation period to continue environmental monitoring and reporting activity. The cost estimate assumes a work schedule of 4 days on, 3 days off, and a weekly cost of $150 for transportation to and from Yellowknife.
- Environmental monitoring in the post-closure phase will be conducted in periodic site visits. Each sampling visit to site would involve 100 person-hours for sampling and reporting activity and a round-trip cost of $1,000 for the charter of a small, fixed-wing aircraft for personnel transport to and from Yellowknife.
- Unit analytical costs are shown in the estimate details in Appendix B. An allowance of 10% of analytical costs is included for supplies and equipment consumed in the ongoing monitoring activities.
- During the closure and reclamation phase, samples will be delivered from site to Yellowknife on regularly scheduled air traffic. An allowance of $500 per month was made for subsequent transportation from Yellowknife to a commercial laboratory during the closure and reclamation phase, and $250 per month during the post-closure phase.
- As discussed in Section 7.1.2, specific details of the AEMP are not available at this time. For the purposes of the estimate, an allowance of $250,000 per program year was included in the two-year closure and reclamation period and for three years post-closure. This allowance was reduced to $125,000 per program year for years 4 through 10, and $60,000 per program year thereafter. These estimates will be updated once the AEMP is finalized.
- The annual geotechnical inspection is estimated to cost $7,500 per program year. As above, the inspection visit will coincide with one of the scheduled environmental monitoring site trips.
- An allowance of $25,000 per year is included for unspecified post-closure maintenance in Years 1 through 3; $10,000 per year in Years 4 through 10; and $5,000 per year in Years 11 through 20.

- A contingency allowance of 15% is included for unanticipated monitoring and maintenance costs that may arise.

Table 7.2 – Post-Closure Environmental Monitoring & Maintenance Cost Estimate Summary

Year	Cost ($)
Closure and Reclamation – Year 1	473,000
Closure and Reclamation – Year 2	473,000
Subtotal – Closure & Reclamation Period	**946,000**
1	385,000
2	385,000
3	385,000
4	194,000
5	50,000
6	194,000
7	50,000
8	194,000
9	50,000
10	194,000
11	29,000
12	29,000
13	29,000
14	29,000
15	98,000
16	29,000
17	29,000
18	29,000
19	29,000
20	98,000
Subtotal – Post-Closure Period	**2,509,000**
Total ($CDN)	**3,455,000**

SECTION 8 • IMPLEMENTATION SCHEDULE AND COST ESTIMATES

8.1 INTRODUCTION

In accordance with DIAND's *Mine Site Reclamation Policy for the Northwest Territories* (Reclamation Policy), the reclamation implementation schedule and liability cost estimates described in this section were developed based on the worst case scenario of third-party management and execution of all closure and reclamation activities, for the purpose of establishing reclamation security under De Beers' Environmental Agreement and Water License. Reclamation liability estimates are presented both inclusive and exclusive of progressive reclamation (financial assurance and security is discussed in Section 9).

8.2 IMPLEMENTATION SCHEDULE

8.2.1 Schedule Summary

A summary-level implementation schedule for final reclamation is provided in Figure 8.1, followed by a more detailed schedule in Figure 8.2. The schedule is based on final reclamation commencing at the end of the planned mine life. In the case of premature mine closure, the implementation schedule would essentially remain the same, with 2029 representing the year in which the mine was shut down.

8.2.2 Schedule Basis

The implementation schedule for final closure and reclamation assumes the following:

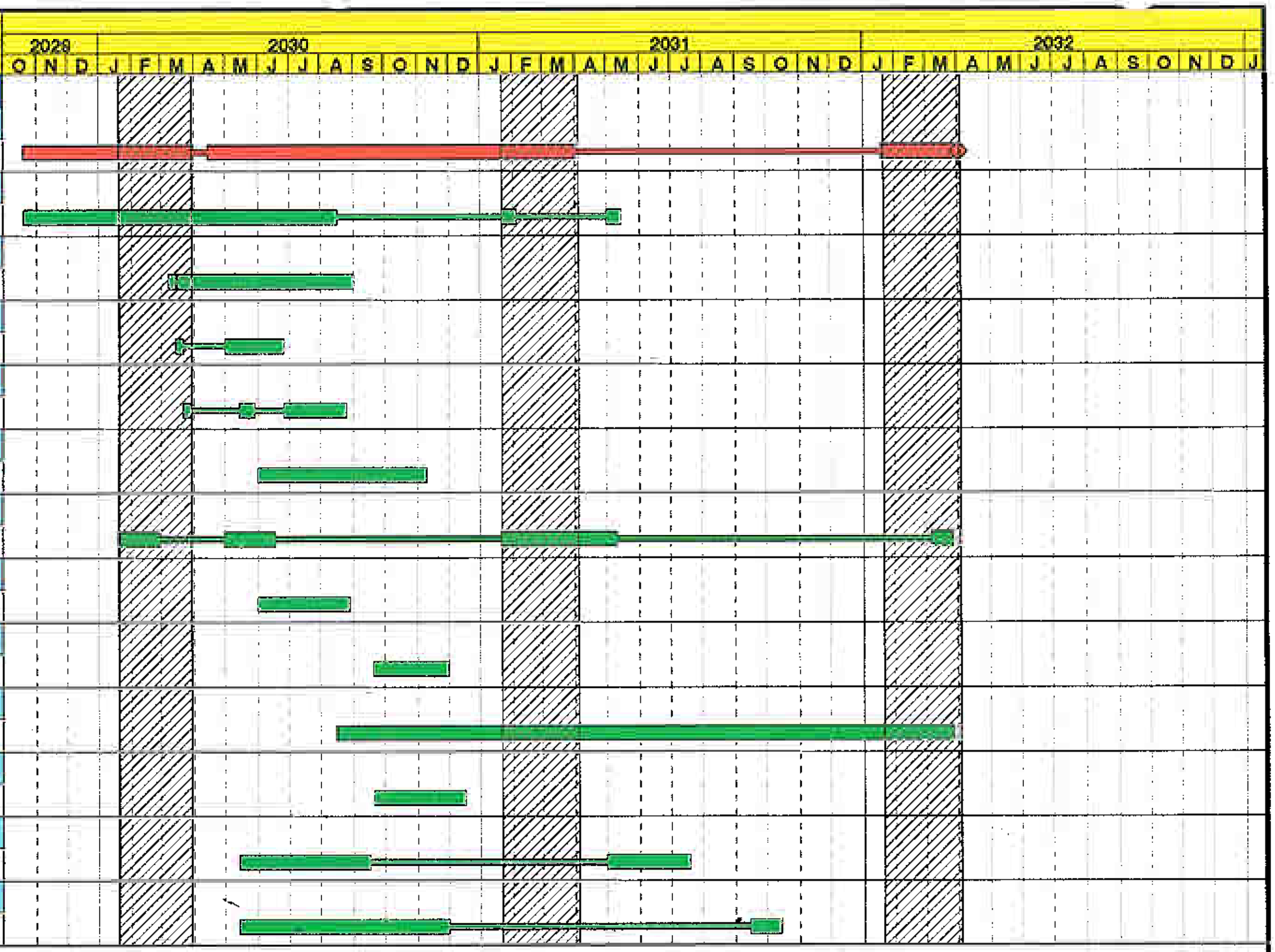
- Upon shutdown of site operations, a contractor will be engaged and mobilized to site via aircraft to operate and maintain site facilities for approximately six months until reclamation activities can commence with the mobilization of equipment over the first available winter road. These facilities include the camp, power plant, mine dewatering system, water management facilities and other site support facilities
- A third-party manager and engineer will be engaged to prepare, tender and administer contracts for the site closure and reclamation activities. The engineer will also prepare detailed decommissioning, demolition and reclamation plans and specifications. This work is expected to take up to three months.

The reclamation contractor will mobilize his construction crews, materials and equipment to site over the first available winter road (January through March 2030) after the cessation of mining and processing operations. Most closure and reclamation activities will then be completed during the rest of 2030, allowing much of the construction equipment and materials to be removed from site over the next year's winter road. Final reclamation of the airstrip and WMP, and removal of temporary facilities and remaining construction equipment from site, is expected in the second year.

Development of the schedule involved detailed input and review by an industrial contractor with extensive experience in northern construction and demolition, including the original construction of the Ekati mine and De Beers' AEP facilities.

Figure 8.1 – Summary Implementation Schedule – Final Reclamation

Activity ID	Orig Dur	Early Start	Early Finish
CLOSURE & RECLAMATION			
+ General Sitewide			
	895	20OCT29	01APR32
+ Underground Mine			
	572	20OCT29	14MAY31
+ Process Facilities (incl Paste & Pilot)			
	177	08MAR30	31AUG30
+ Coarse Ore Storage			
	103	15MAR30	25JUN30
+ Service Complex			
	156	22MAR30	24AUG30
+ Large Fuel tanks			
	163	01JUN30	10NOV30
+ Temporary Facilities			
	796	21JAN30	26MAR32
+ Ancillary Facilities			
	88	01JUN30	27AUG30
+ Camp			
	72	20SEP30	30NOV30
+ Water Treatment Plant			
	590	16AUG30	27MAR32
+ Power Plant			
	88	20SEP30	16DEC30
+ Site Grading			
	431	15MAY30	19JUL31
+ North Pile			
	518	15MAY30	14OCT31



Start Date	01OCT29
Finish Date	01APR32
Data Date	01OCT29
Run Date	27FEB03 11:46

🟩 Early Bar
🟦 Progress Bar
🟥 Critical Activity

SLDD
Sheet 1 of 1

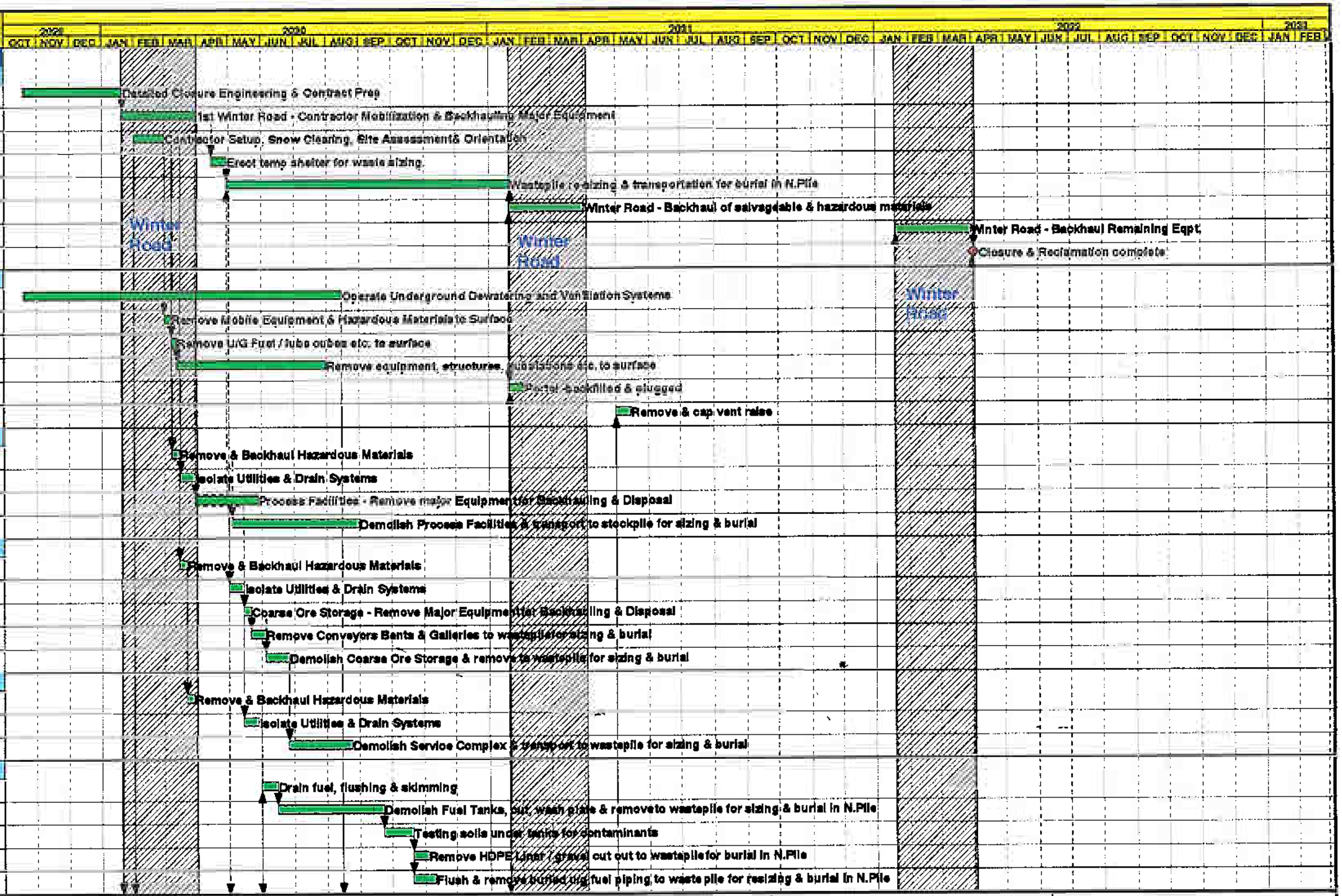
FIGURE 8.1
SNAP LAKE DIAMOND PROJECT PRELIMINARY CLOSURE & RECLAMATION SUMMARY SCHEDULE

amec

Date	Revision	Checke	Approvec

Figure 8.2 – Detailed Implementation Schedule – Final Reclamation

Activity ID	Orig Dur	Early Start	Early Finish
CLOSURE & RECLAMATION			
General Sitewide			
C010	93	20OCT29*	20JAN30
C015	70*	21JAN30*	31MAR30
C165	28*	01FEB30*	28FEB30
C120	14	15APR30*	28APR30
C080	267	29APR30	20JAN31
C170	71	20JAN31*	31MAR31
C166	70	20JAN32*	29MAR32
C156	0		01APR32*
Underground Mine			
C250	300*	20OCT29*	15AUG30
C200	7	01MAR30	07MAR30
C020	5	08MAR30	12MAR30
C255	141*	13MAR30	31JUL30
C130	14	21JAN31	03FEB31
C140	14	01MAY31	14MAY31
Process Facilities (incl Paste & Pilot)			
C035	7	08MAR30	14MAR30
C205	14	16MAR30	29MAR30
C025	60	30MAR30	28MAY30
C030	120	04MAY30	31AUG30
Coarse Ore Storage			
C045	7	15MAR30	21MAR30
C210	14	01MAY30*	14MAY30
C040	7	15MAY30	21MAY30
C050	14	22MAY30	04JUN30
C055	21	05JUN30	25JUN30
Service Complex			
C060	7	22MAR30	28MAR30
C215	14	15MAY30	28MAY30
C005	60	26JUN30	24AUG30
Large Fuel tanks			
C070	14	01JUN30*	14JUN30
C075	100	15JUN30	22SEP30
C085	28	23SEP30	20OCT30
C090	14	21OCT30	03NOV30
C095	21	21OCT30	10NOV30



Start Date 01OCT29
Finish Date 01APR32
Data Date 01OCT29
Run Date 27FEB03 14:00

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🟩 Early Bar
🟦 Progress Bar
🟥 Critical Activity

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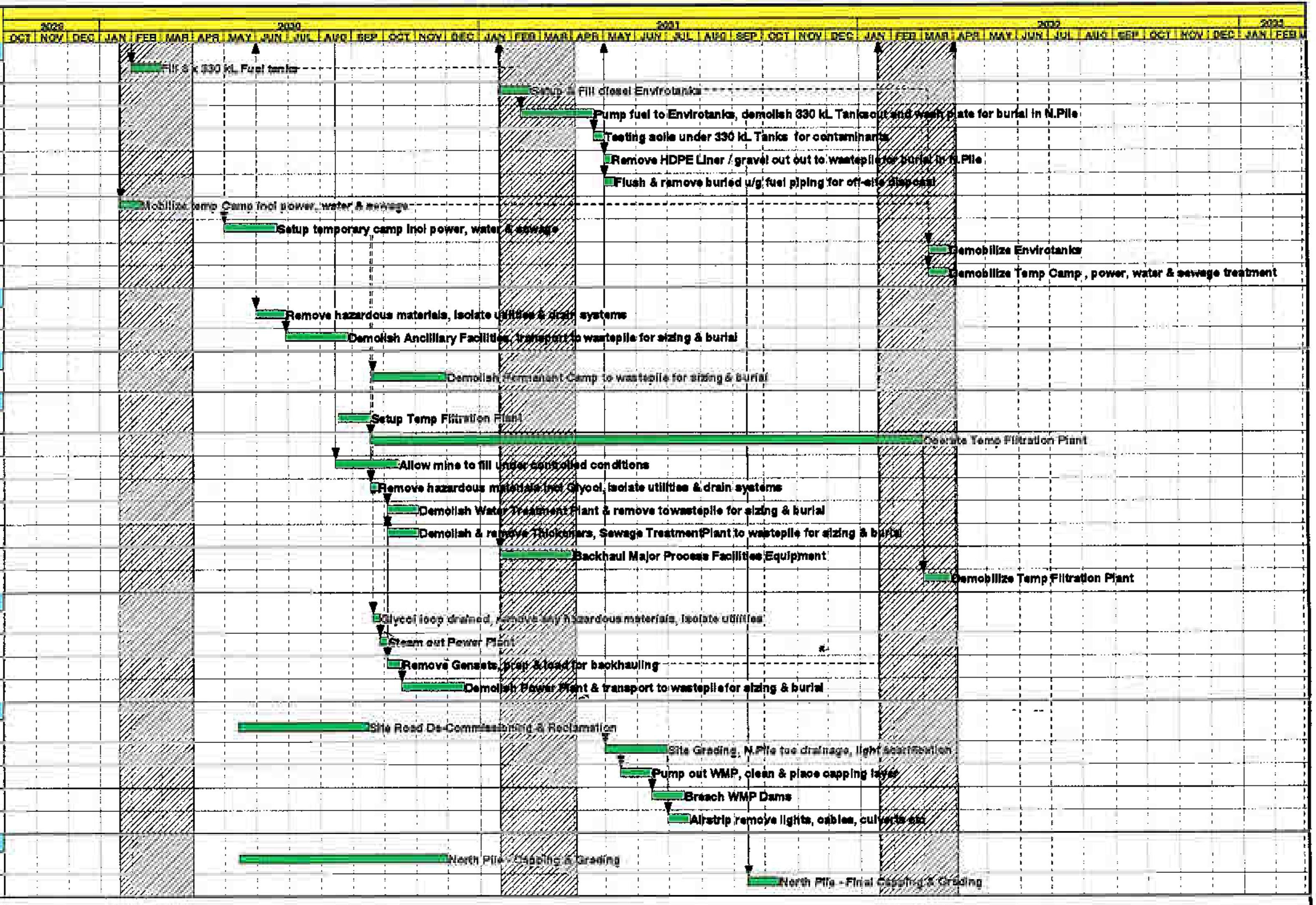
Sheet 1 of 2

FIGURE 8.2
SNAP LAKE DIAMOND PROJECT
PRELIMINARY CLOSURE & RECLAMATION
SCHEDULE

amec

Date	Revision	Checked	Approved

Activity ID	Orig Dur	Early Start	Early Finish
Temporary Facilities			
C220	28	01FEB30	28FEB30
C275	30	21JAN31*	19FEB31
C270	70	10FEB31*	20APR31
C310	10	21APR31	30APR31
C315	7	01MAY31	07MAY31
C320	10	01MAY31	10MAY31
C255	20	21JAN30	09FEB30
C175	50	01MAY30*	19JUN30
C280	20	07MAR32*	26MAR32
C285	20	07MAR32	26MAR32
Ancillary Facilities			
C225	26	01JUN30*	26JUN30
C230	60	29JUN30	27AUG30
Camp			
C180	72	20SEP30*	30NOV30
Water Treatment Plant			
C290	30	19AUG30*	17SEP30
C295	530	19SEP30	29FEB32
C115	60	16AUG30	14OCT30
C100	7	18SEP30*	24SEP30
C105	30	04OCT30	02NOV30
C110	30	04OCT30	02NOV30
C250	71	20JAN31	31MAR31
C300	27	01MAR32	27MAR32
Power Plant			
C145	7	20SEP30*	26SEP30
C150	7	27SEP30	03OCT30
C155	14	04OCT30	17OCT30
C190	60	19OCT30	16DEC30
Site Grading			
C235	124*	15MAY30*	15SEP30
C125	60	01MAY31*	29JUN31
C130	30	16MAY31	14JUN31
C245	30	15JUN31	14JUL31
C135	20	30JUN31	19JUL31
North Pile			
C240	200*	15MAY30*	30NOV30
C305	30	15SEP31*	14OCT31



8.3 COST ESTIMATES

8.3.1 Cost Summary

The estimated final reclamation cost at the end of the planned mine life is summarized in Table 8.1. This includes the expenses anticipated from the time of mine shutdown in 2029 to completion of reclamation activities in 2031 and demobilization of remaining equipment and personnel on the 2032 winter road. This cost does not include progressive reclamation credit.

The estimated final reclamation costs that would be in incurred in any given year of mine life if the mine were to shut down prior to 2029 are shown in Table 8.2. With the exception of 2005, the costs for reclamation of the mine, process facilities, surface infrastructure and water management facilities are assumed to be the same for any given year in the mine life, while the cost of reclamation of the north pile will vary year to year because of its development plan. Closure of the site in 2005 would primarily involve the closure and reclamation of the site as it presently exists (i.e. prior to the main construction period). The annual progressive reclamation credits shown in Table 8.2 reflect the estimated value of the continuing capping operations for the north pile. The credits are based on the work being performed by a third-party contractor, not the owner, and thus reflect the reduction of reclamation liability.

The estimated costs are considered to be Class I or pre-feasibility level, with an expected accuracy of +20%. All costs are presented in 4th quarter 2002 Canadian dollars, with no allowance for escalation. Estimate details are contained in Appendix B.

Table 8.1 – Final Closure & Reclamation Costs (End of Mine Life) ($CDN)

Area	Estimated Cost (CDN$)
Direct Costs	
Underground Mine	516,000
Process Facilities	5,588,000
Surface Infrastructure	9,292,000
Water Management Facilities	656,000
North Pile	1,040,000
Subtotal - Direct Costs	**17,092,000**
Indirect Costs	
EPCM	2,960,000
Site Facilities Operation	3,575,000
Environmental Monitoring	823,000
Temporary Facilities & Equipment (incl. fuel)	3,674,000
Camp & Catering	3,276,000
Freight, Winter Road Tolls and Disposal Fees	8,433,000
Subtotal - Indirect Costs	**22,741,000**
Contingency @ 15% – Mine, Surface and Indirect Costs	5,807,000
Contingency @ 15% – North Pile	156,000
Total (Rounded)	**45,800,000**

Table 8.2 –Final Closure & Reclamation Costs by Year ($CDN)

Year	Total Cumulative Exposure Cost – No Progressive Reclamation Credit			Cumulative Progressive Reclamation Credit (North Pile Reclamation)	Net Reclamation Exposure Cost
	Underground Mine and Surface Facilities	North Pile	Total		
2005	10,000,000	-	10,000,000	-	10,000,000
2006	44,600,000	-	44,600,000	-	44,600,000
2007	44,600,000	2,100,000	46,700,000	-	46,700,000
2008	44,600,000	5,096,000	49,696,000	-	49,696,000
2009	44,600,000	5,296,000	49,896,000	(1,180,000)	48,716,000
2010	44,600,000	3,633,000	48,233,000	(2,480,000)	45,753,000
2011	44,600,000	6,633,000	51,233,000	(2,480,000)	48,753,000
2012	44,600,000	6,633,000	51,233,000	(2,480,000)	48,753,000
2013	44,600,000	6,464,000	51,064,000	(2,480,000)	48,584,000
2014	44,600,000	4,178,000	48,778,000	(2,960,000)	45,818,000
2015	44,600,000	3,138,000	47,738,000	(3,440,000)	44,298,000
2016	44,600,000	1,911,000	46,511,000	(3,920,000)	42,591,000
2017	44,600,000	1,215,000	45,815,000	(4,400,000)	41,415,000
2018	44,600,000	1,125,000	45,725,000	(4,800,000)	40,925,000
2019	44,600,000	1,416,000	46,016,000	(5,200,000)	40,816,000
2020	44,600,000	8,626,000	53,226,000	(5,200,000)	48,026,000
2021	44,600,000	8,556,000	53,156,000	(5,200,000)	47,956,000
2022	44,600,000	8,491,000	53,091,000	(5,200,000)	47,891,000
2023	44,600,000	8,421,000	53,021,000	(5,200,000)	47,821,000
2024	44,600,000	7,103,000	51,703,000	(5,740,000)	45,963,000
2025	44,600,000	5,855,000	50,455,000	(6,220,000)	44,235,000
2026	44,600,000	4,815,000	49,415,000	(6,720,000)	42,695,000
2027	44,600,000	3,567,000	48,167,000	(7,200,000)	40,967,000
2028	44,600,000	2,381,000	46,981,000	(7,700,000)	39,281,000
2029	44,600,000	1,196,000	45,796,000	(8,180,000)	37,616,000

8.3.2 Cost Estimate Basis

General

For the purposes of developing the implementation schedule and cost estimates, it was assumed that the site is abandoned approximately mid-year, following which the site would be maintained by a third-party contractor until construction equipment and materials can be mobilized to site on the next available winter road. Clearly, many other scenarios are possible. For example, in the event that the site is abandoned shortly after closure of the winter road period (i.e. April), there would likely be sufficient diesel fuel in the main storage tanks (likely having been filled during the winter road period) to supply most if not all of the closure and reclamation activity fuel requirements. However, this would also require the site to be maintained for a longer period (resulting in higher maintenance costs) before decommissioning equipment and supplies could be mobilized to site on the next available winter road. Conversely, if the site were abandoned late in the year, the majority of stored diesel fuel would likely have been consumed in operations, and it would probably be necessary to purchase fuel for delivery on the next available winter road, or the year after, to support the closure and reclamation program. In this scenario, however, the site maintenance period and costs would be reduced. It is expected that such variations in costs associated with alternative scenarios, such as those described above, will be accommodated within the range of accuracy of the cost estimates.

The reclamation cost estimates were based on the following general criteria, information and assumptions:

- A third-party contractor will be engaged to operate and maintain the site from the date of mine shutdown by the owner to the completion of reclamation. All closure and reclamation activities, and operation of site support facilities during the care-and-maintenance and reclamation periods, will be performed by contracted labour and equipment.
- The site will be abandoned by the owner in a general state such that site facilities and mobile equipment are operational, but will require inspection, minor repairs, maintenance and an assessment of spare parts inventory needed for the care-and-maintenance period and the closure and reclamation program.
- All progressive reclamation activities will be performed by contracted labour and equipment during the course of regular operations.
- Reclamation measures will be as described in Section 5.
- The overall closure and reclamation schedule will be as described in Section 8.1.

A recently completed cost estimate for project construction was used as a template for the reclamation cost estimate. Labour and equipment costs were applied to decommission, dismantle and dispose of all facilities currently planned for construction in years 2004 through 2007. This method ensures that all project components and their respective quantities and specifications are accounted for in the estimate. Indirect costs were developed in the same manner, thereby ensuring consistency and coverage of all indirect costs associated with project construction.

Labour Costs

Labour costs were estimated by applying an inclusive unit labour rate to the estimated durations for closure and reclamation activities with the exception of those associated with the north pile.

Labour rates were calculated using typical wages and benefits for open shop contractors. The all-inclusive labour costs were based on working 21 ten-hour days followed by a 7-day rotation, which equates to working 210 hours in a four-week period. The following are included in the wage rate:

- base labour wage rate
- overtime premiums
- casual overtime allowance
- benefits and burdens
- Workers' Compensation premiums
- travel time
- travel costs
- appropriate crew mixes
- small tools and consumables
- contractor temporary facilities and services
- contractors' overhead and profit.

An average unit labour rate of $75/h was used for cost estimating purposes.

For the annual, final and progressive reclamation costs associated with the north pile, a unit rate of $20/m^3 was applied to the total estimated volume of capping rock and other earthworks required as detailed in Table 5.1. This rate was based on unit cost data from other similar projects and from the AEP, and includes the following:

- all-inclusive labour wage as outlined above
- earthmoving equipment, including operating and maintenance supplies
- temporary facilities
- camp and catering
- 15% contingency

Winter Access Road

With the exception of the scenario in which the mine is closed in 2005, the cost of construction and maintenance of three winter road spurs to Snap Lake was included to facilitate the closure and reclamation program, as shown in the implementation schedule. In the event of closure in 2005, it was assumed that only two winter roads would be required. The cost for winter road construction and maintenance was based on actual cost data from 2000 and 2001 winter road construction.

The toll cost for usage of the Tibbitt-to-Contwoyto winter road was based on $0.10/t/km for 222 km of road.

Engineering, Procurement and Project and Construction Management

Costs were included for a third-party engineer and manager to carry out the following work:

- project planning, including site visit, kickoff meetings and detailed planning and scheduling of decommissioning, demolition and disposal activities
- review of relevant drawings and information pertaining to equipment and structures to be demolished
- preparation of project and contract documents, including terms and conditions; drawings and specifications; safety, health and environmental management requirements; and schedules
- tendering, evaluation and administration of contracts
- procurement of equipment, materials and consumables required for the reclamation program not supplied by contractors
- construction management functions, including manager, superintendents, safety supervision, accounting, contract administration, cost control, schedule management and general administration.

The above work will be initiated during the care-and-maintenance period, approximately three months prior to the first available winter road for contractor mobilization.

Site Services and Operations

Costs were included for contractor personnel to operate and maintain the site in a care-and-maintenance mode for a period of approximately six months prior to the closure and reclamation contractor mobilizing to site. This includes:

- site manager
- alternative site manager and safety superintendent
- logistics coordinator
- administrator
- four operations and maintenance technicians for the power plant, water treatment plant, sewage treatment plant, fuel system, fresh/potable water system and other utilities
- three general maintenance personnel for snow clearing, road and airstrip maintenance, freight receiving and other general site services
- an allowance for on-call mechanics and electricians for inspection and repairs.

In the first year of closure and reclamation, costs for the above functions were included in the overall construction management cost, with the exception of the operations and maintenance technicians for the power plant, water treatment plant, sewage treatment plant, fuel system, fresh/potable water system and other utilities. Costs for these were included separately.

For the second and final year of reclamation, costs were included for a site manager and alternate and four maintenance staff.

Temporary Construction Facilities and Services

All contractor-related temporary facilities and services were included in the hourly wage rate, with the exception of camp and catering, construction equipment and a temporary shelter structure for waste sizing operations, the costs of which have been estimated separately.

A cost allowance to purchase 6.5 ML of diesel fuel was included for the first year of closure and reclamation for mobile equipment operation and for power generation for the operation of the camp and associated facilities, sewage treatment plant, fuel tank farm, water treatment plant, and mine dewatering and ventilation systems (the mine dewatering and ventilation systems would operate until removal of equipment and hazardous materials from the mine is complete, after which they would be shut down). An allowance of 1.2 ML was included for the second year.

Based on current project plans, it was assumed that the existing tank farm would be filled to its 3 ML capacity in February 2005 to support the planned 2005 site program. Should site activities cease in 2005, and closure and reclamation be necessary, it was assumed for purposes of the estimate that the fuel remaining in the tanks after cessation of site activities would be sufficient to carry out closure and reclamation of the site facilities, given that this would primarily involve only those facilities currently on site.

It was assumed that the permanent power plant would continue to operate to provide power for mine dewatering, ventilation and surface infrastructure until power demand is low enough that a temporary, containerized generator unit can provide the necessary power. An allowance for rental of a temporary generator has been included.

It was assumed that the permanent freshwater intake would be available for fresh and fire water during the reclamation program.

The cost of construction equipment was estimated at $8 per labour hour.

Construction Camp and Catering

An allowance was made for a temporary camp facility during the reclamation program, in order to allow the permanent facility to be demolished. The allowance was based on rental of a temporary, modular 50-person camp facility for a period of two years.

Based on current quotations, the camp and catering cost was estimated to be $125/day/person for up to 25-person occupancy, and $62.50/day/person for over 25-person occupancy.

Freight

Freight costs were based on transportation of 15,000 t of salvageable and recyclable equipment and 5,000 t of hazardous materials to Edmonton; suitable facilities for disposal or deposition of such items were assumed not to be available in Yellowknife. Unit costs of $5,750 and $6,900 per truckload were used for salvageable equipment and hazardous materials, respectively, based on quotations obtained from transportation contractors. It was assumed that a truckload would have an average payload of 25 t.

Disposal

Based on information obtained from auctioneers, it was assumed that costs for storage and insurance of salvageable equipment destined for resale would be deducted from sale proceeds, and are therefore not included in the estimate.

In addition to the cost of transportation, the following unit costs were used for appropriate disposal of various hazardous materials, based on quotations obtained from waste management contractors:

• waste oil:	$65/drum
• glycol:	$170/drum
• other (e.g. paint, chemicals, etc.):	$100/drum (average)

Salvage

No salvage value has been assumed in the estimate; only the cost of transporting salvageable equipment to Edmonton was included.

Post-Closure Monitoring Costs

Post-closure monitoring costs are presented in Section 7 and are not included in the closure and reclamation estimates.

Contingency

A contingency of 15% was applied to all project costs to cover unforeseeable costs within the scope of the estimate.

Exclusions

The following are not included in the estimate:

- government overhead and administration expenses during the care-and-maintenance phase, closure and reclamation phase and post-closure phase
- taxes and duties

- cost of schedule delays such as those caused by:
  - scope changes
  - unidentified ground conditions
  - labour disputes
  - environmental permitting activities
- sunk costs
- owner's costs
- revegetation costs.

8.3.3 Alternatives

For the two disposal alternatives considered, cost estimates were prepared following the same general methodology as described above, although some different estimating techniques, assumptions and costs were applied to each alternative to reflect the respective disposal methods. Each alternative is presented separately below.

Alternative: Underground Disposal

Underground disposal costs will differ from those of the base case for the following reasons:

- The labour effort and overall activity duration required for sizing, transport and placement underground of inert solid materials will be greater than that for burial in the north pile. Labour costs were increased to reflect this.
- Non-hazardous underground equipment and structures such as the primary crushing plant structure and incline conveyor would be left in place.
- The underground mine dewatering system, ventilation and heating systems must operate for a longer duration in order to keep the mine dry during underground disposal activities. In addition, the water treatment plant will need to process mine inflow water (i.e. in addition to surface water) for a longer duration. Finally, underground transport vehicles will consume more fuel than the surface hauling fleet required for transport to and burial in the north pile. An additional 4 ML of diesel fuel was included in the first year of closure and reclamation to accommodate these additional power generation and equipment requirements.

The estimated final reclamation cost at the end of the planned mine life is summarized in Table 8.3. This includes the expenses anticipated from the time of mine shutdown in 2029 to completion of reclamation activities in 2031 and demobilization of remaining equipment and personnel on the 2032 winter road. This cost does not include progressive reclamation credit.

The estimated final reclamation costs that would be in incurred in any given year of mine life if the mine were to shut down prior to 2029 are shown in Table 8.4. With the exception of 2005, the costs for reclamation of the mine, process facilities, surface infrastructure and water management facilities are assumed to be the same for any given year in the mine life, while the cost of reclamation of the north pile will vary year to year because of its development plan, as detailed in Section 5. Closure of the site in 2005 would primarily involve the closure and reclamation of the site as it presently exists (i.e., prior to the main construction period). The annual progressive reclamation credits shown in Table 8.4 reflect the estimated value of the continuing capping operations for the north pile. The credits are based on the work being performed by a third-party contractor, not the owner, and thus reflect the reduction of reclamation liability.

Estimate details are contained in Appendix B.

Table 8.3 – Final Closure & Reclamation Costs (End of Mine Life) – Underground Disposal ($CDN)

Area	Estimated Cost (CDN$)
Direct Costs	
Underground Mine	572,000
Process Facilities	6,240,000
Surface Infrastructure	10,649,000
Water Management Facilities	760,000
North Pile	1,040,000
Subtotal - Direct Costs	**19,261,000**
Indirect Costs	
EPCM	2,960,000
Site Facilities Operation	3,575,000
Environmental Monitoring	823,000
Temporary Facilities & Equipment	6,390,000
Camp & Catering	3,502,000
Freight, Winter Road Tolls and Disposal Fees	8,433,000
Subtotal - Indirect Costs	**25,683,000**
Contingency @ 15% – Mine, Surface and Indirect Costs	6,397,000
Contingency @ 15% – North Pile	156,000
Total (Rounded)	**51,500,000**

Table 8.4 – Final Closure & Reclamation Costs by Year – Underground Disposal ($CDN)

	Total Cumulative Exposure Cost – No Progressive Reclamation Credit				
Year	**Underground Mine and Surface Facilities**	**North Pile**	**Total**	**Cumulative Progressive Reclamation Credit (North Pile Reclamation)**	**Net Reclamation Exposure Cost**
2005	10,000,000	-	10,000,000	-	10,000,000
2006	50,300,000	-	50,300,000	-	50,300,000
2007	50,300,000	2,100,000	52,400,000	-	52,400,000
2008	50,300,000	5,096,000	55,396,000	-	55,396,000
2009	50,300,000	5,296,000	55,596,000	(1,180,000)	54,416,000
2010	50,300,000	3,633,000	53,933,000	(2,480,000)	51,453,000
2011	50,300,000	6,633,000	56,933,000	(2,480,000)	54,453,000
2012	50,300,000	6,633,000	56,933,000	(2,480,000)	54,453,000
2013	50,300,000	6,464,000	56,764,000	(2,480,000)	54,284,000
2014	50,300,000	4,178,000	54,478,000	(2,960,000)	51,518,000
2015	50,300,000	3,138,000	53,438,000	(3,440,000)	49,998,000
2016	50,300,000	1,911,000	52,211,000	(3,920,000)	48,291,000
2017	50,300,000	1,215,000	51,515,000	(4,400,000)	47,115,000
2018	50,300,000	1,125,000	51,425,000	(4,800,000)	46,625,000
2019	50,300,000	1,416,000	51,716,000	(5,200,000)	46,516,000
2020	50,300,000	8,626,000	58,926,000	(5,200,000)	53,726,000
2021	50,300,000	8,556,000	58,856,000	(5,200,000)	53,656,000
2022	50,300,000	8,491,000	58,791,000	(5,200,000)	53,591,000
2023	50,300,000	8,421,000	58,721,000	(5,200,000)	53,521,000
2024	50,300,000	7,103,000	57,403,000	(5,740,000)	51,663,000
2025	50,300,000	5,855,000	56,155,000	(6,220,000)	49,935,000
2026	50,300,000	4,815,000	55,115,000	(6,720,000)	48,395,000
2027	50,300,000	3,567,000	53,867,000	(7,200,000)	46,667,000
2028	50,300,000	2,381,000	52,681,000	(7,700,000)	44,981,000
2029	50,300,000	1,196,000	51,496,000	(8,180,000)	43,316,000

Alternative: 100% Off-site Disposal

Disposal costs for this alternative will be significantly greater than those of the base case, given that an additional 80,000 m^3 of equipment and materials must be trucked to off-site disposal facilities.

For the purposes of cost estimating, the following assumptions and unit costs were used (i.e. in addition to transport costs):

• Destination:	landfills and scrap dealers, Edmonton
• Average material transport density:	1 t/m^3
• Waste makeup:	
– Scrap metals:	80%
– Tires, drywall, wood, other:	20%
• Disposal/tipping fee (based on quotations):	
– Scrap metal:	$42/t
– Other construction debris:	$26/t

The estimated final reclamation cost at the end of the planned mine life is summarized in Table 8.5. This includes the expenses anticipated from the time of mine shutdown in 2029 to completion of reclamation activities in 2031 and demobilization of remaining equipment and personnel on the 2032 winter road. This cost does not include progressive reclamation credit.

The estimated final reclamation costs that would be in incurred in any given year of mine life if the mine were to shut down prior to 2029 are shown in Table 8.6. With the exception of 2005, the costs for reclamation of the mine, process facilities, surface infrastructure and water management facilities are assumed to be the same for any given year in the mine life, while the cost of reclamation of the north pile will vary year to year because of its development plan, as detailed in Section 5. Closure of the site in 2005 would primarily involve the closure and reclamation of the site as it presently exists (i.e. prior to the main construction period). The annual progressive reclamation credits shown in Table 8.6 reflect the estimated value of the continuing capping operations for the north pile. The credits are based on the work being performed by a third-party contractor, not the owner, and thus reflect the reduction of reclamation liability.

Estimate details are contained in Appendix B.

Table 8.5 – Final Closure & Reclamation Costs (End of Mine Life) – Off-Site Disposal ($CDN)

Area	Estimated Cost (CDN$)
Direct Costs	
Underground Mine	572,000
Process Facilities	6,241,000
Surface Infrastructure	10,649,000
Water Management Facilities	760,000
North Pile	1,040,000
Subtotal - Direct Costs	**19,262,000**
Indirect Costs	
EPCM	2,960,000
Site Facilities Operation	3,575,000
Environmental Monitoring	823,000
Temporary Facilities & Equipment	3,905,000
Camp & Catering	3,502,000
Freight, Winter Road Tolls and Disposal Fees	31,721,000
Subtotal - Indirect Costs	**46,486,000**
Contingency @ 15% – Mine, Surface and Indirect Costs	9,693,000
Contingency @ 15% – North Pile	156,000
Total (Rounded)	**75,600,000**

Table 8.6 – Final Closure & Reclamation Costs by Year – Off-site Disposal ($CDN)

	Total Cumulative Exposure Cost – No Progressive Reclamation Credit				
Year	**Underground Mine and Surface Facilities**	**North Pile**	**Total**	**Cumulative Progressive Reclamation Credit (North Pile Reclamation)**	**Net Reclamation Exposure Cost**
2005	10,000,000	-	10,000,000	-	10,000,000
2006	74,400,000	-	74,400,000	-	74,400,000
2007	74,400,000	2,100,000	76,500,000	-	76,500,000
2008	74,400,000	5,096,000	79,496,000	-	79,496,000
2009	74,400,000	5,296,000	79,696,000	(1,180,000)	78,516,000
2010	74,400,000	3,633,000	78,033,000	(2,480,000)	75,553,000
2011	74,400,000	6,633,000	81,033,000	(2,480,000)	78,553,000
2012	74,400,000	6,633,000	81,033,000	(2,480,000)	78,553,000
2013	74,400,000	6,464,000	80,864,000	(2,480,000)	78,384,000
2014	74,400,000	4,178,000	78,578,000	(2,960,000)	75,618,000
2015	74,400,000	3,138,000	77,538,000	(3,440,000)	74,098,000
2016	74,400,000	1,911,000	76,311,000	(3,920,000)	72,391,000
2017	74,400,000	1,215,000	75,615,000	(4,400,000)	71,215,000
2018	74,400,000	1,125,000	75,525,000	(4,800,000)	70,725,000
2019	74,400,000	1,416,000	75,816,000	(5,200,000)	70,616,000
2020	74,400,000	8,626,000	83,026,000	(5,200,000)	77,826,000
2021	74,400,000	8,556,000	82,956,000	(5,200,000)	77,756,000
2022	74,400,000	8,491,000	82,891,000	(5,200,000)	77,691,000
2023	74,400,000	8,421,000	82,821,000	(5,200,000)	77,621,000
2024	74,400,000	7,103,000	81,503,000	(5,740,000)	75,763,000
2025	74,400,000	5,855,000	80,255,000	(6,220,000)	74,035,000
2026	74,400,000	4,815,000	79,215,000	(6,720,000)	72,495,000
2027	74,400,000	3,567,000	77,967,000	(7,200,000)	70,767,000
2028	74,400,000	2,381,000	76,781,000	(7,700,000)	69,081,000
2029	74,400,000	1,196,000	75,596,000	(8,180,000)	67,416,000

SECTION 9 • FINANCIAL SECURITY AND ASSURANCE

9.1 INTRODUCTION

DIAND's *Mine Site Reclamation Policy for the Northwest Territories* (Reclamation Policy) sets the following guiding principles for financial security:

1. The total financial security for final reclamation required at any time during the life of the mine should be equal to the total outstanding reclamation liability for land and water combined (calculated at the beginning of the work year, to be sufficient to cover the highest liability over that time period).
2. Financial security for mine site reclamation for new mines must be readily convertible to cash. Security must meet the following basic criteria:
   - Subject to applicable legislation and due process, the form of security must provide the Crown with immediate, unconditional, unencumbered access to the full amount of the security;
   - The form of security must retain its full value throughout the life of the mine and, if applicable, beyond;
   - The form of security must remain beyond the control of the mining company, or its creditors in the event of insolvency.
3. The Minister of Indian and Northern Affairs may consider new or innovative forms of security, such as reclamation trusts, provided they meet the above criteria.

Regulatory authority to require financial assurance for mine site reclamation is not contained in a single statute. On Crown-owned lands in the Mackenzie Valley, DIAND has jurisdiction with respect to land leases and related security issues. The MVLWB has the jurisdiction to determine the amount of security in water licenses and land use permits, while the Minister for DIAND has the power to determine the form of security provided under these instruments.

Accordingly under the policy it is intended that DIAND take the lead in facilitating discussions between the various regulatory bodies to promote the co-ordination of financial security obligations. This role includes:

- ensuring that, at any given time during the life of the mine, the total financial security for mine site reclamation in place, subject to the timing of any application for credit for progressive reclamation, is equal to the total outstanding reclamation liability of the mine site, and the financial security for closure-related activities, imposed by land and water jurisdictions cumulatively, does not exceed the total reclamation cost estimates for both the land-related and water-related reclamation elements at each mine;
- ensuring that the terms, conditions and notification processes in financial security are compatible for all regulatory instruments; and

- co-ordinating the regulatory determinations required for each decision maker (e.g., the Minister, MVLWB).

9.2 CREDIT FOR PROGRESSIVE RECLAMATION

Ongoing reclamation throughout the life of the mine is preferable from both the environmental and financial liability perspectives. DIAND's Reclamation Policy indicates its intent that the financial security of a mining project be adjusted to reflect progressive reclamation on the following basis:

- When ongoing reclamation work reduces the outstanding environmental liability, it will result in a reduction in the level of financial security required to be maintained.
- Credit for progressive reclamation work should be made in a timely fashion in accordance with authorities set out in the applicable legislation.
- The value of reclamation work will be based on generally accepted modeling and calculated as the difference between previous outstanding liability and estimates made of the remaining liability following the reclamation work (as opposed to actual costs, if actual costs do not fully reduce outstanding liability).
- The amount of financial security on deposit will normally increase proportionately as mining proceeds. Generally this implies that as the mine site grows, water usage increases and the work to restore a site expands. Accordingly, reclamation costs are usually estimated to rise over the life of the mine. However as reclamation is performed, the environmental liability is reduced and the financial security required may decrease proportionately.
- If, during a specific period, the value of any progressive reclamation exceeds the value of new reclamation liability created through additional mining operations, DIAND would reduce the amount of security required through the surface lease and would support an application by the mining company to the MVLWB to reduce the amount of the water license security accordingly.
- Progressive reclamation may not reduce the financial assurance required to zero. Sometimes, a residual amount is required to meet other licensing obligations.

9.3 POST-CLOSURE RECLAMATION AND FINAL DECOMMISSIONING

DIAND's Reclamation Policy indicates that once the reclamation work required under the Mine Closure and Reclamation Plan is deemed completed, the site will be allowed to stabilize. During this time, monitoring will be conducted by the company and verified by DIAND and other agencies as appropriate, with respect to the effectiveness of the mitigative measures, the accuracy of the environmental assessment and any unforeseen environmental impacts. The duration of the required monitoring phase will be reviewed and confirmed at the time of closure and will depend on the risks associated with the potential impacts on the environment.

During this period the mining company will continue to be responsible for the site, including remediation of any additional environmental complications that develop. If warranted by site conditions, the monitoring period may be extended to ensure remedial measures are met.

The Minister may hold back an appropriate amount of financial assurance to cover future requirements for the site. In such cases, the mining company will be responsible for the care and maintenance of the site, but will also maintain a claim to any remaining financial assurance.

When the Minister is satisfied that the operator has met the requirements for the decommissioning under the relevant legislation and that the objectives of the Mine Closure and Reclamation Plan have been fully met, the Minister will provide the mining company with a written acknowledgement to that effect.

9.4 FINANCIAL SECURITY AND ASSURANCE FOR THE PROJECT

De Beers is committed to providing suitable financial security and assurance to cover the cost of full reclamation of the Snap Lake project. Table 8.2 provides an estimate of reclamation liability for each year of the project between mine start-up and projected closure in 2029, utilizing 100% third-party management and contracting. De Beers expects that these estimates will form the basis for future discussions between the MVLWB, DIAND and De Beers in establishing the appropriate level and form of financial security to be posted for the project. De Beers acknowledges the stated principles covering financial security enunciated in the *Mine Site Reclamation Policy for the Northwest Territories*. It is De Beers' intent to enter into discussions with the responsible authorities to reach agreement on an appropriate form and amount of security to be posted for the project.

At this time De Beers has not developed or indicated any preference towards a specific format for the posting of security against reclamation liability. De Beers remains open to consideration of a wide range of options, including but not limited to the creation of a reclamation trust, cash, letter of credit, insurance bond or a combination of these mechanisms and others that may arise as a result of future discussions with the authorities.

De Beers is committed to a program of progressive reclamation at Snap Lake. Progressive reclamation has been built in as an integral part of the mine plan. Consequently, De Beers intends to manage its reclamation liability at Snap Lake by initiating reclamation work at an early point in the mine life, thereby limiting the expansion of overall liability over time.

SECTION 10 • POST-CLOSURE ENVIRONMENT AND LAND USE

The key objectives of the reclamation plan are to:

- protect public health and safety through the use of safe and responsible reclamation practices
- reduce or eliminate environmental effects once the mine ceases operations
- re-establish conditions that permit the land to return to a similar pre-mining land use
- reduce the need for long-term monitoring and maintenance by establishing physical and chemical stability of disturbed areas.

The following provides a brief description of the post-closure environment and land use potential.

10.1 TRADITIONAL LAND USE

The project is located within a region that was used in the past by Aboriginal people for trapping and as a travel route for hunting wolves. At present, however, the project area is not used regularly for traditional hunting or fishing, although caribou are harvested to the north. Impacts to traditional land use will therefore be low, in part because the project footprint is relatively small. Once the project is reclaimed, there should be no effects on traditional land use patterns.

10.2 NON-TRADITIONAL LAND USE

Existing and potential non-traditional land uses within the area affected by the project include extraction of subsurface minerals, domestic hunting and trapping, commercial and recreational fishing, recreation and tourism. The area also has perceived value as an ecologically representative, undeveloped wilderness. Few human activities are common at present because of the isolation of the area. Three camps/lodges approximately 30 to 35 km from the mine site – McKay Lake Lodge, Lac du Rocher Outpost Camp and Warburton Bay Lodge – provide limited recreation and tourism services.

The winter road to Snap Lake will increase surface access into the project area during the operating and reclamation phases of the mine; the last winter road construction will coincide with the end of the two-year long closure and reclamation period. However, the short duration of road availability each year, the restricted use of the road for project-related purposes only and the remoteness of the area make it unlikely that this increased access will have any notable influence on land use.

10.3 AESTHETIC QUALITY

Buildings, steam plumes and outside lighting will be visible well beyond the immediate project site during the operating life of the mine. After closure, the north pile will remain visible because of its size (approximately 92 ha) and height (34 m), comparable to the highest landforms in the area. The pile will be capped with quarried granite to help it blend with the surrounding landscape in terms of colour and texture. All other surface infrastructure will be removed. Site roads and the outlines of laydown areas will remain readily apparent for several decades until native vegetation becomes re-established.

10.4 BIOPHYSICAL ENVIRONMENT

Emissions of greenhouse gases, dust and noise from project facilities will cease after the reclamation period. The rock cap over the north pile will prevent significant dusting. Noise from air and road traffic will be substantially eliminated; only a few aircraft visits per year are anticipated for post-closure monitoring.

Most of the immediate surface area affected by the project will be boulder (415 ha), with lesser amounts of moraine (50 ha), shallow organics (54 ha), deep organics (9 ha) and deep water (32 ha). Winter roads and the small quarry south of the mine will directly affect another 90 ha, including about 0.5 ha of esker. Any developed area that becomes unnecessary as operations proceed will be recontoured to its previous shape as part of progressive reclamation. At closure, the surface disturbed by project facilities will remain visible as rock-covered, gently sloping ground that will blend with the surrounding terrain but still be distinct for several decades until native revegetation becomes re-established.

To reduce impacts to frozen ground and ensure stability of facilities, structures will be built on bedrock or piles. These methods, together with a general absence of ice-rich lenses, will reduce the likelihood of subsidence related to thawing. Except for a surface-active layer, material deposited in the north pile is expected to be frozen within two years of placement. The north pile has been designed to be stable under thawed conditions and would not be affected by global climate change.

The project area currently provides habitat for a variety of terrestrial wildlife and birds. None of these species, including caribou, is heavily dependent on resources within the project footprint, however, and similar habitat is prevalent throughout a wide region surrounding the project site. Nevertheless, the size of the project footprint has been restricted, and the quarry esker beyond the immediate mine site will be used as little as possible. The loss of habitat during project operations and after closure, before vegetation becomes re-established, is therefore expected to have relatively minor impact on wildlife.

In summary, although the project will induce lasting physical changes to the local topography, the proposed reclamation plan will minimize these effects and assure the biodiversity and sustainability of the natural renewable resources of the region.