JERICHO PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

This report assesses potential biophysical impacts from construction, operation, and closure of the Jericho Mine, a diamond mine proposed for the West Kitikmeot, Nunavut. The report forms part of the environmental impact statement (EIS) for the Project.

Environmental Effects

The Project will have negligible to low impacts in a regional context and low to moderate impacts in a site context. No significant impacts on the local or regional climate are expected to result from the proposed mining or processing operations.

Waste Rock

Two waste rock piles will be created to prevent one dump becoming excessively high. The Project Description (Appendix A.1) discusses mine layout as presently conceived. Dump footprints may vary slightly from those shown in the report. Geotechnical drilling at the site of Dump #1 and visual inspection by geotechnical engineers (SRK) confirmed that bedrock is at, or very near, the surface at both locations, making the sites suitable for dump construction. Condemnation drilling will be required at dump site #2 to be assured no economical resources will be covered by the dump.

Processed Kimberlite

Coarse and fine processed kimberlite (PK) will be generated by the diamond plant. Approximately 10-15% of plant production will result in fine PK and 85-90% in coarse PK. Normal operation of the Processed Kimberlite Containment Area (PKCA) will produce low to moderate impacts on the aquatic receiving environment. The lake basin that becomes the PKCA will be removed from aquatic habitat. Long Lake contains limited numbers of burbot and slimy sculpins, but no game fish. Water that meets Project Water Licence criteria will be discharged during summer months through a polishing pond.

Domestic and Industrial Wastes

Domestic sewage will be treated in a plant and water discharged to the processed kimberlite containment area. Domestic garbage, including kitchen wastes will be incinerated. Large industrial wastes will be burned, stored on site, or removed through back hauls on the winter road. Hazardous wastes (e.g. waste petroleum products) will be incinerated on site, or handled through a hazardous waste contractor. Removal from site will be by back haul on the winter road.

Noise

Barren-ground caribou have been found to avoid intense noise, but become habituated to routine noise at mine sites, including explosives discharges (BHP 1995). Noise generated by the mining operations may contribute to avoidance of the site by other large mammals, such as grizzly bears, foxes, and wolves. In general this effect on carnivores is desirable to help mitigate potential conflicts.

Air Emissions

The principal sources of emissions at the Jericho site will be dust from mobile equipment, limited dust generated by explosives discharges, and exhaust emissions from stationary and mobile internal combustion engines. Except in the open pit during prolonged inversion conditions, exhaust gas emissions will be insignificant, due to the small number of sources involved. The effects of dust generated by Project mining activities on productivity of local vegetation will be local, of medium duration, and negligible on the overall tundra biome. Problematic dust sources will be watered during the summer. Winter dust generation should be limited by snow cover.

Terrestrial Habitat and Biota

Approximately 20 percent of the local habitat will be disturbed in the immediate area of the Jericho Diamond Project. Regardless of the effectiveness of mitigation measures the disturbance will persist well beyond the operations phase of the Project. According to criteria established for this environmental effects assessment, the effects of the Jericho Diamond Project on the local plant communities and associated wildlife habitat will be local, moderate (>6 <30% local habitat disturbance), and long-term.

The habitat found in the Project area does not appear to be unique and the area of disturbance is small in relation to the habitats available. Up to 222 ha of land could be directly disturbed by project developments at the pipe: over 130 ha (59%) will be upland (dry and rocky tundra). Locally the impacts on habitat will be significant, but within the context of large mammal and bird habitats, impacts will be low to insignificant. Small mammal and some song bird habitat will be lost until areas are reclaimed at the end of mine life. Habitat occupied by the open pit and waste rock dumps will be permanently altered.

The interactions of construction, operations, transportation, and related support activities for the Jericho Project with wildlife over the life of the Project were examined and their environmental effects on wildlife populations assessed. In all cases: - raptor populations, migratory bird populations, small mammal populations, ungulate populations, and carnivore populations - the environmental effects were found to be contained to the area of the Project, or in the case of caribou, to the limit of the Bathurst herd's range. The environmental effects from the Project on wildlife do not extend beyond the life of the Project, and will not be detectable in any wildlife population.

The sustainability of harvests on populations presently being harvested should not change as a consequence of the overall environmental effects from the Jericho Diamond Project. These findings are consistent with those of the environmental effects assessment of the Diavik Project which is approximately 170 km southeast of Jericho and is proposed to operate for 23 years and disturb an active footprint more than five times greater than that of the Jericho Project (CEAA, 1999).

Aquatic Habitat and Biota

Explosives can negatively affect fish. Impacts from explosives use at the site will be minimized by delaying detonations between successive charges, thus ensuring no multiplicative effects from large blasts.

Angling also has the potential to negatively affect fish populations in relatively small lakes. Angling by mine personnel will be prohibited in the small lakes on the Project site.

Stream C1 at the Jericho site presently runs through the area proposed for the open pit. This stream will be diverted around the north end of the pit, and into Carat Lake. Discharge from the waste rock, overburden, and ore stockpiles will be collected and retained in settling ponds to remove suspended solids; additional treatment may be required to remove ammonia. A number of alternatives are being considered including additional storage time in the PKCA, spray irrigation, and a water treatment plant. Sewage and greywater will be treated prior to discharge to the PKCA. No significant impact is expected on the water resources of the region. Water will require discharge from the processed kimberlite containment area annually to maintain the water balance in the facility. Should water not meet Project Water Licence criteria, alternate methods of water disposal will be used, such as spray irrigation or treatment in a water treatment plant.

There will be direct "footprint" impacts on lake habitat at the Jericho site principally from the processed kimberlite containment area; a small amount of shallow water and foreshore area of Carat Lake will be lost from construction of a causeway for the water intake. A winter road will be required to resupply the Project, with crossings on Lynne (first year only) and Contwoyto lakes. Impacts related to the road crossing will be minimized by avoiding areas with good fish habitat, particularly the potential spawning shoal in Contwoyto Lake at the Jericho site. The most sensitive lake habitat is the near shore shallow (littoral), areas, which contain habitat used by aquatic biota, such as macro-invertebrates and fish. It is expected that the impacts to the receiving water quality will be minor, and will be localized to Lake C3 and Carat Lake at Jericho.

Post-closure plans call for the Jericho pit to fill with water through runoff, precipitation, and possibly re-direction of a portion of the flow of the diverted C1 stream (subject to discussions with Fisheries and Oceans Canada). In time, water level in the pit will reach normal lake levels. However, the water-filled pit it is not expected to result in aquatic productivity levels equivalent to natural lakes in the region, given its relatively great depths and lack of littoral habitat.

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1.0 ENVIRONMENTAL EFFECTS ASSESSMENT

1.1 POTENTIAL ENVIRONMENTAL IMPACTS EXAMINED

Pursuant to the guidelines established by Nunavut Water Board (NWB), September 1999 and as amended April 5, 2000, this environmental impact assessment examines the areas of potential impact listed in Table 1.1. Previous documents submitted by Tahera dealt with the option involving mining at Jericho and processing ore at Lupin Mine as the preferred method, whereas this EIA discusses in detail mining and processing at the Jericho site. Relevant portions of the previous EIA are contained in this report.

A summary of potential impacts of the various mining components and the environment are shown schematically in the block diagram Figure 1.1. All impacts discussed are direct, unless otherwise specified.

1.2 SIGNIFICANCE OF EFFECTS

The significance of impacts to the biophysical environment have been evaluated using criteria listed in "A Reference Guide for the Canadian Environmental Assessment Act for Determining Whether a Project is Likely to Cause Significant Environmental Effects" (CEAA 1994).

1.3 SPATIAL BOUNDARIES OF THE STUDY AREA

The spatial boundaries of the study area varied with the component being studied. The entire West Kitikmeot region was included in socio-economic studies; aquatic studies were limited to a 50 km^2 area centred at Carat Lake. For terrestrial biota, an environmental effect of regional significance would affect a broad area or resource base of common interest to a large number of people. For the purposes of this report, the area encompassing range of the Bathurst Caribou herd becomes the region of spatial significance. This can be described as the central barren lands. The core of the region is an unpopulated, relatively inaccessible area within the tundra biome; it is used at low intensity for resource harvesting by the Inuit communities to the north and northeast, and supports caribou harvested by communities in the Northwest Territories to the south and southwest of the Project. For terrestrial biota a local environmental effect is the consequence of an interaction within the outer limits of the Project footprint. Map A (Appendix E) shows the configuration of the Project infrastructure, contained within a perimeter with an area of less than 900 ha. This area is the extent of the ecological mapping completed by Canamera (1995) and includes the Project's site facilities.

1.4 TEMPORAL BOUNDARIES OF ASSESSMENT

Again, temporal boundaries varied with the component of the biophysical environment being considered. Temporal boundaries for data used to evaluate global warming effects have been variously several millennia to geological epochs. More definitive data are available for the central Arctic for the last 100 years (WKSS 1999). Temporal boundaries for wildlife, vegetation, and aquatic studies are discussed in their respective sections. Where appropriate, historical data over a longer time frame were evaluated, e.g., climate normals were obtained for a 26-year time span.

1.5 VALUED ECOSYSTEM COMPONENTS CONSIDERED

Valued Ecosystem Components (VECs) considered included all physical and biological components of the environment assessed for potential Project impacts. Valued Socio-Economic Components (VSECs) are considered in the Socio-Economic Effects Assessment (Appendix C.1.2). In developing VECs, reference was made to community consultations where people identified issues of concern. Issues raised by communities were very limited and very consistent: water quality, wildlife habitat, and wildlife (specifically caribou, grizzly, wolf, and wolverine). The VEC list considered for cumulative effects assessment for the Jericho Project includes:

- air quality;
- water quantity and quality;
- permafrost;
- terrestrial and aquatic habitats;
- terrestrial and aquatic plants and animals; and
- heritage resources.

The following sections of this report provide details of the assessment of each of these components other than heritage resources, which are reported in detail in the two reports prepared by Fedirchuk, McCullough and Associates (Appendices C.3.1 and C.3.2); heritage resource impacts are discussed in Appendix C.3.3.

1.6 CLIMATE

1.6.1 Potential for Effects from the Project

Given the scale of activities, no changes in the regional or local climate would be possible from exploration-related activities. Changes in microclimate were not measured or evaluated during the exploration phase of the project.

No significant impacts on the local or regional climate are expected to result from the proposed mining or processing operations. At the microclimate level, some impacts will occur from changes in topography at the open pit, dust from operations, and local small changes in water balances from operation of sedimentation ponds and the tailings impoundment. Potential effects on air quality are discussed in the Air Quality Report (Appendix D.1.1).

1.6.2 Potential Effects on the Project

Climate change has been identified by government agencies as an issue of concern, particularly global warming. Global warming over the life of mine for Diavik was discounted as an issue by the Responsible Authorities for the

Diavik Comprehensive Study. Given that the Jericho Project is 170 km north of Diavik, it can be reasonably concluded that global warming will not significantly affect the Project during its life.

Further, the Project does not depend on frozen core dams, nor on permafrost presence, for any Project facility. It is extremely unlikely that the trend in global warming will accelerate enough over the eight-year life of mine to make a winter road supply scenario unworkable. Other climate changes such as changes in precipitation and temperature will not significantly affect operation of the mine or processing plant.

The limitations and opportunities of Arctic climate have been taken into account in Project planning as discussed in the Project Description (Appendix A.1).

1.7 SEISMICITY

While the Jericho area is in a region of low to very low risk for seismic activity, at the request of Natural Resources Canada, a seismic risk analysis was commissioned by the Pacific Geosciences Centre. Their report can be found in Attachment 1.1.

1.8 PERMAFROST

1.8.1 Background

The western Arctic has warmed about 2°C over the past 100 years. In that same time period human activities have caused an increase globally of about 0.5°C (Environment Canada 1991a). By 2050 the amount of carbon dioxide in the atmosphere is predicted to double, which is also predicted to raise the mean annual global temperature between 1.5° and 4.5°C (Environment Canada 1991b). In the continuous permafrost zone the active layer may thicken and permafrost slowly melt. However, specific responses of permafrost and the active layer are difficult to predict, since they also depend on precipitation changes, vegetation, soil moisture, and snow cover (Williams 1979, Maxwell 1992, Harris 1987). Evidence at present suggests that winter warming will be greater than summer, but that winter temperatures will not rise above freezing in the western Arctic (Cohen, et al. 1994). Based on data compiled by the Geological Survey of Canada, Terrain Sciences Division (GSC 2000a), the Project site is in an area of high thermal response to warming, but also an area of low to minimal impact from permafrost thaw.

A lag occurs between changes at the ground surface, e.g. caused by increases in average temperature and changes in permafrost at depth, and will range from years to decades for thin permafrost up to centuries or millennia for thick permafrost (GSC 2000b). Permafrost at Jericho is 540 m thick and would thus be expected to change temperature only over a very long time.

1.8.2 Assessment of Potential Effects

Waste rock, ore, and coarse PK will be placed in areas with little overburden and will be bedrock controlled. Thus, thermokarst erosion will not be an issue. Roads will be constructed on a ballast of crushed rock placed directly on the tundra. Roads constructed in this manner for exploration have not shown any signs of thermokarst activities in five years existence at Jericho. Some melting of small ice lenses occurred at the airstrip. These were monitored for two years after construction of the strip, but have not resulted in significant slumping of soils on the edge of the strip.

In years 4 and 5 during underground mining, air flow to the underground will be kept at a conservatively safe, but not excessive, level to inhibit (to the extent practical) melting of permafrost in underground workings. Most underground access will be in granite, where stability problems, if permafrost thaws, are not expected.

Ice lenses may be encountered in borrow areas. Ice-rich soils will be placed on the overburden stockpile, if required, until the ice melts out of them and they can then be handled normally. Borrow areas will not be created with long, steep slopes subject to erosion. Erosion of borrow areas has not been a problem for those developed for exploration activities, and is not expected to be problematic during mining operations.

Some minor ice cracks exist in the bedrock of the deposit and host rock; they are a few centimeters wide every 10 m depth on average, based on occurrence in the exploration decline. These ice cracks will not cause significant water generation during development of the open pit or underground mining. Melting would be no more than three meters back from the face maximum, based on freeze-thaw estimates for bedrock. While water from ice lenses has been found to be high in metals, dilution by precipitation in the pit will readily reduce metals concentrations in the small amount of ice melt water expected. Despite this prediction, if water is problematic, it will be pumped to the PKCA, or used to water road surfaces away from water bodies.

Based on diamond core drilling, drillhole, and bulk sample decline temperature measurements, and information obtained from nearby Lupin Mine, the permafrost extends to a depth of approximately 540 m. Although some joints within the kimberlite are filled with ice (drill core and underground observation), the country rock granite contains a very limited number of ice filled joints. One exception is along the pipe contact zone. Since the majority of the pit walls will be excavated beyond the contact zones a limited thawing of ice in the active layer during the summer months will not have a major impact on wall stability. In fact the strengthening effect of ice could have a positive impact on the physical stability (as observed in some diamond mines in Siberia).

Permafrost melting will be prevented under heated buildings by placing mats under them, e.g., the mine camp and office trailers, to prevent differential settling from building heat.

1.9 HYDROLOGY

1.9.1 Water Balance

1.9.1.1 Hydrologic Parameters

A site water balance, based on a regional analysis, was developed by SRK Consulting and is presented in this section.

Key hydrologic parameters for the Jericho Site are summarized in Table 1.2. As indicated in Table 1.2, the site has a positive water balance, indicating that precipitation exceeds net evaporation. Mean annual runoff was calculated using two methods. The first method was to subtract mean annual evapotranspiration from mean annual precipitation, which corresponded to an MAR of 130 mm. The second method was regional analysis, which resulted in a much higher estimate, 250 mm based on the catchment area relationship. The basis for the MAR estimates is provided in a March, 1998 memo from P. Bryan to SRK (Attachment 1.2). As indicated in the Table, the majority of the runoff occurs in June, during the spring freshet period.

With the exception of the Long Lake PKCA, flows from each of the mine components were calculated based the mean annual runoff (MAR) and catchment areas, as shown in Table 1.3.

Flows from the PKCA are corrected for lake evaporation, and the additional inputs from the PK slurry and waste water treatment plant, estimated as follows (Table 1.4):

$$Qp = DA*MAR + IA*(P - E_L) + WWTP + TS$$

Where:

Qp = flow from PKCA

IA = Surface area of lake (9.8 ha)

DA = Drainage area (61.3 ha - IA)

P = 330 mm Mean Annual Precipitation

E_L = 280 mm Mean Annual Lake Evaporation

E_T = 200 mm Mean Annual Evapotranspiration

MAR = Mean Annual Runoff

Lower Bound: = 130 mm ($P – E_T$)

Upper Bound: = 250 mm (based on regional analysis)

WWTP = Inputs from waste water treatment plant

TS = Input from PK slurry

The Long Lake catchment is approximately 61 ha. in size. Long Lake has a surface area of 9.8 ha. Monthly runoff to the impoundment is calculated by taking the drainage area not covered by the lake, multiplying by the MAR and adding the direct precipitation onto the lake surface, less lake evaporation. By assuming the PK lake surface area stays static, the increased lake evaporation is neglected, which gives a conservative estimate of runoff. Based on a range of MAR from 130 mm to 250 mm, the expected runoff inflow to the impoundment ranges from 67,000 m^3 to 128,000 m^3. The net precipitation (water surface area multiplied by the difference between the precipitation and the lake evaporation) will account for a further 5,000 m^3.

The sewage treatment plant will contribute another 11,000 m^3 to the PKCA.

1.9.1.2 PKCA

Flow to the PKCA from the processing plant will be 168,000 m^3/year, based on the following:

- plant discharge water 23.7 m^3/hr
- plant operation: 24 hr/d, 365 d/yr
- plant availability factor: 0.9
- plant utilization factor: 0.9

Conservatively, assuming all of this water would separate from the PK solids, and assuming water normally found in the basin would report to the discharge, between 250,000 m^3 and 313,000 m^3 of water would require discharge, dependant on the lower and upper bounds of the MAR. Because there is some excess storage within the facility, the discharge can be distributed over the 3 to 4 month summer period (May to August). If the water were released over 3 months, approximately 84,000 m^3 to 104,000 m^3 would require discharge each month. If the water could be released over 4 months, this range can be reduced to 63,000 m^3 to 78,000 m^3 per month.

Based on the timing of melting of summer lake ice and the experience of northern communities that discharge sewage to wetlands year round (Dillon Consulting 1998), it is probable that ice contained in the east cell from winter plant discharge will not melt before the end of the spring freshet. This will result in some decrease in the effective short-term (summer) storage capacity of the PKCA.

Seepage from the waste rock and low grade ore stockpiles may be directed to the PKCA as a means of providing additional residence time for degradation of ammonia. A worst case analysis, assuming that all of the runoff would need to be diverted to the impoundment, indicates that the above estimates could be 2x higher than indicated for the PKCA alone as shown in Table 1.4.

1.9.1.3 Carat Lake

The volume of Carat Lake, based on a 1996 bathymetric survey is estimated at 27 million m^3 (27,203,110 m^3). The drainage basin area is 148 km^2. At a mean annual runoff of 190 mm, the lake water exchanges in less than a year (28.12 million m^3 annual runoff, leaving aside lake precipitation minus evaporation, which is a small percentage of basin mean annual runoff). The total area of the Project site that drains toward Carat Lake is 1.52 km^2. The contribution to Carat Lake from the site (without drainage controls is 288,800 m^3, or just over 1% of the total runoff as shown in Table 1.5.

With the Jericho mine operating, up to 220,000 m^3 could be withdrawn annually from Carat Lake, or 1% of the annual volume flowing into the lake. With discharge of approximately 300,000 m^3 from the PKCA annually the net change will be close to zero. If water from the mine area and process water is treated by spray irrigation, up to 2% of Carat Lake water could be removed on an annual basis. A small, unestimated, amount of the water withdrawn will be lost to evaporation and some will remain as surface moisture on coarse PK (maximum 12% by volume or approximately 34,000 m^3 annually). Much of this surface moisture will seep from the coarse rejects stockpile and be routed to the PKCA; the remainder will evaporate or freeze. Initially, as PK is added to the impoundment, pore water will remain with the solids in void spaces. Once void spaces are filled no additional pore water will be retained.

1.9.1.4 Lake C3

Lake C3 will receive discharge from the PKCA through Stream C3. The volume of Lake C3, based on 1996 and 2000 (west arm) bathymetry is 4,743,239 m^3. The drainage basin area is 133 km^2. At a mean annual runoff of 190 mm, the lake water exchanges five times per year. The natural drainage basin of Stream C3 (including Long Lake) is 61 ha which would result in an annual runoff (MAR 190 mm) of 115,900 m^3. During PKCA operation, discharge to Lake C3 will increase by 168,175 m^3, if all water pumped to the PKCA is discharged to Stream C3. This represents a 150% increase in discharge. This estimate is conservative because some water will be held as pore water and more will evaporate from the PKCA surface. Water balance for the lake is shown in Table 1.5.

Water drawn from Carat Lake will return to Carat Lake through discharge to the PKCA, Stream C3, and Lake C3. Over an annual cycle then, the water balance of Carat Lake and Lake C3 will change by the amount of water lost in processing, principally water retained by the coarse PK rejects (approximately 10% moisture by weight or 37,668 m^3 per year). Assuming none of the moisture runs off the rejects stockpile where it would be routed to the PKCA, the loss would represent 13% of the total annual volume discharged to Lake C3 through Stream C3, and 0.14% of the volume of Carat Lake. In fact, water will runoff from the coarse PK stockpile, but the amount cannot be easily estimated, since an undetermined amount of freezing will occur.

If PKCA supernatant water is spray irrigated, discharge from C3 would be reduced by an amount equal to the runoff reporting to the PKCA, or approximately 98,000 m^3 at 190 mm annual runoff. This equates to a 2% loss in total runoff to Lake C3, assuming none of the sprayed water seeps into Lake C3.

1.9.2 Mining

1.9.2.1 Assessment of Potential Effects

Control of water from disturbed areas will change natural flows to a limited extent as listed in Table 1.6.

Stream C1 (Map A, Appendix E) presently flows adjacent to the area proposed for the Jericho open pit. This stream will be diverted north of the pit, and back into its present channel above grayling spawning habitat (lower 100 m). No fish habitat will be lost. However, the diversion channel will be constructed so as to allow fish passage, thereby increasing useable habitat in the stream. All water presently flowing in the natural channel will flow through the diversion.

The waste rock dumps may require clean water ditches to divert upslope water around the dump. As well, runoff water from the dumps will require settling. As there are no plans to return treated water to Carat Lake, unless it meets Project Water Licence criteria (e.g. water may be diverted to the PKCA or spray irrigated), some of the annual runoff from the site will be lost. However, this will be a very small fraction of the total runoff for the drainage basin containing Carat Lake; the impact will be unmeasurable.

Seepage into storage facilities (waste rock dumps; ore stockpiles) will modify the annual runoff to varying degrees, depending on: the area of the facility (which will change over life of mine); the composition of the facility (particle size distribution, whether ore or waste rock); and the penetration of permafrost. Seepage may be 30 to 50% of annual precipitation, but could be significantly less (SRK, Appendix D.2.1). Since water handling structures will be sized for 100% runoff, effects on the receiving environment from seepage into ore and waste storage facilities will be nil.

A settling facility/pump system will be required to remove runoff from the open pit; the settling facility will operate in a similar manner to the waste rock dump pond(s). In terms of water volume, the loss of this source of runoff to Carat Lake will have negligible effect on lake volume.

1.9.2.2 Accidents and Malfunctions

Accidents and malfunctions could result in the uncontrolled release of water, the largest volume of which would be from the PKCA from dam failure (discussed in Section 1.11.2). Should the settling embankments fail, the immediate effect would be release of contained water that would enter Carat Lake. The volume of the proposed settling facilities will be very small compared to the volume of Carat Lake; water released by such an accident will have negligible effect on lake level. Sediment control ponds have a relatively small contained volume (the largest is 13,000 m^3) and an uncontrolled release from these structures would not have a measurable effect on the water balance of the Carat Lake basin.

1.9.3 Diamond Processing

1.9.3.1 Assessment of Potential Effects

Changes in the hydrologic regime from operation of the processing plant will include withdrawal of water from Carat Lake (and eventual return through discharge from the PKCA and Lake C3), and some minor alteration of drainage patterns due to the requirement to treat water from the area disturbed by the plant. Water balance changes to the Carat Lake drainage basin will be insignificant (less than 1% change), as will changes in drainage patterns caused by plant construction and operation.

Potable water will be required at the camp and will be drawn from Carat Lake. Potable water use will be approximately 900 m^3/month. Water, after use, will be routed through a sewage treatment plant, resulting in a small amount of evaporation. Water from the treatment plant will be piped to the PKCA and PKCA effluent water ultimately returns to Carat Lake. Thus the impact on water quantity from potable water use would be negligible, unless all or part of the water is spray irrigated (previously discussed).

1.9.3.2 Accidents and Malfunctions

The largest accidental water release would be failure of PKCA dams. An accident of this nature is very unlikely. Dam locations were investigated by geotechnical drilling to confirm dams will be founded on bedrock. The dams are engineered structures and will have a geomembrane core lining to prevent seepage. Further, they will be inspected annually by geotechnical engineers and reports provided to regulatory authorities.

In the unlikely event of an uncontrolled release of water from the PKCA, there would be a short-term significant impact on the water balance of Lake C3 and Carat Lake, causing a rise in water and potentially flooding over a short period of one or two days. Failure of the west tailings dam could result in release of a maximum of 225,000 m^3 of water to the settling pond (if the break occurred in June). Water would then flow over the spillway of the settling pond dam and down Stream C3 to Lake C3. This volume of water is approximately 5% of the volume of Lake C3. Erosion of the Stream C3 channel would be likely, which would result in sediment being carried into Lake C3. Some fine PK would also likely flow into Lake C3, although if the settling pond dam held, much of the PK would be retained in the settling pond. The impact on water volumes in Lake C3 and Carat Lake from a west dam failure would be low, but significant (5% increase in water volume, or less than natural variation) and short-term (a few days at most for water to return to normal levels). The channel between Lake C3 and Carat Lake is rocky and erosion at this point from increased flows is unlikely. The buffering effect of Carat Lake would result in only small increases (a few percent) in outflow from Carat Lake.

Given the small percentage of the Carat Lake basin affected, only a small effect on the water balance would result from the uncontrolled release of 225,000 m^3 of water from the PKCA. The average outflow from Carat Lake is 0.9 m^3/s or 77,760 m^3/day. A release of 225,000 m^3 of water over a short period would result in an increase in outflow from Lake C3 and a subsequent increase in outflow from Carat Lake. Natural outflows at freshet from Carat Lake can reach 10 m^3/s or 864,000 m^3/day, thus a worst case release of water from the PKCA at peak flows would increase outflows over about a five-day period by 4% per day. The result would likely be some bank flooding at both the inflow and outflow points during the freshet period, when water levels are naturally high.

Failure of the east dam of the PKCA would result in the loss of considerably less water because only Cell 1 would be affected. Total volume would be less than 100,000 m^3. Flows would be to an unnamed Lake and then into Key and Lynne lakes, ultimately flowing out of Lynne Lake, down the outlet stream, and into Contwoyto Lake. The volume of the unnamed Lake is approximately 200,000 m^3 and its banks are quite steep. Sufficient volume is available in the basin to prevent water flowing overtop of the basin into adjacent areas. Key Lake has a volume of 225,000 m^3 and Lynne Lake a volume of 1,070,000 m^3. The capacity of the three lakes is such that flood flows from an uncontrolled release would be moderated. Downstream displacement of fish by flood flows in Key and Lynne Lakes is unlikely, although they could be affected by changes in water quality.

1.10 SURFICIAL GEOLOGY/LAND FORMS

1.10.1 Assessment of Potential Effects

The effects on surficial geology will be at the local landscape level. Geomorphological processes will not be affected, but new landscapes will be created by waste dumps (permanent), the open pit (permanent), coarse kimberlite storage (permanent), ore stockpiles (life of mine), the PKCA (permanent), and infrastructure (life of mine). Overburden materials in the vicinity of the open pit will be stripped and placed in an overburden stockpile; overburden volume is estimated to be approximately 900,000 m^3, based on drill holes completed by Bruce Geotechnical Consultants (1996) and exploration drilling by Tahera.

Borrow materials will be required for construction activities, such as roads and embankments for sedimentation ponds. Construction materials will be from three principal sources:

- pit waste rock (which has been determined to be non-acid-generating);
- coarse processed kimberlite; and
- esker borrow material.

To the greatest extent practical, materials generated by mining will be used for construction. Some esker material will be required as top dressing on roads and for dams, especially during the initial construction when stripped overburden will be frozen and not suitable for immediate use. This will require temporary stockpiling of overburden until contained ice melts.

A large esker system is located north of the existing exploration camp (shown as a line north of Carat Lake on Figure 1.2). Use of eskers will result in minor disturbances to the esker landforms, and moderately significant disturbances in the immediate vicinity of the borrow pits. The extent of surface disturbance is discussed in Section 1.15. Revegetation will be required to return the site to pre-disturbance productivity levels.

Total waste rock generation over the eight year mine life will be 12.9 million tonnes; 1.59 million tonnes of overburden will be stripped. Overburden and waste rock will be stockpiled separately and overburden used for top dressing and for reclamation. Waste rock will be dumped on two stockpiles as shown on Map A (Appendix E). Most of the ore mined will be processed; approximately 784,000 tonnes of low grade ore may not be processed and will be stockpiled separately from waste rock. Coarse kimberlite rejects stockpile will occupy 91,603 m^2 and hold up to 2.2 million tonnes. The ultimate open pit will be approximately 350 by 400 m diameter and 180 m deep.

1.10.2 Accidents and Malfunctions

Accidents and malfunctions do not apply to changes in land forms.

1.11 WATER QUALITY

Potential water quality impacts arising from the mining operation are:

- suspended sediment and nutrient discharges from waste rock dumps, ore stockpiles, and overburden stockpile, and from the PKCA;
- possibly copper from the waste rock (maximum leachate concentration from laboratory testing 0.016 mg/L); and
- limited greywater and sewage discharge (11,000 m^3 annually) from the mining camp to the PKCA.

Discharge from the waste rock and overburden and ore stockpiles will be collected and retained in settling ponds or embankments to remove suspended solids; treatment alternatives have been developed as a contingency against water not meeting Licence discharge requirements. Sewage and greywater will be treated prior to discharge to the PKCA. Testing to date (Appendices D.1.3 and D.1.4, respectively) indicates waste rock and JD-01 ore are non-acid generating. Processed kimberlite will be alkaline.

1.11.1 Mining

1.11.1.1 Assessment of Potential Effects

Nutrients

Nitrogen

A flow diagram for nitrogen generation and leaching for the Jericho Project is provided in Figure 1.3. The nitrogen load produced in the mining operations will be dependent on explosives use. Table 1.7 lists the expected use of explosives by year. Release of nitrogen species (NO_3, NO_2, NH^{4+}) was calculated using the Ferguson and Leask (1988) model. Table 1.8 lists the model assumptions. Additionally, it was assumed that leaching would occur equally through the months of May to October, inclusive.

Results of the model, based on the above, are presented in Table 1.9 and the mining schedule is presented in the Project Description (Appendix A.1, Table 5.3).

Water from the waste rock dump and ore stockpile will be treated in sediment collection ponds and discharged to the environment, if it meets Water Licence criteria; otherwise it will be pumped to the PKCA. Alternates (discussed in the Project Description) include: extended storage in the PKCA; spray irrigation; and a water treatment plant.

Explosives use at the Jericho open pit will result in an increase in nitrogen loading to Carat Lake, principally from runoff, but also a more minor source from dust from explosives. Total nitrogen loading from runoff, assuming all N will speciate to nitrate, is provided in Table 1.10, using the nitrogen model results. Further, loading results assume the following: runoff from the open pit, waste rock dumps, overburden stockpile, low grade ore stockpile, and central lobe ore stockpile would flow ultimately to Carat Lake; and coarse kimberlite rejects and northern lobe stockpile runoff would report to the PKCA. Nitrogen loading would only occur during the summer when water is flowing. Air quality is discussed in Section 1.12. Given that this lake is typical of oligotrophic Arctic lakes and is phosphorus limiting, the nitrogen input is not expected to affect primary productivity. This prediction will be monitored by means of periphyton studies in the lake as discussed in the Environmental Monitoring Plan (Appendix

B.3.3). Increases in nitrogen concentration are unlikely to be great enough to be detectable by nitrogen concentration measurements.

The predicted concentrations of nitrogen by month and year are listed in Table 1.9. Inspection of the table indicates that ammonia in runoff may be above receiving environment guidelines (CCME 1999) in May and October of each year of mining after Year 1. Year 1 will be the year the open pit is started, or construction phase.

Guideline ammonia concentrations vary with pH and temperature as shown in Table 1.11 (from CCME 1999).

Water at the Jericho site varies greatly in temperature from zero to about 20°C for small water bodies during sunny summer weather. Carat Lake likely never rises above 15°C, based on temperature profile data collected in 1996 and surface spot measurements to date.

Phosphorus

Nitrogen and phosphorus concentrations in Carat Lake and Lake C3 are very low (ammonia: <0.005 - 0.28; nitrate: <0.005 - 2.5; total dissolved phosphorus: <0.001 - 0.027 mg/L). Since modelling predicts an increase in nitrogen loadings to Carat Lake due to runoff from the mine site, any increase in phosphorus might be expected to lead to some increase in primary productivity. This change could be either positive or negative, depending primarily on the effects on primary producers. A significant increase in benthic algal standing crop each year might have a negative impact on overall aquatic community productivity and thus on the availability of food for fish. However, a moderate increase in phytoplankton productivity would be expected to lead to an increase in zooplankton productivity, and possibly benthic meiofauna productivity. An increase in available fish food would result, in turn, leading to an expected increase in fish standing crop and/or productivity. This latter effect has been observed at EKATI™ Mine with additions of nitrogen and phosphorus to lakes (EKATI™, pers. comm. 2000).

Leach extraction tests (24-hour de-ionized water leach) were conducted on kimberlite ore and waste rock. Phosphorus concentrations remained below detection, as would be expected, given the very low solubility of phosphorus and the low background concentrations of phosphorus in both the host rock granite and kimberlite. Thus, leaching of phosphorus in runoff from waste handling facilities is not expected to add to the available phosphorus in receiving waters.

Suspended Sediment

Suspended sediment will result from runoff from roads, the open pit, waste rock dumps, and the ore stockpile. Water from these areas will be routed to sediment collection ponds. Sedimentation facilities will operate during open water periods (approximately late May to early October each year). Accumulated bottom sediment will be periodically removed (if required) and trucked to the waste dump, where subsequent rock cover will prevent wind erosion and retard water erosion. During periods when facilities are discharging, pond water will be periodically monitored for turbidity. A correlation between turbidity (as measured by a turbidity meter) and total suspended solids will be established. Should turbidity meter readings indicate potential for discharge water to exceed total suspended solid concentrations (specified in the mine Water Licence), the situation will be remedied (by addition of flocculents or other means, as appropriate) in consultation with the Nunavut Water Board).

Low loadings of suspended sediment will also result from wind erosion of disturbed areas and from ore and waste rock handling. Of course, not all, or even most, of the suspended particulate matter from these sources will reach mine area water bodies. Impacts from dust are discussed in Section 1.12. Because of the uncertainty in prediction of the amount of sediment that will report to receiving water bodies from mining operations, this parameter is proposed for operational monitoring as part of the aquatic effects assessment program.

Metals

The Jericho waste rock is comprised of relatively unaltered granitic host rock. The waste is non-acid generating, with negligible levels of sulphides, and low trace metal concentrations. Leach extraction tests (Appendices D.1.3 and D.1.6) indicate that leachate in contact with granitic waste rock is likely to have neutral pH's, moderate alkalinity levels, low total dissolved salts, and low metal concentrations. Concentrations of all metals are likely to be well below the concentrations specified in the Metal Mine Effluent Regulations, and concentrations of most metals are likely to be below the CCME guidelines for protection of aquatic life. Possible exceptions are copper, aluminum, and arsenic, which slightly exceeded the CCME guidelines in several of the test samples. Copper and aluminum concentrations (Cu: 0.003 to 0.016 mg/L; Al: 0.015 to 0.118 mg/L) are limited by solubility controls, and are therefore unlikely to exceed the levels measured in the tests. Arsenic concentrations may be an artefact of the testing; they are not consistent with the extremely low arsenic content of the solids and a second set of tests had consistently low arsenic concentrations. One sample had slightly elevated chromium. This sample was from the contact between kimberlite and granite and represents only a very small proportion of the waste rock.

Kimberlite ore is strongly acid consuming, with a high portion of carbonate, negligible sulphides, and low trace metal concentrations. Leach extraction tests by SRK (Appendix D.1.4) indicate runoff in contact with the kimberlite ore is likely to have slightly alkaline pH's, and elevated alkalinity, hardness, and TDS levels. Metal concentrations are expected to be below the CCME guidelines for the protection of aquatic life. Possible exceptions are copper, selenium, and nickel. However, elevated concentrations of these metals in the tests were all very close to the method detection limits.

1.11.1.2 Accidents and Malfunctions

Water will be controlled for the mining operation by means of sediment containment ponds and will be routed to ponds by ditches and berms. If these structures fail, water would be released to the environment. Direct release from the berms and ditches would be to the tundra, where suspended sediment would settle out and N would be absorbed by plants, based on the experience at EKATI™ Mine (EKATI™ 1999). If the sediment control pond for Dump 1 failed, water could reach Carat Lake before substantial decrease in nitrogen occurred, due to its proximity to Carat Lake. Assuming no flocculents were in use in Pond 1 and the pond was full at the time of failure, some of the suspended sediments might also reach Carat Lake, although substantial amounts would drop out on the tundra prior to the water reaching the lake. No meaningful prediction can be given for the amount of suspended sediment that might reach Carat Lake because of two uncertainties:

- the amount of suspended sediment in the pond at the time of failure;
- the amount of sediment that would drop out in transit to Carat Lake, for instance, EKATI™ has found that 100 m of tundra is effective in filtering sediment from water off waste dumps (EKATI™, pers. comm. 2000).

An increase in sediment would be short term, given that the failure was contained immediately. Sediment dispersion in Carat Lake could be limited with silt fences, which could be quickly placed at the shoreline to prevent further sediment release to the lake. Silt fences would also be placed immediately down slope of the break in the sediment pond dike.

Elevated nitrogen could also result from failure of the pond dikes and could not be controlled as easily as suspended sediment. The impact would be a short-term increase in nitrogen concentrations where the spill entered Carat Lake. Assuming Pond 1 were full, a maximum of 8,300 m^3 could be released, compared to the volume of Carat Lake of 27 million m^3. Of course, the shallows near shore below the pond would receive the water. With an on-shore wind, the concentration of N in the shallows could reach that of the release pond water (Norecol, pers. comm.). The maximum predicted N concentrations from nitrogen modelling for Waste Dump 1 can be found in Table 1.9 and are:

- NO_3: 13.13 mg/L
- NO_2: 0.36 mg/L
- NH_4: 4.50 mg/L

All but ammonia are within CCME guidelines, whereas ammonia is approximately 2.5 times the likely required concentration to meet these guidelines (2 mg/L--ammonia toxicity is based on unionized ammonia and the proportion of unionised ammonia is directly dependent on pH and indirectly dependent on temperature). Potential toxicity is discussed in Section 1.16.

Changes in water quality would be short term (a matter of hours) and could be detectable in the southeast bay of Carat Lake for a distance from the spill, depending on the actual concentration of nitrogen compounds. The actual spatial extent would depend on the amount of mixing and the concentration of nitrogen in the spill.

Accidental release of mine water to the environment at such times as when ammonia levels are high may have a short-term (weeks to one season) effect on ecosystem functioning; the water may be acutely toxic to fish. Most fish would be able to avoid high concentrations of ammonia, but some may not. Effects would be direct to water quality and indirect to fish and fish food organisms.

1.11.2 Diamond Processing

1.11.2.1 Assessment of Potential Effects

Diamond processing will result in fine and coarse fractions of processed kimberlite. Effects on water quality will be related to these waste streams. The other possible water quality effect will be runoff from the plant site, which will be contained and routed to the PKCA.

The fine and coarse fractions of processed kimberlite will be stored in controlled areas; there will be no direct runoff to the environment outside of areas where containment and treatment are possible. Potential impacts could result from nitrogen and suspended solids loadings. Kimberlite tailings supernatant water has been found to be acutely toxic above pH 8.4 (Environment Canada, pers. comm. 2000). EKATI™ ascribed toxicity to suspended sediments (EKATI™ 2000); further test work indicated toxicity was related to pH and ammonia, which was eliminated through residence time in the mine's PKC (EKATI™, pers. comm. 2001).

Fine PK

<u>Dilution Modelling</u>

Because water will need to be discharged annually from the PKCA to maintain storage capacity, a dilution model was run to predict dispersion of the supernatant water in Lake C3 (URS, Appendix D.1.2). Water will be discharged from the polishing pond into Stream C3 over a three or four month period (see Map A for locations mentioned).

The modelled dilution in Lake C3 during each summer month (June through September) was determined. Figure 1.4 provides a summary of results. The overall average dilution ranges from 40 to 100 times with a maximum range of 0 to >200 times. In general, the magnitude of the dilution increases with increasing freshwater inflow. This is not true in September, however, when slightly stronger inflow is accompanied by stronger winds. This results in slightly reduced dilution during September.

<u>Suspended Sediment</u>

Suspended solids in the fines will be controlled with flocculents and coagulants, if required, as discussed in the Project Description (Appendix A.1) and the Environmental Management Plan (Appendix B.3.1). Based on tests conducted during bulk sampling and pilot plant operations, suspended solids levels are expected to be in the 1 to 8 mg/L range (SRK report, Appendix D.1.5). Full scale operations may vary from these results. EKATI™ uses a combination of flocculents and coagulants (EKATI™ pers. comm.), which may be required at Jericho. However, some of the remaining suspended solids in the main cells of the PKCA should drop out of suspension in the polishing pond. EKATI™'s Water Licence limit of 25 mg/L should easily be met if a similar limit is set in the Jericho Water Licence.

Nitrogen

Nitrogen model predicted concentrations in the PKCA are listed in Table 1.12. They are below CCME receiving environment guidelines, and will be further diluted in the polishing pond and in the discharge stream. Concentrations predicted are consistent with findings at EKATI™ Mine (EKATI™, pers. comm.). If water from other waste handling facilities is routed to the PKCA, these concentrations will increase, as discussed below. The temporal extent of effects will be life of mine. The spatial extent of effects will be limited to the PKCA, if concentrations below CCME guidelines are taken to be insignificant.

Other Parameters

Total dissolved solids and alkalinity will be elevated above the receiving environment in the discharge water. Total dissolved solids in pilot plant tailings supernatant averaged 1155 mg/L and conductivity 1424 µS. Total dissolved solids were not monitored in baseline water quality sampling, but conductivity was monitored. Conductivity and TDS are roughly directly proportional, and therefore conductivity can be taken as an approximate indicator of TDS. Background conductivities in baseline water quality samples ranged from 3.5 to 28 µS, or 50 to 400 times lower than those predicted in the PKCA effluent. Average dilution in C3, then, could be expected to bring total dissolved solids down to the 30 mg/L range, which could be approximately at background to five or six times higher than background. There are no guidelines for TDS under CCME (1999).

Alkalinity in pilot plant tailings supernatant ranged from 21 to 168 mg $CaCO_3$/L, whereas natural background alkalinities at Jericho ranged from 4 to 7. Alkalinity of tailings supernatant will be 3 to 42 times higher. It should be noted that the highest alkalinity in tailings supernatant samples was obtained from tailings aged for one year in closed containers, whereas the maximum alkalinity in fresh tailings supernatant was 84. Based on dilution model results, alkalinity will be down to background values at, or before, the outlet of Lake C3. There is no CCME guideline for alkalinity.

Coarse PK

Suspended solids in the coarse fraction of PK will not be problematic due to nature of the material. Predicted concentrations of nitrogen in runoff from coarse kimberlites are listed in Table 1.13. Concentrations are predicted to be well below CCME guidelines, however, runoff water will be directed to the PKCA. Results from EKATI™ Mine (EKATI™ 1999) suggest ammonia concentrations from the coarse rejects could be as high as an order of magnitude greater than those predicted. EKATI™'s coarse rejects stockpile is much larger than that which will be generated at Jericho, which may account for some of the difference. The temporal extent of effects will be life of mine. The spatial extent of any effects will be limited to the Project site by water management plans.

An idea of the amount of increase in nitrogen loading to the PKCA (from routing water from other waste handling facilities) can be gained from an examination of Table 1.10, which provides nitrogen loading estimates based on the nitrogen model. Loss of N to the PKCA from processing represents the following fractions of total N loss from explosives use (Table 1.14).

If all runoff were routed to the PKCA, the volume available for dilution would double from operation of the PKCA for slimes only. Thus, in Year 1, rather than a potential increase of about 9 times in N concentration, a potential increase of 4.5 times would be realized. Review of these data suggest that nitrogen concentrations in the PKCA supernatant water would not likely be acceptable for release without treatment. Alternatives, including extending the holding time by pumping to the PKCA, use of spray irrigation, and a water treatment plant for high nitrogen water are discussed in the Environmental Management Plan (Appendix B.3.1).

Effects from normal operation of the processing plant on water quality will be direct (to water quality) and may be indirect (affect fish and fish food organisms).

1.11.2.2 Accidents and Malfunctions

Accidents that would result in impacts on water quality of receiving environment water bodies include spills from the PKCA. Any other spills would be contained within the plant complex area.

An uncontrolled release of water from the PKCA is a highly unlikely, low probability event, but could result in a short-term significant impact on the water quality of Lake C3 and possibly Carat Lake. Hypothetical failure of the west tailings dam would result in release of water to the polishing pond. Depending on the volume, water could then flow over the spillway of the settling pond dam and down Stream C3 to Lake C3 resulting in a sudden input of between 183,000 and 225,000 m^3, if the break occurred at the beginning of June when the impoundment held the most water. This volume of water is approximately 5% of the volume of Lake C3. The area of Lake C3 immediately adjacent to the mouth of Stream C1 would take on the characteristics of the spill liquid. Erosion of the Stream C3 channel would be likely, resulting in sediment being carried into Lake C3. Some fine PK would also likely flow into Lake C3, although if the settling pond dam held, much of the PK would be retained in the settling pond. It is not possible to provide estimates of the amount of PK that would be released into Lake C3, because that is dependent on the amount and location of PK in the PKCA when the west dam failed, and whether the settling pond held or failed also. The predicted water quality of PK supernatant is provided in Table 1.15, from SRK's assessment of processed kimberlite (Appendix D.1.5).

If only supernatant water reached Lake C3, no dilution would be required to reach receiving environment water quality for parameters other than suspended sediment (assuming ammonia oxidizes in transit, or (as is the case with EKATI™) is below receiving environment guidelines entering the mine's PKC). Up to 5 times dilution would be required to meet clear water suspended sediment guidelines, if suspended sediment concentrations in Lake C3 were at their low range when the spill occurred and no erosion occurred in Stream C3. Two times dilution will be required to meet drinking water guidelines. If ammonia is elevated, as predicted by SRK's tests, but not experienced by EKATI™, ammonia would also be elevated in Lake C3 and could be at toxic concentrations, at least in that part of the lake nearest the mouth of Stream C3.

Failure of the east dam of the PKCA would result in the loss of considerably less water because only Cell 1 would be affected. Total volume would be less than 100,000 m^3. Flows would be to Ash Lake and then into Key and Lynne lakes, ultimately flowing out of Lynne Lake, down the outlet stream (D1) and into Contwoyto Lake. The volume of the unnamed Lake is approximately 200,000 m^3 and its banks are quite steep. Sufficient volume is available in the basin to prevent water flowing overtop of the basin into adjacent areas. Key Lake has a volume of 225,000 m^3 and Lynne Lake a volume of 1,070,000 m^3. The capacity of the three lakes would moderate flood flows from an uncontrolled release. Water quality impacts are as discussed for a west dam failure.

Impacts from dam failure could significantly affect ecosystem functioning for years to decades, depending on the extent of the spill of process effluents. Impacts would be direct on water quality and fish habitat, could be direct on water bird habitat, and would be indirect on fish, fish food organisms, and possibly wildlife including water birds.

1.11.2.3 Dam Failure Frequency

The frequency and length of occurrence of accidents is difficult to predict, as previously discussed. The impacts of a fine PK spill would be largely irreversible and would last beyond life of mine, except in areas where complete cleanup could be effected.

Modes of failure of earth-fill embankments, of which tailings dams are a type, have been found to be the following (Fell, et al. 1999):

- flood: overtopping of the embankment, scour of the spillway chute, or overtopping of the spillway chute walls;
- slope instability: downstream slope instability or upstream slope instability, both of which can cause breaching;
- internal erosion and piping: erosion of dam construction materials from water flow either on a front or channelized, i.e. piping; and
- earthquake: failure caused by liquefaction of the dam foundation, or seepage erosion and piping through earthquake-induced cracking.

World wide, slope instability failure to 1986 had the following average annual frequency (Fell, et al. 1999):

upstream: 0.3×10^{-5} downstream: 2×10^{-5}

which is a low risk for an individual dam. Risk of failure due to downstream slope instability has been historically higher during the first five years than after that time. Other failure mode statistics were not provided by Fell, et al.

Earthquake risk is extremely low (defined as low probability and low magnitude) at the Jericho site (Section 1.7) and therefore this failure mode can be discounted for the eight-year life of the Jericho Diamond Mine.

A survey of world-wide dam failure rates to 1975 (Geoinstitute of ASCE 1998) indicated an average rate of 4 x 10^{-4}. For the United States, a 40-year survey period to 1967 indicated an average rate of 5 x 10^{-4}, which is again, a negligible risk.

Slope stability failures usually provide advance warning (Fell, et al. 1999) and thus remedial action can be taken prior to failure. Likewise, internal erosion/piping can be readily detected through routine inspection by mine site personnel, e.g., through increased seepage rates on the downstream face of dams, and from annual inspections by qualified geotechnical engineers (required as a condition of water licences for mines in Canada).

This leaves flooding, which will be managed through maintaining adequate freeboard, and thus even this probability can be kept extremely low. Spillways will be designed for a 200-year flood event and a minimum of a one-meter dry freeboard will be maintained for all dams. Additional details are provided in the water and waste management plan developed for the mine by SRK (Appendix D.2.1). Statistically, the probability of a 200-year flood event occurring is 0.005 (Wanielista et al. 1996). Since water levels will be continuously monitored in the PKCA and snow accumulation will also be known, remedial action can be taken to prevent overtopping should that develop as a potential risk, e.g., snow removal prior to spring thaw.

Intense rainfall events in the region are rare and heavy rainfall predominantly occurs in July and August well after peak runoff from snowfall. According to the Rainfall Frequency Atlas for Canada (Environment Canada 1985), the 100 year return period, 24-hour extreme rainfall event for the region would be 45 mm. For the catchment area of the PKCA (11 ha), this would amount to only 4,950 m^3, assuming all rainfall resulted in runoff, a scenario that discounts evapotranspiration and absorption of water in the soil. Therefore extreme rainfall can be discounted as a significant factor in flood events, leaving only spring runoff, which can be managed.

Notwithstanding the very low risk/probability of dam failure, the impact from tailings dam failures is potentially high and therefore Tahera will closely and continuously monitor the PKCA dams. This is a government-mandated requirement at all mine tailings impoundment facilities in Canada and North America.

1.11.3 Waste Water Treatment Plant

1.11.3.1 Assessment of Potential Effects

Operation and water quality from the waste water treatment plant (WWTP) are discussed in the Project Description (Appendix A.1). Effluent from the WWTP will be directed to the PKCA. Phosphorus will be absorbed by the PK fines and nitrogen loadings will be diluted a minimum of 15:1. Expected N loading from sewage is 10 g N per person per day (Guillfillan 1997), or 10 kg for 100 people. The potential incremental concentration of total nitrogen in PKCA effluent would be 8 to 9 mg/L. This assumes the proposed secondary treatment plant removes 33% of the

N and P (Guillfillan 1997), none of the N is absorbed in solids, and 100 people are on site every day of the year. Prior to oxidation, much of the N from the WWTP will be in the form of ammonia (Jonsson et al. 1998).

1.11.3.2 Accidents and Malfunctions

Failure of the waste water treatment plant would be noticed immediately and rectified. A failure of the rotating biological contactors would result in only primary treated sewage entering the PKCA. The disinfection and 33% reduction in P and N would not occur as a result. Since only a small volume of water would be involved, no detectable change in water characteristics of the PKCA would be likely, and no change in the quality of water discharged would result. In the case of failure of the WWTP, water in the PKCA polishing pond would be tested for coliform bacteria and proved to be safe prior to discharge to the environment. The consequences of accidents is insignificant.

1.11.4 Landfill

A landfill will be constructed at the north end of Waste Rock Dump 1 to hold non-hazardous unburnable, unrecyclable industrial wastes. Materials placed in the landfill will not contain leachable substances that could degrade water quality. Unburnable, non-hazardous industrial wastes and incinerator ash will be the principal materials landfilled. Runoff and seepage from the landfill will be directed to Sediment Control Pond 1 west of Waste Rock Dump 1. As such, potential negative impacts from the landfill are judged to be negligible. Since water quality in the sediment pond will be monitored, this prediction can be easily verified.

1.12 AIR QUALITY

1.12.1 Assessment of Potential Effects

Air quality effects from mining and processing kimberlite are discussed in the Levelton report (Appendix D.1.1). Potential effects include increase in suspended solids and a small increase in exhaust gases (NOx, SOx, CO, CO_2) for operation of stationary and mobile equipment. Increases in suspended solids, at times, could be significant within the Project area, but will not be outside the norms experienced at operating mines in northern Canada. Increases in exhaust gases will not be significant except for a small area around the processing plant.

Locally, i.e., along side mine roads, ecosystem functioning is predicted to be affected. Some plant functioning will be impaired by dust levels (direct effect) and thus, some forage value for herbivores may be negatively affected (indirect effect).

1.12.2 Accidents and Malfunctions

Accident and malfunction considerations do not apply to air quality effects in general. If roads are not watered in summer, dust will increase to levels predicted in the above assessment. Failure of exhaust emission controls on power generators will result in increases in emissions of NOx, SOx, and possibly TSP and CO. Alternate means of dust control will be employed if the regular water truck is not functioning. All mobile and stationary engines at the site will be regularly maintained to ensure proper efficiency and operation, thus any malfunctions would be short-term. It is in the interest of Tahera and the mining contractor to maintain engines since the cost of fuel is high and a significant part of operating costs for the mine.

1.13 NOISE

1.13.1 Assessment of Potential Effects

Noise is important in the context of its potential impacts on human and wildlife receptors. Noise will be generated from mobile and stationary mining equipment, blasting, and aircraft at the Jericho site. Noise during the construction phase will be less than during operation and occur over a much shorter period (six months vs. 8 years). During closure and post closure phases, noise levels will again be reduced to (or near) background.

Noise limits for occupational safety during operation will be engineered using appropriate measures to ensure compliance with Workers' Compensation Board requirements under the Northwest Territories Mine Health and Safety Regulations.

The Jericho Project proposed mine site is in an undeveloped area. Ambient background noise levels in such areas have been found to be between 25 and 40 dBA (Diavik 1998) with wind, precipitation, and thunder being the principal sources of increases above ambient.

In the Alaska oil fields, where considerably more development has occurred to date than is planned in the near future (one decade plus) in the Contwoyto Lake area, studies suggest that animals (particularly the larger mammals) are not disturbed by noise caused by human activities, unless it is sudden (such as from blasting), and unless the area has a history of trapping or significant hunting activities. Where exploitation of wildlife has occurred, animals tend to avoid any human activity.

1.13.1.1 Sources

Blasting

Blasting will be carried out to develop the open pit. Blasts will not occur daily, but will be at approximately the same time of day. Noise from blasting will be intense near the source and very short duration (typically one second). All personnel and visible wildlife will be cleared to a safe distance prior to blasting (typically 600 m). As the pit develops, blasting noise will increasingly be dampened by pit walls. At 600 m blast noise will be over 100 dB (peak level). Unweighted peak sound levels are not judged by humans (and by inference other animals with similar hearing mechanisms) to be as loud as A-weighted continuous sound levels (measured in dBA).

Other Mining Sources

The principal noise source from mining operations will be mobile equipment outside the limits of the open pit. This will include ore trucks, utility vehicles, pickup trucks, and earth moving equipment (scrapers and crawler tractors). Within the pit a shovel and drills will also operate. Studies at EKATI™ Mine done for Diavik Mines indicate noise from equipment within open pits rapidly reaches near-background levels (40 dbA), and thus is unlikely to be problematic outside the mine's immediate area of influence.

Table 3.1 of the Project Description (Appendix A.1) provides a list of mining mobile equipment that will be used on site by phase of operation.

There is considerable uncertainty as to the operational time overlap of the various vehicles. For the purposes of this assessment, it is assumed the scraper will operate full time during construction and only intermittently and at low speed during normal mine operation, thus noise from this source can be discounted during mine operation. Second, crawler tractors will be used extensively during mine construction (principally for road and pad construction), but during operation will operate exclusively on the waste rock dump and coarse PK stockpile. In assessing noise the loudest (or most intense) source will be perceived by people (and presumably other mammals) to be the dominant source – in fact it may mask quieter sources. For purposes of this evaluation, all mine mobile equipment was assumed to operate at the open pit.

1.13.1.2 Potential Impacts on People

Noise disturbance to human activities in the area, other than those directly related to the Jericho Mine, are unlikely. Observations from 1993 to the present by exploration personnel suggest there is no active hunting or fishing in the immediate area. Canoe expeditions are launched down the Burnside River at its headwaters at the north end of Contwoyto Lake (10 km distant). It is possible under ideal sound transmission conditions that noise from blasts could be heard from the Burnside River, although even then the sound would be similar to distant thunder. No other mining-related noise would be audible at the Burnside River. Blasting noise is very short duration (in the order of one second); canoeists would have to be at the Burnside headwaters on favourable sound transmission days when the blasts occurred to be aware of the activity. Therefore, mine-related noise is unlikely to be problematic for Burnside canoeists. The closest centre of human activity is the Lupin mine, 25 air km south. During summer months recreational fishing by Lupin Mine employees could occur at the north end of Contwoyto Lake, or within approximately 4km of the Jericho Mine site[1]. Blasting would be the only mine-related noise audible at that distance. Fishing occurs during evening hours and will not normally be co-incident with blasting activity at Jericho. Thus noise from the open pit operation will not be problematic for people not employed at the Jericho mine site.

1.13.1.3 Potential Impacts From Noise on Wildlife from Mining

Caribou

Caribou readily habituate to the presence of man as evidenced by nearly 20 years experience by Lupin Mine personnel and others (Bergerud 1974). Caribou closer than about 100 m from mine roads or the airstrip when vehicles approach will likely cease grazing or resting activities and move a short distance away.

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[1] During the summer of 2000 no recreational fishing occurred at Lupin as boats were not put in the water (Lupin mine employees, pers. comm.)

Caribou are less likely to be deterred during spring migration to the calving grounds than during the return migration (summer at Jericho). Grindal (cited in Diavik 1998) found Bathurst herd caribou in the Lac de Gras area responded more strongly during spring migration to predators than to human disturbance.

Diavik (1998) and others have found caribou responses to noise stimuli are considerably modified by insect harassment and that at such times responses are unpredictable. That is, it becomes difficult to separate insect avoidance activities from activities caused by other stimuli. Caribou often seek bare areas as relief from insects; this behaviour could expose such individuals to increased mine-related noise stimulation.

Caribou could be startled by blasting, although animals will be kept away from the blast site (a typical requirement for safety is 600 m). Bradshaw et al. (1997) found that, compared to caribou who were not startled, woodland caribou exposed to a cannon shot of 90 to 110 dB at point source responded by increasing their rate of movement, but not their linear distance from the point source. Lupin Mine uses “bear bangers” to herd small groups of caribou off their runway prior to aircraft landing and takeoff. Caribou move a short distance off the strip, but no further, and continue their previous activity almost immediately.

Within the mine foot print and local area of influence, caribou are expected to incur increased energy costs due to avoidance reactions caused by noise and approach of vehicles or people closer than a tolerated distance (from less than 100 to 300m). Diavik conducted energy modelling studies (1998) and concluded that locally significant increments could occur from caribou avoidance of mine-related activities, but that in a regional context, additional energy expenditures were insignificant and unmeasurable.

Large groups (1,000+ animals) occasionally (once or twice a season) frequent the Jericho area during the summer snow-free period. Groups typically move through the site over a one to few day period. Herds are typically mixed (adults, yearlings, calves). Activities at the mine site can, where practical, be modified so as to reduce to a minimum any negative effects on such herd movements. Deflection devices in the form of fencing or other visual barriers will be used at the Jericho site to encourage caribou to keep away from areas of high activity such as the processing plant, open pit, waste rock dumps, etc. Management of caribou at the Jericho site is discussed in detail in the Jericho Environmental Management Plan (Appendix B.3.1).

Carnivores

Carnivores that can occur at the Jericho site include: barrenland grizzly bears; Arctic wolves; red, Arctic, and cross (hybrid red and Arctic) foxes; and wolverines. All of these animals have been sited near the camp and portal only occasionally since 1995. Carnivores vary in their reaction to noise generated by human activities, but all of the above-referenced have been found to habituate to some degree to noise disturbance by man. Foxes have been found to be the most adaptable followed by wolves, grizzly bears, and wolverines (Diavik 1998; Lupin mine personnel, pers. comm. 2000). Regular food sources (from kitchen wastes or from intentional feeding) are more likely to result in habituation than other activities (Eberhardt et al. 1982). Natal denning is more sensitive than other carnivore activities, such as hunting or movement from place to place. There are no carnivore dens near the Jericho open pit (Figure 1.5). The closest active den is a red fox den 500 m east of the airstrip, which has been monitored during summers since 1995. Foxes have used the den for rearing young each year since monitoring commenced and do not appear to be affected by human activities at the airstrip.

Carnivores are expected to avoid active areas of the mine, due to noise and other activities. Thus the footprint of the mine represents a potential loss of habitat. Habitat effects are further discussed in Section 1.15. Loss of habitat will either be total or loss of effectiveness. Noise disturbance could affect habitat effectiveness for animals that partially habituate to noise and direct loss to animals that avoid the area due to noise from mining activities. As no dens are located at or in proximity to the mine site, loss of habitat would be confined to hunting/foraging. Home ranges of carnivores are discussed below. Habitat loss and loss of effectiveness will continue throughout mine life and are not mitigatable to any extent.

Small Mammals

Mining activities will render the immediate pit area unsuitable for small mammals including voles, lemmings, ground squirrels, and Arctic hares. Ground squirrels and Arctic hares habituate readily to man's activities and will allow relatively close approach prior to a flight response (±10 m). Hares and ground squirrels will therefore likely lose the least amount of useable habitat and may benefit from reduced predation close to mine activities, due to possible avoidance by their predators (carnivores, raptors). No information is available on microtine rodents, but opportunistic observations during the environmental programs for Jericho suggest flight responses are likely from sharp, sudden noises in close proximity (10 to 50 m). Habitat loss due to noise disturbance will likely be limited to areas very close to active disturbance sites, i.e. road corridors, airstrip, pit, waste dumps, stockpiles, plant, and tailings disposal.

Raptors

The closest known raptor nest to the proposed pit is 2 km to the east and since 1995 has been occupied by rough-legged hawks. Surveys for active nests were conducted in 1995 through 1997, 1999, and 2000. The rough-legged hawks' nest located on Lynne Lake was active in 1999 and 2000. This closest raptor nest is outside the range where nesting raptors are known to be sensitive to disturbance (Shank 1988) and thus no significant direct impacts to raptors are expected from mine-related noise, with the exception of flights close to the known nest or other raptor nests. Other than possible requirements for monitoring (under the Project's Water Licence) flights need not occur close to known raptor nests. Thus disturbance arising from mining will be minimal. To the extent that mining activities affect prey species (principally small mammals and birds), some indirect effects on raptors would be expected.

Other Birds

Pacific loons nest on Carat Lake at least in some years. A pair of parasitic jaegers have nested north of Carat Lake outlet at least since 1997. Other waterfowl have been observed between Carat Lake and Jericho Lake, but nesting has not been confirmed; species include Canada and white-fronted geese, greater scaup, oldsquaws, northern pintails, red-breasted and common mergansers, green winged teal, and herring gulls. Nesting occurs predominantly in wetland areas between the north end of Carat Lake and the north end of Jericho Lake (Map A, Appendix E). Mine-related noise, other than blasting will likely not affect nesting birds more than 2 km distant, as the average noise level will be near background. Blasts from the open pit would sound like thunder. Blasting will also result in short, intense noise accompanied by pressure waves and ground vibrations, which could deter waterfowl from nesting on or near Carat Lake. Other than the Pacific loons, no other waterfowl have been observed nesting on Carat Lake, although the potential exists. A worst-case scenario would be loss of all nesting habitat on Carat Lake for waterfowl during mine life; a more realistic scenario is that areas more remote from the pit would continue to be used by waterfowl. Any loss due to blasting disturbance would not be mitigatable, although the effects of blasting noise will diminish as the pit deepens, and will disappear when underground mining replaces open pit operations in Year 5.

Passerines and upland game birds will lose habitat in the immediate area of mine disturbance. Those birds habituating to disturbance will relocate near the site; those not habituating will move further away. Ptarmigan are found in small numbers at the Jericho site (3 or 4 nesting pairs in proximity of areas used for exploration activities). Ptarmigan are relatively tolerant of human disturbance, based on experiences at Diavik (1998) and at Carat Camp. At both locations, ptarmigan nested and raised young in close proximity to exploration camps.

Effects on passerines and upland game birds could be direct (dissuade birds from frequenting sites close to noise) or indirect (e.g., result in the absence of predator species or competitors for food).

1.13.1.4 Potential Impacts of Noise from Diamond Processing

Based on experience with the 10 tonne per hour (TPH) pilot plant, noise from the plant will not be noticeable beyond the walls of the building. The production plant will have a 40 to 50 TPH capacity and is therefore expected to produce somewhat higher noise levels. At full operational capacity, the crusher produces approximately 90 dBA at 15 m. The crusher will operate 24 hours per day inside the plant building, separated by a wall. Noise will be evident outside the plant from the crusher, but will be largely attenuated by the wall. If noise from the crusher becomes problematic, sound deadening can be installed (e.g. blown on insulation).

Other processing noise will be related to mobile equipment, which will include a dozer (D6), front end loader (966), a dump truck (Cat D300 or Kenworth), and a pick up truck. Vehicles will be used intermittently as required to move materials and people.

The power generators will also be in the general vicinity of the plant and will add to the background noise in the area. Power generators will be in a lean-to building adjacent to the plant, will have muffled exhausts, and will generate a constant noise that people and animals will habituate to readily, becoming similar to white noise when habituation occurs.

Effects, although likely negligible, could be direct or indirect, as indicated for mine-related noise.

1.13.1.5 Aircraft Noise

Aircraft will be used for movement of personnel and some supplies to the Jericho site year round. Aircraft noise will be limited to a few minutes during landings and takeoffs. The service schedule is to be determined, but will be less than one flight per day during both construction and operation with an average of 2 to 3 flights per week during open pit operations and 1 to 2 during underground mining and in the final two years of processing. Aircraft will be Twin Otter- or Hawker Siddley 748-class, with the occasional larger or smaller aircraft. The actual times for take offs and landings (between ground and 300 to 400 m) will be a matter of a few minutes per flight. Where safe to do so, landings and takeoffs will not be routed over known concentrations of wildlife, and thus impacts are expected to be minor.

1.13.2 Accidents and Malfunctions

Accidents are unlikely to significantly increase the ambient noise at the site, except momentarily. Malfunctions could include muffling of mobile equipment or the power station. Any malfunction would be repaired immediately.

1.14 HAZARDOUS MATERIALS

1.14.1 Hazardous Materials List

A list of hazardous materials to be used at Jericho is contained in Table 1.16.

Proper management will ensure impacts from hazardous materials are minimized. A hazardous materials management plan is attached in Appendix D.2.3; a spill contingency plan is attached in Appendix D.2.4. Any impacts would therefore be expected to be only from accidents and malfunctions.

1.14.2 Accidents and Malfunctions

Routine spills can be expected from drips and small spills from containers of petroleum products. Spills will be cleaned up immediately and, in the case of soils, remediated by incineration or land farming on site. Spills will be reported to the spill line where required, as detailed in the spill contingency plan.

1.14.2.1 Rupture of a Storage Tank in the Tank Farm

Rupture of a tank in the tank farm will result in spillage of the contents inside the containment berm; no impact on the surrounding environment or water bodies will accrue from such an accident. Response and clean up procedures are detailed in the spill contingency plan. Considering the track record of constructed tanks at the Lupin and EKATI™ mine sites, where no tank failures have occurred (over 20 years in the case of Lupin), the probability of such a failure is rated as very low.

1.14.2.2 Failure of the Tank Farm Berm

Failure of the tank farm berm could occur, if water pressure behind the berm is sufficient to pipe through a weak area in the liner and berm. This type of failure will be prevented by routine inspections and keeping ponded water to a minimum behind the berm. The probability of such a failure is rated as nil with proper inspection and maintenance.

1.14.2.3 Spills of Bulk Petroleum Products

A number of petroleum products will be kept in bulk at the maintenance shop. These include solvent (e.g. Varsol™), hydraulic oil, transmission oil, and so forth. Such products will typically by kept on hand in 205 L barrels that will be stored in silled areas capable of containing the contents. The probability of a spill to soil is rated as low; any such spill would be cleaned up immediately and the soil remediated on site. Because of the storage location of such products, a spill to a water body is rated as nil; the spilled product could not reach a water body.

1.14.2.4 Other Hazardous Materials

Table 1.16 provides a listing of spill potential for other hazardous materials that will be used at the Jericho Mine.

1.14.2.5 Transportation-Related Accidents

Some potential exists for spills of hazardous materials during transportation. Materials will be transported in winter when the opportunity for complete, thorough clean up is great. Although very small, there is some potential for hazardous materials to be lost to water bodies through transport trucks breaking through the ice on a lake. This hazard is discussed under aquatic impact assessment by RL&L (Appendix B.2.3) as aquatic populations would be at risk. Other than irretrievable loss through the ice, spills would be cleaned up promptly through a coordinated effort of the transport carrier and Jericho Mine personnel, as discussed in the spill contingency plan.

Accidents involving hazardous materials have the potential to significantly affect ecosystem functioning both directly and indirectly. However, the likelihood of accidents of this scale is very small. Spills of hazardous materials are further discussed in the aquatic impact assessment report (Appendix B.2.3).

1.15 WILDLIFE AND WILDLIFE HABITAT

1.15.1 Introduction

Potential impacts on wildlife habitat and populations from the Jericho Project are discussed in detail by Hubert & Associates (Appendix B.2.2). The main conclusions of that report are summarized in this section. As well, spray irrigation of mine water has the potential to affect vegetation and soil structure in the area receiving spray water, as discussed in three reports in Appendix D.2.2.

This environmental effects assessment of the Jericho Diamond Project and the local and regional wildlife populations of Nunavut is based on a review of the expected interactions of the Project with the wildlife in the Project area. The information on the wildlife populations in the Project area and the overall region of Nunavut is based on environmental baseline studies conducted in the Project area from 1995 – 2001. The environmental effects assessment examines interaction between the Project and the environment over the life of the Project from Project development and construction, through mining and processing operations, to Project closure and abandonment. Each of these phases includes transportation by air and seasonal resupply by winter road. This environmental effects assessment for wildlife also responds to the direction provided by the Nunavut Water Board (NWB) Guidelines (draft) for the Proposed Jericho Project, September 8, 1999 (as amended by Nunavut Impact Review Board, April 5, 2000).

1.15.2 Assessment Objectives

The objectives for this environmental effects assessment are twofold:

- to describe the nature and significance of potential interactions between the Jericho Diamond Project and the terrestrial environment and wildlife populations in order to provide a sound basis by which the Nunavut Impact Review Board, Nunavut Water Board, DIAND, Government of Nunavut, and the affected public can evaluate the environmental effects of the Project; and

- to describe the nature and significance of potential interactions between the Jericho Diamond Project and the terrestrial environment and wildlife populations in the area to provide a sound base of information for planning, designing, building, operating, and decommissioning the Project.

1.15.3 Wildlife VECs Considered

The terrestrial wildlife VECs considered in this assessment were developed from concerns and values expressed to Tahera during community consultation sessions, and from similar studies completed for other mining ventures that have been conducted in the central mainland tundra over the past 10 years:

- the Izok Project proposed by Metall Mining Corporation in 1993;
- the NWT Diamonds Project (now EKATI™ Mine) in 1996;

- the Ulu Project by Echo Bay Mines Ltd. in 1997; and
- the Diavik Diamonds Project in 1998.

These studies also examined specific interactions between the projects and individual VECs. The terrestrial VECs that emerge from these sources collectively are fairly consistent and include: terrestrial vegetation (as the key component of wildlife habitat), eskers, caribou, muskoxen, carnivores (including grizzly bear, wolves, fox, and wolverines), raptors, and migratory birds.

1.15.4 Potential Effects Assessment

Wildlife and wildlife habitat could be affected by the Project in three principal ways:

- terrain disturbance, loss of vegetation, and loss of wildlife habitat;
- physical presence of the Project during construction, operation, and closure; and
- transportation services.

1.15.4.1 Terrain Disturbance, Loss of Vegetation, and Loss of Wildlife Habitat

Heterogeneous habitats ensure overall biodiversity and so contribute to overall ecological health and stability. The plant communities in the local area around the Project have not previously been subjected to ongoing industrial activity and so should be considered "pristine" in the context of ecosystem health. Plant communities and wildlife habitat types (ecological zones) in the Project area were studied, mapped, and reported by Canamera (1995, 1996, and 1997) and by Burt in 1999 (Vegetation Report, Appendix B.1.2). The plant communities in the Project area are representative of the surrounding tundra biome. No rare or endangered plant species or plant communities were identified during the vegetation studies. Terrain disturbance caused by the Project will change terrain and disturb areas of plant cover, but will not diminish the overall biodiversity of the local tundra biome.

Construction and operations of the Project will disturb or destroy 221.8 ha of terrestrial plant cover and herbivore habitat. The local landscape in the Project area is snow covered for nine months of the year, during which time the plants are dormant. Dust accumulation in the snow layer from winter operations will have little, if any, effect on the onset of the spring melt and run off. Summer blasting, mining, hauling, crushing, waste rock disposal, and stockpiling ore will be associated with the standard dust suppression activities on the roads and in the pit. Also, summer precipitation will wash dust from foliage and inhibit prolonged dust accumulation on plants. Studies at Lupin into the effects of dust on plant density and biodiversity near gravel roads showed the effects of road dust on tundra vegetation (in terms of total cover) seems to be only minor (Svoboda, 1998).

Terrain disturbance sites are the PKCA at Long Lake, waste dumps, and ore stockpiles. Long Lake will be filled with PK and will no longer be a water body. Waste and ore handling facilities will permanently alter local habitat.

Gold and metal mine tailings ponds can contain levels of reagents or metals that are toxic to life including birds, although bird kills are rare, even for cyanide containing gold mill tailings ponds. Processed kimberlite containment areas for diamond mines do not normally contain toxic levels of any chemicals or metals and are thus much less likely to effect birds or other animals that may enter the empoundment.

The potential environmental effects of dust will not lead to significant changes in plant communities at the local level and will have negligible effects on regional plant associations. The potential environmental effects of terrain disturbance will be local, long-term or permanent, and moderately significant.

Spray irrigation has the potential to affect Arctic plant communities by changing the dissolved salt balance in soil. Effects of chloride as well as plant uptake of cations, such as magnesium, calcium, and sodium may occur. Vegetation damage may occur, as salts accumulate in the plant root zone and high osmotic pressures develop. As well, decreased soil permeability may result from cation exchange in clay particles, which will exacerbate the effects of accumulated salts at the root zone by preventing their being flushed out. This latter effect is particularly a concern in high clay soils, whereas Arctic soils, including those at the Jericho site are low in clay content because they are glacially derived and the fines are predominantly granitic rock flour.

The results of trial applications of solutions of salts of sodium chloride, magnesium chloride, and potassium chloride on test plots indicated that, at concentrations of these salts expected in mine water, no harmful impacts to plant communities occurred (Appendix D.2.2).

1.15.4.2 Physical Presence of Project Facilities During Construction, Operations, and Closure

Aspects of Project construction, operations, and related support activities at the site, which could be the source of disturbance effects on wildlife populations include:

- noise from blasting, loading, and site operations generally;
- mobile equipment traffic at the site;
- physical barriers to wildlife movements;
- garbage attracting scavengers;
- harassment by Project personnel.

Wildlife abundance in the area of the Jericho Diamond Project is seasonal. Birds are migratory and use the tundra for summer breeding and fledging. Mammals resident in the Project area on a year round basis are present in relatively low densities. High densities of caribou are probable for short durations (less than 24 hours) several times per year.

Potential interactions between the Jericho Diamond Project and wildlife populations may include:

1) Mine construction and operations, and related support activities will be conducted during raptors' spring nest site selection, breeding, nesting, and fledging periods.
2) Raptor nesting territories may be abandoned due to disturbance.
3) Mine construction and operations, and related support activities will be conducted during migratory birds' spring breeding, nesting, brooding, and fledgling periods.
4) Mine construction and operations, and related support activities may cause disturbance and so reduce or displace migratory bird nesting activities.
5) Mine construction and operations, and related activities may disturb small mammal populations.
6) Disturbance to small mammal populations may cause reduced productivity and abundance.
7) Reduced small mammal productivity and abundance may affect carnivore and raptor populations.
8) Mine construction and operations, and related activities may disturb the local muskox herds and the Bathurst caribou herd.
9) Disturbance to caribou / muskox populations may result in reduced caribou / muskox productivity and abundance.
10) Reduced productivity and abundance may result in reduced caribou / muskox harvests.
11) Mine construction and operations, and related activities may disturb local carnivores:
    - by disturbing denning habitat;
    - by causing den sites to be abandoned;
    - by habituating carnivores to camp garbage;
    - accidents can cause road kills, which attract scavengers that may in turn become road kills, or associate human activities with food.
12) Direct interactions with local carnivores may result in reduced carnivore productivity and abundance:
    - by reduced survival of young animals;
    - by destroying nuisance animals attracted to the site by garbage.

Table 1.17 provides a summary of the assessment. Refer to the Wildlife Effects Assessment Report (Appendix B.2.2) for further details.

1.15.4.3 Environmental Effects of Transportation

There will be three aspects of transportation for the Jericho Project that could affect wildlife populations:

- local road traffic at the site;
- the seasonal winter road resupply; and
- air transport support.

Potential interactions between Project transportation activities and wildlife may include:

1) The winter resupply by winter road may disturb spring raptor breeding and nesting.
2) Disturbances to raptor nesting will result in reduced raptor productivity.
3) The winter resupply will disturb migratory bird nesting.
4) Disturbances to migratory bird nesting will result in reduced productivity.
5) The winter resupply will disrupt caribou spring migration:
    - by affecting spring migration patterns on Contwoyto Lake and between Contwoyto Lake and the Project site on Carat Lake; and
    - by accidental collisions of trucks with caribou.
6) Disruptions to spring migration may reduce caribou productivity.
7) Road kills will attract scavengers that may associate the winter road with food.
8) Scavengers may become nuisance wildlife and be destroyed and so reduce abundance and productivity of scavenger species (carnivores).
9) Summer aircraft movements at Jericho may affect raptor nesting success.
10) Summer disturbances to raptor nesting will result in reduced raptor productivity.
11) Aircraft movements at Jericho may disturb caribou.
12) Disturbance to caribou will result in reduced caribou productivity.
13) Local traffic may disturb wildlife and cause road kills.

Table 1.18 provides a summary of the assessment. Refer to the Wildlife Effects Assessment Report (Appendix B.2.2) for further details.

1.15.5 Accidents and Malfunctions

Conceivable accidents and malfunctions that could increase disturbance areas include failure of waste rock dumps, stockpiles, or dams on the PKCA. Construction of the waste rock dumps and stockpiles will be in lifts with set backs. Factors of safety will be conservative and all stockpiles and dumps will be founded on bedrock over most of their footprints, as detailed in the Project Description (Appendix A.1). Failure of a dump slope could result in minor runout of waste rock. Any failure other than the base 10 m lift would result in most rock runout onto the step-back bench at the foot of the failed slope, rather than beyond the base footprint of the dump. Failure of any part of the base lift would result in additional area being covered with rock, the extent of which would depend on the amount of rock that slid down the failed slope. Assuming an entire slope of Waste Rock Dump 1 failed, an area 10 m by 1,000 m (1 ha) could be affected. This assumes the slope of the dump face would drop from 2:1 to 3:1 and that one of the longest slopes of the largest dump completely failed.

The overburden stockpile, which has the greatest potential to fail, will be constructed with a toe berm of run-of-mine waste rock to prevent runout should slumping occur.

Accidents involving wildlife would be limited to road kills or injuries that would almost always lead to the death of the animal involved. Accidental deaths of wildlife, based on the experience of other Arctic mines (in particular, Lupin Gold Mine), are not expected to be significant.

1.15.6 Summary of Potential Effects on Wildlife and Wildlife Habitat

The interactions of construction, operations, transportation, and related support activities for the Jericho Project with wildlife over the life of the Project were examined and their environmental effects on wildlife populations assessed. In all cases - raptor populations, migratory bird populations, small mammal populations, ungulate populations, and carnivore populations - the environmental effects were found to be contained to the area of the Project, or in the case of caribou, to the limit of the Bathurst herd's range. The environmental effects from the Project on wildlife do not extend beyond the life of the Project, and will not be detectable in any wildlife population.

The sustainability of harvests on populations presently being harvested should not change as a consequence of the overall environmental effects from the Jericho Diamond Project. These findings are consistent with those of the environmental effects assessment of the Diavik Project (approximately 170 km southeast of Jericho), which is proposed to operate for 23 years and disturb an active footprint more than five times greater than that of the Jericho Project (CEAA, 1999).

1.16 AQUATIC RESOURCES

Potential impacts to aquatic resources are discussed in the RL&L report, as amended from the draft EIS by PE Environmental (Appendix B.2.3, Attachment 4.1). The main conclusions are summarized in this section.

1.16.1 Assessment of Potential Impacts

Project activities at the Jericho Site have the potential to affect fish in several ways. These may include direct mortality of fish, changes to habitat, and reduced water quality. Fish habitat could be physically lost to the footprint of the development, or the value of habitat to fish could be reduced through changes in water quality. Water quality may also influence fish by affecting the health of a population, or by changing the reproductive capacity of primary producers (phytoplankton and periphyton), or food sources (zooplankton and benthic invertebrates).

Project activities have been grouped into three pathways of potential effects on fish: direct mortality, loss of habitat by removal or degradation, and reduced water quality (Table 1.19). The specific activity is described and its location and project phase identified. Each pathway represents one primary effect, but it is acknowledged that a project activity could have multiple effects. Potential effects are discussed as they pertain to specific water bodies. Project activities deemed to have no potential adverse effect are not discussed (e.g., extension of airstrip).

1.16.1.1 Direct Fish Mortality

Water Withdrawal

Water withdrawal following DFO (1995a) guidelines will not lead to significant fish mortality.

Use of Explosives

Use of explosives in the mine pit could result in some level of adverse environmental effects, but only on a very localized scale.

Angling

Lakes within the Project site, except Contwoyto Lake, will be designated as no fishing lakes. Angling by Tahera employees will be prohibited in all these lakes.

Scientific Research

The limited number of fish required for monitoring purposes and use of nonlethal sampling methods will minimize the adverse effects of this project activity. As such, the effect of scientific research is considered negligible.

1.16.1.2 Loss of Fish Habitat

Permanent and Winter Roads

The DFO (1995b) guidelines will be met regarding permanent and winter road construction, operation, and closure; therefore, potential effects on streams will be fully mitigated. Because the proposed crossing location of Stream C2 does not traverse a section that is utilized by fish and the ramp at Contwoyto Lake covers a small area of low quality fish habitat, permanent roads have only a very low potential for adverse effects. The same is true for the winter road. Based on this information, there will be no adverse environmental effects associated with loss of fish habitat caused by permanent or winter roads (see the Environmental Management Plan, Appendix B.3.1).

Diversion of Stream C1

Based on information from fisheries studies, removal of potential fish habitat in the upper portion of Stream C1 will not adversely affect fish. Because flows will be maintained by the diversion system, loss of nutrients or invertebrate production from upstream areas will be minimal. The environmental management and mitigation plans are designed to reduce the introduction of sediments into Stream C1; however, increased concentrations of suspended sediments will occur during the open water period immediately following construction and during maintenance activities (see Environmental Management Plan, Appendix B.3.1). As such, there is the potential for adverse environmental effects caused by elevated suspended sediment concentrations in the lower section of Stream C1 and in Carat Lake. Potential adverse effects include physical harm to fish or fish eggs, reduced water quality, and degradation of benthic invertebrate production.

Fish stranding is not likely to occur in the diversion channel. Fish distribution is restricted to the lower 100 m of stream, which is below the entry point into the diversion (275 m); the potential for fish stranding is extremely low.

Based on this information, the diversion of Stream C1 and the resulting loss of a portion of the channel will not result in loss of fish habitat. However, construction and maintenance activities may affect the downstream section of Stream C1, which could cause adverse environmental effects.

Processed Kimberlite Containment Area

Intensive fish sampling during 1999 and 2000 identified only limited numbers of two fish species in this Long Lake (D10) which is proposed for the PKCA: burbot and slimy sculpin. Surveys of the unnamed pond along the north shore of Long Lake recorded 2 slimy sculpin. This small water body is less than 1 ha in size, but has a maximum depth of 7 m. This perched basin is connected to Long Lake by an ephemeral stream that is impassable to fish. During August 2000, this water body had drawn down to approximately two-thirds its spring and early summer area and no water was flowing out of the connecting channel between the pond and Long Lake. This information indicates that Long Lake System supports small populations of slimy sculpin and burbot. Stream C3, which connects this basin to Lake C3, is impassible to fish over much of its length (>600 m); therefore, the Long Lake system fish community is resident.

The Long Lake System supports small, resident populations of slimy sculpin and burbot. The lake and deep ponds provide all the necessary habitats to support viable populations. The shallow ill-defined channel likely provides rearing and feeding habitat for young-of-the-year and small juveniles of these species. Based on this information, removal of waterbodies in the Long Lake System from production will adversely affect existing fish habitat and cause direct mortality of fish.

Water Intake Causeway

Because the causeway will extend only a short distance into Carat Lake (90 m) it is not expected to substantially alter water circulation.

Construction of the causeway has the potential to destroy fish eggs that are deposited in the substrate. Because construction will occur during the period when fish eggs of the majority of species are not present (open water period), this potential effect is negligible.

Sediment control measures implemented during construction and rehabilitation will prevent large amounts of sediment from entering the aquatic environment (see Environmental Management Plan, Appendix B.3.1). As such, physical loss of habitat is deemed to be the only potential adverse effect on fish caused by the water withdrawal causeway.

1.16.1.3 Potential Effects on Water Quality

Mine Site Runoff

Several project components in the mine site are sources of runoff, including the waste rock dumps, overburden stockpile, ore stockpiles, coarse processed kimberlite stockpile, and the mine pit (Map A). Surface runoff from permanent roads associated with the mine may also contain elevated levels of suspended sediments, but this source is considered minor, because it will be contained by ditches or the existing tundra (Project Description, Appendix A.1). Therefore, surface runoff from roads will not be assessed.

<u>Copper</u>

CCME (1999) water quality guidelines for the protection of aquatic life specify that concentrations should not exceed 0.002 mg/L. Given that background levels in Carat Lake are low (0.0016 mg/L) and the predicted maximum concentration in the effluent (0.016 mg/L) is above the CCME (1999) threshold, there is potential for reduced water quality. This, in turn, may adversely affect fish and other aquatic biota.

Because water quality of Carat Lake can be characterized as having low alkalinity and hardness (Baseline Summary Report, Appendix B.1.1) and the fish community is dominated by salmonids such as lake trout, Arctic char, and round whitefish, there is the potential for adverse effects caused by copper. It should be noted that acute toxicity values (LC^{50} - concentration causing 50% mortality) identified for fish and other aquatic organisms are typically greater than 0.030 mg/L (Sorensen 1991; Lewis 1995), which is higher than the maximum concentration that would be present in the mine effluent (0.016 mg/L).

<u>Ammonia</u>

CCME (1999) water quality guidelines for the protection of aquatic life specify that concentrations of ammonia should not exceed 1.37 mg/L (for pH 8.0 at 10^0C). Because the background levels in Carat Lake are low at 0.017 mg/L (Baseline Summary Report, Appendix B.1.1), and the predicted maximum concentration in the effluent

(30 mg/L) is above the CCME (1999) threshold, the potential exists for reduced water quality and adverse affects on aquatic biota.

Based on the assumption that concentrations of suspended sediment, ammonia, and copper in the treated runoff meet metal mine effluent regulation limits and are non-toxic, the potential adverse effects of mine runoff will be negligible.

PKCA Discharges

Potential fish habitat is limited due to the small size of Stream C3. Fish use is restricted to the lower 300 m due to dispersed and subsurface water flow upstream of this point. Multiple channels and shallow riffle habitats dominate the lower 300 m stream section. In 1999, 3 juvenile Arctic char were recorded in Stream C3, while in 2000, 10 Arctic char, 1 burbot, and 37 slimy sculpin were encountered.

Fish use the Stream C3 outlet zone in Lake C3 for rearing and feeding. It is unlikely that the area is important for spawning, due to the absence of suitable spawning habitat. Nor were spawning fish or young-of-the-year fish recorded within the immediate vicinity of the outlet zone. As such, the potential for mortality of fish and fish eggs is deemed to be negligible.

During construction and startup of the PKCA, water inputs from the Long Lake basin into Stream C3 will be eliminated. This will result in loss of fish habitat in the lower section of the stream. During PKCA operation, release of PKCA effluent could potentially affect water quality in Stream C3 and Lake C3, through the introduction of nutrients and contaminants, and suspended sediments. Assuming no input of mine runoff into the PKCA, leach tests conducted by SRK Consulting (Appendix D.1.5) indicate that the only constituents of the PKCA effluent that may exceed water quality guidelines are ammonia (predicted value = 17.3 mg/L) and total suspended sediments (predicted value = 8 mg/L). It should be noted that, based on results at EKATI™ Mine, ammonia is not expected to be above concentrations of 2 mg/L in the PKCA supernatant (EKATI™, pers. comm. 2000). If mine runoff is directed to the PKCA, these values may be higher.

During post-closure, the smaller catchment basin will result in much lower water flows in Stream C3. This could result in dewatering and loss of fish habitat in the lower 300 m of the stream.

Discharges from the operations are targeted to meet metal mine effluent regulation limits and be non-toxic. To ensure that contaminant levels meet these specifications, Tahera will treat the PKCA effluent. Options include use of spray irrigation and a treatment facility. Fish habitat provided by Stream C3 will be permanently removed from production by the Project development; it will be dewatered during the post-construction and post-closure phases. During the operations phase, discharge from the PKCA will maintain fish habitat in Stream C3, but this is deemed a temporary mitigative measure. Contaminant concentrations are assumed to be at acceptable levels due to implementation of mitigative measures; therefore, issues associated with reduced water quality caused by discharge from the PKCA are considered negligible.

Emissions

Emissions generated during construction, operation, and closure, which could potentially affect fish, will be largely confined to dust. Air quality is discussed in Section 1.12 and in Appendix D.1.1. Based on data from the Diavik study, air-borne contaminants generated from the proposed Jericho development will not cause adverse environmental effects on aquatic biota.

1.16.2 Accidents and Malfunctions

1.16.2.1 Road Activities

Only vehicle activity during the construction phase has the potential to affect aquatic biota within the Jericho Site. As such, the assessment will be restricted to this component of the project.

Data for the period 1994 to 1998, presented in Diavik (1998), indicate a spill rate of 9.0×10^{-7} per loaded truck kilometer of travel on the existing route from Yellowknife. Using this information, the estimated number of return trips, and the distance travelled within the Jericho Site (3.5 km), the number of potential spill incidents would be less than 0.01. Even if the total number of predicted trips were used (932), the number of incidents during the entire life of the project would not exceed 0.003. Diesel fuel will be the largest single item transported.

This information suggests that the likelihood of a spill occurring during the life of the project is extremely low. Furthermore, not all truck loads contain materials that are hazardous to the aquatic environment. For the purposes of this assessment, it is assumed that a 'worst case spill of petroleum' may occur in the Jericho Site, mitigative measures will not remove the entire spill, and the spill will enter the aquatic system. Based on these assumptions, there could be residual environmental effects, occurring within the Jericho site or on Contwoyto Lake, associated with a spill on the winter road.

Adverse effects associated with an accidental spill on the winter road in the Jericho site may be high, but they would be restricted to the sub-local or local level. The rating for a 'worst case spill' is significant for Lynne Lake and not significant for Contwoyto Lake. The level of confidence in this rating is low, as is the certainty (qualitative and quantitative) in the evaluation. At the present time, there is insufficient information to accurately predict the magnitude of the effect on fish.

1.16.2.2 Fuel Farm Spill

The fuel farm in the Jericho Site is situated adjacent a fish bearing water body (Lake C1). As such, there is the potential for adverse effects on fish, if a fuel spill were to occur. Tahera's environmental management plan will utilize a containment system around each fuel farm that has a design capacity of 110% of the largest tank within the fuel farm; therefore, no fuel originating from a fuel farm spill would reach the aquatic system. Based on the planned mitigation, no adverse effects on aquatic biota are expected.

1.16.2.3 Waste Rock Dump Structural Failure

Based on the project design (dump slopes and height), the probability of waste rock entering either lake as a result of structural failure is zero. Tahera's water management plan will also utilize a containment system that incorporates a series of berms designed to prevent down slope movement of effluent associated with a potential failure. As such, no waste rock or effluent originating from structural failure of the dump will reach the aquatic system (Project Description, Appendix A.1). Therefore, no adverse effects on aquatic biota would occur.

1.16.2.4 PKCA Failure

Given the location of the PKCA, structural failure of the containment area resulting in an uncontrolled release of fine PK has the potential to adversely affect the aquatic environment in the C3 – Carat Lake and Ash – Key – Lynne Lake systems. There are a limited number of emergency mitigative measures that can be implemented in the event of structural failure. They would involve construction of temporary coffer dams used to contain the spill.

The downstream extent of the detrimental effects on fish of an uncontrolled spill would vary depending on the volume of the material released, as well as dilution effects, and holding times in each basin. An assessment of water quality effects suggests that a spill to the east could influence most lakes and streams in the Contwoyto Lake drainage (all except Contwoyto Lake), but the detrimental effects on fish of a spill to the west would extend only to Lake C3 (Section 1.11.2).

The adverse effects of an uncontrolled spill from the PKCA will be significant. Immediate consequences will include direct mortality of fish due to acute toxicity of contaminants in the effluent. Long-term consequences would involve degradation of habitat due to sedimentation and reduced water quality. The ecological context of an uncontrolled spill is high in all cases and it is unlikely that the effect would be reversible during the life of the Project. Due to the low productivity characteristic of subarctic lakes, fish populations would require several generations to return to pre-affected densities. In addition, barriers to fish passage in the Contwoyto Lake drainage would hamper re-establishment of the fish communities. The geographic extent of the spill would be moderate, because only water bodies within the Jericho Site would be affected. The level of confidence in this rating is low, as is the certainty (qualitative and quantitative) in the evaluation. At the present time, there is insufficient information to accurately predict the duration of the effects.

1.17 BIODIVERSITY

The Canadian government recognizes arctic biodiversity as an item of concern and is a participant in the Arctic Council, established in 1996, with members including Canada, Denmark/Greenland/Faroe Islands, Finland, Iceland, Norway, the Russian Federation, Sweden, and the USA. A working group within the Council, Conservation of

Arctic Flora and Fauna (CAFF), is specifically concerned with biodiversity. One of the four main goals of CAFF is the conservation of Arctic flora and fauna, their biodiversity, and their habitats.

Biodiversity is not dealt with separately in this assessment report, as its key components (terrestrial plants, terrestrial animals, aquatic plants, and aquatic animals) are discussed in these sections. By inference, an assessment of impacts on these components will provide an overall assessment of effects on biodiversity.

On a Project-wide scale, the Project will have a local effect on biodiversity, in that some landforms will be rendered uninhabitable by plants and animals. It is unlikely any known species of plant or animal will be eliminated from the Project footprint area, as there are no unique habitats within this footprint. On the microscale (facility scale) major effects will occur to biodiversity, e.g. in the open pit, where most plants and animals will be eliminated over the life of the mine. On a regional scale, biodiversity will not be measurably affected, principally because the Project site constitutes only a very small part of the range of any populations found in the region. Species of concern that are found in the Project area are barrenland grizzly bears and peregrine falcons; neither will be significantly affected by the Project with proper management of activities. There are no special community assemblages in the Project area, such as waterfowl staging areas, mineral licks, etc. and thus no areas that require special protection or avoidance because of their unique characteristics.

Reclamation, on going through the Project life and on closure, will return much of the habitat of the site to near its original state. Reclamation is detailed in the Reclamation Plan (Appendix B.3.2).

No rare, endangered, or threatened species occur in the Project footprint and thus the potential for extirpation of known species by project activities is negligible.

1.18 MINE CLOSURE

Impacts from temporary and final dosure of the Jericho Diamond Mine are discussed in the Reclamation Plan (Appendix B.3.2). The principal aim of temporary closure procedures will be to ensure the site is secure and stable, and that no accidents or malfunctions of infrastructure and equipment left on site will adversely affect environmental integrity of the site. This will require that certain management activities, such as water management, will need to continue during a temporary closure at the same or nearly the same level as when the mine is operating. Final closure will result in all infrastructure being disassembled and the site being returned to its natural, or near natural, state through reclamation activities. Overall, both temporary and final closure will result in a lessening or elimination of impacts from mining activities.

Monitoring, during a temporary closure and after final closure, will allow comparison of predictions with effects; corrective action will be taken if appropriate.

1.19 UNRESOLVED ISSUES

Unresolved issues include:

1. A concern that the open pit be backfilled. This would render the project uneconomic (further discussion is provided in the Project Description, Appendix A.1) and would not result in the replacement of all waste rock, since void spaces would result from backfilling.

2. A concern that all water bodies remain undisturbed at the site. This would not allow project development since Stream C1 must be diverted, Long Lake will be converted to a processed kimberlite containment area, and a causeway for water intake is required in Carat Lake.

3. A concern that esker material not be used for construction. Some esker material will be required, especially in Year 1 when sufficient waste rock will not be available for construction purposes.

4. The desire for a value-added industry with respect to diamond production. Tahera is committed to investigate the feasibility of providing diamonds for a Nunavut cutting industry and to make training available. At the time of writing of this report, the feasibility of such a proposal had not been fully explored.

There is no practical resolution of items 1 through 3 other than to forego the Jericho Diamond Project. While every effort will be made to minimize disturbance, it cannot be entirely eliminated. The open pit can be made productive habitat once again upon mine closure by filling with water to form a lake. This will provide fish habitat and thus food for birds and other animals that feed on fish.

1.20 SUMMARY OF POTENTIAL IMPACTS

Table1.1, previously discussed, provides a summary of potential environmental effects. Effects are rated qualitatively. The presence of residual effects is also noted. The project will have no significant impacts on the regional environment and the proposed mitigating actions are well defined and practical.

2.0 CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative effects are discussed in a separate report entitled Environmental Cumulative Effects Assessment (Appendix B.2.4).

3.0 RESIDUAL ENVIRONMENTAL EFFECTS

A number of Project activities will cause residual effects and a number of VECs will be affected. This section discusses those residual effects. This document closely follows the environmental impact assessment outlined by the Canadian Environmental Assessment Agency (CEAA 1994, 1997), which provides a clear, well-defined system to classify residual environmental effects and a criteria rating system to ascertain their significance.

Rating criteria developed under the Canadian Environmental Assessment Act (CEAA 1994) were employed to evaluate the significance of the residual environmental effects. The rating criteria used were:

- Magnitude
- Geographic extent
- Duration
- Frequency
- Reversibility
- Ecological context
- Level of confidence
- Certainty

Magnitude

Magnitude describes the nature and extent of the environmental effect. The magnitude of an effect is quantified in terms of the amount of change in a parameter or variable from an appropriate threshold value, which may be represented by a guideline or baseline conditions. Three general categories of change to be employed are low, medium, and high. The definitions used to rate the magnitude will be specific to a particular effect and will depend on the type of effect, the methods available to measure the effect, and the accepted practices for a particular discipline.

Geographic Extent

Geographic extents are similar to the horizontal spatial boundaries of the assessment outlined in each impact section and, in general, vertically above. Geographic extent criteria differ among different VECs and are discussed under each.

Duration, Timing and Frequency

Duration is defined as a measure of the length of time that the potential effect could last. It is closely related to the project phase or activity that could cause the effect. The four project phases, which define the temporal boundaries related to duration, include construction, operation, closure, and post-closure. Duration criteria are discussed in each assessment where relevant.

The duration criterion is divided into three classifications:

Short-term (L) - Effects lasting for less than one year (associated with the construction period, or other short-term activities).

Mid-term (M) - Effects lasting from one to nine years (associated with the life of the mine).

Long-term (H) - Effects lasting longer than 10 years (persisting beyond closure of the mine).

Frequency

Frequency is associated with duration and defines the number of occurrences that can be expected during each phase of the project and differs for each VEC.

Reversibility

Reversibility is the ability of communities to return to conditions that existed prior to the adverse environmental effect. The prediction of reversibility can be difficult, because environmental effects may, or may not, be reversible. Despite this, it is important to ascertain reversibility, because it has an important influence on the significance of an effect. Two rating criteria were used: reversible (R) and not reversible (NR).

Ecological Context or Effects on Ecosystem Functioning

Ecological context is a measure of the relative importance of the affected ecological component to the ecosystem, or the sensitivity of the ecosystem to disturbance. It indicates the degree to which an effect on the component would affect the ecosystem. The ecological context rating criteria are specific to each effect, but they can be grouped into three general categories: low (L), moderate (M), and high (H).

Level of Confidence

Using the rating criteria described in the preceding paragraphs, the significance of adverse environmental effects is evaluated based on a review of project specific data, relevant literature, and professional opinion. Based on recommendations by Barnes and Davey (1999), the assessment should also include a rating system that evaluates the level of confidence in the prediction of significance. Three rating criteria will be used to assess the level of confidence: low (L), moderate (M), and high (H).

Certainty

To arrive at a high level of confidence for a significance rating, it is usually desirable to apply rigorous scientific and/or statistical methods (quantitative approach). Where such methods are not feasible, professional judgement is usually employed (qualitative approach). Rating the certainty of the significance rating is an additional step that can be used to justify or substantiate the level of confidence in the evaluation. The three rating criteria that will be applied to each of the two certainty categories (quantitative and qualitative) are low (L), moderate (M), and high (H).

3.1 PERMAFROST

With the management procedures outlined in Section 2.6 of the Environmental Management Plan (Appendix B.3.1), no residual effects are expected. If increase in the active layer in any mine unit or at facilities becomes problematic, the issue will be addressed so as to reduce or eliminate permafrost melting to the extent practical. For instance, if mats are ineffective in preventing building settling, soils pilings could be driven down to bedrock; for lighter buildings, jacks could be used.

3.2 HYDROLOGY

3.2.1 Mining

3.2.1.1 Assessment of Impacts

Four main residual effects on drainage basins will result from the Jericho Project:

- Stream C1 will remain in its diversion channel through mine life and at closure;
- Long Lake will be filled in with processed kimberlite during mine life and will be reclaimed to land on closure;
- Tundra and wetland areas where the open pit is located will disappear during mining and will become a lake after closure; and
- The hydrologic regime of the area east of Lake C3 will change over the life of mine, if the spray irrigation option is accepted for treatment of some of the mine water.

Natural runoff flow patterns around dumps and the Low Grade Ore Stockpile will be permanently altered, but no substantial change in volume of runoff water will result; the ultimate water bodies will revert to those before mining on closure. With mitigation and management there will be no additional residual impacts. Water management is discussed in the Project Description (Appendix A.1) and under Mine Waste and Water Management (Appendix D.2.1).

The area of drainage affected by mining will be 1.52 km^2 or 0.6% of the total Carat drainage basin above the lake outlet. An area of approximately 0.1 km^2 would be required for spray irrigation. On a regional scale, temporary and residual effects on the drainage basin hydrology will be negligible.

3.2.1.2 Frequency and Length of Occurrence

Life-of-mine changes in hydrology will be from construction through closure, or eight years.

3.2.1.3 Degree and Timeframe for Reversibility

Changes to site hydrology resulting from mine construction and operation will be reversed at the end of mine life.

3.2.1.4 Ecological Context

Effects on ecosystem functioning are discussed in Section 3.8.

3.2.1.5 Level of Confidence

Level of confidence is moderate, since predictions are based on extrapolation from watersheds similar to Jericho and site-specific data that spans a short time frame.

3,2.1.6 Certainty

Certainty is quantitative, because it is based on physical measurements, and moderate, since it is also based on extrapolation from similar watersheds.

3.2.2 Diamond Processing

3.2.2.1 Assessment of Impacts

Withdrawal of water and some redirection of natural drainage patterns are required for plant and mine operation. The changes, while insignificant, will remain throughout the eight year mine life. Once the mine closes, drainage patterns will be returned to as near pre-development as practical.

The flow regime of Stream C3 will be permanently altered, as discussed. During mine life the flow will be augmented to about 1.5 to 2 times pre-mining flows. Upon closure of the PKCA and reclamation to dry land, the flow of Stream C3 will revert to near that of pre-mining (i.e. the drainage basin size will not alter appreciably), but flows will no longer be moderated by Long Lake.

3.2.2.2 Frequency and Length of Occurrence

Changes in hydrological patterns due to planned operations would occur at construction and last either life of mine or indefinitely (changes in flow patterns in Stream C3, due to construction of the PKCA).

3.2.2.3 Degree and Timeframe for Reversibility

The principal change due to diamond processing infrastructure (the PKCA modification of flows of Stream C3) would be permanent. Other, more minor, changes in local runoff in the plant area would be reversed upon decommissioning of the plant.

3.2.2.4 Ecological Context

See Section 3.2.1.4.

3.2.2.5 Level of Confidence

See Section 3.2.1.5.

3.2.2.6 Certainty

See Section 3.2.1.6.

3.3 SURFICIAL GEOLOGY / LAND FORMS

3.3.1 Assessment of Impacts

Most changes in land forms will be permanent and no mitigation is possible. With DFO approval, the open pit will be flooded upon closure and will become a small, deep lake connected by Stream C1 to Carat Lake. The total area affected by the two waste dumps, the low grade ore stockpile, coarse kimberlites, and the open pit will be about 73 ha as indicated in Table 3.1.

3.3.2 Frequency and Length of Occurrence

The frequency of occurrence of effects on land forms will be once over the life of mine.

3.3.3 Degree and Time frame for Reversibility

All effects on landforms will be residual over the life of mine and beyond.

3.3.4 Level of Confidence

The level of confidence is high based on the certainty of change, should the project proceed.

3.3.5 Certainty

Certainty is quantitative and high.

3.4 WATER QUALITY

3.4.1 Mining

3.4.1.1 Assessment of Impacts

The main effects on water quality from mining will be:

- increase in suspended sediments;
- increase in nitrogen; and
- possible small increase in dissolved metals.

These effects will be managed through settling ponds in the case of sediments and through management of explosives use and directing runoff water appropriately in the case of nitrogen, as discussed in the Project's Environmental Management Plan (Appendix B.3.1). A water management plan was developed conceptually by SRK Consulting (Appendix D.2.1) and will be updated during detailed engineering.

Residual effects will include increases in water concentration of nitrogen compounds after dilution of runoff water. Sediment will also increase slightly over background, since Carat Lake normally has very low suspended sediment levels (well below the CCME receiving environment guideline). With normal mixing in Carat Lake, increases in nitrogen and suspended sediments over background will not be detectable beyond the outlet of Carat Lake. Use of spray irrigation to discharge mine water to land would eliminate this source of nitrogen and sediment addition to receiving water bodies.

With reclamation, effects from sedimentation will drop to insignificant levels. Effects from nitrogen will drop to zero on closure, because runoff water will be directed to the open pit and the pit will take a minimum of several decades to fill before discharging into the former Stream C1 channel. By that time, nitrogen residuals on mined rock will have dropped to, or close to, zero.

3.4.1.2 Frequency and Length of Occurrence

Impacts from mining to water quality will be limited to the open water season each year (June through September). The actual impacts on water quality from mining activities will be limited to those that result from discharges that meet water licence discharge criteria, i.e., acceptable to regulatory agencies. Impacts will occur throughout mine life and for a short time after closure (post closure monitoring period).

3.4.1.3 Degree and Timeframe for Reversibility

All effects from normal mine operation will be reversible upon mine closure.

3.4.1.4 Ecological Context

Ecological context is discussed in Section 3.8.

3.4.1.5 Level of Confidence

The level of confidence in the extent of impacts is moderate, since it is based on mathematical modelling and laboratory analyses as well as operating experience at a similar mine (EKATI™).

3.4.1.6 Certainty

Certainty is qualitative. The level of certainty with respect to spatial extent of residual effects is moderate, since the hydrologic regime of the Carat Lake basin is known. The level of certainty with respect to temporal extent of residual effects is high, since they will cease upon mine closure, or shortly thereafter.

3.4.2 Diamond Processing

3.4.2.1 Assessment of Impacts

Potential residual effects on water quality from diamond processing include nitrogen loading to Lake C3 via discharge from the PKCA through Stream C3. The addition of nitrogen will not be ecologically significant (i.e. effect aquatic plant and animal populations), if phosphorus remains limiting (as is predicted) and, particularly, if the nitrogen model results for PKCA concentrations are correct and EKATI™'s diamond plant ammonia levels in effluent occur also at Jericho.

URS's report, Lake C3 Modelling (Appendix D.1.2) indicates that near field effects (where concentrations will be above background) will be the small bay where Stream C3 discharges. Far field effects should not extend beyond Lake C3 outlet, i.e. N concentrations should return to near background (30:1 to 100:1 dilution) by the time water reaches the outlet.

3.4.2.2 Frequency and Length of Occurrence

Effects will be periodic (open water season) throughout the life of mine. The temporal extent of effects on water quality will be the life of mine. The spatial extent of residual effects will be within 200 m of the discharge into Lake C3 for near field effects and Lake C3 outlet for far field effects (Appendix D.1.2).

3.4.2.3 Degree and Timeframe for Reversibility

All impacts from normal operation will be completely reversible and will occur within the timeframe required to flush Lake C3 and Carat Lake, which will be one year or less for water quality. Long Lake will be permanently altered.

3.4.2.4 Ecological Context

See Section 3.8.

3.4.2.5 Level of Confidence

The level of confidence in these predictions is moderate since they are based on mathematical models and not on actual mine experience. There are no operations data to use for comparison, as the receiving environment characteristics are unique to the site and quite different from EKATI™, the only operating diamond mine in the Canadian Arctic at the time this report was written.

3.4.2.6 Certainty

See Section 3.4.1.6.

3.5 AIR QUALITY

Air quality impacts are discussed in Appendix D.1.1. Residual impacts are summarized in this section.

3.5.1 Assessment of Impacts

3.5.1.1 Mining and Ore Processing

The proposed mining activities will introduce air pollutants into the air shed. Since all sources of NOx and SOx will not be active at the same time, the aggregate plume from the site will have a variable concentration, but not maximum concentration over time as was modelled.

Fugitive dust may result in high ambient concentrations. This would be most probable during the summer when mitigation through watering will be most effective. Maximum concentrations tend to occur when the atmosphere is stable and the wind speed is low. However, when the wind speed is low, fugitive dust emissions tend to be at their lowest and hence actual ambient concentrations will also be low. This is not reflected in the model, as an average wind speed of 5 m/s (18 km/hr) was used in the emissions calculation, and hence the model is considered extremely conservative for these meteorological conditions.

Dust emissions may promote snow melt in spring and change plant communities close to the haul roads and waste rock dumps. Particularly sensitive plant communities (i.e. acidic meadows or peatlands), are not located close to proposed roads or dumps and thus, changes in plant communities are expected to be small.

Once the underground mining begins, the potential for fugitive dust emissions should be greatly reduced because surface activity of mobile equipment will be much less. Thus, the impacts on air quality will diminish with time.

3.5.1.2 Borrow Pit Operation

Borrow pits will be operated almost exclusively during winter and spring. Dust will be limited to handling esker materials and cannot be effectively controlled. Dust is expected to cover snow adjacent to operating areas. The extent of dust generation will be dependent on the percentage of fines in the esker materials. Dust will wash away with snow melt and will be most prevalent in the first two years of mine operation when esker borrow materials will be most heavily used. Dust generation at borrow pits will be a residual effect over the life of the mine. Based on EKATI™'s observations (EKATI™, pers. comm.), dust will be expected to travel 100 to 200 m from sources.

3.5.2 Frequency and Length of Occurrence

The spatial extent of effects on air quality from Jericho operations is expected to be most extensive for suspended particulates, as predicted by the Industrial Source Complex, version 3 (ISC3) model. At a distance of up to 8 km from the pit the air may have suspended particulates (PM-10) above the British Columbia guideline of 50 $\mu g/m^3$, under worst-case conditions with conservative assumptions that all dust sources were active at the same time. This prediction is approximately the same order of magnitude as predicted by Diavik (1998) for a much larger operation, which again suggests the model was very conservative. The model largely predicts residual effects, i.e. those that will persist after mitigation.

The temporal extent of effects will be life of mine. Any changes in vegetation due to dust deposition will last decades after the mine closes, because of the slow rate of plant growth. As previously discussed, such changes are expected to be minor.

3.5.3 Degree and Timeframe for Reversibility

All residual effects will be reversible at the end of mine life, except for some residual dust generation that will continue until vegetation covers disturbed areas. It should be noted that dust accumulation on snow adjacent to areas, such as eskers, is a natural occurrence in the Jericho area. The dust source is predominantly bare esker soils.

3.5.4 Ecological Context

Exhaust gases will not affect ecosystem functioning at the Jericho site, based on the concentrations predicted. For sensitive plant communities, i.e., lichen, this prediction will be monitored, as discussed in Appendix B.3.3. Aquatic effects are discussed in Section 3.8; wildlife effects are discussed in Section 3.7.

3.5.5 Level of Confidence and Certainty

Level of confidence and certainty are discussed in the air quality assessment report (Appendix D.1.1).

3.6 NOISE

3.6.1 Assessment of Impacts

Every practical effort will be made to eliminate unnecessary noise sources. Mining operations are by their nature noisy, similar to many other heavy industrial activities. It is not practical, nor possible, to mitigate many major noise sources beyond built-in engineering controls, such as engine exhaust noise from mobile heavy equipment. However, most noise sources are relatively constant when viewed from the perspective of the perimeter of the Project site and thus the impact should be mitigated naturally once wildlife become habituated to the noise. People working at the site will be provided hearing protection, as appropriate. The residual effects from noise will be significant for animals that avoid the noise, limited spatially to the mine site, and of medium term, i.e. life of mine. Noise levels will be reduced at the end of open pit mining with the move to mining underground and further reduced in the last two years of the projected mine life when only ore processing will be undertaken.

3.6.2 Frequency and Length of Occurrence

Frequency of noise will be source dependent. as discussed previously. Length of occurrence, although intermittent in most cases, will be life-of-mine.

3.6.3 Degree and Timeframe for Reversibility

All noise effects will be completely reversible and will cease upon cessation of the noise source. It will likely take one or two seasons for animals that have avoided the site, due to noise, to return.

3.6.4 Ecological Context

As discussed under potential impacts in Section 1.13, noise will have a minor, local effect on wildlife populations sensitive to noise disturbance. Additional comment can be found in Section 3.7.

3.6.5 Level of Confidence

The confidence level for potential effects on people is high, because of the large data base available. Regarding wildlife, confidence ranges from moderately high for caribou (extensively studied over the past two decades) to low for passerines and waterfowl (much less studied).

3.6.6 Certainty

Certainty is semi-quantitative for wildlife and quantitative for humans. The degree of certainty for wildlife is moderate, since it is based mostly on the experience of other mines and to a limited extent on Jericho (exploration and bulk sample activities). The degree of certainty for humans is high.

3.7 WILDLIFE AND WILDLIFE HABITAT

3.7.1 Definition of Wildlife Effects

The basis for categories for wildlife effects differed in certain respects from generalized categories discussed previously in this section. This section defines categories used.

Magnitude varies with respect to the VEC considered, as well as the effect in question (as previously stated). For wildlife, the following categories were set:

- **Major effect**: An environmental effect is rated major when it is judged to result in a ten percent or greater change in the size of an animal population, or the size of a resource harvest.
- **Moderate effect**: An environmental effect is rated moderate when it is judged to result in a one to ten percent change in the size of an animal population, or a resource harvest.
- **Minor effect**: An environmental effect is rated minor when it is judged to result in a change in the animal population size, or resource harvest that is less than one percent. Changes of one percent in a free-ranging wildlife population in the Project area and region would be difficult, if not impossible, to detect

The definitions for levels of significance above were also used by the assessment for the Izok and Ulu projects cited above, as well as the Diavik Diamonds Project for wildlife populations (1998; and CEAA CSR, 1999). Also, this assessment will adopt the Diavik levels of significance for environmental effects on habitat:

- High: change is greater than 30%;
- Moderate: change is 6 - 30%; and
- Low: change is less than 5%.

Terms are combined as appropriate in composing statements that provide a summary conclusion for environmental effects of a particular aspect of the Project on a VEC. For example, an effect can be classified as local, of medium-term, and moderate. In such an interaction, the environmental effect would be restricted to the footprint of the Jericho Project, persist only during the period of Project operations, and affect up to (but not more than) ten percent of the VEC population, or change between six and 30 percent of the habitat in the local Project area.

3.7.2 Residual Effects Assessment

Residual effects are discussed in Environmental Effects Assessment on Wildlife (Appendix B.2.2) under the same categories as for potential impacts. The main conclusions are summarized in this section.

Significant residual impacts to wildlife and wildlife habitat, after mitigation, are all local, most are life of mine, and all are minor or moderate in magnitude at a local scale. On a regional scale, all residual impacts are minor. Proposed mitigation is discussed in the Environmental Management Plan (Appendix B.3.1). The Environmental Effects Assessment on Wildlife report (Appendix B.2.2) discusses local residual impacts for each of the VEC's considered. Table 3.2 summarizes the residual effects assessment.

The disturbance areas shown in Table 3.1 will all be residual (i.e. they will occur with Project development). Consistent with good management practices in Arctic regions, including energy conservation and minimizing land disturbance, the footprint of the Project has been kept as small as practical, given due regard to efficiency of operation and safety. Any significant further reduction in footprint would compromise the mine's ability to operate and safety of personnel.

Residual effects will last for the life of mine and are significant in a local context (Jericho area as shown on Map C, the ecological zones map for the Project). Residual effects are insignificant in a regional context, because of the relatively small areas affected compared to the available habitat types in the region.

With reclamation, most of the disturbed area will slowly return to habitat approximately equivalent to that prior to disturbance. Meadows, located where waste rock dumps will be placed, will be lost. In time rock dumps will resemble rocky tundra on their sides and dry barren tundra on top surfaces.

The open pit will become a lake once runoff and snow melt fill the cavity formed from ore removal. The PKCA, which is currently a mixture of lake, meadow, and tundra habitats will become dry barren tundra and meadow habitat. A total of 11.6 ha of naturally-occurring lakes will be permanently lost. By comparison, the area of Carat Lake is 271 ha and Carat Lake is a very small lake on a regional scale. (Approximately 10 ha of artificially-created lake will be added to the landscape around Jericho).

The level of certainly of predictions is high because they are based on the proposed operation of the mine.

3.7.3 Frequency and Length of Occurrence

Essentially all disturbance, except for borrow pit areas, will occur during mine construction in years 1 and 2. Disturbance in borrow areas will occur mostly during construction, but small amounts of fill material will be required periodically, e.g. to repair roads. Residual effects will occur on a periodic basis throughout the life of mine, with the exception of wildlife that are resident at the Jericho site. For resident wildlife, effects will be continuous.

3.7.4 Degree and Timeframe For Reversibility

Disturbed areas will be reclaimed when no longer active (see previous discussion). It will, however, require decades for disturbed areas to return to their pre-mining level of vegetative cover, because of the slow growth of plants in the Arctic. Some areas, such as dump slopes, will remain bare for many decades until lichens establish. These areas will then be equivalent to rocky tundra, the most prevalent habitat type at Jericho.

3.7.5 Ecological Context

At a regional level, effects on ecosystem functioning will be negligible, except for the Bathurst caribou herd. Due to the use of the Lupin winter road, regional effects on caribou are forecast to be minor. At the local level, small parts of common local ecosystems will be eliminated (see Table 3.1) and effects will be significant.

3.7.6 Level of Confidence

The level of confidence in predictions of wildlife effects is moderate to high, because it is based on a broad range of experience with northern ecosystems, including experience at a nearby gold mine that has operated for over 20 years.

3.7.7 Certainty

Certainty is qualitative and moderate.

3.8 AQUATIC HABITATS AND BIOTA

Residual impacts are discussed in the Aquatic Impact Assessment Report (Appendix B.2.3, Attachment 4.1). Findings are summarized in this section. Criteria for the assessment are as discussed below, where they differ from generalized criteria previously discussed.

Criteria for geographic extent used in this assessment include the following:

- Low - Includes specific areas in water bodies within the immediate influence of the project (foot print and immediately adjoining areas).
- Moderate - Includes entire water bodies within the immediate influence of the project (foot print and immediately adjoining areas).
- High - Includes the Carat Lake and Contwoyto Lake drainage basins, excluding the local study area.

Table 3.3 summarizes residual aquatics effects.

Five residual effects were identified by the aquatics impacts analysis:

1) Use of explosives in the open pit has the potential to damage fish eggs, but effects will be restricted to a small area and will affect only slimy sculpin. Because this species is widely distributed in Carat Lake, the population would likely not be affected by this disturbance.

2) Diversion of Stream C1 will not affect existing fish habitat, but operation and maintenance of the diversion may lead to some downstream sedimentation that could affect the lower portion of the Stream (below the diversion and within 100 m of the mouth) and contiguous areas of Carat Lake shallows. Potential effects include direct mortality of fish eggs, the loss of fish habitat through sedimentation, and lowered production of invertebrates due to reduced water quality. Construction phase, although scheduled for winter, has the greatest potential to result in sedimentation; operation and maintenance potentials are lower, because physical disturbance of the channel will be considerably less. With normal construction management following DFO guidelines (Chilibeck 1992), effects should be negligible.

3) PKCA construction will result in the loss of Long Lake and a small lake to the northeast of Long Lake as fish habitat. The adverse effect on fish will be initiated at the onset of construction and will extend into the post-closure phase of the project. The effect is not reversible and the ecological context is high. The environmental effects evaluation indicated that adverse effects of the PKCA will be high, but they will be restricted to the local level. It should be acknowledged that the affected fish community consists of small, resident populations of slimy sculpin and burbot that are ubiquitous to the Jericho Site. Loss of this particular fish community will have no serious consequences to the ecological integrity of the aquatic system outside of the Long Lake System.

4) The water intake causeway will result in permanent habitat loss. The habitat types of concern include spawning and rearing. Feeding habitat may also be affected, but it is assumed that changes to feeding habitat will not affect the viability of the fish community; this habitat type is abundant and widely distributed in Carat Lake. Rearing habitat is limited in distribution and abundance in Carat Lake, but the approximate area affected (750 m^2) represents a small fraction of rearing habitat available along the Carat Lake shoreline. Only slimy sculpin spawning habitats could be affected by the causeway. The environmental effects evaluation indicated that adverse effects of the causeway will be continuous, but the effects will be at the sub-local level.

5) Discharge from the PKCA during mine life could adversely affect fish habitat in Stream C3. PKCA discharges are targeted to meet metal mine effluent regulation limits and be non-toxic (Environmental Management Plan, Appendix B.3.1), but fish habitat presently available in Stream C3 will likely be permanently lost from production due to dewatering. The PKCA will permanently alter the discharge regime of Stream C3; therefore, the effects on this watercourse are not reversible. The limited habitat quality and size of Stream C3 suggests that it is not important to the fish community; therefore, the ecological context is low. Stream C3 provides only a limited amount of habitat for fish and it is available only on an opportunistic basis; therefore, it is not essential for the long-term viability of the fish community that resides in Lake C3.

4.0 IMPACTS FROM EXPLORATION FACILITIES

Exploration activities to date have resulted in limited disturbance at the site and essentially no disturbance off site. Existing facilities are shown in Figure 3.1 of the Project Description (Appendix A.1) and account for 35.45 ha of disturbance approximately as follows:

- borrow areas 10 ha;
- portal and related 12 ha;
- roads 5.6 ha;
- camp 3.85 ha;
- airstrip 4 ha.

A reclamation bond currently exists, held by NWB, for clean up of the site's exploration-related disturbance.

Impacts have been restricted to surface disturbance and a small amount of contaminated soil resulting from routine spills of petroleum products; soils are currently being amended on site as per recommendations of DIAND and Environment Canada. No soil erosion into water bodies has occurred, although small amounts of soil have eroded to tundra areas adjacent to some disturbed sites.

The principal impact to living organisms has been some displacement of small mammals and breeding birds from nesting, burrowing, and feeding areas. Loss of vegetation is equal to the total disturbance area since very little regeneration has occurred, principally because the areas are still actively used.

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TABLES

TABLE # CHANGES: EIA REPORT	
Old Table Number	**New Table Number**
1.17.1	1.19
3.9.1	3.3

TABLE 1.1
SIGNIFICANCE OF ENVIRONMENTAL EFFECTS

Ecosystem Component	Mining Phase	Effect	Significance	Mitigation Success	Residual	Significance
Regional Climate	Exploration	None significant	None	Not applicable	None	None
	Construction	None significant	None	Not applicable	None	None
	Operation	None significant	None	Not applicable	None	None
	Closure	None significant	None	Not applicable	None	None
Site Climate	Exploration	None significant	None	Not applicable	None	None
	Construction	Micro-climate changes due to local topographic changes, dust	None	Not applicable	Topographic effects at pit and dumps	None
	Operation	Micro-climate changes due to local topographic changes, dust	Moderate	Moderate	Topographic effects at pit and dumps	Low
	Closure	None significant additional to operation	Moderate	High	None additional to operation	Minor
Hydrology	Exploration	Minor alteration of drainage patterns at portal	Low	None	Alterations remain	Low
	Construction	Diversion of deposit stream (C1)	Moderate	High	Diversion will remain	Minor
	Operation	None in addition to construction	Moderate	High	None additional to construction	Minor
	Closure	Potential creation of a pit lake	Moderate	Moderate	Potential fish habitat	Moderate
Surficial Geology	Exploration	Site disturbance for camp, portal, pads and roads, airstrip, borrow areas	Moderate	None prior to final closure	Alterations remain	Moderate
	Construction	Site disturbance: pit development, laydown area, waste dump(s), C1 diversion, (camp); borrow pit use	Moderate	Moderate	Loss of habitat, esp. for small birds and small mammals	Low
	Operation	Site disturbance: pit and waste rock dump expansion	Moderate	Moderate	Loss of habitat, esp. for small birds and small mammals	Low
	Closure	Rehabilitation of laydown area, roads, camp and pads	Moderate	High	Gain in habitat	Moderate
Permafrost	Exploration	None significant	None	Not applicable	None	None
	Construction	None significant	None	Not applicable	None	None
	Operation	None significant	None	Not applicable	None	None
	Closure	None significant	None	Not applicable	None	None
Water Quality	Exploration	None significant	Insignificant	Not applicable	None	None
	Construction	Minor sedimentation; nitrogen loadings to water	Low	High	None	None
	Operation	Minor sedimentation; nitrogen loadings to water	Moderate	High	Minor effects on Lake C3	Low
	Closure	Decreasing nitrogen loadings with time; decay can be predicted from monitoring waste dumps after closure in Year 4	Low	High	Effects may last a few years after mine operations cease	Minor
Air Quality	Exploration	None significant	Minor	Not applicable	None	None
	Construction	Dust; minor NOx, SOx, CO, TSP			Some effects will remain after controls applied	
	Operation	Dust; minor NOx, SOx, CO, TSP			Some effects will remain after controls applied	
	Closure	Dust; minor NOx, SOx, CO, TSP			Effects will cease once rehabilitation complete	
Vegetation, Wildlife Habitat	Exploration	Local terrain disturbance and habitat loss	Minor	None prior to reclamation	Local, long term	Low to moderate
	Construction	Local terrain disturbance and habitat loss; local noise; local dust	Moderate	Effects replaced by operations	Local, long term until reclamation	Low to moderate
	Operation	Additional local disturbance will result in further habitat loss; local noise; local dust	Moderate	None until mine closure	Pit and waste dump areas permanently altered; noise, dust cease on mine closure; reclamation will slowly restore other habitat	Moderate to high
	Closure	Rehabilitation of laydown area, roads, camp and pads			Gain in habitat; loss at pit and dump(s) permanent; alteration of PKCA permanent.	
Wildlife - General	Exploration	None, other than loss of habitat	Minor	None until reclamation	Minor	Minor
	Construction	Intolerant animals will leave the project site;local medium-term disturbance	Minor	None until reclamation	Loss of habitat	Minor
	Operation	None in addition to construction	Minor	None until reclamation	Loss of habitat	Minor
	Closure	Loss of habitat for small mammals and small birds; activity will cause local, short-term disturbance	Minor	Moderate	Loss at pit and dump(s) permanent	Minor
Wildlife - Raptors	Exploration	Local, short-term disturbance	Minor	Not applicable	None	None
	Construction	Local, medium-term disturbance	Minor	Not applicable	None	None

TABLE 1.1
SIGNIFICANCE OF ENVIRONMENTAL EFFECTS

Ecosystem Component	Mining Phase	Effect	Significance	Mitigation Success	Residual	Significance
	Operation	All weather road traffic, blasting could affect nest occupancy; loss of foraging habitat at mine site; local, medium-term disturbance	Minor	Not applicable	None	None
	Closure	Rehabilitation of disturbed sites will return >50% of former foraging habitat and add some on dump sides; activity will cause local, short-term disturbance	Minor	Not applicable	Pit area permanently lost as foraging habitat	Minor
Wildlfie - Waterfowl	Exploration	None; no staging areas in Project area	None	Not applicable	None	None
	Construction	Local, medium-term disturbance	None	Not applicable	None	None
	Operation	Local, long-term displacement from PKCA	Minor	None until reclamation	Displacement from Long Lake will be permanent	Minor
	Closure	Local, long-term displacement	Minor	Moderate	Displacement from Long Lake will be permanent	Minor
Wildlife - Shorebirds and Gulls	Exploration	None; wet meadows not affected; eskers near water not affected	None	Not applicable	None	None
	Construction	Loss of Long Lake meadow at E end (1ha); local, medium-term disturbance	Minor	Not applicable	Habitat loss until end of mine life	Minor
	Operation	Full development of esker at Borrow Area D will result in some potential habitat loss; local medium-term disturbance	Minor	Not applicable	Habitat loss until end of mine life and reclamation	Minor
	Closure	Habitat rehabilitation following closure; local, medium-term displacement	Minor	Moderate	None	Minor
Wildlife - Song Birds	Exploration	None	None	Not applicable	None	None
	Construction	Local, medium-term disturbance	Minor	Not applicable	None	None
	Operation	Local, medium-term disturbance	Minor	Not applicable	None	None
	Closure	Habitat rehabilitation following closure	Minor	Moderate	Decades until habitat returns to pre-disturbance state	Minor
Wildlife - Small Mammals	Exploration	None	None	Not applicable	None	None
	Construction	Local but permanent displacement from disturbed areas of Project site	Minor	Not applicable	Permanent displacement	Minor
	Operation	Local but permanent displacement from disturbed areas of Project site	Minor	Not applicable	Permanent displacement	Minor
	Closure	Original habitat will be replaced by high nutrient reclamation areas	Minor	Moderate	Steady improvement of reclaimed areas	Minor
Wildlife - Muskox	Exploration	None	None	Not applicable	None	None
	Construction	Local, medium-term disturbance	Minor	Moderate	None	None
	Operation	Local, medium-term disturbance	Minor	Moderate	None	None
	Closure	Local development of high nutrient forage sites on reclamation areas	Minor	Moderate	None	None
Wildlife - Caribou	Exploration	None	None	Not applicable	None	None
	Construction	Local, medium-term disturbance	Minor	Moderate	Altered trail pattern through Project area	Minor
	Operation	Local, medium-term disturbance	Minor	Moderate	Altered trail pattern through Project area	Minor
	Closure	Road collision hazard will cease; reclamation will result in rehabilitation of some habitat	Minor	Moderate	Altered trail pattern through Project area	Minor
Wildlife - Fox	Exploration	None	none	Not applicable	None	None
	Construction	Local, medium-term distrubance	Minor	Moderate	None	None
	Operation	Local, medium-term distrubance	Minor	Moderate	None	None
	Closure	Local, medium-term distrubance	Minor	Not applicable	None	None
Wildlife - Wolf	Exploration	None	None	Not applicable	None	None
	Construction	Local, occasional disturbance	Minor	Moderate	None	None
	Operation	Local, occasional disturbance	Minor	Moderate	None	None
	Closure	No incremental effects; removal of facilities will reduce impacts to near zero	Minor	Moderate	None	None
Wildlife - Wolverine	Exploration	None	None	Not applicable	None	None
	Construction	Local, occasional disturbance	Minor	Moderate	None	None
	Operation	Local, occasional disturbance	Minor	Moderate	None	None
	Closure	No incremental effects; removal of facilities will reduce impacts to near zero	Minor	Moderate	None	None
Wildlife - Grizzly Bear	Exploration	None	None	Not applicable	None	None

TABLE 1.1
SIGNIFICANCE OF ENVIRONMENTAL EFFECTS

Ecosystem Component	Mining Phase	Effect	Significance	Mitigation Success	Residual	Significance
	Construction	Local, occasional disturbance	Minor	Moderate	None	None
	Operation	Local, occasional disturbance	Minor	Moderate	None	None
	Closure	No incremental effects; removal of facilities will reduce impacts to near zero	Minor	Moderate	None	None
Fish	Exploration	None; aquatic habitats not affected	None	Not applicable	None	None
Habitat	Construction	Permanent and winter roads	None	Not applicable	None	None
		Diversion of Stream C1	None	Not applicable	None	None
		Causeway will affect SE corner of Carat Lake	Low	Not applicable	Removal of fish habitat	None
		Removal of Long Lake and Stream C3 by PKCA	Low	None	Removal of Long Lake and Stream C3 from production	Moderate
	Operation	Construction impacts	See above			
	Closure	Permanent and winter roads	None	Not applicable	None	None
		Diversion of Stream C1	Low	High	None	None
		Removal of Long Lake and Stream C3 by PKCA	None	None	Removal of Long Lake and Stream C3 from production	Moderate
		Causeway will affect SE corner of Carat Lake	Low	Moderate	Removal of fish habitat; creation of other habitat	None
Fish Populations	Exploration	None	None	Not applicable	None	None
(Direct Mortality)	Construction	None			Permanent; some gain in rearing habitat from subaqueous portions of causeway	
		Entrainment of fish during water withdrawal	Low	High	None	None
		Use of explosives in mine area	Low	Moderate	Destruction of fish eggs in Stream C1 and SE corner of Carat Lake	Low
		Harvest by recreation anglers	None	High	None	None
		Stranding of fish in Long Lake by draining for the PKCA	Low	Not applicable	Destruction of fish in Long Lake	Low
	Operation	Entrainment of fish during water withdrawal	Low	High	None	None
		Use of explosives in mine area	Low	Moderate	Destruction of fish eggs in Stream C1 and SE corner of Carat Lake	Low
		Harvest by recreation anglers	None	High	None	None
	Closure	Potential creation of a pit lake			Gain in habitat when filled; decades	
Benthic Invertebrates	Exploration	None; aquatic habitats not affected	Insignificant	Not applicable	None	Insignificant
	Construction	Loss of 3400 m2 of benthic habitat in Carat Lake; loss of 9.8 ha of benthic habitat in Long Lake			Permanent except for organisms adapted to cobble/rubble substrates	
	Operation	Potential impact from low level metals release and nitrogen loading			Throughout mine life	
	Closure	Pit lake may create a small amount of habitat at edges			Small gain in habitat	
Periphyton	Exploration	None; aquatic habitats not affected	Insignificant	Not applicable	None	Insignificant
	Construction	Loss of <500 m2 of shoreline/shallows habitat at Carat Lake; loss of all shoreline habitat (m) of Long Lake			Short term until causeway rock recolonizes at Carat; loss permanent at Long Lake	
	Operation	None additional			None	Insignificant
	Closure	Pit lake may create a small amount of habitat at edges			Small gain in habitat	
Phytoplankton	Exploration	None; aquatic habitats not affected	Insignificant	Not applicable	None	Insignificant
	Construction	None	Insignificant	Not applicable	None	Insignificant
	Operation	None	Insignificant	Not applicable	None	Insignificant
	Closure	Potential creation of a pit lake			Gain in habitat when filled; decades	
Zooplankton	Exploration	None; aquatic habitats not affected	Insignificant	Not applicable	None	Insignificant
	Construction	None	Insignificant	Not applicable	None	Insignificant
	Operation	None	Insignificant	Not applicable	None	Insignificant
	Closure	Potential creation of a pit lake			Gain in habitat when filled; decades	
Cumulative Effects	Exploration	None significant	Insignificant	Not applicable	None	Insignificant
	Construction	Potential for additive effects on caribou, grizzly bears, some raptors			Some of unknown significance after mitigation	

TABLE 1.1 SIGNIFICANCE OF ENVIRONMENTAL EFFECTS						
Ecosystem Component	**Mining Phase**	**Effect**	**Significance**	**Mitigation Success**	**Residual**	**Significance**
	Operation	Mining and processing will act cumulatively to increase area of disturbance. Potential for additive effects on caribou, grizzly bears, some raptors; 221.8 ha total disturbance	Significant	Not applicable	Moderate significance at the site; negligible significance regionally	
	Closure	None additional			Permanent loss or alteration of 72.8 ha of terrestrial and aquatic habitat	Regionally insignificant

TABLE 1.2 HYDROLOGIC PARAMETERS	
Mean Annual Precipitation (mm)[1]	330
Mean Annual Lake Evaporation (mm)[2]	280
Mean Annual Evapotranspiration (mm)[2]	200
Mean Annual Runoff - Lower Bound (mm) [3]	130
Mean Annual Runoff - Upper Bound (mm) [4]	250
Runoff Distribution	
January	0%
February	0%
March	0%
April	0%
May	2.7%
June	56.9%
July	16.3%
August	9.3%
September	12.5%
October	2.2%
November	0%
December	0%

Notes:
1. The mean annual precipitation is from the AES corrected precipitation archive.
2. MALE & MAE - based on regional analysis using WREVAP model for eight stations in the NWT1 (PJB, Mar-98 memo, Attachment 1.2).
3. Lower bound estimate based on subtracting MAE from MAP
4. Upper bound estimate based on regional analysis comparing MAR to Catchment Area

Table 1.3 Jericho Infrastructure Component Runoff

Component	Catchment (m^2)	MAR (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subtotal (m^3)
			0%	0%	0%	0%	2.7%	56.9%	16.3%	9.3%	12.5%	2.2%	0%	0%	100%
1. Low Grade Ore Stockpile	130,700	130	-	-	-	-	454	9,671	2,775	1,584	2,127	381	-	-	16,991
		250	-	-	-	-	874	18,598	5,336	3,046	4,090	732	-	-	32,675
2. North Ore Stockpile	40,000	130	-	-	-	-	139	2,960	849	485	651	116	-	-	5,200
		250	-	-	-	-	267	5,692	1,633	932	1,252	224	-	-	10,000
3. Coarse Ore Stockpile	39,840	130	-	-	-	-	138	2,948	846	483	648	116	-	-	5,179
		250	-	-	-	-	266	5,669	1,626	928	1,247	223	-	-	9,960
4. Dump Site 1 Area	312,530	130	-	-	-	-	1,086	23,126	6,635	3,787	5,085	910	-	-	40,629
		250	-	-	-	-	2,089	44,472	12,759	7,283	9,780	1,750	-	-	78,133
5. Dump Site 2 Area	254,900	130	-	-	-	-	886	18,861	5,411	3,089	4,148	742	-	-	33,137
		250	-	-	-	-	1,704	36,272	10,406	5,940	7,976	1,427	-	-	63,725
6. Coarse Kimberlite Rejects Storage	166,000	130	-	-	-	-	577	12,283	3,524	2,011	2,701	483	-	-	21,580
		250	-	-	-	-	1,109	23,621	6,777	3,868	5,194	930	-	-	41,500
7. Plant Area	55,260	130	-	-	-	-	192	4,089	1,173	670	899	161	-	-	7,184
		250	-	-	-	-	369	7,863	2,256	1,288	1,729	309	-	-	13,815
8. Overburden Stockpile	189,800	130	-	-	-	-	660	14,044	4,029	2,300	3,088	553	-	-	24,674
		250	-	-	-	-	1,269	27,008	7,749	4,423	5,939	1,063	-	-	47,450
9. Pit & Drainage Area	157,700	130	-	-	-	-	548	11,669	3,348	1,911	2,566	459	-	-	20,501
		250	-	-	-	-	1,054	22,440	6,438	3,675	4,935	883	-	-	39,425

Table 1.4 Jericho PKCA Water Balance

Parameter			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subtotal
Monthly Evaporation Distribution			0%	0%	0%	0%	0%	33%	33%	23%	11%	0%	0%	0%	100%
Monthly Lake Evaporation (mm)			0	0	0	0	0	92.4	92.4	64.4	30.8	0	0	0	280 mm
Monthly Total Precipitation (mm)			9.4	10.4	13.7	15.0	24.5	33.6	48.5	55.0	43.8	41.0	21.0	14.2	330 mm
Net Precip [Ppt.-Lake Evap] (mm)			9.4	10.4	13.7	15.0	24.5	-58.8	-43.9	-9.4	13.0	41.0	21.0	14.2	50 mm
Net Precip [Ppt.-Lake Evap] (m^3)			919	1024	1340	1471	2403	-5768	-4310	-920	1273	4019	2062	1392	4,905 m^3
Monthly Tailings Water Increment (m^3)			14,015	14,015	14,015	14,015	14,015	14,015	14,015	14,015	14,015	14,015	14,015	14,015	168,175 m^3
STP Discharge to Tailings (m^3)			913	913	913	913	913	913	913	913	913	913	913	913	10,958 m^3
Monthly Runoff Distribution			0%	0%	0%	0%	3%	57%	16%	9%	13%	2%	0%	0%	100%
Monthly Runoff (m^3)	MAR =	130 mm	0	0	0	0	1,793	38,167	10,950	6,250	8,393	1,502	0	0	67,054 m^3
		250 mm	0	0	0	0	3,447	73,397	21,057	12,019	16,140	2,888	0	0	128,950 m^3
Total Monthly Inflow (m^3)	MAR =	130 mm	15,847	15,952	16,267	16,399	19,124	47,326	21,567	20,258	24,594	20,448	16,990	16,320	251,092 m^3
		250 mm	15,847	15,952	16,267	16,399	20,779	82,557	31,675	26,027	32,341	21,835	16,990	16,320	312,988 m^3
Required Discharge (m^3)	MAR =	130 mm	0	0	0	0	0	184,673	21,567	20,258	24,594	0	0	0	251,092 m^3
		250 mm	0	0	0	0	0	222,945	31,675	26,027	32,341	0	0	0	312,988 m^3
Required Discharge Rate (m^3/d)	MAR =	130 mm	0	0	0	0	0	6,156	696	653	793	0	0	0	251,092 m^3
		250 mm	0	0	0	0	0	7,431	1,022	840	1,043	0	0	0	312,988 m^3

Hydrologic Parameters	
Mean Annual Precip (mm) [1]	330
Mean Annual Lake Evaporation (mm) [1]	280
Mean Annual Evapotranspration (mm) [1]	200
Mean Annual Runoff - Lower Bound (mm) [2]	130
Mean Annual Runoff - Upper Bound (mm) [3]	250
Nominal Surface Area of Long Lake (m^2) [4]	98,100
Catchment Area of Impoundment (m^2)	613,900

Note: 1. Based on Regional Analysis performed by PJB and summarized in Mar-98 memo (Attachment 1.2)
MAP - based on corrected archive of northern precipitation records
MALE & MAE - based on regional analysis using WREVAP model for eight stations in the NWT
2. Lower bound estimate based on subtracting MAE from MAP
3. Upper bound estimate based on regional analysis comparing MAR to Catchment Area
4. Lowest current pond level (el. 515.4 m) was used to give the most conservative estimate of runoff

TABLE 1.5
CARAT LAKE AND LAKE C3 WATER BALANCE

Hydrologic Parameters		**Water Balance - Carat Lake**	
Mean Annual Precip (mm)[1]	330	Mean Annual Lake Precip (m^3)	903,540
Mean Annual Lake Evaporation (mm)[1]	280	Mean Annual Lake Evaporation (m^3)	766,640
Mean Annual Evapotranspiration (mm)[1]	200	Mean Annual Basin Evapotranspiration (m^3)	29,600,000
Mean Annual Runoff - Lower Bound (mm)[2]	130	Mean Annual Basin Runoff - Lower Bound (m^3)	19,240,000
Average Mean Annual Runoff (mm)	190	Mean Annual Basin Runoff - Average (m^3)	28,120,000
Mean Annual Runoff - Upper Bound (mm)[3]	250	Mean Annual Basin Runoff - Upper Bound (m^3)	37,000,000
Nominal Surface Area of Carat Lake (m^2)	2,738,000	Lower Bound Annual Lake Balance4 (m^3)	19,376,900
Volume of Carat Lake (m^3)	27,203,110	Average Annual Lake Balance[4] (m^3)	28,256,900
Drainage Basin Area (to outlet) (m^2)	148,000,000	Upper Bound Annual Lake Balance[4] (m^3)	37,136,900
		Water Balance - Lake C3	
Nominal Surface Area of Lake C3 (m^2)	679,300	Mean Annual Lake Precip (m^3)	224,169
Volume of Lake C3 (m^3)	4,743,239	Mean Annual Lake Evaporation (m^3)	190,204
Drainage Basin Area (to outlet) (m^2)	133,000,000	Mean Annual Basin Evapotranspiration (m^3)	665,000
		Mean Annual Basin Runoff - Lower Bound (m^3)	17,290,000
		Mean Annual Basin Runoff - Average (m^3)	25,270,000
		Mean Annual Basin Runoff - Upper Bound (m^3)	33,250,000
		Lower Bound Annual Lake Balance4 (m^3)	17,323,965
		Average Annual Lake Balance[4] (m^3)	25,303,965
		Upper Bound Annual Lake Balance[4] (m^3)	33,283,965

[1] Based on Reginal Analysis performed by PJB and sumarized in Mar-98 memo, Attachment 1.2
MAP - based on corrected archive of northern precipitation records
MALE & MAE - based on regional analysis using WREVAP model for eight stations in the NWT

[2] Lower bound estimate based on subtracting MAE from MAP

[3] Upper bound estimated based on reginal analysis comparing MAR to Catchment Area

[4] MAR + lake precipitation - lake evaporation

TABLE 1.6
HYDROLOGIC PATTERN ALTERATIONS

Natural	Operation
Stream C1, Open Pit area	Diversion of most of the stream to the west
Waste Dump 1, 2, Overburden Stockpile, Low Grade Ore runoff	Collection of water and discharge from a sediment control pond; no change in total volume
Plant complex area runoff	Collection and re-routing of water to sedimentation berms or the PKCA; no change in total volume; discharge from PKCA to same drainage basin
Coarse Kimberlite area runoff	Collection and re-routing of water to sedimentation berms or PKCA; no change in total volume; discharge from PKCA to Lake C3, not Key or Lynne lakes.
Withdraw up to 306,600 m^3 annually from Carat Lake	Discharge to PKCA and thence to Stream C3 and Lake C3, then back to Carat Lake. Change in pattern of discharge; little change in total volume
Stream C3	Increase in summer discharge from PKCA
Unnamed, Key lakes	Potential decrease in runoff by <5% if diverted to PKCA
Borrow Areas, Airstrip, Exploration Camp	Drainage unaltered

TABLE 1.7
EXPLOSIVES USE AT JERICHO

	OPEN PIT				**UNDERGROUND**			**TOTAL**
Date	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
Low Grade Ore (mt)	44,784	506,100	762,300	344,000	-	-	-	**1,657,184**
Low Grade Ore (bcm)	17,225	194,654	293,192	132,308	-	-	-	**637,378**
Northern Ore (mt)	-	47,300	435,800	20,400	-	-	-	**503,500**
Northern Ore (bcm)	-	18,192	167,615	7,846	-	-	-	**193,654**
Central Ore (mt)	160,700	320,000	289,000	646,300	50,000	330,000	233,600	**2,029,600**
Central Ore (bcm)	61,808	123,077	111,154	248,577	19,231	126,923	89,846	**780,615**
Waste (mt)	416,502	5,249,650	6,066,600	1,687,100	57,000	-	-	**13,476,852**
Waste (bcm)	157,171	1,981,000	2,289,283	636,642	21,509	-	-	**5,085,605**
Overburden (mt)	770,824	816,891	-	-	-	-	-	**1,587,715**
Overburden (bcm)	428,236	453,828	-	-	-	-	-	**882,064**
Total Material (mt)	1,392,810	6,939,941	7,553,700	2,697,800	107,000	330,000	233,600	19,254,851
Total Material (bcm)	664,438	2,770,751	2,861,245	1,025,372	40,740	126,923	89,846	7,579,316
Anfo Use (LG Ore) kg	13,780	155,723	234,554	105,846	-	-	-	**509,903**
Anfo Use (NF Ore) kg	-	14,554	134,092	6,277	-	-	-	**154,923**
Anfo Use (CF Ore) kg	49,446	98,462	88,923	198,862	10,385	68,538	48,517	**563,132**
Anfo Use (Waste) kg	125,736	1,584,800	1,831,426	509,313	11,615	-	-	**4,062,891**
Anfo Use (OB) kg	141,318	149,763	-	-	-	-	-	**291,081**
Total Anfo Use (kg)	**330,280**	**2,003,302**	**2,288,996**	**820,298**	**22,000**	**68,538**	**48,517**	5,581,930

TABLE 1.8 NITROGEN MODEL ASSUMPTIONS
There are 0.33 kg N/kg of ANFO
0.1% of nitrogen from explosives is residual on blasted materials
Nitrogen residuals report to waste rock and ore in direct proportion to the amounts produced
Half the nitrogen residual would remain in the pit and the rest would be carried on the ore and waste
Leaching continues at the above rate until all available nitrogen has been leached

TABLE 1.9
PREDICTED NITROGEN CONCENTRATION IN RUNOFF AT JERICHO
(mg/L)

LOW GRADE ORE STOCKPILE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitrate												
2002 (0)	0	0	0	0	0.10	0.08	0.08	0.08	0.09	0.08	0	0
2003 (1)	0	0	0	0	0.86	0.76	0.75	0.74	0.79	0.68	0	0
2004 (2)	0	0	0	0	1.78	1.59	1.55	1.53	1.65	1.41	0	0
2005 (3)	0	0	0	0	3.36	3.00	2.94	2.89	3.11	2.68	0	0
2006 (4)	0	0	0	0	3.52	3.14	3.07	3.02	3.25	2.80	0	0
2007 (5)	0	0	0	0	3.52	3.14	3.07	3.02	3.25	2.80	0	0
2008 (6)	0	0	0	0	3.52	3.14	3.07	3.02	3.25	2.80	0	0
2009 (7)	0	0	0	0	3.52	3.14	3.07	3.02	3.25	2.80	0	0
2010 (8)	0	0	0	0	3.52	3.14	3.07	3.02	3.25	2.80	0	0
Nitrite												
2002 (0)	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
2003 (1)	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02	0	0
2004 (2)	0	0	0	0	0.05	0.04	0.04	0.04	0.05	0.04	0	0
2005 (3)	0	0	0	0	0.09	0.08	0.08	0.08	0.09	0.07	0	0
2006 (4)	0	0	0	0	0.10	0.09	0.08	0.08	0.09	0.08	0	0
2007 (5)	0	0	0	0	0.10	0.09	0.08	0.08	0.09	0.08	0	0
2008 (6)	0	0	0	0	0.10	0.09	0.08	0.08	0.09	0.08	0	0
2009 (7)	0	0	0	0	0.10	0.09	0.08	0.08	0.09	0.08	0	0
2010 (8)	0	0	0	0	0.10	0.09	0.08	0.08	0.09	0.08	0	0
Ammonia												
2002 (0)	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0.03	0	0
2003 (1)	0	0	0	0	0.29	0.26	0.26	0.25	0.27	0.23	0	0
2004 (2)	0	0	0	0	0.61	0.54	0.53	0.52	0.56	0.48	0	0
2005 (3)	0	0	0	0	1.15	1.03	1.01	0.99	1.07	0.92	0	0
2006 (4)	0	0	0	0	1.20	1.07	1.05	1.04	1.11	0.96	0	0
2007 (5)	0	0	0	0	1.20	1.07	1.05	1.04	1.11	0.96	0	0
2008 (6)	0	0	0	0	1.20	1.07	1.05	1.04	1.11	0.96	0	0
2009 (7)	0	0	0	0	1.20	1.07	1.05	1.04	1.11	0.96	0	0
2010 (8)	0	0	0	0	1.20	1.07	1.05	1.04	1.11	0.96	0	0

OVERBURDEN STOCKPILE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitrate												
2002 (0)	0	0	0	0	2.033	1.814	1.775	1.749	1.881	1.617	0	0
2003 (1)	0	0	0	0	3.704	3.306	3.234	3.187	3.428	2.947	0	0
2004 (2)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
2005 (3)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
2006 (4)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
2007 (5)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
2008 (6)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
2009 (7)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
2010 (8)	0	0	0	0	4.187	3.736	3.655	3.602	3.875	3.331	0	0
Nitrite												
2002 (0)	0	0	0	0	0.056	0.05	0.049	0.048	0.052	0.044	0	0
2003 (1)	0	0	0	0	0.101	0.091	0.089	0.087	0.094	0.081	0	0
2004 (2)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
2005 (3)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
2006 (4)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
2007 (5)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
2008 (6)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
2009 (7)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
2010 (8)	0	0	0	0	0.115	0.102	0.1	0.099	0.106	0.091	0	0
Ammonia												
2002 (0)	0	0	0	0	0.70	0.62	0.61	0.60	0.64	0.55	0	0
2003 (1)	0	0	0	0	1.27	1.13	1.11	1.09	1.17	1.01	0	0
2004 (2)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0
2005 (3)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0
2006 (4)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0
2007 (5)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0
2008 (6)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0
2009 (7)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0
2010 (8)	0	0	0	0	1.43	1.28	1.25	1.23	1.33	1.14	0	0

TABLE 1.9
PREDICTED NITROGEN CONCENTRATION IN RUNOFF AT JERICHO
(mg/L)

CENTRAL LOBE STOCKPILE

Nitrate

2002 (0)	0	0	0	0	1.118	0.998	0.976	0.962	1.035	0.89	0	0
2003 (1)	0	0	0	0	0.46	0.411	0.402	0.396	0.426	0.366	0	0
2004 (2)	0	0	0	0	0.75	0.669	0.655	0.645	0.694	0.597	0	0
2005 (3)	0	0	0	0	0.802	0.716	0.701	0.69	0.743	0.638	0	0
2006 (4)	0	0	0	0	1.341	1.196	1.171	1.154	1.241	1.067	0	0
2007 (5)	0	0	0	0	0.827	0.738	0.722	0.712	0.766	0.658	0	0
2008 (6)	0	0	0	0	0.779	0.695	0.68	0.67	0.721	0.62	0	0
2009 (7)	0	0	0	0	7E-04	6E-04	6E-04	6E-04	6E-04	6E-04	0	0
2010 (8)	0	0	0	0	7E-04	6E-04	6E-04	6E-04	6E-04	6E-04	0	0

Nitrite

2002 (0)	0	0	0	0	0.031	0.027	0.027	0.026	0.028	0.024	0	0
2003 (1)	0	0	0	0	0.013	0.011	0.011	0.011	0.012	0.01	0	0
2004 (2)	0	0	0	0	0.021	0.018	0.018	0.018	0.019	0.016	0	0
2005 (3)	0	0	0	0	0.022	0.02	0.019	0.019	0.02	0.017	0	0
2006 (4)	0	0	0	0	0.037	0.033	0.032	0.032	0.034	0.029	0	0
2007 (5)	0	0	0	0	0.023	0.02	0.02	0.02	0.021	0.018	0	0
2008 (6)	0	0	0	0	0.021	0.019	0.019	0.018	0.02	0.017	0	0
2009 (7)	0	0	0	0	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	0	0
2010 (8)	0	0	0	0	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	0	0

Ammonia

2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.971	0.867	0.848	0.836	0.899	0.773	0	0
2004 (2)	0	0	0	0	2.997	2.675	2.617	2.579	2.774	2.385	0	0
2005 (3)	0	0	0	0	2.144	1.913	1.872	1.845	1.984	1.706	0	0
2006 (4)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2007 (5)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2008 (6)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2009 (7)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2010 (8)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0

OPEN PIT

Nitrate

2002 (0)	0	0	0	0	1.118	1.00	0.98	0.96	1.04	0.89	0	0
2003 (1)	0	0	0	0	0.46	0.41	0.40	0.40	0.43	0.37	0	0
2004 (2)	0	0	0	0	0.75	0.67	0.65	0.65	0.69	0.60	0	0
2005 (3)	0	0	0	0	0.802	0.716	0.701	0.69	0.743	0.638	0	0
2006 (4)	0	0	0	0	1.341	1	1	1	1	1	0	0
2007 (5)	0	0	0	0	0.827	1	1	1	1	1	0	0
2008 (6)	0	0	0	0	0.779	1	1	1	1	1	0	0
2009 (7)	0	0	0	0	7E-04	0	0	0	0	0	0	0
2010 (8)	0	0	0	0	7E-04	0	0	0	0	0	0	0

Nitrite

2002 (0)	0	0	0	0	0.031	0.027	0.027	0.026	0.028	0.024	0	0
2003 (1)	0	0	0	0	0.013	0.011	0.011	0.011	0.012	0.01	0	0
2004 (2)	0	0	0	0	0.021	0.018	0.018	0.018	0.019	0.016	0	0
2005 (3)	0	0	0	0	0.022	0.02	0.019	0.019	0.02	0.017	0	0
2006 (4)	0	0	0	0	0.037	0.033	0.032	0.032	0.034	0.029	0	0
2007 (5)	0	0	0	0	0.023	0.02	0.02	0.02	0.021	0.018	0	0
2008 (6)	0	0	0	0	0.021	0.019	0.019	0.018	0.02	0.017	0	0
2009 (7)	0	0	0	0	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	0	0
2010 (8)	0	0	0	0	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	0	0

Ammonia

2002 (0)	0	0	0	0	0.383	0.342	0.334	0.33	0.354	0.305	0	0
2003 (1)	0	0	0	0	0.158	0.141	0.138	0.136	0.146	0.125	0	0
2004 (2)	0	0	0	0	0.257	0.229	0.224	0.221	0.238	0.204	0	0
2005 (3)	0	0	0	0	0.275	0.245	0.24	0.236	0.254	0.219	0	0
2006 (4)	0	0	0	0	0.459	0.41	0.401	0.395	0.425	0.365	0	0
2007 (5)	0	0	0	0	0.283	0.253	0.247	0.244	0.262	0.225	0	0
2008 (6)	0	0	0	0	0.267	0.238	0.233	0.23	0.247	0.212	0	0
2009 (7)	0	0	0	0	2E-04	2E-04	2E-04	2E-04	2E-04	2E-04	0	0
2010 (8)	0	0	0	0	2E-04	2E-04	2E-04	2E-04	2E-04	2E-04	0	0

TABLE 1.9
PREDICTED NITROGEN CONCENTRATION IN RUNOFF AT JERICHO
(mg/L)

WASTE DUMP 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitrate												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	2.836	2.531	2.476	2.44	2.625	2.256	0	0
2004 (2)	0	0	0	0	8.752	7.811	7.642	7.531	8.101	6.964	0	0
2005 (3)	0	0	0	0	6.26	5.587	5.466	5.387	5.794	4.981	0	0
2006 (4)	0	0	0	0	13.13	11.72	11.47	11.3	12.16	10.45	0	0
2007 (5)	0	0	0	0	13.13	11.72	11.47	11.3	12.16	10.45	0	0
2008 (6)	0	0	0	0	13.13	11.72	11.47	11.3	12.16	10.45	0	0
2009 (7)	0	0	0	0	13.13	11.72	11.47	11.3	12.16	10.45	0	0
2010 (8)	0	0	0	0	13.13	11.72	11.47	11.3	12.16	10.45	0	0
Nitrite												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.078	0.069	0.068	0.067	0.072	0.062	0	0
2004 (2)	0	0	0	0	0.24	0.214	0.209	0.206	0.222	0.191	0	0
2005 (3)	0	0	0	0	0.172	0.153	0.15	0.148	0.159	0.136	0	0
2006 (4)	0	0	0	0	0.36	0.321	0.314	0.31	0.333	0.286	0	0
2007 (5)	0	0	0	0	0.36	0.321	0.314	0.31	0.333	0.286	0	0
2008 (6)	0	0	0	0	0.36	0.321	0.314	0.31	0.333	0.286	0	0
2009 (7)	0	0	0	0	0.36	0.321	0.314	0.31	0.333	0.286	0	0
2010 (8)	0	0	0	0	0.36	0.321	0.314	0.31	0.333	0.286	0	0
Ammonia												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.971	0.867	0.848	0.836	0.899	0.773	0	0
2004 (2)	0	0	0	0	2.997	2.675	2.617	2.579	2.774	2.385	0	0
2005 (3)	0	0	0	0	2.144	1.913	1.872	1.845	1.984	1.706	0	0
2006 (4)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2007 (5)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2008 (6)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2009 (7)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0
2010 (8)	0	0	0	0	4.498	4.014	3.927	3.87	4.163	3.579	0	0

NORTH LOBE ORE STOCKPILE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitrate												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.114	0.101	0.099	0.098	0.105	0.09	0	0
2004 (2)	0	0	0	0	2.046	1.826	1.786	1.76	1.894	1.628	0	0
2005 (3)	0	0	0	0	3.442	3.072	3.005	2.962	3.186	2.739	0	0
2006 (4)	0	0	0	0	3.442	3.072	3.005	2.962	3.186	2.739	0	0
2007 (5)	0	0	0	0	3.442	3.072	3.005	2.962	3.186	2.739	0	0
2008 (6)	0	0	0	0	3.442	3.072	3.005	2.962	3.186	2.739	0	0
2009 (7)	0	0	0	0	2.168	1.935	1.893	1.865	2.006	1.725	0	0
2010 (8)	0	0	0	0	0.083	0.074	0.072	0.071	0.077	0.066	0	0
Nitrite												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.003	0.003	0.003	0.003	0.003	0.002	0	0
2004 (2)	0	0	0	0	0.056	0.05	0.049	0.048	0.052	0.045	0	0
2005 (3)	0	0	0	0	0.094	0.084	0.082	0.081	0.087	0.075	0	0
2006 (4)	0	0	0	0	0.094	0.084	0.082	0.081	0.087	0.075	0	0
2007 (5)	0	0	0	0	0.094	0.084	0.082	0.081	0.087	0.075	0	0
2008 (6)	0	0	0	0	0.094	0.084	0.082	0.081	0.087	0.075	0	0
2009 (7)	0	0	0	0	0.059	0.053	0.052	0.051	0.055	0.047	0	0
2010 (8)	0	0	0	0	0.002	0.002	0.002	0.002	0.002	0.002	0	0
Ammonia												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.039	0.035	0.034	0.033	0.036	0.031	0	0
2004 (2)	0	0	0	0	0.701	0.625	0.612	0.603	0.648	0.557	0	0
2005 (3)	0	0	0	0	1.179	1.052	1.029	1.014	1.091	0.938	0	0
2006 (4)	0	0	0	0	1.179	1.052	1.029	1.014	1.091	0.938	0	0
2007 (5)	0	0	0	0	1.179	1.052	1.029	1.014	1.091	0.938	0	0
2008 (6)	0	0	0	0	1.179	1.052	1.029	1.014	1.091	0.938	0	0
2009 (7)	0	0	0	0	0.742	0.663	0.648	0.639	0.687	0.591	0	0
2010 (8)	0	0	0	0	0.028	0.025	0.025	0.024	0.026	0.023	0	0

TABLE 1.9
PREDICTED NITROGEN CONCENTRATION IN RUNOFF AT JERICHO
(mg/L)

WASTE DUMP 2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Nitrate												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0	0	0	0	0	0	0	0
2004 (2)	0	0	0	0	0	0	0	0	0	0	0	0
2005 (3)	0	0	0	0	0.605	0.54	0.528	0.521	0.56	0.482	0	0
2006 (4)	0	0	0	0	1.861	1.661	1.625	1.602	1.723	1.481	0	0
2007 (5)	0	0	0	0	1.861	1.661	1.625	1.602	1.723	1.481	0	0
2008 (6)	0	0	0	0	1.861	1.661	1.625	1.602	1.723	1.481	0	0
2009 (7)	0	0	0	0	1.861	1.661	1.625	1.602	1.723	1.481	0	0
2010 (8)	0	0	0	0	1.861	1.661	1.625	1.602	1.723	1.481	0	0
Nitrite												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0.017	0.015	0.014	0.014	0.015	0.013	0	0
2004 (2)	0	0	0	0	0.051	0.046	0.045	0.044	0.047	0.041	0	0
2005 (3)	0	0	0	0	0.051	0.046	0.045	0.044	0.047	0.041	0	0
2006 (4)	0	0	0	0	0.051	0.046	0.045	0.044	0.047	0.041	0	0
2007 (5)	0	0	0	0	0.051	0.046	0.045	0.044	0.047	0.041	0	0
2008 (6)	0	0	0	0	0.051	0.046	0.045	0.044	0.047	0.041	0	0
2009 (7)	0	0	0	0	0	0	0	0	0	0	0	0
2010 (8)	0	0	0	0	0	0	0	0	0	0	0	0
Ammonia												
2002 (0)	0	0	0	0	0	0	0	0	0	0	0	0
2003 (1)	0	0	0	0	0	0	0	0	0	0	0	0
2004 (2)	0	0	0	0	0	0	0	0	0	0	0	0
2005 (3)	0	0	0	0	0.207	0.185	0.181	0.178	0.192	0.165	0	0
2006 (4)	0	0	0	0	0.637	0.569	0.557	0.548	0.59	0.507	0	0
2007 (5)	0	0	0	0	0.637	0.569	0.557	0.548	0.59	0.507	0	0
2008 (6)	0	0	0	0	0.637	0.569	0.557	0.548	0.59	0.507	0	0
2009 (7)	0	0	0	0	0.637	0.569	0.557	0.548	0.59	0.507	0	0
2010 (8)	0	0	0	0	0.637	0.569	0.557	0.548	0.59	0.507	0	0

TABLE 1.10
PREDICTED TOTAL NITROGEN LOSS FROM EXPLOSIVES USE AT JERICHO

	OPEN PIT				**UNDERGROUND**		**PROCESSING ORE**		
Date	2002	2003	2004	2005	2006	2007	2008	2009	2010
N Loss from LG Stockpile (kg)	2	21	43	81	84	84	84	84	84
N Loss from N Ore Stockpile (kg)	-	1	15	25	25	25	25	16	1
N Loss from Waste - Dump 1 (kg)	-	140	434	310	651	651	651	651	651
N Loss from Waste - Dump 2 (kg)	-	-	-	28	87	87	87	87	87
N Loss from Overburden Stockpile	47	85	96	96	96	96	96	96	96
N Loss from Pit (kg)	31	198	546	798	852	861	872	873	873
N Loss from C Ore Stockpile (kg)	8	3	5	6	10	6	6	0	0
N Loss from fine PK[c] (kg)	13	122	112	104	104	104	104	111	70
N Loss from coarse PK[c] (kg)	-	22	18	16	16	16	16	18	14
N Load to PKCA[c] (kg)	13	145	145	145	145	145	145	145	85
Total N Loss (kg)	**114**	**738**	**1,414**	**1,610**	**2,070**	**2,075**	**2,086**	**2,081**	**1,960**
Total N Loss to Carat Lake (kg)	**88**	**447**	**1,124**	**1,319**	**1,779**	**1,784**	**1,795**	**1,791**	**1,791**
Total N Loss to PKCA (kg)	**13**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**85**

Assumes 0.1% loss of available N per year apportioned by weight of material to each facility. No loss from N ore stockpile Years 7 and 8.
Note: All waste rock generated in Year 0 (construction year) will be crushed and used as fill at the site for roads, dams, berms, pads. N loss will therefore be spread over the entire site.
Note: Waste rock dumps assumed not to have permafrost cores throughout mine life.
Note: Loss of N in PK assumed to be 0.5% of explosives used.

TABLE 1.11
Ammonia Receiving Environment Guidelines

pH	Ammonia Concentration (mg/L) for Temperatures Listed (°C)						
	0	**5**	**10**	**15**	**20**	**25**	**30**
6.5	2.5	2.4	2.2	2.2	1.49	1.04	0.73
6.75	2.5	2.4	2.2	2.2	1.49	1.04	0.73
7.0	2.5	2.4	2.2	2.2	1.49	1.04	0.74
7.25	2.5	2.4	2.2	2.2	1.50	1.05	0.74
7.50	2.5	2.4	2.2	2.2	1.50	1.05	0.74
7.75	2.3	2.2	2.1	2.0	1.40	0.99	0.71
8.0	1.53	1.44	1.37	1.33	0.93	0.66	0.47

TABLE 1.12
PREDICTED NITROGEN CONCENTRATION IN PKCA SUPERNATANT WATER

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitrate (mg/L)												
Year												
2002 (0)	0	0	0	0	0	0	0	0	0	0.611	0.660	0.660
2003 (1)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2004 (2)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2005 (3)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2006 (4)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2007 (5)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2008 (6)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2009 (7)	1.602	1.602	1.602	2.182	1.991	0.719	1.377	1.636	1.507	1.483	1.602	1.602
2010 (8)	1.602	1.602	1.602	2.182	1.991	0.719	0.402	0.478	0.440			
Nitrite (mg/L)												
Year												
2002 (0)	0	0	0	0	0	0	0	0	0	0.017	0.018	0.018
2003 (1)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2004 (2)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2005 (3)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2006 (4)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2007 (5)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2008 (6)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2009 (7)	0.044	0.044	0.044	0.060	0.055	0.020	0.038	0.045	0.041	0.041	0.044	0.044
2010 (8)	0.044	0.044	0.044	0.060	0.055	0.020	0.011	0.013	0.012			
Ammonia (mg/L)												
Year												
2002 (0)	0	0	0	0	0	0	0	0	0	0.209	0.226	0.226
2003 (1)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2004 (2)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2005 (3)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2006 (4)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2007 (5)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2008 (6)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2009 (7)	0.549	0.549	0.549	0.747	0.682	0.246	0.472	0.560	0.516	0.508	0.549	0.549
2010 (8)	0.549	0.549	0.549	0.747	0.682	0.246	0.138	0.164	0.151			

TABLE 1.13
PREDICTED NITROGEN CONCENTRATION IN RUNOFF FROM COARSE KIMBERLITE STOCKPILE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitrate (mg/L)												
Year												
2002 (0)					0	0	0	0	0	0		
2003 (1)					0.725	0.647	0.633	0.624	0.671	0.577		
2004 (2)					0.602	0.537	0.525	0.518	0.557	0.479		
2005 (3)					0.512	0.457	0.447	0.441	0.474	0.407		
2006 (4)					0.512	0.457	0.447	0.441	0.474	0.407		
2007 (5)					0.512	0.457	0.447	0.441	0.474	0.407		
2008 (6)					0.512	0.457	0.447	0.441	0.474	0.407		
2009 (7)					0.594	0.530	0.518	0.511	0.550	0.472		
2010 (8)					0.468	0.418	0.409	0.403	0.433	0.372		
Nitrite (mg/L)												
Year												
2002 (0)					0	0	0	0	0	0		
2003 (1)					0.020	0.018	0.017	0.017	0.018	0.016		
2004 (2)					0.016	0.015	0.014	0.014	0.015	0.013		
2005 (3)					0.014	0.013	0.012	0.012	0.013	0.011		
2006 (4)					0.014	0.013	0.012	0.012	0.013	0.011		
2007 (5)					0.014	0.013	0.012	0.012	0.013	0.011		
2008 (6)					0.014	0.013	0.012	0.012	0.013	0.011		
2009 (7)					0.016	0.015	0.014	0.014	0.015	0.013		
2010 (8)					0.013	0.011	0.011	0.011	0.012	0.010		
Ammonia (mg/L)												
Year												
2002 (0)					0	0	0	0	0	0		
2003 (1)					0.248	0.222	0.217	0.214	0.230	0.198		
2004 (2)					0.206	0.184	0.180	0.177	0.191	0.164		
2005 (3)					0.175	0.157	0.153	0.151	0.162	0.140		
2006 (4)					0.175	0.157	0.153	0.151	0.162	0.140		
2007 (5)					0.175	0.157	0.153	0.151	0.162	0.140		
2008 (6)					0.175	0.157	0.153	0.151	0.162	0.140		
2009 (7)					0.203	0.181	0.178	0.175	0.188	0.162		
2010 (8)					0.160	0.143	0.140	0.138	0.148	0.128		

TABLE 1.14 PERCENT OF N LOSS FROM EXPLOSIVES USE TO THE PKCA BY YEAR									
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Percent of Total to PKCA	11	20	10	9	7	7	7	7	4
N Concentration Increase to PKCA by Addition of all Sources	4.5x	2.5x	5x	5.5x	7x	7x	7x	7x	12.5x

TABLE 1.15 JERICHO PK EFFLUENT QUALITY				
Parameter	**Conc**	**CCME**	**Health Can.**	**MMLER**
	(mg/L)			
Total Dissolved Solids	1155		500	
Hardness (CaCO3)	654			
pH	8.84			>5 (>6)
Total Suspended Solids (supernatant)	8	<10mg/L increase		50 (25)
Turbidity (NTU)	5.2			
Conductivity (uS/cm)	1424			
Alkalinity (CaCO3)	39			
Chloride	510		250	
Fluoride	0.35		1.5	
Sulphate	16		500	
Ammonia N	17.3	2		
Dissolved Metals				
Aluminum	0.048	0.1		
Barium	0.75		1	
Calcium	146			
Copper	0.002	0.002	1	0.6 (0.3)
Magnesium	70			
Manganese	0.0028		0.05	
Molybdenum	0.0066			
Nickel	0.025	0.025		1.0 (0.5)
Potassium	34			
Silicon	2.79			
Sodium	33		200	
Strontium	5.26			
Zinc	0.021	0.03		1(0.5)

CCME	Canadian Council of Ministers of the Environment
Health Canada	Drinking water guidelines
MMLER	Metal Mine Liquid Effluent Regulation (of the *Fisheries Act*)

TABLE 1.16			
HAZARDOUS SUBSTANCES INVENTORY - JERICHO MINE SITE			
Substance	**Estimates of On Hand Quantities**	**Risk of Spill**	**Comments**
Diesel	10 million litres	low	In fuel farm with containment berm
Ammonium Nitrate	2300 tonnes	low	Powder, 1 t bags, no proxim ity to water
Sodium Nitrate	to be determined	low	25 kg bags, palletized in C-can
High Explosives (Magnifrak™)	26 tonnes	low	Stick powder in boxes in a magazine
Blasting caps	To be determined	low	In boxes in a magazine
Hydraulic Oil	6 - 205 L barrels	low	Stored in covered warehouse in silled area
Motor Oil	5 - 205 L barrels	low	In mine shop in a silled area or outside the mine shop
Jet Fuel	24 - 205 L barrels	low	Stored at airstrip, no proximity to water
Gasoline	up to 10,000 litres	low	In fuel farm with containment berm
Varsol	205 L	low	In mine shop in silled area
Petroleum grease	50 - 20 L pails	nil	In mine shop or cold storage containers
Transmission Oil	6 - 205 litre barrels	low	In mine shop in silled area
Sulphuric acid (battery acid)	small quantities	low	In mine shop in silled area
Ethylene glycol (vehicle antifreeze)	6 – 205 litre barrels	low	In mine shop in silled area
Ethylene glycol (heating system)	not applicable	very low	In pipes in heating system
Ferrosilicon	120 t, non-hazardous		
Hydrofluoric acid	small quantities	low	In fume cupboard in plant
Hydrochloric acid	small quantities	low	In fume cupboard in plant
Sodium hydroxide	small quantities	low	In lab in plant; in controlled drainage area
Acetone	small quantities	low	In fume cupboard in plant
Flocculent - Percol E-10, or equiv.	2 t, non-hazardous	low	In plant controlled drainage area
Slaked lime	to 10 t	low	Powder in bags on pallets and in container for use in controlled drainage area of plant
Floor Dry	small quantities	nil	In the accommodation complex and mine shop

TABLE 1.17 SUMMARY OF PROJECT ACTIVITIES EFFECTS ON WILDLIFE	
Species	**Effects Assessment**
Raptor: golden eagle	spatial significance: local duration: medium term frequency: periodic magnitude: low
Raptor: rough-legged hawk	spatial significance: local duration: medium term frequency: periodic magnitude: low
Raptor: peregrine falcon	spatial significance: local duration: medium term frequency: periodic magnitude: low
Raptor: gyrfalcon	spatial significance: local duration: medium term frequency: periodic magnitude: low
Migratory birds	spatial significance: local duration: medium term frequency: periodic magnitude: low
Small mammals: herbivores	spatial significance: local duration: medium term frequency: continuous magnitude: low
Muskox	spatial significance: local duration: medium term frequency: periodic magnitude: low
Caribou	spatial significance: local duration: medium term frequency: periodic magnitude: low
Carnivore: fox	spatial significance: local duration: medium term frequency: continuous magnitude: low
Carnivore: wolf	spatial significance: local duration: medium term frequency: periodic magnitude: low
Carnivore: grizzly bear	spatial significance: local duration: medium term frequency: periodic magnitude: low

Source: Hubert 2002, Appendix B.2.2

TABLE 1.18 SUMMARY OF TRANSPORTATION ACTIVITIES EFFECTS ON WILDLIFE	
Species	**Effects Assessment**
Raptors	spatial significance: local duration: medium term frequency: infrequent magnitude: low
Migratory birds	spatial significance: local duration: medium term frequency: infrequent magnitude: low
Caribou	spatial significance: regional duration: medium term frequency: periodic magnitude: low
Carnivores	spatial significance: local duration: medium term frequency: continuous magnitude: low

Source: Hubert 2002, Appendix B.2.2

TABLE 1.19

LIST OF PATHWAYS, ASSOCIATED PROJECT ACTIVITIES AND THEIR POTENTIAL ENVIRONMENTAL EFFECT(S) ON FISH

Pathway	Project			Potential Environmental Effects	
	Activity	**Location**	**Phase**	**Effects[a]**	**Location**
Direct Mortality	Water Withdrawal Intake	Mine Area	Construction Operation Closure	1) Entrainment of fish by intake.	Carat Lake
	Use of Explosives	Mine Area	Construction Operation	1) Shock wave causing mortality of eggs and fish.	Carat Lake, Lake C1, and Stream C1
	Angling	Jericho Site	Exploration Construction Operation Closure	1) Harvest of fish and hooking injuries.	Jericho Site water bodies
	Scientific Research	Jericho Site	Exploration Operation Closure	1) Lethal sampling of fish.	Jericho Site water bodies
Loss of Habitat	Permanent and Winter Roads	Jericho Site	Construction Operation Closure	1) Blockage of fish passage. 2) Altered drainage into stream. 3) Increased suspended sediments and sedimentation (reduced water quality). 4) Foot print of ramp.	Streams C2, D1, and D2 Contwoyto Lake, Lynne Lake
	Stream Diversion	Mine Area	Construction Operation Closure Post-closure	1) Dewatering of natural stream. 2) Foot print of intake and outlet ports. 3) Increased suspended sediments and sedimentation (reduced water quality and direct mortality). 4) Stranding of fish (direct mortality).	Stream C1, Carat Lake
	Processed Kimberlite Containment Area (PKCA)	Mine Area	Construction Operation Closure Post-closure	1) Removal of natural lakes and ponds (direct mortality).	Long Lake, ponds, connecting channel
	Water Withdrawal Causeway	Mine Area	Construction Operation Closure Post-closure	1) Causeway foot print (direct mortality). 2) Increased suspended sediments and sedimentation (reduced water quality and direct mortality).	Carat Lake
Reduced Water Quality	Runoff from Mine Pit, Dumps and Stockpiles	Mine Area	Construction Operation Closure Post-closure	1) Increased contaminant and nutrient concentrations. 2) Increased suspended sediments and sedimentation (habitat loss and direct mortality).	Carat Lake, Stream C1, Lake C1, Key Lake
	Discharge from the PKCA	Mine Area	Construction Operation Closure Post-closure	1) Increased contaminant and nutrient concentrations. 2) Dewatering of stream channel (habitat loss). 3) Increased suspended sediments and sedimentation (habitat loss and direct mortality).	Lake C3, Stream C3
	Emissions from Mining Activities	Jericho Site	Construction Operation Closure	1) Increased suspended sediment concentrations and sedimentation (habitat loss and direct mortality).	Jericho Site water bodies

[a] Items in brackets indicate potential effects that are in addition to those identified by the pathway.

TABLE 3.1 PERMANENTLY DISTURBED AREAS	
Mine Unit	**Area (m^2)**
Open Pit	100,700
Dump #1	217,000
Dump #2	210,900
Coarse Kimberlite	91,600
Low Grade Ore	108,000
TOTAL	**728,200**

TABLE 3.2
SUMMARY OF RESIDUAL ENVIRONMENTAL EFFECTS FROM THE JERICHO DIAMOND PROJECT ON WILDLIFE POPULATIONS

VEC/Activity	Site Development	Mining: April – December	Winter Road Transport: January to April	Air Transport: Year Round
Habitat	Magnitude: low Geographic Extent: local Duration: short term Frequency: continuous Reversibility: variable Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium to long term Frequency: continuous Reversibility: variable Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: regional Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: high Certainty: qualitative, high	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate
Raptors	Magnitude: low Geographic Extent: local Duration: short term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate
Migratory Birds	Magnitude: low Geographic Extent: local Duration: short term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: infrequent Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: infrequent Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate
Small Mammals	Magnitude: low Geographic Extent: local Duration: short term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate

TABLE 3.2 SUMMARY OF RESIDUAL ENVIRONMENTAL EFFECTS FROM THE JERICHO DIAMOND PROJECT ON WILDLIFE POPULATIONS				
VEC/Activity	**Site Development**	**Mining: April – December**	**Winter Road Transport: January to April**	**Air Transport: Year Round**
Muskox	Magnitude: low Geographic Extent: local Duration: short term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate
Caribou	Magnitude: low Geographic Extent: local Duration: short term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: regional Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate
Carnivores	Magnitude: low Geographic Extent: local Duration: short term Frequency: periodic to continuous Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic to continuous Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate	Magnitude: low Geographic Extent: local Duration: medium term Frequency: periodic Reversibility: reversible Ecological context: minor Level of confidence: moderate Certainty: qualitative, moderate

TABLE 3.3

SUMMARY OF RESIDUAL ENVIRONMENTAL EFFECTS ON FISH FROM JERICHO PROJECT CONSTRUCTION AND OPERATION

Residual Effect	Project Phase	Evaluation Criteria for Assessing Significance						Residual Environmental Effects	Level of Confidence	Certainty	
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context			Qualitative	Quantitative
Explosives Use in the Mine Pit											
Damage to Fish Eggs	Construction	H	L	L	H	R	L	NS	H	H	L
	Operation	H	L	M	H	R	L	NS	H	H	L
	Overall							NS	H	H	L
Construction and Operation of C1 Stream Diversion											
Direct Mortality of Fish Eggs	Construction	H	L	L	M	R	H	NS	M	L	L
	Operation	M	L	L	L	R	H	NS	M	L	L
	Closure	M	L	L	L	R	H	NS	M	L	L
	Post-Closure							NS	M	L	L
	Overall							NS	M	L	L
Loss of Habitat	Construction	H	L	L	M	R	H	NS	M	L	L
	Operation	M	L	L	L	R	L	NS	M	L	L
	Closure	M	L	L	L	R	L	NS	M	L	L
	Post-Closure							NS	M	L	L
	Overall							NS	M	L	L
Reduced Invertebrate Production	Construction	H	L	L	M	R	H	NS	M	L	L
	Operation	M	L	L	L	R	L	NS	M	L	L
	Closure	M	L	L	L	R	L	NS	M	L	L
	Post-Closure							NS	M	L	L
	Overall							NS	M	L	L
Processed Kimberlite Containment Area Footprint											
Loss of Fish Habitat	Construction	H	M	H	H	NR	H	S	H	H	L
	Operation	H	M	H	H	NR	H	S	H	H	L
	Closure	H	M	H	H	NR	H	S	H	H	L
	Post-Closure	H	M	H	H	NR	H	S	H	H	L
	Overall	H	M	H	H	NR	H	S	H	H	L
Direct Mortality of Fish	Construction	H	M	H	H	NR	H	S	H	H	L
	Operation	H	M	H	H	NR	H	S	H	H	L
	Closure	H	M	H	H	NR	H	S	H	H	L
	Post-Closure	H	M	H	H	NR	H	S	H	H	L
	Overall	H	M	H	H	NR	H	S	H	H	L

Residual Effect	Project Phase	Evaluation Criteria for Assessing Significance						Residual Environmental Effects	Level of Confidence	Certainty	
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological Context			Qualitative	Quantitative
Discharge from the Processed Kimberlite Containment Area											
Habitat Loss to Stream C3	Construction	H	L	H	H	R	L	NS	H	H	L
	Operation	L	L	L	L	R	L	NS	H	H	L
	Closure	H	L	H	H	NR	L	NS	H	H	L
	Post-Closure	H	H	H	H	NR	L	NS	H	H	L
	Overall							NS	H	H	L
Water Intake Causeway											
Loss of Rearing Habitat	Construction	L	L	H	H	NR	H	NS	H	H	H
	Operation	L	L	H	H	NR	H	NS	H	H	H
	Closure	L	L	H	H	NR	H	NS	H	H	H
	Post-Closure	L	L	H	H	NR	H	NS	H	H	H
	Overall	L	L	H	H	NR	H	NS	H	H	H
Loss of Spawning Habitat	Construction	L	L	H	H	NR	H	NS	H	H	H
	Operation	L	L	H	H	NR	H	NS	H	H	H
	Closure	L	L	H	H	NR	H	NS	H	H	H
	Post-Closure	L	L	H	H	NR	H	NS	H	H	H
	Overall	L	L	H	H	NR	H	NS	H	H	H

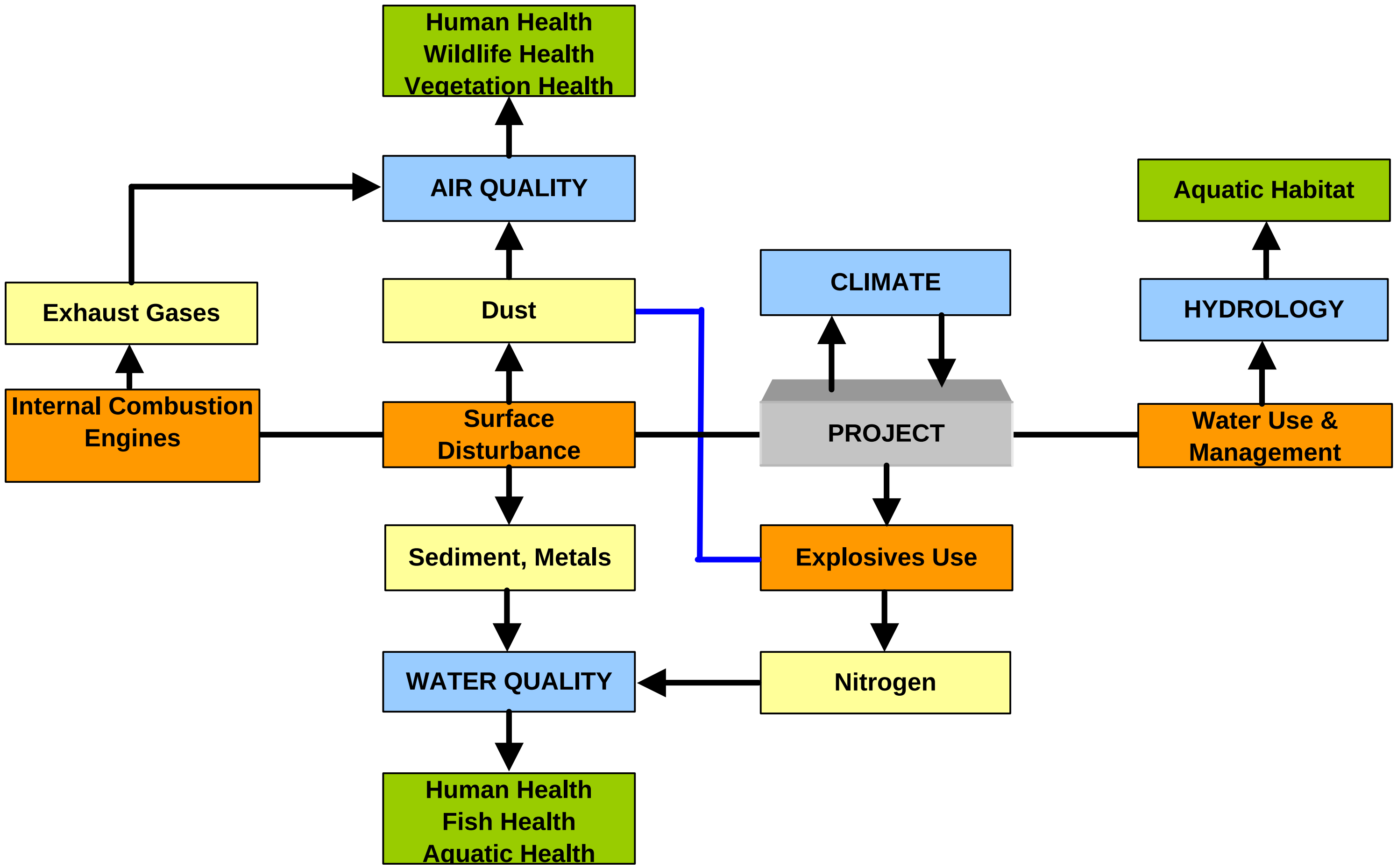
H High
M Moderate
L Low

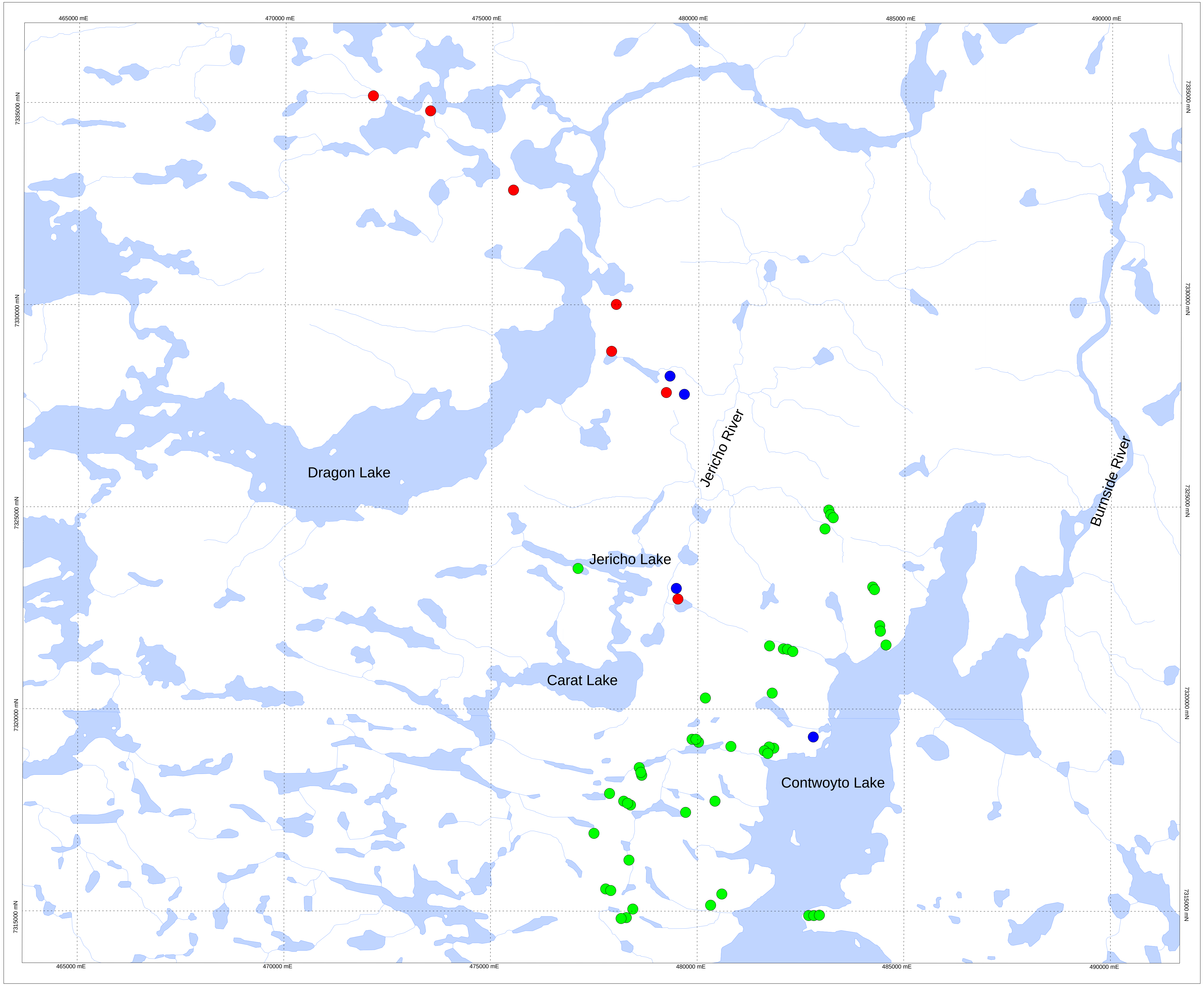
R Reversible
NR Non-reversible

S Significant
NS Not significant

FIGURES

FIGURE 1.1
POTENTIAL IMACTS AND LINKAGES





Legend

- Fox Den (7)
- Nest Site (45)
- Wolf Den (4)

N W E S

Tahera Corporation

FIGURE 1.2

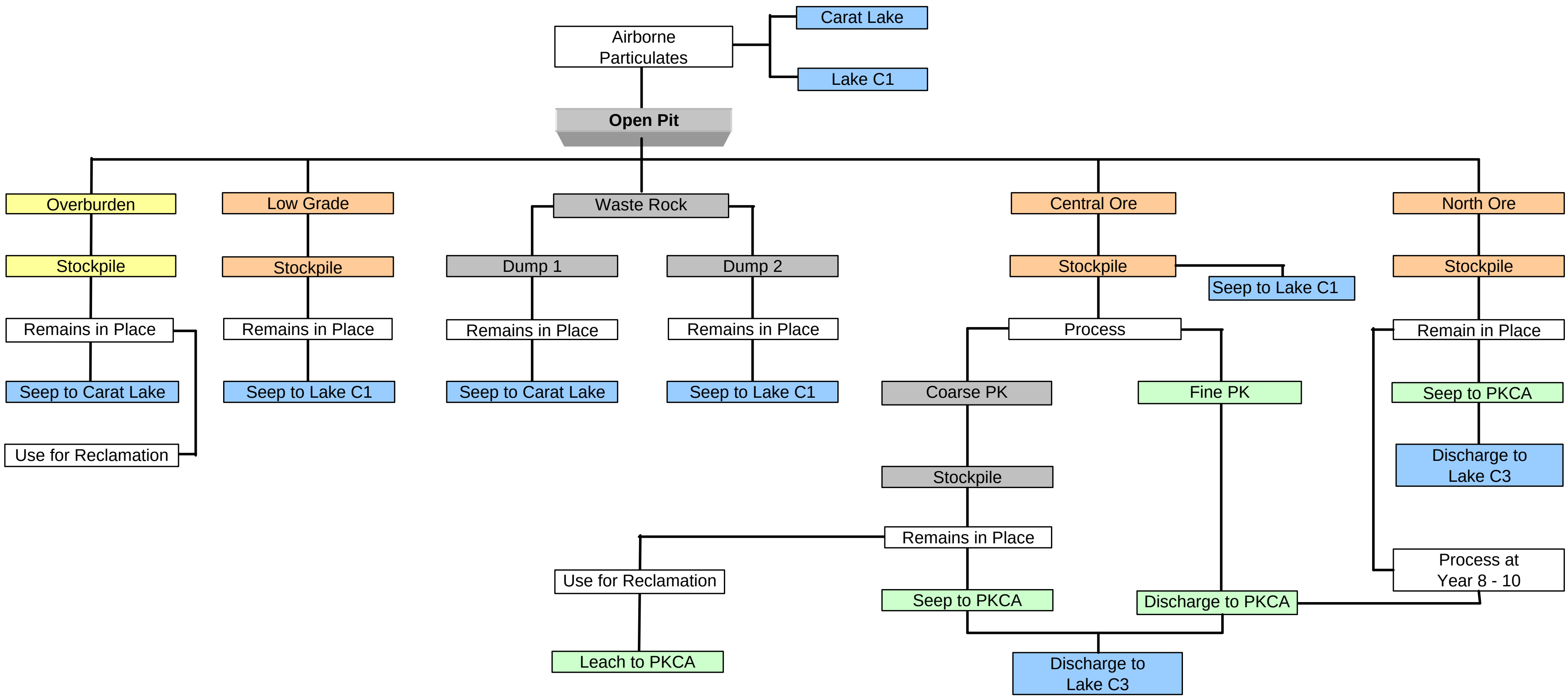
REGIONAL DENNING AND NESTING SITES

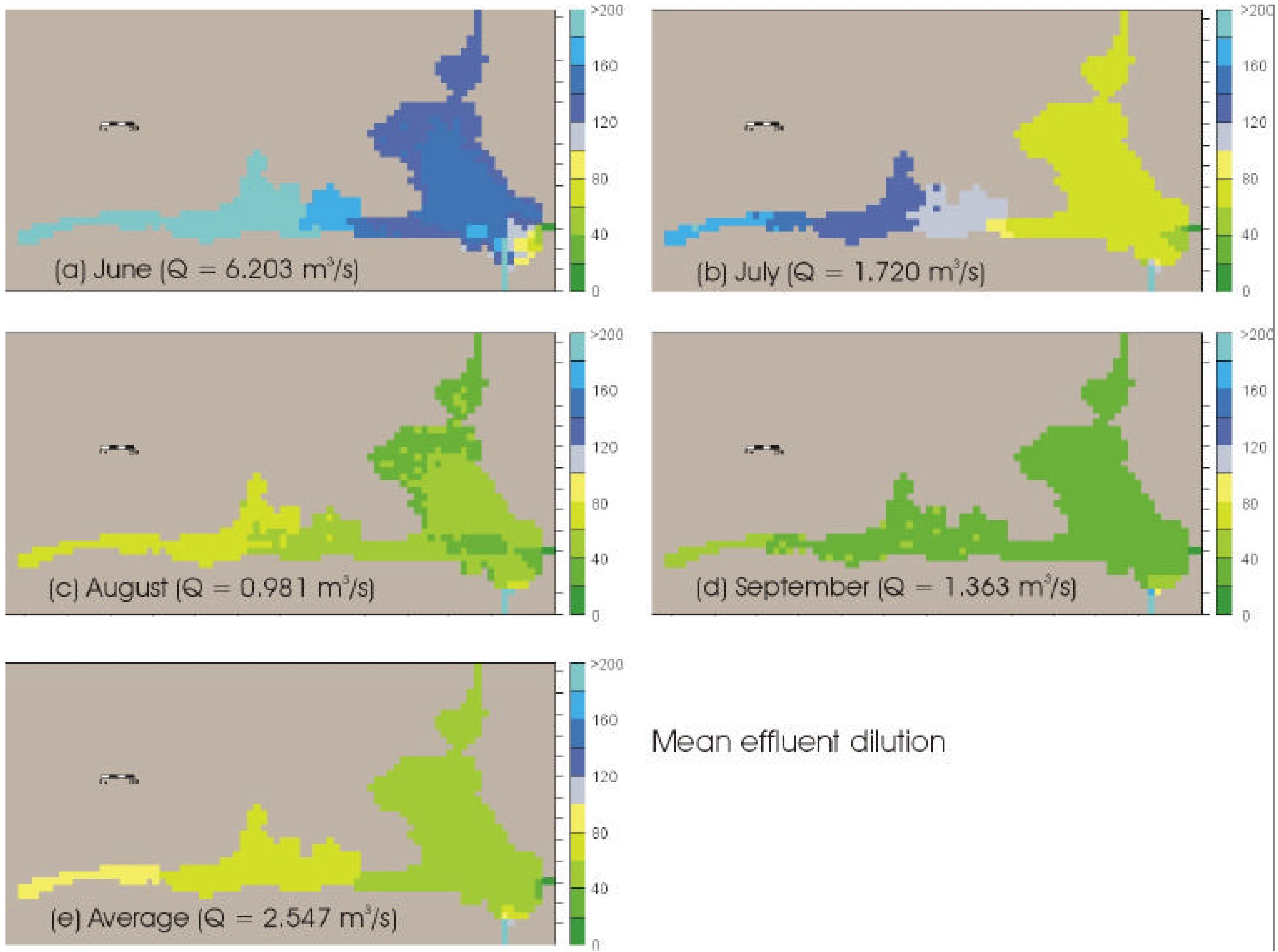
Date:7/11/2000	
Author: MJ/BSO	
Office: Van	
Drawing:	Source: Canamera Geological Ltd (1995-97)
Scale: 1:100000	Projection: UTM Zone 12 (NAD 27)

1.5 0 1.5 3
kilometres

FIGURE 1.3

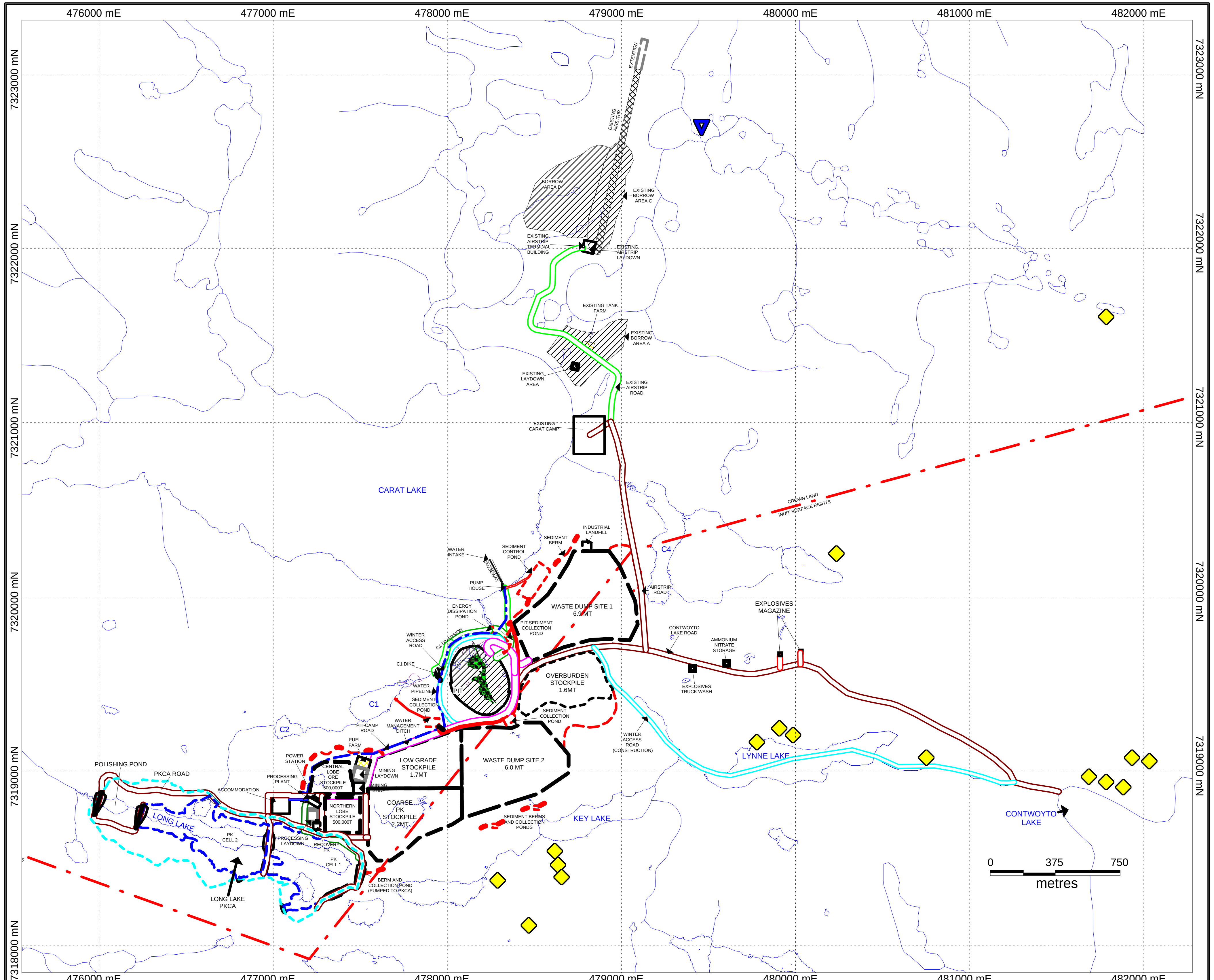
EXPLOSIVES NITROGEN LOSS FLOW DIAGRAM





Source: URS

FIGURE 1.4 MODELLED EFFLUENT DILUTION USING DEPTH-AVERAGED CONCENTRATION



Fox Den

Raptor Nests

Figure 1.5

Approved By:

Jericho Diamond Project
Local Den and Nest Sites

Date:24/6/2000

Drafted By: M.J.

TAHERA CORPORATION

Scale: 1:25,000

Projection: UTM Zone 12 (NAD 27 for Canada)

SRK Consulting
Engineers and Scientists

ATTACHMENTS

ATTACHMENT 1.1
SEISMIC RISK REPORT

NATURAL RESOURCES CANADA
GEOLOGICAL SURVEY OF CANADA

RESSOURCES NATURELLES CANADA
COMMISSION GEOLOGIQUE DU CANADA

SEISMIC RISK CALCULATION * | CALCUL DE RISQUE SEISMIQUE *

REQUESTED BY/ DEMANDE PAR: Bruce Ott, Tahera Corp.

SITE: Great Bear Lake, NWT

LOCATED AT/ SITUE AU: 66.00 NORTH/NORD 111.47 WEST/OUEST

PROBABILITY OF EXCEEDENCE PER ANNUM/ PROBABILITE DE DEPASSEMENT PAR ANNEE	0.010	0.005	0.0021	0.001
PROBABILITY OF EXCEEDENCE IN 50 YEARS/ PROBABILITE DE DEPASSEMENT EN 50 ANS	40 %	22 %	10 %	5 %
PEAK HORIZONTAL GROUND ACCELERATION (G) ACCELERATION HORIZONTALE MAXIMALE DU SOL (G)	0.009	0.011	0.013	0.016
PEAK HORIZONTAL GROUND VELOCITY (M/SEC) VITESSE HORIZONTALE MAXIMALE DU SOL (M/SEC)	0.027	0.032	0.040	0.047

* REFERENCES

1. NEW PROBABILISTIC STRONG SEISMIC GROUND MOTION MAPS OF CANADA: A COMPILATION OF EARTHQUAKE SOURCE ZONES, METHODS AND RESULTS. P.W. BASHAM, D.H. WEICHERT, F.M. ANGLIN, AND M.J. BERRY EARTH PHYSICS BRANCH OPEN FILE NUMBER 82-33, OTTAWA, CANADA 1982.

2. ENGINEERING APPLICATIONS OF NEW PROBABILISTIC SEISMIC GROUND-MOTION MAPS OF CANADA. A.C. HEIDEBRECHT, P.W. BASHAM, J.H. RAINER, AND M.J. BERRY CANADIAN JOURNAL OF CIVIL ENGINEERING, VOL. 10, NO. 4, P. 670-680, 1983.

3. NEW PROBABILISTIC STRONG GROUND MOTION MAPS OF CANADA. P.W. BASHAM, D.H. WEICHERT, F.M. ANGLIN, AND M.J. BERRY, BULLETIN OF THE SEISMOLOGICAL SOCIETY OF AMERICA, VOL. 75, NO. 2, P. 563-595, 1985.

4A. SUPPLEMENT TO THE NATIONAL BUILDING CODE OF CANADA 1990, NRCC NO. 30629. CHAPTER 1: CLIMATIC INFORMATION FOR BUILDING DESIGN IN CANADA. CHAPTER 4: COMMENTARY J: EFFECTS OF EARTHQUAKES.

4B. SUPPLEMENT DU CODE NATIONAL DU BATIMENT DU CANADA 1990, CNRC NO 30629F. CHAPITRE 1: DONNEES CLIMATIQUES POUR LE CALCUL DES BATIMENTS AU CANADA. CHAPITRE 4: COMMENTAIRE J: EFFETS DES SEISMES.

Great Bear Lake, NWT

ZONING FOR ABOVE SITE/ ZONAGE DU SITE CI-DESSUS

1990 NBCC/CNBC: ZA = 0; ZV = 0; V = 0.00 M/S

ACCELERATION ZONE/ ZONE D'ACCELERATION ZA=0
ZONAL ACCELERATION/ ACCELERATION ZONALE 0.00 G

VELOCITY ZONE/ ZONE DE VITESSE ZV=0
ZONAL VELOCITY/ VITESSE ZONALE 0.00 M/S

1990 NBCC/CNBC **
SEISMIC ZONING MAPS/ CARTES DU ZONAGE SEISMIQUE

PROBABILITY LEVEL: 10% IN 50 YEARS
NIVEAU DE PROBABILITE: 10% EN 50 ANNEES

G OR M/S	ZONE	ZONAL VALUE/ VALEUR ZONALE
0.00		
	0	0.00
0.04		
	1	0.05
0.08		
	2	0.10
0.11		
	3	0.15
0.16		
	4	0.20
0.23		
	5	0.30
0.32		
	6*	0.40

* ZONE 6: NOMINAL VALUE/ VALEUR NOMINALE 0.40;
SITE-SPECIFIC STUDIES SUGGESTED FOR IMPORTANT PROJECTS/
ETUDES COMPLEMENTAIRES SUGGEREES POUR DES PROJETS D'IMPORTANCE.

** FOR NBCC APPLICATIONS, CALCULATED ZONE VALUES AT A SITE SHOULD BE REPLACED BY EFFECTIVE ZONE VALUES [ZA(EFF) OR ZV(EFF)] AS SHOWN BELOW/ POUR APPLICATIONS SELON LE CNBC, ON DOIT REMPLACER LES VALEURS ZONALES CALCULEES POUR UN SITE PAR LES VALEURS EFFECTIVES [ZA(EFF) OU ZV(EFF)] COMME MONTRE CI-DESSOUS:

1. IF/SI (ZA - ZV) > 1, ===> ZA(EFF) = ZV + 1.

OR/OU

2. IF/SI (ZA - ZV) < 1, ===> ZA(EFF) = ZV - 1.

OR/OU

3. IF/SI ZV=0 AND/ET ZA > 0, ===> ZV(EFF) = 1.

(SEE REFERENCE 2 CITED ABOVE, PAGE 677)
(VOIR PAGE 677 DE LA REFERENCE 2 CI-DESSUS)

May 5 2000 14:2:

ATTACHMENT 1.2
P. BRIAN MEMO TO SRK

To: File

From: Patrick Bryan

Date: March 15, 1998

Re: Progress Report – Hydrology Study for Jericho Diamond Project

This memorandum describes the progress made to date on the hydrology study for the Jericho Diamond Project.

1.0 Hydrology

No long-term records of streamflow exist within the Jericho River catchment. Despite this, a reasonably accurate assessment of the minesite hydrology can be made using a technique known as regional analysis. In essence, this technique makes use of the streamflow data collected at the network of regional gauging stations operated by the Water Survey of Canada (WSC). An examination is made of correlations between the flows monitored at these regional stations and the physical characteristics of the catchments that generated the flow. Some of the more important physical characteristics are drainage area, latitude, elevation and proportion of catchment area covered by lakes. The correlations between flow and physical characteristics then form the basis for estimating the flows at ungauged locations.

1.1 Available Data

To perform the regional analysis, the first step involved assembling the streamflow records from the regional WSC gauging stations. Despite its remote location, the area around the Jericho site is served by a surprisingly dense network of streamflow gauging stations. From this network, a total of 35 streamflow gauging stations were selected. Table 4 provides details of these stations, including station description, period of record, catchment area and mean annual runoff. All of the selected stations measure unregulated flows, or flows that have been minimally influenced by human activities.

A figure (JCP has the draft version) was prepared to illustrate the network of WSC streamflow gauging stations in the region of the Jericho Diamond Project. This figure, hereafter referred to as the "Catchment Map", shows the locations of the selected streamflow gauging stations, together with the outlines of the catchments controlled by these stations. Some care must be exercised in matching the catchment boundaries to their corresponding gauging station. This need for care is brought about because many of the rivers in the region are gauged at several sites, and may also have tributaries that are gauged. For example, eight of the selected gauging stations are located within the catchment of the Coppermine River, four along the river's main stem and four on some of the main tributaries. Drawing the catchment boundaries for these eight stations had the effect of subdividing the entire Coppermine River catchment into 8 subcatchments. If the reader wanted to identify the catchment area for, say, Station 10PB001 near the midpoint of the Coppermine River, she or he would have to decipher the map to determine which of the 8 subcatchments make up the total catchment of this gauge. One way to do this would be to examine the topography and flow patterns on the map. However, this is difficult because of the small scale of the map (1:1,000,000). In the final report, the scale will be even smaller at about 1:3,000,000.

To aid the reader in figuring out what subcatchments belong to what streamflow gauges, the subcatchments have been labelled with an identification code. This code comprises two parts. The first part is an upper-case letter that designates the river system in which the subcatchment lies. In most cases, the upper-case letter corresponds with the first letter of the river's name. For example, the codes for subcatchments in the Coppermine River catchment begin with a "C". Where more than one river begins with the same letter, one river follows the naming convention outlined above and the others are assigned unused, arbitrary letters. The second part of the identification code is a number that uniquely identifies the subcatchments within each river system. The subcatchments are generally numbered in an upstream to downstream order. Table 4 provides a column that lists the subcatchment identification codes for each streamflow gauging station. For the example station referred to in the preceding paragraph (i.e., Station 10PB001), the table reveals that this station's total catchment comprises three of the subcatchments drawn on the Catchment Map, namely Subcatchment Nos. C1, C2 and C3.

1.2 Mean Annual Runoff

The mean annual runoff (MAR) for the minesite catchments will be estimated using two figures. The first is the Catchment Map referred to in the section above. On this figure estimates of the unit MAR have been plotted for each subcatchment. To facilitate comparison between catchments of different sizes, the MAR values have been expressed as depths (i.e., the equivalent depth to which the total annual runoff volume would spread uniformly over the contributing catchment area). The Catchment Map will be used to examine the areal variation of MAR across the region that encompasses the Jericho River catchment. Table 4 presents the MAR values for "total" catchments and Table 5 presents the values for "incremental" catchments. An effort was made to adjust all MAR values so that they are representative of the 20-year period from 1976 to 1995.

The top plot on Figure 3 presents the second figure that will be used to help establish a MAR value for the minesite catchments. It is a plot of unit MAR versus catchment area. As can be seen, unit MAR appears to increase with decreasing catchment area. This result surprised me somewhat when I saw it. I have two theories to explain it. Both are related to the fact that the smaller catchments are headwater catchments and therefore are generally higher and steeper than the larger catchments. The theories are:

a) The overall evaporation rate is higher in a large catchment than in a small one. This might be related to the fact that small headwater catchments shed runoff quicker than the larger catchments, thus offering less time for evaporation to occur. (In addition, runoff from a headwater catchment continues to lose water to evaporation as it is transmitted by the rivers of the larger catchment.)

b) Catchment area may be acting as a surrogate for elevation. The headwater catchments possess higher average elevations than the larger catchments. If precipitation and/or evaporation vary with elevation, then variation between unit MAR and elevation (and, thus, catchment area) should be observed.

An attempt was made to correlate unit MAR with lake cover (see bottom plot of Figure 3). As can be seen, no significant relationship exists between these variables. This is a somewhat surprising result since one would assume that catchments covered in lakes would evaporate at a greater rate than those without them.

A note should be made about Table 5. The data presented in this table are essentially a subset of the data presented in Table 4. Where more than one streamflow gauge was located on a stream, it was possible to provide a set of hydrological data for the intervening catchment area between the gauges. For example, the WSC operate two streamflow gauges on Burnside River, Stations 10QC001 and 10QC004. In combination, these two stations provide hydrological information for a total of three different catchments. The first two correspond to the total catchments commanded by these gauges. The third one is the incremental catchment between these two gauges (i.e., Subcatchment No. B2 on the Catchment Map). The MAR for Subcatchment No. B2 was computed by subtracting the flows at Station 10QC004 from those at Station 10QC001. The catchment characteristics, on the other hand, were obtained by examining only the area that lies between these two gauging stations. In summary, Table 4 presents the hydrological data for the "total" catchments while Table 5 provides the same information for the "incremental" catchments. By including the incremental catchments, nine additional data points were made available for conducting the regional analysis.

Estimates of MAR made for the minesite catchments should be validated using the spot flow measurements made by Canamera Geological Ltd.

1.3 Seasonal Runoff Distributions

The above section provides a means of estimating the average annual runoff volume at a site. This section presents a technique for distributing this annual total amongst the twelve months of the year. To develop this technique, an examination was made of the average runoff patterns observed at the regional WSC gauging stations.

Figure 4 was prepared to illustrate the range of runoff patterns that are experienced in the region. In general, the runoff patterns can be grouped into two categories, namely: those that exhibit small seasonal variability and those that exhibit large seasonal variability. The distributions for the former group are the result of large lakes that attenuate the runoff distribution. For two of the distributions (Fairy Lake River and Lockhart River), the lake storage is so large that the runoff from the respective catchments is almost perfectly regulated. The distributions in the upper plot can be ignored in estimating the seasonal distribution for any point in the Jericho River catchment because this catchment is devoid of large lakes (i.e., lakes greater than about 100 km^2 in extent).

The bottom plot on Figure 4 contains distributions that can be used to help characterize the average monthly runoff pattern of the minesite streams. Two observations should be noted about the distributions in this plot:

a) All of the distributions, except Indin River, are associated with catchments located north of the tree line. In all cases, the winter flows for these “north of the tree-line” distributions falls to zero or to extremely low values.

b) The shape of the distribution is well correlated with lake cover. As expected, the greater the lake cover, the more attenuated is the runoff peak. Based on this correlation, lake cover can be used to predict the shape of the average streamflow distribution for the minesite drainages.

An important note should be made about lake cover. The values of lake cover presented in Figure 4 were measured from 1:1,000,000 scale topographic maps. At this scale, only lakes with areas greater than about 0.5 km^2 feature. If the measurements were made on larger scale maps, then the measured proportion of the catchment covered in lakes would undoubtedly increase. In determining the lake cover for the Jericho River catchment, measurements should either be made on a 1:1,000,000 scale map or, if on a larger scale map, lakes with areas less than about 0.5 km^2 should be excluded.