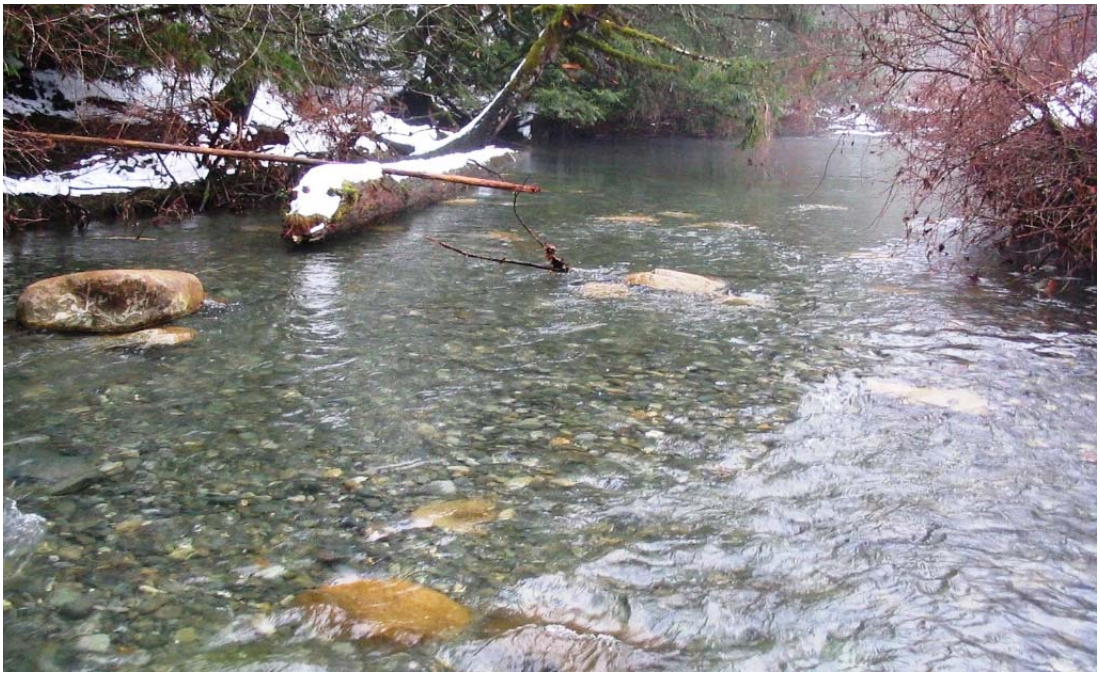
Puntledge River (Reach C) Spawning Gravel Placements for Fish Habitat Restoration, 2006



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STEELHEAD Recovery Plan
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March 2007

Executive Summary

Summer run stocks of Puntledge River steelhead trout and chinook salmon have been classified a conservation concern by provincial and federal fisheries managers. Declines in abundance have been caused by sharply reduced ocean survivals and impaired freshwater habitat capability related to Hydro and other development impacts. These stocks may not recover without significant productivity improvements to their freshwater and marine environments.

This project continues the progress made in 2005 by BCCF and FOC to address factors limiting fish production in Reach C of the Puntledge River by placing high quality spawning gravel in key locations. Approximately 450 m^3 of washed gravel was placed at three sites in August 2006, creating/enhancing 815 m^2 of spawning habitat. By increasing the availability of high quality spawning habitat, egg to fry survival will improve, an important first step in the recovery of these valuable Puntledge stocks.

Funding for this project came from BC Hydro through the Bridge Coastal Fish and Wildlife Restoration Program (BCRP). Project costs including planning, materials, implementation, monitoring and reporting totalled $51,460.08.

TABLE OF CONTENTS

Executive Summary ..... **ii**

1.0 Introduction **1**

1.1 Background 1

1.2 Need Statement 2

2.0 Goals and Objectives **2**

3.0 Study Area **3**

4.0 Methods **4**

5.0 Results **6**

6.0 Site Monitoring **7**

6.1 Fall Surveys 7

6.2 Spring Surveys 8

7.0 Recommendations **10**

8.0 Acknowledgements **10**

9.0 References **12**

LIST OF FIGURES

Figure 1. Puntledge River watershed on the east coast of Vancouver Island. 3

Figure 2. Location of gravel placement sites in Reach C of the Puntledge River, 2006. 6

Figure 3. Gravel pad profile at Site 1 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are referenced to a benchmark arbitrarily set at 100 m. 8

Figure 4. Gravel pad profile at Site 2 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are reference to a benchmark arbitrarily set at 100 m. 9

Figure 5. Gravel pad profile along transect 1 at Site 3 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are reference to a benchmark arbitrarily set at 100 m. 9

Figure 6. Gravel pad profile along transect 2 at Site 3 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are reference to a benchmark arbitrarily set at 100 m. 10

LIST OF TABES

Table 1. Spawning gravel placement sites in the Puntledge River, 2006. 4

LIST OF APPENDICIES

Appendix A. BCRP Financial Statement

Appendix B. BCRP Performance Measures

Appendix C. Confirmation of BCRP Recognition

Appendix D. Photo Documentation

1.0 Introduction

1.1 Background

Hydro-electric development began in the Puntledge River watershed with the construction of the Comox Dam in 1912. Canadian Collieries Dunsmuir Limited initially built the structure to create a central hydroelectric facility that could supply power for its mining operations. In 1953 the dam was purchased by the BC Power Commission (a predecessor of BC Hydro), with a new modern powerhouse built shortly thereafter (BC Hydro 2003). The Comox Dam is located 16 km upstream from the City of Courtenay and provides flow regulation for facilities downstream, including the Diversion Dam which forms the headpond and is the location of the intake for the 5 km long woodstave and steel penstock feeding a 24 MW power generation facility. The river channel from the Diversion Dam to the powerhouse tailrace is known as Reach C or the "Diversion Reach".

In 2000, the strategic plan for the Bridge-Coastal Fish and Wildlife Restoration Program (BCRP) was released and provided the technical framework to guide restoration activities and priorities in the Bridge-Coastal Generation Area, including the Puntledge River watershed (BC Hydro 2000). Primary factors limiting fish diversity and production in the Puntledge River watershed were identified and included restricted access to historic habitats, diversion of water, **loss of habitat and reduced habitat capability**. The loss of spawning habitat has been identified as the limiting factor to chinook production in the system. Restoration objectives aimed at addressing the limiting factors were prioritized in BCRP's strategic plan and included:

1. Restore historic wild salmon access to Comox Lake,
2. **Improve habitat conditions for fish stocks using the river channel between Comox Dam and the tailrace at the BC Hydro generation station,**
3. Conserve and improve habitats for resident wild and supplemented fish stocks in Comox Reservoir and its tributary systems.

In 2001, the Puntledge River water use planning (WUP) consultative process was initiated and consisted of 18 members representing a wide range of interest groups (i.e., power, fish, wildlife, culture, recreation, governments, etc.). The purpose of the planning process was to develop recommendations defining a preferred operating regime using a multi-stakeholder consultative process (BC Hydro 2003). When completed in 2003, the WUP process identified several issues regarding fish production in the Puntledge River, including optimal fish flow requirements for summer migration, rearing and spawning. In addition to recommendations defining a preferred operating regime, the consultative committee suggested that several monitoring studies be undertaken to answer key uncertainties, including spawning gravel monitoring and egg to fry survivals with different flow regimes. Several issues outside the scope of the WUP were also identified by the consultative committee including the recommendation that gravel placements be performed in lieu of operational changes (BC Hydro 2003).

Lough (2003) assessed steelhead and chinook spawning conditions in Reach C and found a total of 1,955 and 705 m^2 of functioning and non-functioning spawning habitat, respectively. Results noted that 90% of the functioning gravel was located in three specific areas: Barber's Pool, Bull Island side-channel, and the Gas Pipeline crossing. The remaining 10% consisted of small patches 5-50 m^2 in size located along the channel's wetted margins. Insufficient depth and/or velocity were cited as the most common reasons why gravel was non-functional in terms of salmonid spawning use.

Over the past 50 years, many restoration projects have occurred in the Puntledge River watershed. Improvements for fish passability at Stotan and Nib Falls, located in Reach C, where completed between 1923 and 1977. Spawning and rearing channels where constructed adjacent to the upper hatchery site between 1965 and 1975 (BC Hydro 2003). Additional side-channel developments and spawning gravel placements include Bull Island, Jack Hames, Powerline, and Powerhouse side-channels. In 2005, BCCF constructed two spawning platforms in the mainstem Puntledge River (Reach C) creating 992 m^2 of spawning habitat. In 2005, FOC also completed a spawning gravel placement project in the mainstem near Supply Creek (Reach B; above diversion) that created 4,756 m^2 of spawning habitat.

1.2 Need Statement

With the creation of storage and diversion dams in 1912, and the flooding of the headpond reach between the Comox Dam and the Diversion Dam (Reach B), it is estimated that approximately 90,000 m^2 of high quality spawning gravel were permanently lost (BC Hydro 2000). This area provided much of the spawning habitat for the river's summer run steelhead and chinook populations. Large spill events below Comox Dam have also scoured spawning gravel and diminished spawning habitat in Reach C. With the exception of small substrates from the Browns River (5 km downstream of the diversion dam), natural gravel recruitment to Reach C also ceased following construction of the storage and diversion dams.

Since the mid 1990s, winter and summer steelhead returns to the Puntledge River have been at or near record lows. Wightman et al. (1998) and Lill (2002) classified both stocks as an extreme conservation concern and at high risk of extinction. The river's unique summer run chinook stock is also severely depressed and would likely be quasi-extinct if not for the long standing federal hatchery program. Loss of habitat is cited as the reason for the summer run chinook decline as the stock dropped from an average of 3,000 fish annually, to less than 300 (http://www-heb.pac.dfo-mpo.gc.ca/facilities/puntledge/background_e.htm).

2.0 Goals and Objectives

Functioning mainstem spawning habitat, as identified during a recent assessment of steelhead and chinook spawning habitat in Reach C, totalled 1,099 m^2, with 777 m^2 in the traditional summer run area upstream of Stotan Falls (Lough 2003). As adult summer and winter steelhead are primarily mainstem spawners, the lack of suitable mainstem spawning habitat, coupled with a lack of natural gravel recruitment to this reach, has greatly reduced the system's productivity, particularly for steelhead.

The overall goal of the 2006 restoration project was to build on progress made in 2005 by creating an additional 1,000 m^2 of spawning habitat in Reach C of the Puntledge River. The work was done to immediately increase the available spawning habitat for all species present in Reach C but would specifically target threatened steelhead and chinook stocks. Site-specific gravel additions over several years should also aid downstream recruitment to other spawning locations. This directly addresses limiting factors of fish production as described in BCRP's Strategic Plan and meets Objective 2 of improving habitat conditions for fish stocks using the river channel between Comox Dam and the tailrace (BC Hydro 2000).

A secondary objective of the project involves post construction monitoring of gravel pad use by spawning salmonids and downstream displacement of gravel to other spawning locations. Detailed

monitoring should help in future site selection and in developing techniques to improve site effectiveness.

3.0 Study Area

The Puntledge River is an important salmon and steelhead producing stream on the central east coast of Vancouver Island (Figure 1). The river historically supported diverse and abundant stocks of salmon and trout that sustained local First Nations, while more recently contributing significantly to economically viable commercial and recreational fisheries (Guimond and Norgen 2003). From its headwaters in Strathcona Provincial Park, the Puntledge River flows northeast from the Vancouver Island Range and joins the Tsolum River to form the Courtenay River before entering the Strait of Georgia at the City of Courtenay (Figure 1). Two headwater lakes, Forbush and Willimar, feed the upper Puntledge River above Comox Lake Reservoir. Major tributaries to the Puntledge system include the Cruickshank River, entering on the west side of Comox Lake, and the Browns River, which enters approximately five kilometres downstream of the Diversion Dam.

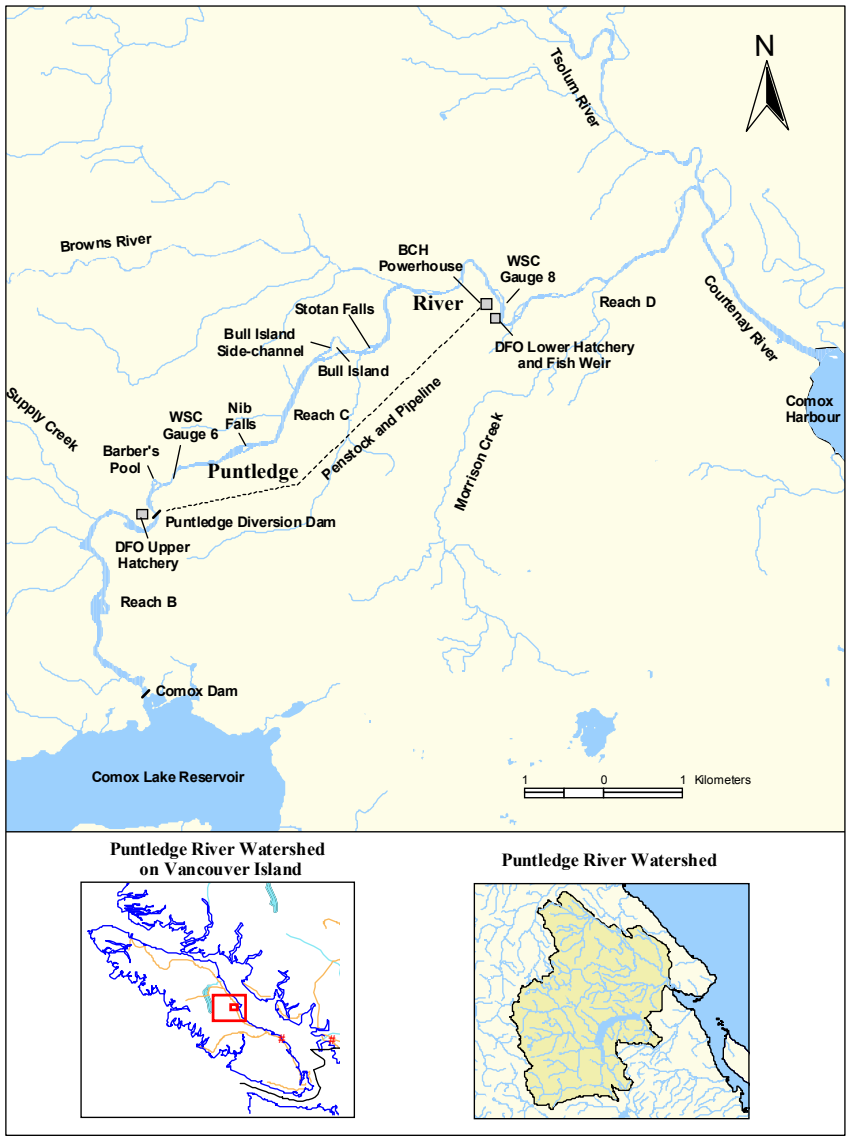

Figure 1. Puntledge River watershed on the east coast of Vancouver Island.

The lower Puntledge River (below the Comox Dam) can be divided into three distinct reaches (Bengeyfield and McLaren 1994). Reach B extends from the impoundment dam at the outlet of Comox Lake to the diversion dam approximately 3.7 km downstream and has a gradient of 0.01% (BC Hydro 2003). Reach C is the section of natural river channel that is bypassed by BCH's penstock diversion and is the focus area for the restoration works completed during this project.

This reach extends approximately 6.4 km from the diversion dam downstream to BC Hydro's powerhouse. Reach C contains a high proportion of bedrock and shale formations, and has a gradient of 1.5%. Two significant falls (Stotan and Nib) located in Reach C have been altered to improve fish passage. Reach D, which lies between the powerhouse and the Tsolum River, is 5.7 km long and has a gradient of 0.05% (BC Hydro 2003).

4.0 Methods

Prior to the BCRP proposal submission deadline in November, 2005, BCCF staff met with a MoE engineer[1] to locate and discuss potential gravel placement sites and options. Of the sites inspected during this visit, three were selected as candidates for gravel augmentation in 2006.

On April 19, 2006, following the conditional approval of the BCRP Puntledge gravel proposal, representatives from BCCF[2], BCRP[3], FOC[4], MoE[5], BCH[6] and the Puntledge River Restoration Committee[7] met to discuss Technical Review Committee (TRC) and Management Board comments and conditions. One condition required the discussion of options presented in a gravel placement feasibility study in 1994 by Bengeyfield and McLaren. Following this review, the group agreed that sites selected by BCCF for construction in 2006 were the priority (Table 1).

Table 1. Spawning gravel placement sites in the Puntledge River, 2006.

Site #	Location	Km downstream of diversion dam
1	Right bank of Barber's Pool	0.5
2	Left bank immediately upstream of Bull Island Side-channel intake	3.2
3	Right bank, opposite Bull Island Side-channel outlet	3.5

Prior to construction, additional approvals were obtained from FOC Habitat Management[8] and Engineering[9] staff during on-site visits. Sites also received approval from the local Watershed Enhancement Manager[10].

A notification under Section 9 of the Water Act for "works in or about a stream" was received by MoE on June 22, 2006. Detailed safety and environmental management plans were submitted and approved by BCH on June 12, 2006. A revised safety plan for Site 1 (Barber's Pool) was approved on August 22, 2006.

[1] Jim Bomford, Head, Engineering Services, Ministry of Environment/Freshwater Fisheries Society of BC, Duncan
[2] James Craig (Senior Fisheries Technician) and Scott Silvestri (Fisheries Biologist), BC Conservation Foundation/Greater Georgia Basin Steelhead Recovery Plan, Nanaimo
[3] Andrew Macdonald (acting manager) and Scott Allen (program biologist), Bridge Coastal Restoration Program, Burnaby
[4] Mel Sheng (Resource Restoration Biologist, FOC, Nanaimo), Shannon Anderson (Oceans and Community Stewardship Biologist, FOC, Campbell River) and Dave Davies (Community Advisor, FOC, Comox)
[5] Mike McCulloch, Anadromous Fisheries Specialist, Ministry of Environment, Nanaimo
[6] Al McLean and Eva Wichmann, Natural Resource Specialists, Vancouver Island Region, BC Hydro, Campbell River.
[7] Larry Peterson (Co-chair) and Nick Strussi (member), Puntledge River Restoration Committee, Courtenay
[8] Doug Swift, Habitat Management Technologist, Fisheries and Oceans Canada, Comox
[9] Russ Doucet, Senior Engineer, Fisheries and Oceans Canada, Nanaimo
[10] Chris Beggs, Watershed Enhancement Manager, Department of Fisheries and Oceans, Courtenay.

Permission to access land near Site 3 was approved by Hancock Forest Management prior to the proposal submission. A road use agreement was obtained from TimberWest Forest Corporation on August 4 to allow for gravel hauling along the Duncan Bay Mainline and to access Site 2. Hancock and TimberWest were again contacted prior to construction to ensure access and gravel delivery/installation schedules did not conflict with commercial operations or recreational activities.

On June 12, 2006, a request was sent to BC Hydro Properties Division to allow for gravel hauling on the penstock road and to develop access to Site 1 near the Diversion Dam. Approval was received from BCH on August 16.

Suitably sized, washed spawning gravel[11] was purchased and stockpiled at Hyland Precast Inc. On August 8, just prior to gravel delivery, a truck mounted Hiab was used to remove lock blocks from the lower Bull Island Side-channel access road (Site 3). Between August 8 and 10, the required quantities of spawning gravel were stockpiled at sites 2 and 3, as were several loads of washed, natural boulders 0.5-1.5 m in diameter

On August 22, a Hitachi EX 150 excavator contracted for the instream work was mobilized along the penstock road to Site 1. An access road and ramp into the river corridor was made from the penstock road for machine and gravel transport. The required gravel was both delivered and installed in river the next day.

On each day of construction, a safety meeting was first held to identify all hazards associated with the project. The prepared safety and environmental management plans were thoroughly discussed to ensure the safety of all personnel and to identify protocols to ensure appropriate environmental protection. Fuel/hydraulic fluid containment booms were installed prior to construction at all sites. All machines used instream employed fish safe hydraulic fluids.

Construction began at Site 3 on August 10. The excavator stockpiled into a 6-WD Caterpillar 25 ton articulated hauler. Gravel was forwarded into the river channel and dumped in position. The excavator then spread and roughly leveled the gravel to create the spawning platform. Boulders were then added to the platform to increase habitat diversity and roughness.

On August 11, gravel staged on the access ramp at Site 2 was mobilized instream by excavator. Spawning gravel was hoe-chucked into position and spread to create the spawning platform. Boulders were placed throughout the platform and at it's downstream end to increase stability and create roughness.

Construction of the spawning platform at Site 1 commenced on August 23, 2006. As gravel was delivered on-site and dumped on the access ramp, the excavator hoe-chucked the material instream. As with the other sites, boulders were placed on top of the pad and at it's downstream end.

Reclamation of all sites was completed prior to demobilization of machinery. Stockpile areas and access ramps were cleaned of most gravels and returned to near natural states. In the case of Site 1, the prepared road and ramp over the BCH dike was repaired to pre-construction conditions. All sites were sown with a mix of native seeds and grasses.

To monitor stability and fish use of the installed gravel, crews surveyed stream bed profiles shortly after construction and completed swims in the fall of 2006 and the spring of 2007. Benchmarked transects were completed at all sites using a Pentax AP-120 level. Snorkellers looked for redds and

[11] Gravel specifications were requested as follows: 10% small gravel (0.63-2.5 cm), 20% medium gravel (2.5-5.0 cm), 60% gravel/cobble (5.0-7.5 cm) and 10% cobble (7.5-10.0 cm).

performed minor excavation to confirm if eggs were present. Habitats immediately downstream of pads were examined to document gravel presence/abundance and enable future comparisons.

5.0 Results

Construction at Site 3, located on the right bank of the Puntledge River opposite the Bull Island Side-channel outlet, occurred on August 10, 2006 (Figure 2). In total, 310 metric tonnes (~176 m^3) of gravel and three loads of boulders were stockpiled on the lower Bull Island Side-channel access road. The articulated hauler completed 12 trips to mobilize the gravel in river, with two additional trips to haul boulders. Gravel delivered to this site was placed in the mainstem's right channel braid, creating approximately 342 m^2 of spawning habitat. Mean gravel depth at this location was 0.5 m.

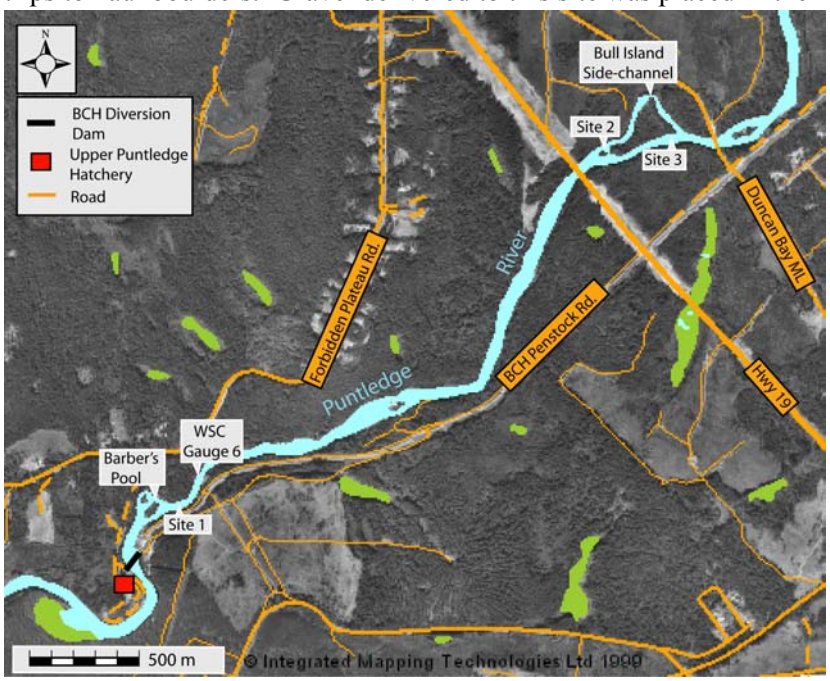

Figure 2. Location of gravel placement sites in Reach C of the Puntledge River, 2006.

Boulders were placed on top of the gravel pad and at the downstream end of the pad to help contain the gravel, and to increase pad roughness and hydraulic diversity.

Construction at Site 2, located immediately upstream of the Bull Island Side-channel intake dike, occurred on August 11. Approximately 153 metric tonnes (87 m^3) of spawning gravel and three loads of boulders were stockpiled on the access ramp. Gravel was installed and spread to create approximately 170 m^2 of spawning habitat, with a mean gravel depth of approximately 0.5 m. Following gravel pad creation, large native boulders delivered to the site were used to complex the spawning platform.

Construction of the spawning pad at Site 1, along the right bank of Barber's Pool, began August 23 as gravel was delivered to the site. A total of 326 metric tonnes (185 m^3) of spawning gravel and four loads of large boulders were delivered and dumped on the prepared ramp. Gravel was then installed to create approximately 303 m^2 of spawning habitat. Mean gravel depth at this location was approximately 0.6 m, while water depths averaged 0.35 m. The gravel pad at this location was also complexed with boulders following spawning pad creation.

Using spawning standards[12] developed for the Campbell River watershed by Burt (2004), the number of pairs of steelhead trout and chinook salmon that may be accommodated by the new spawning habitat is 106 and 81, respectively.

[12] Spawning standards per pair are 7.6 m^2 for steelhead trout and 10 m^2 for chinook salmon.

6.0 Site Monitoring

6.1 Fall Surveys

Fall monitoring of gravel pads constructed in 2006 was completed on December 5 to document salmon use and observe changes to pad profiles following high water conditions in the November. Since construction, the highest discharge recorded in Reach C to December 5 was 159.5 m^3/s (uncorrected, November 20, 2006).

At Site 1, very little gravel movement was noted. Approximately 8.0 m^3 of gravel was displaced from the thalweg edge of the gravel pad, while only a minor amount (<1%) was displaced from the downstream edge of the pad. Most of the displaced gravel appeared to have sloughed off the edge of the pad into pool. Water depth and velocity over the pad appeared poor for spawning at the observed discharge of 5.7 m^3/s. This site would likely become more suitable at flows greater than 20 m^3/s. To assess suitability at higher flows, the site was examined on January 9, 2007 when discharge was approximately 70 m^3/s. Spawning conditions at this discharge appeared highly suitable, as water depth and velocity over the pad was estimated to average 0.7 m and 0.5 m/s, respectively.

Approximately 70% of the gravel pad was covered with a thin layer of dead algae/sediment. Higher velocity areas around complexing rocks and locations where fish had been digging appeared clean. A total of four redd/test redds were noted on this pad. Hand excavation in two of these locations was performed, however no eggs were found. Bone pieces from several salmon carcasses were noted along parts of the pad and along the right bank of the river. No erosion or damage was noted on the re-constructed portion of the dike adjacent to the BC Hydro penstock road.

At Site 2, very little gravel movement (<5%) was observed on December 5. Minor displacement was noted from the pads leading edge towards more central locations. No gravel displacement was noted on the rest of the pad and no material was observed in downstream habitats. Water depth and velocity over the pad appeared poor for spawning at the observed discharge of 5.7 m^3/s. As with Site 1, conditions here would become more suitable at flows greater than 20 m^3/s. An on-site visit on January 9, 2007 confirmed better spawning conditions for fish at the observed discharge of approximately 70 m^3/s. Water depth over the pad was estimated at 0.5 m, while water velocities were estimated between 0.75 and 1.0 m/s.

A couple of depressions were noted near the downstream edge of the pad, possibly indicating spawning activity, however limited hand excavation revealed no eggs present. No erosion or damage was noted on the access road, originally constructed for the Bull Island Side-channel project.

Similar to sites 1 and 2, gravel movement appeared minimal (<2%) at Site 3. The only noticeable shift was along the upstream portion of the pad where the habitat unit transitions from a pool a glide. The slope has become more flattened and less pronounced then it was following construction. No gravel appears to have been displaced from the downstream portion of the pad.
Water depth and velocity over the pad appeared reasonable for spawning at the observed flow of 5.7 m^3/s. Conditions over the pad would likely be improved when BC Hydro implements spawning pulse flows in the fall and spring. Spawning conditions at Site 3 were inspected on January 9, 2007 at a discharge of approximately 70 m^3/s. Estimated to be near 1.5 m/s, water velocity appeared high for steelhead spawning, but likely still favorable for chinook spawning. Water depth over the pad was estimated to average 1.0 m.

Approximately 8-10 redds/test redds were noted over the pad during the December investigation. In addition, three salmon carcasses and numerous remains were also present on the pad.

6.2 Spring Surveys

Spring surveys took place on March 23, 2007 at a discharge near 10 m^3/s. The largest discharge following gravel pad construction occurred on November 20, 2006, when 159.5 m^3/s (uncorrected) was recorded in Reach C. Pad conditions appeared similar to that observed in December. Little additional scour or gravel displacement was noted.

Two recent redds/test redds were observed at Site 3, indicating digging by resident trout or captive brood steelhead (released in October of 2005). No recent fish activity was noted at sites 1 or 2. Most of the gravel and complexing boulders at sites 1 and 2 were covered by a layer of green filamentous algae and/or *Didymosphenia geminata* (diatom species). Neither were present at Site 3, possibly a result of increased flow over the pad and reduced light penetration through the riparian canopy.

At Site 1, streambed profiles confirmed snorkel survey observations noting little gravel movement following high water (Figure 3). An overall flattening of the gravel pad appears to have occurred as a result of high water, with a small amount of gravel displaced from its downstream edge into the tail-out of the pool near right bank.

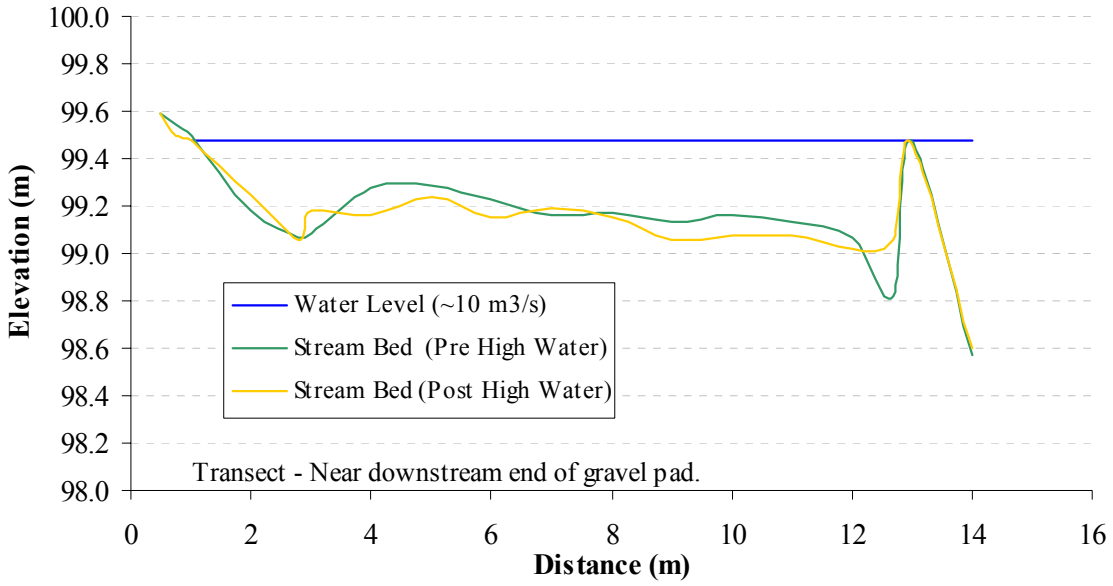

Figure 3. Gravel pad profile at Site 1 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are referenced to a benchmark arbitrarily set at 100 m.

At Site 2, transect data confirmed only minor gravel movement (Figure 4). Similar to the monitoring results from December, a small amount of gravel near the upstream end of the pad appears to have been displaced downstream resulting in a slight increase in pad profile along the transect line.

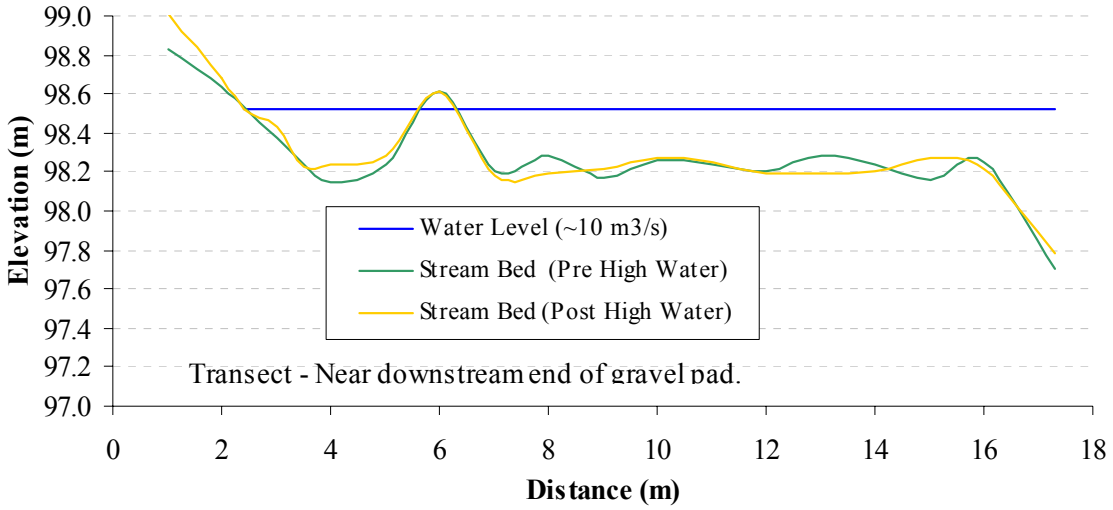

Figure 4. Gravel pad profile at Site 2 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are reference to a benchmark arbitrarily set at 100 m.

Two transects confirmed insignificant gravel movement at Site 3 (Figures 5 and 6). At the upstream transect site, a small amount of gravel was displaced from the left bank side of the pad near the mid-channel island. This gravel appears to have been spread over downstream portions of the pad. Some localized scour occurred near complexing rocks and a large log on right bank.

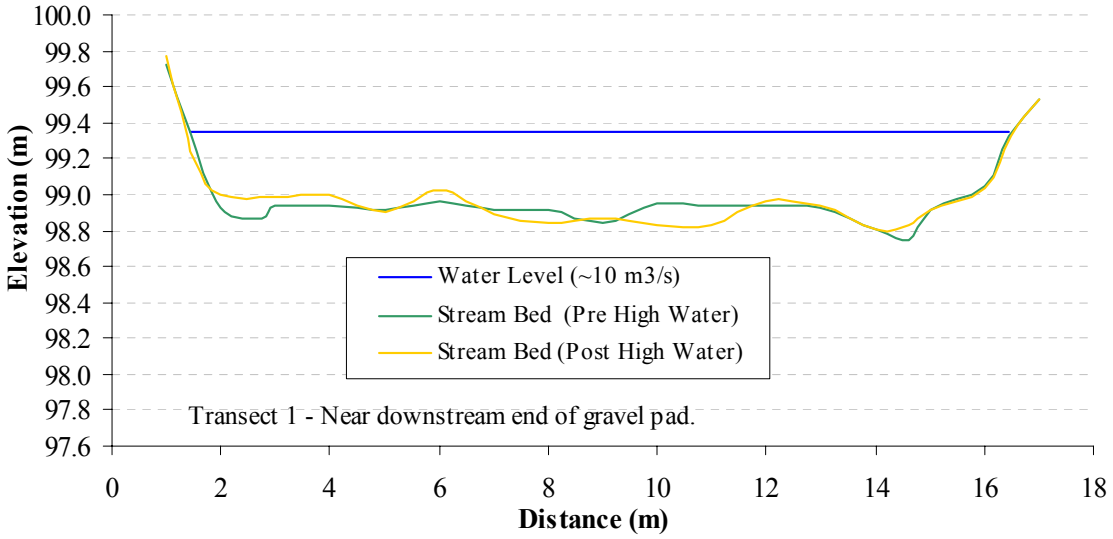

Figure 5. Gravel pad profile along transect 1 at Site 3 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are reference to a benchmark arbitrarily set at 100 m.

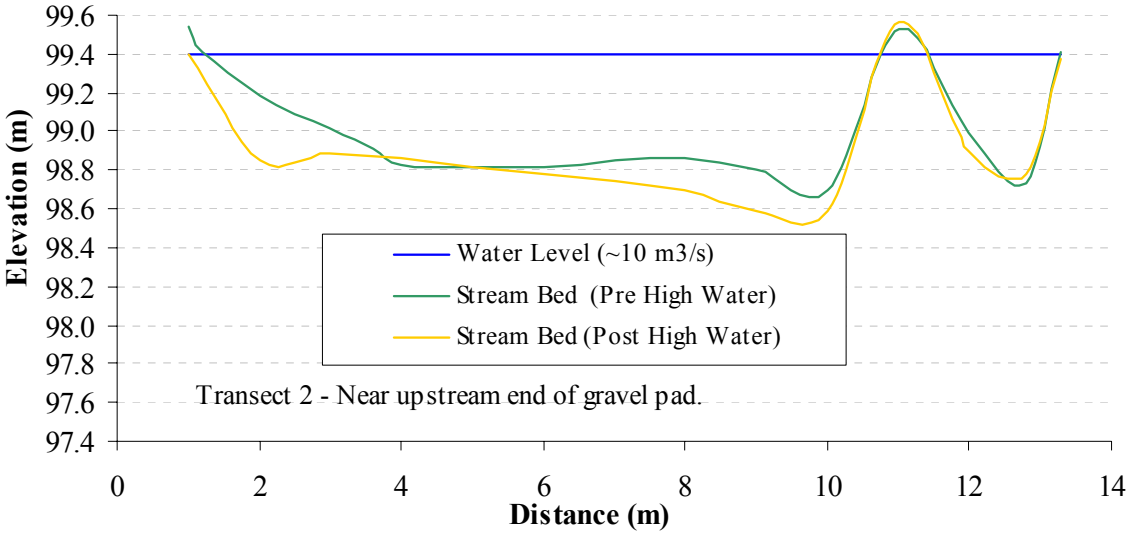

Figure 6. Gravel pad profile along transect 2 at Site 3 before (September 15, 2006) and after (March 23, 2007) high water events. Gravel and water heights are reference to a benchmark arbitrarily set at 100 m.

7.0 Recommendations

To continue to address limiting factors identified in the BCRP Strategic Plan including loss of habitat and reduced habitat capability, we recommend:

1) Continued evaluation of the quantity and quality of naturally occurring and artificially placed gravel in the Puntledge River to ensure adequate spawning habitat for salmon and trout species.
2) Continued monitoring of gravel placed in 2005 and 2006 to document gravel suitability, stability and use by spawning salmonids. Future works may be required to ensure that all sites continue to function as intended. Replacement of gravel lost during extreme spill events will likely be required, particularly for sites that are deemed a priority based on fish use.

8.0 Acknowledgements

Thanks are extended to Craig Wightman[13], for his advice and acting as scientific authority. Hancock Forest Management, BC Hydro, and TimberWest Forest Corporation allowed access to lands to complete this project; their support was appreciated. Kevin Pellett[14] helped during project implementation and with post-construction monitoring. Shayne Johnson[15] aided during materials staging and during construction. Appreciation is extended to James Craig[16] for editing this report. Comox First Nation band members Anthony Hardy, Alan Mitchell, Allan Hardy, and Anthony Fortin helped during project construction and provided safety watches at the impoundment and

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[15] Fisheries Technician, BC Conservation Foundation, Nanaimo.
[16] Project Manager, BC Conservation Foundation, Nanaimo.

diversion dams. Many thanks to Ken Grieves for his valuable knowledge and expert machine operation during site construction. Funding for this project was provided by BC Hydro's Bridge Coastal Fish and Wildlife Restoration Program. Their continued support of steelhead and salmon recovery initiatives in the Puntledge River watershed is greatly appreciated.

9.0 References

BC Hydro. 2000. Bridge-Coastal Fish and Wildlife Restoration Program Strategic Plan, Volume 1: Strategy and Overview. Prepared by Regional Consulting Ltd., Global Fisheries Consultants Ltd., D.B. Lister & Associates Ltd., and Summers Biological Services with mapping by GIS Innovations. 49 p. plus appendices.

BC Hydro. 2003. Puntledge River Water Use Plan Consultative Committee Report. Prepared on behalf of the Consultative Committee for the Puntledge River Water Use Plan. 127 p. plus appendicies.

Bengeyfield, W. and W.A. McLaren. 1994. Puntledge River gravel placement feasibility study. Global Fisheries Consultants Ltd. White Rock, BC and McLaren Hydrotechnical Engineering, Coquitlam, BC for: Environment Resources, BC Hydro, Burnaby. 43 p.

Burt, D.W. 2004. Restoration of the lower Campbell River, a Review of Projects to 2003 and a Plan for Future Works. Prepared for Department of Fisheries and Oceans, Ministry of Water, Land and Air Protection, and Campbell River Gravel Committee. 96 p.

Guimond, E. and R. Norgen. 2003. Puntledge River Spawning Habitat Restoration, Bull Island Side-Channel Gravel Placement Project 202-2004 Final Report. Prepared for BC Hydro's Bridge Coastal Fish and Wildlife Restoration Program, Burnaby, BC. 7 p. plus appendices.

Lill, A.F. 2002. Greater Georgia Basin Steelhead Recovery Action Plan. For Pacific Salmon Foundation and the Ministry of Water, Land and Air Protection. 107 p.

Lough, M.J. 2003. Assessment of steelhead and chinook spawning habitat in Reach C, Puntledge River. For BC Hydro, Water Use Plans, Power Supply and Environment, Burnaby, BC. 9 p. plus appendicies.

Wightman, J.C. et al. 1998. A recovery plan for east coast Vancouver Island steelhead trout. Unpub. Draft. Ministry of Environment, Lands and Parks and Ministry of Fisheries. Nanaimo, BC. 131 p. plus appendices.

Appendix A.

BCRP Financial Statement

Financial Statement Form

Project # 06.Pun.01

	BUDGET		ACTUAL	
INCOME	BCRP	Other	BCRP	Other
Total Income by Source	46,860.55	4,940.00	46,860.55	5,239.11
Grand Total Income (BCRP + other)	**51,800.55**		**52,099.66**	
EXPENSES *Project Personnel*				
Wages (BCCF)	7,290.00		18,209.38	
Sub Contracts (Comox FN)	800.00		913.75	
Fisheries Engineer (MoE)		1,000.00		1,000.00
DFO Biologist/CA				1,500.00
Subtotal	**8,090.00**	**1,000.00**	**19,123.13**	**2,500.00**
Materials and Equipment				
Spawning Gravel + Hauling	18,570.00	3,000.00	11,560.47	1,500.00
Pit Run for road base	800.00			
Large Rock and Hauling	2,700.00		4,333.50	
Excavator	7,598.00		4,460.00	
Excavator Mobilization	400.00		400.00	
Front End Loader	2,400.00			
Travel	292.50		1,276.27	
Truck Lease	1,000.00		130.00	
Fuel Expense	500.00			
Communication	100.00		82.00	
Safety/Survey Equipment		500.00	52.96	500.00
Work Site Equipment		200.00	655.69	200.00
Riparian Planting	150.00			
Subtotal	**34,510.50**	**3,700.00**	**22,950.89**	**2,200.00**
Administration				
Telephone Charges	50.00			
Photocopies and printing	250.00			
BCCF admin @ 10%	3,960.05	240.00	4,146.95	539.11
Subtotal	**4,260.05**	**240.00**	**4,146.95**	**539.11**
Total Expenses	**46,860.55**	**4,940.00**	**46,220.97**	**5,239.11**
Grand Total Expenses (BCRP+other)	**51,800.55**		**51,460.08**	
BALANCE (Grand Total Income - Grand Total Expenses)	**0.00**		**639.58** (spent on GST, not being claimed)	

Appendix B.

BCRP Performance Measures

Performance Measures

Project # 06.Pu.01

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

Performance Measures - Target Outcomes													
Project Type	**Primary Habitat Benefit Targeted of Project (m^2)**	**Primary Target Species**	**Habitat (m^2)**										
			Estuarine	In-Stream Habitat - Mainstream	In-Stream Habitat - Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
Impact Mitigation												
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)											
Habitat Conservation												
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											
Maintain or Restore Habitat forming process												
Artificial gravel recruitment	Area of stream habitat improved by gravel plcmt	Steelhead and Chinook		815								
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											
Habitat Development												
New habitat created	Functional area created											

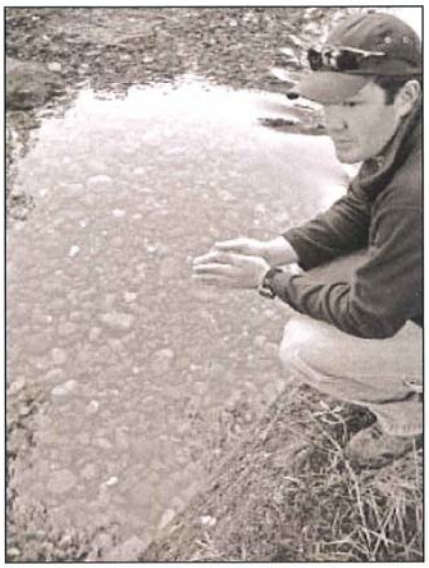
Appendix C.

Confirmation of BCRP Recognition

COMOX VALLEY RECORD

Nearly extinct salmon helped

By Colleen Dane
Record Staff Writer
Sep 08 2006



fisheries technician Scott Silvestri checks on one site of newly added spawning gravel — ready for returning fish this fall/winter.□PHOTO BY colleen dane

It may just look like a pile of rocks — but for salmon heading upstream this year, it'll actually be the perfect place to spawn.

Providing good spawning ground in the Puntledge River is just one goal for the Greater Georgia Basin Steelhead Recovery Plan (GGBSRP). This year, after completing the second year in gravel replacement that added 650 square-metres at three locations between the Stotan Falls and BC Hydro's diversion dam — they've taken great strides in improving that area of salmon habitat.

"High-quality spawning gravel is really important because you get really good egg-to-fry survival," said Scott Silvestri, fisheries technician with the GGBSRP.

Minimal amounts of the healthy environments for reproducing is one of the problems that's been targeted in the Puntledge as a reason for remarkably low return counts.

"We're definitely at record low levels in the Puntledge — like near-extinction levels," said Silvestri about annual steelhead returns.

Those low levels are a result of changes to the river's flow that has happened over many years — Silvestri harkens back to the creation of storage and diversion dams in 1912 and the flooding of the headpond between Comox Lake Dam and the Diversion Dam. That led to an estimated 90,000 square metres of spawning habitat being flushed away permanently.

Since the 1990s, steelhead trout returns have reached record lows, throughout eastern Vancouver Island, he said — and the Puntledge is just one place where projects like these are happening.

While the project is targeting specifically summer run steelhead trout and summer run chinook salmon, other species such as resident rainbow trout, cutthroat troat and coho salmon will also benefit, said Silvestri.

There's little they can do about what happens to these fish when they're at ocean — but groups like these can do their best to increase the survival rate while the fish are still in fresh water, said Silvestri. This project is one way to do that.

Funded by BC Hydro's Bridge Coastal Restoration Program and the province's Habitat Conservation Trust Fund, the two weeks of work last month, including supplies and equipment, cost $51,500.

Appendix D.

Photo Documentation

1. Gravel placement by excavator at Site 1 (Barber's Pool).

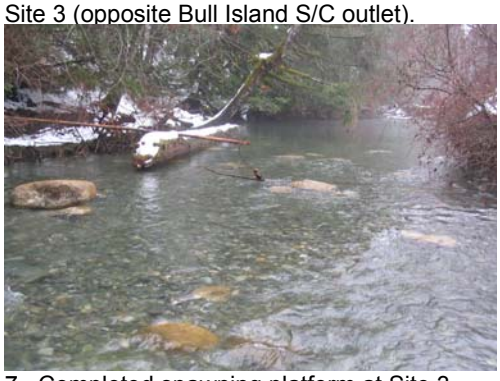
2. Completed spawning platform at Site 1 (Barber's Pool).

3. Gravel placement by excavator at Site 2 (upstream Bull Island Side-channel intake).

4. Completed spawning platform at Site 2 (upstream Bull Island Side-channel intake).

5. Gravel placement by articulated hauler at Site 3 (opposite Bull Island S/C outlet).

6. Gravel pad creation by excavator at Site 3 (opposite Bull Island S/C outlet).



7. Completed spawning platform at Site 3 (opposite Bull Island S/C outlet).

8. Completed spawning platform at Site 3 (opposite Bull Island S/C outlet).