Road access to Cape Christian

Fish habitat compensation and monitoring plan

Municipality of Clyde River

April 2009

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Municipality of Clyde River

Fisheries and Oceans Canada File No.: 07-HCAA-CA7-00004

April 2009

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Referencing

Fisheries and Oceans Canada (DFO) File No.: 07-HCAA-CA7-00004

Title: Contaminated Site, Cape Christian, N. E. Baffin Island, Baffin Bay
Communication letter from :
Amy Liu
Habitat Management Biologist
Fisheries and Oceans Canada
Date : September 10, 2008

1.0 BACKGROUND

The environmental consulting firm Biome Environnement was mandated by Qikiqtaaluk Environmental Inc. to prepare a fish habitat compensation plan in the Municipality of Clyde River, Baffin Island. More precisely, the current compensation plan relates to the repair of a 16 km road section between Clyde River and Cape Christian.

In the water license application for the Clyde River Road construction, corrugated steel pipe culverts are proposed to be installed in 10 unnamed creeks. A fish and fish habitat assessment was conducted on the first seven (7) stream crossings (Impact Faune inc., August 2008). Three of these watercourses crossings where found to be fish bearing with Arctic char parrs being present. A recent change (winter 2009) in the road path resulted in the addition of three (3) additional stream crossings. As no fish and fish habitat assessment could be conducted for those new crossings, they were inferred as being fish bearing.

Based on this information, DFO has concluded that the installation of corrugated steel pipe culverts at the four fish-bearing crossings is likely to result in the harmful alteration of fish habitat, which is prohibited under Section 35 of the *Fisheries Act*. In this case, the issuance of a *Fisheries Act* authorization is conditional on developing habitat compensation and monitoring plans to ensure there will be no net loss in the productive capacity of fish habitat. DFO recommends that the Proponent submit a fish habitat compensation and a monitoring plan to ensure that the mitigation measures function properly and that fish passage is maintained.

The present document therefore constitutes the central information to the permitting process for compliance with the *Fisheries Act* of Canada (DFO - Eastern Arctic Area).

1.1 Summary of the fish habitat assessment

The first seven study streams belong to two distinct watersheds, as sites No. 1, 2 and the Clyde River itself are part of the Clyde River watershed. Sites No. 3 to No. 7 belong to another watershed (unnamed), which outlet is located just south of the Cape Christian airfield (Figure 1).

All watercrossing sites assessed were dominated by fine material (sand) and presented low fish habitat quality for arctic charr for rearing and essentially no spawning habitat. In the Arctic region, Arctic charr spawning habitat correspond to large river reaches with gravel beds and deep pools, characterized by depths varying from 1 m to 4,5 m and low

velocity current (Scott and Crossman, 1974). Habitat evaluation indicates that there are no critical habitats at the study streams, ranging from no habitat to marginal for the seven culvert crossing sites.

Given the very flat topography of the surroundings of the sites, high spring levels were very difficult to delineate which, in return, rendered very difficult the identification delineation of channel bank widths. Clearly, water levels may exhibit limited rise in elevation and very low water velocity, but most streams surveyed lack of well defined channel so bank widths presented in the tables below must be interpreted with care as an indicator of fish habitat. As a result of this topography, banks are very low at crossings sites, which has the advantage of lowering instability and impacts on aquatic habitats for the bridge and culverts installation.

Fish presence was detected at three (3) of the seven (7) sites (Figure 1 and Table 1). A total of 11 individual fish were captured and all were arctic charr parrs, ranging from 56 mm to 197 mm total length.

Despite a variety of gears used, no fish were captured at sites No. 1, 4, 6 and 7, and presented no fish habitat or potential for passage even at higher local spring levels.

Table 1. Proposed culvert watercrossings localization
(coordinates provided by Qikiqtaaluk Environmental Inc., April 2009)

Crossing No.	Stream name	Coordinates (Lat – Long)	Structure type	Fish bearing	Retained for habitat enhancement potential
1	Unknown	70°29'07"- 68°30'30"	Culvert	No	No
2	Unknown	70°29'43"- 68°28'28"	Culvert	Yes	Yes
3	Unknown	70°30'32"- 68°24'39"	Culvert	Yes	Yes
4	Unknown	70°30'33"- 68°23'48"	Culvert	No	No
5	Unknown	70°30'32"- 68°23'39"	Culvert	Yes	Yes
6	Unknown	70°30'37"- 68°21'51"	Culvert	No	No
7	Unknown	70°30'27"- 68°20'22"	Culvert	No	No
8		*Abandoned*			
9	Unknown	70°31'004''- 68°18''97''	Culvert	Yes (inferred)	No
10	Unknown	70°31'086''- 68°18'84''	Culvert	Yes (inferred)	No
11	Unknown	70°31'229''- 68°18'22''	Culvert	Yes (inferred)	No

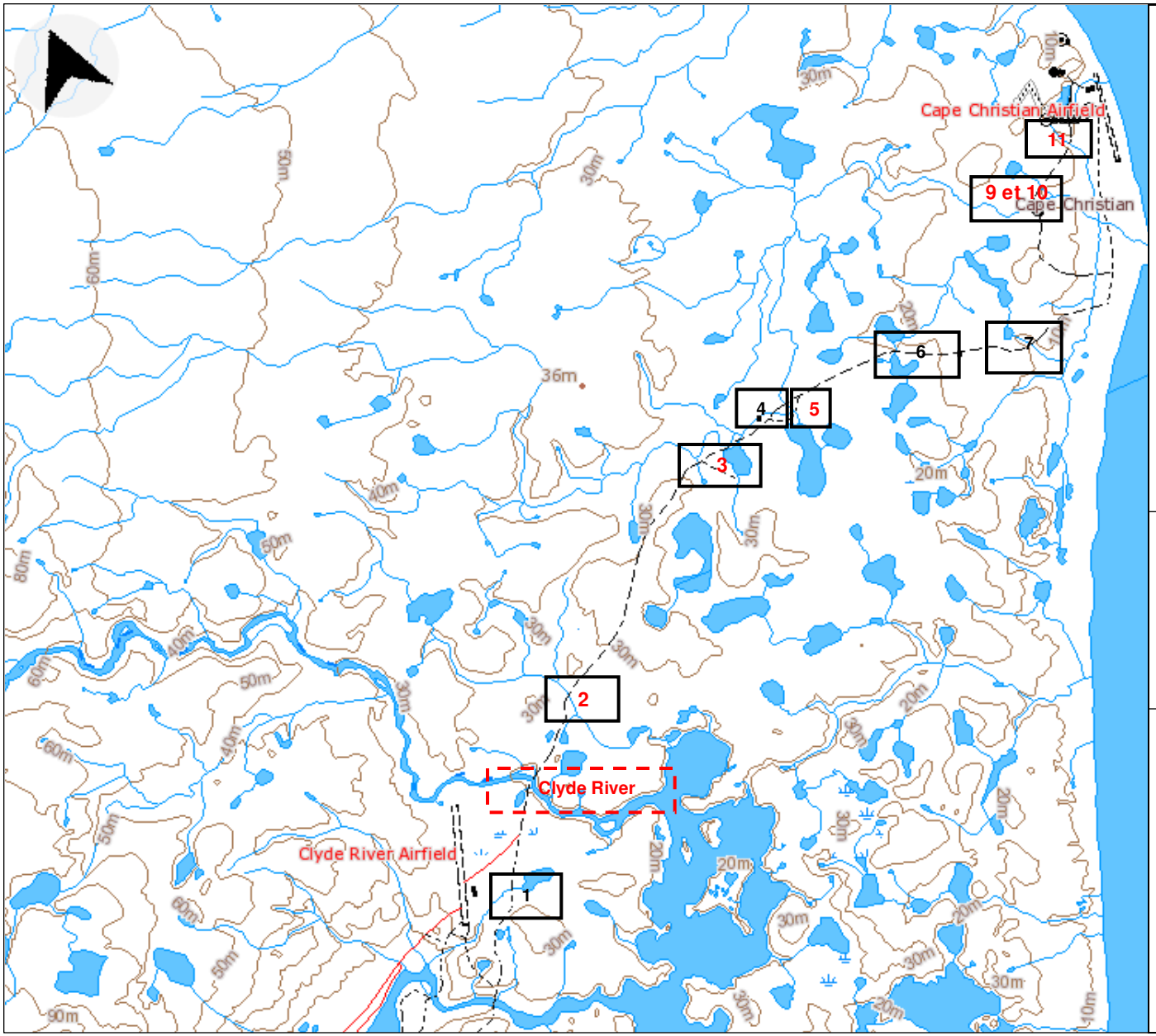

FIGURE 1.

Localization of stream crossings

LEGENDE

Existing road:

Stream:

Lake:

Elevation (m):

Clyde River bridge:
(Fish bearing)

Culvert crossing sites:
Fish bearing (2,3,5 and 9, 10,11) 2

Culvert crossing sites:
Non-fish bearing 1

Base map

Geotiff SoftMap Technologies

Scale: 1: 20 000
27F/8 - Clyde River
27F/9 - Cape Christian

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Table 2. Summary information on culverts installation at the fish-bearing stream crossings

(Road and structures dimensions provided by Qikiqtaaluk Environmental Inc., April 2009)

Site No.	Channel width at crossings (m)	Culvert			Road characteristics at crossings				Total in-stream surface area (m^2)
		Diam. (m)	Lgt. (m)	Area (m^2)	Pltaform width (m)	Slope embankement width (m)	Total width (m)	Total surface (m^2)	
2	10,0	1,22	11	13,4	3,6	6,7	10,3	89,4	102,8
3	4,0	0,91	9	8,2	3,6	5,4	9,0	28,0	36,2
5	3,0	0,91	9	8,2	3,6	5,4	9,0	18,9	27,1
9	20,0	1,22	11	13,4	3,6	6,7	10,3	192,2	205,6
10	6,0	0,3	9	2,7	3,6	3,08	6,68	37,38	40,08
11	4,0	0,3	9	2,7	3,6	3,08	6,68	24,02	26,72
TOTAL									**438,5**

2.0 ANALYSIS AND RATIONAL OF COMPENSATION OPPORTUNITIES

Culverts installation will result in total loss of 438,5 m^2 of fish habitat (Table 2).

Compensation refers to measures taken to replace, repair or enhance fish habitat that will be harmfully altered, disrupted or destroyed (HADD).

In order to develop the most optimal plan, in term of fish habitat productivity, several criteria must be taken into consideration. However, other, more logistic factors must be accounted for, such as access, seasonal window and etc. Below, we list the basic conditions we retained to apply the compensation measures:

1- Habitat creation or enhancement aim at providing equivalent functions as those adversely affected at the crossings (like-for-like category);
2- Aim at providing a greater than 1:1 compensation ratio;
3- Located *in situ* (at least in the same ecological unit); in the present case, the actual compensation measures must take place in the studied streams;
4- Streams must be fish-bearing;
5- Habitat creation versus enhancement of existing conditions

   By contemplating habitat enhancement, we consider that the existing habitat must have intrinsic value and potential for fish productivity increase. We also fully acknowledge that only the difference in productive capacity between the before and after scenarios can be considered as compensatory gains.
6- Apparent stability of the watercourse;
7- Access, in term of logistic and in terms of minimal construction footprint.

We have retained the three (3) fish-bearing streams of the crossings, or linkage to, as potential compensation locations: Sites No. 2, No. 3 and No. 5. The habitat type considered is rearing habitat for arctic charr parr, the equivalent habitat function to be affected by the culverts at all three sites. We detailed the potential of each watercourse for habitat creation or enhancement, in the vicinity of the crossing.

Our evaluation suggests that the watercourse near crossing No. 5, to be the area offering the most valuable habitat creation and enhancement opportunities. The south portion of the crossing is the location considered for the compensation measures (Figure 2).

In summary, this choice is based on the concurrence of at least three of the main conditions for optimal gains:

1) The presence of arctic char parr indicate spawning nearby but the actual rearing habitat quality is not as optimal as for similar areas examined; Sites No. 2 and Site No. 3, which by comparison show diversified habitats and structures.
2) The location selected shows stability, without recurrent important sediments deposits and without erosion. These characteristic make this location of high interest for the long term stability of the measures applied.

3) Access and machinery circulation, can be occur by staying out of any aquatic habitat, eliminating any environmental impact not related to the in-stream activities conducted for the measures.

2.1 Crossing site No. 2

Good actual rearing habitat – No intervention recommended

This watercourse is an intermediate size stream (3rd order, at 1:20k scale), and a direct tributary to the large bay near the Clyde River outlet. Several lakes of various sizes are present in the watershed, on both sides of the crossing (Figure 1).

These conditions provide quality conditions for arctic char spawning and rearing life cycles. The habitat assessment conducted in 2008 over 100 m upstream and downstream of the crossing, revealed a relatively diversified habitat for rearing, as vegetation and boulders are occurring throughout the reach.

We assume that habitat productivity and cover, in quality and quantity, are adequate for the fish run utilizing this watershed. Hence, we believe that other opportunities should be seek for the application of the habitat enhancement measures, in respect to greater benefits for local fish production.

2.2 Crossing site No. 3

Good actual rearing habitat – No intervention recommended

This crossing lies over a small channel connecting a lake, on (south), to the mainstem (north) of a relatively large watershed. The small channel has a permanent flow and shows a relative stability, with a vegetated shore.

Several lakes and small tributaries, of various sizes, are present in the watershed and near the crossing (Figure 1). These conditions provide quality conditions for arctic char spawning and rearing life cycles. The habitat assessment conducted in 2008 revealed a relatively diversified habitat for rearing in the small lake, as vegetation and boulders (on shore and in the lake) are occurring throughout the reach.

Although measures such as the creation of side channels along the lake may increase rearing habitat availability, we believe that the amount of rearing habitat productivity is not an important limiting factor, in terms of local fish production.

2.3 Crossing Site No. 5

Limited rearing habitat – High enhancement potential

This crossing lies over a small channel linking a lake (south), to the mainstem (north) of a relatively large watershed. The channel has a permanent flow and shows stability, with vegetated banks up to the lake.

The lake and the channel do not offer diversified habitat structures. The channel's banks have extensive vegetation indicating stable annual hydrologic conditions but both channel and lake present very little cover for fish.

The stream channel reaches about 100 m from the mainstem to the lake and for the most part (approx. 80 m), appears free of sediment deposits, which are present on the first 15 to 20 meters. These deposits impair water flow and fish passage at low water levels, between the road and the remaining of the channel. These sediments likely originate from the lack of culvert at the crossing, which situation should be corrected by the culvert installation.

Spawning obviously occur close enough for parrs to use this water system but the assessment indicates that habitat suitability may not be optimal and that measures of creation and enhancement are likely to increase productivity in a greater importance than the sole surface area to be compensated.

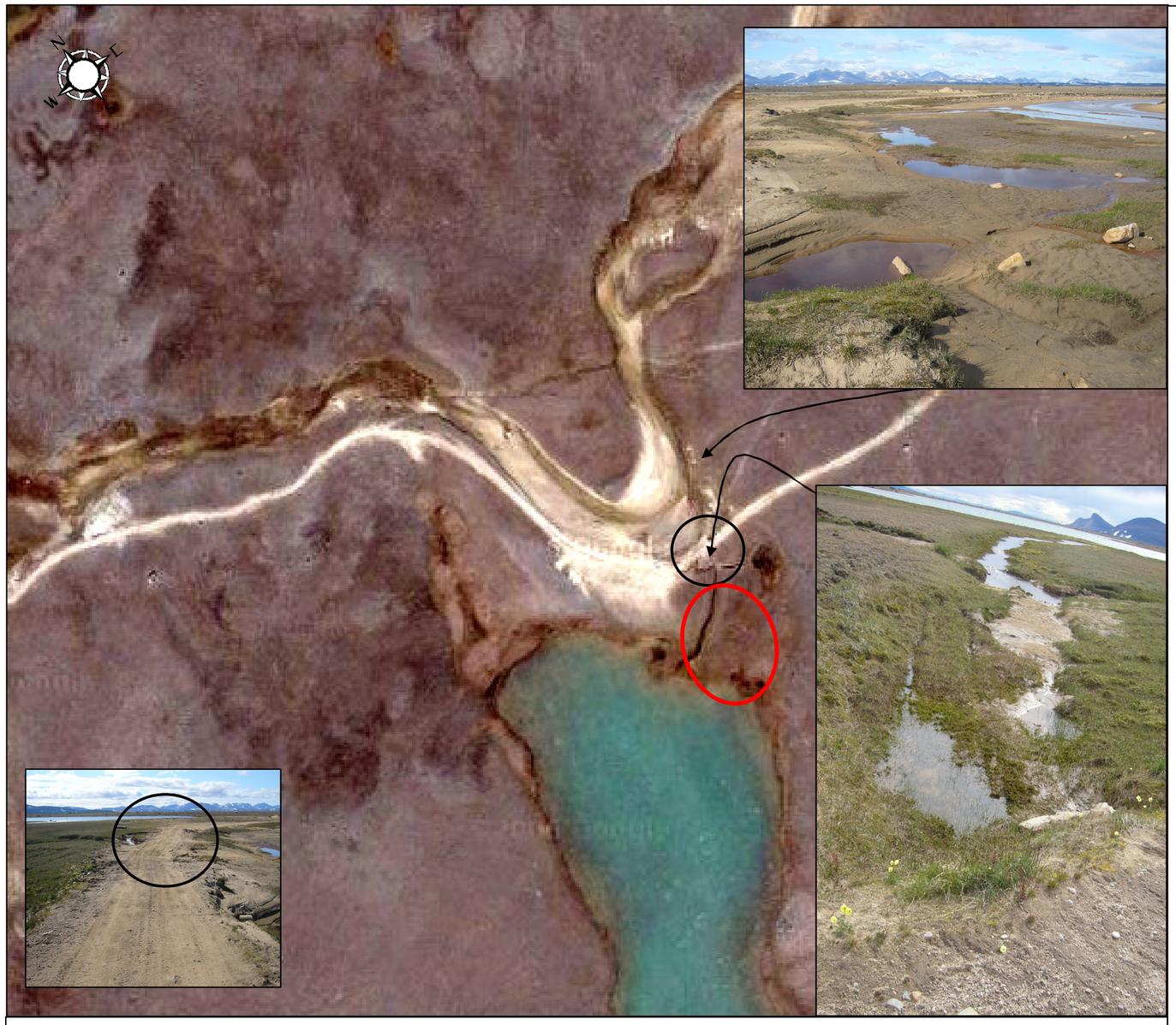

FIGURE 2.

Culvert crossing and habitat enhancement- site No. 5

Crossing:

Mapping sources:

Google Earth © 2009
Pictures by Impact Faune inc. August 2008
Scale: *not scaled*

Habitat enhancement potential

Location of enhancement measures:

Limited rearing habitat – High enhancement potential

This crossing lies over a small channel linking a lake (south), to the mainstem (north) of a relatively large watershed. The channel has a permanent flow and shows stability, with vegetated banks up to the lake.

The lake and the channel do not offer diversified habitat structures. The channel's banks have extensive vegetation indicating stable annual hydrologic conditions but both channel and lake present very little cover for fish.

Along the channel, the top-soil appears suitable for vegetation. The stream channel reaches about 100 m from the mainstem to the lake and for the most part (approx. 80 m), appears free of sediment deposits, which are present on the first 15 to 20 meters. These deposits impair water flow and fish passage at low water levels, between the road and the remaining of the channel. These sediments likely originate from the lack of culvert at the crossing, which situation should be corrected by the culvert installation.

Spawning obviously occur close enough for parrs to use this water system but the assessment indicates that habitat suitability may not be optimal and that measures of creation and enhancement are likely to increase productivity in a greater importance than the sole surface area to be compensated.

STREAM DESCRIPTION AT CROSSING

Site No.	Fish Bearing	Width (m)		Depth (m)	Gradient (%)	Channel morphology	Valley confinement	Flow		Turbidity	Substrate			Cover	Habitat quality
		Channel	Wetted					Conditions	Velocity		Fine	Interm.	Large		
5	YES	3	1,5	0,10	0,5	Uniform	Unconfined	Permanent	Slow	Clear	100			Pool, Vegetation	None

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3.0 PROPOSED COMPENSATION MEASURES

As compensatory measures, we propose three distinct interventions in two distinct locations, the area of crossing Site No.5 and at the Clyde River crossing.

General guidelines for environmental protection and mitigation measures are presented in appendix 1.

3.1 Crossing Site No. 5 area

First is the rehabilitation of the channel section aggraded with sediments and, secondly, is the creation of an off-channel habitat linked to the lake downstream.

The lake and the channel do not offer diversified habitat structures. The channel's banks have extensive vegetation indicating stable annual hydrologic conditions but both channel and lake present very little cover for fish.

3.1.1 Existing stream channel rehabilitation

The stream channel reaches about 100 m from the mainstem to the lake and, for the most part (approx. 80 m), appears free of sediment deposits, which are present on the first 20 meters from the crossing. These deposits impair water flow and fish passage at low water levels. These sediments likely originate from the lack of culvert at the actual crossing. This situation should be corrected by the culvert installation.

This measure consists in the removal of the sediments deposited in the stream channel. The sediments removal within the stream channel and the culvert installation should occur within the same time frame, mainly in order to take advantage of the equipment on site and to avoid any issue of refilling with sediments by a delayed culvert installation. The work tasks to complete this interventions are simple and of very little impact potential. Sediment control is the main issue.

Work methods

This intervention should be conducted before mid-July, in order to avoid overlap with adult arctic charr upstream migration, usually occurring between mid-July and late September.

Prior to begin culvert and sediments removal, the elevation of the stream bed at the beginning of the sediment-free section (downstream) must be recorded. The same data must also be collected on both sides of the future crossing. The application of this information is twofold, in order to ensure uniform channel gradient:

1) The bottom of the culvert should be embedded at 15% to 20% below the streambed elevation (at both downstream and upstream ends), in order to allow fish passing at all flow conditions.
2) Sediments removal will be limited to the quantity of material necessary to reach this depth. Graduated stacks should be installed in the excavation section so that machine operator identifies the limit to be reached.

Before culvert installation, an impermeable membrane should be solidly installed at the end of the sediment section of the stream, across the stream channel and embedded in the channel bed. Once the culvert installed and its embankement stabilized, sediments removal in the channel can begin. Care must be ensured to avoid disturbing the banks, as only the actual sediment deposits within the channel must be removed.

Sediments removed from the channel can be stored in the vicinity, but far enough from the channel to avoid surface runoff in the channel.

3.1.2 Off-channel habitat

We proposed to create an off-channel opened on the lake (Figure 3). This measure consists in the creation of habitat, in both surface area and structure, to favor protection cover and global site productivity. The creation of off-channel habitat is well documented as an effective method to increase productivity within or near rearing habitat for salmonid species (Lister and Finnigan, 1997).

The off-channel will consist of a short channel section with an enlargement (Concept Plans 1 and 2). The constructed channel bed elevation is uniform, graded at 0,5 m under the low water level (LWL) of the lake, providing year-round fish access. As this elevation is not known, it will have to be assessed in the field between the end of July and mid-August.

Bank slopes ratio should vary from 2L : 1H to 3L : 1H. The banks should be stabilized with a mix of rock material ranging from 50 mm to 100 mm in diameter. The material should be applied over a minimum 400 mm thick layer.

We retained boulder as the predominant structure for in-stream cover for fish, as pointed-out by the assessment conducted in 2008 in the local fish-bearing streams and lake shores. Boulders are known to be a key structure for rearing habitat quality and related to salmonid survival and productivity (Ward, 1997).

Concept Plans 1 and 2 present the physical characteristics of the off-channel.

Work methods

This intervention can be conducted any time after the determination of the low water level of the lake until late September.

Prior to begin channel excavation the elevation of the lake's LWL must be surveyed. This elevation must be stacked at the mouth of the off-channel at the lake. The off-channel bed will be uniform to this elevation all along its length.

Excavation of the channel should start in the off-channel enlargement and progressing toward the lake. Prior to reach this limit, a sediment barrier should be installed along the lake shore, to keep sediments from being released in the lake (Concept Plan 3).

After excavation of the slopes, sediments recuperated from the stream channel rehabilitation can be used to fill major terrain depression (resulting from large rocks removal). All areas receiving sediment filling should be graded and compacted with the machinery.

Finally, boulder material to be used for fish cover creation will be, in part or in totality, recuperated from the removal of the rubble mound abutements at the actual Clyde River crossing (see Section 3.1.3 of this document). Boulder material can be transported and stored on site any time prior to the beginning of the off-channel construction.

FIGURE 3.

Compensatory measures at Site No. 5

Mapping sources:

Google Earth © 2009
Pictures by Impact Faune inc. August 2008
Scale: *not scaled*

Habitat enhancement potential

Location of compensatory measures at Site No. 5 :

Specific locations of stream channel rehabilitation measure and off-channel creation measure:

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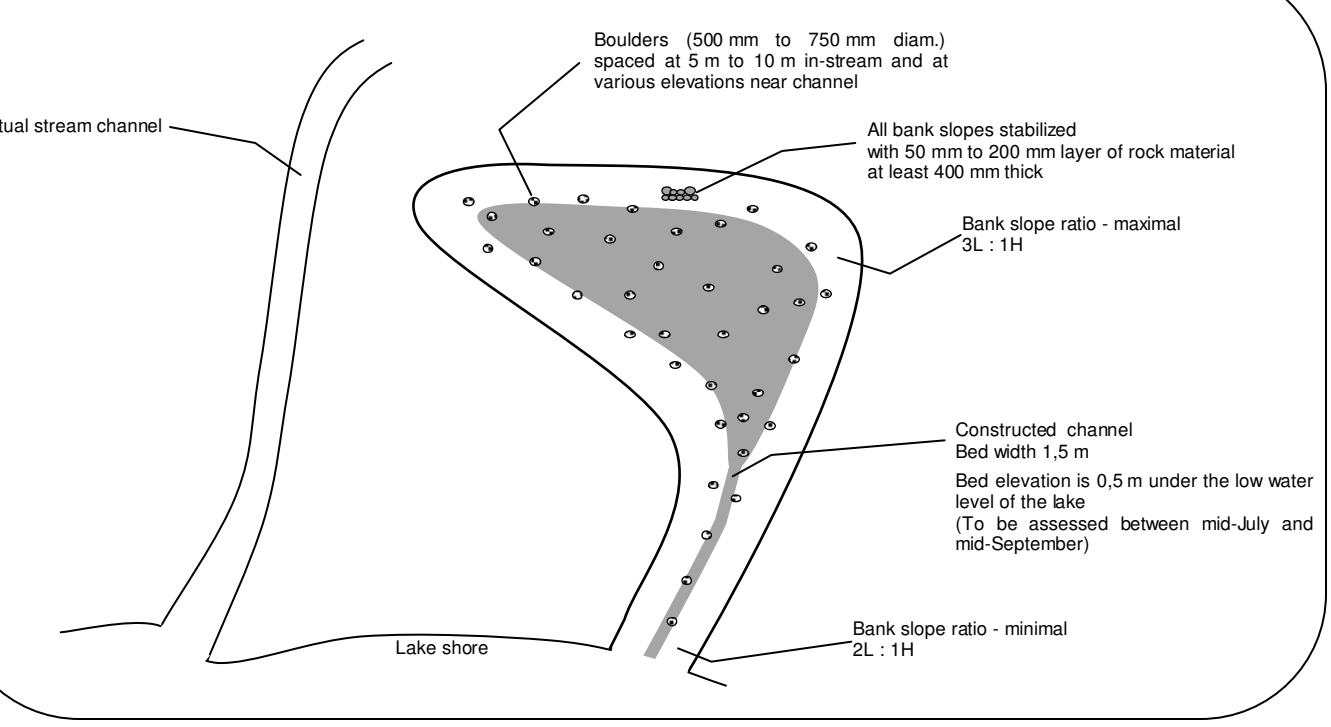
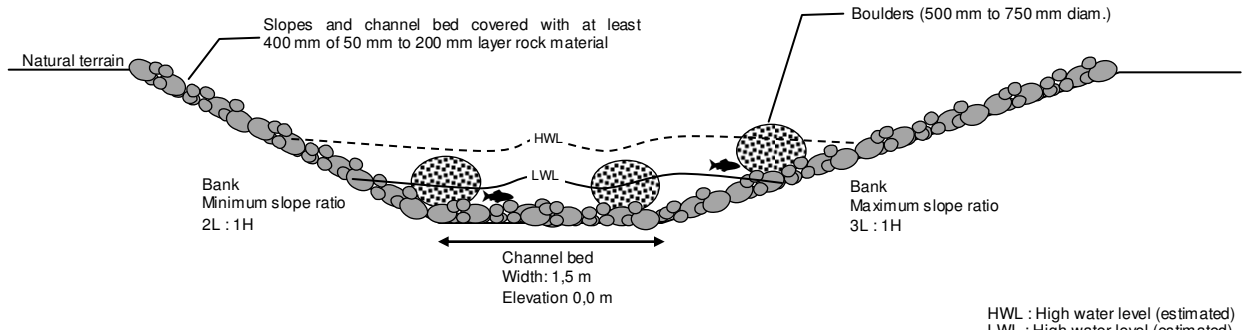
PLAN VIEW



PROFIL VIEW



PLAN 1 – CONCEPT : Off-channel habitat design characteristics **PLAN AND PROFILE VIEWS**

Project: Road access to Cape Christian – Municipality of Clyde River
Fish habitat compensation and monitoring plan

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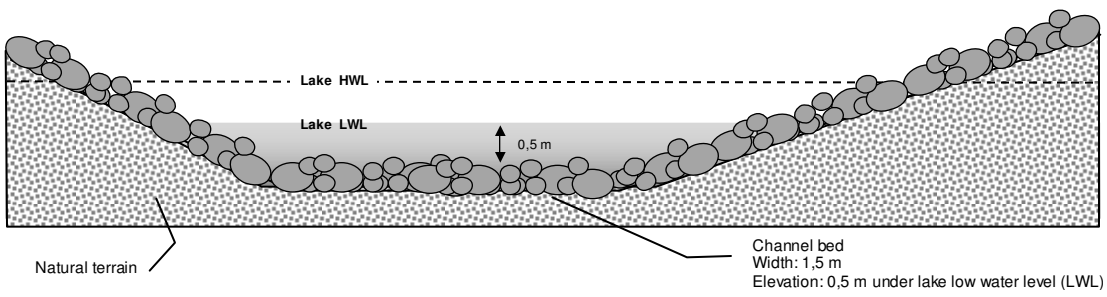
PROFIL VIEW



PLAN 2 – CONCEPT : Off-channel at lake entrance **PROFILE VIEW**

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Fish habitat compensation and monitoring plan

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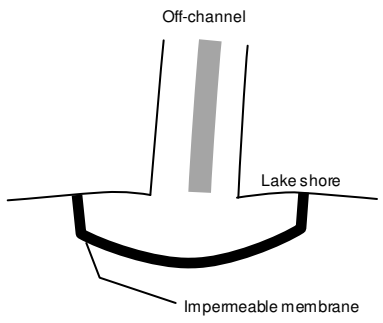
PLAN VIEW



PLAN 3– CONCEPT: Off-channel construction sediments control **PLAN VIEW**

Project: Road access to Cape Christian – Municipality of Clyde River
Fish habitat compensation and monitoring plan

Client: Qikiqtaaluk Environmental Inc.

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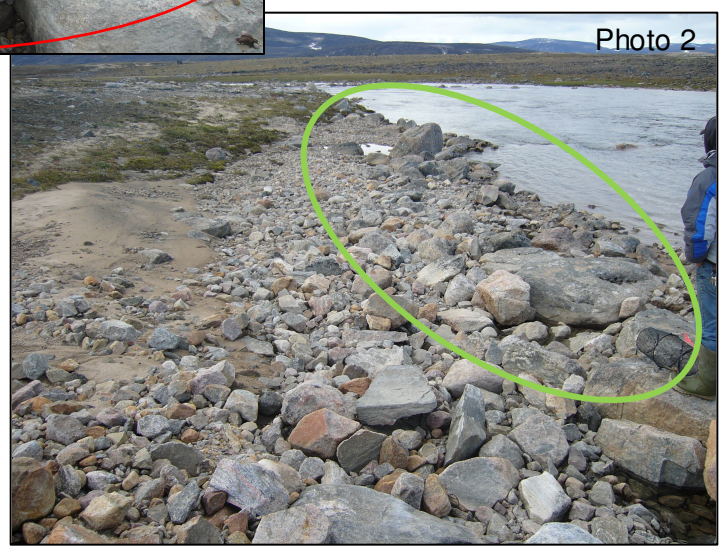
3.1.3 Clyde River existing crossing

The intervention at the Clyde River actually originate from the Application for Water License signed (April 14 2008) where it is stated in the "description of undertaking" that the proposed bridge at Clyde River is located on what appears to be old makeshift bridge crossing, with rubble mound abutements constricting nearly one quarter of the natural riverbed. Prior to the bridge construction, the remains of the abutements (Photo 1) will be removed and the riverbed and bed reclaimed to their original condition (Photo 2). The removal of the rubble mound abutements only involve the additional material placed in Clyde River. The bed and bank of Clyde River should be restored to original condition.

Hence, although this intervention was part of the permitting process, environmental gains are expected.

This intervention should be conducted before mid-July or after mid-September, in order to avoid overlap with adult arctic charr upstream migration, usually occurring between mid-July and late September.



4.0 MONITORING

Monitoring, as described here, encompasses the two types of monitoring; compliance monitoring and effectiveness monitoring.

Table 2 presents the proposed scheduling for the construction and monitoring activities.

4.1 Compliance monitoring

The purpose of compliance monitoring is to determine whether the conditions of the compensation plan have been met. Therefore, compliance monitoring will determine whether the physical structures required in the Authorization were actually built, and built accordingly to the plans.

Compliance monitoring will be conducted, once, during September after all construction activities be completed. The compliance report will consist of baseline information, essentially in the form of detailed pictures, photographs and summary measurements. A short summary report will be prepared and submitted to the DFO project manager within the 25 workings days following site monitoring.

Table 3. Proposed scheduling for construction and monitoring activities

Travaux	2009				2010	2011
	June	July	August	September	July	July
Culverts installation						
Sediments removal in stream channel						
Off-channel habitat construction						
Clyde River abutements removal						
Compliance monitoring of compensatory measures						
Compliance monitoring for physical stability of compensatory measures						
Effectiveness monitoring of compensatory measures						

4.2 Effectiveness monitoring

Effectiveness monitoring measures how well the new habitat is working, including its physical stability. Effectiveness monitoring would measure whether the compensation is functioning or will function as intended.

The effectiveness monitoring will consist of two components:

1) Physical stability

   This component includes the assessment of the physical integrity of the off-channel habitat banks, free water flow and fish circulation between the stream, off-channel and the lake.

   Physical stability will be conducted twice, in July 2010 and July 2011. The verification will also include the verification that the stream channel has remained clear of sediments deposition.

2) Fish habitat function

   Central to the effectiveness monitoring is the capacity of the measure to provide the fish habitat function aimed by the plan. Hence, fish sampling will also be conducted in July 2010 and July 2011, together will physical stability.

Fish sampling will be conducted once every year (2010 and 2011), using minnow-trap (at least 1 trap/10 linear meters over a 24 hour period), or using electrofishing. Visual observation can also be valid, but only as a complementary method.

All fish captured will identified and counted. A summary report will be prepared and submitted to the DFO project manager within the 25 workings days following site monitoring.

The report may also include correction measures, if necessary.

REFERENCES

Lister, D.B, and R.J. Finnigan. 1997. Rehabilitating off-channel habitat. Pages 7-1 to 7-29, in Slaney, P. A. and D. Zaldokas (ed.): Fish habitat rehabilitation procedures. Watershed Restoration Program, Ministry of Environment, Lands and Parks and Ministry of Forests of British Columbia. Watershed Restoration Technical Circular No. 9. 306 pages.

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APPENDIX 1

General guidelines for environmental protection and mitigation measures

The guidelines and mitigation measures presented below are presented as indicative and do not necessarily encompass all measures to be considered.

1) Designate a supervisor responsible for the surveillance and the proper application of the environmental protection measures at all sites, throughout the duration of work. The supervisor is also responsible to communicate all necessary procedures and guidelines to the contractor.
2) Delineate in the field the limits of the working area, in order to keep instream equipment activity to a minimum.
3) Delineate in the field the area where refueling, maintenance and cleaning of the machinery and equipment will be restricted. This area should be located at a minimum of 30 m away from the stream banks or lake shore.
4) All construction equipment shall be inspected daily to ensure that leaks or discharges of lubricants, fuels, or hydraulic fluids do not occur.
5) Ensure that all necessary equipment and all construction materials are present and ready, to avoid any delays during installation work.

Culvert installation

1) Install all fence/geotextile where necessary to intercept sediment release and transportation downstream.
2) Prepare and grade the culvert bed to conform to the design elevation and gradient of the stream, using benchmarks, in order to lay the culvert at the same natural stream gradient.
3) The bottom of the culvert should be embedded at 15% to 20% below the streambed in fish-bearing streams (at both downstream and upstream ends), in order to allow fish passing at all flow conditions. In non-fish bearing streams, culvert embedment can be set at 10%.
4) The culvert foundation, trench walls, and backfill should be free of logs, stumps, limbs, or rocks that could damage or weaken the pipe. All materials used for culvert trench walls and backfill should be compacted for maximum density.
5) Road slope embankements, down to each side of culvert bottom, should be covered with large size rocks (200 to 300 mm diameter), in order to prevent erosion. Thickness of the rip-rap should be 1.5 to 2 times the rock size.