

# Mamquam River Floodplain Restoration SF-2007-H-15



## PROPONENT IDENTIFICATION

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## PROJECT IDENTIFICATION

<b>Project Title:</b> Squamish River Estuary Restoration
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<b>Project Type:</b>	<i>(Check one)</i>
Development of improved information for resource management, including stock assessment; data acquisition & scientific understanding of limiting factors.	
Habitat restoration; rehabilitation or improvement.	x
Enhancement of wild stock production through low technology techniques.	

<b>Project Location:</b> Britannia Slough, Squamish River watershed, Howe Sound, Strait of Georgia Mainland BC
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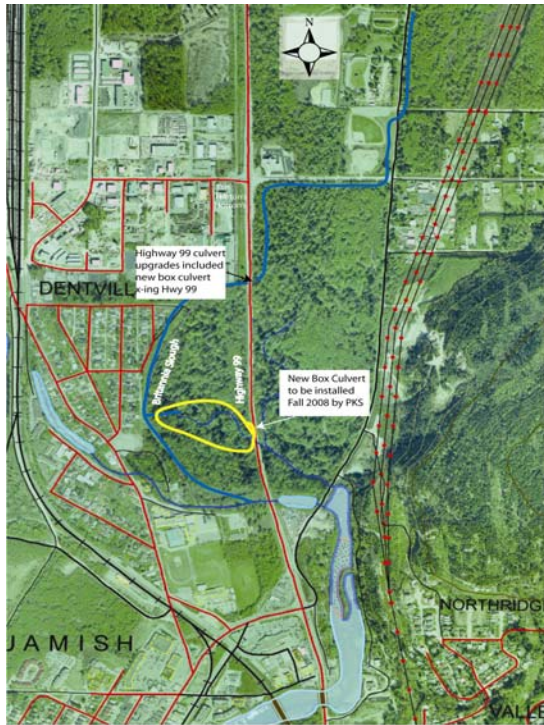
**Start Date:**

**End Date:**

<b>Total PSC Funding Requested:</b>	\$CAN/US 28,405 \$CAN
<b>Total Other Funding &amp; In-Kind Contributions:</b>	\$CAN/US 166,614 \$CAN
<b>Total Project Cost:</b>	\$CAN/US 195,019 \$CAN

## Part 1. RELEVANCE AND SIGNIFICANCE

### 1. Relevance and Significance to the Pacific Salmon Treaty:



Area in yellow identifies current Britannia Slough Tidal Upgrades (works being undertaken in March 2008)

The Mamquam River is an important coho and chinook salmon producing tributary within the Squamish River watershed. The Squamish River estuary, lying at the head of Howe Sound, was formed at the confluences of the Mamquam and Squamish Rivers and historically supported a large complex wetland with interconnected tidally influenced sloughs and channels. These diverse habitats provided exceptional quality habitat for many salmonid species particularly coho and chinook salmon. Diking in the early twentieth century confined the Mamquam River and Squamish Rivers to relatively narrow corridors isolated from most of their historic floodplain lands. Internal drainages remain in some of the undeveloped portions of these isolated floodplain areas but suffer from reduced flows and poor connections to viable salmon populations in adjacent habitats. One such drainage is Britannia Slough which is a branch of the Mamquam Blind Channel

This project directly responds to the desire of the Southern Fund to support projects that increase the productive capacity of Georgia Strait coho, inside chum and Lower Georgia Strait chinook salmon populations. Human population growth within the District of Squamish continues to increase at a rapid rate. Accelerated land development within the eastern portions of the Squamish River estuary lands have degraded and threaten the future viability of estuary fish habitats that are important to Squamish River chinook, coho and chum populations. This project now leads towards the rehabilitation of certain estuary channels in the eastern portion of the Squamish River estuary, within the District of Squamish urban growth area. By reconnecting and deepening these tidal channels viable habitats for supporting juvenile salmonids has been reestablished. This is of primary importance as the Squamish River salmon are primarily harvested in aboriginal, commercial and recreational fisheries within southern BC and northern Washington State.

The current years project is located along the west side of Highway 99 north of the downtown up to the Industrial Park. The site is confined by Highway 99 and the residential community of Dentville (a subcommunity within Squamish) and the Industrial Park.

Britannia Slough provides a year round tidally influenced flow of low oxygenated, poor quality water into the Mamquam Blind Channel. A trail network constructed in partnership with the District of Squamish and the Squamish Trails Society in the late 1990's (the Discovery Trail) traverses this site and through neglect and poor habitat conditions the riparian vegetation and understory have become severely impacted. The intent of this project is to improve water quality, fisheries and wildlife habitat and to provide a productive natural environment to enhance the Discovery Trail network.

Peter Kiewit and Sons installed a 6' concrete box culvert at the northern end of the Britannia Slough in November of 2006 that allows river flows from the Mamquam River to enter once again into this system. A second concrete box culvert is proposed to be installed in late summer of 2008 to complete the circuit, reconnecting the lower end of Britannia Slough with the tidal waters of the Mamquam Blind Channel. With the addition of these two culverts, the Britannia Slough tidal channels on west side of Highway 99 are now interconnected with the entire Mamquam Reunion project allowing fish passage through various routes from Howe Sound through the Mamquam Blind Channel up into the Mamquam River.

In order to maximize on habitat and habitat values it was necessary to improve the Britannia Tidal Slough by deepening it by approximately one metre and installing woody debris (refuge habitat for salmon fry and other fish species) as well as planting native vegetation within the riparian zone to provide shelter, shading, and a food source for wildlife. A further benefit is the improvements to the walking trail (which has become fairly dismal) by sprucing up the surroundings with native vegetation. This area is adjacent to the Squamish Elementary and Howe Sound Secondary Schools as well as Capilano College. Educational outreach programs are already in place to engage students in educational opportunities to learn more about the natural environments adjacent to their learning centres.

The Mamquam Blind Channel is an important waterway for numerous fish species including chinook, coho, chum, and pink salmon, cutthroat trout, Dolly Varden and steelhead as well as numerous non sports fisheries species (sculpins, stickleback, lamprey, etc). Through this project the Britannia Slough branch of the Mamquam Blind Channel will now once again provide the same benefits. The wildlife values include improving habitat for deer, otter, mink (and other members of the weasel family), bear and numerous other mammals. The usage of this area by avian populations has been long studied during the monthly bird counts by the Squamish Environmental Conservation Society and this area provides an important corridor for resident and migratory birds.

## 2. Priority of Need:



Figure 2 – Deepening of the Britannia Tidal Slough

BC Georgia Basin coho salmon populations have experienced declines in overall abundance over the past decades as a result of declining ocean survivals and decreasing freshwater production as watersheds have been developed to serve the growing human population within the basin. Human population growth within Georgia Basin continues to increase and the future viability of many coho populations is in question. In 2001, Fisheries and Oceans Canada identified the Squamish River watershed as a the top priority for salmon stock recovery planning within the Lower Fraser Area due to its high existing and potential fishery value and because of the threats to salmon production from development within the watershed. In 2003, the Pacific Salmon Endowment Fund Society, the Pacific Salmon

Foundation and the Squamish River Watershed Society, working with all three levels of government, Squamish First Nation, industry and community partners began a formal Salmon

Recovery Plan process for the Squamish River watershed. Human development of floodplain areas was identified as a present and future threat to the viability of many coho salmon populations within the watershed. Both protection and restoration of these floodplain habitats, and this project in particular was given a high priority by the Salmon Recovery Workgroup. The District of Squamish is growing at a rapid rate, partly as a result of the 2010 Olympics, the Highway #99 is being widened and upgraded through the Loggers Lane watershed and the relatively undeveloped lands of that watershed are being considered for either protection or development so the timing of this restoration action is critical.

### **3. Context as to relevancy of the Southern Fund and/or Implementation of the Pacific Salmon Treaty:**

- Consistent with Fisheries and Oceans Canada, Lower Fraser Area, priorities as identified in supporting letter.
- High priority activity identified in draft Squamish River Salmon Recovery Plan and identified in supporting letters.
- Consistent with Squamish District vision for enhancing environmental value of Mamquam River, Loggers Lane Creek and the Mamquam Blind Channel and identified in supporting letter.
- Contributes to strengthening natural productivity of a coho population which is a component of the Strait of Georgia Mainland, Southern BC Coho Management Unit, as identified in the Pacific Salmon Treaty.
- Consistent with the overall goal of the Squamish Nation Land Use plan which places a high priority on restoring damaged salmon habitats within the Squamish River watershed and identified in supporting letter.

## **Part 2. TECHNICAL IMPLEMENTATION DETAILS**

### **4. Objectives:**

This project is the final phase of the Mamquam Reunion project and focused on restoring and improving Squamish River estuary habitats, including the former isolated Mamquam Blind Channel and Wilson Slough (an arm of the Blind Channel). Highway and railway corridors had isolated this major distributor channel of the Squamish and Mamquam Rivers for the past 80 years. This tidal channel, that has not supported juvenile salmonids for decades, now once more provides high quality rearing habitats for coho and chinook salmon juveniles throughout the year.

A new culvert will be installed across the Vancouver-Whistler Highway 99 corridor into Wilson Slough and additional channels constructed by the summer of 2008 that will re-connect the eastern and western tidal portions of the Loggers Lane Creek / Mamquam Blind Channel watershed. Peter Kiewit and Sons will fund this project, the private sector delivery partner for this section of the Sea to Sky Highway Improvement Project. The culvert installation is specifically designed as an enhancement legacy of the highway project that will complement the Mamquam River floodplain and Squamish Estuary restoration works which the Southern Fund has supported over the last two years.



The CN railway corridor, which isolated the Mamquam Blind Channel from the central Squamish River estuary, has been breached by a new water control structure which will allow rearing salmonids full use of both habitats by the spring of 2008. The proponents of both those projects will be expending in excess of \$300,000 Canadian in early 2008, as their contribution to the overall Squamish River Estuary and Mamquam River floodplain restoration effort.



Figure 3: Before and After (former tidal channel almost nonexistent as noted in left photo)

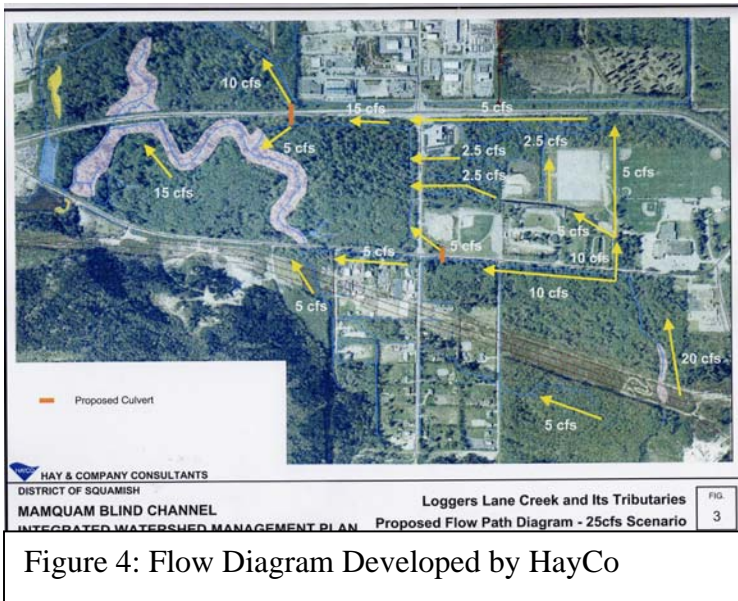
The 2007 contribution requested from the Southern Fundhas allowed further restoration of the tidal habitats adjacent to these two new structures to take advantage of the newly accessible habitats providing good habitat for juvenile chinook, coho, chum and pink salmon during their freshwater rearing phase.

- Objective # 1 : Provide core funds to attract matching funding from a range of partners in 2007 similar to the previous two years.
- Objective # 2 : Develop consistent tidal flows into three channels within the eastern portion of the Squamish River estuary. The Wilson, Britannia and Mamquam Blind Channel Sloughs have been largely cut off from tidal flow from the central Squamish River estuary over the past 50 years.
- Objective # 3 : Excavate tidal channels that have been degraded by past fill activities or by sediment deposition precipitated by loss of tidal flows due to past land development.
- Objective # 4 : Provide channel connections between now isolated channels within the Squamish River estuary through the provision of fish passage through linear corridors such as roads, recreational trails and fields, and the railway line which presently limit juvenile chum, chinook and coho salmon access to critical rearing habitats within the estuary.
- Objective # 5 : Long term agreements between the District of Squamish, Ministry of Transportation, CN Rail and the Ministry of Environment, and other landowners has resulted in the long term management of the floodplain lands ensuring the long term viability of important fish populations in these areas.
- Objective # 6 : Revegetate disturbed areas with 2,000 native trees and shrubs and ensure no incursion of invasive species.

## 5. Approach:

This project continued the rehabilitation of Mamquam River-Squamish River floodplain and estuary habitats begun in 2005. During the first and second phase of the project, Southern Fund contributions initiated an extensive partnership that has attracted other capital dollars contributions at a 3:1 ratio to the PSC funds received. Works to date have targeted the restoration of freshwater channels on the Mamquam River floodplain that convey water flows down to the eastern portion of the Squamish River estuary. The 2007/08 project was directed at rehabilitating the tidally influenced channels that lie downstream from the 2005 and 2006 works.

This phase of the project directly resulted in the restoration of 3,000 square meters of high quality tidal channel habitat. Improved salmon juvenile access to over 20,000 square meters of tidal channel habitat was also generated. Chinook, chum and coho salmon resident to the Squamish watershed will now be able to use these restored habitats. Chinook salmon in particular are critically dependant on estuary habitats during the freshwater to marine transition phase of their life cycle and this project will significantly increase the amount of estuary habitat available to Squamish River chinook salmon juveniles.



A hydrological study and flow model of the Loggers Lane and Mamquam Blind Channel watershed was developed by Hay and Company consultants in 2006, for the partners in this project. The study identified necessary upgrades, replacements and installations of culverts or channels to ensure adequate flow conveyance or fish passage to potential fish habitats within that watershed. This model was used to develop operating principles to safely allow tidal flows into the upper Mamquam Blind Channel, Wilson and Britannia Sloughs for the benefit of fish without compromising

flood protection of adjacent lands. Discussions with Squamish District and CN Rail on how to manage fish passage and tidal flows under the CN Rail corridor and the hydrological model was used as a tool to guide this project.

The 2007/08 PSC funding contributed to a portion of the physical rehabilitation works identified during this process. Technical design and supervision of the physical works were delivered by professional consultants, such as in the case of the CN Rail and Highway 99 crossings, and by Fisheries and Oceans Canada restoration professionals, in the case of the channel restoration. Standard engineering and environmental principles were applied. The Squamish River Watershed Society delivered project management and administration. Land ownership, potential contaminated sediment monitoring and other urban land issues were lead by District of Squamish environmental staff with assistance from the other partners in the project.



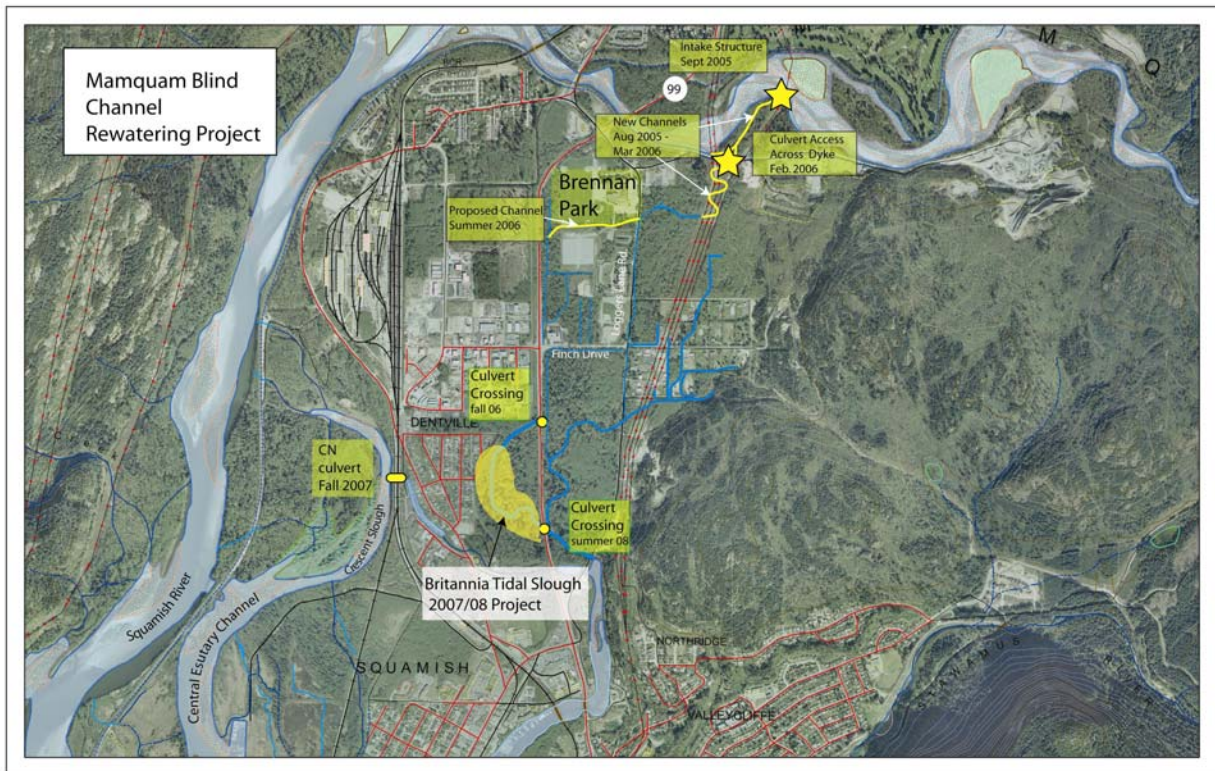


Figure 6 – overview map

### Part 3. HUMAN RESOURCES

#### 6. Key Personnel:

- Negotiations with local government land owners and community interests and overall project management and reporting were lead by Project Manager, Edith Tobe, Squamish River Watershed Society (SRWS).
- Professional Services relating to design and implementation of the channel restoration component of the project were lead by Fisheries and Oceans Canada, Resource Restoration. This group is composed of professional biologists, engineers and technicians employed by the Government of Canada. This group was and is responsible for delivering habitat restoration, improvement and development projects within the DFO Lower Fraser Area and has had a long history of collaborative habitat projects within the Squamish River watershed.
- Railway and highway crossings were designed and installed either by professional consultants hired by CN Rail or Peter Kiewit and Sons or by their own design and construction staff.
- Technical Supervision and Environmental Monitoring during project implementation consisted of representatives from District of Squamish, SRWS, and DFO representatives on the components of the project funded by the PSC.

- Robert Glenn Nurseries was hired to provide the plant stock and perform the actual plantings under SRWS supervision.

## **7. Consultation, Coordination and Approvals:**

- Multi-agency effort to develop a Salmon Recovery Plan in this area were complemented in the goals and objectives complements this project.
- Specific discussions with DFO regarding this project as to who is responsible for the management of fish habitat and salmon populations in watershed resulted in long-term monitoring by DFO staff to ensure that the site remains functional.
- Specific discussions with District of Squamish regarding how this project would reflect land use priorities as identified in the Squamish District Official Community Plan.

The 2005 and 2006 projects demonstrated the depth of commitment by the many partners interested in the overall goal of restoring the Loggers Lane Creek and the Mamquam Blind Channel watershed. The result was an overwhelming response in both direct capital contributions by all parties with direct and in-kind funding and assistance in project design and approvals. This is a strong partnership with a clear vision and purpose.

## **8. Partnerships:**

- The Bridge Coastal Restoration Program has provided \$84,300 in funds towards the estuary component of channel connections and reestablishing fish habitat.
- CN provided an intake structure into Wilson Slough (the westernmost branch of the Mamquam Blind Channel). These funds were applied directly to the project and did not include any SRWS involvement but likely amounted in approximately \$350,000.
- The District of Squamish continued to provide in-kind support through their staff. Several meetings were held on-site to discuss the details and work out any concerns.
- Fisheries and Oceans Canada has agreed to protect significant in-kind services and materials to this project over the next several years.
- The Sea to Sky Improvement Project and Peter Kiewit and Sons installed two 6' concrete box culverts (independent of the SRWS project costs) each of which is estimated to be \$250,000.
- Squamish Nation remains a strong partner in all these works which are recognized by Chief and Council as being an important waterway and habitat for spawning and rearing salmonids.
- The local neighbourhood birding community has dubbed the entire woodlot the "Dentville Bird Sanctuary" and were invited to review the project site prior to construction works to ensure that their needs for migratory and residential avian populations were met.



## Part 4. BENEFITS

### 9. Measures of Success:

- Support and approvals from Fisheries and Oceans Canada, District of Squamish and Squamish Nation for all of the restoration works;
- Reconstruction of over 390m of Britannia Tidal Slough to deepen it by one metre and restore it to active tidal function and open it up once again to fish access;
- Revegetation of disturbed slopes with over 2,000 native trees and shrubs to reestablish the riparian habitat for wildlife and habitat values;
- Building partnerships that have resulted in two 6' box culvert crossings of Highway 99 (one at the upper end and one at the lower end of the Britannia Slough) – funded by Sea to Sky Improvement Project and Peter Kiewit and Sons, further partnerships that have allowed an intake to be installed in upper Wilson Slough opening up the Mamquam Blind Channel for the first time in over 40 years to tidal waters from the Central Estuary (CN funded);
- Community support and recognition of the importance of this site as being the Dentville Bird Sanctuary;
- Over 1200 square metres of new habitat for spawning and rearing salmonids, in particular, prime habitat for chinook fry.

### 10. Cost Effectiveness:

The overall cost of the 2007/08 Squamish River Estuary Restoration Project was over \$195,019 (Can.) direct costs in addition to which there is approximately \$58,000 in-kind contributions (staff time and resources) of which the Pacific Salmon Commission Southern Fund contribution would be \$28,405 (Can.).

The majority of the in-kind costs for consultant fees were related to the two new structures to be installed across the Highway 99 corridor and the CN Rail corridor that leads to Squamish Terminals. The CN Rail Crossing will soon allow tidal flows and juvenile salmonids to pass under the four tracks of the Squamish port rail corridor at a depth of up to 7 meters below grade through a fish friendly fish passage structure. This has required a major design, excavation and construction effort. Likewise the 99 corridor crossing will pass under a four lane highway section with wide shoulders which again requires a major design, excavation and construction effort. The size and scale of these projects are reflected in the budget estimates for both equipment rental and materials purchased.

Fisheries and Oceans Canada has taken the lead in the overall design of this restoration project since its inception and will continue to serve this function in the 2007/08 project. This role has been critical for focusing all the partner efforts to deliver a high quality and effective restoration project over the last three years.

Likewise the Squamish River Watershed Society, with its close working relationship with Squamish Nation and the District of Squamish, has played a critical role at focusing the efforts of local interests such that land ownership and public consultation considerations have been dealt with in a timely and professional manner. This has been invaluable in getting the necessary

political support for such a complex project that crosses so many jurisdictions in its implementation. This provides a high value to this project.

Without these critical contributions from these partners the eastern Squamish River Estuary would not have had the opportunity to be restored to a healthy and productive condition for the use to rearing salmonids. The benefits of the 2007/08 works has been significant in reestablishing freshwater and tidal flow and juvenile salmon access to very large amounts of estuary habitat within the eastern Squamish River delta. These channel excavation works, from the PSC funds, have linked and restored tidal channel habitats to maximize the benefits of these restored flows and increase in rearing fry populations in that area.

Through this collaborative process, the partnership between the Pacific Salmon Commission, Squamish River Watershed Society, Fisheries and Oceans Canada, Squamish Nation, Squamish Stream keepers, BC Ministry of the Environment, CN Rail, Peter Kiewit and Sons and District of Squamish were all strengthened. Additional partners on this project include: BC Ministry of Transportation and Highways, Pacific Salmon Foundation, Terasen Gas Inc. and Canadian Hydro Developers Inc. The success in implementing the complex Mamquam Reunion project has demonstrated to all these groups the benefits of working together in a coordinated manner when developing plans for the restoration of fish habitat and strengthen the concept of community based watershed management. These partnerships have become invaluable when developing and implementing further fish habitat restoration projects within the Squamish River watershed of which the Pacific Salmon Commission has been the initial lead and moving force.

The funding contribution from the Pacific Salmon Commission Southern Fund to this project has increased the amount of productive estuary habitat readily accessible to juvenile salmonids to over 35,000 square meters over the past three years. This increase in habitat quality and quantity will improve the production of wild Squamish River chinook, chum and coho salmon smolts and improve production capacity. The result of this all is providing additional adults to contribute to fisheries within Canada and the United States of America.

Appendix: Photos



Effort was taken to preserve mature trees and an island was built up around this cedar



Moving from west to east down the channel as it is being deepened



Before and after comparison shots





Before and after comparison shots (note tepid water colour from high tannins and iron in water)



More before and after photos nearing the western section towards Dentville residential area

