JERICHO PROJECT

ENVIRONMENTAL MANAGEMENT PLAN

Tahera Corporation
Suite 803
121 Richmond Street West
Toronto, Ontario
M5H 2K1

January 20, 2003

EXECUTIVE SUMMARY

Environmental management plans are the minimum commitments by Tahera Corporation for environmental protection. Plans have been made sufficiently flexible so that changes to the mining operation or other external changes can be responded to and accommodated appropriately.

Annual evaluation of the Environmental Management Plan, evaluation of response if accidents occur, and continual evaluation of ways to reduce pollution at source will be integral management functions at the Jericho Mine. Feedback and suggestions from employees and the community liaison committee will be key tools in pollution prevention analysis. The mine safety committee will also be charged with evaluation of environmetnal issues and responses.

Rehabilitating the Land

Mitigation of disturbance at closure and during mine operation for sites no longer active will be managed through the reclamation plan. Liabilities have been assigned to various mining phases in the Jericho Diamond Project Mine Reclamation Plan. A final operating reclamation plan will be developed prior to mine operation and modified as required throughout the mine life to reflect actual operating conditions.

Habitat disturbance will be addressed through progressive and final reclamation and by keeping the mine footprint as small as possible, consistent with a safe and efficient operation.

Terrain disturbance at the Jericho site will include constructing level building and storage pads, establishing waste rock disposal sites, building roads and possibly expanding existing esker borrow sites for granular materials. On dry sites plant regeneration will be slow and take many years. Mesic sites are expected to regenerate more quickly, based on Arctic tundra experience of others. The most direct mitigation practice will be to reduce the disturbed surfaces to as small an area as possible. Most surface materials on disturbed sites will be mineral and granular. Therefore, revegetation will not show any significant effect until the disturbed surfaces contain the organics and fine windblown debris necessary for moisture retention and true soil development that promotes seed germination and sustained growth. All soil that is stripped to develop the pit and other sites will be salvaged, where practical, for reclamation and revegetation purposes.

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 the 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 effects of dust generated by Project mining activities on productivity of local vegetation will be local, of medium duration (life of mine), and negligible (unmeasurable) on the overall tundra biome.

Waste Rock

Two waste rock dumps will be created to prevent one dump becoming excessively high and to maximize materials handling efficiency. 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 #2 to be assured no resources will be covered by the dump.

Waste rock will be built in 10 m lifts to a maximum total height of 35 to 40 m by end dumping. Each successive lift will be set back from the one below by approximately 15 m. Upon completion of each dump the slopes will be graded down, resulting in an overall slope of less than 26°. This will provide for a stable structure during construction and, at the same time, minimize costs. A crawler tractor (D9 or D10 class) will be used to move the rock, if required, after dumping from the ore trucks.

Processed Kimberlite

Coarse and fine processed kimberlite (PK) will be generated by the diamond processing plant. Approximately 10-15% of plant production will result in fine PK and 85-90% in coarse PK. Coarse PK will be stockpiled southeast and proximate to the processing plant. This sand-like material will be left at the angle of repose. Fine PK will be pumped as a slurry to the processed kimberlite containment area, southwest of the plant. The proposed basin has a very small drainage area and can be easily controlled, making the site ideal for fine PK disposal. Supernatant water will be discharged in the spring and summer, through a polishing pond and small drainage to a lake upstream of Carat Lake. Discharged effluent will be non-acutely toxic to aquatic organisms.

Domestic and Industrial Wastes

Domestic sewage will be treated in a plant and water pumped to the processed kimberlite containment area after purification. Domestic garbage, including kitchen wastes, will be incinerated. Large industrial wastes will be burned, stored on site or removed through backhauls 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 backhaul on the winter road.

Water Management

Tahera is committed to ensuring that the effluent generated at the mine site will not be acutely toxic to aquatic biota. To accomplish this, a surface runoff collection system, consisting of containment berms and ditches, will be employed to contain and direct the effluent into one of three separate settling ponds and a processed kimberlite containment facility. This system would operate during all phases of the project, including post-closure. At that time treatment would continue until concentrations reached acceptable levels. Final reclamation of the processed kimberlite containment area will include covering with coarse kimberlite rejects, capping with esker material and revegetating, if practical.

Several alternatives for water management have been developed including:

1. release of runoff from sedimentation ponds by exfiltration, given that water quality meets Water Licence requirements;
2. increased holding time in an expanded processed kimberlite containment area to reduce ammonia levels;
3. spray irrigation; and
4. a water treatment plant.

In addition to this collection and treatment system, mine water releases would be tested routinely to ensure that they are non-acutely toxic, as defined by appropriate bioassays. The effluent discharge would be controlled by a government water licence.

The diamond processing plant will be completely contained within the footprint of the Mine. Surface runoff will be pumped to the processed kimberlite containment area.

Fuel, ammonium nitrate, and other supplies will be hauled to the Jericho site over the Lupin winter road with extension to Jericho (the overland portion north of Contwoyto Lake by all-weather road). Spill plans will be required by all hauling contractors and existence of an acceptable plan will be verified prior to engaging a new contractor. Tahera's winter haul coordinator will ensure all parties involved understand procedures to be followed in the event of a spill or other emergency associated with the haul. No interference with wildlife movement is anticipated, however trucks will be radio-equipped and drivers will keep each other informed as to any wildlife movements across the winter road corridor. Such wildlife movements will always have the right of way.

Aquatic Management

Both population and habitat impacts could result from mine operation. Fish can be negatively affected by explosives. 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 Carat Lake.

The Project will affect fish habitat in several ways:

- water in a small stream must be diverted around the open pit with a loss of potential stream habitat (not inhabited by fish);
- a water intake causeway in Carat Lake will eliminate a small amount of habitat;
- the processed kimberlite containment area will eliminate a 9 ha lake, which currently contains small populations of burbot and slimy sculpins; and
- the flow regime of the outlet stream from the processed kimberlite containment area will be altered (reduced to zero during construction and increased to 150% of natural flows during operation).

None of the potential impacts are likely to significantly affect fish popultions, except loss of Long Lake habitat. Compensation will be provided by creation of new fish habitat.

Fish Habitat Compensation

Tahera has used a structured approach to achieve a habitat compensation plan that meets the requirements of DFO. Fish habitats affected by specific Project activities were identified and the effectiveness of proposed mitigation measures evaluated. Where Project effects could not be fully mitigated and there was a harmful alteration, disruption, or destruction (HADD) resulting in the need for compensation, affected habitats were quantified and characterized in terms of their importance to fish.

Project activities will impact 2,153 m^2 of fish habitat in four locations. These include: the access ramp on Contwoyto Lake (150 m^2); the water intake causeway on Carat Lake (1395 m^2); introduction of suspended sediments during construction and maintenance of the diversion into Stream C1 (387 m^2) and Carat Lake (40 m^2); and altered flow of Stream C3 from the PKCA (181 m^2). The majority of these areas were characterized as rearing habitats for fish residing in the affected water bodies, although spawning and feeding habitats were also affected. A fifth Project activity, construction of the PKCA, will remove water bodies in the Long Lake System from production, which represents 92,500 m^2 of marginal habitat.

The compensation proposed by Tahera is based on the type of habitat affected and the availability of habitat compensation opportunities. The proposed compensation plan is conceptual, but is technically feasible. Tahera acknowledges that detailed design specifications are required before implementation. The compensation plan adheres to the no net loss principle and the need to maintain habitat productive capacity as recommended by DFO. The plan's fundamental goal is to ensure the long-term viability of the fish community in the Project area.

Noise

Barren-ground caribou have been found to avoid intense noise, but become habituated to routine noise at mine sites, including explosives discharges. 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 with mine personnel. However, avoidance will result in some loss of foraging habitat.

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. Exhaust gas emissions will be minor due to the small number of sources involved. Dust could have a significant local impact, particularly on vegetation and early snow melt. Problematic dust sources will be watered during the summer. Winter dust generation should be limited by snow cover.

Wildlife Management

The most effective mitigation of environmental effects is an operating ethic that reduces and avoids interactions to the maximum practical extent. This will be achieved at Jericho through the Environmental Management Plan (EMP) that addresses all potential interactions between the Project and the environment. The implementation of the EMP will follow, in a general sense, ISO 14000 objectives, which measure effectiveness of an EMP by measurable standards and continuous improvement in EMP execution. General guidelines for minimizing effects on wildlife and wildlife habitat are discussed in this report.

<u>Raptors</u>

Environmental effects of the Project on raptor populations are expected to be minimal. Disturbance of nesting areas will be kept to a minimum and nesting areas monitored for project impacts.

Ungulates

Muskox and caribou will be guided around hazards at the Jericho site. As a general practice, ungulates will be deflected around the Jericho site by waste dumps; other measures such as fencing and berms will be employed when required, e.g., the open pit lip will be bermed on closure to prevent animals falling into the pit. Very large groups of caribou, migrating through the Jericho site, will trigger mining shutdown, where appropriate, until the animals have passed.

Carnivores

There are no carnivore dens in areas that will be disturbed by the Project. Interactions with personnel will be minimized by scrupulous attention to removal of road kills and incineration of kitchen wastes to prevent development of associations between Jericho activities and food for carnivores.

Monitoring

Requirements for monitoring the biophysical, socioeconomic / cultural and heritage resources throughout the mine life will be part of the terms and conditions appended to the Project's Water Licence and land leases.

TABLE OF CONTENTS

LIST OF TABLES

All tables are located at the back of the report.

LIST OF MAPS

All maps are located in Appendix E.

ATTACHMENTS

1.0 ENVIRONMENTAL MANAGEMENT PLAN GOALS

The environmental management plan (EMP) will have three primary goals:

- to keep the Jericho Mine in compliance with all governing regulatory instruments;
- to direct mine activities so as to minimize environmental impacts; and
- to continually strive to reduce residual impacts and improve pollution prevention, i.e., reduce the generation of contaminants at source.

The principal methods Tahera will use to ensure environmental compliance include: monitoring; training of employees to recognize potential environmental problems before they occur; and emergency and spill response plans[1].

Annual evaluation of the EMP, evaluation of response if accidents occur, and continual evaluation of ways to reduce pollution at source will be integral management functions at the Jericho Mine. Feedback and suggestions from employees and the community liaison committee will be key tools in pollution prevention analysis. The mine safety committee will also be charged with evaluation of environmental issues and responses.

1 Spill and emergency response plans, based on feasibility mine plans, have been developed. The plans will be updated once final engineering is completed and reviewed and then updated annually throughout mine operation.

2.0 MITIGATION AND MANAGEMENT

2.1 OVERVIEW

Mine development plans are at the feasibility stage (completed June 2000) at present and the mitigation and management plans provided in this section may require modification to address any changes in design upon completion of detailed engineering and following government review. Changes are expected to be minor and will be made in order to afford the same or greater environmental safeguards to operations. Environmental management plans provided here are the minimum commitments by Tahera Corporation for environmental protection. Plans have been made sufficiently flexible so that changes to the mining operation or other external changes can be responded to and accommodated appropriately. Any change that resulted in permanent mine closure would trigger final reclamation and abandonment plans.

2.2 WASTE MANAGEMENT

This section describes handling and storage of waste rock, overburden, ore, low grade ore, processed kimberlite, domestic solid waste, non-hazardous industrial waste, and hazardous waste.

2.2.1 Waste Rock

Approximately 12.9 million tonnes (7.2 million m^3) of waste rock will be generated over the 4 year open pit phase and an additional 57,000 tonnes in the first year of underground operation. As underground mining methods are selective, no significant volume of waste rock is expected to be generated through the remaining underground mining phase.

The waste rock will either be placed in one of two waste rock dumps located adjacent to the open pit, as shown in Map A (Appendix E), or used for construction of the processed kimberlite containment dams, roads, water intake causeway, and the building of any required pads. The waste rock dumps have a total capacity of 8.0 million m^3. Dump 1 could be expanded to the north to accommodate additional materials, if necessary.

Waste rock will be hauled to the dumps using off-road mine trucks on all-weather mine access roads. If waste rock is accidentally spilled it will be retrieved by front end loader and reloaded in a mine truck for disposal. Dust control will be by watering of driving surfaces during summer months. Potential conflicts with wildlife will be minimized by giving wildlife the right of way, by limiting vehicle speed, and by directing wildlife away from active areas to the extent practical.

The waste rock dumps will be constructed by end dumping. The dumps will be built in 10 m high lifts to a maximum of 40 meters. Each successive lift will be set back from the one below by approximately 15 m (Appendix A.1, Project Description, Figure 14.1). Waste rock will be spread with a dozer (D9 or D10 class) to make a flat surface for trucks to drive on and to incline the top of the lift so as to direct runoff water toward the berms and sedimentation ponds. The dump faces will be re-sloped during reclamation to a slope of 26° or less.

Visual inspections complemented by geotechnical drilling at the dump sites, indicate that bedrock is at, or very near, the surface at both dump locations. The foundation conditions are therefore well suited to dump development.

The waste rock is comprised of granite, with negligible amounts of carbonate and sulphide. Results of geochemical testing by SRK in 2000 (Appendix D.1.6) indicate the waste rock is non-acid generating, with a low potential for release of soluble metals. Results of leach extraction tests and seep samples collected from waste rock outside of the exploration drift indicate ammonia and copper concentrations (in discharge from the exploration waste rock dumps) may exceed receiving water guidelines. Use of explosives will be closely managed to reduce residual nitrogen levels in the waste rock to the extent practical. Techniques currently employed at EKATI™ include close coordination of all departments at the mine, segregation of waste that contains blasting misfires, and strict control of explosives use to ensure overuse does not occur (EKATI™, pers. comm, June 2000). Contingencies for addressing the water quality issues are discussed in Section 2.3. No significant wind erosion or dust is expected from waste rock dumps, based on the experience at the EKATI™ Mine.

Approximately 750,000 m^3 of the waste rock mined during the starter pit development (Year 1 and 2) will be used for construction of roads, and pads needed for mine infrastructure, such as the mine camp, ore stockpile pad, etc.

2.2.2 Overburden

Approximately 882,000 m^3 of overburden will be produced during mining. The overburden will be placed in a stockpile southeast of the open pit for use in reclamation. Overburden from the processed kimberlite containment area (PKCA) dike excavation (approximately 45,000 m^3) will also be stockpiled, either temporarily at the PKCA site or on the overburden stockpile (Map A, Appendix E). Since stripping will occur in winter, the overburden will be frozen. When the frozen overburden thaws each summer, it may have a tendency to slump. To prevent overburden movement off the storage area, a waste rock berm will be constructed on the downhill side of the overburden prior to summer thaw. Water from thawed overburden will be collected and treated, as appropriate, to ensure it meets Project Water Licence discharge criteria.

2.2.3 Low Grade Ore

Approximately 1.7 million tonnes of low grade ore will be produced over the mine life. Depending on its grade, the low grade ore will be placed in one of two stockpiles, constructed in a similar manner to the waste dumps, with 10 meter high lifts to a maximum height of 30 m. If economically feasible, the low grade ore may be processed at a later date. Further definition of this part of the JD/01 kimberlite pipe is required to better assess the grade.

Geochemical testing of the kimberlite ore by SRK (Appendix D.1.4) indicates a low potential for acidic or strongly alkaline drainage. Results from leach extraction tests indicate that runoff in contact with the stockpiled ore could have high total dissolved salts and elevated ammonia levels. The drainage is expected to be alkaline with pH's in the range of 8, and alkalinity in the range of 40 mg/L. Suspended sediments are also expected to be an issue with respect to discharge water quality. Contingencies for addressing the water quality issues are discussed in Section 2.3.

2.2.4 Ore

Ore will be placed on two pads with a live capacity of 500,000 tonnes each. The pads will be constructed of waste rock and located near the processing plant (Central and North lobe ore). Although both ore types will be extracted, only Central lobe ore will be processed during the first few years of mining. North lobe ore will be stockpiled for processing starting in Year 7. The ore piles will be stacked to a maximum height of 8.0 meters. Ore will be loaded from the piles with a front end loader.

Drainage from the ore stockpiles will be collected and routed to the PKCA.

2.2.5 Processed Kimberlite

Approximately 2.53 million tonnes of ore will be processed over the mine life. The waste materials generated during ore processing are fine PK (10-15%), coarse PK (85-90%), and recovery plant PK (<2%). Fine PK will be pumped to a PKCA located in Long Lake southwest of the plant (Map A). Coarse PK will be placed in the coarse PK stockpile (approximately 1.1 million m^3), or used in reclamation of the PKCA (approximately 75,000 m^3). The recovery plant PK will be retained in a fenced impoundment adjacent to the plant.

The geochemical characteristics of the PK are presented in the SRK report (Appendix D.1.5). The test results indicate both size fractions have a low potential for acid generation and metal leaching. The fine PK supernatant is expected to have a slightly alkaline pH, and may have slightly elevated levels of ammonia. In this respect SRK's results are at variance with operating experience at EKATI ™, where processing plant effluent has ammonia concentrations below 2 mg/L (EKATI ™, pers. comm. 2000). Runoff from the coarse PK piles is expected to be similar.

2.2.5.1 Long Lake Processed Kimberlite Containment Area

The fine processed kimberlite (PK) will be deposited in the PKCA located in a long narrow lake south of the processing plant area (Map A). Embankments will be constructed at either end of the valley and at low points around the valley perimeter to confine the fine PK. The PKCA will be divided into two cells by constructing a permeable separation dike across the centre of the impoundment. PK deposition between the cells will be alternated approximately every 6 months so as to allow seasonal thawing of the ice that accumulates concurrently with the cell used for winter deposition.

A small polishing pond will be constructed in an existing basin, immediately west of the Long Lake PKCA.

Based on current reserves estimates, approximately 380,000 tonnes of fine PK solids will be produced over the mine life. In-situ dry densities are expected to vary between 0.5 and 1.0 tonnes/m^3, depending on the amount of ice entrainment. At an in-situ dry density of 0.5 tonnes/m^3, the fine PK volume would be on the order of 760,000 m^3. Allowing for the temporary storage of up to approximately 300,000 m^3 of water, the total storage requirement is approximately 1.1 million m^3. Based on the current embankment crest elevation, and allowing for 1 m of freeboard, there is potentially 400,000 m^3 of additional capacity that would be capable of providing storage for the fine PK from additional ore reserves, should any future reserves be deemed worthy of processing. Alternatively, the embankments could be lowered nominally.

The fine PK will be thickened to approximately 25% solids, then pumped into the PKCA. The PK will be discharged year round through a four-inch line from the plant.

For simplicity, the site plan (Map A, Appendix E) shows fine PK discharged at a fixed point in the impoundment. Fine PK will be discharged against the dams to keep water away from the upstream dam face. Supernatant water will flow towards the west into the polishing pond and from there via a small stream to Lake C3.

The PK water balance is presented in Section 2.4. PK supernatant water will need to be discharged each summer to maintain storage capacity for solids and water in the PKCA.

2.2.5.2 Coarse Processed Kimberlite

Approximately 2.15 million tonnes of coarse PK will be produced over the mine life. At an assumed density of 1.8 g/cc , this corresponds to 1.19 million m^3 of coarse PK. The coarse PK will be stockpiled south of the low grade stockpile (Map A). A small portion will also be used as a cover for fine PK. The coarse PK pile will be stacked with a truck and/or loader, supported by a D6R class dozer, in 10 meter lifts to a maximum height of 30 meters.

Experience at EKATI™ mine suggests that dust should not be problematic. The kimberlite will be deposited wet and freeze in the winter or remain moist in the summer. Any runoff from the stockpile will be directed to the PKCA by drainage ditches as discussed in Section 2.3.

2.2.6 Domestic Solid Waste

Limited domestic garbage will be generated by the mine camp. All small burnable garbage (cardboard boxes, waste paper) will be burned in an approved camp incinerator. Kitchen wastes will be burned daily in the camp incinerator. The incinerator will be located just to the north of the Central Lobe ore stockpile. Ash from the incinerator will be trucked to the landfill and covered with fill to prevent dust generation. Alternately, ash will be incorporated into the waste rock dumps.

Waste water treatment plant (WWTP) sludge will be placed in a bermed area once treated in the plant. The bermed area will be located away from water bodies and at least 30 m from the accommodation building. It will be fenced to prevent unauthorized access. Alternately, if a bermed area is not accepted, WWTP sludge will be dewatered and incinerated as per kitchen wastes. If approved, WWTP sludge could be used for reclamation purposes.

2.2.7 Industrial Waste

To the greatest extent possible, industrial waste will be recycled or reused on site. The mine will maintain a bone yard of used equipment that can be drawn on for spare parts, where appropriate. The bone yard location has not been finalized, but will likely be near the mine office and laydown area. Alternately, the existing laydown area 200 m north of the existing exploration camp may be used. The existing area is on esker material (sandy gravel) and thus no direct runoff from the site occurs.

An application will be filed with DIAND to burn large wood and cardboard refuse on site at an appropriate location proximate to the mine camp.

Other wastes that cannot practically be recycled will be landfilled at a proposed site north of Dump 1. A landfill permit will be applied for prior to mine construction to cover operation of the site. No hazardous wastes will be dumped in the landfill. Drainage from the proposed site is to the tundra. A pad for the landfill will be constructed from ROM granite and a cap of esker material will be added. Esker fill material will be stockpiled at the site for use as cover. No kitchen or other organic wastes will be placed in the landfill, except in the form of ash. Any drainage from the landfill will be combined with Dump 1 drainage and treated as discussed in Section 2.3.

2.2.8 Petroleum Contaminated Soil

While all precautions will be taken to prevent the spillage of petroleum products, from time to time, routine spills to soil may occur. Such soil will be scraped up and incinerated or placed in a landfarm to decontaminate. Decontaminated soil will be tested, and once petroleum levels are low enough (as set by CCME guidelines), soil will be placed on the overburden stockpile for re-use.

The landfarm would be located in a suitable corner of the industrial landfill site and would be lined with a geomembrane to prevent any leachate from contaminating the landfill. For construction, graded soil would be placed on top of the crush rock landfill pad. The geomembrane liner will be laid down so as to form a continuous berm around the landfarm perimeter, similar to a fuel farm berm construction. Graded soil will then be placed on the geomembrane to protect it.

Contaminated soil would be mixed in a proportion of approximately 5% with overburden or esker soil. Nitrogen fertilizer may be added to aid bacterial digestion of the petroleum. Soil in the landfarm would be periodically mixed, either manually or with machinery depending on the volume of soil to handle. Careful management, a spill prevention, contingency and countermeasures plan, and employee training should ensure only small volumes of soil require decontamination.

2.3 WATER MANAGEMENT PLAN

2.3.1 Site Water Balance

A site water balance, based on a regional analysis, was developed by SRK Consulting and is presented in their report on Mine Waste and Water Management (Appendix D.2.1).

2.3.2 Water Management

2.3.2.1 Introduction

The water management plan was developed by SRK Consulting and will be updated pursuant to additional field investigations for detailed engineering design. Map E (Appendix E) shows the proposed water management facilities. Water and sediment management at the Jericho site will consist of:

- clean water ditches to route water from upslope of disturbed areas around mine and camp facilities where required;
- a series of ditches and sedimentation ponds to capture and temporarily hold water from disturbed areas, principally the waste rock dumps, ore and coarse kimberlite stockpiles, and open pit;
- the Stream C1 water diversion around the pit; and
- a polishing pond that facilitates controlled discharges to the receiving environment. The PKCA will be required to treat fine processed kimberlite from the diamond processing plant.

A more detailed description of key elements of the water management plan are provided in Appendix D.2.1, and the Project Description, Sec. 16.2.1, Appendix A.1.

2.3.2.2 Sediment Control

An overview of site water management is shown on Map E. Additional details are provided in drawings in the SRK Waste and Water Management Plan (Appendix D.2.1):

Ditches and Berms

Sediment control berms will be 1 m high, 0.5 m wide at the top and have 2:1 side slopes. Berms will be constructed of overburden or esker materials. Ditches in overburden will be geotextile-lined to limit seepage.

Waste Dumps

Much of the site is bedrock controlled and surface water flows overland to natural depressions. Diversion ditches will be located on the road east and south of Waste Dump 1, where required. Waste Dump 2 will be sloped toward the northwest, but may require two short clean water ditches in depressions on the south side as shown on Map E, if the full extent of the footprint is required. Initially, Dump 2 will not extend south of the drainage divide and thus all water will flow northward.

If water quality from this area proves problematic, water can be captured in sumps, pumped to the north, and flow to the control berm on the north side of the dump, or to the PKCA. Alternates for water management are discussed below.

Coarse Kimberlite

The coarse kimberlite and stockpile will have a collection sump on the south side and water will be pumped to the PKCA at Long Lake.

Ore Stockpiles

Impermeable ditches can be constructed along the north and west side of the central lobe ore stockpile. Runoff water and seepage will be directed from along the pit-camp road to a sediment collection pond. If water meets licence requirements after settling, it will be allowed to exfiltrate across the tundra toward Lake C1. If water is problematic (e.g. with respect to ammonia or metals) it will be pumped to the Waste Rock Dump 1 sediment control pond or the PKCA.

Processing Plant and Accommodation Area

All plant area drainage south of the central lobe stockpile will be directed to the PKCA.

Fuel Farm

The fuel farm will be completely surrounded by a berm with a capacity of at least 110% of the largest tank. Water outside the berm will flow to the central lobe ore stockpile drainage control system. Under normal circumstances there is very little runoff in this area, except during snow melt in the spring. Water from snow melt and precipitation will be removed periodically, as required to maintain the storage capacity of the berm. Water from the fuel storage area will be trucked to the PKCA for disposal, unless visible oil is present. In this case the water will be treated through an oil water separator prior to disposal. Should a spill occur inside the berm, petroleum will be collected and shipped off site with a hazardous waste contractor, or burned (with approval from DIAND / Environment Canada). Until clean after a spill (i.e. no visible oil), water from inside the berm will be routed through a grease trap / oil-water separator to remove petroleum products.

Open Pit

There will be no clean water ditch system around the open pit, although once the final pushback is complete, a rock berm will be constructed around the perimeter. This berm, although permeable, will tend to limit water entering the pit from the top edge, as spaces in the rock are slowly filled with fine material. Drainage to the pit will be minimized to the extent possible and all precipitation falling directly in the pit will be collected in the pit sump.

Existing Carat Camp and Airstrip

There are no collection ditches around the camp or the airstrip and negligible runoff has occurred in six years of operation. The pad built for the camp absorbs all water that falls on the site; snow is plowed in the winter to keep the camp area clear. The airstrip is on an esker system with very pervious soil and runoff has never been significant.

PKCA

The PKCA is in a small drainage basin; no clean water ditches will be constructed for this facility, as all water in the drainage basin will report to the impoundment. A number of dikes will be required to increase the capacity of the impoundment, as shown schematically on Map E (Appendix E).

Sediment Collection Ponds

As shown in Map E, a number of sediment collection ponds will be constructed to provide holding time for water and to settle sediment. The sediment control pond at Waste Rock Dump 1 will be sized for a 10-year-24-hour storm event. Snow accumulations will be removed from all collection and control ponds prior to snow melt in the spring to prevent overtopping of the ponds. Each pond will be constructed with an emergency spillway to prevent structural damage to berms in the event of an extreme storm. After settling of sediment, water will normally flow from the ponds to the receiving environment. Contingencies are discussed below.

The sediment control pond for Dump 1 will be 50 m wide by 200 m long with baffles, as shown conceptually in SRK's report (Appendix D.2.1). Settling particle size design diameter is 10 µm (0.01 m), or fine silt. A particle size of this diameter requires a design surface area of 5,500 m^2 in order to meet British Columbia MOE / DFO design guidelines (Chilibeck 1992). Sediment control berms at the toe of the dump dictate baffles to increase surface area of the pond slightly. The pond will have a depth of 1.5 m to allow storage of sediment, as well as the ability to store 10 hours of a 10-year, 24-hour design storm.

Dump Site 1 sediment control pond berms will have a 2:1 side slope, a 1m top width, and be constructed of overburden or esker material. Some excavation will be required on the upslope side of the pond to provide the required depth. An internal baffle will be constructed in this pond to improve sediment settling. Flocculents will be used in all sediment ponds, if required. Anionic flocculents will be chosen (in consultation with Department of Fisheries and Oceans) that are non-toxic to fish. To date, tests have been conducted by the manufacturer on Percol™ E-10, which is an anionic flocculent. Satisfactory settling results were obtained.

There is insufficient room for the design pond size for Dump 2 downslope of the pit-plant road. British Columbia / DFO guidelines indicate a pond 30 m by 150 m. Water will be collected from the dump in a baffled pond and flocculents will be added when required. Non-toxic flocculents approved by DFO will be used. In the event water does not meet discharge criteria, it will be pumped either to the Dump 1 sediment control pond or to the PKCA.

No groundwater flow in the open pit is expected, given the shallow occurrence of permafrost at the kimberlite pipe. Significant ice lenses were not encountered in the exploration decline and are not expected in the pit. The pit area sediment pond will be approximately 300 m^2 and fed from a sump in the Pit. If water meets discharge quality as defined in the Project Water Licence, water will be discharged into the energy dissipation pond. In the event water does not meet discharge criteria, it will be pumped to the PKCA.

A correlation will be established between turbidity and total suspended solids so that water can be monitored directly at the site. Ammonia in sediment pond water will also be monitored in the field.

Options for Dealing with Ammonia

Options for dealing with the ammonia issue include:

1. increased residence time by pumping to the PKCA;
2. spray irrigation; and
3. a water treatment plant to reduce ammonia levels to approximately 2 mg/L.

The PKCA containment area is much larger than sedimentation ponds and thus would allow increased residence time before water would require discharge. Water of questionable quality would be pumped to the PKCA, if it could not be contained in the settling ponds. If all the water from the site is routed to the PKCA the water balance will be altered with approximately twice the amount of water requiring discharge to maintain storage capacity, as detailed in SRK technical memorandum (Attachment 2.2). Prior to discharge from the PKCA polishing pond, water will be analyzed to ensure it meets Water Licence discharge criteria. Monitoring is discussed in Appendix B.3.3.

If water does not meet Water Licence discharge criteria, spray irrigation may be an alternative. Spray irrigation is a recognized technique for treatment of waste water to remove: biochemical oxygen demand (BOD) (not an issue with mine water); nitrogen compounds (ammonia and nitrate); and, to a lesser extent, phosphorus. This option has been investigated by Microbial Technologies, consultants for the Jericho Project (Appendix D.2.2). Based on their assessment, an area of less than 10 ha would be required to treat mine water. Treatment would consist of spraying the water onto alternate areas of the site when the ground is not frozen and snow covered. Site selection is pending, but will be in an area where any runoff water can be collected, tested and retained for further treatment if necessary. Based on Microbial Technologies' analysis, much of the water sprayed will be absorbed by the soil and essentially all of the nitrogen compounds will be utilized by plants. A long slope toward Lake C3 affords: sufficient area for irrigation; absorption of most if not all of the water by the soil and plants; removal of ammonia and nitrate by plants; and the opportunity for installation of monitor and pump back wells, should water be problematic prior to its reaching Lake C3. Microbial Technologies also investigated an increased volume of water being sprayed in the event that all of the mine, process, and runoff water required treatment by spray irrigation. Their findings indicate that the increased annual discharge from the PKCA impoundment under a revised water balance, including all site runoff and process water, can be adequately treated by land spray irrigation. The increased discharge will be accompanied by decreased ammonia concentrations, if production rates and corresponding ammonia loadings do not change. It appears that the existing land availability (4 to 8 ha) is adequate for the PKCA effluent treatment considered, using hydraulic, nitrification, and phytotoxicity criteria[2]. Their report is contained in Appendix D.2.2.

Water treatment would also provide an alternate solution. Water treatment to remove ammonia is currently being used successfully by Homestake Mining at their Nickel Plate Mine at Hedley, B.C.. Water treatment would probably be the most costly option and is unattractive because of: the need to heat water year round, thus increasing the use of fossil fuel; the increasing storage requirement for fuel; and the need for additional qualified staff to operate the treatment plant.

Use of explosives will be closely managed to reduce nitrogen loss to the extent possible. As previously discussed, such techniques are currently employed successfully at the EKATI™ Mine. Operational monitoring will be employed to determine whether sublethal aquatic effects are occurring (see Environmental Monitoring Plan, Appendix B.3.3).

2.3.2.3 Stream C1 Diversion

Stream C1 diversion is shown in its approximate location on Map E and with more detail in SRK's Waste and Water Management Plan (Appendix D.2.1). The purpose of the diversion will be:

- to prevent surface water entering the pit; and
- to prevent dewatering and potential contamination of the downstream reaches of Stream C1 downslope from the pit.

The diversion will be constructed so as to minimize impacts on Stream C1. The diversion will have three principal components:

[2] To arrive at the final (worst-case) spray application rates and the required land areas concluded in several multiplicative safety factors were applied to the results of the lab and field trials. These safety factors include combination of pessimistic assessment of ammonia loadings, nitrification rates, hydraulic travel times, and climatic window of opportunity to conduct the irrigation treatment. Properly engineered and maintained, the spray irrigation system is likely to provide adequate ammonia treatment using the available land at the revised water balance scenario.

- an upstream dike to impede water flow so it can be directed into the diversion channel;
- the diversion channel through bedrock and overburden; and
- an energy dissipation pond at the downstream end to prevent erosion where the diversion rejoins Stream C1.

The diversion will be constructed in winter when pre-stripping is carried out. A length of approximately 541 m of Stream C1 will be diverted away from the open pit. The diversion will be cut through 175 m of bedrock and 242 m of overburden. No ice-rich soils are expected to be encountered, based on geotechnical drilling carried out in September 2000. Borehole logs for the two holes drilled are presented in Attachment 2.1 together with a location map. If ice-rich soils are encountered that section of the diversion ditch will be lined with a geotextile and supported by rockfill to prevent slumping of the channel side slope and subsequent movement of fines into Stream C1. The sides of the diversion channel will be 0.75:1 in rock and 2:1 in soil. The channel will be sized to pass a 200 year flood (estimated to be 3.7 m^3/s) and will be rip-rapped to prevent erosion.

The upstream end of the diversion will require a dike in the present Stream C1 channel. Standard construction practices will be employed to minimize disruption of the stream and sedimentation. A coffer dam will be required to temporarily divert Stream C1. Water will be pumped around the diversion dike location while in-stream construction is carried out, unless there is no flow due to winter ice conditions. Figures 5.6 and 5.7 from SRK's report (Appendix D.2.1) show details of the dike. The dike will be constructed of sand and gravel and will be keyed into bedrock or permafrost, have a 2.5 m height and a 5 m width on the top. Sides will be sloped 2:1. A centre-line geomembrane made of high-density polyethylene (HDPE) will be installed to ensure impermeability.

The energy dissipation pool will be located in the centre of the channel on Stream C1 at the downstream end of the diversion channel. It will also receive water from the open pit sediment collection pond when water can be discharged directly from the pond. The energy dissipation pool construction will require in-stream work. Work will occur outside of the time grayling are spawning to help minimize any impacts from the work. Stream C1 will be routed around the pool construction location by means of a temporary channel or pipe. The pool will be 15 m by 10 m by 0.5 m deep. Erosion protection will be afforded with a 0.4 m thick rip rap liner; average rip rap diameter will be 0.25 m. The diversion channel and the channel from the open pit sediment collection pond will also be rip-rap lined.

The diversion channel will not be daylighted to the upstream dike until all construction has been completed. Silt fencing will be placed in Stream C1 downstream of the energy dissipation pool initially to trap any residual sediment left from construction. Once sediment drops to background, as measured by stream turbidity, silt fencing will be removed.

Maintenance of Water Levels in Lake C1

The water level in Lake C1 will be controlled by the outlet stream from the Lake at its eastern end. Stream diversion will not affect this level for the following reasons:

- the upstream takeoff point for the diversion will be downstream below the rockfall at the outlet of Lake C1 at a lower elevation than the lake; and
- the diversion dam will be constructed with the outlet invert at the same elevation as the existing stream that flows from the samll pond where the diversion is proposed to start.

Not only will natural water levels be maintained upstream of the diversion, but also downstream, as the diversion is designed to pass all water from Stream C1.

Energy Dissipation Pond Fish Passage

The energy dissipation pond will allow passage of fish at high and moderate flows, but not likely at low summer flows. Note that, since the bottom will be rip rap lined with moderately coarse rock, and permeable, the movement of fish at low water may be impeded more than would occur with a sand or gravel bed. A fine gravel bed would not serve to dissipate water energy without creating a sedimentation problem downstream of the pond. Construction is therefore constrained somewhat by the intended purpose of the pond. The downstream section of the diversion has a design grade of -1.8% which will allow fish passage. This section will be rip-rap lined and the same consideration about low water passage of fish would apply. From RL&L's experience with natural streams in the project area and nearby, fish appear to be able to navigate between and around rocks in stream beds at low water and thus the rip rap may not present a barrier.

Energy Dissipation Pond Maintenance

As sediment accumulates in the energy dispersion pond it will be cleaned out. Timing for clean out of sediment will be summer low water. A silt fence will be installed downstream of the pond, assuming water is flowing in Stream C1 at the time the work is undertaken. Turbidity readings will be taken upstream and downstream of the silt fence prior to commencement of in-pond work. Sediment will be removed by hand or backhoe, if one is available and appropriate for use. Sediment will be transported to one of the waste rock dumps and covered with run-of-mine rock in the course of dump development to ensure dust erosion does not become problematic. During in-pond operations turbidity readings will be taken daily. Once operations have been completed (including any maintenance of the rip-rap required from inspection) daily turbidity readings will continue until such time as turbidity reaches background. At that time the silt fencing will be removed.

Depending on the amount of sediment in the pond and water flows, there is also the option that water may be temporarily pumped around the pond by blocking the downstream end of the diversion with sand bags before it enters the pond. In this case, silt fencing would be installed downstream of where the temporary diversion pipe re-enters the stream.

2.3.2.4 Processed Kimberlite Containment Area

Impoundment Facility

The PKCA site was selected because the drainage basin is not much larger than the ultimate size of the PKCA and therefore will result in a minimum of upland runoff outside the PKCA. No clean water ditches will be required around the impoundment. The embankments constructed to create the PKCA will also be used to control water discharge. Water will be discharged from the western end of the PKCA into a polishing pond and from there to Stream C3 where it will flow naturally to Lake C3 (Map A, Appendix E). External dams will be keyed into bedrock and have a geomembrane core to render them nearly impermeable. The internal divider dike will be permeable to the exchange of water, but not solids.

A combination of adequate height of embankments and the use of siphons or a similar mechanism to discharge water will be used to manage the PKCA. Pipe diameter or valves in the siphons will limit flow. Lupin Mine uses multiple siphons to discharge water from the mine's tailings containment area. Use of multiple pipes allows for discharge under flood conditions without making a single pipe excessively large for normal flows. Armouring of the Stream C3 bed may be required in areas where gradients are steep and the stream runs in overburden, to prevent erosion of the stream bed from the higher than natural flows.

Water will normally be discharged from the PKCA from June 1 through September 30. If the spring is cold the discharge period could be moved back to later in June and continue through October. In this way, a full four months will be available for discharge.

PK Effluent Water Quality

Based on leach tests conducted by SRK (Appendix D.1.5), characteristics of the expected effluent from the PKCA are listed in Table 1.15 of the Environmental Impact Assessment Report (Appendix B.2.1). Aeration in the polishing pond may drop ammonia levels; other parameters will remain as indicated.

No dilution will be required to reach receiving environment water quality, assuming ammonia oxidizes in transit, or (as with EKATI™) is below receiving environment guidelines entering the mine's PKCA. Two times dilution will be required to meet drinking water guidelines. As no drinking water will be drawn from Lake C3, this is not an issue for discharge, since dilution will occur in the lake as supernatant diffuses into lake water. Based on modelling results by URS (Appendix D.1.2), 20:1 dilution will occur in the small bay of Lake C3, where Stream C3 empties. PK supernatant water will be tested, by Inductively Coupled Plasma / Mass Spectrometer (ICP/MS) for chemical parameters, and for acute toxicity with rainbow trout bioassay (or as specified in the Project's Water Licence) prior to discharge and at the end of the discharge season.

2.3.2.5 Waste Dumps

There will be two waste rock dumps at Jericho as shown in Map A. Water from Waste Rock Dump 1 will consist of runoff from the drainage area shown on Map A. The drainage area will be 4.2 ha larger than the dump footprint (27 ha). The top lift of the dump at any time will be sloped slightly toward the west so that any runoff water in the spring will flow toward the sediment control pond. Most rain and snowmelt will infiltrate the dump surface and resurface as seepage at the toe of the dump. Seepage will be directed toward the sediment control pond, previously discussed.

Similarly, water from Waste Rock Dump 2 will consist of runoff from the drainage area shown on the map. The drainage area is nearly identical to the footprint (22 ha). The dump will be situated near the top of a low rise and water will drain off the dump to the north and south. A ditch along the pit-plant access road will capture water flowing north and northeast; topography will direct any runoff to the east in a northerly direction. Berms and collection ponds will be constructed on the south side at two locations where ephemeral streams are presently located. Water from these collection facilities will be pumped to the PKCA.

2.3.2.6 Ore Stockpiles

There will be three ore stockpiles. Runoff will be controlled with collection ditches. The Central Lobe ore stockpile runoff will drain naturally northward, whereas the runoff from the Northern Lobe and Low Grade Ore stockpiles will drain naturally southward.

Runoff from the Central Lobe stockpile will be caught by a control ditch west and north of the pad. This ditch can be made impermeable if required. Water will be directed to the pit-plant road northeast of the fuel farm. A culvert will carry water under this road and an impermeable ditch will carry the water down the south side of the road. Water will either be directed north through a culvert to the sediment collection pond north of the low grade stockpiles (if acceptable for direct discharge after sediment removal) or east to a collection pond between the Open Pit and Dump 2. Water will be pumped from this latter pond to a ditch along the east side of the pit-plant road and then to the sediment control pond west of Dump 1. If site conditions indicate, this ditch will be made impermeable; the objective will be to keep as much water as possible out of the open pit.

2.3.2.7 Open Pit

The catchment area for the open pit will be kept as small as possible to limit runoff into the pit. The pit will have a sump in the floor from which water will be pumped to a collection pond. If water meets discharge criteria it will be discharged from this pond to the energy dissipation pond. If not, water will be pumped to the ditch connecting Dump 2 and the sediment control pond for Dump 1, or to the PKCA.

2.3.2.8 Overburden Stockpile

The catchment area for the overburden stockpile will be increased by 6.5 ha over the footprint of 12.5 ha as a ditch on the south against the hillside above the stockpile is not planned. All water from the stockpile will drain toward the Dump 2 - Dump 1 control pond ditch and be captured for treatment. The toe of the stockpile will not be ditched, thus maximizing infiltration of water into the surrounding tundra when the ground is not frozen.

2.3.2.9 Ancillary facilities

Ancillary facilities include:

- ammonium nitrate storage;
- high explosives storage;
- explosives truck wash;
- fuel farm (previously discussed);
- accommodation;
- existing airstrip; and
- existing exploration camp (previously discussed).

Ancillary facilities are not located near water bodies. Water will normally be allowed to flow to the adjacent tundra off pads or seep from the toe of pads to the tundra where natural processes will clean the water of silt or nitrogen. Areas where special considerations are required are discussed in the following subsections.

Explosives Truck Wash

Excess water from the truck wash will be settled in a holding tank to remove solids and then recycled when practical. If oil and grease are not visible, sludge from the tank will be used for reclamation purposes, as the expected elevated ammonium nitrate will act as fertilizer. Alternately, sludge will be incinerated or trucked to the land farm if oil and grease are visible.

Airstrip

No drainage control has been in place on the airstrip since construction. Minor ice melting occurred after construction, but did not lead to significant erosion and no erosion has occurred subsequently. The airstrip extension will require esker fill material to construct. The running surface and sides of the extension will be monitored for signs of erosion and appropriate repairs made as soon as possible after erosion is noted. Any runoff from the strip will infiltrate the surrounding tundra prior to reaching a water body.

De-icing is not expected to be routinely required. Aircraft turn around time will normally be very short, obviating the need for de-icing at the Jericho strip under normal circumstances.

2.4 SEWAGE DISPOSAL

2.4.1 Location

A waste water treatment package system will be installed at the mine site, housed in a stand alone building next to the plant. The building will be founded in a manner similar to the accommodation building and will be supplied heat from the plant.

2.4.2 Operation of The Rotating Biological Contactor Waste Water Treatment Plant

The following information was provided by a potential waste water treatment plant supplier:

The waste water treatment plant (WWTP) employs aerobic digestion of raw sewage to reduce the biochemical oxygen demand (BOD) and total suspended solids (TSS) in the treated effluent concentration to less than 30 mg/L each. Field operations of such equipment has consistently yielded effluent qualities of less than 20 mg/L for these parameters.

In addition to aerobic digestion, chlorine is injected directly into the clarified plant effluent stream ensuring the complete destruction of any pathogens and bacteria prior to its discharge to the environment.

Raw camp effluent is gravity fed through piping to a small volume aluminum lift station placed below the camp outfall height. The effluent collects within the lift station and is transferred to the RBC system via a level activated submersible solids grinding pump. The lift station tank is also equipped with a submersible heating element for winter operations.

The raw effluent enters the plant through the primary treatment chamber. This chamber is designed to provide an adequate volume storage buffer so the treatment system is not shocked with a sudden volume of influent quality change. Air is blown into the primary chamber to initiate the biological destruction process using a small regenerative blower.

An overflow line from the primary tank feeds into a small volume biozone feed tank leaving the collected inlet solids within the primary tank. A bucket wheel assembly, connected to the end of the biorotor drive shaft rotates through the feed tank delivering a measured volume of influent to the biozone tank.

The biorotor sitting within the biozone tank rotates continuously through the delivered influent. Through this rotating action, the naturally occurring bacteria within the influent, are alternately exposed to the air and the wastewater. This alternating sequence provides the environment required for the biological digestion of the wastewater, resulting in the formation of a biological mat formed on the rotor itself.

A direct correlation exists between treatment efficiency, retention time within the biozone, and surface area available to the biological digestion. To maximize surface area, decrease the overall size and retention capacity of the system, the biorotor media is comprised of several 3.8 cm solvent-welded PVC tubes. The biorotor for this specific application has 2,134 m^2 available for the biological digestion process. To further reduce the overall outside dimension of the entire treatment process the biozone tank is placed on stilts within the primary tank.

Waste water flows through the biozone tank in an equilibrated pattern. This simply means that a gallon of influent flow to the biozone equals a gallon of treated effluent out. The treated effluent from the biozone tank flows into a conical clarifier tank where the contained biomass particles settle out of suspension. On a timed basis a return pump within the clarifier delivers the collected biomass particles to the primary tank. This ensures an adequate supply of bacteria in the primary tank to initiate the digestion process.

Clarified liquid overflows into the discharge tank. As the fluid enters the discharge chamber it flows over a chlorine element that destroys all entrained bacteria and pathogens. On a discharge tank level signal the digested, clarified and chlorinated effluent is discharged to the environment (at Jericho, the PKCA).

A single 5 cm drain line runs the length of the system. Each tank segment of the system is isolated from the drain line by a ball valve. This allows for each segment to be drained individually when required. The drain line is completed with a 5cm camlock connection allowing a vacuum truck to connect and drain the system. This is required each time the system is to be moved to a new location or at the end of a specific project. Sludge from the plant will be periodically removed as required and placed in a fenced berm a minimum of 30 m from the accommodation building. If odor or other issues become problematic the treatment plant can be equipped to dewater the sludge and the sludge can be incinerated.

Annual volume of effluent from the plant will be 11,000 m^3, as discussed under water balance. The expected quality of discharge with respect to nitrogen and phosphorus is discussed in Section 1.11.3 of the Environmental Impact Assessment report (Appendix B.2.1). Quality of discharge is guaranteed by the manufacturer to be better than *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* (1992), which are (for lakes):

BOD	360 mg/L
Suspended Solids	100 mg/L
Phosphorus	Site specific
Fecal Coliform	100 CFU/.dL
pH	6 – 9
Oil and Grease	< 5 mg/L

mg/L: milligrams per litre CFU/dL: coliform units per 10 litres

2.5 HAZARDOUS MATERIALS AND WASTES

2.5.1 Hazardous Materials

Table 1.16 of the Environmental Impact Assessment Report (Appendix B.2.1) lists the hazardous materials that will be used for mining and diamond processing at the Jericho Project. The list includes all major chemicals.

As a general practice, all chemical handling will follow strictly requirements set out in Material Safety Data Sheets (MSDS). All employees will be provided with Work Place Hazardous Materials Information system (WHMIS) training. All hazardous materials will be stored in approved containers. Small liquid petroleum containers (e.g. 205 L barrels) will be kept in silled areas, where accidental spills will be contained.

For the Project, the largest single product required will be diesel fuel. During open pit mining 10 million litres will be stored in the fuel farm.

The single largest other hazardous material handled at the mine will be ammonium nitrate, used for explosives and stored in a cold storage warehouse on the explosives magazine road. Ammonium nitrate is flammable, but not explosive itself. It will be delivered during the winter haul in bags and stacked on the gravel pad constructed for the purpose, or on pallets. Spills (from torn bags) will be cleaned up immediately and reported to the mine contractor Operating Supervisor. Cleaned up ammonium nitrate will be rebagged and used as fertilizer for reclamation if not salvageable for explosives use.

Caps and stick powder (likely Magnifrak™) will be stored in steel waterproof containers approved by the NWT Worker's Compensation Board at the explosives magazine. Explosives will be handled by trained employees of the mining contractor who have approved blasting certificates. Spills are not an issue for either caps or stick powder.

2.5.2 Hazardous Wastes

Waste oil will be collected in an approved double-walled waste oil tank. Waste oil will be periodically removed (during winter months via the winter road) by a hazardous waste contractor, or burned if allowed (e.g. Lupin Mine has a permit to burn waste oil). Other waste petroleum products, such as oil filters and grease cartridges will be stored in marked waste receptacles and removed by a hazardous waste contractor.

Any other hazardous wastes such as batteries, reagents etc. will be segregated in marked containers and removed by a hazardous waste contractor. No significant quantities of non-petroleum hazardous wastes are anticipated to be generated by either mining or processing of Jericho ore.

Treatment of petroleum contaminated soils was previously described; volumes of contaminated soils are expected to be small.

2.6 PERMAFROST

2.6.1 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.

2.6.2 Site Management

Waste rock, ore, and coarse PK will be placed in areas with little overburden and thus will be bedrock controlled. Therefore, 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.

During underground mining in Years 5 and 6, 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 ice cracks exist in the bedrock of the deposit and host rock, but these are very minor (ice cracks a few centimeters wide every 10 m depth on average, based on occurrence in the exploration decline) and 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.

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 the building heat.

2.7 AIR EMISSIONS

The principal sources of air emissions at the Jericho Mine will be exhaust gases from mobile and stationary internal combustion engines and dust from mobile equipment and to a much lesser extent, from explosives use. Dust will account for most of the emissions generated.

2.7.1 Exhaust Gases

2.7.1.1 Mobile Equipment

Likely, diesel equipment will be used exclusively at the mine; diesel or electric-powered mechanical equipment will be used at the diamond processing plant. Exhaust fumes from mechanical equipment has been found to be problematic in deep open pit diamond mines, when inversion conditions occur. This issue will be monitored at the Jericho Project. If air quality becomes an issue, it will be addressed by temporary shut downs during temperature inversion periods, when air contaminants approach safe thresholds as set by the Northwest Territories Mine Health and Safety Regulations and/or the American Conference of Government Industrial Hygienists (ACGIH). Elsewhere on the Project site, the level of exhaust gases is not expected to result in significant increases in airborne contaminants, given the normal moderate amount of wind experienced at the site and the pristine clarity of the air. Background levels of PM-10, for instance, have been found to be $<10\ \mu g/m^3$ at Daring Lake and Snare Rapids by GNWT (Sparling, pers. comm. 1999). Diavik (1998) concluded emissions from mobile equipment, other than dust, would not have any significant effect on the regional air quality; dust emissions would be local to the Project. The air quality study for the Jericho Project arrived at essentially the same conclusions (Appendix D.1.1).

2.7.1.2 Power Generation

The air quality study for the Jericho Project concluded impacts to air quality, except in a very localized area near the process plant under very stable conditions, would not result in significant impacts to air quality at the Project site. Generators will be chosen that are fuel efficient for economic reasons, which will also result in minimizing emissions. Routine maintenance and use of low-sulphur fuel will be used to manage emissions from power generators.

2.7.2 Dust

Dust may be problematic at the open pit, on roads, at waste rock dumps, ore stockpiles, crushers (enclosed in the plant; ore sprayed with water before crushing), and at PK impoundment beaches. Levelton's assessment (Appendix D.1.1), using conservative assumptions, indicates PM_{10} may be above 50 $\mu g/m^3$ over the mine site. However, as indicated by Levelton, this prediction assumed major sources would emit dust continuously.

A water truck will be dedicated to watering roads and the top surface of waste rock dumps, when required. As well, water sprays will be used on ore stockpiles if dust generation becomes a problem. Due regard will be given to freezing conditions, which would make subsequent handling of ore difficult.

Dust levels will be monitored during mine operation to ensure compliance with the aforementioned regulations, where workers are exposed to >5 mg/m^3 as inhalable (total) particulate or >1.5 mg/m^3 as respirable particulate (PM4).

A crusher will be employed during the construction phase. Since pre-stripping and initial pit development will occur during winter, dust control will not be feasible. However, crushing of granite waste rock is not expected to prove problematic for dust generation due to the coarse nature of the end product (gravel-sized material). Should dust prove to be a problem (if the crusher is operated during summer months) the crusher will be fitted with a water spray or similar dust control. The crusher will operate most during the construction period and periodically thereafter when crushed run of mine rock is required for construction purposes.

2.8 GENERAL CONTINGENCY, EMERGENCY RESPONSE AND SPILL PLAN

Spill Prevention, Countermeasures and Control and Emergency Response plans (Apendices D.2.4 and D.2.5, respectively) have been developed and will be updated in consultation with the mining contractor prior to mine construction. The plans will meet requirements of the NWB and WCB.

The plans cover planning to prevent spills and accidents and include:

- hazard identification and risk assessment;
- details of a response organization and a reporting procedure;
- provides a list of emergency contacts and external resources;
- provides environmental mapping of the Jericho site;
- details procedures to be followed for emergencies and spills that could occur at Jericho; and
- provides outlines of appropriate clean up procedures for likely spills.

Plans also include procedures for plan evaluation and continual improvement.

2.9 WILDLIFE MANAGEMENT PLAN

2.9.1 General

The most effective mitigation of environmental effects will be an operating ethic that reduces and avoids interactions to the maximum practical extent. The implementation of the EMP will follow, in a general sense, ISO 14000 objectives that measure effectiveness of an EMP by measurable standards and continuous improvement in EMP execution (Cascio et al., 1996). Guidelines for minimizing effects on wildlife and wildlife habitat are discussed in this section.

2.9.2 Mitigation Measures – Raptors

Notwithstanding that environmental effects of the Project on raptor populations are expected to be minor, there are measures that can be implemented to reduce or eliminate effects that might otherwise occur. Guidelines for mitigating the effects of disturbance to nesting raptors were developed by Chris Shank, a raptor biologist formerly with the Wildlife Service, Government of the Northwest Territories (unpublished, 1988). These guidelines follow and to the greatest extent practical, will be implemented for the Jericho Project Environmental Management System (EMS).

2.9.2.1 Principle #1 Disturbance Is Most Harmful Early In The Nesting Period

Raptors act to maximize their chances of raising the greatest number of young possible. If they “decide” early in the breeding period that their nest is insecure, they may abandon it. Sometimes they will re-nest at another site, but such “re-nests” usually fledge fewer young than first nests. If nests are disturbed late in nesting, insufficient time remains for a re-nesting attempt and the parents accordingly have little to lose by sticking to their original nest site. Risk of nest abandonment therefore declines through the nesting period.

The management implications for the Project will be to minimize disturbance to nesting raptors to the greatest extent practical in the critical nesting period of late spring and early summer. This will be accomplished by reducing to a minimum disturbance in areas known from baseline surveys to have had occupied nests, e.g., the all-weather road to Contwoyto Lake. In practice, there will be no project-related reason to use this route during the spring and early summer east of the high explosives magazines which will be located approximately 1.5 km east of the open pit (see Map A, Appendix E). Further, there will be no project-related reason to employ low-level helicopter flights over nesting areas during this period. Regional exploration activities will be outside known raptor nesting areas at Jericho.

2.9.2.2 Principle #2 Individuals Show Variability In Their Response To Disturbance

A predominant finding of most wildlife harassment studies is that there is considerable variability in the response to disturbance between individuals and areas. These differences apparently result from differing genetic propensities of individuals, unique life experiences, and specific conditions such as vulnerability, body condition, and so on.

For the Jericho Project to protect individuals and populations at the sensitive end of the disturbance spectrum, management practices will err on the conservative side. It therefore follows that most raptors should be over protected. Wildlife viewing by Jericho employees proximate to raptor nesting sites will be discouraged.

2.9.2.3 Principle #3 Nest Failures In Several Subsequent Years Can Lead To Territory Abandonment

Experience has shown that failure of a nest or breeding territory in several consecutive years often leads to abandonment of the breeding territory and loss of the breeding pair to the population. This is particularly evident at marginal nest sites; ones providing minimal protection. Nest failure and loss of a single year's breeding effort is regrettable, but rarely of major significance to long-term population trends. However, loss of breeding pairs in low-density species like raptors can quickly lead to population decline. Much stricter controls must be placed on persistent, resident disturbances than on those occurring during a single season.

For the Jericho Project there are no marginal nest sites near the area of disturbance. Multiple nest sites have been located east of the proposed open pit in the Willingham Hills, thus affording nesting pairs a choice of nests if one site is unsuitable. Controls listed under Principle 1 should be adequate to protect nesting raptors at Jericho. On-going monitoring will determine whether this prediction is accurate and appropriate measures will be taken, if nesting raptors are negatively impacted by Project activities.

2.9.2.4 Principle #4 Approaches By Animals, Including Humans, Are Among The Most Severe Disturbances To Nesting Raptors

Raptors generally nest in cliffs or treetops as a means of providing their young protection from ground predators. This strategy is effective, but costly, with nest site availability acting to limit populations in many areas. Predation has exercised strong selective pressure on the reproductive strategy of raptors. This would appear to explain why raptors react so severely to approach from the ground by free moving animals.

Protective measures at Jericho will emphasize mitigating the proximity of free moving people near nests. Raptors will be provided protection from close proximity by viewers and photographers as a matter of priority.

2.9.2.5 Principle #5 Startling Nesting Raptors Leads To Worse Consequences Than A Deliberate, Gradual Disturbance

When startled, an incubating raptor leaps instantly from the nest. The sharp talons can puncture the eggs or slash the young. A progressively intensifying disturbance alerts the incubating bird gradually, allowing a gentler and safer exit from the nest.

Jericho Project employees (staff and contractors) will be educated not to attempt to sneak up on raptor nests. Use of blinds or hides in close proximity to nests will not be allowed. Low level flights by aircraft during critical nesting periods will be avoided.

2.9.2.6 Principle #6 Entering the nest near the time of fledging often leads to premature nest departure

During the last week or so as nestlings, severe disturbance at the nest often causes young raptors to jump out of the nest. This can cause death from exposure, predation, starvation, or from the fall itself.

Jericho staff will be discouraged from approaching nests during this critical period as discussed above.

The following specific mitigation measures will be implemented:

- All site personnel will be briefed on the sensitivity of raptors to disturbance especially during nesting. Site personnel will be required specifically to avoid direct disturbance (i.e. close approach) to known nests.
- Nest sites within 2 km of the road to Contwoyto Lake at Jericho will be monitored to assess their reaction to traffic (see Environmental Monitoring Plan, Appendix 3.3).
- Aircraft flight paths will be routed to avoid known raptor nest sites during the nesting season. Project staff will be briefed on the general location and sensitivity of nesting raptors and instructed not to approach within 500 m of active nests.
- Surface disturbance of foraging habitat will be confined to the minimum areas needed.
- Reclamation and revegetation efforts will concentrate on habitats having the highest biomass of prey species used by raptors, i.e. wetlands and areas peripheral to wetlands.

Rugged habitats suitable for cliff-nesting raptors are not continuously distributed across the tundra, and at least one species at risk (Peregrine Falcon) nests in the vicinity of the Jericho pipe. Should any impacts occur, they would be moderately significant. However, with careful attention to mitigation procedures, the significance of impacts should be no more than minor, and quite likely negligible, during the life of the Project.

2.9.3 Mitigation Measures – Waterfowl

There are no waterfowl staging areas close (within 10's of km) to the Jericho site. Small lakes in the general area may be used by waterfowl during the spring moulting, but moulting birds have not been observed on small lakes in the Project area over the five years environmental monitoring has taken place. Limited use of the lakes has occurred for nesting. The spill prevention, countermeasures and control plan includes contingencies against contaminants from accidental spills entering Carat Lake. Fisheries mitigation measures will protect aquatic habitats also used by waterfowl.

2.9.4 Mitigation Measures – Shorebirds and Gulls

Potential mitigation measures include the following:

- minimize the areal extent of surface disturbance, particularly wet meadow and esker habitats;
- minimize disturbance of beach shorelines adjacent to water bodies.

Gull or shorebird nests are not present in areas planned for Project developments; habitat loss or alteration are not expected for shorebirds.

2.9.5 Mitigation Measures – Song Birds

Mitigation measures include:

- minimize area of surface disturbance;
- reclamation and revegetation where feasible.

Significance of impacts is rated as minor in a local context, but would probably be negligible in a regional or larger context.

2.9.6 Small Mammal - Herbivores Mitigation Measures

Road kills will be kept to a minimum by limiting vehicle road speed and by according all animals the ”right-of-way” when encountered by vehicles of any size. In the event accidents occur that kill ground squirrels and hare, their remains will be collected immediately to avoid attracting scavengers that may associate human activity with food and then, in turn, risk themselves becoming road kills. The remains of all road kills will be destroyed by incineration. Records will be kept of all incidents as these are instructive on conditions that precipitated the accident in the first place. Hunting by mine workers at the minesite and camp will be prohibited.

2.9.7 Mitigation Measures – Muskox

Vehicle/wildlife accidents will be kept to a minimum by limiting vehicle road speeds and by according all animals the ”right-of-way” when encountered by vehicles of any size.

2.9.8 Mitigation Measures – Caribou

The distribution and density of caribou trails in the Project area and adjacent lands in relation to proposed Project facilities is shown in Figure 10 of the Environmental Effects Assessment on Wildlife Report (Appendix B.2.2). The effect of these facilities on caribou movements in the Project area is shown by the expected movement corridors drawn in Map B (Appendix E). While the site plan may facilitate unimpeded movement of large (>1,000) concentrations of caribou through the Project area, mitigation measures are available to further reduce the risk of unintended interactions between caribou and the Jericho Project seasonal mining activities.

The placement of the waste rock dumps south and east of Carat Lake will serve to deflect caribou movement around the mine workings. The effectiveness of these waste dumps may possibly be augmented by the deployment of low cost, low maintenance fences as described in studies by Gunn et al. (1998) at the Lupin Mine. It was found that rope festooned with ripstop nylon streamer flagging, spaced 30 cm apart, was an effective barrier to both passive and disturbance induced caribou movements. However, experience at EKATI™ (pers. comm. 2000) suggests such fences at that mine site are ineffective. While traditional knowledge suggests such fences are effective in deflecting caribou, a critical element is missing from the modern configuration – placement of people along the fence. Nonetheless, rope fences can be tried at Jericho, if it appears some additional deflection of animals is required. Any fencing program instituted will be done in consultation with DSD, Kugluktuk, and with Inuit elders of West Kitikmeot communities.

Fencing may be expected to be effective for directing caribou traffic during migration events, but not necessarily in the case of individual caribou or small bands (<10) that may take up temporary residence in the Project area for periods of a week or more during the snow free mining season. It may be impossible to avoid such caribou use inside the perimeter as the mine site will have a very low predator risk and may support local sites with lush growth due to an altered moisture regime. In this situation the nature of the risk faced by the animals in interactions with normal minesite activities and conditions will be examined and addressed. Hunting caribou at the Jericho Project site by mine workers will be prohibited.

Caribou migrating southward may be effectively directed around the airstrip by placement of large boulders at the north end of the strip. Pursuant to safety concerns and the availability of such boulders, this mitigation measure will be investigated.

The most common interaction will likely be road traffic, in which case caribou will always have the right of way. During the study by Gunn et al. (1998) at Lupin, caribou "(spent) more time bedded in open developed areas (airstrip/tailings)"... than on undeveloped (undisturbed) sites. The same can be expected at Jericho, where non-migrating caribou will use the airstrip, roads, pads, and waste rock dumps as resting locations. Implementing the principle that "animals have the right of way" will ensure that negative effects will be kept to a minimum. Individual non-migrating caribou will also graze within the mining activity perimeter. To reduce the risk of impact or injury at the perimeter of the pit (reacting to a blast for example), the pit perimeter will also be bermed as described above. The pit slope for the top two benches will be 45 degrees and the benches separated by a 10 meter horizontal berm; this is rather benign topography compared to the natural landscape of the Willingham Hills just 3 km east of the airstrip.

It will be necessary to protect Project-related structures from the effects of caribou traffic. The sedimentation ponds below the waste rock dumps will be low profile aggregate berms placed to collect run off from the rock piles. Those structures are at risk of damage from trampling by caribou during a mass movement through a constricted corridor. Effective caribou deflection devices will likely be required to maintain the integrity of the sedimentation pond berms; EKATI™ has found that chain link fences are the only effective measure to deflect caribou (EKATI™ pers. comm. 2000).

Effective site planning, possible deployment of deflector fencing, and ensuring that caribou have the right of way to local traffic will ensure that environmental effects of seasonal mining over the eight year life of the Jericho Project will be local, moderate, and negligible on the Bathurst caribou. These steps will also ensure that no consequential changes to the caribou harvest (for the herd to remain sustainable at historic levels) result from effects of the Jericho Project.

Construction and mine operation activities will be temporarily halted when safety of ungulates (caribou, muskoxen) and grizzly bears is threatened. Animals will be herded away from the danger zone, if possible, prior to resumption of work. Prior to daily blasting during the mining season, when open pit mining is taking place, the area within 600 m of the blast site will be swept and all large animals herded away, if required.

Habitat loss and alteration will be mitigated as follows:

- only the minimum land areas needed for each project component will be developed;
- random vehicular movement on the tundra will be prohibited; and
- reclamation and revegetation will be attempted on sites where there is some likelihood of success.

Miscellaneous accidental mortality will be reduced by fencing or other means to prevent caribou entry into sites where injury or mortality could occur.

2.9.9 Mitigation Measures – Fox

Foxes are skilful scavengers as well as predators, and so care will be taken to dispose of all food scraps from the camp mess and from bag lunches away from camp. Foxes can also become habituated to “handouts” and so that practice will be avoided to reduce interactions. Also, all food shipments to the airstrip or by winter road will be kept inaccessible to foxes or be attended while they are being stowed. Unattended food shipments can quickly be scavenged by fox and so invite a repeat visit to sites and objects with associated smells and aromas. Also any road kills will be disposed of by incineration immediately.

Foxes can also cause considerable damage to unoccupied camps by digging and chewing at buildings emanating food smells. Therefore a camp attendant will be present at times when mining and/or ore hauling are suspended. Also, trapping foxes at the Jericho site by mineworkers will not be allowed.

2.9.10 Mitigation Measures – Wolf

Little mitigation is needed for wolves, but the following items warrant attention:

- protection of caribou as per mitigation recommendations for that species;
- scrupulous waste management so that attraction of wolves is avoided;
- minimal destruction of esker habitats having potential for future denning; and
- avoidance of existing denning areas (none close to the Project footprint).

2.9.11 Mitigation Measures – Wolverine

Little or no mitigation is required for wolverines other than strict removal and incineration of road kills. Kitchen waste management practices will ensure that wolverines are not attracted to the site by food. On closure, to the extent practical, large run-of-mine rock on waste rock dump slopes will be rearranged so as to form potential den sites for wolverine. No attempt at den enhancement will be undertaken while waste rock dumps and/or the mine are active. Wolverines have not been problematic (and were uncommonly seen) during the nine years exploration camps have operated at Jericho.

2.9.12 Mitigation Measures – Grizzly Bear

The following measures will be implemented:

- A prompt road kill removal and timely garbage disposal program for all perishable camp refuse and garbage will be developed.
- Feasibility of use of an electric fence around the mine camp will be investigated.
- A bear response plan will be developed and all staff made aware of it. Notices of it will be posted at key points in camp, airstrip, and mine site. (This system has been effective at Lupin for many years.)
- Back-up incineration capacity for garbage and road kill disposal will be in place to ensure equipment failure does not compromise the overall effectiveness of the bear deterrent program at the Jericho Project camp and minesite. There are two incinerators presently at the existing exploration camp, each capable of handling kitchen waste from the 100 person camp. A dedicated incinerator will be installed for the production mine camp (Jericho Project Description, Appendix A.1)
- Hunting at the minesite by mineworkers will be prohibited.

- Disturbance of potential denning habitat will be minimized to the greatest extend feasible and should not be an issue as there were no dens identified in baseline studies near the Project site.

2.9.13 Caribou Transportation Impact Mitigation Measures

Interactions between caribou and all forms of Jericho Project transportation services and equipment will take place during the spring migration through late summer period (April to September). The experience at Lupin shows that accidental deaths to caribou as a result of these interactions can be kept to a minimum. The primary mitigation measure for containing the effects of surface transport will be to give wildlife the right of way at all times. Winter road oprations will be contracted to carriers that have many years experience on the Tibbot to Contwoyto winter road. These operations are subject to rigorous operating conditions, including spill contingency and response plans.

Several measures will be implemented for the Jericho Project:

- All trucks serving the Project will be equipped with radios so that drivers can alert each other to caribou (and other wildlife) either approaching or crossing the Project road network.
- Transportation will be suspended on segments of road (and airstrips) when a significant number of caribou are present. "Significant" should be a predetermined number; 2,000 is used by the Red Dog Project in Alaska (Delong Mountain Transportation Operating Plan - Road, no date).
- A thorough visual check will be made for caribou on and near the Jericho airstrip and pilots of all flights into the Jericho Project airstrip will be briefed on the status of caribou on/near the strip as is done at the Lupin airstrip.
- Caribou will be herded off the strip by appropriate techniques prior to aircraft landing or takeoff. Lupin Mine uses starter pistols or "bear bangers".
- All accidental deaths will be reported to the appropriate party(s) and removed for immediate incineration.
- The Jericho Project will participate with the Government of Nunavut and other governments and industrial interests in monitoring the response of caribou and the nature of caribou/truck interactions, in order to improve mitigation measures and winter road operating plans for all roads on caribou range.

Implementing these measures will ensure that road kills are avoided with no consequent effects on scavengers who would become at risk of a similar fate.

2.9.14 Rare/Endangered Species

There are no rare and endangered wildlife species expected at the Jericho Project site. Two species of management concern are the peregrine falcon and barrenland grizzly bear. Mitigation addressing concerns about Project interactions with these species was previously discussed.

2.10 AQUATIC EFFECTS MANAGEMENT

2.10.1 Potential Effects Causing Fish Mortality

The Department of Fisheries and Oceans (DFO) has specific guidelines for the screening of water intake structures for the protection of fish (DFO 1995a). The guidelines present design criteria that are intended to protect small fish, such as young-of-the-year and juveniles, from becoming entrained in the intakes. The criteria are based on fish length and water uptake volume per unit time, and are used to specify requirements for screen mesh size, water velocity, and surface area of the intake opening. Adhering to these criteria ensures that fish are not drawn into water intake structures. Tahera is committed to meeting these screening guidelines. In addition, the water intake structures will be placed at water depths that are outside the most important fish habitat zone (e.g., near shore rearing habitat). This measure will prevent destruction of critical fish habitat and will reduce the possibility of smaller fish encountering the intake structure.

Details of the water intake are discussed in the Project Description (Appendix A.1).

2.10.1.1 Use of Explosives

Open Pit

The Aquatic Impact Assessment Report (Appendix B.2.3, Attachment 4.1) discusses in detail effects of explosives use and the mitigation measures to be employed by Tahera to minimize any effect on fish in Carat Lake and the bottom end of Stream C1.

Based on the maximum weight of explosives that can be expected, only the *Peak Particle Velocity* guidelines for use of explosives will be exceeded in the lower section of Stream C1 and in Carat Lake. As there is the potential to exceed thresholds, an application will be submitted for authorization under Sections 32 and/or 35(2) of the Federal Fisheries Act for the use of explosives.

The predicted *Peak Particle Velocity* impact zone is estimated to be 225 m from point of the detonation (taken to be the edge of the open pit). Based on this critical radius, the lower section of Stream C1 will be affected; however, only a small part of the Carat Lake shoreline is within the critical radius.

Based on their habitat requirements, slimy sculpin is the only species that uses Stream C1 for spawning and egg incubation (Scott and Crossman 1973). Arctic grayling is the only other species residing in Carat Lake that could potentially deposit eggs in Stream C1; however, extensive inventories never recorded spawning Arctic grayling or incubating eggs of this species in this system.

Stream C1 Diversion

For the diversion ditch, a maximum of two sticks of powder will be used per hole. Three rows of holes will be drilled and powder inserted in the pattern of dice 5:

```
o       o       o
    o       o
o       o       o
```

Delay between detonations will be 25 milliseconds or longer. The diversion ditch will be constructed during winter and therefore lakes will contain ice. An analysis of the potential effects from pit mining were provided in RL&L's aquatic impacts report. The maximum effect of the explosives will be approximately one-fifth of that from mining the open pit. Based on that analysis, fish will not be impacted from explosives detonation for diversion construction.

There are a number of mitigative measures available to reduce the magnitude of the shock waves produced by the explosion (Munday et al. 1986). The most appropriate mitigation would be to reduce the total weight of explosives, or separate the total explosion into a series of smaller explosions (and weights) by increasing the detonation delay period between charges (Munday et al. 1986). *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998) recommend a minimum detonation delay period of 25 milliseconds (ms). To reduce the potential effects of explosives in the mine pit, Tahera will implement the following measures:

- there will be a detonation delay of 500 ms between each of the five rows of explosives; and
- there will be a detonation delay of 25 ms between each charge within each row.

Based on these mitigation measures, which correspond to the guidelines outlined in Wright and Hopky (1998), the maximum weight of explosive that may potentially affect fish is limited to an individual charge and will not exceed 227 kg.

2.10.1.2 Angling

Tahera proposes to implement a no angling policy in the vicinity of Carat Lake, as a condition of employment for the life of the proposed mine. This would entail a complete ban on angling in all water bodies (lakes and streams) except Contwoyto Lake, where Lupin Mine employees and possibly visitors presently angle. Small lakes within the Project footprint will be posted “No fishing” with multi-lingual signs.

Employees will be made aware of the policy upon engagement at the initial orientation meeting. The policy will apply to Inuit and non-Inuit employees alike. While the Nunavut Land Claims Agreement (1996) allows Inuit to hunt and fish at most locations in Nunavut, Section 5.7.17(b) of the NLCA excludes areas within one mile of any building, structure, or other facility on lands under surface lease, an agreement for sale, or owned in fee simple. The fishing ban would also likely be supported by Sections 5.1.4 and 5.1.5 which address conservation and the maintenance of the natural balance of ecological systems. The purpose of the policy is to conserve the fish stocks in small lakes on the Project site. Fishing pressure from mining crews could endanger fish populations in these lakes within a very short time (less than one season).

2.10.2 Loss of Fish Habitat

2.10.2.1 Permanent and Winter roads

Tahera will utilize standard mitigative measures during construction, operation, and closure of permanent and winter roads and will follow guidelines specified in *Fish Habitat Protection Guidelines - Road Construction and Stream Crossings* (DFO 1995b). For example, silt fences will be employed during construction of the permanent roads to prevent suspended sediments from entering the stream. If erosion potential exists, ditches will be armoured or routed to settling ponds that have been incorporated into the Project design.

2.10.2.2 Stream C1 Diversion

Tahera will implement erosion control techniques during instream construction and maintenance activities. The introduction of sediment can be minimized by utilizing several practices outlined in Furniss et al. (1991) and DFO (1995b):

- minimize the area of bank that is cleared during construction;
- work areas should be isolated from the stream by use of cofferdams, berms, etc.;
- employ isolation methods (i.e., work in dry channel), where practical, during construction of diversion channel;
- minimize siltation by opening the diversion channel at the downstream end first;
- diversion channel gradient at its terminal end should approximate those of the existing stream;
- if fill is required, use clean granular material for fill within the channel;
- ensure that pollutants from the machinery using the crossing do not enter the stream;
- where spawning fish are known to be present, timing constraints may be applied to in-stream work; and,
- implement temporary and permanent erosion control measures, where warranted, on the banks and approach slopes to watercourses.

To minimize the transportation of sediment and the length of the downstream impact zone, instream construction will be conducted during the winter at periods of base (zero) flow. Construction can also be timed to avoid stream spawning activities of slimy sculpins. For the first spring runoff season silt fences will be placed downstream of the energy dissipation pond to catch any unexpected sediment that may be carried downstream by water flowing in the diversion for the first time.

2.10.3 Reduction in Water Quality

2.10.3.1 Mine Effluent

Water management is discussed in Section 2.3.

2.10.3.2 Sewage and Greywater Disposal

The mining contractor will install sewage and grey water treatment systems of approved design prior to construction and operation of the mine as detailed in Section 2.4. As such, there will be no discharge directly to natural water bodies.

2.10.3.3 Processed Kimberlite Effluent Discharge

Water reaching the receiving environment from fine PK effluent discharge (Lake C3) is expected to meet receiving environment quality guidelines (CCME 1999) and will be non-acutely toxic to fish. Table 1.15 in the Environmental Impact Assessment Report (Appendix B.2.1) lists expected quality and pertinent guidelines.

2.10.4 Accidents And Malfunctions

2.10.4.1 Road Activities

There will be a network of permanent and winter roads in the Jericho Site, which will be used to transport a variety of items. The tonnage transported and the frequency of traffic will be much higher on the winter road; therefore, the potential for an accident or malfunction to occur is greatest during winter road activities.

Access to the Jericho Site during winter will include use of a winter road that extends from the Lupin Site. This route goes in a northerly direction across Contwoyto Lake, before turning west to traverse a 3 km section to the Jericho Site. The winter road in this section will cross three water bodies (Lynne Lake and Streams D1 and D2) and the small bay where the winter road intercepts Contwoyto Lake. Stream D1 is the drainage channel between Lynne Lake and Contwoyto Lake. It has extremely limited value as fish habitat due to the absence of a defined channel (RL&L 1997). However, it has been included in this assessment because a spill in this system could drain directly into Contwoyto Lake. After the first year an all-weather road will replace the winter road portion from Contwoyto Lake to the Jericho Mine site.

The Tahera winter road will be an extension of an existing route that has been in use since 1983 to provide transportation from Yellowknife to Echo Bay's Lupin facility. Based on statistics for the existing route from

Yellowknife (Diavik 1998), the Tahera route will operate from 50 to 76 days per year depending on climatic conditions. A list of major resupply items is contained in Table 8.4 of the Project Description (Appendix A.1).

A number of hazardous materials would be transported along the winter road. If an accidental spill occurred, Tahera's contractor would implement an established emergency response procedure to minimize the potential impact. All spills that are accessible would be properly collected and disposed. It is possible that some material would remain after clean up and could potentially affect fish, depending on the location and timing of the spill.

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, the number of incidents during the entire life of the Project would not exceed 0.003.

This information suggests that the likelihood of a spill occurring within the Jericho Site during the life of the project is extremely low.

2.10.4.2 Fuel Farm Spill

The planned fuel farm in the Jericho Site is situated adjacent to 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 will construct a containment system around the fuel farm that has a design capacity of 110% of the largest tank. Therefore, no fuel originating from the fuel farm spill would reach the aquatic system. Spill and emergency response plans have been prepared (Appendices D.2.4 and D.2.5, respectively). The plans address accidental spills of petroleum and other hazardous substances through preventative pre-planning, contingency measures, and controls should spills occur.

2.10.4.3 Structural Failure of Waste Rock Dump

The two waste rock dumps in the Jericho Site will be situated adjacent to fish bearing water bodies (Carat Lake and Lake C1). Structural failure of these dumps may allow rock and effluent to enter each lake. If this happens, fish could potentially be affected due to introduction of contaminants. Based on the project design, the probability of waste rock entering either lake as a result of structural failure is zero, as discussed in the Environmental Impact Assessment (Appendix B.2.1). Tahera's environmental 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. An integral part of this plan will be an effluent collection and treatment system. As such, no waste rock or effluent originating from structural failure of the dump will reach the aquatic system, so no potential adverse effects on aquatic biota would occur.

2.10.4.4 Failure of PKCA Dykes

Failure of PKCA dykes would result in the release of PK fines to the environment; this is a low probability event. The potential for impact would depend on the dyke that failed. Reference should be made to the site arrangement map for the following discussion (Map A, Appendix E).

Complete failure of the east end dyke could result in supernatant reaching Ash or Key Lake east of Long Lake. Key Lake contains fish and fish habitat which could be adversely affected. The kimberlite fines will not be high in metals content, however suspended solids will be above receiving environment criteria under a failure scenario. Sediment has the potential to affect both ability of fish to feed and spawning beds. As well, reduction in light could adversely affect phytoplankton production which, in turn, could ultimately affect food availability for fish. If solids levels are extremely high, fish might also suffer some gill abrasion. If SRK's test results on pilot tailings water are a reflection of operating fine PK supernatant water, ammonia could also be elevated and might occur in toxic concentrations in the lake chain east of Long Lake.

Failure of the west dam would result in fine PK spilling into the polishing pond and the water from the polishing pond being displaced over the polishing pond dam and flowing down Stream C3 to Lake C3. Suspended solids are less likely to be problematic under this scenario. Depending on the amount of water suddenly released from the polishing pond this may or may not adversely affect fish in Lake C3. Erosion of the stream channel may lead to high suspended solids levels in the water flowing into Lake C3. This sediment would be coarser than kimberlite fines and would settle relatively rapidly and close to the mouth of Stream C3.

Failure of the polishing pond dike would result in the sudden release of polishing pond water. Depending on the amount of water release some erosion of the stream channel may occur. Again sediment may be eroded and settle in Lake C3, which could affect both fish feeding and spawning beds.

Management

Dikes will be keyed into bedrock, will be lined or grouted depending on ground conditions, and will not depend on permafrost to function. Management of tailings dikes will include routine inspections on at least a weekly basis by processing plant staff and yearly inspections by a qualified geotechnical engineer. Seepage from the dams would be addressed in a manner appropriate to the situation; at a minimum seepage will be pumped back to the PKCA, or polishing pond, as the case may be. As is normal practice with tailings dikes, fine PK will be spigotted against the upstream dam faces to ensure water in the impoundment does not rest directly against dikes. This management procedure will not apply to the internal dike.

3.0 MANAGEMENT OF RESIDUAL EFFECTS

Residual effects will occur at various time scales throughout the mining phases of construction, operation, closure, and abandonment. Effects will be temporary, except for those remaining on abandonment. Temporary effects have been previously discussed. The principal methods available for management of residual effects are:

- reduce residual effects to the greatest extent possible by Project design;
- for habitat-related residual effects, rehabilitate habitat as soon as possible upon cessation of activities affecting the habitat; and
- employ adaptive management principles, whereby effects are monitored and management plans modified as practical to address unexpected harmful changes in the receiving environment.

3.1 ESKERS

There will be considerable residual impact on vegetation within the development footprint, but the area affected will be small. Eskers should be capable of being successfully revegetated and are expected to reach their pre-mining level of productivity, although, based on experience elsewhere, this recovery may be decades in length (15 to 40 years; Truett and Kertell 1992). Principal management procedures for eskers will be to minimize disturbance and reclaim disturbed areas as soon as possible once they are no longer active. Erosion will be minimized by ensuring no steep, easily erodable slopes are left at the end of disturbance.

3.2 WETLANDS

It will not be possible to restore wetlands to their original condition. Their loss must be considered a residual impact. A potential area of 44 ha of wetlands and birch meadows could be affected by the Project. The birch seep area, which will become Waste Rock Dump 1, has a number of small meadows which will be lost. There are a lesser number of small meadows where Waste Rock Dump 2 and ore stockpiles will be located. Management procedures will involve minimizing the disturbance footprint.

3.3 DRY BARREN AND ROCKY TUNDRA

There will be residual impact on these ecotypes at the mine area, due to the impracticality of completely restoring severely disturbed habitats. This habitat forms part of the feeding habitat for caribou and muskoxen, nesting and feeding habitat for upland and song birds, feeding areas for small mammals, and hunting areas for raptors. In total, up to about 130 ha of this habitat will be affected.

With respect to residual effects on caribou, it should be noted that the entire 220 ha footprint of the Jericho Mine is 0.0008% of the total distribution range of Bathurst Caribou, and that no critical uses such as calving or wintering occur at, or near, the project site. Habitat avoidance could involve 10 km^2 of habitat (0.004% of the Bathurst range), but would not be a residual impact.

Muskoxen do not overwinter on Contwoyto Lake, but apparently move further north, such as to Victoria Island, or to areas on the mainland where wind keeps snow cover off grazing areas. There should therefore be no additional residual effects on muskoxen above those predicted for caribou.

The equivalent to rocky tundra habitat will be created by the waste rock dumps, but these areas will remain unvegetated for many years and will thus not equal the productivity of pre-existing rocky tundra. The management procedure for rocky tundra will be to keep disturbance to a minimum.

3.4 LAKES

Long Lake and three small ponds adjacent to Long Lake will be used for the PKCA. All but the small pond to the west of Long Lake would eventually hold fine PK solids; the small western pond will remain as a polishing pond and only hold water. Thus these lakes, except the small west lake, would be permanently removed from lake habitat. A total of 11 ha of lake would be removed. The PKCA will be reclaimed to dry land; the polishing pond will remain a small lake. Over time, since moisture will accumulate in the basin, the area may revert to wetland thus providing a net gain in wetland equivalent to the loss of lake area. There is no practical mitigation for the loss of this lake area.

3.5 GRIZZLY BEAR HABITAT

Potential impacts on grizzly bears can almost entirely be mitigated. Exceptions include habitat avoidance during the life of the mine, and any permanent habitat loss or degradation. However, these effects should be minor. Permanently altered areas occupied by the mine will be limited to the open pit and waste rock dumps. The waste rock dumps could be used by grizzly bears in much the same way as is rocky tundra. The pit will be permanently alienated as grizzly bear habitat, but is a very small fraction of the normal range of the grizzly bear. Other potential project impacts are expected to be negligible.

3.6 SMALL MAMMAL HABITAT

Some effects of mining may be residual, depending upon the extent and success of reclamation programs. The available surface area equivalent to rocky tundra will increase after mining with the addition of the sides of the waste rock dump (minus the difference between the top and the footprint of the dump which will cover existing tundra habitat).

3.7 RAPTORS AND RAPTOR HABITAT

Residual impacts should be minor, if project activities do not cause nest abandonment.

3.8 SHOREBIRD HABITAT

There will be some permanent loss of habitat, depending on the extent and success of reclamation. As well, Long Lake shoreline will be lost as habitat for a total of 3.67 km, including the two adjacent small ponds that will be filled. Because of the rocky terrain less than one tenth of the shoreline that will be lost is currently useable shorebird habitat for nesting (see Map C, Appendix E).

3.9 OPEN PIT

Given the realities of climate in the Jericho Project region, it is unlikely that the open pit can be revegetated. Creation of a lake in the pit area will be investigated and discussed with NWB, DFO, and DIAND Water Resources. The most likely scenario to be considered is natural flooding of the pit, which would occur by re-directing runoff in the drainage basin and part of the stream C1 flow back through the pit. Use of excess flows from Stream C1 might be accomplished by means of a weir that allowed water, surplus to maintenance of downstream fish habitat, to flow into the open pit. Once the pit filled and water was of acceptable quality, the pit outflow would connect to stream C1 and the pit could provide some additional fish habitat.

3.10 WASTE ROCK DUMPS

The waste rock dumps will form relatively small (compared to the Willingham Hills) hills of rock where flat tundra previously existed. The dump tops may be revegetated, but the slopes are unlikely to be successfully revegetated. While flat tundra habitat will be lost, perching (and possibly nesting) habitat for raptors will be gained (hawks have occasionally been observed hunting on the rocky tundra near the exploration camp). As well, spaces in the rocks will provide shelter for small mammals, although the waste rock will not likely be suitable for burrows or den sites.

3.11 WATER INTAKE

The water intake will cover an area of 1,400 m^2 of Carat Lake bottom from shore to approximately 5.5 m depth (see Map A, Appendix E). The causeway should not need to be more than 90 m long. Some habitat replacement will result from the rock fill on the sides of the causeway (estimated at 600 m^2). The remainder of the area will be lost. As well, the replacement habitat (rocky substrate) will be different from that lost (typical lake bottom sediments, or fines). The rocky substrate will serve as feeding and shelter habitat, but not likely as spawning habitat. Thus a small amount of shallow spawning habitat nearshore in Carat Lake will be permanently lost (estimated at less than 750 m^2). Compensation for loss of habitat is the proposed mitigation. Details of this compensation will be developed in negotiations with DFO. Tahera's proposed compensation is outlined in Section 4.

4.0 FISH HABITAT COMPENSATION

This section contains a summary of the fish habitat compensation proposal for the Project. The complete proposal is contained in Attachment 4.1. The proposal must be viewed as conceptual at present, as it is prior to detailed engineering.

Tahera has used a structured approach to achieve a habitat compensation plan that meets the requirements of DFO. Fish habitats affected by specific Project activities were identified and the effectiveness of proposed mitigation measures evaluated. Where Project effects could not be fully mitigated and there was a harmful alteration, disruption, or destruction (HADD) resulting in the need for compensation, affected habitats were quantified and characterized in terms of their importance to fish.

Project activities will impact 2,153 m^2 of fish habitat in four locations. These include: the access ramp on Contwoyto Lake (150 m2); the water intake causeway on Carat Lake (1395 m^2); introduction of suspended sediments during construction and maintenance of the diversion into Stream C1 (387 m^2) and Carat Lake (40 m^2); and altered flow of Stream C3 from the PKCA (181 m^2). The majority of these areas were characterized as rearing habitats for fish residing in the affected water bodies, although spawning and feeding habitats were also affected. A fifth Project activity, construction of the PKCA, will remove water bodies in the Long Lake System from production, which represents 92,500 m^2 of marginal habitat.

The compensation proposed by Tahera is based on the type of habitat affected and the availability of habitat compensation opportunities. The proposed compensation plan is conceptual, but is technically feasible. Tahera acknowledges that detailed design specifications are required before implementation. The compensation plan adheres to the no net loss principle and the need to maintain habitat productive capacity as recommended by DFO. The plan's fundamental goal is to ensure the long-term viability of the fish community in the Project area.

Compensation targeted habitats thought to be limiting fish populations in the Project area. The compensation plan proposed for the Jericho Diamond Project used two approaches to achieve this goal: creation of habitats similar to those that were impacted in the same or adjacent water bodies (Habitat Enhancement); and improving access to habitats similar to those that were impacted in adjacent water bodies (Improved Access).

4.1 HABITAT ENHANCEMENT

Habitat enhancement will entail construction of high quality spawning, rearing, and feeding habitats in lakes and streams. The species and life stage targeted by the enhancement are those that are affected by the Project. The primary target species are Arctic grayling, Arctic char, lake trout, burbot, and slimy sculpin. In lakes, enhancement will provide sheltered areas that promote warmer water temperatures and increased food production, which can be used as rearing habitats for young-of-the-year and juvenile fish. Lake sites will provide shelter to small fish from larger predators, as well as provide spawning habitat for slimy sculpin. The perimeter zones of enhanced lake sites will provide feeding habitat for larger adult fish. Stream enhancement will focus on creation of high quality rearing habitat for all species and spawning habitat for Arctic grayling.

Habitat enhancement will target four locations within selected lakes and one stream that presently contain limited amounts of these habitats. These include the perimeter of the causeway, the southeast shore of Carat Lake, as well as Lakes O1 and O2 and Stream O9, which are situated to the north of the mine site.

Enhanced areas will be constructed using large rock materials available from the mine site. In lakes, rocks will be placed on the ice in winter over discrete areas of selected lake shorelines. In Stream O9 boulder clusters can be placed in the channel. In addition, small gravels used as spawning substrates can be distributed on the channel bottom in select locations. The proposed habitat enhancement will create 2,790 m^2 of high quality habitat, which will compensate for most of the habitats impacted by the Project.

4.2 IMPROVED ACCESS

The proposed habitat enhancement is not sufficient to address the impacts on the Long Lake System caused by construction of the PKCA. Short of creating a new lake, the large amount of compensation would be extremely difficult to achieve through creation of new habitat. These constraints necessitate use of a novel approach to compensation.

Access to critical habitats may limit the productive capacity of fish populations in the Project area. There are opportunities to improve fish access between water bodies; therefore, barrier removal has been put forward as a compensation option. The barriers of interest are located in the ‘O’ series of lakes situated north of the mine site. The fish community in this drainage is, in part, affected by the lack of ease of fish movement between the lakes via the interconnecting streams.

The two barriers targeted for compensation are a cascade on Stream O18 and a shallow ill-defined section of Stream O21. Eliminating these barriers would improve fish access between several water bodies, increase the availability of important habitats to fish, and prevent stranding of fish in unsuitable areas. Removal of the barriers is technically feasible, but the exact approach to be used has not been finalized. If both barriers were removed, 317,000 m^2 of habitat in three lakes and 695 m^2 of habitat in 5 streams would become available. The gain in habitat by improving access could be used to offset the loss in habitat caused by construction of the PKCA.

5.0 ENVIRONMENTAL TRAINING

In this section "training" refers to environment-related training.

5.1 PURPOSE AND SCOPE

The purpose of environmental training is to identify, provide, and track environmental training that will help employees to minimize impacts.

This procedure covers the identification of training requirements for all employees in the organization and the types, methods, and frequency of environmental training.

5.2 RESPONSIBILITIES

Training needs will be identified by the environmental department. The responsibility for training will be determined in consultation between the environmental manager and plant manager. Training will be done by the environmental department or outside vendor. Overall responsibility and tracking of environmental training is the responsibility of the environmental department.

5.3 IDENTIFICATION OF ENVIRONMENTAL TRAINING NEEDS

Since a number of key activities will be carried out by contractors, training needs will be assessed and training programs developed in cooperation with contractors, which include:

- open pit mine contractor (Years 1 to 5);
- explosives contractor (Years 1 to 4);
- underground mine contractor (Year 5 to 7);
- catering contractor (Years 1 to 9).

Everyone at the Jericho Diamond Mine will be trained on the environmental policy, significant environmental impacts of their work activities, key Environmental Management System (EMS) roles and responsibilities, procedures that apply to their activities, and the importance of conformance with EMS requirements.

As well, Tahera Corporation will work cooperatively with Kitikmeot Employment and Training Partners (KETP) to ensure that basic, general information on impacts and mitigation measures available to the individual are taught to all potential employees taking KETP-sponsored training programs.

A number of training programs mandated by legislation governing operation at the mine will also address environmental issues. These include: Mine Health and Safety Act, Transportation of Dangerous Goods Act [TDGA], and Work Place Hazard Materials Information System. Observance of practices outlined by these regulations substantially increases the effectiveness of pollution and environmental accident prevention.

Initial orientation training of employees will include the site-specific measures Tahera Corporation will implement to prevent, or reduce to the greatest extent practical, environmental impacts, as discussed in previous sections. Orientation training will include both mine site wide and job specific items. Employees working in areas that have the potential for large environmental impacts will be made aware of their special responsibilities and that their job performance will be partly rated on how effectively they implement EMS procedures in their work.

5.4 IDENTIFICATION OF LAWS AND REGULATIONS REQUIRING TRAINING

A large number of laws govern mining activities. The most important from a job action point of view are those that regulate activities that can affect the environment in which the mine is situated, i.e., the land, water, and air. The EMS has been developed to manage activities so as to eliminate, or minimize to the greatest extent practical, environmental impacts. Since the EMS requires active, knowledgeable participation by employees and will benefit from suggestions coming from employees, a key component of environmental training will be imparting an understanding to each employee what EMS procedures affect their daily work and potential impacts if these procedures are not followed. Both legal liability and environmental integrity aspects will be examined. Table 5.1 provides a partial list of key regulations and the aspects of the environment they are designed to protect or the job activities they regulate.

5.5 PROVIDING THE TRAINING

Adequate resources will be made available to provide the training identified. Some training will be provided by certified trainers, such as first aid and CPR. The training will be provided within a certain period of time from hiring and some annual refresher provided as well. The environmental training will be provided by a variety of resources, depending on size and type of employee body. When the population of employees needing the training is smaller it will be done by the environmental manager. Other training, such as TDGA, will be provided by consultants.

5.6 TRACKING THE TRAINING HOURS

To show compliance with the laws mentioned above the training hours will be collected and tracked. In addition to name, the employee's social security number, job title, job description, and training requirements will be kept in the file. Total training hours by category will be calculated and reported to management. Hours per employee will be determined to ensure that goals are met. If practical, a computer database that matches employee name and job code with required training will be used. A printout would then show whether the particular employee is adequately trained and current.

6.0 COMMUNICATION

6.1 INTERNAL

This section describes Tahera Corporation's processes for internal communication on various elements of the Company's EMS, including the environmental policy and the EMS objectives.

6.1.1 General Procedures

The plant manager is responsible for communicating the organization's environmental policies and procedures to all employees. The plant manager is also responsible for communicating roles and responsibilities for environmental management. Since the mining part of the operation will be run by a contractor, arrangements will be made with the mining contractor to conduct joint internal environmental communications sessions.

Environmental targets for functional areas (i.e. processing plant and mining operations) will be communicated separately by the plant manager and mine operating superintendent, respectively. The plant manager and mine operating superintendent are also responsible for communicating environmental procedures (and any changes to the procedures), results of accident and "near miss" investigations in their areas (see the Occupational Health and Safety Plan, Appendix C.2), and other significant environment-related information (such as up-coming training classes).

The responsible manager will select the most appropriate mechanism(s) to be used for internal communication; these may include one, or more, of the following:

- site-wide employee meetings;
- area environmental meetings;
- workstation procedures;
- bulletin boards and posters;
- memoranda and employee letters; and
- newsletters.

6.1.2 Hazard and Emergency Reporting

All employees are responsible for reporting environmental or health and safety hazards (see also Appendix C.2) or emergencies, including spills and fires (see also Appendices D.2.4 and D.2.5) immediately upon discovery. Such hazards are to be reported to the plant manager or mine superintendent. If necessary, such hazards must also be reported to the appropriate emergency contacts as identified in the emergency response procedures (see the Jericho Project Spill Prevention, Countermeasures and Control Plan, Appendix D.2.4).

If the area manager (plant manager or mine superintendent) are not available, employees report environmental or health and safety hazards to their supervisor.

Tahera's environmental manager will maintain a log of all reported environmental or health and safety hazards. The environmental manager will track the investigation and correction (as needed) for all reported hazards.

Communication of the results of investigating/correcting reported hazards is the responsibility of the plant manager or mine superintendent.

Emergency response procedures are described in Appendix D.2.5.

6.2 EXTERNAL

This section describes how Tahera Corporation receives, documents, and responds to communications from external parties. As well, it discusses proactive steps that Tahera Corporation takes to maintain a meaningful dialogue with external parties on environmental matters.

6.2.1 Interested Parties

By interested parties is meant individuals or groups with an interest in the environmental impacts of Jericho's activities. A list of parties identified through the approvals and permitting processes is provided in Table 6.1.

6.2.2 Outreach to Interested Parties

On an as-needed basis, Tahera Corporation solicits the views of interested parties on its environmental management system, its environmental performance, and other related matters. Specifically, these items are discussed at periodic community liaison committee meetings. In particular, such outreach is conducted when significant changes at the facility are being considered, such as facility expansion or other actions that might affect the actual or potential environmental impacts of the organization's products, activities, or services.

As part of the management review process, the team designated to conduct the review evaluates proactive efforts to communicate with external parties. Based on this evaluation and other factors, Tahera Corporation's management determines the need for outreach with external parties in the coming year and how such communications can be carried out most effectively.

7.0 CHECKING AND CORRECTIVE ACTION

The environmental monitoring program will be the principal tool used to check predictions made by the environmental impact assessment and the effectiveness of the EMP in preventing pollution and reducing residual effects. Annual evaluation of the EMP will provide a formal measure of its effectiveness. Following recommendations from annual reviews and at other times where environmental issues arise, appropriate corrective action will be taken and actions documented. Certain expenditures of funds may require approval of senior management.

Triggers for corrective action will include, but not necessarily be limited to:

- non-compliance with regulations governing the Mine operation;
- occupational health and safety-related issues;
- degradation in performance of environmental indicators, e.g. sedimentation pond or receiving environment water quality;
- issues raised at community liaison committee meetings that can be reasonably resolved by changes to the EMP;
- recommendations from government inspectors and outside consultants that can be reasonably resolved by changes to the EMP.

8.0 AUDIT AND CONTINUAL IMPROVEMENT

Despite careful planning, it is highly probable that certain components of the EMP will need to be modified. It will therefore be necessary to audit or review the plan to pinpoint those components that need to be corrected, adjusted or upgraded. Not only the operational aspects of the plan, but any paperwork that deals with the plan will be reviewed. A goal will be to continuously audit all aspects of the plan for effectiveness. In general, the ISO-14001 protocols will be followed.

Throughout the mine life, as policies and regulations change and technology advances, the EMP will be modified to address changes and to benefit from technology advances where benefits can be clearly demonstrated. The number one objective will always remain maintaining compliance with regulations governing the Project.

Formal evaluations of the EMP will be documented, deficiencies noted in the report, and progress in addressing deficiencies tracked in writing. Responsibilities to address deficiencies and accountabilities will be assigned and deadlines for addressing required changes will be set. The Jericho Mine site supervisor (mining contractor or Tahera employee, to be determined) will assume overall responsibility for the process; authorization for expenditures may be required from other management personnel.

8.1 PURPOSE

The purpose of Tahera's auditing and continual improvement program is to continuously improve the environmental management and control systems in order to minimize impacts to the environment.

8.2 RESPONSIBILITIES

It is the responsibility of the environmental department to conduct the audits or to arrange for a third-party audit. The environmental manager will arrange contracting with third-party auditors.

The operation departments have the responsibility to promptly correct audit findings or provide documentation as to why an audit correction is not necessary.

8.3 PROCEDURE

8.3.1 Schedule and Purpose

The environmental manager will schedule the audit date with the Jericho Mine in consultation with the plant manager and the mine superintendent and will alert them to the purpose of the visit.

8.3.2 Continual Improvement of Audit System

It is important to adjust the audit checklist to ensure that it is meaningful and comprehensive. The audit team composition and other components of the entire audit system may need to be adjusted.

8.3.3 Corrective Action Procedure for Noncompliant Items

When action items are noted during an audit they will be corrected quickly. In order to make sure correction is done quickly and efficiently, the following procedure will be followed:

8.3.3.1 Identification

The first obvious step is to identify the action that needs correction.

8.3.3.2 Method of Correction

The suggested corrective action may include an action plan including possible solutions.

8.3.3.3 Transmittal

The corrective action required will be sent to the party who is responsible for implementation of the correction. There may be many people who actually correct a finding, therefore one person with overall responsibility for correction will receive the notice.

8.3.3.4 Followup

The environmental manager and site managers are responsible for followup to ensure that the correction has been completed. Depending on the item, this may require another site visit, a call and/or several memo reminders. The frequency of the follow-ups is determined by the seriousness of the deficiency.

8.3.3.5 Continuous Improvement

It may be necessary to change an overall system or procedure that may affect several sites. The audit procedure itself may need to be changed.

8.3.3.6 Audit Documentation

The audit report plus follow up data and reports will be filed on site and with the environmental manager.

8.3.4 Audit Reporting Procedure and Management Review

The findings and recommended corrective actions from audits will be relayed in writing to the environmental manager.

Management will use the audit findings to their full extent. This is valuable information that can help the organization improve. Targets, objectives, and policies may be adjusted based on the audits. When and if this is done, the site management must be involved.

8.3.5 Continual Audit Improvement

After the programs, process, and plans discussed are implemented they will be continually improved. The improvement would be based on data obtained, audit results, and other types of feedback available. The audit program will be reegineered or continually adjusted based on output and input from other systems.

9.0 TECHNOLOGICAL CHANGE

Mining, as with most resource industries, is very capital intensive. Given that reality, it is not practical for a mining operation to change major infrastructure or methods of mining and processing to reflect the "state-of-the-art" every time the state changes. As well, in the harsh Arctic environment, the prudent operator will stay with proven technologies that have extensive track records in the Arctic, which state-of-the-art would not.

Open pit and underground mining techniques, as well as diamond processing, will be chosen at the commencement of mining and are unlikely to change significantly throughout mine life, especially given the timeframe for the Jericho Project – to do so would be prohibitively expensive.

However, improvements in equipment that are found to be successfully applied to Arctic environments may be implemented at the Jericho Project, at the discretion of contractors for the mining operation and Tahera senior management for the Project. Cost-benefit analyses will be fundamental to any consideration of equipment change. Improvements in equipment are reported in trade journals, which will be followed by Jericho mine site management.

Two areas that will be closely monitored for technological improvements will be advances in Arctic reclamation, especially the experience at other Canadian Arctic mines, and tailings impoundment management, the latter through contact with consulting geotechnical engineers for the Mine. As discussed elsewhere, annual inspections of the PKCA dams by qualified geotechnical engineers are expected to be required under the Mine's water licence. Where changes in PKCA management make sense, they will be considered for implementation by Tahera senior management; discussions with regulators may be required as part of these considerations. Professional third party evaluations are also likely to be considered.

As discussed in Section 8, Audit and Continual Improvement, where environmental management practices for Arctic mines make proven advances, those practices will be reviewed for their appropriateness and adaptability to the Jericho Diamond Mine. This review will be the responsibility of the mine's environmental manager, who will maintain an environmental control database from information obtained principally from other Arctic mine operations, but also the published and unpublished environmental management literature.

Tahera's programme to monitor developments in technology will consist of an integration of all of the above.

10.0 FEASIBILITY AND COSTS OF MITIGATION

10.1 FEASIBILITY

All mitigation measures proposed are proven management techniques used successfully at other mines, with the exception of revegetation tests. All of the technologies are mature and have a track record of success at other mine sites. Tahera Corporation will be conducting reclamation trials to determine under what circumstances vegetation will grow successsfully at the Jericho site. The EKATI™ Mine has been successful in estabishing vegetation on tailings and other surfaces and, since the mine has at least six years head start on the Jericho Project, their progress with revegetation will be followed by Tahera. While the mine is 135 km south of Jericho, the climate is essentially identical with only a negligibly longer growing season. The environmental manager in conjunction with the mine manager will be responsible for the implemention of mitigation measures. Timeline will follow that of the mining operation.

10.2 COST

Cost estimates for mitigation measures proposed have been incorporated into the feasibility study conducted by SRK, which concluded that the project is economic as proposed. Since most mitigation measures are built into the mine design, changes in the economics of the project once it commences operation will have a limited effect on the economics of the proposed mitigation. Reclamation is an exception, since much of the reclamation cannot take place until mine closure, the principal exception being reclamation associated with the open pit and waste rock dumps. However, reclamation will still be carried out should Tahera become insolvent because of the provision of a reclamation bond for the project.

REFERENCES

Canadian Council of Ministers of the Environment (CCME). 1999. Canadian Water Quality Guidelines Prepared by the Task Force on Water Quality Gu idelines of the Canadian Council of Ministers of the Environment. Water Quality Objectives Division, Water Quality Branch, Inland Waters Directorate, Environment Canada, Ottawa, Canada.

Cascio, J., G. Woodside and P. Mitchell. 1996. ISO 14000 Guide. The new international environmental management standards. McGraw Hill. 221pp.

Chilibeck, B. 1992. Land Development Guidelines for the Protection of Aquatic Habitat. Department of Fisheries and Oceans, Ministry of Environment, Lands and Parks.

Cohen, S.J., T.A. Agnew, A. Headley, P.Y.T. Louie, J. Reycraft, and W. Skinner. 1994. Climate Variability, Climate Change and Implications for the Future of the Hudson Bay Bioregion. Environment Canada, Atmospheric Environment Service, Downsview, Ont.

Delong Mountain Transportation. nd. Delong Mountain Transportation System Operating Plan - Road: Caribou monitoring program.

DFO. 1995a. Freshwater Intake End-of-Pipe Screen Guideline.

DFO. 1995b. Fish habitat protection guidelines - road construction and stream crossings.

Diavik 1998. Environmental Environmental Impact Statement.

EKATI™ Diamond Mine. 2000. Personal Communication.

Environment Canada. 1991a. The State of Canada's Environment.

Environment Canada. 1991b. Canadian Climate Board. Climate Change and Canadian Impacts: The Scientific Perspective. AES, EC Climate Change Digest 91-01, Ottawa.

Furniss, M.J., T.D. Roelofs, and C.S. Yeel. 1991. Road construction and maintenance. Pages 297-323. In: Influences of forest and rangeland management on salmonid fishes and their habitats. Ed. by W.R. Meehan. American Fisheries Society Special Publication 19, Bethesda, Maryland.

Geological Survey of Canada. 2000a. Permafrost and Climate Change. sts.gsc.nrcan.gc.ca/permafrost/climate.htm.

Geological Survey of Canada 2000b. Permafrost and Climate Change Studies. sts.gsc.nrcan.gc.ca/peremafrost/suppdoc.htm.

Gunn, A., J. Dragon, S. Papik, D. Panayi, M. Svoboda and M. Sutherland. 1998. *Summer behaviour of Bathurst caribou at mine sites and response of caribou to fencing and plastic deflector*. (July 1997). manuscript report to the West Kitikmeot / Slave Study. 14pp plus appendices.

Harris, S.A. 1987. Northern Perspectives 15: 7-9.

Maxwell, B. 1992. Pp 11-34, In: F.S. Chapin III, et al. (eds). Arctic Ecosystems in a Changing Climate - An Ecophysiological Perspective. Academic Press, NY.

Munday, D.R., G.L. Ennis, D.G. Wright, DE.C. Jeffries, E.R. McGreer and J.S. Mathers. 1986. Development and evaluation of a model to predict effects of buried underwater blasting charges on fish populations in shallow water areas. Can. Tech. Rpt. of Fisheries and Aquatic Sciences, No. 1418: 49 p.

RL&L. 1997. Jericho Diamond Project Aquatic Studies Program (1996). Report prepared for Canamera Geological Ltd. RL&L Report No. 501F.

Scott, W.G., and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184.

Shank, C. 1988. *Guidelines for mitigating harassment of nesting raptors.* Unpublished manuscript dated 88/11/07; Department of Resources, Wildlife and Economic Development, Government of the NWT. Yellowknife.

Sparling, pers. comm. 1999. GNWT RWED, Yellowknife.

Truett, J.C. and K. Kertell. 1992. Tundra disturbance and ecosystem production: implications for impact assessment. Environ. Manag. 16: 485-494.

Williams, P.J. 1979. Pp 1-98, In: D. Davidson and J. Dawson (eds). Topics in Applied Geography.

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rpt. of Fish and Aquat Sci. 2107.

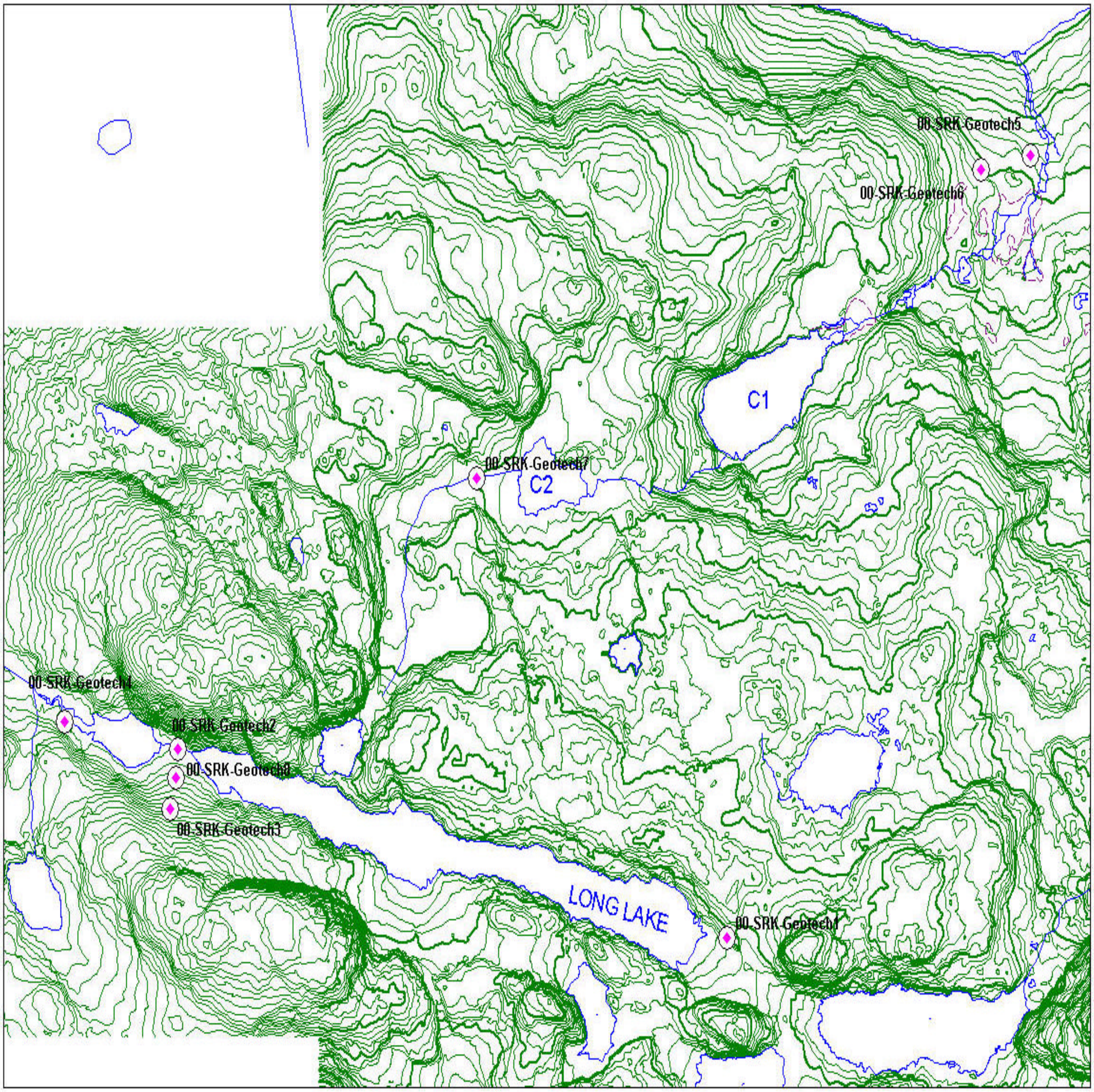
Tables

TABLE 5.1 KEY LEGISLATION GOVERNING MINING IN NUNAVUT	
Legislation/Regulation/ Guidelines	**Aspect Governed**
Mine Health and Safety Act	Workplace health and safety
Transportation of Dangerous Goods Act	Safe handling of dangerous goods
WHMIS	Safe handling of hazardous substances
Fisheries Act	Protection of fish and fish habitat
NWT Waters Act	Protection of water quality
NWT Lands Act	Protection of terrestrial and aquatic habitat
Nunavut Land Claims Act	General provisions that address environmental integrity
CCME Environmental Quality Guidelines	Canadian air and water quality

TABLE 6.1 JERICHO DIAMOND PROJECT INTERESTED PARTIES		
Name	**Affiliation**	**Interest**
NIRB	Nunavut Government	Regulator
NWB	Nunavut Government	Regulator
KIA	Designated Inuit Organization	Land Lord
DSD	Nunavut Government	Advisor
CLEY	Nunavut Government	Advisor
HSS	Nunavut Government	Advisor
CGT	Nunavut Government	Advisor
NPC	Nunavut Government	Land Use Plans
DIAND	Federal Government	Regulator/Land Lord
DFO	Federal Government	Regulator
NRCAN	Federal Government	Regulator
CCG	Federal Government	Regulator
EC	Federal Government	Advisor
TC	Federal Government	Advisor
HC	Federal Government	Advisor
WCB	NWT Government	Workplace Safety
MVEIRB	NWT Government	Transboundary Issues
HTAs	Inuit Hunters' Representatives	Resource Use
Hamlets	Municipal Government	Community Reps
Yellowknifes Dene	First Nations Band Council	Cumulative Effects

ATTACHMENTS

ATTACHMENT 2.1
GEOTECHNICAL DRILL PROGRAM RESULTS



00-SRK-Geotech5
00-SRK-Geotech6
C1
00-SRK-Geotech7
C2
00-SRK-Geotech4
00-SRK-Geotech2
00-SRK-Geotech8
00-SRK-Geotech3
LONG LAKE
00-SRK-Geotech1

BOREHOLE LOGS FOR SEPTEMBER 2000 GEOTECH DRILLING PROGRAM - JERICHO PROJECT				
BH No.	**Location (UTM, Nav 27)**	**Depth (ft)**	**Depth (m)**	**Log**
00SRKGeotech 1	477499E 7318460N	0 - 0.7	0 - 0.2	Organics
		0.7 - 10	0.2 - 3.05	Silty sand till with minor gravel (<10%)
		10 - 15	3.05 - 4.6	Increased gravel & cobbles in silty sand matrix
		15 - 25	4.6 - 7.6	As previous, poor recovery, silty sand matrix
		25 - 28	7.6 - 8.5	Broken bedrock
		28	8.5	Bedrock
00SRKGeotech 2	476207E 7318783N	0 - 0.3	0 - 0.1	Organics
		0.3 - 2	0.1 - 0.6	Gravels & cobbles in silty sand matrix
		2 - 5	0.6 - 1.5	Boulders (granite)
		5 - 10	1.5 - 3.05	Cobbles & silty sand
		10 - 17	3.05 - 5.2	Increasing cobbles and coarse sand
		17 - 29	5.2 - 8.8	Gravels in fine silty sand matrix
		29	8.8	Bedrock
00SRKGeotech 3	476189E 7318681N	0 - 0.5	0 - 0.15	Organics
		0.5 - 4	0.15 - 1.2	Fine silty sand with minor gravel
		4 - 12	1.2 - 3.7	Assorted cobbles & gravel in silty sand
		12 - 15	3.7 - 4.6	Gravel, pebbles & cobbles in silty sand
		15	4.6	Bedrock
00SRKGeotech 4	475940E 7318831N	0 - 0.8	0 - 0.25	Organics
		0.8 - 12	0.25 - 3.7	Silty sand till with minor gravels
		12 - 65	3.7 - 19.8	Very bouldery (granite) with silty sand till matrix. No discernable evidence of permafrost noted
		65	19.8	Hole abandoned
00SRKGeotech 5	478216E 7319806N	0 - 0.4	0 - 0.13	Organics
		0.4 - 10	0.13 - 3.05	Coarse sand (beach), minor silt.
		10 - 16	3.05 - 4.9	Boulders & cobbles, minor sand
		16	4.9	Bedrock
00SRKGeotech 6	478099E 7319782N	0 - 0.8	0 - 0.25	Organics
		0.8 - 1.7	0.25 - 0.5	Very silty sand, no gravel
		1.7 - 9	0.5 - 2.7	Mixed cobbles & silty sand
		9 - 13	2.7 - 4.0	Broken bedrock
		13	4.0	Bedrock
00SKRGeotech 7	476912E 7319251N	0 - 0.7	0 - 0.2	Organics
		0.7 - 2	0.2 - 0.6	Silty sand till & pebbles
		2 - 10.5	0.6 - 3.2	Silty sand till & minor pebbles; permafrost at 2 ft
		10.5	3.2	Bedrock
00SRKGeotech 8	476204E 7318735N	0 - 0.25	0 - 0.08	Organics
		0.25 - 8	0.08 - 2.4	Silty sand till with minor gravel
		8 - 15	2.4 - 4.6	Boulders and cobbles, silty sand matrix
		15 - 20	4.6 - 6.1	Cobbles & broken bedrock with silty sand
		20	6.1	Bedrock

ATTACHMENT 2.2
REVISED WATER BALANCE

Steffen Robertson and Kirsten (Canada) Inc.
Suite 800, 1066 West Hastings St.
Vancouver, BC.
Canada
V6E 3X2

email: vancouver@srk.com
URL: http://www.srk.com
Tel: 604.681.4196
Fax: 604.687.5532

TECHNICAL MEMORANDUM

To:	Greg Missal, Tahera Corp.	**Pages:**	1 of 4
cc:		**Date:**	December 20, 2002
From:	Cam Scott	**Project Number:**	1CT004.02
Subject:	**Water Balance**		

Dear Mr. Missal,

In regards to your request to "revisit the water balance given the preferred option of spray irrigation," we have prepared the following response.

Water Balance

The project water balance is driven largely by the mean annual runoff (MAR). The methods used to evaluate the MAR have produced the following two estimates: 130 mm and 250 mm. These values, which are considered a lower and upper bound, respectively, yield a positive water balance that leads to an annual discharge requirement.

Table 1, which takes into account lake evaporation and the additional inputs from the processed kimberlite (PK) slurry and waste water treatment plant, summarizes the water balance for the PKCA based on the two MAR estimates. Table 1 also assumes that water from other areas of the mine is not added to the PKCA. In the case of the PKCA and its downstream polishing pond, a conservative estimate of the annual discharge is approximately 250,000 to 313,000 m^3.

Table 1
Jericho PKCA Water Balance

Parameter			Subtotal
Mean Annual Evaporation Distribution			100 %
Mean Annual Lake Evaporation (mm)			280 mm
Mean Annual Total Precipitation (mm)			330 mm
Net Precip [Ppt.-Lake Evap] (mm)			50 mm
Net Precip [Ppt.-Lake Evap] (m^3)			4,905 m^3
Mean Annual Tailings Water Increment (m^3)			168,175 m^3
STP Discharge to Tailings (m^3)			10,958 m^3
Mean Annual Runoff Distribution			100%
Mean Annual Runoff (m^3)	MAR =	130 mm	67,054 m^3
		250 mm	128,950 m^3
Total Mean Annual Inflow (m^3)	MAR =	130 mm	251,092 m^3
		250 mm	312,988 m^3
Required Discharge (m^3)	MAR =	130 mm	251,092 m^3
		250 mm	312,988 m^3

Runoff water that is collected at other areas of the site could be directed to the PKCA. Table 2 summarizes the quantities of runoff associated with each of the mine components, assuming the MAR varies from 130 mm to 250 mm.

Table 2
Jericho Infrastructure Component Runoff

Component	Runoff based on an MAR of 130 mm	Runoff based on an MAR of 250 mm
1. Low Grade Ore Stockpile	16,991	32,675
2. North Ore Stockpile	5,200	10,000
3. Coarse Ore Stockpile	5,179	9,960
4. Dump Site 1 Area	40,629	78,133
5. Dump Site 2 Area	33,137	63,725
6. Coarse Kimberlite Rejects Storage	21,580	41,500
7. Plant Area	7,184	13,815
8. Overburden Stockpile	24,674	47,450
9. Pit & Drainage Area	20,501	39,425
Annual Totals	175,075	336,683

This means that if water collected from all other areas of the mine is directed to the PKCA, the discharge requirement would increase by a factor of 1.7 for the low MAR estimate to 2.1 for the high MAR estimate (Table 3). However, in practice, water from other areas of the mine would be directed to the PKCA only if the respective water quality was problematic due to, for instance, ammonia levels.

Table 3
Range of Jericho Discharge Options

Discharge Component	Discharge in m^3 associated with a MAR of 130 mm (lower bound)	Discharge in m^3 associated with a MAR of 250 mm (upper bound)
PKCA (without other sources)	251,092	312,988
Sum of all infrastructure components	175,075	336,683
Total Combined (all sources)	426,167	649,671
Ratio of Total to PKCA	1.7	2.1

Depending on water quality, discharge from the PKCA will be handled by one of the following three methods:

- Discharge from the polishing pond to Stream C3, provided the water quality meets water licence discharge criteria;
- Spray irrigation at an area of approximately 4 to 8 ha east of Lake C3, if ammonia is largely responsible for an exceedance of water licence discharge criteria; or
- Water treatment if the water quality cannot be handled by spray irrigation.

In all three cases, the discharge is expected to occur over a 3 to 4 month period in the summer and early fall.

The other possibility is that the waters are handled separately based on water quality. For instance, the discharge from the PKCA could be handled in isolation. Water from the waste dumps and low grade ore stockpiles, which may be high in ammonia due to blasting, might be handled by spray irrigation. Water from other areas could be released or sent to the PKCA, depending on its quality.

Regards,

STEFFEN ROBERTSON AND KIRSTEN (CANADA) INC.

ATTACHMENT 4.1
FISH HABITAT COMPENSATION PROPOSAL

FISHERIES COMPENSATION PLAN FOR THE PROPOSED JERICHO DIAMOND PROJECT

Prepared for

Tahera Corporation
Suite 803
121 Richmond St. West
Toronto, Ontario
M5H 2K1

By

P&E Environmental Consultants Ltd.
Box 33178 Glenwood P.O.
Edmonton, Alberta
T5P 4V8

Phone: (780) 662-3697
Fax: (780) 662-4102
peenv@telusplanet.net

January 2003

Suggested Citation: P&E Environmental Consultants Ltd. 2003. Fisheries compensation plan for the proposed Jericho Diamond Project. Prepared for Tahera Corporation. P&E Report No. 01002AF: 32 p.

TABLE OF CONTENTS

Page #

LIST OF TABLES AND FIGURES

TABLES

Page #

FIGURES

Page #

1.0 INTRODUCTION

1.1 BACKGROUND

The Jericho Diamond Project, subsequently referred to as the Project, constitutes an application by Tahera Corporation (Tahera) to construct and operate a diamond mine in Nunavut on the northwest side of Contwoyto Lake (65^{o} 59' 50" Latitude, 111^{o} 8' 30" Longitude). The Project is located 420 km northeast of Yellowknife and 170 km north of the Ekati NWT Diamonds Project, NWT. It is a 'stand-alone' operation, which entails mining and processing diamonds from a single kimberlite pipe situated beside a small, unnamed waterbody locally known as Carat Lake.

The Project is subject to the environmental review and related licensing and permitting processes established by the Nunavut Land Claims Agreement (INAC and TFN 1993). As part of this review, Tahera is required to prepare an application that includes sufficient data and analyses for a complete assessment of anticipated impacts of the Project by the regulatory authorities.

Under the Fisheries Act, the Department of Fisheries and Oceans (DFO) has authority for the conservation and protection of fish and fish habitat (DFO 1998a). The Project has the potential to affect fish and fish habitat; therefore, DFO is mandated to assess the impacts of the Project and ascertain whether it will result in a habitat harmful alteration, disruption, or destruction (HADD).

Tahera has taken steps to mitigate the potential impacts of the Project on fish and fish habitat; however, the Project as presently designed will have unavoidable impacts on fish habitat. As such, Tahera requires authorization from DFO under Section 35 of the Fisheries Act. In order to obtain authorization, they are obligated to provide habitat compensation that meets the requirements specified by the regulatory agency.

1.2 REGULATORY FRAMEWORK

Section 34 of the Fisheries Act defines fish habitat as: "spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes". These habitats are any aquatic environments that support fish populations (DFO 1998a), which include areas that currently produce fish, or could potentially produce fish for harvest in subsistence, commercial, or recreational fisheries.

Although not directly supporting fish, areas that provide nutrients and/or food supply to adjacent habitat or contribute to water quality for fish are also considered as fish habitats. In Arctic environments, overwintering habitat also is important to fish.

DFO has adopted a no net loss principle regarding the productive capacity of fish habitat, which strives to balance unavoidable habitat losses with habitat replacement (DFO 1986). To further the no net loss principle, DFO has developed the "Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction (HADD) of Fish Habitat" (DFO 1998b), with respect to Section 35 of the Fisheries Act. The document outlines a structured decision process for authorization of a HADD as follows:

1. Within the initial application process, DFO determines if the proposed project could result in a HADD.
2. If a HADD could occur, the impacts are assessed to ascertain whether they could be fully mitigated.
3. If the impacts can be fully mitigated then a Letter of Advice specifying mitigation is issued.
4. If the potential impacts cannot be fully mitigated, then a decision is made as to whether compensation is possible.

Whether compensation is possible depends on the habitat that is affected and its importance to the fish population. DFO has developed guidelines to assist in this part of the decision process as follows (DFO 1998a):

1. Critical Habitats
   - In general, habitat compensation is not possible for critical habitats because they have a high productive capacity that requires a high level of protection. These areas are unique and are essential in sustaining fish populations (e.g., discrete spawning areas).
2. Important Habitats
   - Habitat compensation is appropriate for important habitats, which require a moderate level of protection. These are areas that are used by fish, but they are not critical to the population and similar habitats are available elsewhere in the system.
3. Marginal Habitats
   - Habitat compensation also is appropriate for marginal habitats, which have a low productive capacity. These areas are infrequently used by fish and have limited importance to the population.

If a decision is made that compensation is possible, the next step in the decision process is to follow a hierarchical list of choices regarding habitat compensation as follows (DFO 1998a):

1. Create similar habitat at or near the development site within the same ecological unit.
2. Create similar habitat in a different ecological unit that supports the same stock or species.
3. Increase the productive capacity of existing habitat at or near the development site and within the same ecological unit.
4. Increase the productive capacity of a different ecological unit that supports the same stock or species.
5. Increase the productive capacity of existing habitat for a different stock or a different species of fish either on or off site.

The amount and type of habitat compensation that is required by is project specific, and depends on the type and importance of the habitat that is affected, the method of compensation, and the certainty of success (DFO 1998a). DFO has indicated that they will not consider increasing productive capacity (choices 3 to 5) as compensation for the Project (e.g., nutrient enrichment), because it is not an acceptable choice for Arctic environments (Tahera, pers. comm.).

For creation of similar habitats (Choices 1 and 2), a general rule of thumb is followed regarding the amount of habitat that is required for compensation. Because constructed habitats do not always achieve their full potential, a conversion ratio is used to ensure that a sufficient amount of habitat is built. Compensation for marginal habitats typically requires creation of similar habitats versus affected habitats at a ratio of one to one. For important habitats, the conversion ratio increases to at least two to one. The ratio may increase to three or four to one if the habitats are deemed very important to a fish population.

1.3 APPROACH

This document presents a structured approach to achieve a habitat compensation plan that meets the requirements of DFO. Fish habitats affected by specific Project activities are identified and the effectiveness of proposed mitigation measures evaluated. Where Project effects cannot be fully mitigated and there is a HADD resulting in the need for compensation, affected habitats are quantified and they are characterized in terms of their importance to fish.

The choice of compensation is based on the type of habitat affected and the availability of compensation opportunities. The proposed compensation plan is conceptual, but is technically feasible. Tahera acknowledges that detailed design specifications are required before implementation. The compensation plan adheres to the no net loss principle and the need to maintain habitat productive capacity as recommended by DFO. The plan's fundamental goal is to ensure the long-term viability of the fish community in the Project area.

2.0 AFFECTED HABITATS

2.1 PROJECT ACTIVITIES AND MITIGATION

A detailed description of Project activities that potentially affect fish habitat and measures used to mitigate their effects are presented in an amendment to the Jericho Diamond Project aquatic biota EIA (P&E 2002). This section provides a summary of the information for each Project activity that has the potential to affect fish habitat and discussion of whether habitat compensation is warranted.

2.1.1 Permanent Roads

Project Activities

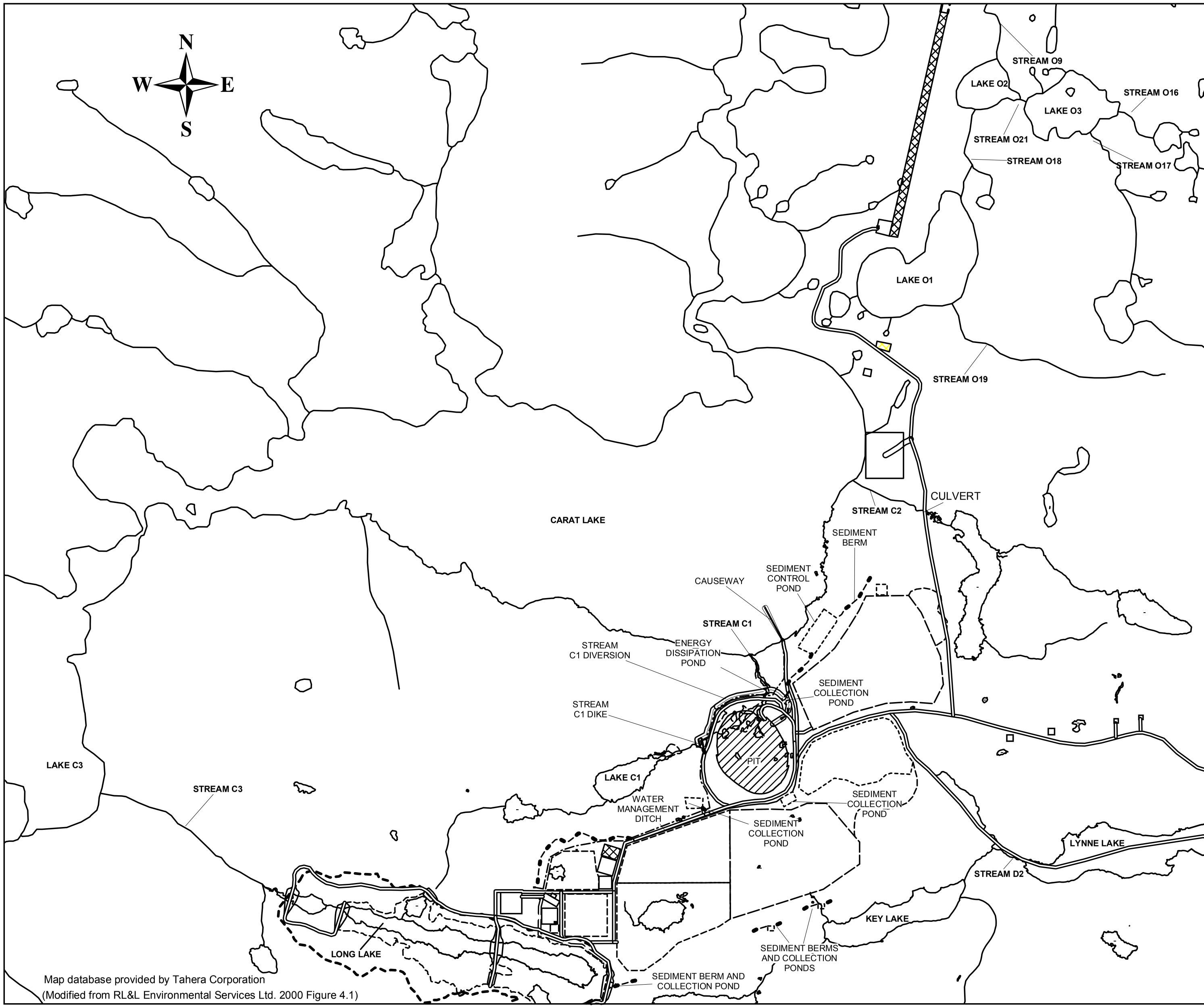
The mine infrastructure would require a 6.9 km network of permanent roads within the mine area (Figure 2.1). Only one defined stream channel would be crossed (Stream C2). The existing permanent road, which connects the exploration camp to the portal, has an existing culvert at the Stream C2 crossing. The proposed road alignment at this location is approximately the same as the existing alignment (Tahera 1999). A permanent road connecting the mine to the western shore of Contwoyto Lake would also be required. The road would traverse approximately 3.5 km over tundra before connecting to the lake, but would not cross any defined watercourses (Tahera, pers. comm.). The road will end as a ramp that will facilitate vehicle access to Contwoyto Lake during winter and emergency boat access during summer (Tahera, pers. comm.). The exact dimensions of this ramp are not presently known, but it would be approximately the 10 m width of the road and would extend no more than 15 m into the lake. As such, the surface area of the ramp that infringes on fish habitat would be 150 m^2.

Prior to construction of the permanent road, a winter road along a pre-existing route would be used to access Contwoyto Lake (during the construction phase). This road would traverse two watercourses (Streams D1 and D2) and Lynne Lake, but no permanent structures, such as culverts, would be required.

Upon closure of the mine, all permanent roads and associated structures (culverts) will be removed, and the sites rehabilitated (Final EIS Project Description, Appendix A.1).

Potential Effects

All streams traversed by permanent and winter roads freeze to the channel bottom during winter; therefore, potential adverse effects would occur only during the open water period. Construction, operation, and closure of permanent roads in the Project area have the potential to alter drainage patterns by preventing down slope movements of surface water, resulting in altered stream flows (Table 2.1).



P&E Environmental Consultants Ltd.

Figure 2.1 Activities in the Jericho Project Area

Table 2.1 List of Project activities, phases, potential effects on fish habitat in affected waterbodies, and whether habitat compensation is required, Jericho Diamond Project.

Project Component	Potential Effect	Phase				Waterbody[a]												Fully Mitigated/ No Adverse Effect	Habitat Compensation Required
						Lake							Stream						
		Construction	Operation	Closure	Post-closure	Carat	C3	C1	Long	Contwoyto	Lynne	Key	C1	C2	C3	D1	D2		
Permanent and Winter Roads	1) Altered flow	x	x								x			x		x	x	Yes	
	2) Suspended sediments and sedimentation.	x	x											x		x	x	Yes	
	3) Foot print of culvert.	x	x	x										x				Yes	
	4) Foot print of access ramp.	x	x	x						x								No	Yes
Stream C1 Diversion	1) Dewatering of stream channel.	x	x	x	x								x					Yes	
	2) Foot print of diversion.	x	x	x	x								x					Yes	
	3) Suspended sediments and sedimentation.	x	x			x							x					No	Yes
Processed Kimberlite Containment Area (PKCA)	1) Foot print of PKCA.	x	x	x	x				x									No	Yes
Water Withdrawal Causeway	1) Foot print of causeway	x	x	x	x	x												No	Yes
	2) Suspended sediments and sedimentation.	x	x	x		x												Yes	
Runoff from Mine Area	1) Suspended sediments and sedimentation.	x	x	x	x	x		x				x						Yes	
	2) Contaminants and nutrients.					x		x				x						Yes	
Discharge from the PKCA	1) Dewatering of stream channel.	x		x	x										x			No	Yes
	2) Suspended sediments and sedimentation.	x	x	x			x								x			Yes	
	3) Contaminants and nutrients.	x	x	x			x								x			Yes	
Emissions from Mining Activities	1) Suspended sediments and sedimentation.	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	Yes	
	2) Contaminants and nutrients.	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	Yes	

[a] Waterbodies identified in Figure 2.1; Long Lake includes lake plus two ponds and connecting channels.

Ditching along permanent roads may also accelerate erosion processes and funnel sediment laden water into the stream. Placement of the culvert at Stream C2 will remove a small section of stream channel from production (culvert foot print) a may create a barrier to fish passage by preventing access to upstream habitat.

The proposed crossing location on Stream C2 is not a fish-bearing section. Inventories indicated that fish distribution was limited to the first 100 m upstream of the lake confluence. The crossing is situated well upstream of this point (approximately 400 m). Due to its small size and ill-defined channel, the stream section at the proposed crossing is not easily accessible to fish; therefore, its value as fish habitat is negligible.

The permanent road to Contwoyto Lake would require a ramp on the shore of Contwoyto Lake. Construction of the ramp would potentially reduce water quality by increasing suspended sediment concentrations and could cause sedimentation in the immediate vicinity of the ramp.

The primary concern of the ramp would be potential loss of fish habitat caused by the foot print. The affected shoreline is characterized by large boulder and bedrock substrates and has a very steep gradient. As such, it provides a limited area of useable habitats for adult feeding and juvenile rearing. Concentrations of fish were not recorded in the vicinity of the ramp, either in the main lake or in the outlet area of Stream D1. Species recorded during inventories included lake trout and Arctic char, although other species such as round whitefish, burbot, and slimy sculpin likely utilize the area Stream D1 consists of a boulder field along its entire length and no fish habitat is available in this watercourse.

Winter road crossings over streams that are frozen to the channel bottom are considered temporary (DFO 1995), and if constructed without disturbance to the stream bed or its banks, the effects on fish habitat are deemed as negligible. Because no permanent structures or alterations are required to operate and maintain the winter road, and all activities occur when the stream bed is frozen, there is no potential for adverse effects on fish habitat.

Mitigation

Tahera will utilize standard mitigation measures during construction, operation, and closure of permanent and winter roads (Final EIS, Environmental Management Plan, Appendix B.3.1) and will follow guidelines specified in *Fish Habitat Protection Guidelines - Road Construction and Stream Crossings* (DFO 1995). For example, silt fences will be employed during construction of the permanent roads and the access ramp to prevent suspended sediments from entering Stream C2 or Contwoyto Lake. If the potential for erosion exists, ditches will be armoured or routed to settling ponds that have been incorporated into the Project design. Good engineering practices require appropriate placement of roads allowances and use of culverts to ensure that drainage into existing streams is not altered. Sediment catchment ponds along ditch alignments will be inspected frequently and sediment removed as required. Silt fencing downstream of sediment removal will be employed if clean out is required during periods when water is flowing in ditches (Tahera, pers. comm.).

Assessment of Need for Habitat Compensation

DFO (1995) guidelines will be met regarding permanent and winter road construction, operation, and closure; therefore, potential effects on streams will be fully mitigated. The foot print of the permanent road crossing on Stream C2 does not impinge on useable fish habitat. As such, there is no need for habitat compensation for effects on streams.

An area (150 m^2) of fish habitat will be removed from production by the access ramp into Contwoyto Lake. This Project activity cannot be mitigated and will require habitat compensation.

2.1.2 Diversion of Stream C1

Project Activities

Stream C1 is part of a small drainage basin (1.13 km^2) situated at the southeast corner of Carat Lake. The foot print of the proposed mine pit will include a section of this stream (Figure 2.1). To maintain the drainage capacity of the basin and to prevent flooding of the pit, a diversion channel will be constructed along the western perimeter of the mine. The diversion system would consist of a dike across Stream C1 at the upstream end, a man-made channel to divert the flow around the mine pit and a dissipating pond at the downstream end where the flow re-enters the original stream bed. The diversion system will be designed to accept a predicted 1- in - 200 year return period flood discharge of 3.7 m^3/s and will be armoured with riprap to prevent erosion.

Construction of the diversion system will require instream activities at the upper and lower ends of the artificial channel during winter. Once operational, the system will divert all flow from Stream C1 into the artificial channel at a point that is approximately 815 m upstream from Carat Lake. The water will be transported around the pit and diverted back into Stream C1 at a point that is approximately 275 m upstream of Carat Lake. The total length of the stream section that will be dewatered will be 541 m; it will be replaced by 425 m of diversion channel.

Upon closure of the mine, the diversion system will be modified (Final EIS Project Description, Appendix A.1). With approval from DFO, a weir will be placed in the diversion dike to allow excess flood water not required to maintain flow in the diversion system and the lower section of Stream C1 to flow via the natural channel to the mine pit. This water will gradually fill the mine pit; when full, the pit water would then flow through the lower natural channel to Carat Lake. It is estimated that the mine pit would require in excess of 180 years to fill to capacity (Final EIS Project Description, Appendix A.1). Runoff water from areas upstream of the pit will also drain into the pit once mine closure is complete.

Potential Effects

Stream C1 originates as the outlet of Lake C1 and flows a distance of 1031 m before draining into Carat Lake. During the open water period, this stream exhibits discharges that range from 0.06 m^3/s during spring snow melt to 0.002 m^3/s during summer base water flows. Stream C1 has an average channel width of 1.6 m and an average maximum depth of 0.15 m and like all small systems in the Project area it freezes to the channel bottom during winter.

Stream C1 is a complex system composed of 10 reaches. Its major features include a natural barrier to fish passage (5.3 m in height) that is located 815 m upstream from Carat Lake and a large impounded area (351 m from confluence) that was formed by a man-made berm constructed during the winter of 1995-96. The impoundment inundated a portion of the existing channel and diverted part of the stream discharge to the west, where it flows over the tundra and rejoins Stream C1 near its confluence with Carat Lake.

Based on these characteristics, potential fish habitat is available to fish up to the natural barrier (815 m of stream); however, inventories completed in 1995, 1996, 1998, 1999, and 2000 provided strong evidence that fish distribution was restricted to the lower section of stream. Despite extensive sampling in the entire stream, no fish were ever recorded more than 100 m upstream from the confluence with Carat Lake.

Species recorded in the lower section of Stream C1 included Arctic char, Arctic grayling, burbot, lake trout, round whitefish, and slimy sculpin. Young-of-the-year and small juvenile fish that used the system opportunistically for rearing consistently dominated the fish community. Adult fish were not recorded in Stream C1 (except slimy sculpin) and no fish eggs were ever found; therefore, the system was not used for spawning or feeding and it does not provide a movement corridor. Fish also use the outlet zone of Stream C1 and Carat Lake for rearing and feeding and the area may be used for spawning and egg incubation. This assumption is made based on indirect evidence (i.e., presence of suitable spawning habitat, fish in spawning condition, and young-of-the-year Arctic char that still had yolk sacs) rather than a physical record of fish eggs. Although no spawning by larger fish species was documented in Stream C1, slimy sculpin likely use this system for spawning and egg incubation.

Project activities affecting Stream C1 have the potential to impact fish habitat in Stream C1 and its outlet zone with Carat Lake. The effects may include removal of fish habitat due to dewatering of a stream section, removal of fish habitat by construction of the intake and outlet ports of the diversion channel, and a reduction of water quality and habitat quality in Stream C1 and Carat Lake due to increased suspended sediment concentrations during construction, operation and closure phases.

Mitigation

Tahera will implement erosion control techniques during instream construction and maintenance activities where required (Tahera, pers. comm.). Sediment introduction can be minimized by utilizing several practices outlined in Furniss et al. (1991) and DFO (1995) as follows:

- Minimize the area of bank that is cleared during construction.
- Work areas should be isolated from the stream by use of cofferdams or berms.
- Employ isolation methods (i.e., work in dry channel), where practical, during construction.
- Minimize siltation by opening the diversion channel at the downstream end first.
- Diversion channel gradient at its terminal end should approximate those of the existing stream.
- If fill is required, use clean granular material for fill within the channel.
- Ensure that pollutants from the machinery used during construction do not enter the stream.
- Where spawning fish are known to be present, timing constraints can be applied to in-stream work.
- Implement temporary and permanent erosion control measures, where warranted, on the banks and approach slopes to watercourses.
- Use silt curtains at the mouth of Stream C1 to limit the extent of sedimentation in Carat Lake.

Assessment of Need for Habitat Compensation

Stream C1 provides rearing habitat for young-of-the-year and juveniles of several species; however, extensive fisheries inventories documented that the distribution of fish was restricted to the lower 100 m section immediately upstream of Carat Lake. Based on this information, removal of potential fish habitat in the upper portion of Stream C1 starting 275 m upstream from Carat Lake 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. Therefore, habitat compensation is not required for the stream section affected by the diversion channel or for the foot print of the intake and outlet ports.

Mitigation is 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. As such, there is the potential for adverse effects on fish habitat caused by elevated suspended sediment concentrations in the lower section of Stream C1 and in Carat Lake. These impacts will be short-lived. Once activities causing introduction of sediment cease, water flow in the stream and wave action in the lake will flush the materials from the system and return it to its former productive capacity.

Given that there will be an impact on fish habitat caused by the introduction of sediments during construction and maintenance activities, habitat compensation may be required.

2.1.3 Processed Kimberlite Containment Area

Project Activities

The Processed Kimberlite Containment Area (PKCA) would be required to store the fine fraction (<1 mm) generated by the processing operation, discharge from the waste water treatment system, runoff from the plant site, and possibly runoff from the mine site (Figure 2.1). The PKCA would consist of two storage cells and a polishing pond. Construction of the PKCA would require the use of several waterbodies in the collectively termed ‘Long Lake System’. These include Long Lake, an unnamed pond at its west end, an ill-defined channel connecting the two, and an unnamed pond perched above Long Lake along its northern shore.

Upon closure of the mine, the dry portions of the PKCA would be rehabilitated, leaving a much smaller lake basin at its western end. Due to its small size and shallow depth, the waterbody will not support a viable fish population.

Potential Effects

There are several potential effects associated with the PKCA. The primary effect would be permanent loss of fish habitat that presently occurs in the Long Lake System. During construction and operation of the PKCA, direct mortality of fish would occur due to stranding or increased toxicity of the water within the storage cells.

Long Lake is a small (9 ha), elongated waterbody with a maximum depth of 8 m that has a moderate shoreline development ratio of 2.4 and a short shoreline length of 2571 m. Intensive fish sampling during 1999 and 2000 identified only limited numbers of two fish species in this waterbody: burbot and slimy sculpin.

The unnamed pond to the west is connected to Long Lake via a shallow, ill-defined channel that is approximately 75 m in length. In 2000, this channel consisted of a boulder field with subsurface water flow. The unnamed pond to the west is less than 1 ha in size, but has a maximum depth of 7 m. This unnamed pond also contained a small number of burbot and slimy. The connecting channel was not sampled for fish, but it is likely that both species use the area as habitat on an opportunistic basis.

Surveys of a second unnamed pond along the north shore of Long Lake recorded 2 slimy sculpin. This small waterbody is less than 1 ha in size, but also 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 waterbody had drawn down to approximately two-thirds of its spring and early summer surface area and no water flowed out of the connecting channel between the pond and Long Lake.

This information indicates that the 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.

In addition to habitat loss due to the PKCA, the altered discharge regime of Stream C3 during construction and operation of the facility also could have detrimental effects on fish habitat. These effects are discussed in Section 2.1.6.

Mitigation

No mitigation measures are available to prevent loss of fish habitat in the Long Lake System.

Assessment of Need for Habitat Compensation

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 habitat for young-of-the-year and juveniles of these species. Based on this information, removal of waterbodies in the Long Lake System from production will impact fish habitat; therefore, habitat compensation is required.

2.1.4 Water Withdrawal Causeway

Project Activity

A single water withdrawal system would be constructed in Carat Lake approximately 150 m east of the outlet of Stream C1 to supply potable water to the camp and raw water to the mine and processing plant. The water withdrawal system, which consists of an intake and pipeline, will be protected from ice damage by a causeway constructed from waste rock material generated during construction of the mine. The design of the causeway requires that it extend offshore to a water depth of 5.5 m no more than 90 m offshore. For the purposes of this assessment, it is assumed that the length of the causeway will be 90 m (Final EIS Project Description, Appendix A.1). Assuming a maximum length and width (90 m and 15.5 m, respectively), the foot print of the causeway would not exceed 1395 m^2. This foot print represents part of the Crown Land Lease ‘E’ (Water Lot Lease) for the Project (Tahera, pers. comm.).

Rehabilitation during the closure phase will entail sealing the water intake pipe and grading the causeway down to ice level during winter. In spring, the dislodged material would sink to the lake bottom. Alternatively, sections of the causeway above ice level could be graded onto shore or other upland areas during winter (Tahera, pers. comm.).

Potential Effects

Carat Lake in the vicinity of the causeway is used by several fish species including lake trout, Arctic char, burbot, round whitefish, and slimy sculpin. The lake margin is used for rearing and feeding purposes and spawning does occur in the vicinity of the causeway.

The foot print of the causeway will cause loss of fish habitat. Habitat loss could also result indirectly from the causeway by alteration of water movement patterns in the southeast corner of Carat Lake. In lake environments, char species such as lake trout and Arctic char often seek areas exhibiting water movements to maximize the viability of incubating eggs that are deposited on rock substrates (lake trout) or in redds (Arctic char). An obstruction such as the causeway could impede water movement to the extent that fish may no longer use these sites for spawning. Because the causeway will extend only a short distance into Carat Lake (90 m) it is not expected to substantially alter water circulation.

Use of waste rock materials from the mine could introduce fine materials into the water resulting in increased suspended sediments and sedimentation of fish habitat. Rehabilitation of the causeway will result in additional loss of fish habitat by increasing the size of the foot print, destruction of fish habitat provided by the causeway and introduction of sediments from the top dressing of the roadway.

Mitigation

Tahera will implement sediment control measures during construction of the causeway to minimize sediment inputs (Final EIS Project Description, Appendix A.1). Tahera can also remove the top dressing from the causeway before grading to minimize sediment inputs during rehabilitation, or is willing to leave the causeway intact if acceptable to the regulatory authorities (Tahera, pers. comm.). Other mitigation measures being considered are shortening the causeway to minimize the footprint and/or burying the water intake pipeline in the lake bottom to protect it from ice damage instead of using the causeway (Tahera, pers. comm.). If the latter measure was implemented, the pipeline would have to be buried the same length as the proposed causeway, it would cause a temporary loss of habitat, and sediment production potentially would be a more serious issue.

Assessment of Need for Habitat Compensation

Assuming that a causeway is built, construction and rehabilitation activities will cause physical loss of fish habitat. Water circulation patterns also will be altered in the immediate vicinity of the causeway, but given the short length of the causeway, these effects have a low probability of extending to spawning sites used by Arctic char and lake trout. It is assumed that the sediment control measures implemented during construction and rehabilitation will prevent sediments from entering the aquatic environment. As such, physical loss of habitat is deemed to be the only impact on fish habitat caused by the water withdrawal causeway that will require compensation.

2.1.5 Runoff from Mine Site

Project Activity

Several Project activities 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 (Figure 2.1). Surface runoff from permanent roads associated with the mine may also contain elevated levels of suspended sediments. This potential effect is considered minor because ditches or the tundra would contain the sediment (Final EIS Project Description, Appendix A.1); therefore, it will not be assessed.

Potential Effects

Given the topography of the mine site and the proposed layout of the mine area, mine runoff could potentially affect fish habitat in three fish-bearing lakes (Carat Lake, Lake C1, and Key Lake) through the introduction of nutrients and contaminants and/or sediments. Based on leachate tests of the waste rock and ore undertaken by Tahera (SRK Consulting, Final EIS, Appendices D.1.4 and D.1.6), the only constituents of the mine runoff that may exceed water quality guidelines are copper and ammonia. No quantitative data are available for suspended sediments levels associated with mine runoff. Experience at the EKATI™ Mine indicates that suspended sediment levels in mine runoff typically do not exceed water quality guidelines (Tahera, pers. comm.), but for the purposes of this assessment it is assumed that they could be problematic.

Mitigation

Tahera is committed to ensuring that the runoff generated at the mine site would be contained and treated so that it would not be acutely toxic to aquatic biota (Final EIS, Environmental Management Plan, Appendix B.3.1). To accomplish this, a collection system consisting of containment berms and ditches will be employed to contain and direct the runoff from the mine site into collection ponds. The collection ponds will allow settlement of sediments and partial oxidation of the ammonia. This system would operate during all phases of the Project. If ammonia and copper concentrations exceed water quality guidelines the runoff will be treated until concentrations reach acceptable levels. Treatment measures for the collected runoff being considered by Tahera include the preferred option spray irrigation, transfer to the PKCA, and use of a treatment plant (Final EIS, Environmental Management Plan, Appendix B.3.1).

Upon mine closure, all runoff will be directed to the mine pit. The estimated amount of time required to fill the pit would be approximately 180 years. For the purposes of the assessment, it is assumed concentrations of potential contaminants will return to background levels within this period.

Assessment of Potential Effects

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.

Assessment of Need for Habitat Compensation

Given that there will be no impact on fish habitat caused by mine runoff, habitat compensation is not required.

2.1.6 Discharge from Processed Kimberlite Containment Area

Project Activities

The Processed Kimberlite Containment Area (PKCA) would be required to store the fine fraction (<1 mm) generated by the processing operation, waste water, runoff from the plant area, and possibly runoff from the mine area. Construction of the PKCA would entail use of four dams and a series of small dikes. It is assumed that the first dam will be placed at the outlet zone of the Long Lake basin during winter, which would prevent disturbed sediment laden water from traveling downstream. This approach would also eliminate the primary water source for Stream C3 during filling of the PKCA.

During operation, discharge from the PKCA would be released from the polishing pond into Stream C3, which connects the Long Lake System to Lake C3. The amount of discharge from the PKCA would vary depending on several factors including snowpack depth, precipitation, and mining activities, but is not predicted to exceed 313,000 m^3 annually and a controlled release during the 3 to 4 month open water period of approximately 0.034 m^3/s would accommodate this requirement (Final EIS Project Description, Appendix A.1).

Upon mine closure, the dry portions of the PKCA would be rehabilitated leaving a much smaller lake basin at its western end. This would result in a smaller catchment basin and lowered water inputs to Stream C3.

Potential Effects

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. Juvenile Arctic char and burbot, as well as slimy sculpin were recorded in Stream C3 during fisheries inventories.

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 Stream C3 outlet.

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 discharge could potentially affect fish habitat 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 (Final EIS, Appendix D.1.5) indicate that the only constituents of the PKCA discharge 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 (Tahera, pers. comm.). 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.

Mitigation

Logistical constraints during construction and startup of the PKCA preclude use of mitigation designed to maintain water flows in Stream C3. During operation, it is expected that containment within Cell 2 and the polishing pond of the PKCA will allow settlement of suspended sediments and oxidation of some ammonia before release into Stream C3. The discharge would then travel approximately 1080 m down slope through the Stream C3 channel before entering Lake C3. Due to the variability in stream flows with time, which results in both variable oxygenation of the water and variable water velocities, an unknown amount of ammonia oxidation and sediment settlement will occur during this transit. PKCA discharge released into Lake C3 will be tested routinely and will be controlled by a government license. 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 discharge. Measures being considered include use of the preferred option spray irrigation and a treatment facility (Final EIS, Environmental Management Plan Appendix B.3.1).

Assessment of Need for Habitat Compensation

Contaminant concentrations are assumed to be at acceptable levels due to implementation of mitigation measures; therefore, issues associated with reduced water quality caused by discharge from the PKCA are considered negligible. Fish habitat provided by Stream C3 will be permanently removed from production by the development because it will be dewatered during the post-construction and post-closure phases of the Project. It should be noted that during the operations phase, discharge from the PKCA will maintain fish habitat in Stream C3, but this is deemed a temporary mitigation measure. As such compensation will be required for loss of fish habitat in Stream C3.

2.1.7 Emissions

Project Activity

Development of the open pit, use of haul roads, processing plant operation, infrastructure development and use of a sand/gravel air strip are all potential sources of air-borne contaminants (primarily dust). Other potential sources of air emissions include the diesel generator and the camp incinerator. The majority of emissions would mostly likely be dust generated from mining activities, such as blasting and the transportation of the waste rock and ore.

Potential Effects

A portion of the dust generated from the proposed development would eventually be deposited onto the surface of Carat Lake and other waterbodies within the Project area. These deposits would disperse into the water column and ultimately settle on the bottom. The potential effect of dust on water quality would include increased levels of suspended sediment in the water column and sediment deposition on lake bottom habitat. This could result in decreased quality of fish habitat.

Mitigation

Tahera will initiate an environmental management plan that will meet all government standards for dust control, such as watering road surfaces during warm weather months (Final EIS, Environmental Management Plan, Appendix B.3.1).

Assessment of Potential Effects

Quantitative data are not currently available for the Project to assess the potential effects of dust and air emissions on fish habitat; however, information is available from the environmental impact assessment of the Diavik Diamonds Project (Diavik 1998). The Diavik Diamonds Project is also located in the subarctic approximately 170 km southeast of the Project area, and is much larger in terms of its potential to generate air-borne contaminants.

The effects of dust deposition on water quality were evaluated for several fish bearing lakes in the vicinity of the proposed Diavik mine by calculating annual total suspended sediment (TSS) concentrations and sedimentation rates (Diavik 1998). The maximum annual potential increase was 5 mg/L for TSS and

0.05 mm/year for sedimentation; neither value exceeded the threshold for the protection of aquatic biota (5 mg/L and 1 mm/year for TSS and sedimentation, respectively). The Diavik EIA concluded that the effect of dust on water quality (fish habitat) had a negligible effect on aquatic biota.

Based on data from the Diavik study, air-borne contaminants generated from the Project will not cause an impact on fish habitat.

2.2 CHARACTERISTICS OF HABITATS REQUIRING COMPENSATION

To properly identify appropriate habitat compensation, impacted habitats need to be characterized in terms of the amount and quality of affected area. This information is required to evaluate the importance of each affected habitat to a particular species life stage. The values presented in this section were derived from data collected during aquatic baseline inventories undertaken in preparation for the Jericho Diamond Project EIA (RL&L 1996, 1997, 2000a, 2000b).

The discussion presented in Section 2.1 identified five Project activities that will cause a HADD resulting in the need for habitat compensation as follows:

1. The foot print of the access ramp on Contwoyto Lake will cause permanent removal of fish habitat.
2. The foot print of the water withdrawal causeway in Carat Lake will cause permanent removal of fish habitat.
3. The foot print of the PKCA will cause permanent removal of fish habitat in Long Lake, two ponds, and connecting channels.
4. The suspended sediments produced during construction and maintenance of the diversion will cause temporary alteration to fish habitat in the lower section of Stream C1 and the Stream C1 outlet to Carat Lake.
5. Discharge from the PKCA will alter the flow regime of Stream C3, which will cause permanent removal of fish habitat.

2.2.1 Access Ramp

The access ramp requires a 150 m^2 (10 m wide x 15 m long) foot print that will infringe on the shoreline of Contwoyto Lake. The area exhibits a steep slope and substrates consist of large boulders and bedrock. These characteristics provide rearing and feeding habitats for several species that are considered important to fish (Table 2.2). The very large substrate sizes and the sheltered location of the site (i.e., limited water circulation) indicate that it is not suitable for spawning. The area has no value as overwintering habitat because it freezes to the bottom.

Table 2.2 Summary of the quality and amount of fish habitat that require habitat compensation, Jericho Diamond Project.

Activity	Waterbody	Habitat[a]	Quality[a]	Area (m^2)	Species[b]
Access Ramp	Contwoyto Lake	Total Affected Area		150 [c]	
		Spawning	Nil	-	None
		Rearing	Important	150	ARCH, ARGR, BURB, LKTR, RNWH, SLSC
		Feeding	Important	150	ARCH, ARGR, BURB, LKTR, RNWH, SLSC
		Overwintering	Nil	-	None
Causeway	Carat Lake	Total Affected Area		1395[c]	
		Spawning	Important	30	SLSC
		Rearing	Important	232	ARCH, ARGR, BURB, LKTR, RNWH, SLSC
		Feeding	Important	232	ARCH, ARGR, BURB, LKTR, RNWH, SLSC
			Marginal	1163	ARCH, BURB, LKTR, RNWH
		Overwintering	Nil	-	None
PKCA	Long Lake System	Total Affected Area		92,500[c]	
		Spawning	Important	69,461	SLSC
			Important	3216	BURB
		Rearing	Important	69,461	BURB, SLSC
		Feeding	Important	92,500	BURB, SLSC
		Overwintering	Important	3216	BURB, SLSC
Diversion Construction and Maintenance	Stream C1	Total Affected Area		387 [c]	
		Spawning	Important	124	SLSC
		Rearing	Important	124	ARCH, ARGR, BURB, LKTR, SLSC
		Feeding	Important	124	SLSC
		Food Production	Important	387	ARCH, ARGR, BURB, LKTR, SLSC
		Overwintering	Nil	-	None
	Carat Lake	Total Affected Area		40[c]	
		Spawning	Important	40	SLSC
		Rearing	Important	40	ARCH, ARGR, BURB, LKTR, RNWH, SLSC
		Feeding	Important	40	ARCH, ARGR, BURB, LKTR, RNWH, SLSC
		Overwintering	Nil	-	None
PKCA Discharge	Stream C3	Total Affected Area		181[c]	
		Spawning	Marginal	181	SLSC
		Rearing	Marginal	181	ARCH, BURB, LKTR, SLSC
		Feeding	Marginal	-	SLSC
		Overwintering	Nil	-	None

[a] Habitat type and quality definitions based on DFO (1998a) and described in Section 1.2.
[b] ARGR -- Arctic grayling; ARCH -- Arctic char; BURB -- burbot; LKCH -- lake trout; RNWH -- round whitefish; SLSC -- slimy sculpin.
[c] Cumulative total of individual habitat types exceeds total because affected area has multiple habitat uses.

2.2.2 Causeway

The causeway requires a 1395 m^2 (90 m long and 15.5 m wide) foot print that will impact fish habitat in Carat Lake (Table 2.2). The affected shoreline contains a narrow 2 m band of rock substrates in shallow water (<1.5 m) that provides spawning habitat for slimy sculpin (30 m^2) and rearing habitat for several species. Farther offshore to a distance of 15 m, the water depth is greater (2 m) and rock substrates are less frequent. This zone contains good rearing habitat for several species and is used for feeding by adult fish (232 m^2). From 15 m to the outer extent of the causeway, the water depth increases to 5.5 m and fine materials dominate the substrate (1163 m^2). This area is marginal habitat infrequently used by feeding fish. The entire area affected by the causeway freezes to the bottom; therefore, it has no value as overwintering habitat.

2.2.3 Processed Kimberlite Containment Area

Construction of the PKCA would require the use of several waterbodies in the collectively termed 'Long Lake System' that support small resident populations of slimy sculpin and burbot. Because entire waterbodies will be removed an extensive amount of fish habitat totaling 92,500 m^2 will be affected (Table 2.2). The waterbodies include Long Lake (90,000 m^2), an unnamed pond at its west end (1,000 m^2), an ill-defined channel connecting the two (500 m^2), and an unnamed pond perched above Long Lake along its northern shore (1,000 m^2).

Based on definitions of habitat quality (DFO 1998a), the habitats in the affected waterbodies would be categorized as important or even critical to the slimy sculpin and burbot populations because, if removed, the loss would eliminate those populations. But, for purposes of habitat compensation related to the Project they are deemed marginal fish habitats for the following reasons. First, characteristics of the affected waterbodies indicate that they have a very low productive capacity. The small size and limited amount of deep water (overwintering habitat) likely results in fish kills and the waterbodies are isolated from the remainder of the watershed, which hinders colonization by fish. These characteristics would explain why only two species are present in the system and low numbers of fish were recorded. Second, when compared to characteristics of waterbodies that support viable fish populations elsewhere in the Project area, the Long lake System would be considered marginal fish habitat. This conclusion will influence the amount and type of habitat compensation that is proposed for the Long lake System.

2.2.4 Diversion Construction and Maintenance

Fish habitat in the lower 275 m of Stream C1 downstream of the diversion will be altered by introduction of sediments during construction and maintenance activities. Sediments also may enter Carat Lake in the outlet zone of Stream C1. Assuming successful mitigation, the extent of the affected area in Carat Lake will be limited to 40 m^2, which represents a radius of 10 m from the stream mouth. Also, the effects will be temporary because sediments will be flushed from the system once construction or maintenance activity ceases.

The total area of affected habitat in Stream C1 is 387 m^2 (Table 2.2). Because the upper extent of fish distribution in the stream is 100 m, 124 m^2 of slimy sculpin spawning habitat and rearing habitat for several species will be altered. It should be noted that the entire section (387 m^2) contributes to food production. Larger adult fish cannot access this small watercourse, but slimy sculpin use the system as feeding habitat. Similarly, there is no overwintering habitat because the stream freezes to the bottom. Stream C1 has stable water flows during the open water period and it provides an area that is protected from predation; therefore, the affected habitats are important to young-of-the year and juveniles of several species, and adults of slimy sculpin.

The affected area of Carat Lake provides spawning habitat for slimy sculpin, as well as rearing and feeding habitats for several species (40 m^2). Given the abundance of physical cover, the area provides important habitat for fish.

2.2.5 PKCA Discharge

Stream C3 is a small ephemeral system that drains into Lake C3. The small size, channel characteristics, and intermittent water flow of Stream C3 limits its potential as fish habitat. Juvenile Arctic char and burbot, and slimy sculpin use the lowermost 300 m of Stream C3 on an opportunistic basis. Based on these characteristics Stream C3 provides marginal fish habitat and the total affected area is limited to 181 m^2 (Table 2.2).

3.0 HABITAT COMPENSATION

3.1 AMOUNT AND TYPE OF COMPENSATION

Fish habitats requiring compensation due to the effects of Project activities can be grouped into two categories based on waterbody type: lake habitats and stream habitats (Table 3.1). In Carat Lake and Contwoyto Lake, Project effects are largely restricted to shallow shoreline areas that are used for spawning by slimy sculpin, and for rearing and feeding by all species found in the lake. These habitats are considered important to fish. In Carat Lake, feeding habitat located farther offshore also is affected. In this case the habitat is marginal because it is unlikely that the area is used extensively for feeding by fish. All affected habitats in Carat Lake and Contwoyto Lake are deemed to be not critical (i.e., essential for the viability of a fish population) because similar habitats are abundant and are available elsewhere in the waterbody. Also, all affected areas freeze to the bottom; therefore, they do not provide overwintering habitat for fish. Based on this evaluation, 1585 m^2 of habitat will be lost from production. This amount represents a loss of 1.2% of shoreline habitat in Carat Lake and <0.1% of shoreline habitat in Contwoyto Lake, assuming that shoreline habitat is represented by a 10 m wide band adjacent to shore.

Table 3.1 Summary of habitat compensation required for the Jericho Diamond Project.

Environment	Waterbody	Habitats Requiring Compensation			Compensation	
		Area (m^2)	Habitat Type (Species)[a]	Quality	Ratio	Area (m^2)
Lake	Carat	272	Spawning (SLSC)/Rearing/Feeding (All)	Important	2	544
		1163	Feeding (All)	Marginal	1	1163
	Contwoyto	150	Spawning (SLSC)/Rearing/Feeding (All)	Important	2	300
	Total	**1585**				**2007**
Long Lake System		92,500	All Habitats (SLSC, BURB)	Marginal	1	**92,500**
Stream	C1	387	Spawning (SLSC)/Rearing (All)	Important	1[b]	387
	C3	181	Spawning (SLSC)/Rearing (All)	Marginal	1	181
	Total	**568**				**568**

[a] SLSC -- Slimy sculpin; All -- all species found in the waterbody.
[b] Effects are temporary; therefore, conversion ratio for important habitat (2:1) is reduced to 1:1.

Using conversion ratios of 2:1 for important habitat and 1:1 for marginal habitat, the affected areas should be replaced with at least 2007 m^2 of similar shoreline habitat.

Construction of the PKCA will remove all habitats in the Long Lake System from production, which is equal to a total area of 92,500 m^2. Adherence to the guidelines specified in DFO (1998a) would require that the lost habitats be defined as critical because they are needed to ensure the viability of these fish populations. However, these waterbodies are considered marginal fish habitats when compared to other lakes in the Project area because of their small size and/or shallow water depths. For this reason the amount of compensation is calculated based on a conversion ratio of 1:1 or 92,500 m^2.

In streams, Project effects requiring compensation are restricted to two small watercourses (Streams C1 and C3). Because they freeze to the bottom, fish that use these systems originate from lakes that provide suitable overwintering habitat. The affected streams are used for spawning by slimy sculpin and rearing by all species that can utilize stream habitats for this purpose (i.e., all except round whitefish). Stream C1 is considered important fish habitat because it is one of the few systems that has water flow during the entire open water period. The Project effects on the system will be temporary; therefore, compensation should be provided at a ratio of 1:1. Stream C3 is considered marginal fish habitat because it is an ephemeral system. Based on this evaluation, a total of 568 m^2 of fish habitat will require compensation using 568 m^2 of similar habitat.

3.2 COMPENSATION OPTIONS

The options available for physical habitat compensation are more restricted in Arctic environments than for more southern climates. This is primarily due to logistical and engineering constraints in the Arctic. Accessing candidate sites without damaging the surrounding landscape can be difficult and the necessary materials can be difficult and expensive to acquire. The most serious problems from an engineering perspective are the presence of permafrost in stream channels and extensive ice in lakes. Permafrost can play a fundamental role in the formation and maintenance of small stream channels. Construction activities that disrupt this balance can cause erosion and/or destruction of the natural channel. Ice in Arctic lakes has the ability to move a physical habitat works by first adhering and then lifting the structures from the lake bottom. Damage also can be incurred when wind-blown lake ice is pushed into structures situated in exposed areas. These issues need to be addressed when physical habitat compensation is being contemplated in Arctic environments.

From a biological perspective, compensation that targets factors that limit the productive capacity of a target fish population is preferred. In the Arctic, fish populations are generally limited by the lack of nutrients, low water temperatures, and a short growing season, which limits primary production (food) and fish growth.

A paucity of important habitat can also limit fish populations. In the Arctic, these could include areas with sufficient water depth to provide overwintering habitat, areas that provide suitable substrates for spawning habitat, and areas that provide food and abundant physical cover for rearing habitat. These factors likely limit fish production in some waterbodies within Jericho Diamond Project area.

The compensation plan that is proposed for the Jericho Diamond Project will use two approaches to meet the requirements for habitat compensation outlined in DFO (1998a) as follows:

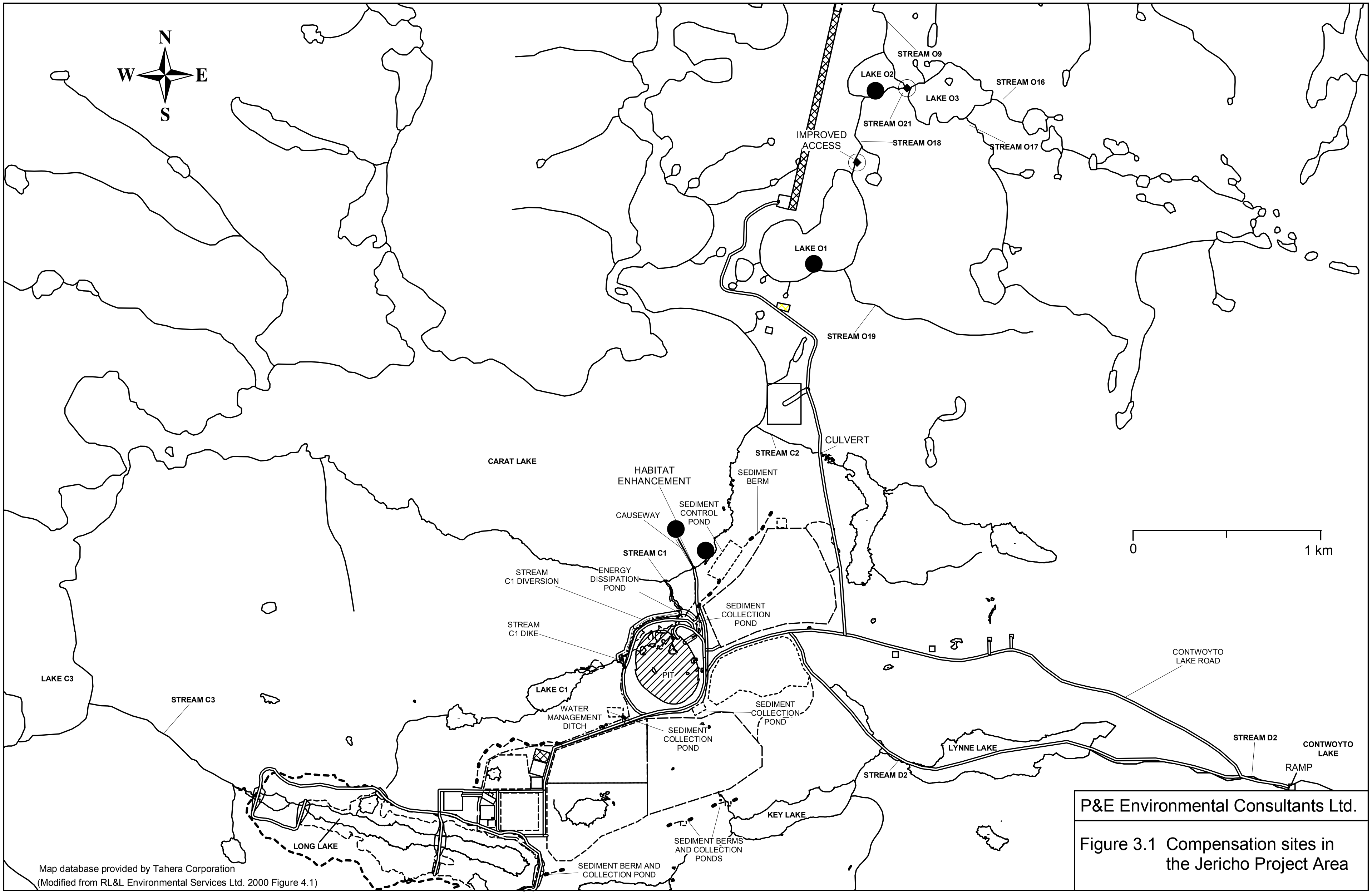
1. Creation of habitats similar to those that are impacted in the same or adjacent waterbodies (Habitat Enhancement).
2. Improving access to habitats similar to those that are impacted in adjacent waterbodies (Improved Access).

3.2.1 Habitat Enhancement

Habitat enhancement will entail construction of high quality spawning, rearing, and feeding habitats in lakes and streams. The species and life stage targeted by the enhancement are those that are affected by the Project. The primary target species are Arctic grayling, Arctic char, lake trout, burbot and slimy sculpin. In lakes, enhancement will provide sheltered areas that promote warmer water temperatures and increased food production that can be used as rearing habitats for young-of-the-year and juvenile fish. Most importantly, enhanced sites will provide shelter to small fish from larger predators. Enhanced areas will provide spawning habitat for slimy sculpin. The perimeter zones of enhanced sites will provide feeding habitat for larger adult fish.

Enhancement will target locations within selected waterbodies that presently contain limited amounts of these habitats (Figure 3.1). Candidate sites include the perimeter of the causeway, the southeast shore of Carat Lake that is sheltered from wave action by the causeway, and two lakes situated to the north of the mine site. Lake O1 and Lake O2 are small sheltered waterbodies located in an esker complex east of the existing airstrip. These lakes presently support fish populations, but each exhibit very low habitat complexity. Small streams are the only rearing habitats available to small fish in these systems.

The proposed enhancement locations are accessible to heavy equipment during the winter, they are located in sheltered areas (all except the causeway), their shorelines exhibit gradual slopes, and they are presently limited by a lack of good quality rearing habitat.



P&E Environmental Consultants Ltd.

Figure 3.1 Compensation sites in the Jericho Project Area

Enhanced areas will be constructed using large rock materials available from the mine site. It is anticipated that rocks can be placed on the ice in winter. They will melt through the ice in spring and fall to the lake bottom where they will create fish habitat. The exact design and dimension of enhanced sites have yet to be finalized. The causeway perimeter will be enhanced by using large rock materials instead of the standard grade waste rock originally proposed for construction of the causeway. Assuming that a 2 m band around the entire perimeter of the causeway is enhanced, this will create 390 m^2 of high quality habitat. In each of Carat, O1, and O2 lakes, discrete areas of shoreline will be enhanced. Assuming each site is 6 m wide and 100 m long, 600 m^2 of habitat will be created in each lake.

Habitat enhancement can also be undertaken in streams. There is a candidate watercourse (Stream O9) located north of the mine site that is presently used by fish, that is accessible to heavy equipment, and that has a limited amount of good quality spawning and rearing habitat (Figure 3.1). Approximately 400 m of stream is available for enhancement. Boulder clusters can be placed in the channel, which has an average width of 1.5 m to provide physical cover for fish. In addition, small gravels used as spawning substrates can be distributed on the channel bottom in select locations. If the entire section were enhanced, 600 m^2 of high quality rearing habitat and spawning habitat would be created. The three species that would benefit most from enhancement would be Arctic grayling, Arctic char, and slimy sculpin.

The proposed enhancement will create a total of 2,790 m^2 of high quality habitat (Table 3.2). The enhancement will compensate for most of the habitats impacted by Project activities (2,153 m^2). These include areas affected by the access ramp on Contwoyto Lake (150 m^2), the causeway on Carat Lake (1,395 m^2), the diversion on Stream C1 (387 m^2 in stream and 40 m^2 in lake) and dewatering of Stream C3 caused by the PKCA (181 m^2).

In order to maximize the benefits of habitat enhancement, design specifications will incorporate characteristics that benefit fish and that are technically feasible. Careful consideration will be given to placement of the enhanced sites to ensure that existing habitats that are important to fish are not adversely affected (e.g., spawning areas).

The proposed habitat enhancement is not sufficient to address the impacts associated with loss of the Long Lake System by construction of the PKCA. Short of creating a new lake, the large amount of compensation (92,500 m^2) would be extremely difficult to achieve. Upon mine closure, the mine pit could be developed as a suitable fish-bearing lake. Unfortunately, at least 180 years will be required to fill the basin (Final EIS Project Description, Appendix A.1), which makes it unsuitable for immediate compensation of Project effects. These constraints place severe limitations on options available for habitat compensation, which necessitates a novel approach to the problem.

Table 3.2 Summary of habitat compensation proposed for the Jericho Diamond Project.

Type	Environment	Location	Target Habitat Type (Species)[a]	Compensation (m^2)
Habitat Enhancement	Lake	Causeway	Spawning (SLSC)/Rearing/Feeding (All)	390
		Carat Lake	Spawning (SLSC)/Rearing/Feeding (All)	600
		Lake O1	Spawning (SLSC)/Rearing/Feeding (All)	600
		Lake O2	Spawning (SLSC)/Rearing/Feeding (All)	600
		Total		**2190**
	Stream	Stream O9	Spawning (SLSC/ARGR)/Rearing (All)	600
		Total		**600**
Improved Access	Lake	Lake O1	Spawning/Rearing/Feeding/Overwintering (All)	181,000
		Lake O2	Spawning/Rearing/Feeding/Overwintering (All)	53,000
		Lake O3	Spawning/Rearing/Feeding/Overwintering (All)	83,000
		Total		**317,000**
	Stream	Stream O16	Spawning (SLSC/ARGR)/Rearing (All)	15
		Stream O17	Spawning (SLSC/ARGR)/Rearing (All)	110
		Stream O18	Spawning (SLSC/ARGR)/Rearing (All)	270
		Stream O19	Spawning (SLSC/ARGR)/Rearing (All)	75
		Stream O21	Spawning (SLSC/ARGR)/Rearing (All)	225
		Total		**695**

[a] ARGR -- Arctic grayling; SLSC -- Slimy sculpin; All -- all species found in the waterbody.

3.2.2 Improved Access

Access to critical habitats can limit the productive capacity or even prevent establishment of a fish population. Access to spawning habitats, rearing, and overwintering habitats likely limit the productive capacity of fish populations in the Project area. Habitat enhancement plans described in Section 3.2.1 will provide access to suitable habitats for fish populations that reside in the enhanced waterbodies. However, there are opportunities to improve fish access to suitable habitats between waterbodies.

There are a number of physical barriers in the Jericho Diamond Project area that limit fish access. The barriers of interest are located in the 'O' series of lakes situated north of the mine site (Figure 3.1). Streams in the 'O' series watershed drain into the Jericho River, which flows into Kathawachaga Lake. The fish community in the 'O' series lakes is, in part, affected by the ease of fish movement between the lakes via the interconnecting streams. This is particularly evident for Arctic grayling, which is a species that becomes progressively less abundant the farther upstream a waterbody is situated within the system, even though there is an abundance of suitable habitat. A likely reason for this distribution pattern is the existence of barrier to fish passage.

The two barriers of interest include a small cascade located on Stream O18 and a shallow ill-defined section of Stream O21 (Figure 3.1). Stream O18 is a 450 m watercourse that connects Lake O1 to Lake O2. Stream O21 is a short (90 m), shallow, ill-defined watercourse that connects Lake O2 to Lake O3.

Fish passage likely is possible at both sites during high flows of early summer, but they are complete barriers when water levels drop following the freshet. These barriers prevent access to important habitats. For fish that reside in Lake O1 the barrier on Stream O18 prevents access to high quality rearing habitats in this watercourse. Fish that do manage to cross the barrier are unable to return to Lake O1 to overwinter. The barrier on Stream O18 likely is sufficient to hinder movement of adult Arctic grayling to spawning areas in the Lake O1 system.

Stream O21 allows fish movement between Lakes O2 and O3 during high water, but falling water levels in summer can severe the connection. This blockage can be detrimental for migratory fish such as Arctic grayling that may move into Lake O3 system to spawn. It is likely that Arctic grayling originating from Kathawachaga Lake move into the Lake O3 system to take advantage of spawning habitats, but are prevented from returning back to overwintering areas. The trapped fish likely suffer high mortality rates caused by lake trout predation, and therefore, are lost to the population.

Eliminating barriers would improve fish access between several waterbodies. It would increase the availability of important fish habitats and prevent stranding of fish in unsuitable areas. Removal of these two particular barriers is technically feasible, but the exact approach to be used has not been finalized. If both barriers were removed the amount of habitat that would become more accessible to fish would be substantial (Table 3.2). This includes 317,000 m^2 of habitat in three lakes and 695 m^2 of habitat in 5 streams. The gain in habitat by improving access could be used to offset the loss in habitat caused by construction of the PKCA.

If this compensation option is accepted, a number of approaches could be used to improve fish passage. Regardless of the method used, care will be required to ensure that the flow regime associated with the drainage is not altered (e.g., maintain appropriate lake levels). Also, the fish passage facilities should be designed to limit access to large predator fish, which may be attracted to the newly available habitats.

4.0 SUMMARY

Tahera has used a structured approach to achieve a habitat compensation plan that meets the requirements of DFO. Fish habitats affected by specific Project activities were identified and the effectiveness of proposed mitigation measures evaluated. Where Project effects could not be fully mitigated and there was a HADD resulting in the need for compensation, affected habitats were quantified and characterized in terms of their importance to fish.

Project activities will impact 2,153 m^2 of fish habitat in four locations. These include the access ramp on Contwoyto Lake (150 m^2), the water intake causeway on Carat Lake (1395 m^2), introduction of suspended sediments during construction and maintenance of the diversion into Stream C1 (387 m^2) and Carat Lake (40 m^2), and altered flow of Stream C3 from the PKCA (181 m^2). The majority of these areas were characterized as rearing habitats for fish residing in the affected waterbodies, although, spawning and feeding habitats were also affected. A fifth Project activity, construction of the PKCA, will remove waterbodies in the Long Lake System from production, which represents 92,500 m^2 of marginal habitat.

The compensation proposed by Tahera is based on the type of habitat affected and the availability of habitat compensation opportunities. The proposed compensation plan is conceptual, but is technically feasible. Tahera acknowledges that detailed design specifications are required before implementation. The compensation plan adheres to the no net loss principle and the need to maintain habitat productive capacity as recommended by DFO. The plan's fundamental goal is to ensure the long-term viability of the fish community in the Project area.

Compensation targeted habitats thought to be limiting fish populations in the Project area. The compensation plan proposed for the Jericho Diamond Project used two approaches to achieve this goal, which included creation of habitats similar to those that were impacted in the same or adjacent waterbodies (Habitat Enhancement) and improving access to habitats similar to those that were impacted in adjacent waterbodies (Improved Access).

<u>Habitat Enhancement</u>

Habitat enhancement will entail construction of high quality spawning, rearing, and feeding habitats in lakes and streams. The species and life stage targeted by the enhancement are those that are affected by the Project. The primary target species are Arctic grayling, Arctic char, lake trout, burbot and slimy sculpin. In lakes, enhancement will provide sheltered areas that promote warmer water temperatures and increased food production that can be used as rearing habitats for young-of-the-year and juvenile fish. Lake sites will provide shelter to small fish from larger predators, as well as provide spawning habitat for slimy sculpin. The perimeter zones of enhanced lake sites will provide feeding habitat for larger adult fish. Stream enhancement will focus on creation of high quality rearing habitat for all species and spawning habitat for Arctic grayling.

Habitat enhancement will target four locations within selected lakes and one stream that presently contain limited amounts of these habitats. These include the perimeter of the causeway, the southeast shore of Carat Lake, as well as Lakes O1 and O2 and Stream O9, which are situated to the north of the mine site.

Enhanced areas will be constructed using large rock materials available from the mine site. In lakes, rocks will be placed on the ice in winter over discrete areas of selected lake shorelines. In Stream O9 boulder clusters can be placed in the channel. In addition, small gravels used as spawning substrates can be distributed on the channel bottom in select locations. The proposed habitat enhancement will create 2,790 m^2 of high quality habitat, which will compensate for most of the habitats impacted by the Project.

Improved Access

The proposed habitat enhancement is not sufficient to address the impacts on the Long Lake System caused by construction of the PKCA. Short of creating a new lake, the large amount of compensation would be extremely difficult to achieve through creation of new habitat. These constraints necessitate use of a novel approach to compensation.

Access to critical habitats may limit the productive capacity of fish populations in the Project area. There are opportunities to improve fish access between waterbodies; therefore, barrier removal has been put forward as a compensation option. The barriers of interest are located in the ‘O’ series of lakes situated north of the mine site. The fish community in this drainage is, in part, affected by the ease of fish movement between the lakes via the interconnecting streams.

The two barriers targeted for compensation are a cascade on Stream O18 and a shallow ill-defined section of Stream O21. Eliminating these barriers would improve fish access between several waterbodies, increase the availability of important habitats to fish, and prevent stranding of fish in unsuitable areas. Removal of the barriers is technically feasible, but the exact approach to be used has not been finalized. If both barriers were removed, 317,000 m^2 of habitat in three lakes and 695 m^2 of habitat in 5 streams would become available. The gain in habitat by improving access could be used to offset the loss in habitat caused by construction of the PKCA.

5.0 LITERATURE CITED

Department of Fisheries and Oceans. 1986. The Department of Fisheries and Oceans policy for the management of fish habitat. 28 p.

Department of Fisheries and Oceans. 1995. Fish habitat protection guidelines - road construction and stream crossings. 25 p. + 3 app.

Department of Fisheries and Oceans. 1998a. Habitat conservation and protection guidelines. Developed from the Policy for the Management of Fish Habitat (1986). 2nd Edition (1998). 25 p.

Department of Fisheries and Oceans. 1998b. Decision framework for the determination and authorization of harmful alteration, disruption or destruction of fish habitat. 22 p.

Diavik Diamonds Project. 1998. Environmental effects report, Fish and Water. 309 p.

Furniss, M.J., T.D. Roelofs and C.S. Yee. 1991. Road construction and maintenance. Pages 297-323 in Influences of forest and rangeland management on salmonid fishes and their habitats. Edited by W.R. Meehan. American Fisheries Society Special Publication 19, Bethesda, Maryland.

INAC and TFN (Indian and Northern Affairs Canada and Tungavik Federation of Nunavut). 1993. Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada. Ottawa, Ontario: INAC and TFN.

P&E Environmental Consultants Ltd. 2002. Jericho Project Aquatic Biota EIA Amendment. Prepared for Tahera Corporation. P&E Report No. 01002F: 62 p.

R.L. & L. Environmental Services Ltd. 1996. Jericho Diamond Project Aquatic Studies 1995. Report prepared for Canamera Geological Ltd. R.L. & L. Report No. 462BF: 122 p. + 10 app.

R.L. & L. Environmental Services Ltd. 1997. Jericho Diamond Project Aquatic Studies Program (1996). Report prepared for Canamera Geological Ltd. R.L. & L. Report No. 501F: 239 p. + 9 app.

R.L. & L. Environmental Services Ltd. 2000a. Jericho Diamond Project Aquatic Studies Program (1999). Report prepared for Tahera Corporation. R.L. & L. Report No. 738F: 93 p. + 5 app.

R.L. & L. Environmental Services Ltd. 2000b. Jericho Diamond Project Aquatic Studies Program (2000). Report in preparation for Tahera Corporation. R.L. & L. Report No. 857AD.