REVISED FISH HABITAT NO NET LOSS PLAN
- JERICHO PROJECT -

Prepared for

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

By

Mainstream Aquatics Ltd.
6956 Roper Road
Edmonton, Alberta
T6B 3H9

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mainstream
AQUATICS LTD

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1.0 INTRODUCTION

1.1 BACKGROUND

The Jericho Diamond Project, subsequently referred to as the Project, constitutes an application by Tahera Diamond Corporation (Tahera) to construct and operate a diamond mine in Nunavut near the northwest corner of Contwoyto Lake (65° 59' 50" Latitude, 111° 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.

Under the *Fisheries Act*, Fisheries and Oceans Canada (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, some Project components will have unavoidable impacts. As such, Tahera requires authorization from DFO under Section 35 (2) of the Fisheries Act. In order to obtain authorization, they are obligated to provide a fish habitat no net loss plan 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, which include areas that currently produce fish, or could potentially produce fish for harvest in subsistence, commercial, or recreational fisheries (DFO 1998a). 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.

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 required is site specific, 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.).

1.3 APPROACH

This document presents a structured approach to achieve 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 characterized in terms of their importance to fish.

The compensation plan components are based on the type of habitat affected and the availability of compensation opportunities. The compensation plan is conceptual, but is technically feasible (Tahera, pers. comm.). It is acknowledged 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 PROJECT ACTIVITIES

Evaluations of Project activities that affect fish and fish habitats have been previously completed and are outlined in supporting documents submitted to the Nunavut Impact Review Board (NIRB) during the regulatory review of the Jericho Diamond Project. This section is based on information presented in those documents, as well as materials currently being developed in preparation for licensing by the Nunavut Water Board (NWB). All supporting documents are referenced where appropriate. This section will consider only those activities that have the potential to affect fish habitat. These are as follows:

1. Permanent and Winter Roads
2. Water Intake Causeway
3. Processed Kimberlite Containment Area (PKCA)
4. PKCA Discharge
5. Mine Pit Diversion
6. Water Management Plan

2.1 ROADS

2.1.1 Description

Mine operation will require use of permanent and winter roads (Figure 2.1; Table 2.1). The permanent road network will require two crossings of streams that contain fish habitat. The first crossing, on Stream C1, is needed to access the Carat Lake water intake and will be located immediately downstream of the diversion dyke. The crossing will consist of a culvert overlain by rock fill built up to the appropriate elevation. The second crossing, on Stream C2, will be located along the existing road alignment that connects the exploration camp to the mine area. The culvert that is presently in use will be replaced to upgrade the existing crossing.

A winter road along an established route will be used to access Contwoyto Lake. The winter road will traverse two intermittent watercourses (Streams D1 and D2) and cross Lynne Lake. By necessity, winter road construction and operation will occur when the water courses and lakes are frozen.

DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	CHK'D	APP'D	DATE	REV.	ISSUE PURPOSE	AUTH. BY	DATE
							A	WATER LICENSE APPLICATION	CCS	JUNE 2004

REFERENCE DRAWINGS — REVISIONS — ISSUE AUTHORIZATION

WATER LICENSE APPLICATION

SRK Consulting
Engineers and Scientists

DESIGNED BY: CCS — DRAWN BY: JM
DATE: APRIL 2004 — DATE: MAR. 2004
CHECKED BY: CCS — DISCIP. ENGR.
DATE: JUNE 2004 — DATE:
PROJ. MGR: — PROJ. ENGR.
DATE — DATE
SRK PROJECT NUMBER: 1CT004.06

Tahera Corporation

JERICHO PROJECT

Figure 2.1

GENERAL ARRANGEMENT
AT END OF DECEMBER 2013

DRAWING NUMBER: 1CT004.06 – G12
REV. A

Table 2.1 Project activities, phases, potential effects on fish habitat in affected waterbodies, and the potential need for habitat compensation, Jericho Project.

Project Component	**Potential Effect**	**Phase**			**Waterbody[a]**									**Fully Mitigated**	**Potential Need for Habitat Compensation**
					Lake				**Stream**						
		Construction	**Operation**	**Closure**	**Carat**	**C3**	**Long**	**Lynne**	**C1**	**C2**	**C3**	**D1**	**D2**		
1) Permanent and Winter Roads	1) Altered flow.	x	x						x	x		x	x	Yes	No
	2) Water quality degradation.	x	x					x	x	x		x	x	Yes	
	3) Foot print of culvert.	x	x						x	x				Yes	
2) Water Intake Causeway	1) Water quality degradation.	x		x	x									Yes	Yes
	2) Foot print of causeway.	x	x	x	x									Partial	
	3) Altered shoreline water currents.	x	x	x	x									Yes	
3) PKCA[b]	1) Foot print of PKCA.	x	x	x			x							No	Yes
4) PKCA Discharge	1) Altered water flow.	x	x								x			Yes	Yes
	2) Water quality degradation.	x	x	x							x			No	
5) Stream C1 Diversion	1) Water quality degradation.		x						x					Yes	Yes
	2) Foot prints of dyke and diversion outlet.		x	x					x					Partially	
	3) Dewatering of stream channel.		x	x					x					Partially	
6) Stream C1 Water Management	1) Altered water flow.		x	x					x					No	Yes
	2) Water quality degradation.	x	x	x					x					Yes	

[a] Waterbodies identified in Figure 2.1; Long Lake includes lake and one unnamed pond to the north.

[b] Processed Kimberlite Containment Area.

Based on information supplied by Nuna Logistics (the probable winter road contractor) 5,700 m^3 of water will be required to make snow for the winter road. Over half of that will be drawn from Contwoyto Lake. The remainder of winter road water requirements will be drawn from Lynne Lake whose volume is over 1,000,000 m^3 (Table 5.1.1, RL&L 1997). The anticipated water withdrawal from Lynne Lake (2850 m^3) constitutes 0.27% of the lake volume and thus no negative effects will accrue to fish habitat or fish populations from water use for the winter road.

Upon closure of the mine, all drainage structures (culverts) and permanent roads will be removed, and the sites reclaimed (Abandonment and Restoration Plan, AMEC 2004a).

2.1.2 Potential Effects and Mitigation

All streams traversed by permanent and winter roads freeze to the channel bottom during winter; therefore, potential effects would occur only during the open water period. The effects related to fish and fish habitats are as follows:

- Water quality degradation through introduction of sediments.
- Change in stream flow due to altered surface runoff.
- Removal of fish habitat.

The watercourse crossings will be designed and constructed to meet the federal policy of no net loss of productive fish habitat (DFO 1986). Each culvert will be designed with input from a structural engineer and qualified fish biologist to ensure proper drainage capacity and to allow fish passage. Detailed design drawings of the culvert crossings will be completed during the final design phase.

Mitigation measures will be used that meet or exceed recommendations specified in *Fish Habitat Protection Guidelines for Road Construction and Stream Crossings* (DFO 1995). Specifically, culverts will be designed to pass fish and measures will be used to prevent degradation of stream water quality and alteration of surface water flow. This will include use of established protocols and 'fish friendly' culvert designs (Furniss *et al.* 1991; DFO 1995; Washington Department of Fish and Wildlife 1999; Alberta Transportation 2002).

Permanent road crossing locations on Streams C1 and C2 are not fish-bearing sections (RL&L 1997, Section 3.6.2.1, Appendix G2; RL&L 2000a, Sections 3.4.2.1 and 4.2.1, Appendix D6; RL&L 2000b Sections 3.3.1.2 and 3.4.2, Appendix D6). Fish inventories during multiple years established that fish are limited to within 100 m of lake confluences. The crossings are situated well upstream of these points (785 m on Stream C1 and 430 m on Stream C2). As such, affected habitats on each stream are not physically used by fish.

The winter road crossings over streams that are frozen to the channel bottom are considered temporary (DFO 1995). Because the winter road will be constructed without disturbance to the stream bed or its banks, effects will be negligible.

2.1.3 Need for Habitat Compensation

The permanent road crossing will require use of culverts. Appropriate design and mitigation measures will allow fish passage, and prevent degradation of water quality and subsequent effects on downstream fish habitat. The culverts will physically alter the stream bed of each channel, but the affected sections are not used by fish. In addition, the effects of the culverts are temporary because the crossing will be reclaimed at mine closure. As such, potential effects associated with permanent and winter road stream crossings will be fully mitigated. Therefore, habitat compensation for these Project activities is not required.

2.2 WATER INTAKE CAUSEWAY

2.2.1 Description

A water intake and transfer system will supply potable water from Carat Lake to the camp and raw water to the mine and processing plant (Drawing W6, Site Water Management Report, SRK 2004a). The system will consist of an intake pump, intake pump well casing, pipeline, and causeway. The causeway, which is needed to access deeper water and for operational and maintenance reasons, will be constructed from the shoreline of Carat Lake 205 m west of the outlet of Stream C1 (Figure 2.1).

The causeway will be constructed during winter using clean rock fill and will extend approximately 100 m offshore to a water depth of 4.0 m to 5.0 m. The intake pump well casing placed at the offshore end of the causeway will be surrounded by clean rock fill, which will serve as a filtration system. At closure the water pipeline and intake pump will be removed and the causeway will be excavated below the water level.

2.2.2 Potential Effects and Mitigation

The potential effects of the causeway on fish habitat are as follows:

- Water quality degradation through introduction of sediments.
- Foot print of the causeway.
- Altered shoreline processes.

Construction of the causeway has the potential to affect adjacent fish habitats by introduction of suspended sediments. Use of clean rock fill and construction during the winter period will largely eliminate this effect. Monitoring suspended sediment levels will occur during ice melt.

The footprint of the causeway will remove shoreline fish habitat from production. This effect will be mitigated as follows:

- Construct the minimum length of the causeway needed to ensure a water intake is below ice level.
- Modify the size of rock materials placed along the causeway margins. Use of larger rock materials will increase the amount and quality of habitat that is presently available to fish along the affected shoreline.
- At closure, use the causeway to create high quality fish habitat in the form of a rock reef.

The causeway could have indirect effects on adjacent fish habitats by altering along-shore currents. To mitigate the effects on along-shore currents mitigation measures to be employed will be to construct the minimum length of the causeway needed to protect the intake from ice damage.

Incorporation of culverts into the causeway structure to facilitate water movement was considered. Several negative impacts were identified if culverts were placed in the causeway. During winter, water in the culvert will freeze resulting in potential damage to the culvert and heaving of the causeway. After consideration of these issues, beneficial use of culverts to mitigate potential alteration of along-shore movements was judged to be unlikely (Tahera, pers. comm.).

A detailed discussion of causeway effects on along-shore currents (Memorandum A: Response to outstanding items to allow DFO to conclude EA, Mainstream 2004) took into account the causeway position, location of adjacent fish habitats, and the characteristics of those habitats. It concluded that the indirect effects on fish habitat by altering along-shore currents would be negligible.

2.2.3 Need for Habitat Compensation

Construction of the causeway will cause physical loss of fish habitat. Measures implemented during operation and closure will mitigate a portion or all of those losses. As such, the requirement for habitat compensation needs further investigation.

2.3 PROCESSED KIMBERLITE CONTAINMENT AREA

2.3.1 Description

The Processed Kimberlite Containment Area, or PKCA (Figure 2.1), will be used to store the fine fraction generated by the processing operation, discharge from the waste water treatment system, and runoff from the mine site. Construction of the PKCA will inundate two fish-bearing waterbodies collectively termed the 'Long Lake System'. These include Long Lake and an unnamed pond perched above Long Lake along its northern shore.

On closure, the dry portions of the PKCA will be rehabilitated, leaving a much smaller, shallower basin at its western end. This waterbody will not support a viable fish population.

2.3.2 Potential Effects and Mitigation

Formation of the PKCA will result in permanent loss of fish habitat that presently supports slimy sculpin and burbot populations (Long Lake) and a slimy sculpin population (unnamed pond). Potential mitigation for loss could entail creation of a lake from the mine pit following closure. An evaluation of this option concluded that current estimates of long-term water quality in the pit lake indicate that it may not meet CCME guidelines for receiving waters (Technical Memorandum Q: Post Closure Pit Lake Quality, SRK 2004b). Therefore, use of a pit lake as mitigation is not appropriate.

2.3.3 Need for Habitat Compensation

Habitat compensation will be required.

2.4 PKCA DISCHARGE

2.4.1 Description

The effects of the PKCA on fish habitat are discussed in Section 2.2. This section will focus on the effects of PKCA discharge on Stream C3 fish habitat. The PKCA will store fine processed kimberlite, runoff from the mine area, and treated wastewater from the camp during mining operations (Memorandum W: Site Water Management, SRK 2004a). Water will need to be discharged from the PKCA on a seasonal basis because the site has a positive water balance. Stream C3 will be used as the conduit for PKCA discharge water to Lake C3 during construction and operation (Figure 2.1).

During the construction phase, a partial draining of Long Lake will be completed (Technical Memorandum P: Design of the Processed Kimberlite Containment Area, SRK 2004c). Commencing in late summer, pumping of water from Long Lake will commence. The lake will be pumped down by approximately 100,000 m^3 over an estimated 50 days. The pump rate will not exceed the estimated pre-construction flow of Stream C3 at the Long Lake outlet (0.0235 m^3/s; Table 2.2). Frozen core dam construction of the west dam at the outlet of Long Lake would take place during the ensuing winter months.

Table 2.2. Estimated monthly flows in Stream C3 during the open water period (from Table W2, Technical Memorandum W: Site Water Management, SRK 2004a).

Flow at Outlet of Long Lake (m^3/s)			
Month	**Pre-Construction**	**Operation**	**Post-closure**
May	0.0014	0.0000	0.0004
June	0.0235	0.1165	0.0242
July	0.0056	0.0276	0.0042
August	0.0066	0.0280	0.0062
September	0.0034	0.0139	0.0032

During operation, discharge from the PKCA will be released into Stream C3 during non-winter months at a controlled rate by pumping (Table 2.2). While it will be necessary to meet Project water license discharge criteria at Lake C3, conservative estimates of water quality indicate that the concentration of several constituents are not expected to meet CCME (1999) guidelines for receiving waters during transit through Stream C3 (Table 2.3).

The amount of water released will depend on the volume stored in the PKCA and quality of the discharge. The operational goal will be to maintain the freestanding water level near the current natural elevation by pumping out water that meets the Project license water quality criteria.

Table 2.3 Constituent concentrations in PKCA discharge during operation and post-closure with comparison to CCME (1999) guidelines for receiving waters (from Tables 2 and 5, Technical Memorandum N: Estimates of Receiving Water Quality, SRK 2004d).

Parameter mg/L, or specified	Receiving Water Background Concentration	Estimated Operation Water Quality from PKCA	Estimated Post-Closure Water Quality from PKCA	CCME Guidelines for Receiving Waters
Aluminum - Al	0.052	0.49	0.019	0.1
Ammonia – N (unionized)	0.00001	0.075	0.014	0.016
Ammonia - N (total)	0.009	1.8	0.33	0.59
Cadmium – Cd	0.00005	0.0008	0.0004	0.000017
Copper – Cu	0.002	0.020	0.0031	0.002
Iron – Fe	0.025	0.63	0.18	0.3
Lead – Pb	0.00005	0.0038	0.0012	0.001
Nickel – Ni	0.0005	0.042	0.017	0.025
Nitrate - as N	0.18	5.0	0.83	4.0
Nitrite - as N	0.001	0.16	0.024	0.06
pH	6.63	8.2	8.2	6.5
Total Dissolved Solids	11	1074	440	na
Total Suspended Solids	1.4	6.3	3	5

PKCA discharge scenarios include the following:

1. The expected base case will be discharge to Stream C3 each year during the open water period as water meets Project water license criteria.
2. If the water does not meet discharge criteria, pumping will be temporarily discontinued. Pumping would resume as soon as the monitoring indicates that discharge criteria can be met.
3. Under the unlikely scenario where discharge is not possible for a given year, inflows will be stored until the following year. During the one year storage period, a pilot spray irrigation test will be undertaken to establish that spray irrigation will provide a viable means of removing nutrients and metals from the discharge (Spray Irrigation Plan, AMEC 2004b). For the purposes of the assessment it is assumed that a full scale spray irrigation system could be implemented if treatment is required to meet discharge criteria.
4. The next scenario will be to store water for a second consecutive year. Two years of natural runoff added to the PKCA will provide additional dilution, settling and attenuation, likely resulting in improved water quality suitable for discharge.

Under the first (base case) scenario annual water flow will be maintained in Stream C3. Under Scenarios 2 to 4, water flows may be reduced or eliminated for an extended length of time depending on the strategy. Under the worst-case scenario (#4), complete stoppage of all PKCA discharge into Stream C3 would not exceed two years.

The base case is the expected PKCA discharge scenario.

On mine closure, the PKCA will be reclaimed (Abandonment and Closure Plan, AMEC 2004a). During post-closure, the catchment area will approximate the pre-development area and runoff from the mine site area will not be directed to the reclaimed PKCA. As such, the flow regime will approximate pre-development conditions (Table 2.2). Following closure water quality of the PKCA discharge for most constituents is expected to return to pre-development conditions (Table 2.3). Concentrations of some constituents (cadmium and copper) are expected to remain above CCME (1999) guidelines for receiving waters.

2.4.2 Potential Effects and Mitigation

PKCA discharge will have two potential effects on Stream C3 fish habitat as follows:

- Water quality degradation.
- Altered flow regime.

During construction mitigation measures will be used to ensure no adverse effects on fish habitat. First, suspended sediment concentrations in discharged water will be controlled by adjusting the pumping rate. If water quality criteria are exceeded pumping will be stopped. Second, the average pumping rate (0.0235 m^3/s) will create flows that are within the expected average monthly discharge capacity of Stream C3 (Table 2.2), which will eliminate the risk of increased bank erosion.

During construction increased water flow will improve the quality of Stream C3 fish habitat. Stream C3 is a small stream that exhibits base water flows of $<0.007 m^3/s$ during July, August and September (Table 2.2). As a consequence of this flow regime, habitat quantity, quality, and fish use of the system are limited (RL&L 1997 Appendix H; RL&L 2000a, Section 3.4.2.2, Tables 3.15 and 3.16, Appendices B4 and D6; RL&L 2000b Section 3.3.1.2, Table 3.9, Figure 3.16, Appendix D6). Augmentation of water flow will enhance habitat conditions resulting in a positive effect.

During operation, suspended sediment concentrations in PKCA discharge (estimated at 6.6 mg/L) could be above the average pre-construction background concentration of 3 mg/L and slightly above the CCME (1999) guideline for the protection of aquatic life of 5.0 mg/L (Table 2.3). This slightly elevated concentration of suspended sediments may result in alteration of fish habitat in Stream C3.

During operation, it is possible that elevated levels of several other constituents may cause chronic toxicity to fish (Table 2.3). The 1051 m travel distance to Long Lake will result in degradation of some constituents and some dilution of constituent concentrations; however, the magnitude of this effect cannot be predicted with certainty (Technical Memorandum N: Estimates of Receiving Water Quality, SRK 2004d).

To mitigate the adverse effects of chronic toxicity on fish health should these levels of toxicity be present, measures would be taken to prevent fish movement into Stream C3. This could be achieved by constructing a physical barrier to fish passage at the outlet of the stream. The barrier will consist of a vertical drop that exceeds the swimming capacity of fish. At the end of the operation phase, the barrier will be removed. Although the mitigation measure relates to fish health, this would constitute as temporary removal of Stream C3 fish habitat during operation. As a conservative approach, it is assumed that Stream C3 habitat will be removed until monitoring of PKCA discharge demonstrates otherwise.

During operation there is the potential that the PKCA releases could cause bank erosion and degradation of fish habitat. Stream C3 is a small, ill-defined watercourse dominated by large rock materials overlain by organics (RL&L 2000a, Table 3.16 and Appendix B4). The estimated 10 year return period pre-development peak flow is 0.28 m^3/s at the PKCA outlet and 0.47 m^3/s at the outlet to Lake C3. These flows are two to four times higher than the expected operational peak release discharge of 0.1165 m^3/s (Clearwater Consultants Ltd., pers. comm.). Given that the bank materials are dominated by large rock and the watercourse has been regularly subjected to higher flows in the past, it is unlikely that operational flows will cause erosion.

Potential erosion issues will be mitigated by implementing prudent operational practices. The measures to be used are as follows:

- Inspection of Stream C3 for potential erosion sites by a qualified hydrologist.
- Regular monitoring of Stream C3 during discharge to identify active erosion sites.
- Use rock armouring to protect erosional areas where appropriate.

Following closure, Stream C3 flow regime will return to pre-construction conditions and water quality is expected to approach CCME guidelines for receiving waters (Table 2.3). As such, fish habitat in Stream C3 will return to pre-construction conditions.

2.4.3 Need for Habitat Compensation

Stream C3 fish habitat will not be adversely affected during construction or closure phases of the Project because effects will be positive (construction) or neutral (closure). During operation potential erosion will be fully mitigated. However, water quality impacts to fish health may require exclusion of fish from Stream C3. This potential temporary effect during the eight-year span of mine operation will require habitat compensation.

2.5 STREAM C1 DIVERSION

2.5.1 Description

The footprint of the pit will include a section of Stream C1 (Figure 2.1). To prevent flooding into the pit, a channel will be constructed along the planned ultimate western perimeter to divert water around the work area. The diversion system will consist of a dyke to divert water out of Stream C1, a diversion channel to transport the water around the mine pit, and an outlet at the downstream end of the channel to return diverted water back into Stream C1. The diversion system will be built in Year 1 and will be operational in Year 2.

The diversion system will be designed to accommodate 1-in-200 year return period flow event and ensure long-term stability of the structure (Memorandum W: Site Water Management, SRK 2004a). The dyke will divert all flow from Stream C1 into the diversion channel at a point 761 m upstream from Carat Lake. The water will be transported around the pit and discharged back into Stream C1 at a point 232 m upstream of Carat Lake.

The general arrangements of the diversion system and design specifications are illustrated in Drawings W2 and W3 in Memorandum W: Site Water Management (SRK 2004a). The dyke will consist of mined rock materials and will be approximately 20 m wide. The diversion channel will consist of three sections. Reach A of the diversion (first 174 m) will be excavated into bedrock. Reach B of the diversion will then transition through a rock chute 146 m long terminating in a small dissipation pond. Water will then flow into a 150 m long lined channel excavated into the active layer of the overburden materials (Reach C). Water will discharge into Stream C1 via a small transition pond.

On closure two options are available regarding continued diversion of Stream C1 flow (Abandonment and Restoration Plan, AMEC 2004a). Use of either option will depend on mine site runoff water quality post-closure and requirements of regulators. The option to be used cannot be established until several years of mine operation data are collected.

Option one involves taking a portion of the flow from the diversion during freshet periods and directing it into the pit. If this option were adopted minimum flows would be maintained in Stream C1 to satisfy fish habitat requirements. After the pit has filled and water quality is acceptable, water flow from the pit could be directed into the lower section of Stream C1. An alternative option would be to continue to divert all water flow through the diversion. Under both options the diversion would remain operational following mine closure.

2.5.2 Potential Effects and Mitigation

The potential effects of the Stream C1 diversion (Table 2.2) are as follows:

- Water quality degradation through introduction of sediments.
- Foot prints of the dyke and diversion outlet.
- Dewatering of the stream channel.

During construction, mitigation measures will be used to reduce the potential for degradation of water quality caused by introduction of sediments. Construction of the non-rock sections of the diversion channel as well as the upstream dyke and downstream dissipation pond will occur in winter when the stream and surrounding ground are frozen. The dyke, diversion, and ponds will be designed and built to proper engineering standards that address the special requirements of the Arctic environment (Technical Memorandum W: Site Water Management, SRK 2004a). In addition appropriate mitigation measures will be used to eliminate introduction of sediments (Furniss *et al.* 1991; DFO 1995).

Examples include:

- Construction during winter.
- Use of appropriate controls to prevent erosion and suspended sediment production.
- Monitoring water quality conditions during construction.
- Immediate rehabilitation of exposed banks.

During initial operation of the diversion, there will be an unavoidable flush of sediments from the channel through Stream C1 to Carat Lake. Because the diversion system will be designed to appropriate engineering standards, the potential effect on downstream habitat will be temporary and minor. In the event that problem areas are identified during operation the mitigation measures similar to those used for construction will be employed.

The footprints of the upstream dyke and downstream dissipation pond will remove fish habitat. In addition, the diversion will cause dewatering of fish habitat in the upper section of Stream C1. These impacts will be partially mitigated in three ways. First, the diversion channel will maintain water flows as part of the Stream C1 drainage. As such, the productive capacity of downstream habitat will be maintained, in terms of conveyance of nutrients and food (i.e., benthic invertebrates and zooplankton). Second, the entire length of the diversion channel can be viewed as an artificial stream that will contribute to downstream fish habitat by producing nutrients and food. Because the diversion channel length (470 m) replaces 89% of the affected section of Stream C1 (529 m), this represents partial mitigation. Third, a 150 m section of the diversion (Reach 3) will be naturalized thereby replacing a portion of fish habitat lost due to dewatering.

2.5.3 Need for Habitat Compensation

Appropriate engineering design and mitigation measures will eliminate potential effects on downstream fish habitat associated with degraded water quality caused by introduction of sediments. The footprints of the upstream dyke and downstream dissipation pond, and dewatering of the upper section of Stream C1 will result in permanent loss of fish habitat that likely can only be partially mitigated. As such, habitat compensation may be required.

2.6 STREAM C1 WATER MANAGEMENT

2.6.1 Description

A detailed overview of the mine site water management plan, which describes potential sources of contamination, water management facilities, and water management plan for each phase of the Project, is provided in the Memorandum W: Site Water Management (SRK 2004a) and illustrated in Drawing W1. In general, site runoff will be directed to the PKCA before release. Runoff meeting CCME (1999) guidelines for receiving waters will be released directly to the Project area waterbodies.

Part of the mine site water management plan requires diversion of mine site runoff from the Stream C1 basin. A detailed evaluation of potential effects associated with this diversion is presented in Mainstream (2004). Based on modeling, flows in Stream C1 during mine operation are predicted to be approximately 48% less than pre-construction flows at the mouth of Carat Lake (Table 2.4). Post-closure flows are predicted to be similar to operation flows based on the assumption that there will be no change in the post-closure water management plan (see Section 2.5.1, Abandonment and Restoration Plan, AMEC 2004a).

Table 2.4 Estimated monthly flows in Stream C1 during the open water period (from Table W2, Memorandum W: Site Water Management, SRK 2004a).

Month	**Flow at Mouth of Stream C1 (m^3/s)**			
	Pre-Construction	**Operation**	**Closure**	**Percent Reduction**
May	0.0062	0.0032	0.0032	48.4
June	0.0905	0.0483	0.0483	46.6
July	0.0265	0.0137	0.0137	48.3
August	0.0276	0.0145	0.0145	47.5
September	0.0139	0.0073	0.0073	47.5

2.6.2 Potential Effects and Mitigation

Redirecting surface runoff away from the Stream C1 basin has the potential to affect fish habitat in the lower section of Stream C1. Because water quality may not meet CCME guidelines, it may not be possible to direct mine site area runoff into Stream C1 as a mitigation measure. Removal of the drainage area by the mine pit, which accounts for a portion of the loss, also cannot be mitigated. Due to location, clean surface runoff that will be directed away from Waste Dump Site 1 by the C4 ditch also cannot be used (Technical Memorandum W; Site Water Management, SRK 2004a).

Since the flow regime will remain close to natural and water flow will be maintained during all months of the open water period the effects on fish habitat are not absolute (i.e., not a complete loss of habitat). A reduction in water flow will result in a reduction in the wetted surface area of fish habitat in Stream C1 downstream of the diversion. Field investigations documented fish use of Stream C1 under a flow regime similar to that being proposed during mine operation (RL&L 2000a and 2000b). The results suggest that the reduction in wetted surface area should not significantly affect fish use of the stream.

2.6.3 Need for Habitat Compensation

Given that there will be a reduction in wetted surface area, it is likely that there will be some effect on fish habitat and this impact cannot be mitigated. As such, habitat compensation may be required.

3.0 NO NET LOSS CALCULATIONS

The first step to identify appropriate compensation options involves the calculation of habitat losses before and following mitigation. This involves characterizing the quantity and quality of affected habitats. The result of this process provides a value that represents the net change in habitat that requires compensation. Section 2.0 identified five Project activities that may result in habitat loss as follows:

1. The water intake causeway in Carat Lake will cause a loss of shoreline fish habitat.
2. The PKCA will cause permanent loss of fish habitat in Long Lake and an unnamed pond.
3. The possible requirement to exclude fish from Stream C3 due to parameter concentrations that do not meet CCME guidelines for receiving waters may cause temporary loss of fish habitat caused by PKCA discharge.
4. The diversion system will cause permanent loss of fish habitat in Stream C1 either by physical removal (upstream dyke and downstream dissipation pond) or dewatering (diversion channel).
5. Management of mine site runoff will alter fish habitat in the lower section of Stream C1 by reducing water flow.

The modified Habitat Evaluation Procedure (HEP) outlined in USFWS (1981) was used to calculate the net change in habitat. This is a structured approach that provides an objective method to calculate the quantity and quality of fish habitats. It combines a rating of habitat quality for each habitat class, defined as Habitat Suitability Index (HSI), with habitat quantity to generate Habitat Units (HU). This methodology has been used to calculate net change in habitats for other mining projects in the Arctic (Diavik 1998; De Beers 2002; RL&L/Golder 2004).

The HEP approach has two advantages. First, it provides an objective method to characterize the quality or importance of affected habitats to fish species and fish stages. Second, it allows standardization of habitat quality ratings relative to other habitats that may have different physical characteristics. This facilitates comparisons among habitats (e.g., stream versus lake habitats) and ultimately allows affected habitats to be evaluated as a single group for the no net loss calculation.

Habitat classes suitable for fish populations in the Project area used for the HEP analyses are as follows:

- Spawning habitat is used by fish specifically for spawning and embryo development.
- Nursery/Rearing habitat is used by young-of-the-year and early aged subadult fish for foraging and refuge from predators.
- Foraging habitat is used by adult fish for feeding.
- Wintering habitat is used by all fish for overwintering.
- Food production habitat is not used by fish, but provides benefits to downstream populations.

The HSI rating system used in the HEP approach was based on physical criteria developed for each fish species and life stage (Appendix A). Using these criteria, each affected habitat was rated using a five point system as follows:

0.00 Zero quality (Unsuitable)
0.25 Low quality (Below Average)
0.50 Moderate quality (Average)
0.75 High quality (Above Average)
1.00 Very High quality (Excellent)

Once HU values were generated they were weighted based on the importance of the affected habitats to the fish species in a particular waterbody. This protocol was derived from Minns (1995) and has been used for other no net loss habitat calculations for other mining projects in the Arctic (Diavik 1998; De Beers 2002; RL&L/Golder 2004).

Importance weightings were apportioned to each species known to occur in the Carat Lake watershed based on one or more category designations, which were domestic (0.3), recreation (0.3), and ecological (0.4). If several species were assigned to one category, the portion was equally divided among the species. Ecological category weightings were based on the ecological niche of the fish species. These were piscivore (0.2), insectivore (0.1), and forage (0.1). The values were assigned based on the relative importance of each group in Arctic aquatic systems. A mean value for each species within the watershed was generated by summing values for each weighting category (Table 3.1).

Table 3.1 Importance weightings applied to habitat units.

Watershed	Ecological Niche	Species	Weight			Overall Weighting
			Domestic	**Recreation**	**Ecological**	
Carat Lake	Piscivorous	Arctic char	0.06	0.10	0.07	**0.23**
	Benthic	Arctic grayling	0.06	0.10	0.05	**0.21**
	Piscivorous	Burbot	0.06		0.07	**0.13**
	Piscivorous	Lake trout	0.06	0.10	0.07	**0.23**
	Benthic	Round whitefish	0.06		0.05	**0.11**
	Forage	Slimy sculpin			0.10	**0.10**
		Total	*0.30*	*0.30*	*0.40*	***1.00***

Weighted Habitat Units (WHU) were used to calculate habitat losses and habitat gains for each species and habitat class. The values were then summed to generate the net change in habitat. This number was used as a basis for habitat compensation.

Summaries of no net loss calculations will be presented for each Project activity. Detailed results are presented in appendices as follows:

Appendix B – Habitat suitability ratings and habitat units.
Appendix C – Weighted habitat units.

3.1 WATER INTAKE CAUSEWAY

The causeway design and site plan are presented in Attachment 2 of Memorandum W: Site Water Management (SRK 2004a). The structure will be 100 m long and change in width from 10 m on shore to 30 m offshore and will extend to a maximum water depth of 4.0 m to 5.0 m. The footprint of the structure will affect 1,800 m^2 of fish habitat in Carat Lake.

Habitat surveys completed in 1999 (RL&L 2000a, Appendix E3), lake bathymetry (RL&L 2000a, Figure 3.3), and field records from 2004 (unpublished data) were used to characterize the physical attributes of fish habitats within the causeway footprint. The entire area exhibited a low slope, but bed materials changed with depth. The lake bed was dominated by boulders and large cobbles for a distance of 51 m to a depth of 2.5 m. From 51 m to the outer extent of the causeway, the water depth increased to 5.0 m and silts dominated the lake bed. Based on these characteristics the area covered by the footprint of the causeway was categorized into two fish habitat types as follows:

1. Nearshore with abundant rock; 0.0 m to 2.5 m depth
2. Farshore with no rock; 2.5 m to 5.0 m depth

Habitat and fish surveys did not identify important fish habitats within the footprint of the causeway. Potential spawning sites of lake trout and possibly Arctic char were located 709 m east, 495 m west, and 205 m east in the vicinity of Stream C1 outlet into Carat Lake (RL&L 2000c, Figure 3.4). The four primary fish species potentially affected by the causeway include lake trout, round whitefish, Arctic char, and slimy sculpin. Incidental species that may use the area include Arctic grayling and burbot.

Clean rock fill will be used to construct the causeway and larger-sized rock materials (up to 0.5 m diameter) will be incorporated into the causeway margins to improve the quality of fish habitat. Lake shore bed materials consisting of rock with abundant interstitial spaces provide a variety of high quality habitats for fish (see Appendix A). As such, use of larger rock for the causeway margin is suitable mitigation, which has been used at other diamond mines in the Arctic (e.g., Diavik 1998, De Beers 2002). This mitigation will result in a 607 m^2 surface area of enhanced causeway margin that will be permanently wetted. Surface areas of the two habitat types affected by enhancement were segregated by depth strata to generate WHUs. For example Habitat No. 2 contained two depth strata each of which had a different area and HSI (depth strata were 0.0 m to 2.5 m, and 2.5 m to 5.5 m).

On closure, the causeway will be reclaimed by excavating the structure below the water line to a maximum depth of 2.5 m. Excavation depths will progressively decrease from offshore to shore. This will result in creation of a rock reef that will provide 1,207 m^2 of enhanced fish habitat in addition to habitat created during causeway operation. Rock reefs that extend to 5.0 m depths provide one or more of spawning, nursery/rearing, foraging, and wintering habitats for the fish species affected by the causeway; therefore, it is a suitable mitigation measure.

Construction of the causeway will result in a loss of 1542 WHUs (Table 3.2). Placement of larger rock material along the causeway margins will create 1220 WHUs, which would provide partial mitigation for the loss.

Table 3.2 Summary of habitat losses and gains (WHU) associated with the water intake causeway during operation and closure.

Habitat Type	Area (m^2)	Class	Operation			Closure			Net Change
			Losses	Gains[a]	Change	Losses	Gains[b]	Change	
Shoreline; rock; 0.0 m to 2.5 m	685	Spawning	34	10	-25		57	57	32
		Nurse./Rear.	343	96	-247		388	388	141
		Foraging	343	96	-247		388	388	141
		Wintering			0				0
		Subtotal	*720*	*202*	*-518*		*832*	*832*	*314*
Farshore; no rock; 2.5 m to 5.0 m	1129	Spawning		1119	1119		276	276	395
		Nurse./Rear.		360	360		489	489	849
		Foraging	285	360	74		489	489	564
		Wintering	537	180	-357		489	489	132
		Subtotal	*822*	*1018*	*196*		*1744*	*1744*	*1940*
Total	**1,814**		**1542**	**1220**	**-322**		**2576**	**2576**	**2254**

[a] Mitigation gains achieved by constructing with larger rock along causeway margin.
[b] Mitigation gains achieved by converting causeway into a rock reef.

The deficit of 322 WHUs would remain until closure. The causeway will be reclaimed by creating a submerged reef, which will result in an additional gain of 2576 WHUs at closure.

Following closure the combined effect of mitigation will result in a net gain in fish habitat of 2254 WHUs or a 146% increase over the habitat losses. Differentiating the gains by habitat type indicates that the offshore area receives the greatest benefit (1940 WHUs) compared to shoreline habitat (314 WHUs).

The results indicate that habitat losses associated with the causeway footprint will be fully mitigated. There will be a temporary deficit (322 WHUs) during eight years of mine operation, but full mitigation will occur on closure and these measures will result in a net gain in habitat. These actions will maintain the long term capacity of fish habitats affected by the causeway footprint, which is the goal of DFO's no net loss policy (DFO 1986). Therefore, habitat compensation will not be required for the water intake causeway.

3.2 PROCESSED KIMBERLITE CONTAINMENT AREA

The PKCA will permanently remove fish habitats in the Long Lake system, which includes Long Lake (10.03 ha) and a small, unnamed pond to the north (0.71 ha). Intensive sampling identified only two fish species populations in Long Lake: slimy sculpin and burbot (RL&L 2000a and 2000b). The unnamed pond supports a small slimy sculpin population (RL&L 2000a, 2000b). In total, 29 slimy sculpin and 48 burbot (46 young-of-the-year and 2 juvenile) were recorded during sampling in 1999 and 2000 (Table 3.3).

Table 3.3 Numbers and catch rates of fish species recorded in Long Lake system.

Year	Waterebody	Method	Burbot	Slimy Sculpin
1999[a]	Long Lake	Gill Net	0	1 (1.60)
		Backpack Electrofisher	0	17 (3.50)
		Minnow Trap	0	0
2000[b]	Long lake	Gill Net	0	0
		Minnow Trap	0	0
		Backpack Electrofisher	47 (3.87)	4 (0.33)
		Fyke Net	1 (0.02)	3 (0.04)
2000 [b]	Unnamed Pond	Backpack Electrofisher	0	4 (0.56)

[a] RL&L 2000a, Appendix D3 to D6.
[b] RL&L 2000b, Appendix D3 to D6.

To calculate the amount of habitat that will need compensation, the two waterbodies were delineated into habitat types based on physical characteristics. Habitat surveys and bathymetric data collected in 1999 were used as the basis for the Long Lake assessment (RL&L 2000a, Figure 3.7 and Appendix E3).

Habitat and bathymetric surveys were not completed in the unnamed pond; therefore, the assessment was based on general field observations.

Long Lake is 1.2 km in length and rarely exceeds 100 m in width. The majority of the lake is < 3.0 deep, although the eastern basin has a maximum depth of 8 m. The lake margin is generally steep and the lakeshore is dominated by boulder and bedrock. Nineteen distinct shoreline habitat zones were recorded in Long Lake during habitat surveys. These were grouped into three habitat types based on physical characteristics related to the amount and type of lake bed material, which are features that affect the suitability of lake habitats (Appendix A). A fourth habitat type was delineated based on a depth criteria of >3.0 m to reflect the presence of wintering habitat. Ice depths in the study area typically ranged between 2.0 m and 2.5 m. In small Arctic lakes, the absence of deep water may be an important limiting factor for fish populations (Hershey *et al.* 2004).

The habitat types were as follows:

1. Nearshore with interspersed boulders; 0.0 m to 3.0 m depth
2. Nearshore with boulders; 0.0 m to 3.0 m depth
3. Nearshore dominated by bedrock; 0.0 m to 3.0 m depth
4. Farshore; >3.0 m depth

A similar approach was used to segregate habitat types in the unnamed pond. The pond was situated in a steep rock basin; therefore, it was assumed that the entire shoreline consisted of Habitat No. 3. The location of Habitat No. 4 was assumed to be equidistant between the shoreline and the center of the lake.

Construction of the PKCA will result in a loss of 16,745 WHUs (Table 3.4), of which 15,718 WHUs are attributed to Long Lake. Losses associated with habitat types 1 to 4 are 596, 8227, 0, 6895 WHUs, respectively. Habitat type No. 3 received zero WHUs because shallow lake margins with sheer bedrock shorelines have no value to fish (Appendix A). No mitigation measures can be applied to reduce these losses; therefore, the entire amount will require compensation.

3.3 PKCA DISCHARGE

During operation, discharge from the PKCA will be released into Stream C3 during non-winter months at a controlled rate by pumping. Concentrations of several constituents would meet the license discharge criteria, but may not meet CCME (1999) guidelines for receiving waters. As such, potential water quality impacts to fish health may require exclusion of fish from Stream C3. This potential temporary effect during the eight-year span of mine operation will require habitat compensation.

Table 3.4 Summary of habitat losses (WHU) in Long Lake and the unnamed pond associated with the PKCA.

Habitat Type	Class	Long Lake		Unnamed Pond		Total Losses
		Area (ha)	WHU	Area (ha)	WHU	
Nearshore; interspersed boulders 0.0 m to 3.0 m	Spawning		108			108
	Nurse./Rear.		244			244
	Foraging		244			244
	Wintering		0.00			0
	Subtotal	*4300*	*596*	*0*	*0*	*596*
Nearshore; boulders; 0.0 m to 3.0 m	Spawning		1485		280	1765
	Nurse./Rear.		3371		280	3651
	Foraging		3371		280	3651
	Wintering		0		0	0
	Subtotal	*29,700*	*8227*	*5600*	*840*	*9067*
Nearshore; bedrock; 0.0 m to 3.0 m	Spawning					
	Nurse./Rear.					
	Foraging					
	Wintering					
	Subtotal	*42,000*	*0*	*0*	*0*	*0*
Farshore; rock and or silt >3.0 mm	Spawning		1379		38	1417
	Nurse./Rear.		1379		38	1417
	Foraging		1379		38	1417
	Wintering		2758		75	2796
	Subtotal	*24,300*	*6895*	*1500*	*188*	*6970*
	Total	**100,300**	**15,718**	**7100**	**1028**	**16,745**

Stream C3 is a small watercourse that originates at the outlet of Long Lake and flows a distance of 1051 m before draining into Lake C3 (Plate 1). Peak average monthly discharge is 0.024 m^3/s (Table 2.2). This watercourse can be differentiated into 6 reaches based on changes in physical characteristics (Table 3.5). Reach 6 is situated closest to Long Lake but is not accessible to fish originating from Lake C3. This is due to a 276 m boulder garden and the absence of surface water flow in Reach 5 (Plate 2). Reaches 1 and 2, which represent the lower section of Stream C3, exhibit defined channels and channel banks (Plates 3, and 4, respectively). These reaches were the only areas where fish were recorded. Due to its small size, the stream bed in most reaches is dominated by organic materials underlain by boulders. In general, RIFFLE habitats dominate in the lower reaches (Table 3.6). The remainder of the stream is dominated by DISPERSED habitat.

Table 3.5 Summary of reach characteristics of Stream C3 (from RL&L 2000b, Appendix B4).

Reach	Gradient (%)	Length (m)	Area (m^2)	Sample Size	Mean Wetted Width (m)	Max. Depth (m)	Channel Type (%)			Bank Type (%)		Bed Material (%)				
							Single	Multi.	Dispersed	Defined	Ill-Defined	Om	Si/ Sa	Gr/ Pe	Co	Bo
1	2	110	92	7	0.8	0.08		100		71	29	33	9	21	19	19
2	4	215	118	8	0.6	0.11	100			100		23		39	15	24
3	2	113	482	5	4.3	0.16		20	80	20	80	80		20		
4	3	198	147	6	0.7	0.14	67	33		50	50	48	2	8	13	28
5	3	276	-	1	-	-			100		100					100
6	1	139	1585	5	11.4	0.20			100	20	80	74				26

Table 3.6 Summary of habitat types recorded in Stream C3 (from RL&L 2000b, Table 3.16).

Reach	Surveyed Length (m)	Habitat Type (%)					
		Pool	Run	Riffle	Flat	Dispersed	Boulder Garden
1	110			90		10	
2	215	10	10	80			
3	113					100	
4	198					50	50
5	276						100
6	200				50	50	

Fish were present in Stream C3, but were restricted to the two lowermost reaches. Fish species recorded during three surveys included Arctic char, burbot, and slimy sculpin (Table 3.7). Although fish were present in the stream, its small size restricted fish use and limited its value as fish habitat. Stream flows are minimal after the spring freshet (Table 2.2).

Table 3.7 Catch rates (No. fish/min sampling) of fish species recorded in Stream C3.

Year	Arctic char	Burbot	Slimy sculpin
1995[a]			0.44
1999[b]	0.55		
2000[c]	0.52	0.05	1.94

[a] RL&L 1996, Appendix H3.
[b] RL&L 2000a, Appendix D6.
[c] RL&L 2000b, Appendix D6.

Fish use of Stream C3 may be affected during mine operation, which would constitute a temporary loss of fish habitat. Reaches 1 and 2 (325 m), which are the fish bearing sections of Stream C3 provide rearing habitat for all species and most life requisites for slimy sculpin. The remainder of the stream up to the large boulder garden (Reach 5) is not physically used by fish, but it does provide a habitat function. Reaches 3 and 4 (311 m) provide food production habitat.

For no net loss calculations Stream C3 was categorized into two habitat types based on physical characteristics and the potential use by fish as follows:

1. Confined stream channel that is physically used by fish.
2. Confined stream channel that is not physically used by fish.

In total, 839 m^2 of Stream C3 fish habitat will be affected (Table 3.8). This will result in a loss of 248 WHUs. Losses associated with each habitat type are 91 WHUs (Type No. 1) and 157 WHUs (Type No. 2).

Table 3.8 Summary of habitat losses (WHU) in Stream C3.

Habitat Type	Area (m^2)	Class	Losses
Defined channel; fish use	210	Spawning Nursery/Rearing Foraging Production *Subtotal*	22 58 11 *91*
Defined channel; no fish use	629	Spawning Nursery/Rearing Foraging Production *Subtotal*	 157 *157*
Total	**839**		**248**

3.4 STREAM C1 DIVERSION AND WATER MANAGEMENT PLAN

This section will evaluate habitat losses associated with two Project activities: the diversion system and the management of mine site runoff. The no net loss calculations for these activities are combined because both will affect Stream C1 fish habitat.

3.4.1 Fish Habitats and Fish Use

The following is a summary of information presented in Section 4.0 of RL&L (2000b). Stream C1 originates at the outlet to Lake C1 and flows a distance of 1031 m before draining into Carat Lake (Figure 3.1, Plate 5). Stream C1 is a complex system that has been modified by exploration activity in the Project area. Its major features include a natural barrier to fish passage (5.3 m in height) that is located

815 m upstream from Carat Lake (Plate 6) and a large impounded area (351 m from confluence) that was formed by a berm constructed during the winter of 1995-96 (Plate 7). The impoundment inundated a portion of the existing channel and diverted part of the stream discharge to the west. This diverted water flows over the tundra and rejoins Stream C1 near its confluence with Carat Lake.

Fish Habitats

Stream C1 can be differentiated into 10 reaches based on changes in gradient and physical characteristics (Table 3.9). Reach 10 is situated closest to Lake C1 but is not accessible to fish originating from Carat Lake due to a 5.3 m barrier at Reach 9. The stream exhibits a wide range of gradients from 0.1 m/100 m to 7.1 m/100 m (excluding the barrier). Reaches 1 and 2, which represent the lower section of Stream C1 where fish were recorded (Plate 8), exhibit high gradients (7.1 and 5.0 m/100 m, respectively). Reaches 3, 4, 6, and 8 exhibit low gradients and are generally dominated by ponded water. Reaches with higher gradients have narrower channel widths and multiple channels. The majority of reaches have well-defined channel banks and bed materials in most reaches are dominated by cobbles and boulders.

Table 3.9 Summary of reach characteristics in Stream C1.

Reach	Grad. (%)	Len. (m)	No.	Mean Wet. Width (m)	Mean Depth (m)		Mean Velocity (m^3/s)	Mean Percent Channel Type			Mean Percent Bank Type		Bed Material (%)					
					Avg.	Max		Single	Multiple	Disp.	Defined	Ill-Defined	Om	Si/Sa	Gr/Pe	Co	Bo	Be
1	7.1	92	9	1.25	0.08	0.15	0.1		89	11	100		2	1	5	66	27	
2	5.0	70	5	2.03	0.08	0.11	0.13		100		100				5	42	53	
3	0.1	177	9	1.15	0.08	0.12	0.09		100		89	11	9		9	71	11	
4[a]	0.2	134	6		0.28		0.00											
5	2.7	102	9	0.84	0.08	0.11	0.16	100			100			8	10	47	36	
6	0.1	24	1			0.67							100					
7	3.8	82	5	1.04	0.13	0.16	0.28	100			100		16	2	12	36	34	
8	0.5	134	6	4.57	0.18	0.24	0.09		67	33	67	33	2	27	12	5	48	3
9	33.1	16																

[a] Impounded stream section.

mainstream AQUATICS LTD

Figure 3.1 Major features of Stream C1, Jericho Study Area, 1999.

The physical characteristics of each reach are influenced by these major features. In general, RIFFLE and/or RUN habitats dominate (Table 3.10). In high gradient sections, their combined values exceeded 75% in terms of surface area and frequency of occurrence. In lower gradient reaches, FLAT and DISPERSED habitats were more prevalent.

Reach 4 represents an impounded area (5842 m^2) that resulted following construction of a berm in winter 1995. This resulted in inundation of the original stream channel. Assuming that Reach 4 exhibited the same physical characteristics as Reach 3 prior to impoundment, this affected 154 m^2 of the channel.

Table 3.10 Summary of habitat types (area and occurrence) in reaches of Stream C1.

Reach	Group	Coverage (m^2)		Frequency	
		Area	Percent	Number	Percent
1	Flat	43	12.1	4	12.9
	Pool	2	0.6	1	3.2
	Riffle	173	48.9	14	45.2
	Run	136	38.4	12	38.7
	Subtotal	*354*	*100*	*31*	*100*
2	Flat	4	2	1	11.1
	Pool				
	Riffle	154	76.2	6	66.7
	Run	44	21.8	2	22.2
	Subtotal	*202*	*100*	*9*	*100*
3	Dispersed	305	54.4	1	4.5
	Flat				
	Pool				
	Riffle	169	30.1	11	50
	Run	87	15.5	10	45.5
	Subtotal	*561*	*100*	*22*	*100*
4	Impounded	*5842*	*100*	*1*	*100*
	Pre-impoundment[a]	*154*	*100*		
5	Flat				
	Pool	17	12	1	20
	Riffle	107	75.4	3	60
	Run	18	12.7	1	20
	Subtotal	*142*	*100*	*5*	*100*
6	Pond	*971*	*100*	*1*	*100*
7	Flat				
	Pool	4	4.5	1	20
	Riffle	76	85.4	3	60
	Run	9	10.1	1	20
	Subtotal	*89*	*100*	*5*	*100*
8	Boulder Garden	113	12.2	1	16.7
	Dispersed	676	73.2	1	16.7
	Flat	93	10.1	2	33.3
	Pool	0	0	0	0
	Riffle	42	4.5	2	33.3
	Run	0	0	0	0
	Subtotal	*924*	*100*	*6*	*100*

[a] Assumes pre-impoundment stream width of Reach 4 is similar to Reach 3.

Habitat complexity (frequency of occurrence) is highest in Reach 1 (31 habitat units). Overall, habitat complexity is higher downstream compared to upstream (62 versus 17 habitat units, respectively). These data indicate that fish habitats are available to fish in Reaches 1 to 8.

Construction of a berm across the drainage path of Stream C1 in winter of 1995 resulted in diversion of part of the flow to the west. The diversion of a portion of stream flow may have reduced the amount of fish habitat in the original stream channel downstream from the berm.

To ascertain the effect on fish habitat availability, discharge in the original stream channel was compared to that in the diverted channel (Table 3.11). Based on five measurements in June 1999, the average discharge in the original channel was 0.012 m^3/s compared to 0.062 m^3/s in the diversion.

Table 3.11 Comparison of discharge in two channels of Stream C1.

Date (1999)	Discharge (m^3/s)		Difference	
	Original Channel	West Channel	Discharge (m^3/s)	Percent
June 4	0.007	0.037	-0.030	-68.2
June 5	0.010	0.056	-0.046	-69.7
June 7	0.011	0.059	-0.048	-68.6
June 9	0.018	0.085	-0.067	-65.0
June 14	0.015	0.073	-0.058	-65.9
Average	**0.012**	**0.062**	**-0.050**	**-67.1**

This represented an average difference of -0.050 m^3/s or a reduction in flow of 67%. It should be noted that these values are not precise estimates of stream discharge in each channel, but instead, should be used to ascertain the relative differences in discharge.

Based on these findings, it is assumed that the amount of fish habitat provided by Stream C1 has been reduced by the diversion of water away from the original channel. Due to the lack of data collected prior to construction of the berm, it is not possible to quantify the magnitude of this reduction.

Fish Use

Fish use of Stream C1 was recorded during each of five survey years (Table 3.12). Six species were recorded, which included Arctic char, Arctic grayling, burbot, lake trout, round whitefish, and slimy sculpin. Some species were infrequently encountered. Stream C1 was used primarily by young-of-the year and small sub-adult fish; no adult fish were ever recorded in Stream C1.

Synoptic surveys indicated that fish catch rates recorded in Stream C1 in a given year were variable (Table 3.12). The results likely were a reflection of stream conditions at the time of sampling and natural variation in fish population size.

Accurate estimates of fish density were developed in 1999. Four species of fish were present in Stream C1 during the detailed survey. Densities were in decreasing order of abundance 54 fish/100 m for slimy sculpin, 30 ± 4 fish/100 m for Arctic char, 15 ± 12 fish/100 m for lake trout, and 5 ± 2 fish/100 m for burbot.

Table 3.12 Numbers and catch rates of fish species recorded in Stream C1.

Year	Arctic char	Arctic grayling	Burbot	Lake trout	Round whitefish	Slimy sculpin
1995[a]		34 (1.71)	1 (0.05)	2 (0.10)		18 (0.90)
1996[b]	48			9	8	9
1998[c]	13		1			10
1999[d]	31 (1.50)		5 (0.24)	25 (1.21)		39 (1.89)
2000[e]	6 (1.12)			9 (1.68)		10 (1.87)

a RL&L 1996, Appendix H3.
b RL&L 1997, Appendix H3.
c RL&L unpublished data.
d RL&L 2000a, Appendix D6.
e RL&L 2000b, Appendix E1.

A large portion of Stream C1 was sampled for fish. Inventories extended from the confluence with Carat Lake to near the headwater area of Lake C1. During every survey, fish were recorded only in the lowermost 100 m of the stream. The reason for this restricted distribution is unclear, but likely is related to the small size, shallow water depth, and high gradient of the lower section of Stream C1. These characteristics form a partial barrier to fish passage, which hinders upstream movement.

Two species of fish were recorded in Stream C1 only once. Arctic grayling were found in this system in 1995, while round whitefish were recorded in 1996. The absence of Arctic grayling in Stream C1 is probably due to the scarcity of this species in Carat Lake. Arctic grayling were not encountered in Carat Lake at the mouth of Stream C1 during two years of investigation using multiple sample techniques (RL&L 2000a and 2000b). In contrast, younger-aged round whitefish were relatively abundant. Therefore, habitat conditions of Stream C1 likely were not suitable for this species during most years.

3.4.2 Project Activities Affecting Fish Habitat

Diversion System

A diversion channel will be constructed around the western perimeter of the mine pit to divert water around the work area (Drawing W1, Memorandum W: Site Water Management, SRK 2004a). The diversion system will consist of a dyke to divert water out of Stream C1, the diversion channel to transport the water around the mine pit, and dissipation pond at the downstream end of the channel to return diverted water back into Stream C1. The dyke will divert flow from Stream C1 into the diversion channel at a point 761 m upstream from Carat Lake. The water will be transported around the pit and discharged back into Stream C1 at a point 232 m upstream of Carat Lake. This configuration will affect 529 m of Stream C1, either by the footprint of the structures (upstream dyke and downstream transition pond) or by dewatering by the diversion channel. For the purposes of this assessment, it is assumed that the diversion system will be a permanent structure that will not be removed at closure. Although the long-term plans for the diversion system cannot be fully addressed until the final closure plan stage (Abandonment and Restoration Plan, AMEC 2004a), use of this assumption provides a conservative approach to the no net loss calculations.

The diversion dyke will remove 20 m of Reach 8 or 91 m^2 from production (20 m long x 4.57 m rooted channel width). The downstream transition pond will be located in Reach 3. The pond footprint will cover a 5 m section of Reach 3, or 5.8 m^2 (5.0 m long x 1.2 m rooted channel width). The pond will be modified to mitigate the effects on fish habitat. It will have sufficient depth to support fish at minimum flows (0.5 m) and it will contain physical instream cover in the form of boulders. This design will create 30 m^2 of high quality rearing habitat (5 m x 6 m).

The diversion channel will remove 504 m or 2055 m^2 of Stream C1. The diversion channel will be 470 m in length and will consist of three reaches. The channel will be constructed to withstand a 1-in-200 year flow event and to transport water through an elevation drop of 9 m. These requirements require a robust design, which is not compatible with fish habitat requirements. The primary issue is the inability to maintain surface water flow during non-freshet periods. This characteristic is similar to features of small streams that traverse boulder fields (e.g., Stream C3).

Despite these engineering constraints, a portion of the channel will be designed to provide fish habitat by maintaining surface water flow during all flow conditions. The lower 150 m of the channel (Reach 3) will be designed to fish-friendly specifications as follows:

- A sinuous configuration to mimic natural channel form and maximize channel length.
- A low flow channel designed to maintain a wetted width of 0.5 m and water depths up to 0.5 m.
- Low gradient to facilitate fish movement (1%).
- Boulder placements in channel to provide physical instream cover.

This mitigation measure will create 75 m^2 of fish habitat.

Although the remaining sections of the diversion channel will not allow fish passage at all flows, they will provide a fish habitat function. Over the long-term, Reaches A and B will provide nutrients and food to the lower fish-bearing section of Stream C1. This function fits the definition of fish habitat by DFO (DFO 1998a), and therefore, should be incorporated into the no net loss calculations. As such, Reaches A and B are considered mitigation for the dewatered section of Stream C1. Based on a design width of 2.0 m and a length of 320 m, 640 m^2 of food production fish habitat will be maintained.

<u>Management of Mine Site Runoff</u>

As part of the water management plan for the mine, site area runoff will be directed to the PKCA. Part of the plan requires diversion of mine site runoff from the Stream C1 basin. Based on modeling, flows in Stream C1 at the mouth of Carat Lake during mine operation are predicted to be approximately 48% less than pre-construction flows. Post-closure flows will be similar to operation flows based on the assumption that there is no change in the post-closure water management plan. The final post-closure water management plan criteria will not be finalized until several years of mine operation (Abandonment and Restoration Plan, AMEC 2004a); therefore, this is an appropriate and conservative assumption for no net loss calculations.

A decrease of water flow will result in a reduction of the amount of fish habitat in Stream C1. Precise quantification of the effects of a 48% decrease is not possible using available data. For the purposes of the evaluation it is assumed that the relationship between stream flow and habitat surface area is linear.

No active mitigation will be undertaken to augment surface runoff into the Stream C1 basin. It should be noted that, where practical, surface runoff that meets water quality criteria all be discharged to the Stream C1 basin.

There will be indirect augmentation of existing water flows in Stream C1. In 1995, a berm was constructed 340 m upstream of Carat Lake. The berm diverted a portion of water flow away from the original Stream C1 channel (approximately 67% during spring freshet). The berm will be removed as part of the water management plan, thereby providing additional flow. Because this measure will mitigate pre-existing Project effects it cannot be applied to the current no net loss calculations. As such, it is assumed that the water management plan will result in a permanent 48% reduction in water flow in the lower section of Stream C1.

A 232 m section of Stream C1 will be affected by this Project activity. Assuming a 48% reduction in flow affected areas include Reach 1 (92 m, 170 m^2), Reach 2 (70 m; 97 m^2), and a portion of Reach 3 (70 m, 47 m^2). Reach 1 and a portion of Reach 2 are used by fish, while Reach 3 is food production habitat (see Section 3.3.1).

3.4.3 No Net Loss Calculations

Stream C1 is a small watercourse that is used only for rearing by most fish species populations originating in Carat Lake. There are two exceptions. Slimy sculpin may use the system for spawning and foraging and Arctic grayling may potentially use Stream C1 for spawning. Habitat use is opportunistic based on water flows and temperatures. During periods of low flow and/or high temperatures, fish leave the stream for more favourable conditions in Carat Lake.

The affected areas of Stream C1 were categorized into three habitat types based on physical characteristics and the potential use by fish as follows:

1. Confined stream channel that is physically used by fish.
2. Confined stream channel that is not physically used by fish.
3. Ponded stream sections that are not physically used by fish.

In total, 2466 m^2 of Stream C1 fish habitat will be affected by the Project (Table 3.13). Of this loss 2153 m^2 is attributed to the diversion system and 313 m^2 to the water management plan. Without mitigation, this will result in a loss of 717 WHUs. The diversion system accounts for 75% of the losses, and within this Project activity, 96% of the losses are associated with the diversion channel. All habitat losses associated with the diversion system (539 WHUs) are attributed to food production habitat. The water management component will cause a loss of 179 WHUs. In contrast to the diversion system, a large percentage of these losses are associated with fish bearing habitat (93%) compared to food production habitat (6%).

The losses will be partially offset by gains associated with mitigation. As a result, there will be a net loss of 530 WHUs of fish habitat from Stream C1 that will require compensation.

Table 3.13 Summary of habitat losses and mitigation gains (WHU) in Stream C1.

Activity	Component	Habitat Type	Area (m^2)	Class	Losses	Gains[a]	Net Change
Diversion (2152.6 m^2)	Channel	Confined channel; no fish use	798	Spawning			
				Nursery/Rearin			
				Foraging			
				Production	200	179	-21
				Subtotal	*200*	*179*	*-21*
		Ponded; no fish use	1258	Spawning			
				Nursery/Rearin			
				Foraging			
				Production	315		-315
				Subtotal	*315*	*0.0*	*-315*
	Dyke	Ponded; no fish use	91	Spawning			
				Nursery/Rearin			
				Foraging			
				Production	23		-23
				Subtotal	*23*	*0.0*	*-23*
	Dissipation Pond	Confined channel; no fish use	6	Spawning			
				Nursery/Rearin			
				Foraging			
				Production	2	8	6
				Subtotal	*2*	*8*	*6*
				Diversion Subtotal	**539**	**187**	**-352**
Water Management (313 m^2)		Confined channel; fish use	266	Spawning	27		-27
				Nursery/Rearin	126		-126
				Foraging	13		-13
				Production	0.0		0.0
				Subtotal	*167*	*0*	*-167*
		Confined channel; no fish use	47	Spawning			
				Nursery/Rearin			
				Foraging			
				Production	12		-12
				Subtotal	*12*	*0*	*-12*
				Water Management Subtotal	**179**	**0**	**-179**
Total			**2466**		**717**	**187**	**-530**

3.5 NO NET LOSS SUMMARY

Project activities will cause potential loss of fish habitat. The losses will occur in Carat Lake, the Long Lake system, Stream C1, and Stream C3. Habitat losses associated with the water intake causeway and the PKCA discharge will be temporary. The PKCA, Stream C1 Diversion, and Stream C1 water management will result in a permanent loss of fish habitat.

Habitat losses associated with one Project activity, the water intake causeway, will be fully mitigated on closure (Table 3.2). During the operation phase there will be a deficit of 322 WHUs. The footprint of the causeway will remove 1542 WHUs of fish habitat from Carat Lake, but mitigation measures will completely offset these losses leaving 1227 WHUs in excess mitigation.

These gains can be applied against habitat losses caused by other Project activities (Table 3.14). This rationale has merit for three reasons. First, species assemblages using affected habitats are similar to the Carat Lake population (Species Assemblage #1). The populations of this assemblage, which consists of Arctic char, Arctic grayling, burbot, lake trout, round whitefish, and slimy sculpin, can potentially use the habitats provided by the causeway mitigation. This is particularly true for Stream C1 fish populations.

Table 3.14 Summary of habitat change (WHU) associated with Project activities.

Habitat Class	**Species Assemblage #1**				**Species Assemblage #2**
	Intake Causeway (Carat Lake)	**PKCA Discharge (Stream C3)**	**Diversion/ WMP (Stream C1)**	**Net Change**	**PKCA (Long Lake)**
Spawning	+427	-22	-27	*+378*	**-3289**
Nurs./Rear.	+990	-58	-126	*+806*	**-5312**
Foraging	+705	-11	-13	*+681*	**-5312**
Wintering	+132	0	0	*+132*	**-2832**
Production	0	-157	-364	*-521*	**0**
Total	**+2254**	**-248**	**-530**	**+1476**	**-16,745**

Second, the habitats affected by other Project activities are identical to the habitats created by causeway mitigation. The only exception is food production habitat, which is of lesser value than fish-bearing habitats (i.e., cannot physically support fish). Even though the physical characteristics of stream habitats differ from that of lake habitats differ their functions are the same. As such the potential benefits derived from mitigation in Carat Lake can be applied to habitats affected in Streams C1 and C3.

Third, gains associated with causeway mitigation, which will be realized at closure are appropriate to offset habitat losses that will occur during operation. Mitigation is required to maintain the productive capacity of affected habitats, which is defined as the ability of those habitats to maintain fish populations (DFO 1986). The majority of fish populations affected by the Project activities will not be impacted by the short-term loss of fish habitats because those habitats are abundant, widely available elsewhere in the system, and are not critical to the long-term viability of the affected populations. As such, fish populations will benefit from ‘delayed’ mitigation. The only exceptions are the Long Lake slimy sculpin and burbot populations, which will be extirpated.

By applying the gains associated with the causeway mitigation to waterbodies having the same species assemblage (Streams C1 and C3), full mitigation is achieved for these waterbodies (Table 3.14). After full mitigation there is still an excess of 1476 WHUs, which represents a net gain in habitat following full mitigation.

Habitat losses remain that cannot be mitigated (16,745 WHUs of the Long Lake system). These losses will require compensation.

4.0 HABITAT COMPENSATION

4.1 COMPENSATION OPTIONS

The options available for physical habitat compensation are more restricted in Arctic environments than for southern climates. This is primarily due to logistical and engineering constraints. Accessing candidate sites without damaging the surrounding landscape is an issue and acquiring materials can be difficult and expensive. The most serious problems from an engineering perspective are the presence of permafrost in stream channels and extensive ice depth in lakes. Construction activities in streams can disrupt permafrost resulting in unexpected channel degradation. Ice has the ability to move physical habitat works by adhering and lifting structures from the lake bottom. Damage also can occur when wind-blown ice is pushed into structures situated in exposed areas. These issues need to be addressed when physical habitat compensation is being considered 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 wintering 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 in the Project area (e.g., Long Lake).

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).

Habitat losses and gains associated with compensation works are listed in Appendix D.

4.2 HABITAT ENHANCEMENT

Habitat enhancement will entail construction of high quality spawning, rearing, foraging, and wintering habitats. The species targeted by the enhancement are those that are affected by the PKCA: slimy sculpin and burbot. Enhancement will benefit other species including Arctic char, Arctic grayling, lake trout, and round whitefish. In lakes, enhancement will provide sheltered areas that provide protection from predation, promote warmer water temperatures and increase food production. Enhanced areas located in deeper water will provide spawning, feeding, and wintering habitats.

Enhancement will target sites in selected waterbodies that have severely limited amounts of these habitats (Table 4.1, Figure 4.1). Five sites have been selected based on quantitative data collected during fish and habitat surveys in the Project area. Based on DFO's fish habitat criteria, existing habitats at the target sites are defined as marginal (DFO 1998a).

Table 4.1 Fish communities and existing physical characteristics at target enhancement sites.

Site	Waterbody	Species	Shoreline Length (m)	Slope	Bed material (%)			
					Sa	Gr	Co	Bo
1	Carat Lake[a]	ARCH, ARGR, BURB, LKTR, RNWH, SLSC	914	Low	90			10
2	Interbasin Lake[b]	ARCH, ARGR, BURB, LKTR, RNWH, SLSC	905	Low	95			5
3	Lake O1[c]	ARCH, ARGR, BURB, LKTR, RNWH, SLSC	265	Low	80	5	10	5
4	Lake O3[d]	ARCH, ARGR, BURB, LKTR, RNWH, SLSC	279	Low	100			
5	Lake O4[e]	ARCH, ARGR, BURB, LKTR, RNWH, SLSC	660	Low	95			5

[a] RL&L 1997, Section 3.5, Appendix G1; RL&L (2000a) Section 3.3, Figure 3.3.
[b] RL&L 1997, Section 3.5, Appendix G1.
[c] RL&L 1997, Section 3.5, Figure 4.1.2, Appendix G1.
[d] RL&L 1997, Section 3.5, Appendix G1.
[e] RL&L 1997, Section 3.5, Appendix G1.

The first two enhancement sites include the northeast shore of Carat Lake and the southeast shore of the Interbasin Lake situated immediately north of Carat Lake. Both areas are dominated by sand bed material, are devoid of physical cover, and exhibit a low bed slope. They are also located in areas that are sheltered from the prevailing winds that cause ice movement.

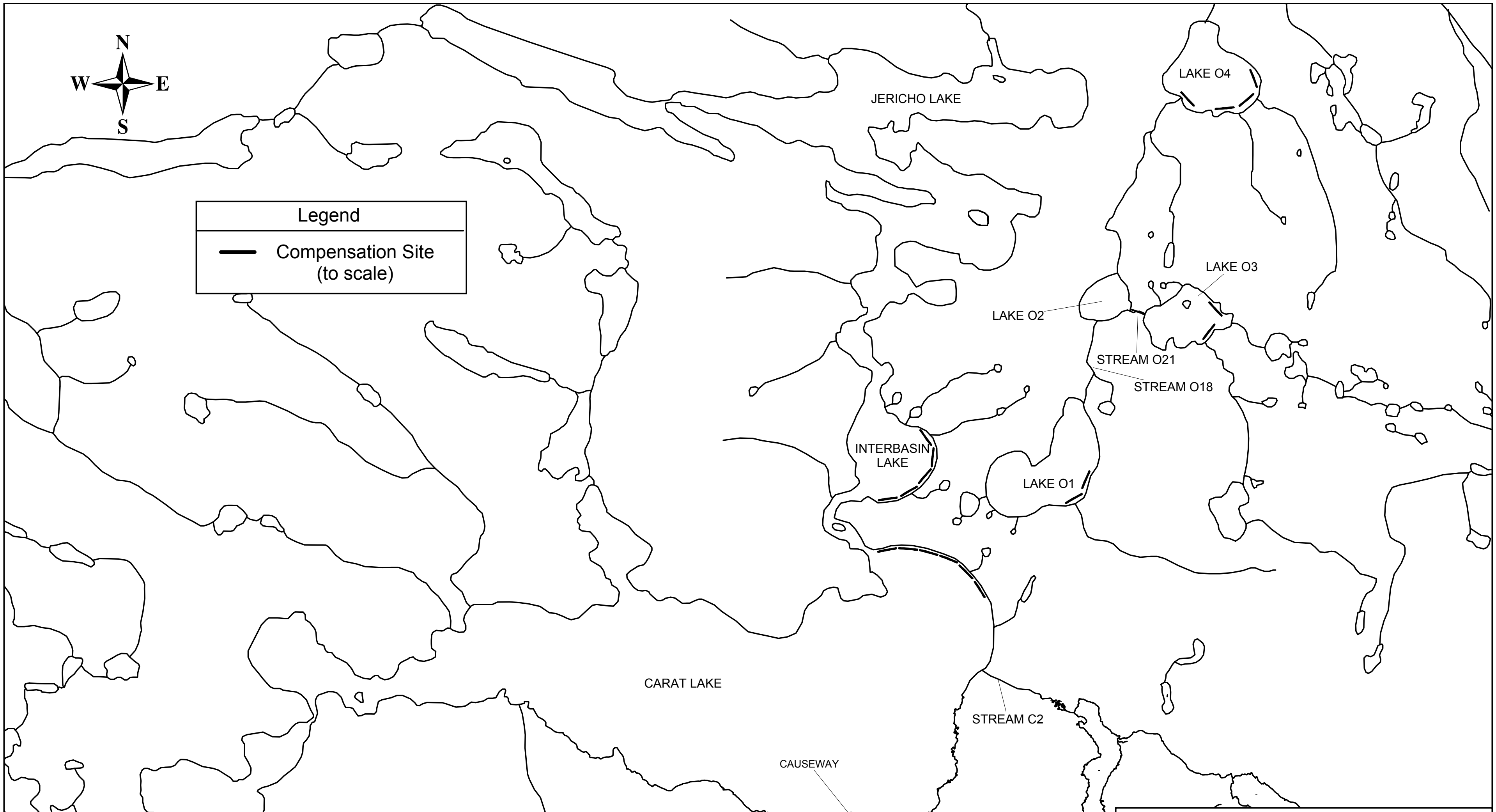

Figure 4.1 Compensation sites in the Jericho Project Area

The three remaining enhancement sites are located in Lakes O1 O3, and O4. These are small, deep, sheltered waterbodies located northeast of the mine site. These lakes are part of the Jericho watershed, but are separate from the Carat Lake system. All three O Series lakes support fish populations, but each exhibit very low habitat complexity.

Like the candidate sites in the Carat Lake watershed, the shorelines of these lakes are dominated by sand bed material, are devoid of physical cover, exhibit moderate bed slopes, and they are located in areas that are sheltered from the prevailing winds. The primary difference between the O Series lakes and the Carat Lake system is the relative abundance of Arctic grayling in the former.

Enhanced areas will be similar to compensation works developed or proposed for other diamond mines in the Arctic (Diavik 1998, RL&L/Golder 2004). Rock reefs constructed of large diameter rock generated by mine pit excavation will be used for this purpose. The rock material will be placed on ice in winter at pre-determined locations. It will melt through the ice in spring and fall to the lake bottom where it will create rock reefs at least 1 m in thickness. Enhanced sites will be placed at two depth strata to create two distinct habitat areas. Rock reefs placed at 1.5 m to 2.5 m depth will provide high quality shallow water habitats (spawning for slimy sculpin, and rearing, foraging for all species). Rock reefs placed below the ice depth at 3.0 m to 4.0 m depths will provide high quality spawning, foraging, and wintering habitats for most species.

The exact design and dimension of enhanced sites will be finalized following discussions with DFO. In general, the rock reefs will follow the natural shoreline configuration. Each reef will be 10.0 wide and 100 m long. Depending on the available shoreline length several reefs will be constructed. All construction will occur in winter to facilitate equipment access and eliminate damage to the tundra.

In total, 19 enhanced areas will be constructed (Table 4.2). The enhanced area in each lake will vary from 6000 m^2 in Carat Lake to 2000 m^2 in Lakes O1 and O3. The percentage of existing marginal habitat that is available for enhancement at each site that will be modified will range from 72% (Lake O3) to 54% (Lake O3). The proposed enhancement sites will create a total of 33,260 WHUs of high quality habitat. The largest gains will occur for rearing and foraging habitat classes, although there will be gains in spawning and wintering habitats.

4.3 IMPROVED ACCESS

Access to critical habitats can limit the productive capacity or even prevent establishment of a fish population. Access to spawning, rearing, and overwintering habitats likely limit productive capacities of fish populations in some waterbodies in the Project area. Habitat enhancement described in Section 4.2 will provide access to suitable habitats for fish populations that reside in the enhanced waterbodies. There also are opportunities to improve access, which would facilitate fish use of important habitats in adjacent waterbodies. This enhancement method is being proposed as compensation at one other mine in the Arctic (RL&L/Golder 2004).

Table 4.2 Summary of habitat losses, gains, and net change (WHU) at enhanced sites in lakes.

Waterbody	No. Reefs	Area (m^2)	Percent of Available Habitat	Habitat Class	Losses	Gains	Net Change
Carat Lake	6	6000	66%	Spawning	0	1494	1494
				Nursery/Rearing	0	4505	4505
				Foraging	1502	4505	3003
				Wintering	751	2252	1502
				Subtotal	*2252*	*12,755*	*10,503*
Interbasin Lake	5	5000	55%	Spawning	0	1245	1245
				Nursery/Rearing	0	3754	3754
				Foraging	1251	3754	2503
				Wintering	626	1877	1251
				Subtotal	*1877*	*10,629*	*8753*
Lake O1	2	2000	75%	Spawning	0	498	498
				Nursery/Rearing	0	1502	1502
				Foraging	501	1502	1001
				Wintering	250	751	501
				Subtotal	*751*	*4252*	*3501*
Lake O3	2	2000	72%	Spawning	0	498	498
				Nursery/Rearing	0	1502	1502
				Foraging	501	1502	1001
				Wintering	250	751	501
				Subtotal	*751*	*4252*	*3501*
Lake O4	4	4000	61%	Spawning	0	996	996
				Nursery/Rearing	0	3003	3003
				Foraging	1001	3003	2002
				Wintering	501	1502	1001
				Subtotal	*1502*	*8504*	*7002*
Summary	**19**	**19,000**	**-**	**Spawning**	**0**	**4731**	**4731**
				Nursery/Rearing	**0**	**14264**	**14264**
				Foraging	**4755**	**14264**	**9510**
				Wintering	**2377**	**7132**	**4755**
				Total	***7132***	***40,392***	***33,260***

There are several physical barriers in the Project area that limit fish access; however, most candidate sites are inappropriate due to engineering or logistical constraints. There are barriers that can be modified to facilitate fish access in the O Series of lakes situated north of the mine site (Figure 4.1).

Streams in this watershed drain into the Jericho River, which flows into Kathawachaga Lake. The fish community in the watershed is, in part, affected by the ease of movement between lakes via 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 (RL&L 1997, Section 4.5). A likely reason for this distribution pattern is the existence of barriers to passage that limits access by migratory Arctic grayling that originate from Kathawachaga Lake. The two barriers of interest include a small cascade located on Stream O18 and a shallow ill-defined section of Stream O21.

Stream O18 is a small 450 m watercourse that connects Lake O1 to Lake O2. Fish passage at the O18 barrier likely is possible during high flows of early summer, but it is a complete barrier when water levels drop following freshet. For fish that reside in Lake O1 the barrier prevents access to high quality rearing habitats in the downstream section of the watercourse. Fish that do manage to cross the barrier are unable to return to Lake O1 to overwinter. The barrier is sufficient to hinder movement of adult Arctic grayling to spawning areas in the Lake O1 system at all flows.

Stream O21 is a short (90 m), shallow (<0.20 m water depth), ill-defined watercourse that connects Lake O2 to Lake O3. The watercourse allows some fish movement between the lakes during periods of high water (spring and early summer), but falling water levels sever the connection in late summer. This blockage can be detrimental for migratory fish such as Arctic grayling that move into Lake O3 system to spawn. Arctic grayling originating from Kathawachaga Lake that move into Lake O3 to spawn are prevented from returning back to overwintering areas. The trapped fish likely suffer high mortality rates caused by predation, and therefore, are lost from production.

Eliminating these two barriers would improve fish access between several waterbodies. Specifically it would increase the availability of important fish habitats and prevent stranding of fish in unsuitable areas.

Removal of the Stream O18 barrier is technically feasible, but there are potential negative consequences. First, the flow regime and water levels in the drainage may be altered resulting in adverse effects to existing fish habitat. Second, improving fish passage may facilitate access by larger piscivorous fish. Introduction of large predators may upset the ecological balance in the present fish communities. Based on these potential negative impacts the Stream O18 barrier should not be targeted for improved access.

Improving access at the Stream O21 barrier has few potential negative consequences. Improved access can be achieved simply by deepening the shallow, wide connection between Lake O2 and Lake O3. The outlet on Lake O2 controls water levels of both lakes; therefore, deepening Stream O21 will not adversely affect water levels or fish habitats. The two lakes have similar fish assemblages (RL&L 1997, Table 4.5.2), which makes disruption of the fish community unlikely.

The benefits associated with Stream O21 improved access are two-fold. First, the productive capacity of the migratory Arctic grayling population originating from Kathawachaga Lake will be increased by improving the survival of the spawning cohort. Second, natural habitats, as well as enhanced habitats in Lake O3 (see Section 4.2) would become accessible to fish originating in Lake O2. Third, the relative amount of habitat available to the Lake O2 and Lake O3 fish communities would be increased. Lake size (surface area and water depth) and ease of access have been identified as important factors that control fish distribution in the Arctic (Hershey *et al*. 2004). Increasing the effective size of the waterbody (Lake O2 plus Lake O3) would reduce these limitations thereby improving the productive capacity of the system.

It is acknowledged that the three potential benefits that could result from improved access at Stream O21 cannot be stated with certainty. However, when viewed as a whole there is a high likelihood for success. As such, it is recommended that the Stream O21 barrier be targeted for improved access.

To improve access, a 90 m channel 2 m in width will be excavated between Lake O2 and O3. The channel will have a mean minimum depth of 1 m. The channel banks will be armoured with large rock material to maintain bank stability. If this option is approved by DFO, detailed design specifications will be developed and submitted for review.

Habitat gains provided by improved access at Stream O21 are difficult to quantify. Gains will be realized by creation of habitat associated with the constructed channel. Gains will be created from Lake O3 habitats based on the assumption that fish will move into the waterbody from Lake O2. A conservative approach was adopted when calculating gains provided by Lake O3 habitat. For the purposes of the evaluation, it is assumed that the gains are associated only with the physical enhancement works and not natural habitats in the entire lake.

Improved access will provide 4032 WHUs of additional habitat (Table 4.3). This includes a small amount of stream habitat associated with improvements in Stream O21 (241 WHUs). The remaining gains are due to the physical enhancement sites (3501 WHUs).

4.4 SUMMARY

The total amount of compensation provided by habitat enhancement and improved access is substantial (Table 4.4). In total, 37,002 WHUs will be created and gains will occur for all habitat classes. The gains will be used to replace slimy sculpin and burbot habitats lost from the Long Lake system due to construction of the PKCA. The species populations that will benefit from these gains will be Arctic char, Arctic grayling, burbot, lake trout, round whitefish, and slimy sculpin.

Compensation ratios of losses to gains vary depending on habitat class (1:1.59 to 1:2.99). Overall, the compensation ratio achieved using the proposed habitat compensation methods will be 1:2.21.

Table 4.3 Summary of habitat losses, gains, and net change (WHU) associated with improved access at O21 Barrier.

Waterbody	Habitat Class	Losses	Gains	Net Change
Stream O21	Spawning	0	14	14
	Nursery/Rearing	0	137	137
	Foraging	5	96	91
	Wintering	0	0	0
	Subtotal	*5*	*246*	*241*
Lake O3 Enhanced Sites	Spawning	0	498	498
	Nursery/Rearing	0	1502	1502
	Foraging	501	1502	1001
	Wintering	250	751	501
	Subtotal	*751*	*4252*	*3501*
Summary	**Spawning**	**0**	**512**	**512**
	Nursery/Rearing	**0**	**1639**	**1639**
	Foraging	**506**	**1598**	**1092**
	Wintering	**250**	**751**	**501**
	Total	***756***	***4498***	***3742***

Table 4.4 Summary of habitat losses versus compensation gains (WHU).

Habitat Class	PKCA Losses	Compensation Gains			Net Change	Ratio Gains to Losses
		Physical Works	Improved Access	Total		
Spawning	-3289	4731	512	5243	1954	1.59
Nursery/Rearing	-5312	14264	1639	15,903	10,591	2.99
Foraging	-5312	9510	1092	10,602	5290	2.00
Wintering	-2832	4755	501	5256	2424	1.86
Total	**-16,745**	**33,260**	**3742**	**37,002**	**20,257**	**2.21**

5.0 MONITORING

Monitoring will be conducted to determine the effectiveness of the no net loss measures. This is required to confirm that mitigation and compensation activities related to the no net loss plan function as intended. Monitoring activities discussed in this section are specific to concerns identified in relation to the no net loss plan. The Aquatic Effects Monitoring Program Protocols document provides a comprehensive overview of the Aquatic Effects Environmental Monitoring (Mainstream and AMEC 2004).

Monitoring of mitigation measures will include the following:

1. Measurement of total suspended sediment concentrations adjacent to or immediately downstream of activities during construction and/or initial activation. Sites will include Carat Lake in the vicinity of the causeway, Stream C1 downstream of the diversion system, Stream C3 downstream of the PKCA, Streams C1 and C2 downstream of the watercourse crossings.
2. Undertake a fish salvage program in Long Lake and the unnamed pond following guidelines specified in Draft General Fish-out Protocol for Lakes (DFO 2004). The fish salvage will adhere to the objectives of the DFO guidelines, which are to avoid the wasting of fish and to determine fish population characteristics.
3. Monitor potential erosion of Stream C3 channel. This will include inspection of Stream C3 for potential erosion sites by a qualified hydrologist prior to PKCA discharge, regular monitoring of the channel during discharge to identify erosion sites if they exist, and use of rock armouring to protect problem areas where appropriate.
4. Monitor the structural stability and fish habitat conditions in the Stream C1 diversion. This will include inspection of the diversion system by a qualified hydrologist and fish biologist.
5. Monitor the structural stability of the causeway margins and the rock reef that remains following closure.

Monitoring of no net loss measures will include the following:

1. Pre-enhancement surveys of proposed sites (physical enhancement and improved access) to describe habitat characteristics and fish use.
2. Post-enhancement surveys of enhanced sites (physical enhancement and improved access) to describe habitat characteristics and fish use.

Habitat surveys will quantify physical characteristics and will focus on features that affect habitat quality (Appendix A). Fish surveys will characterize the fish community that uses the enhancement sites, the relative abundance of the fish populations, and their biological characteristics.

6.0 CONCLUSIONS

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 it is likely that Project effects can not be fully mitigated, affected habitats are quantified and characterized in terms of their importance to fish using accepted evaluation procedures.

Project activities may impact fish habitat in several locations. These include road crossings on Streams C1 and C2, the water intake causeway on Carat Lake, removal of Long Lake and an unnamed pond by construction of the PKCA, PKCA discharge into Stream C3, and the effects of the C1 diversion and water management on Stream C1. Mitigation measures will remove the need for habitat compensation for most Project activities. The only exception is loss of 16,745 WHU of habitat from Long Lake and an unnamed pond due to construction of the PKCA. The affected fish populations are slimy sculpin and burbot.

The no net loss plan proposed by Tahera is based on the type of habitat affected and the availability of habitat compensation opportunities in the Project area. The plan is technically feasible, it adheres to the no net loss principle, and it meets the need to maintain habitat productive capacity recommended by DFO. The plan's fundamental goal is to ensure the long-term viability of the fish community in the Project area.

Compensation will be provided using two approaches. It includes creation of habitats similar to those that are impacted in the same or adjacent waterbodies (habitat enhancement) and improving access to habitats similar to those that are impacted in adjacent waterbodies (improved access).

Habitat enhancement will entail construction of high quality spawning, rearing, and feeding habitats in lakes. The target species are Arctic char, Arctic grayling, burbot, lake trout, round whitefish, and slimy sculpin. Habitat enhancement will target sites in selected lake sections that contain limited amounts of these habitats. At each site enhancement will occur in two areas. These are shallow sheltered areas that promote warmer water temperatures and increased food production that will be used primarily as rearing and foraging habitats. Deeper areas, which will be constructed below ice level, will provide spawning and foraging habitats.

Enhanced areas will consist of rock reef that will be constructed using large rock materials available from the mine site. Enhancement will create 33,260 WHUs (Weighted Habitat Units) of habitat.

Access to important habitats may limit the productive capacity of fish populations in the Project area; therefore, improved access is proposed as a second compensation method. The barrier targeted for improvement is a shallow ill-defined section of Stream O21. Eliminating this barrier would increase the availability of important habitats to fish and prevent stranding of fish in unsuitable areas. Improved access would increase the amount of available habitat by 3742 WHUs.

The total net change in habitat associated with physical enhancement and improved access will be 37,002 WHUs. Overall, this represents a compensation ratio of 1: 2.21 for losses to gains.

Monitoring to determine the effectiveness of both the mitigation measures and compensation measures will be conducted to ensure that the no net loss plan functions as intended. Activities will include monitoring during construction, operation, and closure, fish salvage in the Long Lake system, as well as measuring pre- and post-enhancement site and improved access conditions. Monitoring of compensation sites will involve quantification of habitat and fish community characteristics.

In summary, the no net loss plan has been designed to balance unavoidable habitat losses associated with the Project with habitat replacement using methods that have been accepted by DFO at other mining projects in the Arctic. Steps also will be taken, via monitoring, to ensure that the no net loss plan is successful. As such, Tahera Diamond Corporation is confident that the plan meets the requirements of DFO's no net loss principle regarding the productive capacity of fish habitat.

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PLATES


Plate 1 Stream C3 (*July 2004*). Mouth looking upstream


Plate 2 Stream C3 (*July 2004*). Reach 6 looking upstream.


Plate 3 Stream C3 (*July 2004*). Reach 1 looking upstream.


Plate 4 Stream C3 (*July 2004*). Reach 2 looking downstream.


Plate 5 Stream C1 (*August 1999*). Reaches 1, 2, 3, and Carat Lake.


Plate 6 Stream C1 (*July 2004*)**.** Reach 9 barrier looking upstream.


Plate 7 Stream C1 (*August 1999*)**.** Man-made berm and impounded area.

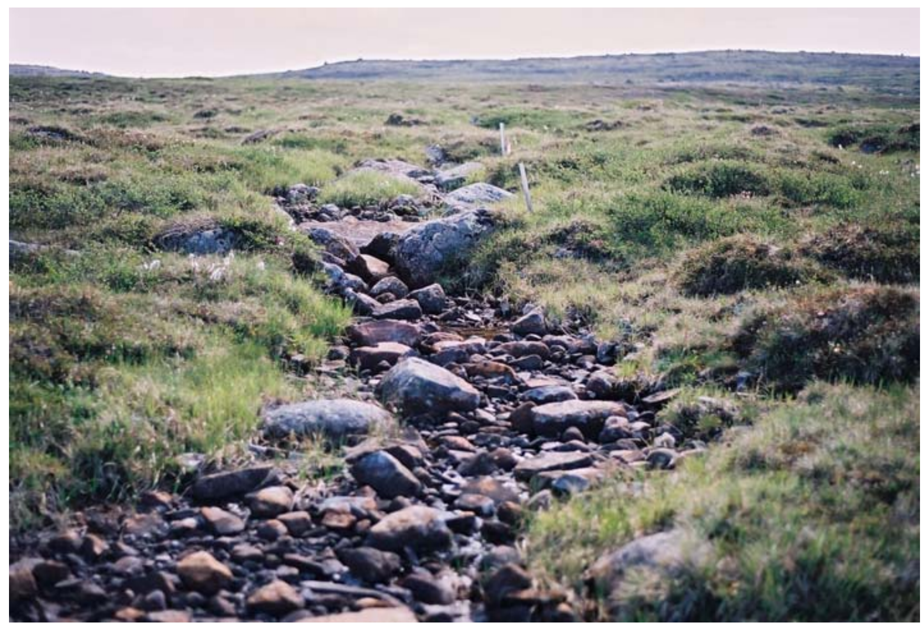
Plate 8 Stream C1 (*July 2004*). Reach 1 looking upstream.

APPENDIX A

Appendix A1. Habitat suitability index habitat criteria for Arctic char (adapted from RLL/Golder 2004).

Arctic char

Physical habitat	SPAWNING					NURSERY				
	Excellent	**Above Average**	**Average**	**Below Average**	**Unsuitable**	**Excellent**	**Above Average**	**Average**	**Below Average**	**Unsuitable**
HSI value	1.00	0.75	0.50	0.25	0.00	1.00	0.75	0.50	0.25	0.00
Substratum type	G dominant	G and C	G or C	Bo/C with G	Bd or CS	G dominant	G and C	G or C	Bo/C with G	Bd or CS
Minimum depth	2 m	2 m	<2 m	<2 m	<2 m	2 m	2 m	1.5 m	<2 m	<2 m
Maximum depth	4.5 m	3 m	3 m	2 m	>2 m	4.5 m	3 m	>1.5 m	>1 m	>1 m
Substratum shape	round	round	angular or round	angular or round	-	round	round	angular or round	angular or round	-
Substratum cleanliness	clean	clean	some silt	silt/algae covered	-	clean	clean	some silt	silt/algae covered	-
Exposure to predominant wind & wave action	full exposure	full exposure	moderate exposure	low exposure	-	full exposure	full exposure	moderate exposure	low exposure	-
Proximity to deep water areas	directly adjacent	-	-	-	not adjacent	directly adjacent	-	-	-	not adjacent

Physical habitat	REARING					FORAGING				
	Excellent	**Above Average**	**Average**	**Below Average**	**Unsuitable**	**Excellent**	**Above Average**	**Average**	**Below Average**	**Unsuitable**
HSI value	1.00	0.75	0.50	0.25	-	1.00	0.75	0.50	0.25	0.00
Substratum type	Bo/C	C	-	S/CS	Bd	Bo/C	-	G/S and pelagic	CS/Bd	-
Minimum depth	-	-	variable	variable	-	1 m	-	10 m	-	-
Maximum depth	<10 m	<10 m	variable	variable	-	10 m		30 m	>30 m	-
Substratum shape	round/angular	round/angular	round	100% fines	-	angular or round	-	-	-	-
Substratum cleanliness	-	-	-	-	-	-	-	-	-	-
Exposure to predominant wind & wave action	low exposure	low exposure	moderate exposure	full exposure	full exposure	-	-	-	-	-
Proximity to deep water areas	directly adjacent	-	-	not adjacent	-	-	-	-	-	-

Physical habitat	WINTERING				
	Excellent	**Above Average**	**Average**	**Below Average**	**Unsuitable**
HSI value	-	-	-	-	-
Substratum type	Bo/C	C	-	-	-
Substratum size	-	-	-	-	-
Minimum depth	-	-	-	-	-
Maximum depth	>5 m	>5 m	>5 m	3 m	<3 m
Slope of rock substratum	-	-	-	-	-
Substratum shape	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-

Notes:cm = centimetres; m = metres; Bd = Bedrock, Bo = Boulder (>25 cm), C = cobble (>6.5 cm), R = rubble (>6.5 cm, angular), G = gravel (>0.2 cm), S = sand (>0.06 mm) and CS = clay/silt (<0.06 mm)

Appendix A2. Habitat suitability index habitat criteria for Arctic grayling (adapted from Diavik 1998 and DeBeers 2002).

Arctic grayling

Physical habitat	SPAWNING					NURSERY				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	0.00	1.00	0.75	0.50	0.25	0.00
Substratum type	G	G/C	G/C	C	C	-	-	-	-	-
Substratum size					-	-	-	-	-	-
Minimum depth	0.75	0.5	0.25	0.1	0.1	-	-	-	-	-
Maximum depth	-	-	-	-	-	-	-	-	-	-
Proximity to Physical Cover	high	high	moderate	low	nil	-	-	-	-	-
Substratum shape	-	-	-	-	-	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-	-	-	-	-	-

Physical habitat	REARING					FORAGING				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	-	1.00	0.75	0.50	0.25	0.00
Substratum type	large Bo/C	-	sparse Bo/C	sand/silt	Bd	variable	-	variable	variable	CS/S
Substratum size	>25 cm	-	-	<0.06 cm	-	-	-	-	-	-
Minimum depth	50 cm	-	-	<50 cm	-	0 m	-	5 m	10 m	>20 m
Maximum depth	>50 cm	-	-	<50 cm	-	5 m		10 m	50 m	>20 m
Slope of rock substratum	-	-	-	-	-	-	-	-	-	-
Substratum shape	round/angular	-	angular only	fines		-	-	-	-	-
Substratum cleanliness	clean	-	moderately clean	heavily silted	-	clean	-	moderately clean	heavily silted	heavily silted
Depth of interstitial spaces	-	-	-	-	-	-	-		-	-
Exposure to predominant wind & wave action	-	-	-	-	full exposure	-	-	-	-	-
Proximity to deep water areas	directly adjacent	-	-	not adjacent	-	directly adjacent	-	-	-	not adjacent

Physical habitat	WINTERING				
	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	-	-	-	-	-
Substratum type	Bo/C	C	-	-	-
Substratum size	-	-	-	-	-
Minimum depth	-	-	-	-	-
Maximum depth	>5 m	>5 m	3-5 m	>3 m	<2 m
Slope of rock substratum	-	-	-	-	-
Substratum shape	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-

Notes:cm = centimetres; m = metres; Bd = Bedrock, Bo = Boulder (>25 cm), C = cobble (>6.5 cm), R = rubble (>6.5 cm, angular), G = gravel (>0.2 cm), S = sand (>0.06 mm) and CS = clay/silt (<0.06 mm)

Appendix A3. Habitat suitability index habitat criteria for burbot (adapted from Diavik 1998 and DeBeers 2002).

Burbot

Physical habitat	SPAWNING					NURSERY				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	0.00	1.00	0.75	0.50	0.25	0.00
Substratum type	Bo/C	-	G/S	-	Bd/CS	Bo/Co	-	G/S	-	Bd/CS
Substratum size	6.5-25 cm	-	>0.2 cm	-	-	6.5-25 cm	-	>0.2 cm	-	-
Minimum depth	2 m	-	5 m	-	>20 m	2 m	-	5 m	-	>20 m
Maximum depth	10 m	-	20 m	-	>20 m	10 m	-	20 m	-	>20 m
Slope of rock substratum	10-20°	-	>5°	-	>0°	10-20°	-	>5°	-	>0°
Substratum shape	angular or round	-	angular or round	-	-	angular or round	-	angular or round	-	-
Substratum cleanliness	clean	-	moderately clean	-	-	clean	-	moderately clean	-	-
Depth of interstitial spaces	>1 mm	-	>0.2 m	-	>0.06 m	>1 mm	-	>0.2 m	-	>0.06 m
Exposure to predominant wind & wave action	full exposure	-	partial exposure	-	<180° exposure	full exposure	-	partial exposure	-	full exposure
Proximity to deep water areas	directly adjacent	-	-	-	not adjacent	directly adjacent	-	-	-	not adjacent

Physical habitat	REARING					FORAGING				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	0	1.00	-	0.50	0.25	0.00
Substratum type	Bo/C	-	C/G	CS/S	Bd	variable	-	Bo/C	Bd	Bd
Substratum size	6.5->25 cm	-	>0.2 cm	0.06-0.2 cm	-	-	-	-	-	-
Minimum depth	0.25 m	-	1 m	>6 m	-	0 m	-	10 m	20 m	-
Maximum depth	3 m	-	6 m	>6 m	-	10 m	-	30 m	30 m	-
Slope of rock substratum	0-10°	-	0-20 m	>20°	-	-	-	-	-	-
Substratum shape	angled or round	-	angled or round	round		-	-	-	-	
Substratum cleanliness	clean	-	moderately clean	silt/algae	-	-	-	-	-	-
Depth of interstitial spaces	>2 mm	-	>1 mm	<1 mm	-	-	-		-	-
Exposure to predominant wind & wave action	>180° exposure	-	>180° exposure	full exposure	full exposure	-	-	-	-	full exposure
Proximity to deep water areas	directly adjacent	-	-	not adjacent	-	-	-	-	-	

Physical habitat	WINTERING				
	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	-	-	-	-	-
Substratum type	Bo/C	C	-	-	-
Substratum size	-	-	-	-	-
Minimum depth	-	-	-	-	-
Maximum depth	>5 m	>5 m	>5 m	3 m	<3 m
Slope of rock substratum	-	-	-	-	-
Substratum shape	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-

Notes:cm = centimetres; m = metres; Bd = Bedrock, Bo = Boulder (>25 cm), C = cobble (>6.5 cm), R = rubble (>6.5 cm, angular), G = gravel (>0.2 cm), S = sand (>0.06 mm) and CS = clay/silt (<0.06 mm)

Appendix A4. Habitat suitability index habitat criteria for lake trout (adapted from Diavik 1998 and DeBeers 2002).

Lake trout

Physical habitat	SPAWNING					NURSERY				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	0.00	1.00	0.75	0.50	0.25	0.00
Substratum type	Bo dominant	Bo or C	Bo or C	Bo/C with G	Bd or CS	Bo dominant	Bo or C	Bo or C	Bo/C with G	Bd or CS
Substratum size	20-50 cm	10-50 cm	5-60 cm	>1 cm	<1 cm	20-50 cm	10-50 cm	5-60 cm	>1 cm	<1 cm
Minimum depth	2 m	2 m	1.5 m	<3 m	<3 m	2 m	2 m	1.5 m	<3 m	<3 m
Maximum depth	>4 m	>3 m	>1.5 m	>1.5 m	>1.5 m	>4 m	>3 m	>1.5 m	>1.5 m	>1.5 m
Slope of rock substratum	30-50°	30-50°	15-50°	>0°	>0°	30-50°	30-50°	15-50°	>0°	>0°
Substratum shape	angular/fractured	angular	angular or round	angular or round	-	angular/fractured	angular	angular or round	angular or round	-
Substratum cleanliness	clean	clean	some silt	silt/algae covered	-	clean	clean	some silt	silt/algae covered	-
Depth of interstitial spaces	>30 cm	>20 cm	>10 cm	>3 cm	-	>30 cm	>20 cm	>10 cm	>3 cm	-
Exposure to predominant wind & wave action	full exposure	full exposure	>180° exposure	<180° exposure	-	full exposure	full exposure	>180° exposure	<180° exposure	-
Proximity to deep water areas	directly adjacent	-	-	-	not adjacent	directly adjacent	-	-	-	not adjacent

Physical habitat	REARING					FORAGING				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	-	1.00	0.75	0.50	0.25	0.00
Substratum type	Bo/C	C	-	S/CS	Bd	B/C	-	G/S and pelagic	CS/Bd	-
Substratum size	>6.5 cm	>6.5 cm	<6.5 cm	0	-	2.5-6.5 cm	-	-	-	-
Minimum depth	-	-	variable	variable	-	1 m	-	10 m	-	-
Maximum depth	<10 m	<10 m	variable	variable	-	10 m		30 m	>30 m	-
Slope of rock substratum	-	-	25°	0°	-	-	-	-	-	-
Substratum shape	round/angular	round/angular	round	100% fines	full exposure	angular or round	-	-	-	-
Substratum cleanliness	-	-	-	-	-	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-	-	-	-	-	-
Exposure to predominant wind & wave action	<180° exposure	<180° exposure	>180° exposure	full exposure	-	-	-	-	-	-
Proximity to deep water areas	directly adjacent	-	-	not adjacent	-	-	-	-	-	-

Physical habitat	WINTERING				
	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	-	-	-	-	-
Substratum type	Bo/C	C	-	-	-
Substratum size	-	-	-	-	-
Minimum depth	-	-	-	-	-
Maximum depth	>5 m	>5 m	>5 m	3 m	<3 m
Slope of rock substratum	-	-	-	-	-
Substratum shape	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-

Notes:cm = centimetres; m = metres; Bd = Bedrock, Bo = Boulder (>25 cm), C = cobble (>6.5 cm), R = rubble (>6.5 cm, angular), G = gravel (>0.2 cm), S = sand (>0.06 mm) and CS = clay/silt (<0.06 mm)

Appendix A5. Habitat suitability index habitat criteria for round whitefish (adapted from Diavik 1998 and DeBeers 2002).

Round whitefish

Physical habitat	SPAWNING					NURSERY				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	0.00	1.00	0.75	0.50	0.25	0.00
Substratum type	G and C	G or C	Bo or C/G	Bo or S	Bd or CS	G and C	G or C	Bo or C/G	Bo or S	Bd or CS
Substratum size	0.2-6.5 cm	0.2-6.5 cm	0.2-25 cm	>1 mm	<1 mm	0.2-6.5 cm	0.2-6.5 cm	0.2-25 cm	>1 mm	<1 mm
Minimum depth	4 m	<4 m	<4 m	<4 m	<4 m	4 m	<4 m	<4 m	<4 m	<4 m
Maximum depth	20 m	>20 m	>20 m	>20 m	>20 m	20 m	>20 m	>20 m	>20 m	>20 m
Slope of rock substratum	10-25°	10-40°	10->25°	>0°	>0°	10-25°	10-40°	10->25°	>0°	>0°
Substratum shape	angular or round	angular or round	angular or round	angular or round	-	angular or round	angular or round	angular or round	angular or round	-
Substratum cleanliness	clean	some silt	some silt	silt/algae covered	-	clean	some silt	some silt	silt/algae covered	-
Depth of interstitial spaces	>5 cm	>5 cm	>5 cm	>1 mm	-	>5 cm	>5 cm	>5 cm	>1 mm	-
Exposure to predominant wind & wave action	full exposure	full exposure	>180° exposure	<180° exposure	-	full exposure	full exposure	>180° exposure	<180° exposure	-
Proximity to deep water areas	directly adjacent	-	-	-	not adjacent	directly adjacent	-	-	-	not adjacent

Physical habitat	REARING					FORAGING				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	-	0.50	0.25	-	1.00	0.75	0.50	0.25	0.00
Substratum type	G/S/SC	-	C/G/S/SC	Bo/C	Bd	Bo/C	-	G/S	CS/Bd	-
Substratum size	<0.2	-	<6.5	<25 m	-	2.5-6.5 cm	-	0.2->0.06 mm	<0.06 mm	-
Minimum depth	<1 m	-	<5 m	>10 m	-	0 m	-	6 m	20 m	<2 m
Maximum depth	3 m	-	<10 m	>10 m	-	6 m		20 m	50 m	>7 m
Slope of rock substratum	-	-	-	-	-	-	-	-	-	-
Substratum shape	-	-	-	-		angular or round	-	-	-	-
Substratum cleanliness	-	-	-	-	-	clean	-	moderately clean	heavily silted	heavily silted
Depth of interstitial spaces	-	-	-	-	-	-	-		-	-
Exposure to predominant wind & wave action	<180° exposure	-	>180° exposure	full exposure	full exposure	-	-	-	-	-
Proximity to deep water areas	directly adjacent	-	-	not adjacent	-	-	-	-	-	not adjacent

Physical habitat	WINTERING				
	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	-	-	-	-	-
Substratum type	Bo/C	C	-	-	-
Substratum size	-	-	-	-	-
Minimum depth	-	-	-	-	-
Maximum depth	>5 m	>5 m	>5 m	3 m	<3 m
Slope of rock substratum	-	-	-	-	-
Substratum shape	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-

Notes:cm = centimetres; m = metres; Bd = Bedrock, Bo = Boulder (>25 cm), C = cobble (>6.5 cm), R = rubble (>6.5 cm, angular), G = gravel (>0.2 cm), S = sand (>0.06 mm) and CS = clay/silt (<0.06 mm)

Appendix A6. Habitat suitability index habitat criteria for slimy sculpin (adapted from Diavik 1998 and DeBeers 2002).

Slimy sculpin

Physical habitat	SPAWNING					NURSERY				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	0.00	1.00	0.75	0.50	0.25	0.00
Substratum type	Bo, C, and G	-	S	CS	detritus	Bo and C		S and CS	detritus	-
Substratum size	0.06 mm ->25 cm	-	0.06 mm	<0.06 mm	-	0.06 mm ->25 cm	-	<0.06-0.06 mm	-	-
Minimum depth	<1 m	-	2 m	-	5 m	<1 m	-	2 m	-	-
Maximum depth	2 m	-	5 m	-	>10 m	2 m	-	10 m	-	pelagic
Slope of rock substratum	-	-	-	-	-	-	-	-	-	-
Substratum shape	angular or round	-	-	-	-	angular or round	-	-	-	-
Substratum cleanliness	-	-	-	-	-	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-	-	-	-	-	-
Exposure to predominant wind & wave action	in-situ cover	-	-	-	-	in-situ cover	-	-	-	-
Proximity to deep water areas	-	-	-	-	-	-	-	-	-	-

Physical habitat	REARING					FORAGING				
	Excellent	Above Average	Average	Below Average	Unsuitable	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	1.00	0.75	0.50	0.25	-	1.00	0.75	0.50	0.25	0.00
Substratum type	Bo and C	-	R,G, and S	detritus	Bd	R,G,S and CS	-	Bd, Bo, and C	detritus	Bd
Substratum size	6.5->25 cm	-	0.06 mm->6.5 cm	-	-	<0.06 mm->6.5 cm	-	>6.5 cm	-	-
Minimum depth	<1 m	-	2 m	-	-	1	-	-	-	-
Maximum depth	2 m	-	10 m	>10 m	-	>10 m	-	-	<1 m	-
Slope of rock substratum	-	-	-	-	-	-	-	-	-	-
Substratum shape	-	-	-	-		angular	-	-	-	-
Substratum cleanliness	-	-	-	-	-	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-	-	-		-	-
Exposure to predominant wind & wave action	in-situ cover	-	-	-	full exposure	in-situ cover	-	-	-	full exposure
Proximity to deep water areas	-	-	-	-	-	-	-	-	-	-

Physical habitat	WINTERING				
	Excellent	Above Average	Average	Below Average	Unsuitable
HSI value	-	-	-	-	-
Substratum type	Bo/C	C	-	-	-
Substratum size	-	-	-	-	-
Minimum depth	>5 m	>5 m	>5 m	3 m	<3 m
Maximum depth	-	-	-	-	-
Slope of rock substratum	-	-	-	-	-
Substratum shape	-	-	-	-	-
Substratum cleanliness	-	-	-	-	-
Depth of interstitial spaces	-	-	-	-	-
Exposure to predominant wind & wave action	-	-	-	-	-
Proximity to deep water areas	-	-	-	-	-

Notes:cm = centimetres; m = metres; Bd = Bedrock, Bo = Boulder (>25 cm), C = cobble (>6.5 cm), R = rubble (>6.5 cm, angular), G = gravel (>0.2 cm), S = sand (>0.06 mm) and CS = clay/silt (<0.06 mm)

APPENDIX B

Appendix B1. Habitat losses and gains in Carat Lake due to the water intake causeway.

Species	Habitat No.	Life Stage	Losses			Operation Mitigation							Closure Mitigation		
						Habitat No. 1			Habitat No. 2			Total			
			Area (m²)	HIS	HU	Area (m²)	HIS	HU	Area (m²)	HIS	HU	HU	Area (m²)	HIS	HU
Arctic char	1	Foraging	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Nursery/Rearing	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.75	416
		Spawning	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
		Wintering	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
	2	Foraging	1129	0.25	282	240	0.75	180	240	0.75	180	359	652	0.75	489
		Nursery/Rearing	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Spawning	1129	0.00	0	240	0.00	0	240	0.00	0	0	652	0.00	0
		Wintering	1129	0.50	565	240	0.00	0	240	0.75	180	180	652	0.75	489
Arctic grayling	1	Foraging	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.75	416
		Nursery/Rearing	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.75	416
		Spawning	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.25	139
		Wintering	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
	2	Foraging	1129	0.25	282	240	0.75	180	240	0.75	180	359	652	0.75	489
		Nursery/Rearing	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Spawning	1129	0.00	0	240	0.00	0	240	0.00	0	0	652	0.00	0
		Wintering	1129	0.50	565	240	0.00	0	240	0.75	180	180	652	0.75	489
Burbot	1	Foraging	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Nursery/Rearing	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.75	416
		Spawning	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
		Wintering	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
	2	Foraging	1129	0.25	282	240	0.75	180	240	0.75	180	359	652	0.75	489
		Nursery/Rearing	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Spawning	1129	0.00	0	240	0.00	0	240	0.75	180	180	652	0.75	489
		Wintering	1129	0.50	565	240	0.00	0	240	0.75	180	180	652	0.75	489
Lake trout	1	Foraging	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Nursery/Rearing	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.75	416
		Spawning	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
		Wintering	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
	2	Foraging	1129	0.25	282	240	0.75	180	240	0.75	180	359	652	0.75	489
		Nursery/Rearing	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Spawning	1129	0.00	0	240	0.00	0	240	0.75	180	180	652	0.75	489
		Wintering	1129	0.50	565	240	0.00	0	240	0.75	180	180	652	0.75	489

Appendix B1. Habitat losses and gains in Carat Lake due to the water intake causeway.

Species	Habitat No.	Life Stage	Losses			Operation Mitigation							Closure Mitigation		
						Habitat No. 1			Habitat No. 2			Total			
			Area (m²)	HIS	HU	Area (m²)	HIS	HU	Area (m²)	HIS	HU	HU	Area (m²)	HIS	HU
Round whitefish	1	Foraging	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Nursery/Rearing	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Spawning	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
		Wintering	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
	2	Foraging	1129	0.50	565	240	0.75	180	240	0.75	180	359	652	0.75	489
		Nursery/Rearing	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Spawning	1129	0.00	0	240	0.00	0	240	0.75	180	180	652	0.75	489
		Wintering	1129	0.50	565	240	0.00	0	240	0.75	180	180	652	0.75	489
Slimy sculpin	1	Foraging	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.75	416
		Nursery/Rearing	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Spawning	685	0.50	343	128	0.75	96	0	0.00	0	96	555	0.50	278
		Wintering	685	0.00	0	128	0.00	0	0	0.00	0	0	555	0.00	0
	2	Foraging	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Nursery/Rearing	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Spawning	1129	0.00	0	240	0.75	180	240	0.75	180	359	652	0.75	489
		Wintering	1129	0.25	282	240	0.00	0	240	0.75	180	180	652	0.75	489

Appendix B2. Habitat losses in the Long Lake system due to the PKCA.

Project Activity	Species	Habitat No.	Life Stage	Area (m²)	HIS	HU	Importance Weighting	Weighted Losses
Long Lake	Burbot	1	Foraging	4300	0.25	1075	0.13	137
			Nursery/Rearing	4300	0.25	1075	0.13	137
			Spawning	4300	0.00	0	0.13	0
			Wintering	4300	0.00	0	0.13	0
		2	Foraging	29700	0.50	14850	0.13	1886
			Nursery/Rearing	29700	0.50	14850	0.13	1886
			Spawning	29700	0.00	0	0.13	0
			Wintering	29700	0.00	0	0.13	0
		3	Foraging	42000	0.00	0	0.13	0
			Nursery/Rearing	42000	0.00	0	0.13	0
			Spawning	42000	0.00	0	0.13	0
			Wintering	42000	0.00	0	0.13	0
		4	Foraging	24300	0.25	6075	0.13	772
			Nursery/Rearing	24300	0.25	6075	0.13	772
			Spawning	24300	0.25	6075	0.13	772
			Wintering	24300	0.50	12150	0.13	1543
	Slimy sculpin	1	Foraging	4300	0.25	1075	0.10	108
			Nursery/Rearing	4300	0.25	1075	0.10	108
			Spawning	4300	0.25	1075	0.10	108
			Wintering	4300	0.00	0	0.10	0
		2	Foraging	29700	0.50	14850	0.10	1485
			Nursery/Rearing	29700	0.50	14850	0.10	1485
			Spawning	29700	0.50	14850	0.10	1485
			Wintering	29700	0.00	0	0.10	0
		3	Foraging	42000	0.00	0	0.10	0
			Nursery/Rearing	42000	0.00	0	0.10	0
			Spawning	42000	0.00	0	0.10	0
			Wintering	42000	0.00	0	0.10	0
		4	Foraging	24300	0.25	6075	0.10	608
			Nursery/Rearing	24300	0.25	6075	0.10	608
			Spawning	24300	0.25	6075	0.10	608
			Wintering	24300	0.50	12150	0.10	1215

Appendix B2. Habitat losses in the Long Lake system due to the PKCA.

Project Activity	Species	Habitat No.	Life Stage	Area (m²)	HIS	HU	Importance Weighting	Weighted Losses
Unnamed Pond	Burbot	1	Foraging	0	0.25	0	0.13	0
			Nursery/Rearing	0	0.25	0	0.13	0
			Spawning	0	0.00	0	0.13	0
			Wintering	0	0.00	0	0.13	0
		2	Foraging	0	0.50	0	0.13	0
			Nursery/Rearing	5600	0.00	0	0.13	0
			Spawning	5600	0.00	0	0.13	0
			Wintering	5600	0.00	0	0.13	0
		3	Foraging	0	0.00	0	0.13	0
			Nursery/Rearing	0	0.00	0	0.13	0
			Spawning	0	0.00	0	0.13	0
			Wintering	0	0.00	0	0.13	0
		4	Foraging	1500	0.00	0	0.13	0
			Nursery/Rearing	1500	0.00	0	0.13	0
			Spawning	1500	0.00	0	0.13	0
			Wintering	1500	0.00	0	0.13	0
	Slimy sculpin	1	Foraging	0	0.25	0	0.10	0
			Nursery/Rearing	0	0.25	0	0.10	0
			Spawning	0	0.25	0	0.10	0
			Wintering	0	0.00	0	0.10	0
		2	Foraging	5600	0.50	2800	0.10	280
			Nursery/Rearing	5600	0.50	2800	0.10	280
			Spawning	5600	0.50	2800	0.10	280
			Wintering	5600	0.00	0	0.10	0
		3	Foraging	0	0.00	0	0.10	0
			Nursery/Rearing	0	0.00	0	0.10	0
			Spawning	0	0.00	0	0.10	0
			Wintering	0	0.00	0	0.10	0
		4	Foraging	1500	0.25	375	0.10	38
			Nursery/Rearing	1500	0.25	375	0.10	38
			Spawning	1500	0.25	375	0.10	38
			Wintering	1500	0.50	750	0.10	75

Appendix B3. Habitat losses in Stream C3 due to PKCA discharge.

Species	Habitat No.	Life Stage	Area (m²)	HIS	HU
Arctic Char	1	Foraging	210	0.00	0
		Production	210	0.00	0
		Nursery/Rearing	210	0.25	53
		Spawning	210	0.00	0
	2	Foraging	629	0.00	0
		Production	629	0.25	157
		Nursery/Rearing	629	0.00	0
		Spawning	629	0.00	0
Arctic grayling	1	Foraging	210	0.00	0
		Production	210	0.00	0
		Nursery/Rearing	210	0.25	53
		Spawning	210	0.25	53
	2	Foraging	629	0.00	0
		Production	629	0.25	157
		Nursery/Rearing	629	0.00	0
		Spawning	629	0.00	0
Burbot	1	Foraging	210	0.00	0
		Production	210	0.00	0
		Nursery/Rearing	210	0.25	53
		Spawning	210	0.00	0
	2	Foraging	629	0.00	0
		Production	629	0.25	157
		Nursery/Rearing	629	0.00	0
		Spawning	629	0.00	0
Lake trout	1	Foraging	210	0.00	0
		Production	210	0.00	0
		Nursery/Rearing	210	0.25	53
		Spawning	210	0.00	0
	2	Foraging	629	0.00	0
		Production	629	0.25	157
		Nursery/Rearing	629	0.00	0
		Spawning	629	0.00	0
Round whitefish	1	Foraging	210	0.00	0
		Production	210	0.00	0
		Nursery/Rearing	210	0.25	53
		Spawning	210	0.00	0
	2	Foraging	629	0.00	0
		Production	629	0.25	157
		Nursery/Rearing	629	0.00	0
		Spawning	629	0.00	0
Slimy sculpin	1	Foraging	210	0.50	105
		Production	210	0.00	0
		Nursery/Rearing	210	0.50	105
		Spawning	210	0.50	105
	2	Foraging	629	0.00	0
		Production	629	0.25	157
		Nursery/Rearing	629	0.00	0
		Spawning	629	0.00	0

Appendix B4. Habitat losses and gains in Stream C1 due the diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				Area (m²)	HIS	HU	Area (m²)	HIS	HU
Diversion Channel	Arctic char	3	Foraging	798	0.00	0	715	0.00	0
			Production	798	0.25	199	715	0.25	179
			Nursery/Rearing	798	0.00	0	715	0.00	0
			Spawning	798	0.00	0	715	0.00	0
		4	Foraging	1258	0.00	0	0	0.00	0
			Production	1258	0.25	315	0	0.25	0
			Nursery/Rearing	1258	0.00	0	0	0.00	0
			Spawning	1258	0.00	0	0	0.00	0
	Arctic grayling	3	Foraging	798	0.00	0	715	0.00	0
			Production	798	0.25	199	715	0.25	179
			Nursery/Rearing	798	0.00	0	715	0.00	0
			Spawning	798	0.00	0	715	0.00	0
		4	Foraging	1258	0.00	0	0	0.00	0
			Production	1258	0.25	315	0	0.25	0
			Nursery/Rearing	1258	0.00	0	0	0.00	0
			Spawning	1258	0.00	0	0	0.00	0
	Burbot	3	Foraging	798	0.00	0	715	0.00	0
			Production	798	0.25	199	715	0.25	179
			Nursery/Rearing	798	0.00	0	715	0.00	0
			Spawning	798	0.00	0	715	0.00	0
		4	Foraging	1258	0.00	0	0	0.00	0
			Production	1258	0.25	315	0	0.25	0
			Nursery/Rearing	1258	0.00	0	0	0.00	0
			Spawning	1258	0.00	0	0	0.00	0
	Lake trout	3	Foraging	798	0.00	0	715	0.00	0
			Production	798	0.25	199	715	0.25	179
			Nursery/Rearing	798	0.00	0	715	0.00	0
			Spawning	798	0.00	0	715	0.00	0
		4	Foraging	1258	0.00	0	0	0.00	0
			Production	1258	0.25	315	0	0.25	0
			Nursery/Rearing	1258	0.00	0	0	0.00	0
			Spawning	1258	0.00	0	0	0.00	0
	Round whitefish	3	Foraging	798	0.00	0	715	0.00	0
			Production	798	0.25	199	715	0.25	179
			Nursery/Rearing	798	0.00	0	715	0.00	0
			Spawning	798	0.00	0	715	0.00	0
		4	Foraging	1258	0.00	0	0	0.00	0
			Production	1258	0.25	315	0	0.25	0
			Nursery/Rearing	1258	0.00	0	0	0.00	0
			Spawning	1258	0.00	0	0	0.00	0
	Slimy sculpin	3	Foraging	798	0.00	0	715	0.00	0
			Production	798	0.25	199	715	0.25	179
			Nursery/Rearing	798	0.00	0	715	0.00	0
			Spawning	798	0.00	0	715	0.00	0
		4	Foraging	1258	0.00	0	0	0.00	0
			Production	1258	0.25	315	0	0.25	0
			Nursery/Rearing	1258	0.00	0	0	0.00	0
			Spawning	1258	0.00	0	0	0.00	0

Appendix B4. Habitat losses and gains in Stream C1 due the diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				Area (m²)	HIS	HU	Area (m²)	HIS	HU
Diversion Dyke	Arctic char	4	Foraging	91	0.00	0	0	0.00	0
			Production	91	0.25	23	0	0.25	0
			Nursery/Rearing	91	0.00	0	0	0.00	0
			Spawning	91	0.00	0	0	0.00	0
	Arctic grayling	4	Foraging	91	0.00	0	0	0.00	0
			Production	91	0.25	23	0	0.25	0
			Nursery/Rearing	91	0.00	0	0	0.00	0
			Spawning	91	0.00	0	0	0.00	0
	Burbot	4	Foraging	91	0.00	0	0	0.00	0
			Production	91	0.25	23	0	0.25	0
			Nursery/Rearing	91	0.00	0	0	0.00	0
			Spawning	91	0.00	0	0	0.00	0
	Lake trout	4	Foraging	91	0.00	0	0	0.00	0
			Production	91	0.25	23	0	0.25	0
			Nursery/Rearing	91	0.00	0	0	0.00	0
			Spawning	91	0.00	0	0	0.00	0
	Round whitefish	4	Foraging	91	0.00	0	0	0.00	0
			Production	91	0.25	23	0	0.25	0
			Nursery/Rearing	91	0.00	0	0	0.00	0
			Spawning	91	0.00	0	0	0.00	0
	Slimy sculpin	4	Foraging	91	0.00	0	0	0.00	0
			Production	91	0.25	23	0	0.25	0
			Nursery/Rearing	91	0.00	0	0	0.00	0
			Spawning	91	0.00	0	0	0.00	0

Appendix B4. Habitat losses and gains in Stream C1 due the diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				Area (m²)	HIS	HU	Area (m²)	HIS	HU
Transition Pond	Arctic char	3	Foraging	6	0.00	0	30	0.00	0
			Production	6	0.25	1	30	0.25	8
			Nursery/Rearing	6	0.00	0	30	0.00	0
			Spawning	6	0.00	0	30	0.00	0
	Arctic grayling	3	Foraging	6	0.00	0	30	0.00	0
			Production	6	0.25	1	30	0.25	8
			Nursery/Rearing	6	0.00	0	30	0.00	0
			Spawning	6	0.00	0	30	0.00	0
	Burbot	3	Foraging	6	0.00	0	30	0.00	0
			Production	6	0.25	1	30	0.25	8
			Nursery/Rearing	6	0.00	0	30	0.00	0
			Spawning	6	0.00	0	30	0.00	0
	Lake trout	3	Foraging	6	0.00	0	30	0.00	0
			Production	6	0.25	1	30	0.25	8
			Nursery/Rearing	6	0.00	0	30	0.00	0
			Spawning	6	0.00	0	30	0.00	0
	Round whitefish	3	Foraging	6	0.00	0	30	0.00	0
			Production	6	0.25	1	30	0.25	8
			Nursery/Rearing	6	0.00	0	30	0.00	0
			Spawning	6	0.00	0	30	0.00	0
	Slimy sculpin	3	Foraging	6	0.00	0	30	0.00	0
			Production	6	0.25	1	30	0.25	8
			Nursery/Rearing	6	0.00	0	30	0.00	0
			Spawning	6	0.00	0	30	0.00	0

Appendix B4. Habitat losses and gains in Stream C1 due the diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				Area (m^2)	HIS	HU	Area (m^2)	HIS	HU
Water Management	Arctic char	1	Foraging	266	0.00	0	0	0.00	0
			Production	266	0.00	0	0	0.00	0
			Nursery/Rearing	266	0.50	133	0	0.50	0
			Spawning	266	0.00	0	0	0.00	0
		3	Foraging	47	0.00	0	0	0.00	0
			Production	47	0.25	12	0	0.25	0
			Nursery/Rearing	47	0.00	0	0	0.00	0
			Spawning	47	0.00	0	0	0.00	0
	Arctic grayling	1	Foraging	266	0.00	0	0	0.00	0
			Production	266	0.00	0	0	0.00	0
			Nursery/Rearing	266	0.50	133	0	0.50	0
			Spawning	266	0.25	67	0	0.25	0
		3	Foraging	47	0.00	0	0	0.00	0
			Production	47	0.25	12	0	0.25	0
			Nursery/Rearing	47	0.00	0	0	0.00	0
			Spawning	47	0.00	0	0	0.00	0
	Burbot	1	Foraging	266	0.00	0	0	0.00	0
			Production	266	0.00	0	0	0.00	0
			Nursery/Rearing	266	0.50	133	0	0.50	0
			Spawning	266	0.00	0	0	0.00	0
		3	Foraging	47	0.00	0	0	0.00	0
			Production	47	0.25	12	0	0.25	0
			Nursery/Rearing	47	0.00	0	0	0.00	0
			Spawning	47	0.00	0	0	0.00	0
	Lake trout	1	Foraging	266	0.00	0	0	0.00	0
			Production	266	0.00	0	0	0.00	0
			Nursery/Rearing	266	0.50	133	0	0.50	0
			Spawning	266	0.00	0	0	0.00	0
		3	Foraging	47	0.00	0	0	0.00	0
			Production	47	0.25	12	0	0.25	0
			Nursery/Rearing	47	0.00	0	0	0.00	0
			Spawning	47	0.00	0	0	0.00	0
	Round whitefish	1	Foraging	266	0.00	0	0	0.00	0
			Production	266	0.00	0	0	0.00	0
			Nursery/Rearing	266	0.25	67	0	0.25	0
			Spawning	266	0.00	0	0	0.00	0
		3	Foraging	47	0.00	0	0	0.00	0
			Production	47	0.25	12	0	0.25	0
			Nursery/Rearing	47	0.00	0	0	0.00	0
			Spawning	47	0.00	0	0	0.00	0
	Slimy sculpin	1	Foraging	266	0.50	133	0	0.50	0
			Production	266	0.00	0	0	0.00	0
			Nursery/Rearing	266	0.50	133	0	0.50	0
			Spawning	266	0.50	133	0	0.50	0
		3	Foraging	47	0.00	0	0	0.00	0
			Production	47	0.25	12	0	0.25	0
			Nursery/Rearing	47	0.00	0	0	0.00	0
			Spawning	47	0.00	0	0	0.00	0

APPENDIX C

Appendix C1. Weighted habitat unit losses and gains in Carat Lake due to the water intake causeway.

Species	Habitat No.	Life Stage	Losses	Operation Mitigation	Closure Mitigation	Weighted Habitat Units			
			HU	HU	HU	Importance Weighting	Weighted Losses HU	Weighted Operation Mitigation HU	Weighted Closure Mitigation HU
Arctic char	1	Foraging	343	96	278	0.23	78	22	63
		Nursery/Rearing	343	96	416	0.23	78	22	94
		Spawning	0	0	0	0.23	0	0	0
		Wintering	0	0	0	0.23	0	0	0
	2	Foraging	282	359	489	0.23	64	82	111
		Nursery/Rearing	0	359	489	0.23	0	82	111
		Spawning	0	0	0	0.23	0	0	0
		Wintering	565	180	489	0.23	128	41	111
Arctic grayling	1	Foraging	343	96	416	0.21	72	20	87
		Nursery/Rearing	343	96	416	0.21	72	20	87
		Spawning	0	0	139	0.21	0	0	29
		Wintering	0	0	0	0.21	0	0	0
	2	Foraging	282	359	489	0.21	59	75	103
		Nursery/Rearing	0	359	489	0.21	0	75	103
		Spawning	0	0	0	0.21	0	0	0
		Wintering	565	180	489	0.21	119	38	103
Burbot	1	Foraging	343	96	278	0.13	43	12	35
		Nursery/Rearing	343	96	416	0.13	43	12	53
		Spawning	0	0	0	0.13	0	0	0
		Wintering	0	0	0	0.13	0	0	0
	2	Foraging	282	359	489	0.13	36	46	62
		Nursery/Rearing	0	359	489	0.13	0	46	62
		Spawning	0	180	489	0.13	0	23	62
		Wintering	565	180	489	0.13	72	23	62
Lake trout	1	Foraging	343	96	278	0.23	78	22	63
		Nursery/Rearing	343	96	416	0.23	78	22	94
		Spawning	0	0	0	0.23	0	0	0
		Wintering	0	0	0	0.23	0	0	0
	2	Foraging	282	359	489	0.23	64	82	111
		Nursery/Rearing	0	359	489	0.23	0	82	111
		Spawning	0	180	489	0.23	0	41	111
		Wintering	565	180	489	0.23	128	41	111

Appendix C1. Weighted habitat unit losses and gains in Carat Lake due to the water intake causeway.

Species	Habitat No.	Life Stage	Losses HU	Operation Mitigation HU	Closure Mitigation HU	Weighted Habitat Units: Importance Weighting	Weighted Losses HU	Weighted Operation Mitigation HU	Weighted Closure Mitigation HU
Round whitefish	1	Foraging	343	96	278	0.11	38	11	31
		Nursery/Rearing	343	96	278	0.11	38	11	31
		Spawning	0	0	0	0.11	0	0	0
		Wintering	0	0	0	0.11	0	0	0
	2	Foraging	565	359	489	0.11	62	40	54
	2	Nursery/Rearing	0	359	489	0.11	0	40	54
	2	Spawning	0	180	489	0.11	0	20	54
	2	Wintering	565	180	489	0.11	62	20	54
Slimy sculpin	1	Foraging	343	96	416	0.10	34	10	42
		Nursery/Rearing	343	96	278	0.10	34	10	28
		Spawning	343	96	278	0.10	34	10	28
		Wintering	0	0	0	0.10	0	0	0
	2	Foraging	0	359	489	0.10	0	36	49
		Nursery/Rearing	0	359	489	0.10	0	36	49
		Spawning	0	359	489	0.10	0	36	49
		Wintering	282	180	489	0.10	28	18	49

Appendix C2. Weighted habitat losses in the Long Lake system due to the PKCA.

Project Activity	Species	Habitat No.	Life Stage	HU	Importance Weighting	Weighted Losses
Long Lake	Burbot	1	Foraging	1075	0.13	137
			Nursery/Rearing	1075	0.13	137
			Spawning	0	0.13	0
			Wintering	0	0.13	0
		2	Foraging	14850	0.13	1886
			Nursery/Rearing	14850	0.13	1886
			Spawning	0	0.13	0
			Wintering	0	0.13	0
		3	Foraging	0	0.13	0
			Nursery/Rearing	0	0.13	0
			Spawning	0	0.13	0
			Wintering	0	0.13	0
		4	Foraging	6075	0.13	772
			Nursery/Rearing	6075	0.13	772
			Spawning	6075	0.13	772
			Wintering	12150	0.13	1543
	Slimy sculpin	1	Foraging	1075	0.10	108
			Nursery/Rearing	1075	0.10	108
			Spawning	1075	0.10	108
			Wintering	0	0.10	0
		2	Foraging	14850	0.10	1485
			Nursery/Rearing	14850	0.10	1485
			Spawning	14850	0.10	1485
			Wintering	0	0.10	0
		3	Foraging	0	0.10	0
			Nursery/Rearing	0	0.10	0
			Spawning	0	0.10	0
			Wintering	0	0.10	0
		4	Foraging	6075	0.10	608
			Nursery/Rearing	6075	0.10	608
			Spawning	6075	0.10	608
			Wintering	12150	0.10	1215

Appendix C2. Weighted habitat losses in the Long Lake system due to the PKCA.

Project Activity	Species	Habitat No.	Life Stage	HU	Importance Weighting	Weighted Losses
Unnamed Pond	Burbot	1	Foraging	0	0.13	0
			Nursery/Rearing	0	0.13	0
			Spawning	0	0.13	0
			Wintering	0	0.13	0
		2	Foraging	0	0.13	0
			Nursery/Rearing	0	0.13	0
			Spawning	0	0.13	0
			Wintering	0	0.13	0
		3	Foraging	0	0.13	0
			Nursery/Rearing	0	0.13	0
			Spawning	0	0.13	0
			Wintering	0	0.13	0
		4	Foraging	0	0.13	0
			Nursery/Rearing	0	0.13	0
			Spawning	0	0.13	0
			Wintering	0	0.13	0
	Slimy sculpin	1	Foraging	0	0.10	0
			Nursery/Rearing	0	0.10	0
			Spawning	0	0.10	0
			Wintering	0	0.10	0
		2	Foraging	2800	0.10	280
			Nursery/Rearing	2800	0.10	280
			Spawning	2800	0.10	280
			Wintering	0	0.10	0
		3	Foraging	0	0.10	0
			Nursery/Rearing	0	0.10	0
			Spawning	0	0.10	0
			Wintering	0	0.10	0
		4	Foraging	375	0.10	38
			Nursery/Rearing	375	0.10	38
			Spawning	375	0.10	38
			Wintering	750	0.10	75

Appendix C3. Weighted habitat losses in Stream C3 due to PKCA discharge.

Species	Habitat No.	Life Stage	HU	Importance Weighting	Weighted Losses
Arctic Char	1	Foraging	0	0.23	0
		Production	0	0.23	0
		Nursery/Rearing	53	0.23	12
		Spawning	0	0.23	0
	2	Foraging	0	0.23	0
		Production	157	0.23	36
		Nursery/Rearing	0	0.23	0
		Spawning	0	0.23	0
Arctic grayling	1	Foraging	0	0.21	0
		Production	0	0.21	0
		Nursery/Rearing	53	0.21	11
		Spawning	53	0.21	11
	2	Foraging	0	0.21	0
		Production	157	0.21	33
		Nursery/Rearing	0	0.21	0
		Spawning	0	0.21	0
Burbot	1	Foraging	0	0.13	0
		Production	0	0.13	0
		Nursery/Rearing	53	0.13	7
		Spawning	0	0.13	0
	2	Foraging	0	0.13	0
		Production	157	0.13	20
		Nursery/Rearing	0	0.13	0
		Spawning	0	0.13	0
Lake trout	1	Foraging	0	0.23	0
		Production	0	0.23	0
		Nursery/Rearing	53	0.23	12
		Spawning	0	0.23	0
	2	Foraging	0	0.23	0
		Production	157	0.23	36
		Nursery/Rearing	0	0.23	0
		Spawning	0	0.23	0
Round whitefish	1	Foraging	0	0.11	0
		Production	0	0.11	0
		Nursery/Rearing	53	0.11	6
		Spawning	0	0.11	0
	2	Foraging	0	0.11	0
		Production	157	0.11	17
		Nursery/Rearing	0	0.11	0
		Spawning	0	0.11	0
Slimy sculpin	1	Foraging	105	0.10	11
		Production	0	0.10	0
		Nursery/Rearing	105	0.10	11
		Spawning	105	0.10	11
	2	Foraging	0	0.10	0
		Production	157	0.10	16
		Nursery/Rearing	0	0.10	0
		Spawning	0	0.10	0

Appendix C4. Weighted habitat losses and gains in Stream C1 due to diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				HU	Wt.	Wt. Losses	HU	Wt.	Wt. Gains
Diversion Channel	Arctic char	3	Foraging	0	0	0	0	0	0
			Production	199	0	45	179	0	41
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
		4	Foraging	0	0	0	0	0	0
			Production	315	0	71	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Arctic grayling	3	Foraging	0	0	0	0	0	0
			Production	199	0	42	179	0	38
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
		4	Foraging	0	0	0	0	0	0
			Production	315	0	66	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Burbot	3	Foraging	0	0	0	0	0	0
			Production	199	0	25	179	0	23
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
		4	Foraging	0	0	0	0	0	0
			Production	315	0	40	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Lake trout	3	Foraging	0	0	0	0	0	0
			Production	199	0	45	179	0	41
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
		4	Foraging	0	0	0	0	0	0
			Production	315	0	71	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Round whitefish	3	Foraging	0	0	0	0	0	0
			Production	199	0	22	179	0	20
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
		4	Foraging	0	0	0	0	0	0
			Production	315	0	35	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Slimy sculpin	3	Foraging	0	0	0	0	0	0
			Production	199	0	20	179	0	18
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
		4	Foraging	0	0	0	0	0	0
			Production	315	0	31	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0

Appendix C4. Weighted habitat losses and gains in Stream C1 due to diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				HU	Wt.	Wt. Losses	HU	Wt.	Wt. Gains
Diversion Dyke	Arctic char	4	Foraging	0	0	0	0	0	0
			Production	23	0	5	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Arctic grayling	4	Foraging	0	0	0	0	0	0
			Production	23	0	5	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Burbot	4	Foraging	0	0	0	0	0	0
			Production	23	0	3	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Lake trout	4	Foraging	0	0	0	0	0	0
			Production	23	0	5	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Round whitefish	4	Foraging	0	0	0	0	0	0
			Production	23	0	3	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Slimy sculpin	4	Foraging	0	0	0	0	0	0
			Production	23	0	2	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0

Appendix C4. Weighted habitat losses and gains in Stream C1 due to diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses			Mitigation		
				HU	Wt.	Wt. Losses	HU	Wt.	Wt. Gains
Transition Pond	Arctic char	3	Foraging	0	0	0	0	0	0
			Production	1	0	0	8	0	2
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Arctic grayling	3	Foraging	0	0	0	0	0	0
			Production	1	0	0	8	0	2
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Burbot	3	Foraging	0	0	0	0	0	0
			Production	1	0	0	8	0	1
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Lake trout	3	Foraging	0	0	0	0	0	0
			Production	1	0	0	8	0	2
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Round whitefish	3	Foraging	0	0	0	0	0	0
			Production	1	0	0	8	0	1
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Slimy sculpin	3	Foraging	0	0	0	0	0	0
			Production	1	0	0	8	0	1
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0

Appendix C4. Weighted habitat losses and gains in Stream C1 due to diversion system and water management.

Project Activity	Species	Habitat No.	Life Stage	Losses HU	Losses Wt.	Losses Wt. Losses	Mitigation HU	Mitigation Wt.	Mitigation Wt. Gains
Water Management	Arctic char	1	Foraging	0	0	0	0	0	0
			Production	0	0	0	0	0	0
			Nursery/Rearing	133	0	30	0	0	0
			Spawning	0	0	0	0	0	0
		3	Foraging	0	0	0	0	0	0
			Production	12	0	3	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Arctic grayling	1	Foraging	0	0	0	0	0	0
			Production	0	0	0	0	0	0
			Nursery/Rearing	133	0	28	0	0	0
			Spawning	67	0	14	0	0	0
		3	Foraging	0	0	0	0	0	0
			Production	12	0	2	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Burbot	1	Foraging	0	0	0	0	0	0
			Production	0	0	0	0	0	0
			Nursery/Rearing	133	0	17	0	0	0
			Spawning	0	0	0	0	0	0
		3	Foraging	0	0	0	0	0	0
			Production	12	0	1	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Lake trout	1	Foraging	0	0	0	0	0	0
			Production	0	0	0	0	0	0
			Nursery/Rearing	133	0	30	0	0	0
			Spawning	0	0	0	0	0	0
		3	Foraging	0	0	0	0	0	0
			Production	12	0	3	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Round whitefish	1	Foraging	0	0	0	0	0	0
			Production	0	0	0	0	0	0
			Nursery/Rearing	67	0	7	0	0	0
			Spawning	0	0	0	0	0	0
		3	Foraging	0	0	0	0	0	0
			Production	12	0	1	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0
	Slimy sculpin	1	Foraging	133	0	13	0	0	0
			Production	0	0	0	0	0	0
			Nursery/Rearing	133	0	13	0	0	0
			Spawning	133	0	13	0	0	0
		3	Foraging	0	0	0	0	0	0
			Production	12	0	1	0	0	0
			Nursery/Rearing	0	0	0	0	0	0
			Spawning	0	0	0	0	0	0

APPENDIX D

Appendix D1. Habitat losses and gains at each compensation site in lakes.

Species	Habitat No.	Life Stage	Loss			Compensation							Weighted Values			
						Shallow			Deep							
			Area (m2)	HSI	HU	Area (m2)	HSI	HU	Area (m2)	HSI	HU	Total HU	Wt.	Weighted Loss	Weighted Gain	Net Gain
Arctic char	1	Foraging	500	0.25	125	500	0.75	375	0	0.00	0	375	0.23	28	85	57
		Nursery/Rearing	500	0.00	0	500	0.75	375	0	0.00	0	375	0.23	0	85	85
		Spawning	500	0.00	0	500	0.00	0	0	0.00	0	0	0.23	0	0	0
		Wintering	500	0.00	0	500	0.00	0	0	0.00	0	0	0.23	0	0	0
	2	Foraging	500	0.25	125	0	0.75	0	500	0.75	375	375	0.23	28	85	57
		Nursery/Rearing	500	0.00	0	0	0.75	0	500	0.75	375	375	0.23	0	85	85
		Spawning	500	0.00	0	0	0.00	0	500	0.00	0	0	0.23	0	0	0
		Wintering	500	0.25	125	0	0.75	0	500	0.75	375	375	0.23	28	85	57
Arctic grayling	1	Foraging	500	0.25	125	500	0.75	375	0	0.00	0	375	0.21	26	79	53
		Nursery/Rearing	500	0.00	0	500	0.75	375	0	0.00	0	375	0.21	0	79	79
		Spawning	500	0.00	0	500	0.00	0	0	0.00	0	0	0.21	0	0	0
		Wintering	500	0.00	0	500	0.00	0	0	0.00	0	0	0.21	0	0	0
	2	Foraging	500	0.25	125	0	0.75	0	500	0.75	375	375	0.21	26	79	53
		Nursery/Rearing	500	0.00	0	0	0.75	0	500	0.75	375	375	0.21	0	79	79
		Spawning	500	0.00	0	0	0.00	0	500	0.00	0	0	0.21	0	0	0
		Wintering	500	0.25	125	0	0.75	0	500	0.75	375	375	0.21	26	79	53
Burbot	1	Foraging	500	0.25	125	500	0.75	375	0	0.00	0	375	0.13	16	48	32
		Nursery/Rearing	500	0.00	0	500	0.75	375	0	0.00	0	375	0.13	0	48	48
		Spawning	500	0.00	0	500	0.00	0	0	0.00	0	0	0.13	0	0	0
		Wintering	500	0.00	0	500	0.00	0	0	0.00	0	0	0.13	0	0	0
	2	Foraging	500	0.25	125	0	0.75	0	500	0.75	375	375	0.13	16	48	32
		Nursery/Rearing	500	0.00	0	0	0.75	0	500	0.75	375	375	0.13	0	48	48
		Spawning	500	0.00	0	0	0.75	0	500	0.75	375	375	0.13	0	48	48
		Wintering	500	0.25	125	0	0.75	0	500	0.75	375	375	0.13	16	48	32

Appendix D1. Habitat losses and gains at each compensation site in lakes.

Species	Habitat No.	Life Stage	Loss			Compensation							Weighted Values			
						Shallow			Deep							
			Area (m2)	HSI	HU	Area (m2)	HSI	HU	Area (m2)	HSI	HU	Total HU	Wt.	Weighted Loss	Weighted Gain	Net Gain
Lake trout	1	Foraging	500	0.25	125	500	0.75	375	0	0.00	0	375	0.23	28	85	57
		Nursery/Rearing	500	0.00	0	500	0.75	375	0	0.00	0	375	0.23	0	85	85
		Spawning	500	0.00	0	500	0.00	0	0	0.00	0	0	0.23	0	0	0
		Wintering	500	0.00	0	500	0.00	0	0	0.00	0	0	0.23	0	0	0
	2	Foraging	500	0.25	125	0	0.75	0	500	0.75	375	375	0.23	28	85	57
		Nursery/Rearing	500	0.00	0	0	0.75	0	500	0.75	375	375	0.23	0	85	85
		Spawning	500	0.00	0	0	0.75	0	500	0.75	375	375	0.23	0	85	85
		Wintering	500	0.25	125	0	0.75	0	500	0.75	375	375	0.23	28	85	57
Round whitefish	1	Foraging	500	0.25	125	500	0.75	375	0	0.00	0	375	0.11	14	41	28
		Nursery/Rearing	500	0.00	0	500	0.75	375	0	0.00	0	375	0.11	0	41	41
		Spawning	500	0.00	0	500	0.00	0	0	0.00	0	0	0.11	0	0	0
		Wintering	500	0.00	0	500	0.00	0	0	0.00	0	0	0.11	0	0	0
	2	Foraging	500	0.25	125	0	0.75	0	500	0.75	375	375	0.11	14	41	28
		Nursery/Rearing	500	0.00	0	0	0.75	0	500	0.75	375	375	0.11	0	41	41
		Spawning	500	0.00	0	0	0.75	0	500	0.75	375	375	0.11	0	41	41
		Wintering	500	0.25	125	0	0.75	0	500	0.75	375	375	0.11	14	41	28
Slimy sculpin	1	Foraging	500	0.25	125	500	0.75	375	0	0.00	0	375	0.10	13	38	25
		Nursery/Rearing	500	0.00	0	500	0.75	375	0	0.00	0	375	0.10	0	38	38
		Spawning	500	0.00	0	500	0.75	375	0	0.00	0	375	0.10	0	38	38
		Wintering	500	0.00	0	500	0.00	0	0	0.00	0	0	0.10	0	0	0
	2	Foraging	500	0.25	125	0	0.75	0	500	0.75	375	375	0.10	13	38	25
		Nursery/Rearing	500	0.00	0	0	0.75	0	500	0.75	375	375	0.10	0	38	38
		Spawning	500	0.00	0	0	0.75	0	500	0.75	375	375	0.10	0	38	38
		Wintering	500	0.25	125	0	0.75	0	500	0.75	375	375	0.10	13	38	25

Appendix D2. Habitat losses and gains at the compensation site in Stream O21.

Species	Habitat No.	Life Stage	Losses			Compensation			Weighted HU			
			Area (m2)	HSI	HU	Area (m2)	HSI	HU	Wt.	Weighted Loss	Weighted Gain	Net Gain
Arctic char	1	Foraging	182	0.00	0	182	0.50	91	0.23	0	21	21
		Nursery/Rearing	182	0.00	0	182	0.75	137	0.23	0	31	31
		Spawning	182	0.00	0	182	0.00	0	0.23	0	0	0
		Wintering	182	0.00	0	182	0.00	0	0.23	0	0	0
Arctic grayling	1	Foraging	182	0.00	0	182	0.50	91	0.21	0	19	19
		Nursery/Rearing	182	0.00	0	182	0.75	137	0.21	0	29	29
		Spawning	182	0.00	0	182	0.00	0	0.21	0	0	0
		Wintering	182	0.00	0	182	0.00	0	0.21	0	0	0
Burbot	1	Foraging	182	0.00	0	182	0.50	91	0.13	0	12	12
		Nursery/Rearing	182	0.00	0	182	0.75	137	0.13	0	18	18
		Spawning	182	0.00	0	182	0.00	0	0.13	0	0	0
		Wintering	182	0.00	0	182	0.00	0	0.13	0	0	0
Lake trout	1	Foraging	182	0.00	0	182	0.50	91	0.23	0	21	21
		Nursery/Rearing	182	0.00	0	182	0.75	137	0.23	0	31	31
		Spawning	182	0.00	0	182	0.00	0	0.23	0	0	0
		Wintering	182	0.00	0	182	0.00	0	0.23	0	0	0
Round whitefish	1	Foraging	182	0.00	0	182	0.50	91	0.11	0	10	10
		Nursery/Rearing	182	0.00	0	182	0.75	137	0.11	0	15	15
		Spawning	182	0.00	0	182	0.00	0	0.11	0	0	0
		Wintering	182	0.00	0	182	0.00	0	0.11	0	0	0
Slimy sculpin	1	Foraging	182	0.25	46	182	0.75	137	0.10	5	14	9
		Nursery/Rearing	182	0.00	0	182	0.75	137	0.10	0	14	14
		Spawning	182	0.00	0	182	0.75	137	0.10	0	14	14
		Wintering	182	0.00	0	182	0.00	0	0.10	0	0	0