Salmonid Habitat Assessment and Restoration Plan
for

Nile Creek

DRAFT

Prepared for

Nile Creek Enhancement Society
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and

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Introduction

Nile Creek is a 16.9 km^2 watershed on the East coast of Vancouver Island in the community of Qualicum Bay (C. Braybrook et al, 1995). This system has historically held runs of Coho, Chum, Pink, and Steelhead Salmon as well as anadromous Cutthroat (DFO/MOEP, 1992). This inventory was conducted to assess the current condition of the system with respect to Salmonid habitat and population. The report is also to recommend any possible enhancement options based on these findings.

Nile creek was inventoried on September 4th through 8th 1996, with the assistance of the Nile Creek Enhancement Society and the Ministry of Environment Lands and Parks, to assess the Salmonid habitat and population of the lower six kilometer anadromous portion.

The Nile Creek Enhancement Society is a non profit society dedicated to the preservation and enhancement of watersheds in the Qualicum Bay area.

The Ministry of Environment Lands and Parks supplied the funding for the assessment through the Urban Salmon Habitat Program. A provincial government initiative to help repair salmon streams effected by urbanization.

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The stream was inventoried by D.R. Clough Consulting on September 5th, 6th, and 7th 1996, with the assistance of the Nile Creek Enhancement Society and the Ministry of Environment Lands and Parks, to assess the Salmonid habitat and population of the lower six kilometer anadromous portion. The Salmonid habitat was assessed using the format outlined in the Urban Salmonid Habitat Program (USHP) draft Assessment and Mapping Procedures manual July 1996 edition ,(Michalski and Reid). Also included was an habitat assessment following the Watershed Restoration Program (WRP) Fish Habitat Assessment Procedures Technical Circular #8 April 1996 edition, (Johnston and Slaney). A sample ratio of 1:5 was used for the WRP assessment. This data was only reported in the field data section Appendix A and C of this report. The USHP procedure required a 100% sample of some habitat parameters and a subsample of others on a once every 250m. With the combined WRP and USHP sample format the 100% sample was observed and a more frequent WRP sample style of 1 in 5 habitat units was used in place of the USHP 1 in 250m sampling method.

Two fish population sample methods were used to attempt a comparison of method. The methods were the two pass removal method utilizing electroshocking and a Peterson mark recapture method using fry traps. The same two sites were sampled within the reach using both sample methods.

The riparian condition of the steam was assessed using the format outlined in the Urban Salmonid Habitat Program (USHP) draft Assessment and Mapping Procedures manual July 1996 edition ,(Michalski and Reid).

Results

Overview Assessment

Nile Creek is a 16.9 km^2 watershed with a mean annual discharge of 0.985 m^3/s and a mean seven day average low flow of 0.154 m^3/s (C. Braybrook et al). Nile Creek is located north of the Big Qualicum River near the village of Qualicum Bay. This system has historically held runs of Coho, Chum, Pink, and Steelhead Salmon as well as anadromous Cutthroat in the lower reach (DFO/MOEP, 1992). The upper reach has had some preliminary fish sampling conducted by MacMillan Bloedel that found no fish populations. MacMillan Bloedel states this inventory was limited in scope and that good fish habitat exists in the area that has the potential to hold resident fish populations (pers. com. I. Reddin M&B). Nile Creeks watershed code is 92 -3480. The Nile Creek watershed headwaters have been logged extensively in the past and are still being logged today. The lower watershed was logged in late 1890s through 1913 (Local knowledge; B. Burgess, R. Allen). Airphotos show that most of the past logging was conducted before 1979 and that almost all of the upper watershed has been logged in that time. The first 1000m of stream are all that is effected by privet land owners and public land use. This subdivision on the south side of the stream was started in 1977. Nile Creek has in the past been used as a research stream by the Department of Fisheries and Oceans who conducted fish density and spawning experiments with Pinks and Chum from 1947 to 1948.

Nile Creek is a high energy system with no lakes to moderate flow rates, therefore the system is prone to quick floods. This flooding is causing minor localized scour in the lower reach inventoried. Some of the older headwater clearcuts are maturing and the new forest should help stabilize the system flows. The forest in the lower reach is maturing but the LWD recruited naturally is still predominately small and medium sized alder. There are some larger Cedar being recruited but not enough to produce sufficient LWD levels. The debris jams in the lower reach are mainly composed of one or two large Cedar logs that have captured loose alder logs and other small debris. These jams do create new channels and localized scour until the alder rots away an the stream reestablishes its old course.

Big Qualicum hatchery has in the past periodically stocked Coho and Chum in the system (pers com, G. Ladouceur, 1996). This practice started in the mid 1970's and has continued until recently. This practice has been discontinued until summer fry densities can be analyzed. An incubator was constructed by the Nile Creek Salmon Enhancement Society on the lower reach in 1995 to hold 1 million eye Pink eggs annually. This incubator runs of and old water intake that was constructed by the Qualicum Bay water district as a municipal water supply. The intake has since been downgraded to a backup and emergency

system by the Water board. This intake has potential to be used as the intake for a side channel as well as its current use as the intake for the Pink incubator.

Habitat Assessment

This reach of Nile Creek ranked well only in overhead cover and obstructions. Other parameters assessed showed various levels of degradation. Most notably were the percent pools, off channel habitats, and percent boulder cover. These parameters all scored 5 on a scale of 1 - 5, with 5 being the poorest rating. There were 15 erosion sites throughout the six km reach. Most of the erosion sites were caused by natural stream action and do not require any alteration. Some of the sites in the lower part of the reach have had minor alterations by local land owners. None of these site require anything more than public education on the effects of stream alteration and some input on measures to minimize flood damage. Table #1 lists the habitat parameters of concern and their ratings. Further habitat parameter summaries can be found in appendix A.

Table 1 Habitat Data Summary and Rating, Reach #1

Habitat parameter	Value	Diagnostic	Rating
Percent Pool:	27.4	Poor	5
LWD per Channel Width:	1.6	Fair	3
Total Erosion Sites:	15		15
Total Altered Sites:	9		9
Total Obstructions:	1		1
Average Substrate Type:	Cob/Grav	Fair	3
Average Instream Cover (%):	9.0	Fair	3
Number of Off Chan. Habitats:	5.0	Poor	5
Average % Boulder Cover:	4.8	Poor	5
Average Crown Cover (%):	77.8	Good	1
		Total	50

Fisheries Assessment

The fish population of reach #1 was determined using two methods at the same site. This was to attempt to evaluate the two methods. The sites were chosen prior to the inventory and fry trapping was conducted. The results of both methods were limited by site choice or procedural problems. The sites were limited in effectiveness as electroshocking sites due to the depth and size of site #1 and the presents of a steel intake pipe and a 2.5m undercut in site #2. The mark recapture was effected by the failure to capture any marked fish on the second capture attempt. The captures do show however the relative abundance of the different fish species found at each site.

Electrofishing produce Coho fry per square meter numbers of 0.49 and 0.19 from sites #1 and #2 respectively. Both of these estimates are considered low due to the site problems. By combining the two methods and using the actual number of Coho captured, an estimation of Coho population was achieved. The revised population densities are 0.5 Coho fry per square meter for site #1 and 1.0 Coho fry per square meter for site #2. Both Coho densities are below the biostandard of 2.0 fry per square meter. The Cutthroat Trout population was shown to be low but again sample technique problems reduce any confidence in the numbers. The Cottid population in site #1 is high relative to the Salmonids as expected for a site near the estuary. The lower relative population of Cottids in sample site #2 reflect its location higher in the system.

Table 2 Fish Population by Species, Site #1, Reach #1

Capture Method	Coho	Cutthroat	Cottids	Stickleback
Electrofishing	196	3	176.4	3
Fry per m^2	0.488	0.007	0.439	0.007
Traps				

Data group #1	35	17	136
Calculated	45.0	17.3	840.2
Fry per m^2	0.112	0.043	2.092

Table 3 Fish Population by Species, Site #2, Reach #1

Capture Method			
Electrofishing	**Coho**	**Cutthroat**	**Cottids**
Calculated Pop.	77.6	4	19
Fry per m^2	0.303	0.016	0.074
Traps			
Data group #1 Catch	141	6	50
Calculated Pop.	456.1	6.3	50.9
Fry per m^2	1.780	0.024	0.199
Data group #2 Catch	66		
Calculated Pop.	76.8		
Fry per m^2	0.300	0.000	0.000
Data group #3 Catch	16	3	0
Calculated Pop.	570.3	3	16
Fry per m^2	2.226	0.012	0.062

Riparian Assessment

The riparian condition of reach #1 is good. Only the portions of the lower area of the reach and the new Island Highway area showed any lack of riparian cover or depth. Table #4 shows the ratings for other riparian parameters assessed. The main land use for the reach was natural. The lower section of the reach was the only area with privet land use adjacent to the stream. This land use had minimal impact on the stream character. Some short section of stream bed and bank had been altered for bank protection or irrigation proposes. Further riparian summaries can be found in appendix A.

Table 4 Riparian Habitat Ratings, Reach #1 Average

Parameter	Rating
Land Use:	1.2
Livestock:	0.0
Slope:	1.3
Stability:	1.6
Total:	4.1

Discussion

Nile Creek is in fair habitat condition based on the diagnostics provide by the USHP Assessment and Mapping Procedures. The Salmonid habitat is lacking in pool area, off channel habitat, and boulder cover. The percent pool area was ranked based on the diagnostic for reaches less than 2% gradient. With an average grade of 1.8% and a percent pool area of 27.4 the lack of pool area is closer to a fair ranking based on the 2 - 5% gradient diagnostic. This still however indicates a lack of pool area. The LWD in the system is high at 1.6 pieces per channel width but it is mainly clustered and composed of short lived materials. The pool area could be increased by the addition of more large wood debris (LWD) to aid scour. A more appropriate method then importing LWD to the system would be to separated the LWD from specific debris jams and use it to complex local habitat units. There are some debris piles already identified instream

that require clean up to allow better fish passage and reduce bank scour that could be used for this. The addition of boulder cover would also increase the pool area though scour and increase the total boulder cover. How ever difficulty of access severely limits the opportunities to add LWD or boulders. The addition of LWD or boulders should be carried out on a site specific basis were local materials can be utilized without the use of large machinery. A inventory to locate suitable sites for LWD and boulder recruitment and to assess specific side channel opportunities would be and asset.

Construction of side channels and off channel ponds could be used to increase off channel habitat at the same time helping to increase the pool area. Complexing of the constructed channels would also increase pool cover. A full inventory of all suitable side channel and pond sites would have to be conducted in order to determine viability and cost. The costs of side channel construction are such that a joint venture with some other funding source would most likely be required. If sites could be found for small off channel pond construction, the cost would not be as limiting as with full scale side channel construction. The option of using the old water district intake for a side channel would help to decrease the costs of construction. Again a assessment of side channel opportunities near the intake is required.

A very cost effective way to improve the minor scour and stream alteration problems in the lower section of the reach is a public education program. Discussing site specific problems with individual land owners in an informal setting would be most successful. Signing to indicate salmon utilization would also go a long way to reducing some of the urban impacts. Some assessment and possible implementation of bank protection measures could also be used in these areas as a trade off for better riparian cover and reduce stream bank alteration.

The fish population numbers are low, but due to sampling difficulties resampling the system would be highly recommended before any stocking plans are considered.

The riparian condition of the reach is good and if left as is will continue to develop into a mature forest. This continued maturation will continue to improve the riparian conditions and in time will increase the recruitment of new LWD.

The tributaries encountered were not inventoried but are already mapped. Inventory of the tributary encountered would produce limited data due to its size and location. A small groundwater inflow was noted at 155m and should be inventoried for potential off channel pond construction sites.

Priorities for Instream and Riparian Restoration

Reach #1 of Nile Creek is in fair to good condition. A public awareness program undertaken to increase knowledge of the value of the system is most important. This program would include one on one talks with land owners in the areas effected by there use. These areas are all in the first 1000m of the reach. All of the land owners along this reach should be contacted regardless of the habitat condition on there land. Signs stating the value of the system should be placed on each side of the old and new island highways as well as at the access trial at the end of Charleton Road and in the park on Charleton Road.

The main priorities for enhancement aside from public awareness are to address the debris jams, low pool area and low off channel habitat. The construction of side channel habitat would be one option to accomplish an increase in pool area and off channel habitat. The drawback of this is the cost of such and option. An inventory of specific side channel sites should be used calculate channel construction costs. The potential side channel site near the existing intake should be of highest priority. Removal of LWD from problem jams and relocating it to new habitat units would also serve to improve pool area. This option is limited however to small areas associated with existing debris jams. There are eight jams in the 3845m to 5753m section that require alteration. Other jams that may offer some LWD for placement are in the section from 2855m to 5977m. These areas will be best accessed from the new island highway at 4300m.

Table #6 the planned scheduling for the enhancement objective for reach one. The list is divided into the project years. Some of the projects in year two and three will be shuffled to other years depending on what the assessments carried out in year one find and the availability of funding. Within each year the project schedule will follow the time line shown in table #5.

Table 5 Project Timeline per Year

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Dec

LWD, Boulder, Side Channel and Pond Assessments											
Fish density Assessments											
pre alteration assessment and photos											
Public awareness											
Instream work											
Data analysis											
Report writing											

Table 6 Project Enhancement objective Timeing for Reach One

Year one

- Undertake signing at areas of public access and public awareness program
- The assessment of side channel and off channel pond opportunities in reach one (with special attention to the existing intake and the groundwater tributary at 155m)
- Inventory sites to use existing LWD and boulders for complexing as well as sites with access to allow the addition of new LWD and boulders
- Assess any flood control measures that can be taken on the lower 1000m section
- Reassessment fish densities
- Alteration of problem debris jams
- Recruitment of LWD from altered debris jams and other sites determined by assessment

Year Two

- The addition of new LWD in reach one were possible
- The addition of new boulders were possible
- Construction of off channel pond(s)
- Addition of flood protection on lower 1000m section

Year Three Through Five

- Construction of side channel(s)

Project Monitoring

Project monitoring will require assessment of fish production from any side channel constructed. This is best accomplished by the use of a smolt fence to assess the Coho production. Observation of pool formation and the stability of new LWD and boulder placements will also need assessment. This would be best assessed by the use of before and after photos from marked photo locations at each site. Tracking fish density around three representative altered sites and LWD/Boulder placement sites would also be useful. A more intensive method would be to directly monitor the stream bed movement at each site by a detailed survey of stream bed composition and elevation. But this method would be too costly and beyond the scope of this project. The condition of altered debris jams will also have to be assessed. The same method as used for the LWD placement should be used here.

Table 7 Project Monitoring Timeline per Year

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Dec
Side channel fish fence operation											
Post alteration site assessment and photos											
Data analysis											
Report writing											

Table 8 Project Monitoring Objective Timeing for Reach One

Year one

- Pre alteration fish densities measured at three specific altered sites
- Pre construction photographs of all altered sites

Year two through five

- Post alteration fish densities at the three specific altered sites
- Post construction photographs of all altered sites
- Post construction assessment of fish densities in side channels
- Post construction assessment of fish densities in off channel ponds

Stream and Tributary Mapping

Only one main tributary was encountered in reach one. This tributary has been mapped previously and is on the 1:10000 map provided. A small ground water tributary enters from the south at 155m. This tributary should be inventoried to determine any potential off channel pond sites and to map its location. Public awareness of the tributary would also be part of such an inventory. This inventory will be included in the Inventory to assess possible off channel pond locations.

Photographs

Project Accounting

Enhancement Option Costs and Scheduling

Year One

Public Awareness Program

The total cost associated with a public awareness campaign and sign construction and placement is $1,367.00 (table #9). The one to one talks with land owners would be a ongoing volunteer action undertaken by the Nile Creek Enhancement Society, thus reducing the cost to the USHP to $ 722.00.

Table 9 Sign Construction and Placement Cost

Sign Construction and Placement	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*

Materials or Equipment	Signs (metal 18x24) Post hole digger Shovel Wheel barrow Concrete Wood posts 4x4x8'	80 each 10/day 25.00 80.00 150/yrd 12 each	6 2 days 1 1 1yrd 6	480.00 20.00 25.00 80.00 150.00 72.00	480.00 20.00 150.00 72.00		 25.00 80.00
Contractor or Professional Services							
Volunteer Value	2 persons	10.00/hr	20.00	40.00			40.00
Printing Cost							
Administration Costs							
Other Costs	1 person to (talk to land owners)	10.00/hr	50.00	500.00			500.00
Totals				$1,367.00	$ 722.00	$ 0.00	$ 645.00

Assessment of possible side channel sites and off channel pond sites

The assessment of side channels and off channel pond sites will pay special attention to the tributary at 155m and the existing intake area. The tributary at 155m is within the park on Charleton Road and is a possible site for a off channel pond. The existing intake has a overflow that is now flowing into a natural side channel. This side channel is currently not fish accessible and offers little habitat. Inventory of the surrounding area would determine the costs of improving the channel. Table #10 shows the cost of inventorying the lower reach for possible side channel sites and assessing the cost of options found.

Table 10 Assessmnet Costs for Side Chan/Pond Construction & LWD/Boulder Complexing Sites

Assessment Costs (side chan, ponds, & Complexing).	***# of Persons or Units***	***Rate/hr or Cost/unit***	***# of Hrs or # of Units***	***Total Cost***	***USHP Request***	***Other Funding***	***In kind Contributions***
Materials or Equipment							
Contractor or Professional Services	1 biologist	300/day	4 days	1200.00	1200.00		
Volunteer Value	1 person	10.00/hr	40	400.00			400.00
Printing Cost							
Administration Costs							
Other Costs	Mileage	0.33/km	500	165.00	165.00		
Totals				$1,765.00	$1,365.00	$ 0.00	$ 400.00

Inventory of LWD/boulder complexing sites, debris jams needing alteration, and sources of LWD and boulders

This assessment can be carried out in one pass combined with the side channel and off channel pond assessment. The costs of this assessment are included in table #10 . This inventory will have to be conducted early in the summer to allow planing of instream work for later in the summer.

Assessment of Flood control measures on the lower 1000m of reach one

This assessment will involve the lower 1000m of the reach. Its goal will be to assess the current condition of scoured areas for land owner safety and to determine if any work can or should be done to reduce the scour. This inventory should be combined with some of the public education program. The costs of this assessment are included in table #11 . This inventory will have to be conducted early in the summer to allow planing of instream work for later in the summer.

Table 11 Assessment Costs of Flood Control Options

Enhancement and Inventory Costs	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment							
Contractor or Professional Services	1 Biologist 1 engineer	300/day 500/day	1 day 1 day	300.00 500.00	300.00 500.00		
Volunteer Value	1 person	10.00/hr	10 hrs	100.00			100.00
Printing Cost							
Administration Costs							
Other Costs	mileage	0.33/km	100	33.00	33.00		
Totals				$ 933.00	$ 833.00	$ 0.00	$ 100.00

Reassessment of reach one fish densities

Two electrofishing site will be chosen on reach #1 to assess the base low flow fish densities. These sites will be chosen to reflect areas of average habitat within the reach. The two pass removal method outlined in the draft USHP assessment procedures manual (1996) will be used to determine fish populations. Table #12 shows the costs of this procedure.

Table 12 Reach One Fish Density Assessment Costs

Fish density electroshock costs (2-3 sites)	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	1 Electroshocker & safety gear 1 weigh scale 1 length board 3 - 5 gal buckets Bromoseltzer 3 dipnets 2 Stop nets	 150/day 10/day 5 each 5 bottle 10/day 10/day	 1 day 1 day 3 1 bottle 1 day 1 day	 150.00 10.00 15.00 5.00 10.00 10.00	 150.00 10.00 15.00 5.00 10.00 10.00		
Contractor or Professional Services	1 Electroshocker (leader) 1 Electroshocker (crew member)	300/day 275/day		300.00 275.00	300.00 275.00		
Volunteer Value	2 persons	20.00/hr	10 hrs	400.00			400.00
Printing Cost							
Administration Costs							
Other Costs	mileage	0.33/km	100	33.00	33.00		
Totals				$1,208.00	$ 808.00	$ 0.00	$ 400.00

Debris Jam Alteration, LWD and Boulder Placement

The eight jams that need alteration to allow fish passage will cost $12,214.00 (table #13). The debris jam alteration and LWD/boulder placement are related so the table brakes shows costs combined for all of the procedures. This cost includes the placement of any LWD or boulders found by the inventory earlier in the summer.

Table 13 Debris Jam Alteration and LWD/boulder placement Cost (8 jams)

Jam Alteration, LWD & Boulder placement	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Fundin g*	*In kind Contributions*
Materials or Equipment	Chainsaw winch Chainsaw Come-along Axe Block 2.5 ton Cable	250/week 180/week 120.00 30.00 18.00/week 0.42/ft	1 1 1 1 2 500 ft	500.00 400.00 120.00 30.00 64.00 250.00	500.00 400.00 120.00 30.00 64.00 250.00		

	Staples or clamps Fuel and oil Steel bar Safety gear	1.50 each 30.00	75 2	125.00 100.00 60.00	125.00 100.00 60.00		
Contractor or Professional Services	2 Chainsaw operators 2 Laborers 1 Supervisor	25.00/hr 10.00/hr 300.00/day	100 hrs 100 hrs 10 days	5000.00 2000.00 3000.00	5000.00 2000.00 3000.00		
Volunteer Value							
Printing Cost							
Administration Costs	First Aid Training	100.00	4 persons	400	400		
Other Costs	mileage	0.33/km	500 km	165	165		
Totals				$12,214.00	$12,214.00	$ 0.00	$ 0.00

Year Two

Addition of new LWD and boulders

The exact costs of these operations will be assessed in the spring of year one. The overall costs are dependent on the amount of materials added and the number of sites were it is added. Table #14 lists the estimated costs of placing LWD boulders in stream at an easily accessible site. It must be noted that the labour and some equipment costs of each site will decrease with the more sites worked on and if trained crew members and equipment can be used from year one instream work.

Table 14 Costs of New LWD and Boulder Placement per Site

Costs of LWD & boulder placement per site	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	1 back hoe 1 LWD or boulder 1 Chainsaw 1 Come-along 1 Axe 1 Block 2.5 ton ¼" Cable Staples or clamps Fuel and oil 6 ' Steel bar Safety gear	75/day 40 each 30/day 120.00 30.00 10/day 0.42/ft 1.50 each 30.00	1/2 day 1 1/3 day 1 1 1/3 day 50 ft 4 1	37.50 40.00 30.00 120.00 30.00 10.00 21.00 6.00 30.00	37.50 40.00 30.00 120.00 30.00 10.00 21.00 6.00 30.00		
Contractor or Professional Services	1 Chainsaw operator 1 Supervisor	25.00/hr 300./day	3 hrs 3 hrs	75.00 100.00	75.00 100.00		
Volunteer Value	2 Laborers	10.00/hr	3 hrs	60.00			60.00
Printing Cost							
Administration Costs	First Aid Training	100.00	3 persons	300.00	300.00		
Other Costs	mileage	0.33/km	100 kms	33.00	33.00		
Totals				$ 892.50	$ 832.50	$ 0.00	$ 60.00

Flood protection measures on the lower 1000m

The costs for Flood protection measures required, if any, on the lower 1000m will be determine by the inventory carried out in year one. No costs can be estimated at the time of this writing.

Estimated Costs of Off Channel Pond Construction

The cost of constructing off channel ponds can only be estimated at this time. After the year one assessment of possible site a more accurate cost evaluation can be performed. The estimated cost of constructing a 10m by 20m off channel pond is shown in table #14. This estimation assumes easy access for a 4x4 backhoe to the work site.

Table 15 Estimated Off Channel Pond Construction Costs per Pond

Off Channel Pond Costs (10mx20m pond)	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Fundin g*	*In kind Contributions*
Materials or Equipment	Backhoe Grass Seed	80/hr 100/bag	10 hrs 1	800.00 100	800.00 100		
Contractor or Professional Services	Supervisor	300/day	1/day	300.00	300.00		
Volunteer Value	1 Swamper	10/hr	10 hrs	100.00			100.00
Printing Cost							
Administration Costs							
Other Costs	Mileage	0.33/km	100 kms	33.00	33.00		
Totals				$1,333.00	$1,233.00	$ 0.00	$ 100.00

Year Three Through five

Estimated Side Channel Construction Costs

The side channel cost will be calculated by estimating all costs involved in standard channel construction and using this data to produce a table showing estimated cost per meter of channel constructed. The tables also separate the channel types into fully altered, partially altered, and natural with constructed intake. This cost section is meant only as a outline of costs, further inventory is required to determine costs more accurately. One potential site on lower Nile Creek has a intake in place and therefore would be less costly but some alteration of the Channel is required. An inventory of this site would be of highest priority to fully assess the costs. Opportunities for off channel ponds will be assessed along with side channel options.

Table 16 Estimated Fully Altered Side Channel Construction Costs

Fully altered Channel with Intake (500m x 5m)	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	Intake (all materials and equipment) Excavator Truck Rip Rap Road Fill Pipe Grass Seed	15,000.00 20/m^2 inclusive all materials and machinery	1 500m	15,000.00 65,000.00	15,000.00 65,000.00		
Contractor or Professional Services	Engineer Supervisor	Included above					
Volunteer Value	2 Swampers	10/hr	80/hrs	160.00			160.00
Printing Cost							
Administration Costs							
Other Costs							
Totals				$80,160.00	$80,000.00	$ 0.00	$ 160.00

Table 17 Estimated Partly Altered Side Channel Construction Costs

Partly altered Channel with Intake (500m x 5m)	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	Intake (all materials and equipment)	15,000.00	1	15,000.00	15,000.00		

	Excavator Truck Rip Rap Road Fill Pipe Grass Seed	15/m^2 inclusive all materials and machinery	500m	52,500.00	52,500.00		
Contractor or Professional Services	Engineer Supervisor 2 Swampers	Included above 10/hr	 80/hrs	 160.00			 160.00
Volunteer Value							
Printing Cost							
Administration Costs							
Other Costs							
Totals				$67,660.00	$67,500.00	$ 0.00	$ 160.00

Table 18 Estimated Natrual Side Channel with Intake Construction Costs

Natural Channel with Intake (500m x 5m)	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	Intake (all materials and equipment)	15,000.00	1	15,000.00	15,000.00		
Contractor or Professional Services	Engineer Supervisor 2 Swampers	Included above 10/hr	 80/hrs	 160.00			 160.00
Volunteer Value							
Printing Cost							
Administration Costs							
Other Costs							
Totals				$15,160.00	$15,000.00	$ 0.00	$ 160.00

Project Monitoring Costs

Year One

Pre altered site fish density monitoring (three sites)

Three representative sites will be chosen to be monitored for changes in fish densities from pre alteration densities. These sites will be used to evaluate the effectiveness of the alteration procedure. The sites sampled will be, one site of LWD placement, one site of boulder placement, and one site of debris jam alteration. The two pass removal method outlined in the draft USHP assessment procedures manual (1996) will be used to determine fish populations. The costs of this monitoring will be $1,208.00 (table 19).

Table 19 Fish density Electroshock of Pre Altered Sample Sites

Fish density electroshock costs (2-3 sites)	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	1 electroshocker & safety gear 1 weigh scale 1 length board 3 - 5 gal buckets Bromoseltzer 3 dipnets 2 Stop nets	 150/day 10/day 5 each 5 bottle 10/day 10/day	 1 day 1 day 3 1 bottle 1 day 1 day	 150.00 10.00 15.00 5.00 10.00 10.00	 150.00 10.00 15.00 5.00 10.00 10.00		
Contractor or Professional Services	1 Electroshocker (leader) 1 Electroshocker (crew member)	300/day 275/day		300.00 275.00	300.00 275.00		
Volunteer Value	2 persons	20.00/hr	10 hrs	400.00			400.00

Printing Cost							
Administration Costs							
Other Costs	mileage	0.33/km	100	33.00	33.00		
Totals				$1,208.00	$ 808.00	$ 0.00	$ 400.00

Photographic Monitoring of Altered Sites, LWD Sites, and Boulder Placement Sites

The photography of all altered sites plus the LWD and boulder placement sites before and after for two years will cost $ 601.00 (table #15). This would include costs of film, film developing, photography time and travel. A more costly method of surveying the sites would produce accurate indicators of scour depths as well as bank and structure movement. The photo should provide sufficient evidence of this and greatly reduce costs.

Table 20 Altered site, LWD and Boulder Placement Monitoring Costs

Monitoring Altered Sites	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	Camera Film	200.00 2.00	1 4	200.00 8.00	 8.00		200.00
Contractor or Professional Services	Photographer Mileage	30.00/hr 0.33/km	10 100 km	300.00 33.00			300.00 33.00
Volunteer Value							
Printing Cost	Photo development	15.00	4	60.00	60.00		
Administration Costs							
Other Costs							
Totals				$ 601.00	$ 68.00	$ 0.00	$ 533.00

Year Two though Five

Post alteration fish density sampling

The same three sites sampled pre alteration will be sampled at similar water levels and conditions as they were in year one. The two pass removal method outlined in the draft USHP assessment procedures manual (1996) will be used to determine fish populations. This data will be used to evaluate the fish utilization of the altered sites. This monitoring will continue for two years post alteration. The costs of the sampling per year are outlined in table #19 under the pre altered site fish density monitoring heading.

Post alteration photographs

Photographs are to be taken from the same point as pre alteration photographs to show any changes created by the alteration over the year. These photographs will be taken for three years post alteration. The cost of the monitoring per year are shown in table #20 under the photographic monitoring of altered sites, LWD sites, and boulder placement sites heading.

Post construction off channel pond monitoring

Post construction of channel pond monitoring will consist of fry trapping with “Gee” type traps in the ponds at base low flow. The mark recapture method outlined in the draft USHP assessment procedures manual (1996) will be used to determine fish populations. This sampling will be conducted for three years post construction. Table #21 outlines the cost of this monitoring on a per year, per pond basis.

Table 21 Post Construction Monitoring Costs of Off Channel Ponds (per pond, per year)

Monitoring Costs fish densities in	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*

Off chan ponds (1 pond for 1 yr)							
Materials or Equipment	Gee traps Bait 1 weigh scale 1 length board 3 - 5 gal buckets Bromoseltzer 3 dipnets	20 each 5 each 10/day 5 each 5 bottle 5 each	6 1 1 day 20.00 1 bottle 3 nets	120.00 5.00 10.00 60.00 5.00 15.00	120.00 5.00 10.00 60.00 5.00 15.00		
Contractor or Professional Services							
Volunteer Value	2 persons	20.00/hr	10 hrs	400.00			400.00
Printing Cost							
Administration Costs							
Other Costs							
Totals				$ 615.00	$ 215.00	$ 0.00	$ 400.00

Side Channel Monitoring Costs (construction costs and continued monitoring costs)

The side channel monitoring costs will be capital extensive in year one. Labour will be the only cost in following years. This labour cost could be eliminated with the use of trained volunteers.

Table 22 Counting Fence Construction and Monitoring Cost

Counting Fence Construction and Monitoring	*# of Persons or Units*	*Rate/hr or Cost/unit*	*# of Hrs or # of Units*	*Ongoing Monitoring Cost*	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Materials or Equipment	Generator Circular saw 2x4's 2x6's 2x10's ¼ " Hardware cloth ¾" plywood ¼" plywood Dip nets 3 - 5 gal Buckets Bromoseltzer	35/day 30/day 1.50 ch 4.00 ch 15.00 ch 200.00 ch 35.00 ch 20.00 ch 5 each 20 each 5 bottle	5 days 5 days 36 4 7 1 role 5 sheets 1 sheet 3 3 2	 15.00 60.00 10.00	175.00 150.00 54.00 16.00 105.00 200.00 175.00 20.00 15.00 60.00 10.00	175.00 150.00 54.00 16.00 105.00 200.00 175.00 20.00 15.00 60.00 10.00		
Contractor or Professional Services	Construction Supervisor	300/day	5 days		1500.00	1500.00		
Volunteer Value	3 person construction crew 2 person monitoring crew	10.00 hr 20.00 hr	50 hrs 300 hrs	 12000.00	1500.00 12000.00			1500.00 12000.00
Printing Cost								
Administration Costs								
Other Costs	mileage	0.33/km	500.00		165.00	165.00		
Totals				$12,085.00	$16,145.00	$2,645.00	$ 0.00	$13,500.00

Summary of Project Costs

Table 23 Total Cost of All Enhancement and Inventory Options

Note: Some costs in this table are based on estimates and single unit costs see text for details

Inventory and Enhancement Costs	*Total Cost*	*USHP Request*	*Other*	*In kind Contributions*

			Funding	
Year One				
Public Awareness Program	$1,367.00	$ 722.00	$ 0.00	$ 645.00
Assessment of possible side channel sites and off channel pond sites	$1,765.00	$1,365.00	$ 0.00	$ 400.00
Inventory of LWD/boulder complexing sites, debris jams needing alteration, and sources of LWD and boulders	Cost included above	Cost included above	Cost included above	Cost included above
Assessment of Flood control measures on the lower 1000m	$ 933.00	$ 833.00	$ 0.00	$ 100.00
Reassessment of reach one fish densities	$1,208.00	$ 808.00	$ 0.00	$ 400.00
Debris Jam Alteration, LWD and Boulder Placement	$12,214.00	$12,214.00	$ 0.00	$ 0.00
Total Year One	$17,487.00	$15,942.00	$ 0.00	$1,545.00
Year Two				
Addition of new LWD and boulders (per site cost)	$ 892.50	$ 832.50	$ 0.00	$ 60.00
Flood protection measures on the lower 1000m (dependant on yr 1)	NA	NA	NA	NA
Estimated Costs of Off Channel Pond Construction (per pond cost)	$1,333.00	$1,233.00	$ 0.00	$ 100.00
Total Year Two	$2,225.50	$2,065.50	$ 0.00	$ 160.00
Year Three - Five				
Estimated Side Channel Construction Costs (fully altered site)	$80,160.00	$80,000.00	$ 0.00	$ 160.00
Total Year Three - Five	$80,160.00	$80,000.00	$ 0.00	$ 160.00
Total All Years	$99,872.50	$98,007.50	$ 0.00	$1,865.00

Table 24 Total Cost of All Monitoring Programs

Note: Some costs in this table are based on estimates and single unit costs see text for details

Monitoring program Costs	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Year One				
Pre altered site fish density monitoring (three sites)	$1,208.00	$ 808.00	$ 0.00	$ 400.00
Photographic Monitoring of Altered Sites, LWD Sites, and Boulder Placement Sites	$ 601.00	$ 68.00	$ 0.00	$ 533.00
Total Year One	$1,809.00	$ 876.00	$ 0.00	$ 933.00
Year Two - Five				
Post alteration fish density sampling	$1,208.00	$ 808.00	$ 0.00	$ 400.00
Post alteration photographs	$ 601.00	$ 876.00	$ 0.00	$ 933.00
Post construction off channel pond monitoring	$ 615.00	$ 215.00	$ 0.00	$ 400.00
Side Channel Monitoring Costs (construction & monitoring costs)	$16,145.00	$2,645.00	$ 0.00	$13,500.00
Total Year Two - Five	$18,569.00	$4,544.00	$ 0.00	$15,233.00
Total All Years	$20,378.00	$5,420.00	$ 0.00	$16,166.00

Table 25 Grand Total of All Project Costs

Note: Some costs in this table are based on estimates and single unit costs see text for details

Project Costs total	*Total Cost*	*USHP Request*	*Other Funding*	*In kind Contributions*
Inventory and instream work	$99,872.50	$98,007.50	$ 0.00	$1,865.00
Monitoring of enhancements	$20,378.00	$5,420.00	$ 0.00	$16,166.00
Totals	$120,250.50	$103,427.50	$ 0.00	$18,031.00

References

Ian Reddin MacMillan Bloedel

Reid and Michalski

G. Ladouceur

Rod Allen

Bob Burgess

Slaney & ? WRP

Appendices

Appendix A Habitat Parameter Summaries

Habitat Data Summary, Reach #1			
Habitat parameter	Value	Diagnostic	Rating
Reach Area (m^2):	37760.6		
Percent Pool:	27.4	Poor	5
LWD per Channel Width:	1.6	Fair	3
Total Erosion Sites:	15		15
Total Altered Sites:	9		9
Total Obstructions:	1		1
Number Pools:	147		
Number Riffles:	180		
Number Glides:	94		
Reach length (m):	6081.1		
Average Grade (%):	1.8		
Average Bankfull Width (m):	11.8		
Average Wetted Width (m):	6.2		
Average Depth (m):	0.4		
Wetted Area (m^2):	37760.6		
Average Temperature (C):	8.0		
Discharge (m^3/sec):	0.00		
Average Substrate Type:	Cob/Gr	Fair	3
Average Instream Cover (%):	9.0	Fair	3
Number of Off Chan. Habitats:	5.0	Poor	5
Percent Fines:	na		
Average % Boulder Cover	4.8	Poor	5
Average Crown Cover (%):	77.8	Good	1
Dissolved Oxygen (mg/l):	10.5 mg/l		
pH:	na		
Total Dissolved Solids:	na		
		Total	50

WRP FORMAT		
Parameter	Value	Diagnostic
Percent Pools	27.39	Poor
Pool Frequency	3.51	Fair
LWD per Bankfull	1.57	Fair
Average % Wood Cover in P.	13.86	Fair
Average % Boulder Cover in R.	4.78	Poor
Average Overhead cover	77.82	Good
Substrate condition	Cob/Grav	Fair
Off Channel habitat	5	Poor
Holding Pools	8	Fair
Spawning access	Good	Good
Gravel Quantity	Fair	Fair
Gravel Quality	Fair	Fair
Redd Scour	NA	NA
Inorganic Nutrients	NA	NA

Riparian Data	Summary									
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Land Use:	1	3	1	1	1	3	1	1	1	3
Livestock:	0	0	0	0	0	0	0	0	0	0
Slope:	3	1	1	3	1	1	1	1	1	1
Stability:	1	1	1	5	1	1	3	1	1	3
Total:	5.00	5.00	3.00	9.00	3.00	5.00	5.00	3.00	3.00	7.00
	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19	Unit 20
Land Use:	1	3	1	1	1	1	1	1	1	1
Livestock:	0	0	0	0	0	0	0	0	0	0
Slope:	1	1	1	1	1	1	1	1	1	1
Stability:	3	3	5	3	1	3	1	3	1	1
Total:	5.00	7.00	7.00	5.00	3.00	5.00	3.00	5.00	3.00	3.00
	Unit 21	Unit 22	Unit 23	Unit 24	Unit 25	Unit 26	Unit 27	Unit 28	Unit 29	Unit 30
Land Use:	1	1	1	1	1	1	1	1	1	1
Livestock:	0	0	0	0	0	0	0	0	0	0
Slope:	3	3	1	1	1	1	1	1	1	1
Stability:	1	1	1	1	1	3	1	1	1	1
Total:	5.00	5.00	3.00	3.00	3.00	5.00	3.00	3.00	3.00	3.00
	Unit 31	Unit 32	Unit 33	Unit 34	Unit 35	Unit 36	Unit 37	Unit 38	Unit 39	Reach Average
Land Use:	1	1	1	1	1	1	1	1	1	1
Livestock:	0	0	0	0	0	0	0	0	0	0
Slope:	1	1	1	1	1	1	1	1	5	1.3
Stability:	1	1	1	1	1	1	1	1	1	1.6
Total:	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	7.00	4.1

Appendix B Counting Fence Design

Appendix C Field data

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