Fish Habitat Rehabilitation in the Englishman River, 2006

prepared for:

Georgia Basin Living Rivers Program
Habitat Conservation Trust Fund
Pacific Salmon Foundation

by:

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Greater Georgia Basin Steelhead Recovery Plan

GREATER GEORGIA BASIN STEELHEAD Recovery Plan
www.SteelheadRecoveryPlan.ca

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ACKNOWLEDGEMENTS

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Many thanks go to machine operators and materials suppliers for their professionalism and hard work during this project. These companies include Copcan Contracting Ltd., Parksville Sand and Gravel, W.R. Addison Loading and Hauling Co., and Johel Bros. Contracting Ltd.

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1.0 INTRODUCTION

The Englishman River is one of the most significant salmon bearing streams on the central east coast of Vancouver Island (Figure 1). The watershed supports all five species of anadromous salmon as well as rainbow and cutthroat trout, and supplies water for the city of Parksville, BC. In 2000, the BC government designated the Englishman River as a sensitive stream under the Fish Protection Act. Also in 2000, the watershed became part of the United Nations designated Mount Arrowsmith Biosphere Reserve (Jamieson 2000). In recent years, the Outdoor Recreation Council of British Columbia has identified the Englishman River as one of the most threatened watersheds in BC.

Figure 1. Location of Englishman River watershed on the central east coast of Vancouver Island.

The Englishman River was the first watershed to be selected by the Pacific Salmon Endowment Fund Society to receive attention in the Georgia Basin salmon recovery planning process for coho and steelhead. The vision of the Pacific Salmon Endowment Fund (PSEF) is to achieve healthy, sustainable and naturally diverse Pacific salmon stocks through strategic and focused efforts where people and resources are mobilized to work together to achieve common goals. The Englishman River Watershed Recovery Plan (ERWRP; Bocking and Gaboury 2001) was developed to identify and prioritize activities required to achieve recovery goals for the watershed and its fish stocks. Several other reports including *Overview Assessment of Fish and Fish Habitat in the Englishman River Watershed* (Lough and Morley 2002) and *Englishman River Channel Condition Assessment* (nhc 2002) have been developed to complement the original plan and facilitate recovery activities.

Significant off-channel development has taken place in the Englishman River watershed, with the creation of the TimberWest (a.k.a. Clay Young) and Weyerhaeuser (a.k.a. Nature Trust) side-channels. These channels extend for 1,300 and 950 m, respectively (8% of watershed anadromous length), and account for 15-25% of coho smolt production in the watershed (Decker et al. 2002).

Extensive restoration work in the mainstem Englishman and South Englishman rivers occurred from 2003 to 2005 with the installation of 54 LWD and boulder riffle sites, based on prescriptions by LGL Ltd. (Gaboury 2003; Appendix A). Previous work completed through the ERWRP included several "debris catcher" structures designed to protect the Weyerhaeuser side-channel, capture wood and create lateral scour pools. Additional projects have been completed near the Highway 19a Bridge to reduce bank erosion with ancillary fish habitat benefits.

2.0 STUDY AREA

From its headwaters on Mount Arrowsmith (1,817 m) the Englishman River flows east draining 324 km^2 of the central east coast of Vancouver Island, entering Georgia Strait near Parksville, BC (Figure 2). Mainstem anadromous length is 15.8 km to the barrier in Englishman River Falls Provincial Park. Mean annual discharge (MAD) for the watershed is 14 m^3/s and pre-Arrowsmith Dam summer base flow was as low as 4.6% MAD (Lill 2002). The largest sub-basin, the South Englishman River, enters the mainstem 8.3 km upstream from the mouth. It drains 83 km^2 and has an anadromous length of 4.5 km. Other tributaries include Centre Creek (a sub-basin of the South Englishman), Morison Creek and Shelley Creek with anadromous lengths of 5.2, 2.1 and 1.0 km, respectively (Lough and Morely 2002). Island Timberlands Limited Partnership (ITLP) owns 69% of the watershed (Weyerhaeuser 2003). Of the total watershed area, 27% is below 300 m, 47% is between 300 – 800 m elevation and 26% is above 800 m (Weyerhaeuser 2003).

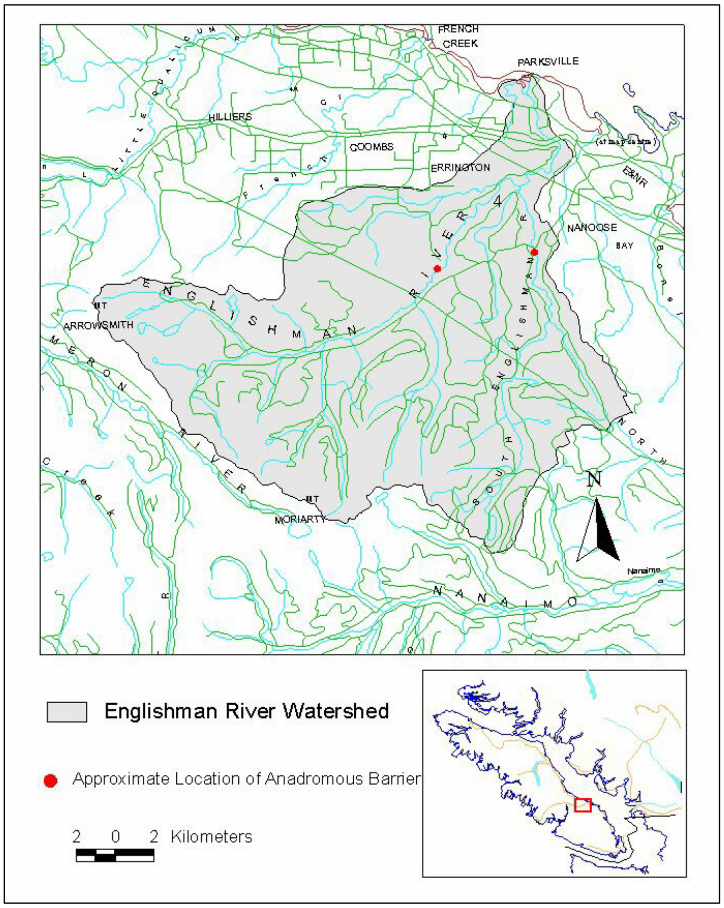

Figure 2. Englishman River watershed, Vancouver Island.

Reach E3 (Allsbrook Canyon to South Englishman confluence) has been identified as the most active reach on the Englishman River based on the downstream progression of meanders, cutoffs and avulsions, and many banks in this reach were eroding along part or most of their length (nhc 2002). Riparian forests adjacent to many eroding banks are of insufficient age, and therefore tree size, to contribute to bank stability and, after falling in, trees are quickly moved into non-functional locations or are transported out of the target restoration reach. Despite the current volatility of this reach, aerial photo interpretation has determined that channel narrowing and gravel bar re-vegetation are occurring (nhc 2002).

Mainstem reaches E3 and E4 (Allsbrook Canyon to Morison Creek confluence) and South Englishman reaches SE1 and SE2 are suitable for restoration because:

- gradient and channel morphology are conducive to instream restoration activities;
- juvenile and adult target species (steelhead trout and coho salmon) are relatively abundant;
- road access allows transport of restoration material to identified sites; and,

- these reaches were previously identified by nhc (2002) and Lough and Morley (2002) as primary candidates for instream restoration works.

In October 2005, LGL Limited released a follow-up document to the initial Englishman River Recovery Plan, entitled *A strategy for protection and restoration of the Englishman River mainstem (Gaboury 2005)*. This document identified and prioritized remaining mainstem works within the Recovery Plan, including amongst others and in order of priority, (1) improved flow management from Arrowsmith Dam, (2) securement of riparian corridor, and (3) bank stabilization in Reach E3. Guided by this document, work in 2006 aimed to stabilize E3 streambanks vulnerable to continued erosion, particularly two meander bends of special concern.

Located approximately 250 m upstream (identified as Site C) and 400 m downstream (identified as Site A) of the powerline crossing, these two bends have a combined length of approximately 500 metres. LWD structures that primarily provide instream cover have been constructed along these two bends over the past three years but provide only partial bank protection due to structure spacing and high porosity. The recommended restoration treatments to stabilize these two meander bends as identified in the report are:

1. Increase the functional projection length of existing structures to about 8-9 m by adding more riprap to the upstream leading edge and core of each LWD structure; and,
2. Where current spacing of LWD structures is >20 m, construct additional sites (LWD structure, rock groin or rock deflector vane in between to ensure a functional projection length of 8-9 m, throughout the meander.

The report specifically identifies and recommends nine additional structures be installed at a spacing of 2-3 times the projection length, on the two meander bends (five at Site A and four at Site C). The report also recommends that for each new LWD structure, additional riprap should be placed along the upstream leading edge of the LWD structures, to decrease porosity and increase the functional projection length for bank protection.

2.1 Hydrology

Englishman River discharge has been gauged by the Water Survey of Canada at the Highway 19a Bridge crossing (Station 08HB002) continuously since 1979. This rainfall driven watershed follows trends similar to other east coast Vancouver Island streams with the largest flows typically occurring from November through February. Typical summer base flow (August and September) before development of storage at Arrowsmith Lake in 1999 was 1.2 m^3/s, or 8.5% MAD (nhc 2002). With the Arrowsmith Lake reservoir in operation, the minimum mandated flow is now 1.6 m^3/s or 11.3% MAD. In a recent analysis of flood frequency the 2-year and 50-year maximum daily flows were estimated at 204 and 471 m^3/s, respectively (nhc 2002).

Gaboury (2003) measured channel widths at five sites within reaches E3 and E4. Bankfull channel widths averaged 37.7 m. Bank heights and bankfull depth averaged 2.3 m and 1.8 m, respectively (Appendix A). Gradient in the upper restoration reach (E4) averaged 0.9% while gradient in the lower reach (E3) averaged 0.7%.

Complete hydrological assessments including detailed analysis of flood and drought return period and channel condition can be found in *Englishman River Channel Condition Assessment* (nhc 2002), and in *Fish Habitat Restoration Designs for the Englishman River* (Gaboury 2003).

2.2 Fisheries Resources

The Englishman River supports resident and anadromous populations of rainbow (steelhead) and cutthroat trout, as well as chum, coho, chinook, pink and occasionally sockeye salmon. Dolly Varden char, stickleback and cottid populations are also found in the watershed (Lough and Morley 2002).

Hatchery programs have historically included combinations of fry out-planting, bulk incubation/volitional release and fed fry release for pink salmon (Quinsam River brood), chinook salmon (Big Qualicum River brood) and native coho salmon stocks. Using native brood, steelhead trout were historically enhanced with a smolt program operated out of the provincial hatchery in Duncan (1979–1997) and the Little Qualicum Project (1991–1999). Englishman cutthroat continue to be augmented with smolts (Little Qualicum stock) from the Little Qualicum Project.

Recent steelhead abundance trends in the Englishman River remain relatively low, with annual peak snorkel counts in the mainstem ranging from 45 to 73 adults since 2002 (Silvestri 2005). The wild stock trend was most recently classified as “stable at a low level” (Lill 2002).

Coho population estimates have historically ranged from 750 to 1,500 adults, with a long term mean (1953–2000) of 960 adults (Bocking and Gaboury 2001). Recent escapements have been substantially higher (4,900 estimated in 2005) with a range of 3,100 to 8,000 from 2000-2005. Recent increases in coho abundance likely relate to changes in enumeration methodology and decreases in marine exploitation rather than a significant increase in smolt production or ocean survival (Baillie and Young 2003).

3.0 METHODS

3.1 Materials/Staging

A diverse range of instream enhancement projects has been completed on Vancouver Island and across BC since the mid 1990s under programs such as the Watershed Restoration Program and Forest Renewal BC. Reviews and monitoring of such projects have consistently recommended that wood used in artificial habitat structures be:

- large in bole diameter (>0.5 m) for structural durability;
- green wood to maximize structure life; and
- coniferous species (cedar is preferred) as they generally rot slower than hardwoods.

Cover, complexity, and fish use of instream structures increases dramatically when rootwads or branched trees are incorporated into structures. Structures located in moderate to high flow velocities consistently see the highest use by steelhead fry and parr.

With suggestions from ITLP staff (Northwest Bay Division), July 2006 field surveys identified a number of large non-merchantable logs left in harvested areas of the Englishman River watershed. Consisting of mountain hemlock, yellow cedar and Douglas fir, these split or otherwise damaged logs were suitable for use in fish habitat restoration structures, having diameters of 0.4-0.7 m and lengths of 8-20 m.

In July 2006, BC Conservation Foundation fisheries staff and K. Lafond[1] identified approximately 12 candidate trees located on TimberWest private forest land in the upper Centre Creek sub-basin. Diameters at breast height ranged from 0.40-0.60 m. The trees, which were donated by TimberWest, included Douglas fir, western red cedar, balsam fir and lodgepole pine.

Also in July, nearby quarries were investigated as potential sources for ballast rock. Factors influencing supplier selection included rock cost, haul times, availability, rock competency (resistance to fracture) and rock size. Parksville Sand and Gravel (Spider Lake Quarry) provided the most cost-efficient option for the project.

With all wood and rock sources identified, staging began in mid July. A self-loading logging truck salvaged four loads of non-merchantable logs (boles only) from the Englishman River watershed. Once loaded, the logs were delivered to staging areas near river access points.

Harvesting of whole trees was completed on July 17, 2006. Trees selected were well-spaced at the perimeter of the stand. Trees were pushed over by an excavator with a hydraulic thumb (Komatsu PL 200). Trees were temporarily staged along the spur road and cut to fit inside a 52 foot (15.8 m) long hydraulic dump bin truck. Remediation and clean-up of the area occurred immediately following tree removal. Following temporary staging, the trees were transported by bin truck to appropriate staging areas near river access points.

Ballast rock hauling commenced on July 11, 2006. To fulfill the prescribed rock requirements, a total of 489,000 kg of rock was required for the LWD and rock deflector groyne sites. In total, 23 tandem dump truck and trailer loads were hauled to the staging areas.

Hauling of the staged material into the river channel began on July 18, 2006. Ballast and groyne rock, as well as whole and bole only trees were loaded into a rubber-tired 6WD articulated hauler (Caterpillar, model D300E) using an excavator (Komatsu PL 200) operating a "clamshell" bucket (Appendix B, Photo 1-2). Both machines were equipped with fish-safe hydraulic fluid[2] (Appendix B, Photo 3). Additionally, five loads of round boulders from the local pit were transported to several boulder-riffle enhancement sites. Typically, the prescribed amount of rock and trees were delivered via dry portions of the river channel to gravel bars opposite each restoration site, minimizing "wet" crossings as much as possible.

3.2 Construction

Sites were generally constructed in sequence going upstream from the lowermost site, with the excavator operating in the stream channel only when necessary. The excavator, project supervisor and cable crews carried spill kits for containment of deleterious materials, and time in or near the river was minimized. A spill boom installed across the stream's wetted width was maintained downstream of each construction site (Appendix B, Photo 4)

Rather than a standard bucket and thumb, the excavator was equipped with a versatile "clamshell" hydraulic bucket that could quickly and easily rotate and orient large logs and rocks (Appendix A, Photo 5). This combination was effective at placing and orientating logs and ballast in desirable locations. During LWD site construction, two or three key wood pieces were positioned and the

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[1] Engineer, Nanaimo Lakes Division, TimberWest Forest Corp., Nanaimo, BC.
[2] Chevron Clarity® Hydraulic Oils.

remaining logs were "knitted" into the structure to simulate a natural log jam. The clamshell enabled large ballast rock to be inserted laterally or "tucked" under key logs as required.

Rock deflector structures were created at identified sites using the same equipment. Large boulder pieces were keyed into the stream bed, with additional rock placed on top to a specific height. Deflector structures were constructed with low profiles to provide the required protection and minimize hydraulic disturbance (Appendix C).

Boulders were installed at riffle locations to roughen the stream bed and enhance steelhead parr habitat. The heights of boulders were adjusted relative to the stream bed to achieve hydraulic conditions preferred by steelhead parr (McCulloch 2000), including:

- pockets of at least 0.5 m in depth;
- areas of non turbulent (laminar) flow; and
- broken water cover from aeration and surface turbulence.

Access routes were naturalized (covered with small logs, branches and native forest debris) in all cases to reduce potential for erosion or sediment transport. Reclamation seed[3] was applied to all temporary accesses once they were put to bed.

Half inch steel cable (ungreased, wire core) was used to attach ballast rock to LWD. New cable was used for the best possible epoxy bond between the cable ends and the rock drill holes. Less expensive previously used half inch cable was employed to tether LWD to stable trees in the riparian zone. Once positioned, ballast rock was drilled using an electric hammer drill (Bosch, model 11241 EVS) and a 9/16 inch drill bit. Rock drill bits were 13 or 21 inches in length, the latter used for boulders that were somewhat submerged. Holes eight to ten inches deep were scrubbed and flushed to remove loose material, and two part epoxy (Epcon, model no. C6) secured the cables. In each case, a sufficient quantity of epoxy was injected to ensure all space in the hole was filled once the cable end was inserted. Cable was cut onsite with an electric grinder (Dewalt, 7 inch) and attached to LWD or anchor trees using galvanized cable clamps secured with an electric impact wrench (Dewalt, ½ inch chuck). Care was taken to ensure cables between ballast and LWD were as short and tight as possible to reduce wear and movement within the structure. To secure and further tighten cables, steel staples (4 x 3/8 inch minimum) were also hammered into the logs. To hide cables, LWD boles were occasionally bored with an electric wood drill (Dewalt, ½ inch chuck) and a 3/4 inch ship auger bit with a welded extension (total length 35 inches; Appendix A, Photo 4)). To prevent girdling of live trees, cables were loosely attached around the base and sheathed with 3/4 inch (ID) black pvc tubing. A portable generator (Honda, model EW 2500) supplied power to the equipment.

Construction and cable crews followed forest fire prevention and suppression regulations as outlined in the Forest Practices Code of BC Act. On particularly hot days, crews sprayed down sites and riparian brush prior to using equipment, and pumps were left nearby and primed during cabling. Sufficient shovels, pulaskis, and hand-tank pumps were kept on hand at all times during falling and site construction. Fire watches occurred following each day's activities, as required.

All construction personnel used safety equipment including hard hats, high visibility vests, eye and ear protection, and gloves. Emergency procedures were clarified, and first aid equipment kept on hand included Level 1 first aid kits, blankets, neck collars, eye wash bottles and VHF radios programmed with the appropriate frequencies. The site supervisor and at least one other

[3] CWH biogeoclimatic zone mix, Common No.1 Forage; Pickseed Canada Inc., Abbotsford, BC.

crew person had a cellular phone and held Level 1 First Aid certification and Transportation Endorsement.

Photographs were taken of all sites prior to construction.

4.0 RESULTS

A notification for work in and about a stream under Section 9 of the Water Act was received by MoE on June 22, 2006. Pursuant to the Navigable Waters Protection Act, written approval was obtained from Transport Canada[4] on July 21, 2006.

Access construction and staging of construction materials was completed by late July, with all non-merchantable logs, harvested wood and ballast rock positioned next to restoration sites.

4.1 Site Construction

A total of six new LWD sites, six boulder groynes and two boulder-riffle enhancement sites were constructed in six and a half days from July 19-27, 2006 (Figure 3; Appendix B, Photos 7-8; Appendix D). Additionally, five previously constructed LWD site were enhanced with additional wood and rock to increase complexity and reduce site porosity.

In all cases, LWD structures were triangulated and ballasted, and all were tethered to trees on the streambank. A three-person crew completed cable and epoxy work from July 20 to August 10. Approximately 450 m of cable, 180 steel staples, 18 rock/wood drill bits, 11 epoxy cartridges, 115 cable clamps, and 25 m of cable sheathing tube were used in site construction. Approximately 148 metric tons of large rock (0.6-1.2 m mean diameter), appropriate for drilling, were used to ballast structures, while the remaining 341 metric tons were used to create the six boulder groynes. Five articulated truck loads of large and small round river rock (1.2-0.35 m mean diameter) from the local pit was used for riffle enhancement sites.

Following site construction and cabling, the access routes were decommissioned and seeded with a native reclamation mix, applied at a density of approximately 40 kg/ha.

Post construction monitoring of all sites constructed occurred throughout the fall and winter following high water. On November 15, 2006 a large rain on snow event in the upper Englishman River watershed resulted in a significant one in ten year flood event in the lower river (un-corrected peak discharge near 550 m^3/s). In total, six LWD structures were displaced, while four other LWD sites were significantly damaged. Maintenance works to repair or replace these structures will be scheduled for the summer of 2007

[4] Approved by J. Schellenberg, Navigable Waters Protection Office, Transport Canada, Vancouver, BC

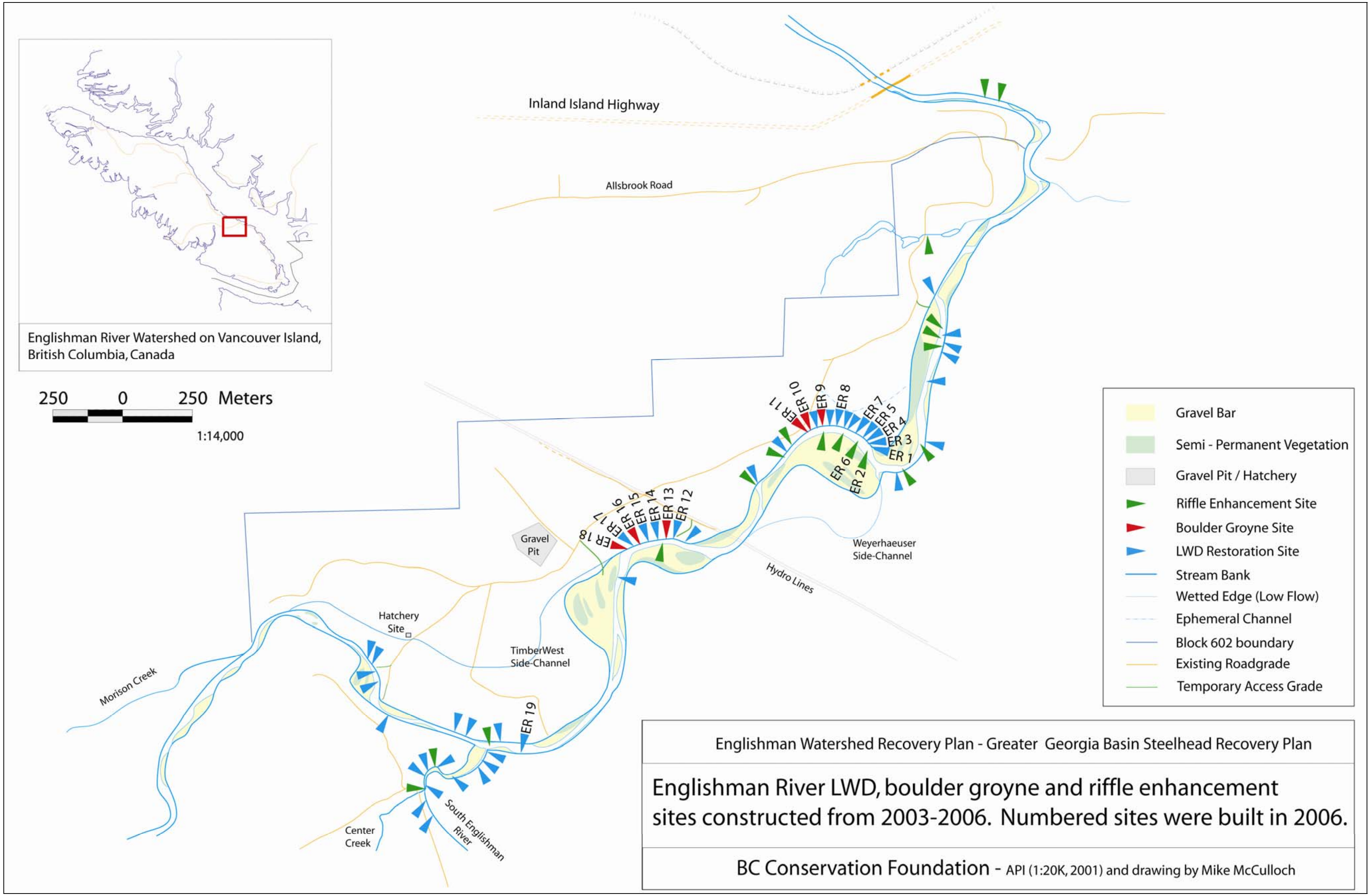

Figure 3. Location of fish habitat restoration sites constructed in the Englishman River, 2006.

The total budget for the instream restoration activities in 2006 was $54,671.57, plus donations of wood from TimberWest Forest Corporation and Island Timberlands Limited Partnership (Appendix E). Funding partners included:

- Habitat Conservation Trust Fund - *Greater Georgia Basin Steelhead Recovery Plan* (34% of total project cost or $18,435.35);
- Pacific Salmon Foundation - *Community Salmon Program* (14% of total project cost or $7,500); and,
- Georgia Basin Living Rivers Program (52% of total project cost or $28,736.22)

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APPENDIX A

Englishman River statistics and engineering specifications

from

Fish Habitat Restoration Designs for the Englishman River (Gaboury 2003)

Summary of Wetted and bankfull channel measurements for each surveyed cross section (Gaboury 2003)

Site (m)	Wetted Width (m)	Wetted Depth (m)	Bankfull Width (m)	Bankfull Depth (m)	Bankfull Width to Depth Ratio	Bank Height (m)	Bank Height to Bankfull Depth
7+045	30.7	0.31	37.0	1.24	29.9	1.4	1.1
7+280	13.3	0.60	35.4	1.38	25.7	2.1	1.5
7+450	23.8	0.61	38.7	1.61	24.0	1.7	1.1
8+210	25.1	0.30	49.5	1.51	32.7	3.0	2.0
8+400	21.4	0.32	28.0	0.97	29.0	3.1	3.3
Mean	22.9	0.43	37.72	1.34	28.3	2.3	1.8

Estimates of Englishman River channel hydrology and morphology at flood discharges using Manning’s equation.

Flood Event	Discharge (cms)	Channel Width (m)	Velocity (m/s)	Estimated n	Depth (m)	Slope (m/m)	Tractive Force (kg/m^2)
2 yr maximum daily	204	38.8	3.52	0.031	1.49	0.007	10.43
2 yr instantaneous	320	38.8	4.21	0.031	1.95	0.007	13.65
50 yr maximum daily	471	50	4.33	0.030	2.17	0.006	13.02
50 yr instantaneous	740	50	5.19	0.030	2.85	0.006	17.10

Note: 1) instantaneous discharge estimated at 1.57 x maximum daily flow (nhc 2002).
2) channel width, slope and roughness for 50 yr floods are approximate.

Ballast requirements and boulder size options for the LWD structures in Englishman River. Buoyancy and sliding safety factors > 1.5; ballast factor = 1; and specific gravity of LWD (S_L) = 0.5. (Modified after D'Aoust and Millar (1999); from Gaboury, 2003).

No. of Logs	Average Submerged Length of Each Log (m)	Log 0.5 @ 190 or 500 kg/m	Rootwad 660 kg/log (0.5x2x3m)	Total Mass of Ballast Required (kg)	Alternative Quantities for Each Boulder Diameter (m) 0.3 @ 35 kg	0.4 @ 90 kg	0.5 @ 190 kg	0.6 @ 300 kg	0.7 @ 480 kg	0.8 @ 700 kg	0.9 @ 1000 kg	1 @ 1400 kg
3	10	7800	1980	9780	279	109	51	33	20	14	10	7
4	10	7800	2640	10440	198	116	55	35	22	15	10	7
5	10	9500	1320	10820	309	120	57	36	23	15	11	8
6	10	15600	2640	18240	521	203	96	61	38	26	18	13
10	10	19000	2640	21640	618	240	114	72	45	31	22	15

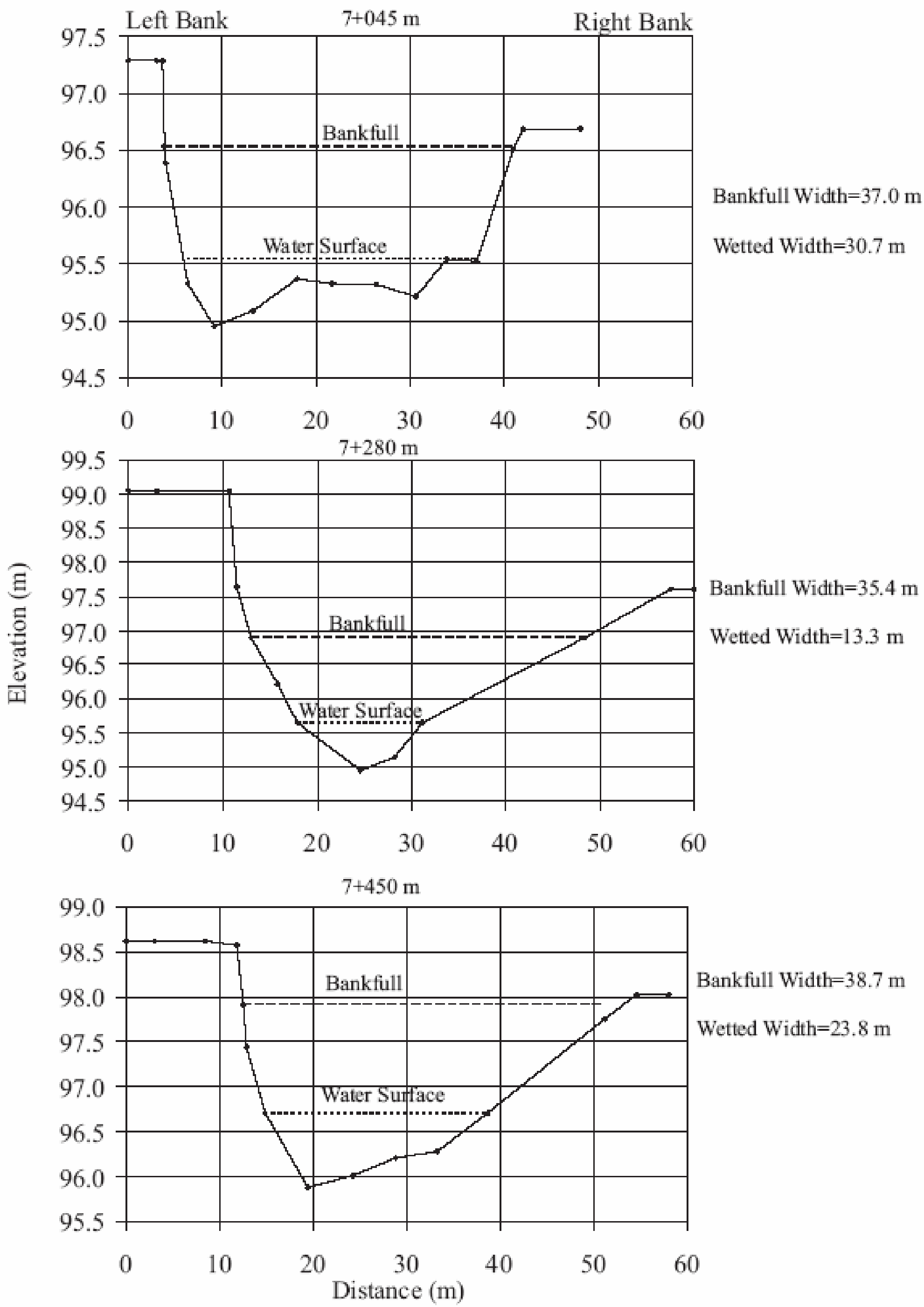


Figure 2. Representative cross sections in Englishman River near restoration Sites 7+120, 7+260 and 7+420 m.	LGL Limited

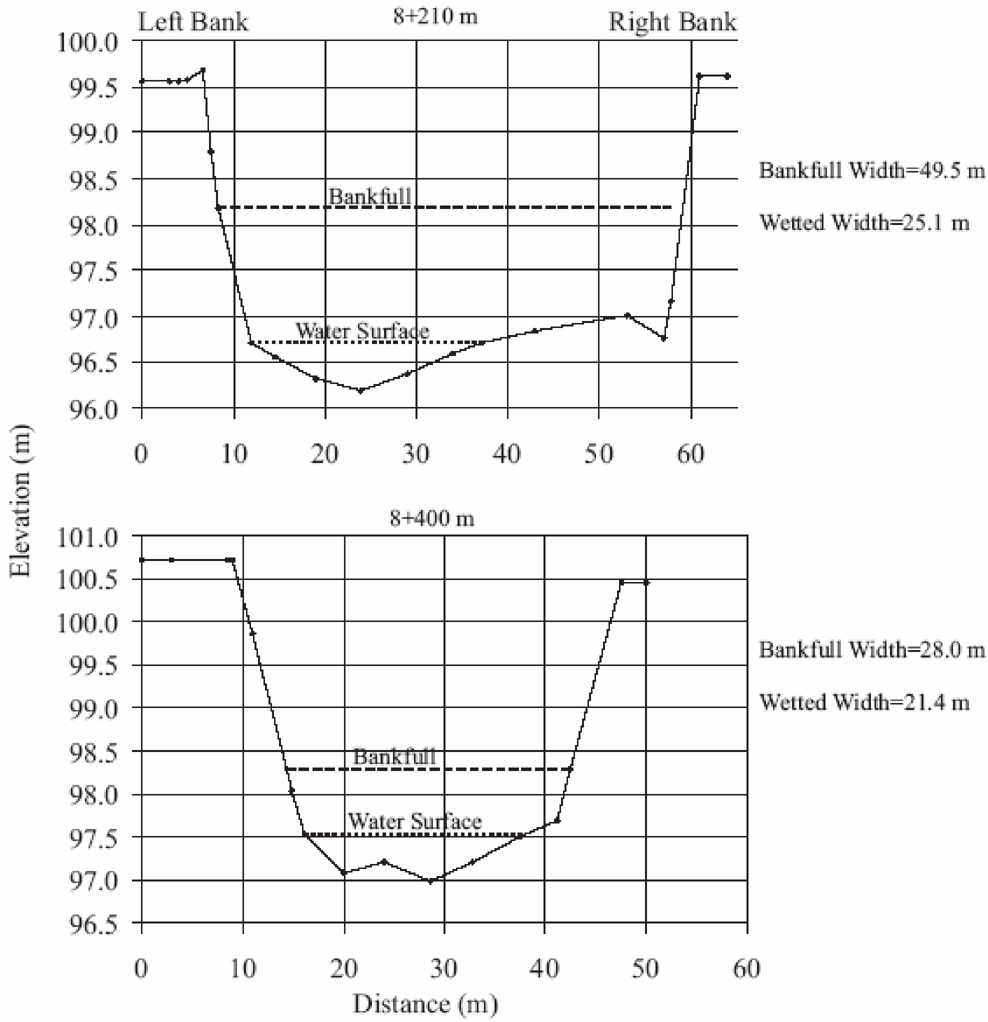


Figure 3. Representative cross sections in Englishman River near restoration Site 8+240 m.	LGL Limited

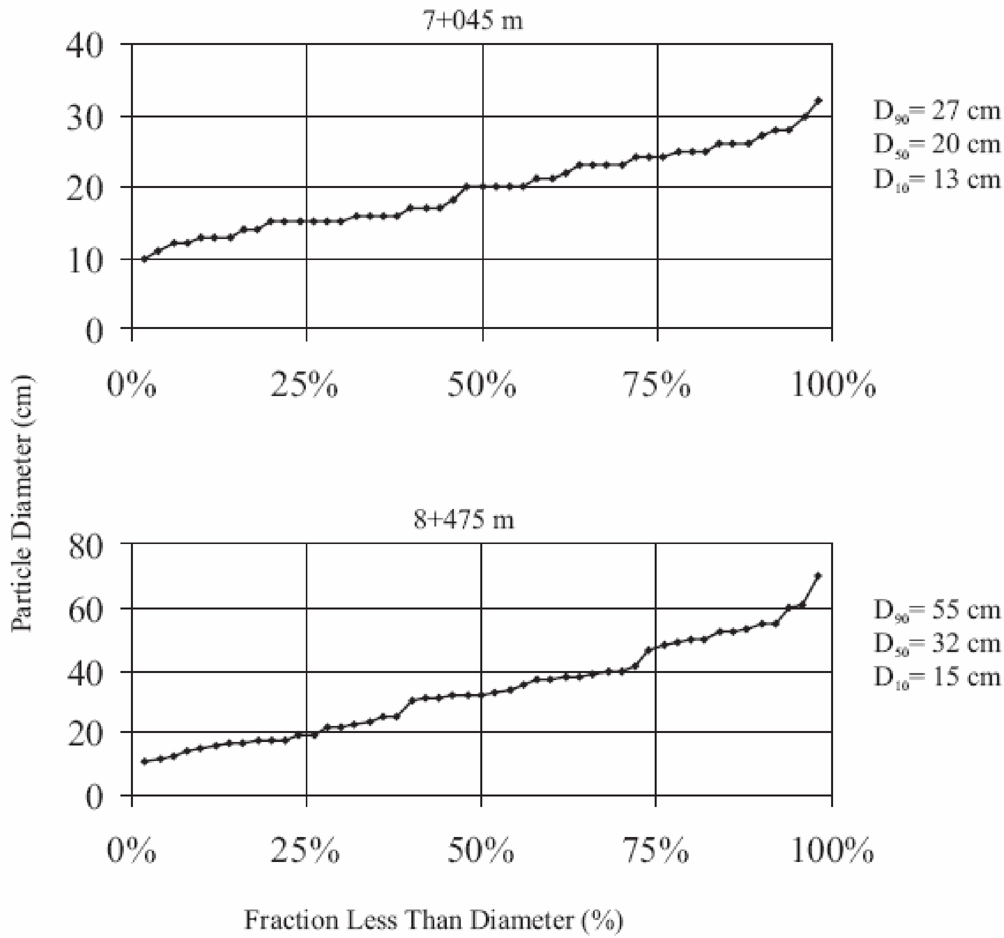
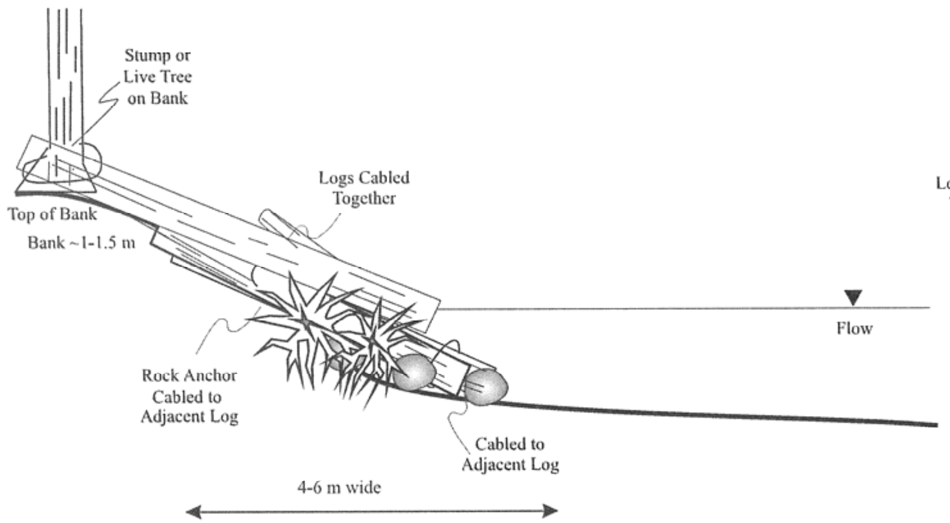
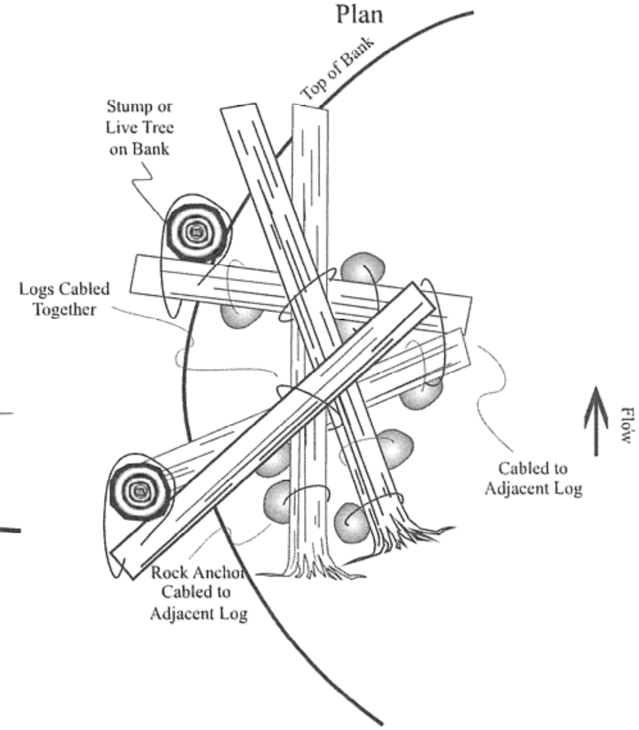


Figure 4. Substrate characteristics from pebble counts in Englishman River.	LGL Limited

Cross Section



Plan



ANCHOR DIMENSIONS

Rock Required:

17 - 0.6 m diameter or
7 - 0.8 m diameter boulders

Construction Notes:

1) LWD pieces may be between 10 and 12 m long x 0.5 m diameter.
2) Number and size of rock anchors depends on predicted maximum flow, maximum flow velocity and number and size of LWD used.
3) Leave cable anchors slack so that rock anchors scour into stream bed.
4) If using deadman anchors instead of stumps or live trees on the bank care should be given to the positioning of the anchors to not allow the spur to shift downstream.

LWD Design: DJ-5

Figure 8. Typical LWD Jam Structure, Plan and Cross Section.

LGL Limited

Scale: Not to scale

APPENDIX B

Photo documentation

Photo 1. Ballast rock loading into the 6-WD articulated hauler.

Photo 2. Tree mobilization using the 6-WD articulated hauler.

Photo 3. Fish safe hydraulic fluid used by instream machinery. .

Photo 4. Typical environmental controls (oil boom) installed in the Englishman River.

Photo 5. Excavator with clamshell bucket positioning deflector groyne rock.

Photo 6. Technician drilling log with a wood auger.

Photo 7. Constructed rock deflector groyne at the top of the "Long Run".

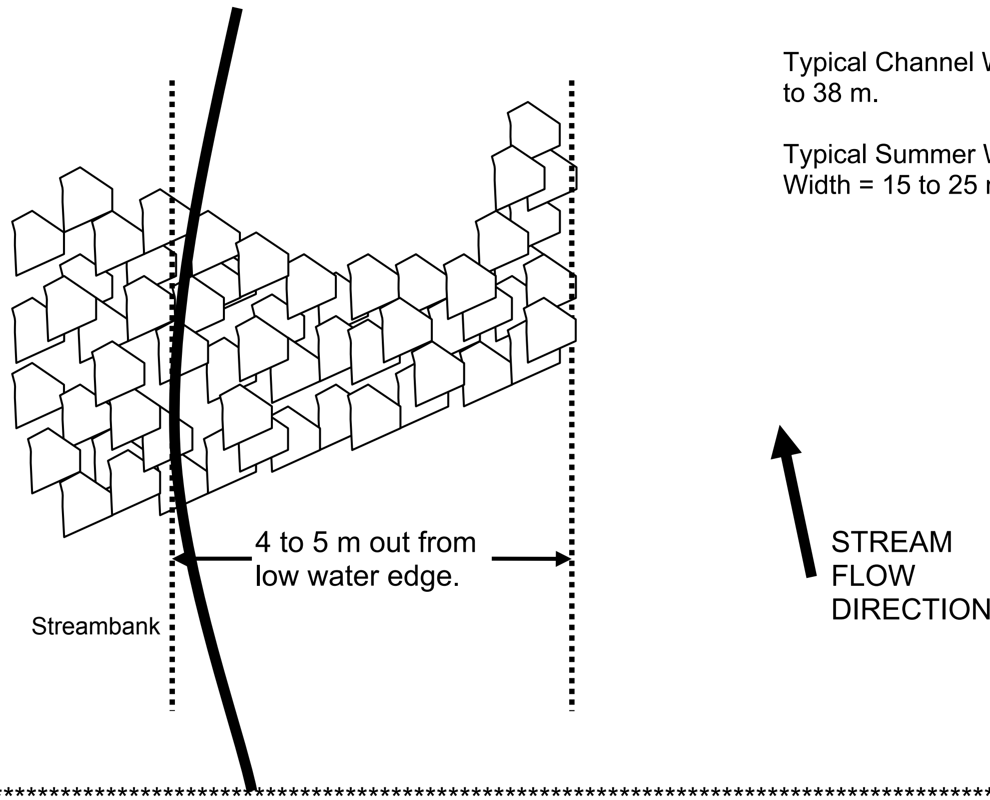
Photo 8. Newly constructed LWD structure at the bottom of the "Long Run".

APPENDIX C

Boulder groyne design

Englishman River, 2006
Template – Low Profile Boulder Groyne

PLAN VIEW



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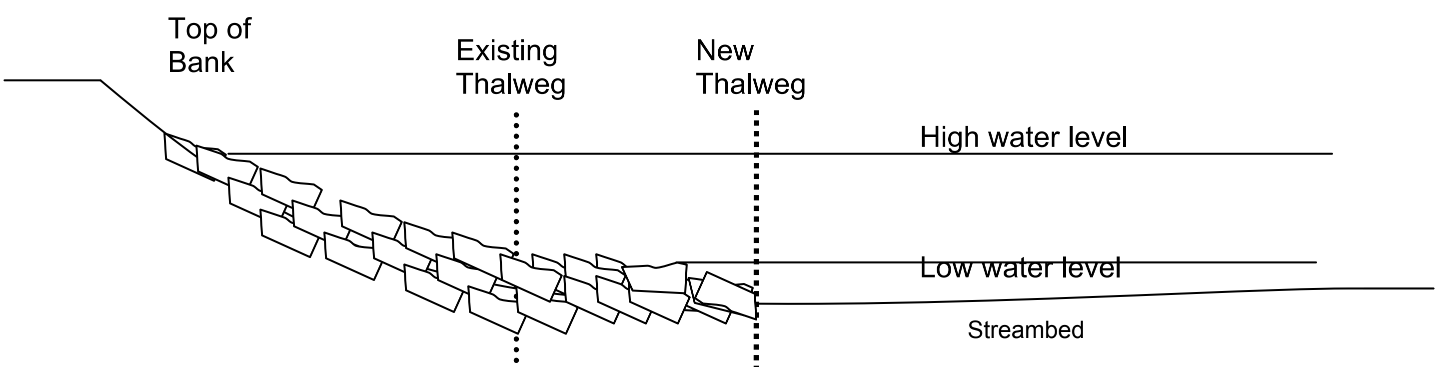
CROSS SECTION (Downstream View)

Toe of groyne to be ~ 1 m higher than streambed.

Top surface of groyne to slope downstream, at ~ 10:1.



APPENDIX D

Construction site list including location and wood used

Site Reference	Site Chainage	Description	Location	Pieces of Wood	Riffle Rocks	Comments
ER 1	(E3) 6+120	Log jam enhancement	LB	24	---	Additional protection for natural flood/side-channel
ER 2	(E3) 6+120	Boulder riffle enhancement	Centre channel	---	27	Riffle enhancement associated with u/s LWD
ER 3	(E3) 6+135	DJ-5	LB	10	---	Last LWD in series, u/s log jam enhancement
ER 4	(E3) 6+155	DJ-5	LB	8	22	Second last LWD in series along Long Run. Boulder enhancement with LWD
ER 5	(E3) 6+175	DJ-5	LB	7	---	Triangulated LWD structure along Long Run
ER 6	(E3) 6+185	Boulder riffle enhancement	Centre channel	---	23	Riffle enhancement between 2 LWD structures
ER 7	(E3) 6+195	DJ-5	LB	7	---	Triangulated LWD structure along Long Run
ER 8	(E3) 6+260	LT-3	LB	3	---	Enhancement of natural site
ER 9	(E3) 6+290	Boulder groyne	LB	---	---	Small groyne to protect bank between LWD sites
ER 10	(E3) 6+336	Boulder groyne	LB	---	---	Second large groyne d/s of Long Run access
ER 11	(E3) 6+356	Boulder groyne	LB	---	---	First large groyne d/s of Long Run access
ER 12	(E3) 7+140	LWD enhancement	LB	5	---	Immediately u/s hydroline access
ER 13	(E3) 7+160	Boulder groyne	LB	1	---	Small groyne to protect bank between LWD sites
ER 14	(E3) 7+180	LWD enhancement	LB	4	---	3 logs and 1 large stump added
ER 15	(E3) 7+220	LWD enhancement	LB	4	---	3 large logs and 1 small log added to existing structure
ER 16	(E3) 7+260	Boulder groyne	LB	---	---	Small boulder groyne on d/s side of LWD structure
ER 17	(E3) 7+260	LWD enhancement	LB	3	---	3 logs cabled to existing structure d/s s/c outlet
ER 18	(E3) 7+280	Boulder groyne	LB	---	---	Large groyne d/s s/c outlet
ER 19	(E3) 8+140	LWD enhancement / maintenance	RB	---	---	Cedar windfall structure repair/enhancement

Notes: Section E3 begins at the South Englishman River confluence and continues downstream. DJ=debris jam, LO=log only, LT= log triangle, LB = left bank; RB = right bank, d/s = downstream, u/s = upstream, s/c = side-channel.

APPENDIX E

Project financial summary

Category	Description	Amount
Major Equipment:		
	Self-loading logging truck (hauling)	$1,800.00
	Excavators (falling, staging, construction, cleanup, incl mob)	$11,746.01
	Articulated hauler (ballast transport, incl mob)	$3,625.00
	Sub-total	**$17,171.01**
Light Equipment:		
	Construction equipment rental,	$781.64
	Sub-total	**$781.64**
Materials/Project Costs:		
	Ballast rock and hauling	$11,672.06
	Cable, epoxy, staples, seed, fuel, etc.	$2,522.12
	Vehicle expenses and travel costs	$1,968.52
	Sub-total	**$16,162.70**
Manpower:		
	BCCF Labour (Project manager and Technicians).	$5,421.52
	Technician (1)	$1,641.23
	Labourer (2)	$5,229.44
	Sub Contract Labourer (1)	233.98
	LGL Limited	2,333.60
	Sub-total	**$14,859.77**
Administration:		
	BCCF	$4,660.75
	Sub-total	**$4,660.75**
GST:		
	GST	$1035.70
	Sub-total	**$1035.70**
Total Estimated Cost:		**$54,671.57**

APPENDIX F

Media coverage

Fourth year for fish rehab

By FRED DAVIES
NEWS REPORTER

FRED DAVIES PHOTO

FISHERIES TECHNICIAN FOR the British Columbia Conservation Foundation, James Craig, indicates how boulders and large wood is anchored alongside the Englishman River to create a safe environment for fish.

For the fourth consecutive year, work is being done to rehabilitate fish habitat on the Englishman River.

The Pacific Salmon Foundation has kicked in a large portion of the $50,000 budget, but this is the last year they will do so. Next year the foundation's focus will shift towards the lower Fraser River Basin.

"This may well be the last year of in-stream work on the Englishman," says a lead technician for the project James Craig, but he adds restorative work is still scheduled for the area.

"The Department of Fisheries and Oceans will start turning earth next spring," Craig says in relation to a planned channel extension that will create stable over wintering habitat for fish.

Work on the Englishman River involves the anchoring of large woody debris to imitate natural wood accumulations that are used as cover for stream rearing trout and salmon. Large wood in the channel is generally lacking due to land development and past logging practices. Also included in the project is the placement of boulder riffles to benefit young steelhead.

The project is part of the Greater Georgia Basin Steelhead Recovery Plan, a Ministry of Environment initiative. Also contributing are the Habitat Conservation Trust Fund and Georgia Basin Living Rivers. TimberWest and Island Timberlands donated the wood.

Craig says what's being done on the river — in conjunction with riparian plantings done by local stream keepers groups — is improving its overall health.

"Fishing during steelhead season has been closed for the last five or six years," he says. "They're opening a section for catch and release this winter because the stocks are stabilizing."

Since the land conservation agency Nature Trust has finalized a 99-year lease arrangement with the Regional District of Nanaimo, "we now have a mile long protected stretch of riparian corridor along both sides of the river where the vast majority of spawning and rearing occurs," says Craig.