

# Rehabilitation of Sockeye Spawning Gravel in the Gates Creek Spawning Channel

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## Executive Summary

During 2008 Northern St'at'imc Fisheries partnered with Fisheries and Oceans Canada to undertake a gravel replacement project at the Gates Creek Spawning Channel. Existing boulders in the channel and large cobble substrates were removed from the channel and replaced with more suitably sized spawning gravel. Approximately 360 m<sup>3</sup> of cobble and boulders was replaced with 680 m<sup>3</sup> of graded gravel. Channel slope was also increased in the treated section resulting in increased water velocities. Approximately 46% of the channel was treated and rejuvenated in 2008. It is expected that the gravel replacement project can be completed in 2009 with a similar level of investment as in 2008 by following the gravel treatment procedures adopted during 2008.



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## 1. Introduction

The Gates Creek spawning channel (Figure 1), originally constructed by the International Pacific Salmon Fisheries Commission (IPSF) in 1968, is a key fisheries enhancement facility in the Seton/Anderson drainage system. The fish produced at this facility contribute to numerous fisheries including the traditional St'at'imc fishery. This BCRP project was undertaken to revitalize the Gates Creek Spawning Channel so as to enhance production of sockeye salmon.

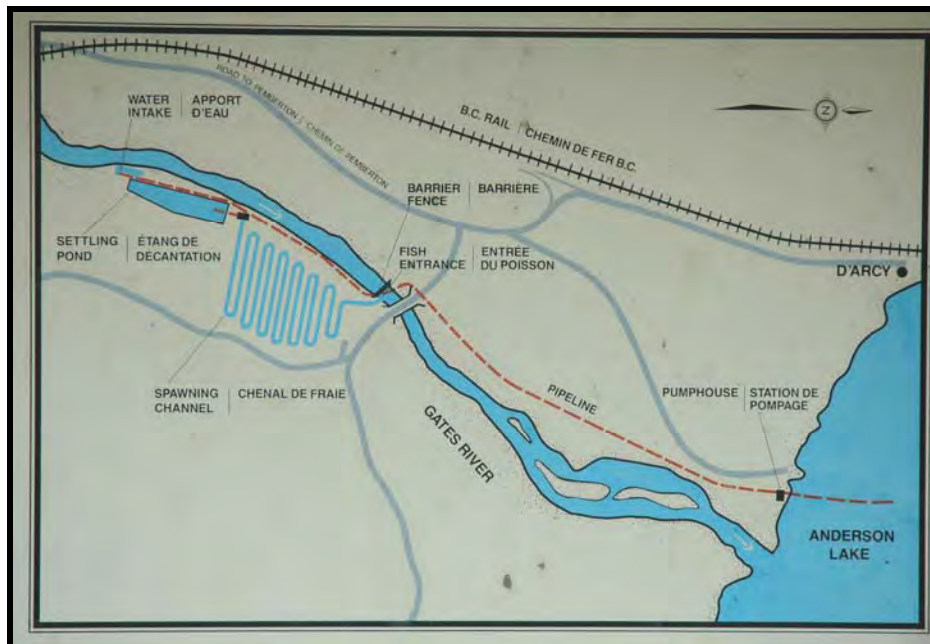


Figure 1. Upper: Airphoto of the Gates Creek spawning channel in the 1970's, Lower: Schematic drawing.

Production of sockeye in the Gates Creek channel is presently compromised by inadequate gravel composition. Over the years smaller gravels have migrated to the bottom of the substrate matrix, resulting in the gravel being somewhat “armoured”, a sub-optimal condition for successful spawning and egg deposition.

This project focused on replacing these degraded gravels with a new gravel source. The intention was to increase sockeye egg to fry survival, stimulate adult sockeye production, and mitigate some of the footprint impacts of the Seton Dam e.g. smolt entrainment mortality and adult migration difficulties.

A time series of sockeye escapements to Gates Creek (both river and channel) is shown in Figure 2. Very high escapements were observed in the years 1996 and 2000, indicating considerable upscale potential for increased sockeye production at this facility.

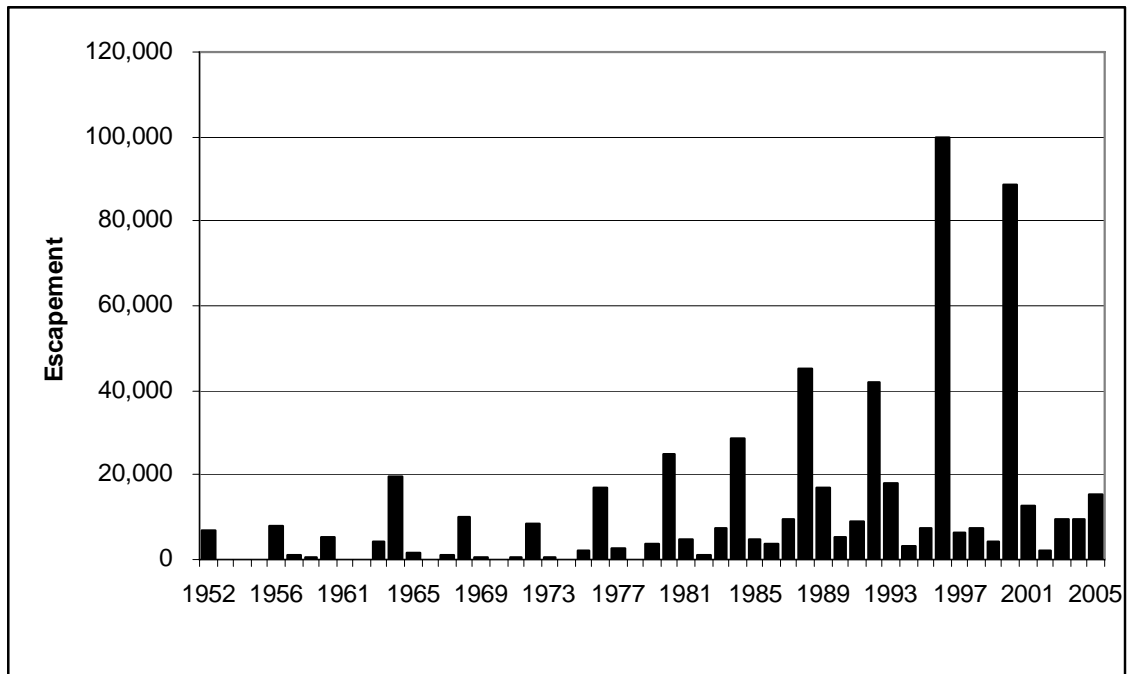


Figure 2. Time series of Gates Creek sockeye escapements.

## 2. Goals and Objectives

The primary objective of this 2-year duration project (2008-2009) is to replace the improperly sized large boulder and cobble substrate in the Gates Creek spawning channel with appropriately sized and graded gravel that will promote high egg to fry survival, thereby contributing to enhanced sockeye production. The goals of the project during 2008 were to: 1. remove large cobble and boulder substrates from the channel, 2. source a supply of new gravel, 3. undertake gravel cleaning and gravel replacement, and 4. revitalize as much of the channel as possible within the available budget.

### 3. Study Area

All of the work was carried out in the Gates Creek Spawning Channel located in Darcy, close to the western edge of Anderson Lake (Figure 3).

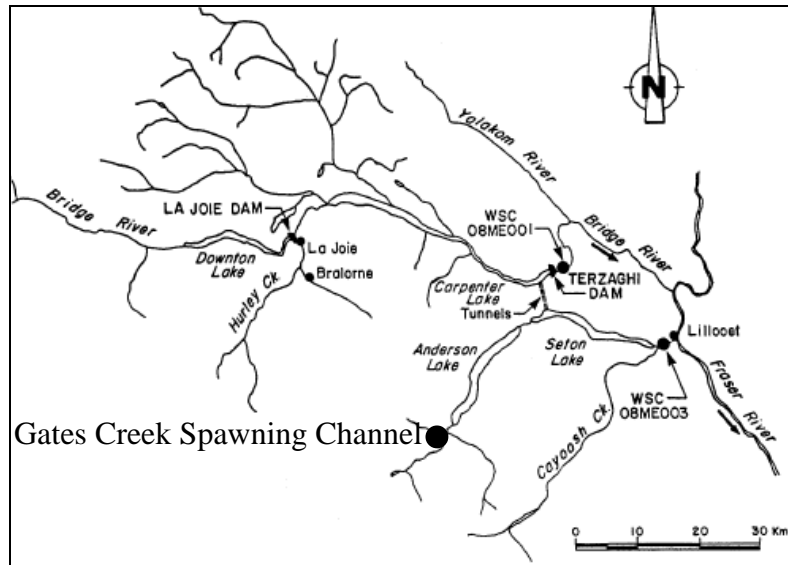


Figure 3. Location of the Gates Creek spawning channel.

### 4. Methods

The gravel replacement procedures are illustrated in Figure 4. Large boulders and cobbles were removed by means of a small excavator and stock-piled on site for future in-stream work contemplated by NSF and DFO for 2009. Following large boulder removal, the gravel bed was cleaned and drained. A source of new gravel was located at Fee Creek beneath the BC Hydro right-of-way and was donated to the project by BC Hydro. The gravel was screened at source and transported to the channel by dump truck where it was stock-piled. A small excavator and a backhoe were used to deposit the new replacement gravel onto the cleaned bed. Once the new gravels were positioned, the channel was flushed and effluent was diverted to a pond to trap the sediments associated with the new gravel.

Activities were scheduled during a 6-week June-July timing window when neither adults nor eggs/juveniles were physically present.

### 5. Results

The channel is 1584 m long x 6 m wide. There is an estimated volume of 4500 m<sup>3</sup> of gravel present. During 2008, 730 m out of 1584 m, or 46% of the channel, was treated. The total volume of gravel removed (large cobble and boulders) was 360 m<sup>3</sup> and 680 m<sup>3</sup> of new graded gravel was added.

On April 28, a DFO team comprised of Tori Soames, Harold Beardmore, Pete Campbell, Doug Lofthouse and Matt Foy made a field inspection of the channel. The following observations were made:

- The channel itself in general looks in good repair.
- The gravel in the channel appears to have more of the 4-6 inch size stones than considered optimum and this may be reducing the ability of female salmon to excavate their redds during spawning.
- The gradient over the gravel legs in each channel is extremely low partially due to original design and the suspected raising of the cobble weirs during maintenance over the years.
- This has led to a reduced water velocity and almost no gradient over the gravel bed which may be the primary cause of lower incubation survival in recent years. Sedimentation may not as large a factor as originally suspected.
- It is recommended that the 4 inch and above gravel be removed if possible.
- Supplementary gravel in the 1/2 to 2 inch range should be added to bring the average gravel size down. This should make it easier for the spawners to move the gravel thereby promoting good egg deposition and a cleaning of the intra gravel environment by the fish themselves. As a large percentage of the present gravel appears somewhat angular, any new material should be more rounded in nature.
- Remove all the cobble weirs and re-grade the channel to increase the actual slope of the gravel bed thereby improving intragravel water exchange. The slope is expected to increase to 0.18 % by these actions. It appears to be close to 0.0% at the moment and may only be functioning due to passive water exchange in the gravel or from down welling due to perforations in the liner.
- The channel bed may need to be roughed up in first year to ensure adequate water depth until the fish re-profile the bed.
- It may be possible to lower the fry enumeration weir up to 0.3 m to increase head available for the spawning channel upstream, and a new fry sampler could be installed (based on the current Weaver Creek design) which is more effective, requires less driving head and has lower maintenance requirements.
- The adult fence weir at the lower end needs to allow fish to be directed over to the right bank and a proper migration channel provided so that all life stages of fish can migrate to the creek upstream as they wish.
- In the future it is suggested that a minimum of 30% of the sockeye salmon return each year be allowed to migrate upstream to spawn in the natural grounds in

Gates Creek. One practical way this may be accomplished would be to open the river fence for one day every three throughout the run and closing the channel on that day to promote upstream migration.

- The settlement pond looks in good repair but may benefit from excavation to remove accumulated sediment in the future (this does not seem to be required at the moment).
- The intake structure is failing and is a major impediment for upstream migrating fish of all species and sizes and may be a complete barrier to fish below 50 cm or less. It requires immediate attention and a long term plan to rehabilitate the weir and river channel downstream to make it more conducive to fish passage.
- All cobble weirs up the top of leg 8 should be removed, the gravel scarified and sloped and the large stone armouring the top layer either partially removed or mixed in as able. This is a temporary fix until the smaller gravel supplementation can occur for each channel leg.
- A temporary fish fence should be placed at the top of leg 8 to keep spawners to the more productive lower half of the channel.
- The cobble weirs above leg 8 could be temporarily raised to make the channel deeper and slower and thereby a more effective settlement area for fine sediments.
- A plan should put in place to allow 30% of the return upstream into Gates Creek (past the fish fence) this year.

Many of the suggested works were completed during 2008, including the channel regrading and part of the gravel replacement component.

The channel was inspected both on Aug. 8 and Sep. 1 to determine whether adult sockeye were utilizing the new gravel substrate. Numerous spawning sockeye were observed on the new gravel (Figure 5), and the project can be viewed as successful in terms of attracting spawners.

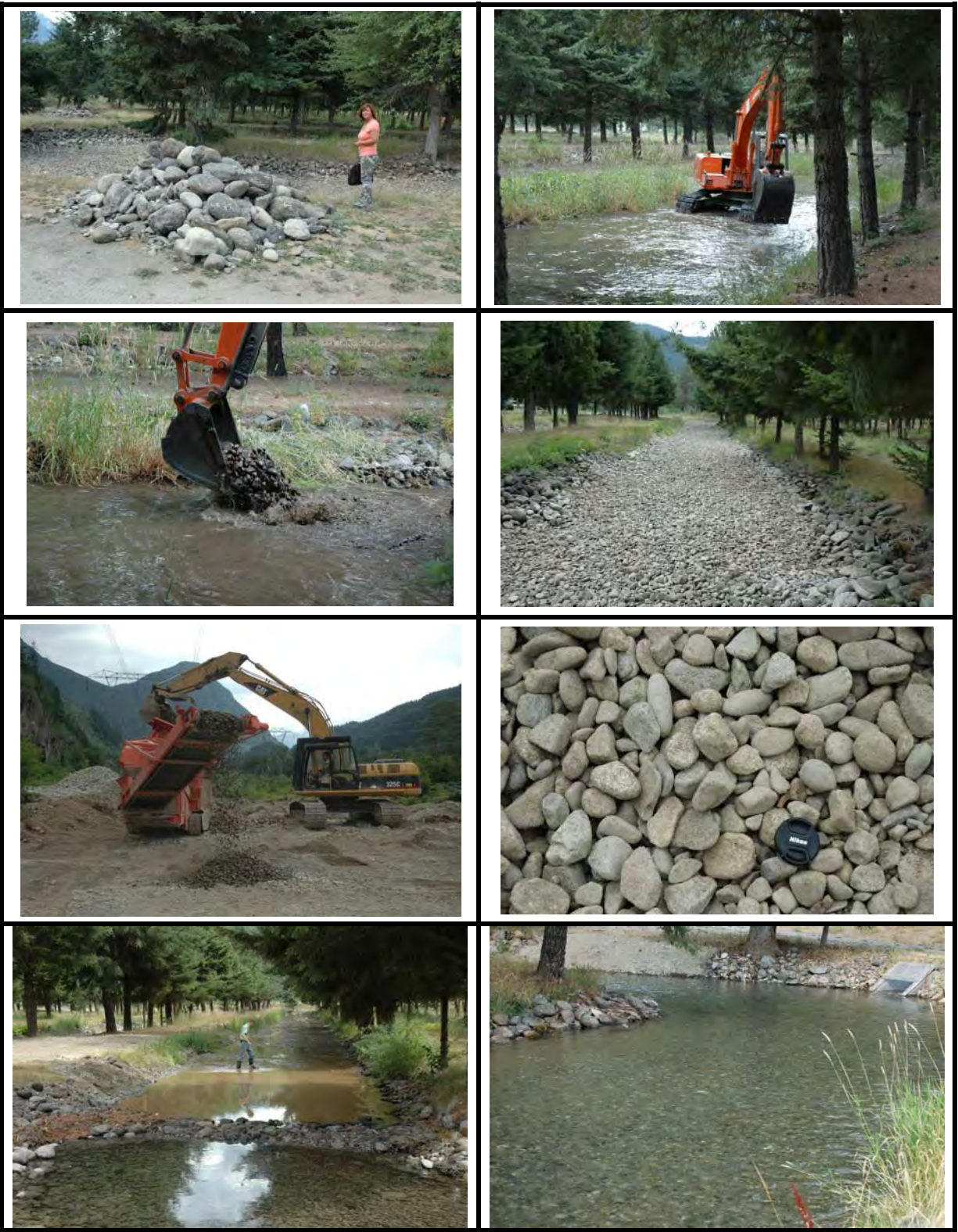


Figure 4. Methods utilized during the Gates Creek spawning channel gravel replacement project.

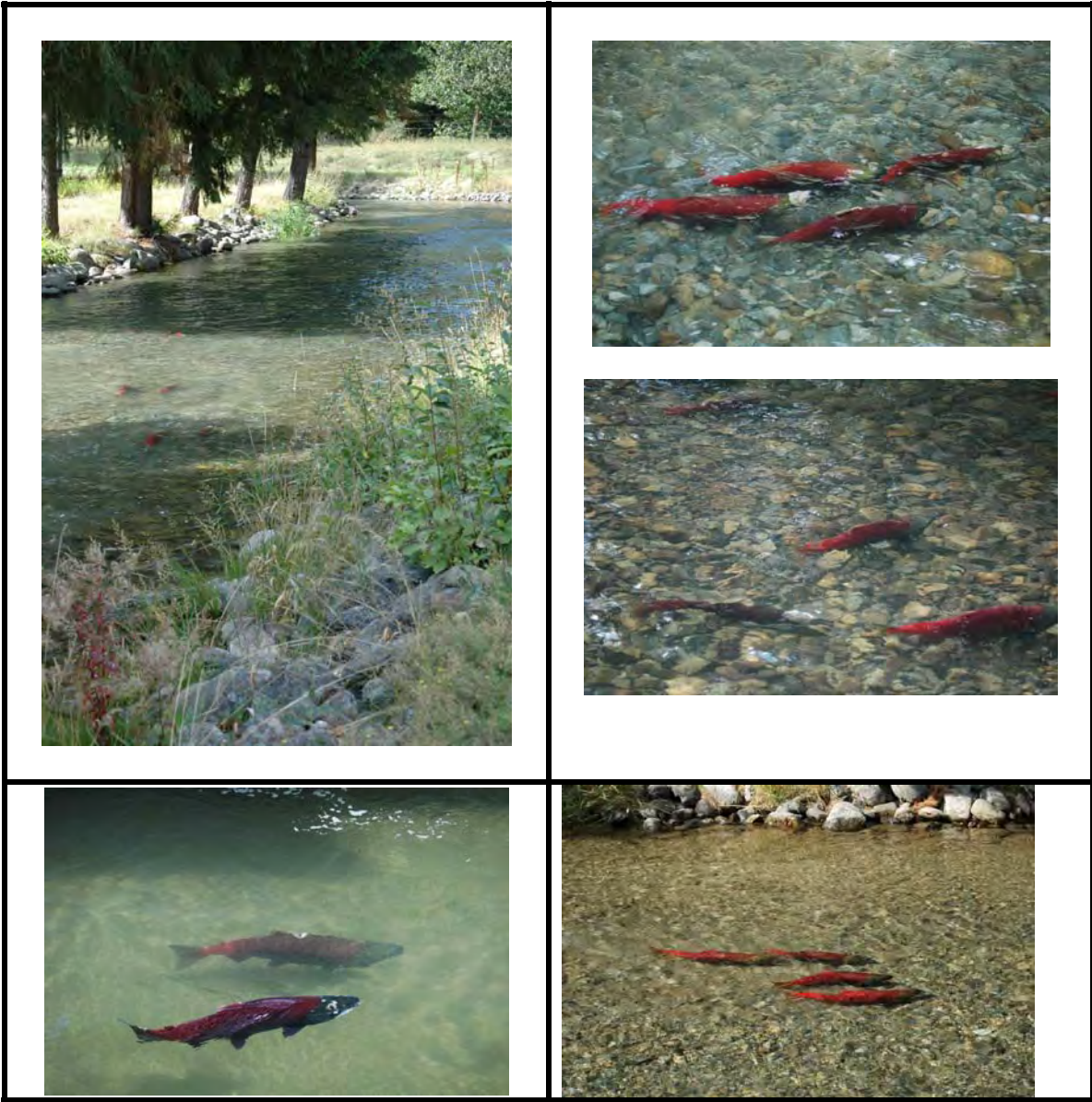


Figure 5. Photos of adult sockeye utilizing the replacement gravel in the spawning channel.

## **6. Discussion**

During initial project development, it was anticipated that the total cost to replace the gravel in the entire Gates Creek channel would be roughly \$500,000. Scheduling was envisaged over a 4-yr period to keep annual funding levels manageable. In reality, the entire project in 2008 replaced 46% of the channel gravels at a cost of \$70,000. It is anticipated that the channel replacement can be completed in 2009 for a similar level of investment.

While undertaking this BCRP project, it was found that the weir adjacent to the water intake required some emergency machine work in order to buttress the rock footings. There were concerns that the weir and its fish ladder were impeding upstream fish migrations under high and low flows. A small bypass channel was opened around the weir during the sockeye migration to permit upstream fish passage. However, the bypass ceases to function at low flows and there is a question whether other fish species, e.g. coho, can bypass the weir at all flow levels. The improvement of this weir is viewed as a high priority for conserving the threatened interior coho population of Gates Creek. In addition, an improved counting facility to accurately enumerate fry and adults coupled with a simple means for diverting returns into the river or channel is also needed. Northern St'at'imc Fisheries and Fisheries and Oceans Canada intend to jointly pursue both of these projects at Gates Creek in 2009 in addition to completing the gravel replacement in the channel itself.

## **7. Recommendations**

Utilize the same gravel source at Fee Creek to complete the channel upgrading during June-July 2009.

## **8. Acknowledgements**

St'at'imc personnel involved in the project included Bonnie Adolph (Project Manager), Taya Rankin and Audrey Casper (LTC Bookkeeper). Dave Levy was St'at'imc Technical Advisor. An experienced DFO Fisheries Engineer, Harold Beardmore undertook the engineering aspects of the project and developed the gravel replacement procedures. As well, DFO made a substantive in-kind contribution to the project involving multiple personnel including Matt Foy, Sean Bennett, Tori Soames, Pete Campbell and Doug Lofthouse. BC Hydro provided access to their right-of-way at Fee Creek and supplied river gravel at no cost which contributed greatly to the success of this project.

Contractors involved in the project included:

- Greg Thompson Ltd, Darcy: Excavator, Dumptruck, Backhoe
- John Hunter Co. Ltd., Squamish: Excavator, Screening, Trucking

This project was supported financially by the BC Hydro Bridge Coastal Fish and Wildlife Restoration Program.

## Appendix 1: Financial Statement

	BUDGET		ACTUAL	
	BCRP	Other	BCRP	Other
<b>INCOME</b>				
<i>Total Income by Source</i>	\$ 82,900.00		\$ 65,148.91	
<b>Grand Total Income</b> (BCRP + other)				
<b>EXPENSES</b>				
<i>Note: Expenses must be entered as negative numbers (e.g. – 1000, etc.) in order for the formulas to calculate correctly.</i>				
<b>Project Personnel</b>				
Wages (labourers/techs)	\$ -9,000.00		\$ - 0.00	
Consultant Fees <i>(List others as required)</i>				
<b>**GST#</b>				
Project Manager	\$ -6, 400.00		\$ -13,683.60	
<b>Materials &amp; Equipment</b>				
Equipment Rental Backhoe (removing risers)	\$-5,000.00		\$ - 586.86	
Materials Purchased(gravel screens)	\$ - 3,000.00		\$ 0.00	
Travel Expenses (Trucking Gravel)	\$-7,500.00		\$-2,160.00	
Permits				
Excavator (inc.low bed, loader)	\$ -45,000.00		\$-47,664.85	
<b>Administration</b>				
Office Supplies				
Photocopies & printing				
Postage <i>(List others as required)</i>				
Admin. Labour	\$ -7,000.00		\$ -7,000.00	
<i>Total Expenses</i>				
<b>Grand Total Expenses</b> (BCRP + other)	<b>\$- 82,900.00</b>		<b>\$ -71,095.31</b>	
<b>BALANCE</b>				
(Grand Total Income – Grand Total Expenses) <b>inclusive of GST obligations</b>	<i>The budget balance should equal \$0</i>		<i>The actual balance might not equal \$0*</i>	
			<b>\$ -5,946.40</b>	

## Appendix 2: Performance Measures-Actual Outcomes

Project #08.BRG.01

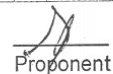


### Appendix II

#### Performance Measures

Using the performance measures applicable to your project, please indicate the amount of habitat actually restored/enhanced for each of the specified areas (e.g. riparian, tributary, mainstream).

Performance Measures – Target Outcomes			Habitat (m <sup>2</sup> )									
Project Type	Primary Habitat Benefit Targeted of Project (m <sup>2</sup> )	Primary Target Species	Estuarine	In-Stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
			<b>Impact Mitigation</b>									
Fish passage technologies	Area of habitat made available to target species											
Drawdown zone revegetation/stabilization	Area turned into productive habitat											
Wildlife migration improvement	Area of habitat made available to target species											
Prevention of drowning of nests, nestlings	Area of wetland habitat created outside expected flood level (1:10 year)											
<b>Habitat Conservation</b>												
Habitat conserved – general	Functional habitat conserved/replaced through acquisition and mgmt											
	Functional habitat conserved by other measures (e.g. riprapping)											
Designated rare/special habitat	Rare/special habitat protected											
<b>Maintain or Restore Habitat forming process</b>												
Artificial gravel recruitment	Area of stream habitat improved by gravel placement											
Artificial wood debris recruitment	Area of stream habitat improved by LWD plcmt											
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing											
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved											
<b>Habitat Development</b>												
New Habitat created	Functional area created											



### **Appendix 3: Confirmation of BCRP Recognition**

The project has already been written up in the July issue of the St'at'imc Runner, a monthly newspaper publication of the Lillooet Tribal Council.

It should be possible to confirm recognition of BCRP in 2009 when the channel works have been completed. There is an opportunity to organize a media event when spawners are present in August 2009 that would acknowledge the project and its contribution to enhanced sockeye production.