Site Survey and Design
for
Reach 1 of Tributary 1
Kitseguecla River South Sub-Basin

Prepared for the

Gitsegukla Band Council

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Introduction

The area surrounding Tributary 1 (see Figure 1) of the Kitsegukla River South Sub-Basin was logged extensively, beginning at the lower elevations about 1974 and thereafter continuing into the upper elevations in the 990's. The stream is a relatively low elevation system that was considered likely to once have been very important to salmonids in the Kitseguecla system.

As part of the provincial Watershed Restoration Program, a Level I Overview assessment of fish and fish habitat was carried out in the entire Kitsegukla River watershed in1995 (Wild Stone 1995). This was followed in 1997 by a Level I detailed field assessment of the southern sub-basin (BioLith 1998). This study made recommendations for restorative treatments of the Tributary 1 system. The prescriptions addressed problems of loss of riparian function, bank and channel instability, lack of functional large woody debris (LWD), lack of habitat variety and lack of cover. During 1998, a 100 m portion of the stream was treated by installing 18 trees, complete with root wads, into the stream's channel to address some of these concerns.

As the next step in this process, BioLith Scientific Consultants Inc. and Hydroglyphic Terrain Analysts were contracted by the Gitsegukla Band Council in March, 1999, to produce a Site Survey and Design for restorative works in a larger portion of the Tributary 1 system. As a result of BioLith's understanding of an agreement reached at a meeting in Decemeber with the Contract Monitor, this larger area included the length of the stream from its confluence with the Kitseguecla River upstream as far as the Branch 200 Forest Service Road (FSR), and included Tributaries 2, 3 and 4. Although this larger area was not included in the ammended Standards Agreement, it was considered a biologically and logistically functional unit by BioLith. This work had originally been planned for the later part of the fall of 1998 but weather conditions prevented its implementation at that time. The work was implemented in mid-March of 1999.

The purpose of this report is to describe in detail what works need to be implemented and how that should be carried out. The results of the study are reported as required in Sections 5 and 6.1 of Schedule A of the Standards Agreement.

Methods

Procedures for conducting a Site Survey and Design were specified in a Standards Agreement between the Ministry of Environment, Lands and Parks (MELP) and the Gitsegukla Band Council (GBC). Those standards define four Types of project. The simplest, Type 1, involves less than 50 m of stream and requires limited survey data to be gathered for the Site Survey and Design. A Type II project involves more than 50 m of stream and requires more extensive survey work, including longitudinal profiles and multiple cross sections. All five of the sites for which prescriptions are given in this report were categorized as Type I projects late in the project and so information additional to that strictly required for a Type I project was acquired, analyzed and is included in this report.

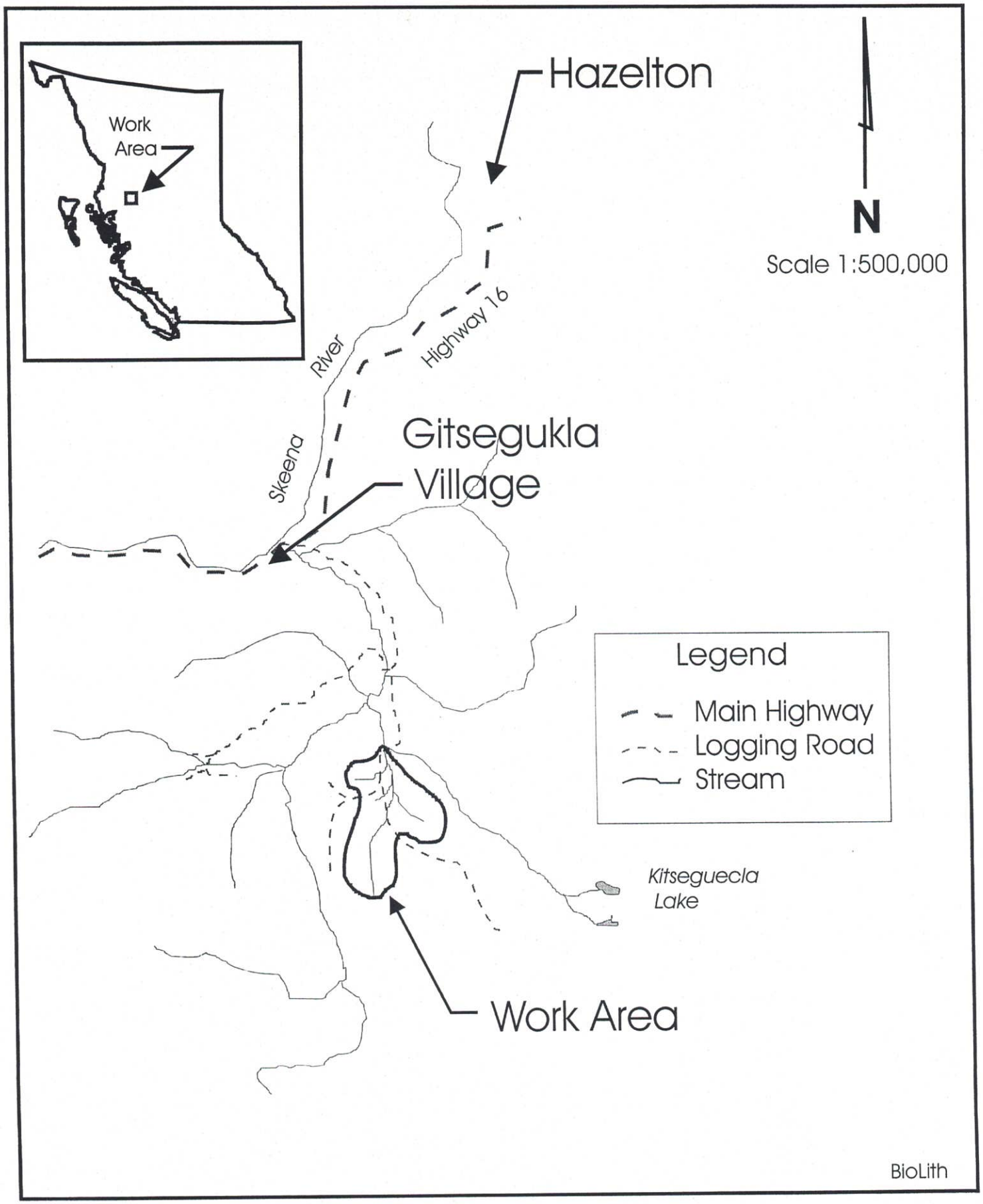

FIGURE 1. Map showing the work area.

After analysis of all pre-existing information, including limited air photo coverage of parts of the system, prior reports and maps, all of the streams in the area were walked by an experienced restoration biologist and an experienced fisheries technician, however, attention was focused on the areas where the review and previous visits by BioLith staff suggested there were concerns. The area assessed included the 100 m that had undergone treatment in 1998.

In the areas of concern, a longitudinal survey was done using a clinometer, compass, hip chain and tape measure. At the sites where work was to be prescribed, the crew took photographs to show the nature of the impact and the site's characteristics. Labeled flagging was hung at those points.

The results of the field work were then discussed among the biological and hydrological team The results of these discussions and the data were then synthesized into the construction drawings and work plans that form the prescriptions of this report.

The reader should be aware that this assessment was incomplete in that, although the field crew members were confident that they saw most of the problems in the area during the field work, they may also have missed some areas that needed work. The reason for this caveat is that there was still approximately 0.75 m of snow over most of the area and the stream was showing through at only a few places. As a result, little of the channel substrate could be seen. Although snow made a comprehensive assessment difficult, the significant problems were still evident and were addressed in this study.

Site Survey and Design for Reach 1 of Tributary 1, Kitsegukla River South Sub-Basin

Purpose of the project

The purpose of the project is to improve fish habitat. Specifically, the goals of the project are to improve bank stability and improve habitat variety and complexity for fish through the installation of large woody debris (LWD) and large rocks at five sites in the Tributary 1 system of the Kitsegukla River South Sub-Basin.

Location

The five sites are located approximately 19 km south of Gitsegukla Village near the Branch 200 FSR (see Figure 1). To get there, turn south approximately 500 m east of the Highway 16 bridge over the Kitsegukla River at Gitsegukla Village onto . KITSEGUECLA Road. Continue on this road, generally traveling south for 17 km, the location of the access road that approaches Site A (see Figure 2). The area of the proposed works is included on NTS 1:250,000 scale map number 93L, on NTS 1:50,000 scale map number 93L13 and on BCGS TRIM and Forest Cover maps numbered 093L092.

Access

Sites C and B are accessible by a branch road from the Branch 200 FSR. Sites D and E are accessible with an excavator from the road at Site C but will require special care in order to avoid damaging riparian vegetation. If materials are delivered to Site A by helicopter then the they should also be delivered to Site E while the helicopter is nearby. Site A will necessitate the use of an helicopter to deliver the wood and rocks required. No ground based machine access is available.

Physical and Biological Objectives

This tributary system likely contains critical rearing habitat, particular for steelhead. Past logging practices have resulted in damage to the stream and its fish habitat. The main problem is bank erosion and channel instability. A secondary problem is lack of habitat variety and cover.

The physical objectives of the work at Sites A through E include
the stabilization of eroding banks through the placement of trees, complete with root wads, in the form of revetments against the banks, and

- the production of scour by deflection of water around the root wads of the trees that will be placed into the wetted channel.

The biological objectives of the work include

- the reduction of fine sediment input to the stream from eroding banks that might limit respiration in fish, especially incubating eggs,
- an increase in the variety of fish habitat, especially deep pool habitat for protection of rearing juveniles in winter and summer, and

- an increase in the amount of protective cover for fish.

This stream has been fairly energetic in the past and this is what has led to the erosion problems. This energy dictates that none of LWD should be channel spanning. Rather, all structures have been prescribed for the side of the channel where energies are reduced during flood. As this stream is one of only a few low gradient rearing streams in the Kitseguecla River South Sub-Basin, the risks and costs associated with these prescribed treatments were considered justified.

Monitoring Plan

The efficacy of the restorative treatments implemented can only be assessed through quantitative comparisons of parameters measured before and then after construction. The two most significant parameters to measure are changes to fish populations and changes to fish habitat. Only limited data on each of these characteristics is available from the Level I field assessment, as that process involved sampling of representative parts of a much larger portion of the watershed. A reasonably valid assessment of efficacy will require a more intensive program of measurements. In particular, the construction sites should be the subject of an intensive topographic survey of the stream's channel to determine its characteristics over time, along with an intensive fishing program to determine changes in the fish population over time.

Fish Habitat

The stream channel will be the subject of an intensive topographic survey, using a total station, to quantify the shape of the channel immediately after construction and before any significant alterations. The Fish Habitat Assessment Procedure (FHAP; Johnston and Slaney 1996) will be applied to this site and compared with similar data gathered during the original FHAP. A photographic record of the site will also be compiled over time using the photo points that will be established during construction.

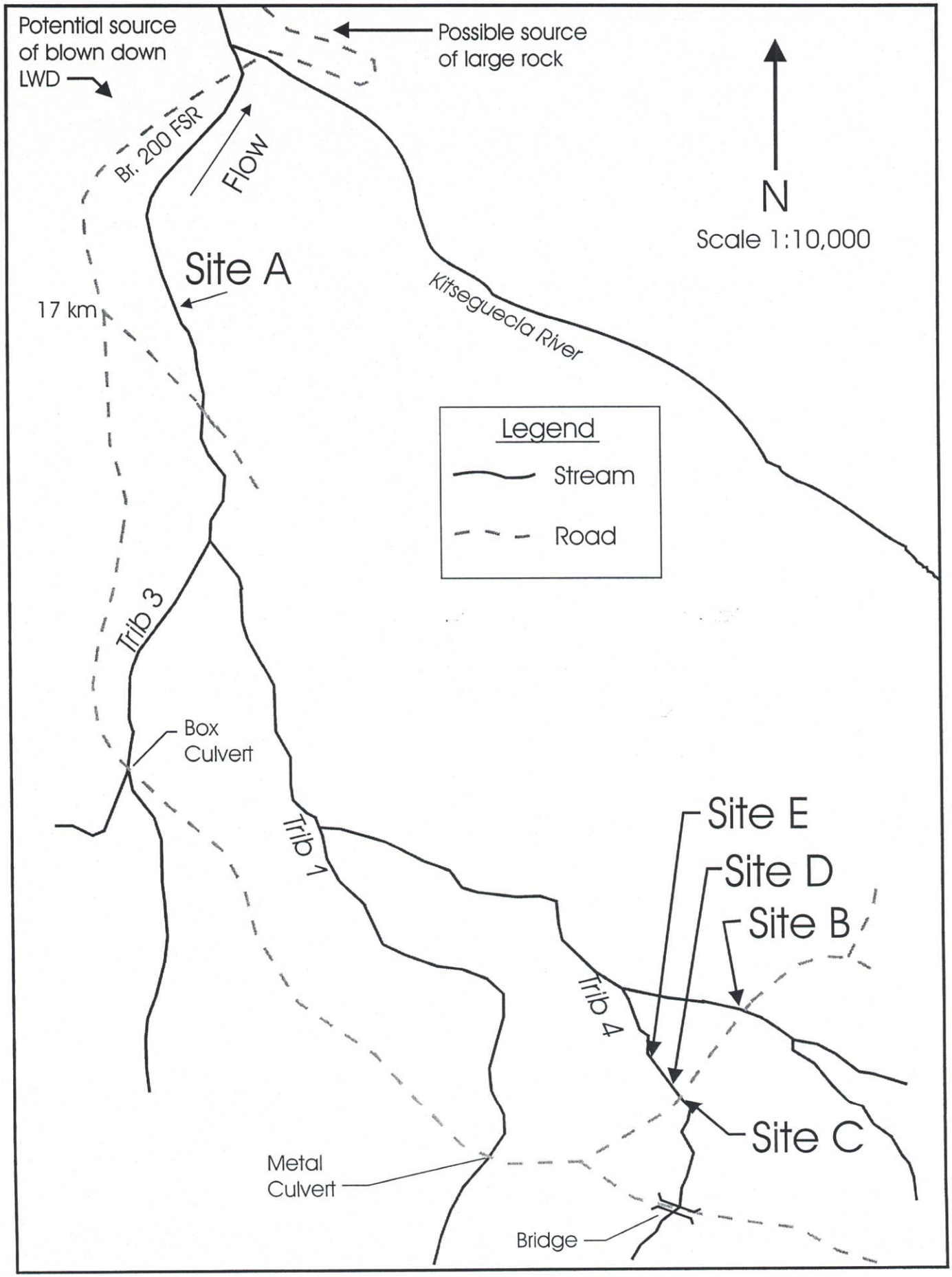

Figure 2. Map showing the locations of the work sites.

Fish

The sites will be fished intensively before construction to determine species composition, micro-distribution, and relative abundance. These parameters will be determined through a mark-recapture program using at least five roe baited minnow traps at each site. The traps will be set out and left to fish for 2 hours, after which time marking of all captured individuals will occur, regardless of species. Before marking, all fish will be anaesthetized and after marking all fish will be held in a recovery bucket until fully recovered before release. While being handled for marking fish will also be measured for fork length. All fish captured will be marked with a caudal fin clip of no more than 2 mm^2 at the bottom trailing edge. All fish identification will be carried out or verified by a fisheries biologist. Once the marked fish are released, a similar fishing effort to recapture marked fish will be conducted at each site within 7 days but not before 3 days after the first effort. Appropriate aging tissue will collected from larger fish and analyzed. The results of all analyses will be presented in the final report.

Similarly intense repetitions of the methods used will be implemented each year, beginning within two weeks of, but not before 3 days after construction completion, and continuing for at least four years, in order to produce reasonably valid assessments of the efficacy of the treatments.

Environmental Safety

An Environmental Monitor will be required to be on site during any stream crossings and during all construction work in and around the stream. The Environmental Monitor must be an experienced fisheries Biologist.

Methods for Design

Sites A, C, D and E are eroding banks which require stabilization, and the prescription formulated for each is similar. It involves installing whole coniferous trees such as western red cedar or hemlock, with the base of the root wad facing upstream and anchored by rock ballast, and the trunk resting on the top of the bank further downstream and anchored to existing stumps or a dead man. A series of whole trees are to be installed side by side so as to provide a barrier to prevent erosion at each site. The root wad acts to capture sediment and stabilize the structure while the root wad and rock ballast will provide valuable additional fish habitat in the tributary. The root wad will provide erosion protection during moderate flows although erosion will continue behind the structures during major floods. Site B is a corduroy road that crosses a swamp and acts as a barrier to fish. The prescription at this site is to remove a 12 meter section of the road and re-establish access by fish to the upstream section of the swamp. In addition, it is proposed that coarse rock be laid down across the bed of the access channel opened by the prescription so as to prevent erosion of unstable roadbed material.

The proposed structures have been designed using well developed procedures given in Newbury and Gaboury (1993), Slaney and Zaldokas (1997; see Appendix 1) and Anonymous (1998). Field data has been collected and the channel characteristics for each site are given in the table below. Note that because sites 3, 4, and 5 are close together so that average data has been presented. Bankfull velocity has been calculated with Manning's Equation, with the Manning's coefficient (n) determined with reference to the roughness of the channel bed at each site.

TABLE 1. Summary of the Channel Characteristics of the Surveyed Sites

Parameter	Site A	Site B	Sites C,D & E
Bankfull Width (m)	11.5	12	6
Bankfull Depth (m)	1.2	1	1.8
Average Slope	0.02	0.01	0.038
Manning's n	0.055	0.08	0.065
Bankfull Velocity (m/s)	2.6	1.1	3.2
Bankfull Discharge (m^3/s)	35.9	13.2	34.6
Bankfull Froude #	0.76	0.35	0.76
Stable Bed Material Size (cm)	24	10	68

The standards for Aquatic Habitat Restoration Site Survey and Design state that structures in Type I projects should be designed to withstand a 1 in 50 year flood event. HydroGlyphics (1998) has already calculated the discharge of a 1 in 50 year flood event for Tributary 1 from a comparative analysis of other stream flow records in the area including the Kitseguecla River. That analysis indicates that a 1 in 50 year flood has a maximum instantaneous discharge of 29 m^3/s and a daily peak discharge of 17 m^3/s. The bankfull discharge for Sites A, C, D and E are in excess of the 1 in 50 year flood event. This is quite unusual, especially since sites C, D and E are quite high in the watershed, and may indicate that the estimation of the 1 in 50 year flood from a comparative analysis underestimates the true value. However, in the absence of further information, it is assumed that bankfull conditions represent a major flood approximating the 1 in 50 year flood, and so the structures are designed to withstand bankfull conditions.

The prescription for Sites A, C, D and E requires that whole trees be anchored by rock ballast. Using the channel characteristics in the table above, the following ballast requirements have been determined for whole trees that are approximately 10 meters long, 50 centimeters in diameter at breast height with a root wad with a diameter of 1.5 - 2 meters. It is assumed that 7.5 meters of each log is submerged in the flow during bankfull discharge. In addition to the total ballast required, the diameter of rocks providing the correct ballast has been calculated for scenarios where two, three and four rocks are used to anchor each log. The ballast rocks are to be connected to the tree by galvanized steel cable with means of a lease or ring bolt epoxied into a drilled hole in the rock.

TABLE 2. Summary of the Ballast Requirements for Whole Trees at Sites A, C, D and E

Parameter	Site A	Site C, D & E
Total Ballast Required Per log (kg)	1500	2063
Rock Diameter (cm) for Two Rocks	80	103
Rock Diameter (cm) for Three Rocks	73	84
Rock Diameter (cm) for Four Rocks	64	74

Site one is in a lower gradient stream (2%) and the tree revetment should work very well in this setting. In the case of Sites C, D and E, that are in higher gradient reaches (average of 3.8%), these sites should have some additional rocks (LLD) integrated into the structure that are at least 68 cm in diameter. The additional rocks need not be anchored to the trees but should be placed at the toe of the eroding slope between the root wads.

The prescription for site 2 suggests that a 12 meter long section of corduroy road should be removed and the channel be re-established. Given the characteristics of this channel, it has been calculated that rock with a diameter of at least 10 cm is stable and should be used to line the re-established channel. The application thickness should be 20 cm and the rock should be keyed into the bed of the swamp. The volume of rock required is approximately $25m^3$. Pullback of the road bed should be completed to no more than 2H:1V (50%).

Machinery

A medium size, wide tracked excavator with a thumb, such as a Hitachi EX200, complete with spill kit and vegetable-based hydraulic fluid will be required for this work. The machine will be refueled at least 100 m away from the stream.

Delivery of the wood and rocks prescribed to Site A and possibly Site E will require an helicopter with a lifting capacity of at least 3000 kg. A Sikorski 61 will be the minimum size required.

Approvals

Work in and around the stream will require the written approval of the MELP and DFO. In particular,

- The Water Management Branch of the Ministry of Environment, Lands and Parks must receive 'Notification' under Section 9 of the Water Act of B.C. at least 45 days before the intention to begin work. An application form can be obtained from MELP at 3726 Alfred Ave., Smithers, B.C., V0J 2N0.

- A Fish Collection Permit must be acquired to allow salvaging of fish during construction as well as to allow fishing before and after construction for the purpose of monitoring the effectiveness of treatments. The application should be addressed to the Fisheries Branch of MELP at 3726 Alfred Ave., Smithers, B.C., V0J 2N0. It should describe the purpose of the project, list all persons who will be doing the fishing, describe their level of experience and training, describe the exact locations of fishing, list the start and end dates and describe the exact methods and equipment intended. The letter of application must be accompanied by a payment of $25.00 made payable to the Minister of Finance.
- A permit for the purposes of salvage and scientific collection of fish must also be obtained from the DFO. The application letter should describe the purpose of the project, list all persons who will be doing the fishing, describe their level of experience and training, describe the exact locations of fishing, list the start and end dates and describe the exact methods and equipment intended. This application should be sent to DFO at Box 578, 3177 Tatlow Road, Smithers, B.C., V0J 2N0. There is no charge for this permission.

Copies of all permits must accompany the project supervisor at all times on the site. In addition, the local MELP Conservation Officer and the local DFO Habitat Technician must be notified of the exact time the work is to begin and when it ends.

Work Plan and Schedule

At sites where the excavator is available, it will be used to do most of the positioning work. At Site A and possibly Site E, where materials are delivered by helicopter, the excavator must not be present, as the reason for using the helicopter is to prevent damage to the riparian vegetation and the stream channels. The helicopter will be used to place the materials in the approximate position required through a system of labeling of placement sites, such that these are readily visible to the pilots, and through radio contact. Exact placement with a helicopter is prohibitively expensive. They are best at simply delivering the material. Boulders are easier for them to place than LWD. The possibility of moving this material using human labour, once it is on the ground, even if assisted by powered hand winches, is very limited. Therefore, if LWD cannot be delivered to the precise position on the first attempt, then it should be placed above its final position so that movement of it by hand later can be assisted by gravity.

Construction details are shown in the sketches in Figures 3 through 7. Additional information about each site is presented in the form of longitudinal plan and profile drawings in Appendices 2 through 5. A copy of a sketch showing the installation of a generic tree revetment is provided in Appendix 1 and a diagram showing critical time periods for the various fish species in Region 6 is given in Appendix 6. Photographs of each of the sites are presented in Appendix 7.

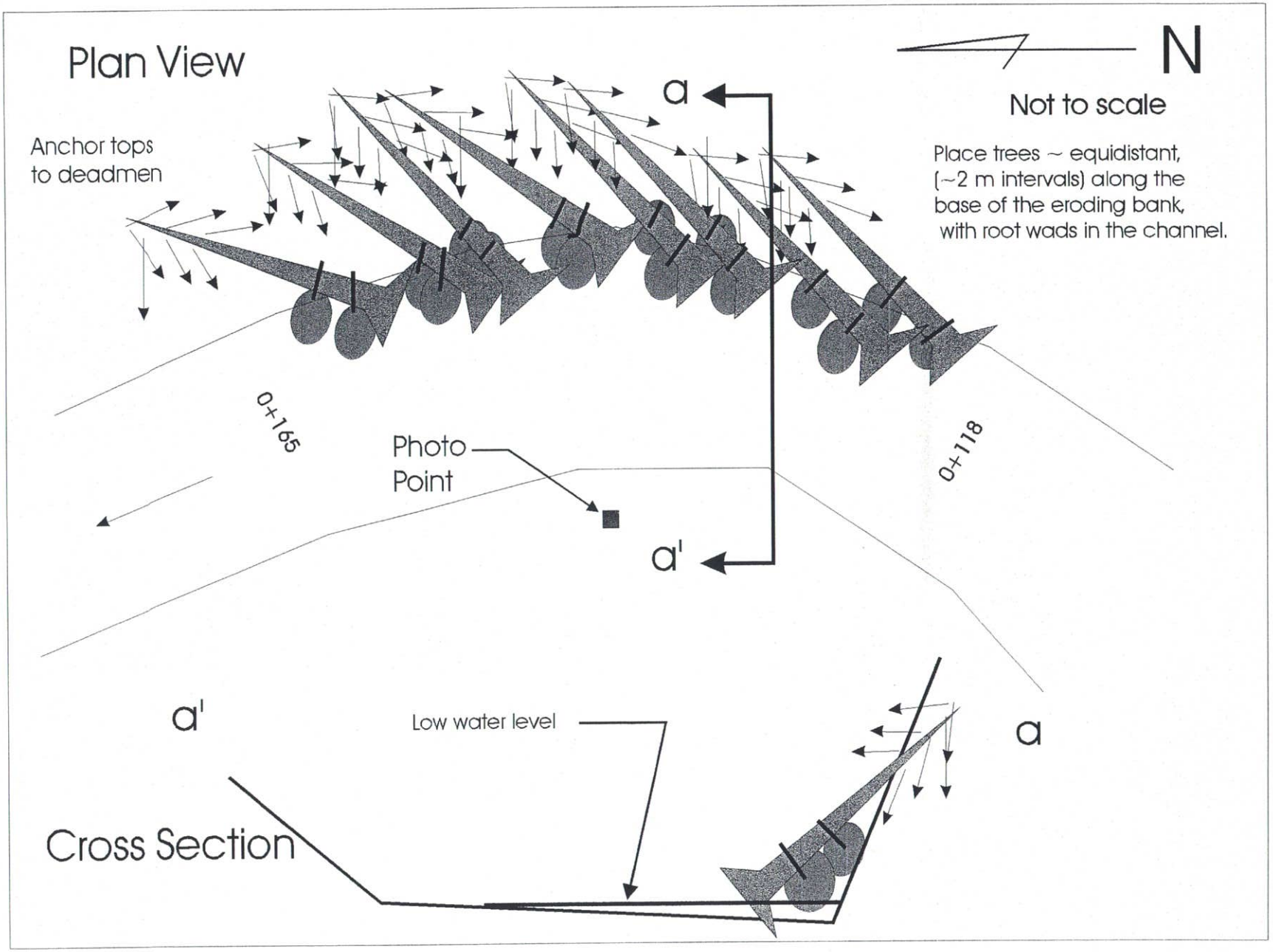

Figure 3. Sketch of the construction required at Site A.

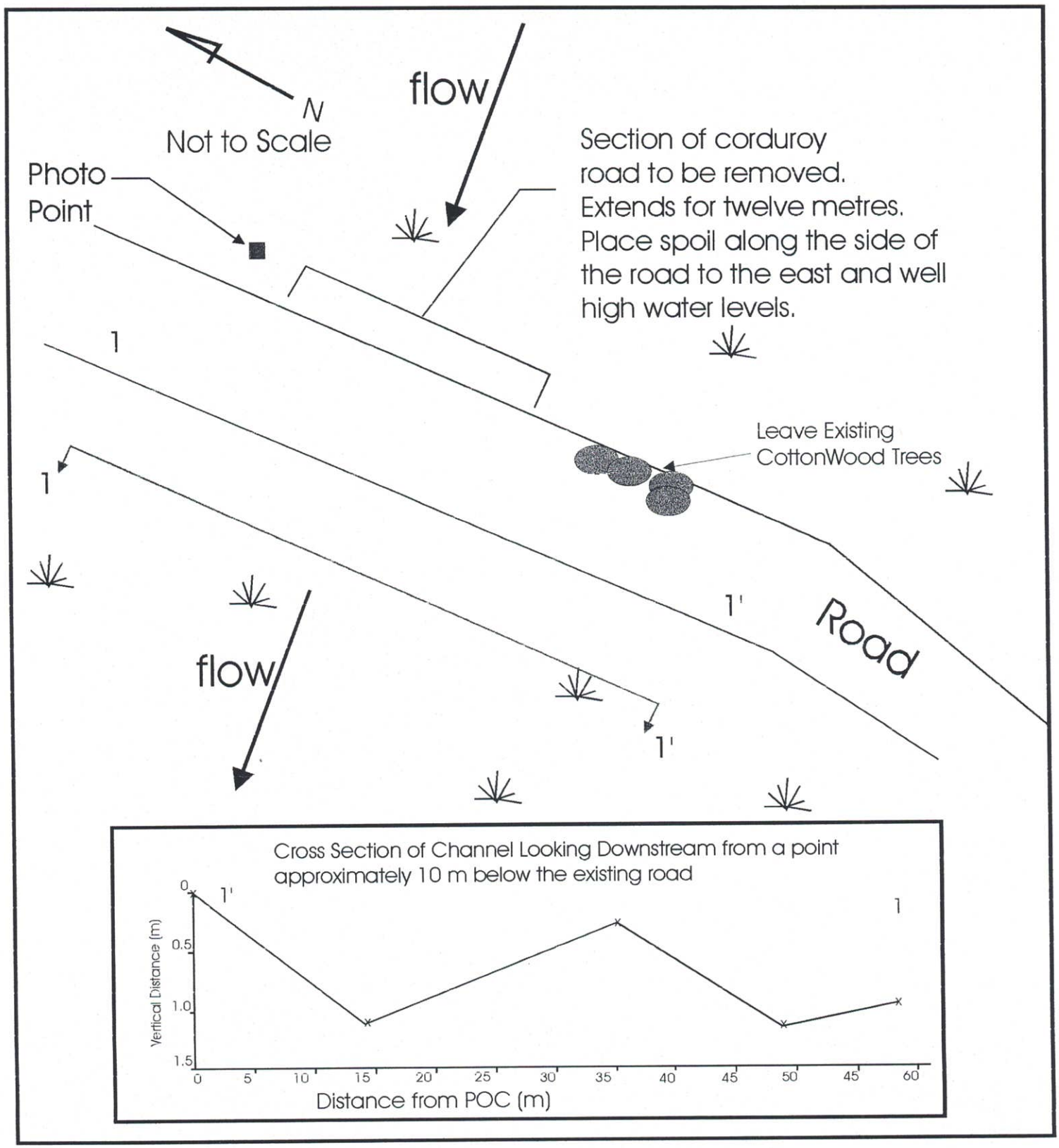

Figure 4. Sketch of the required construction work at Site B.

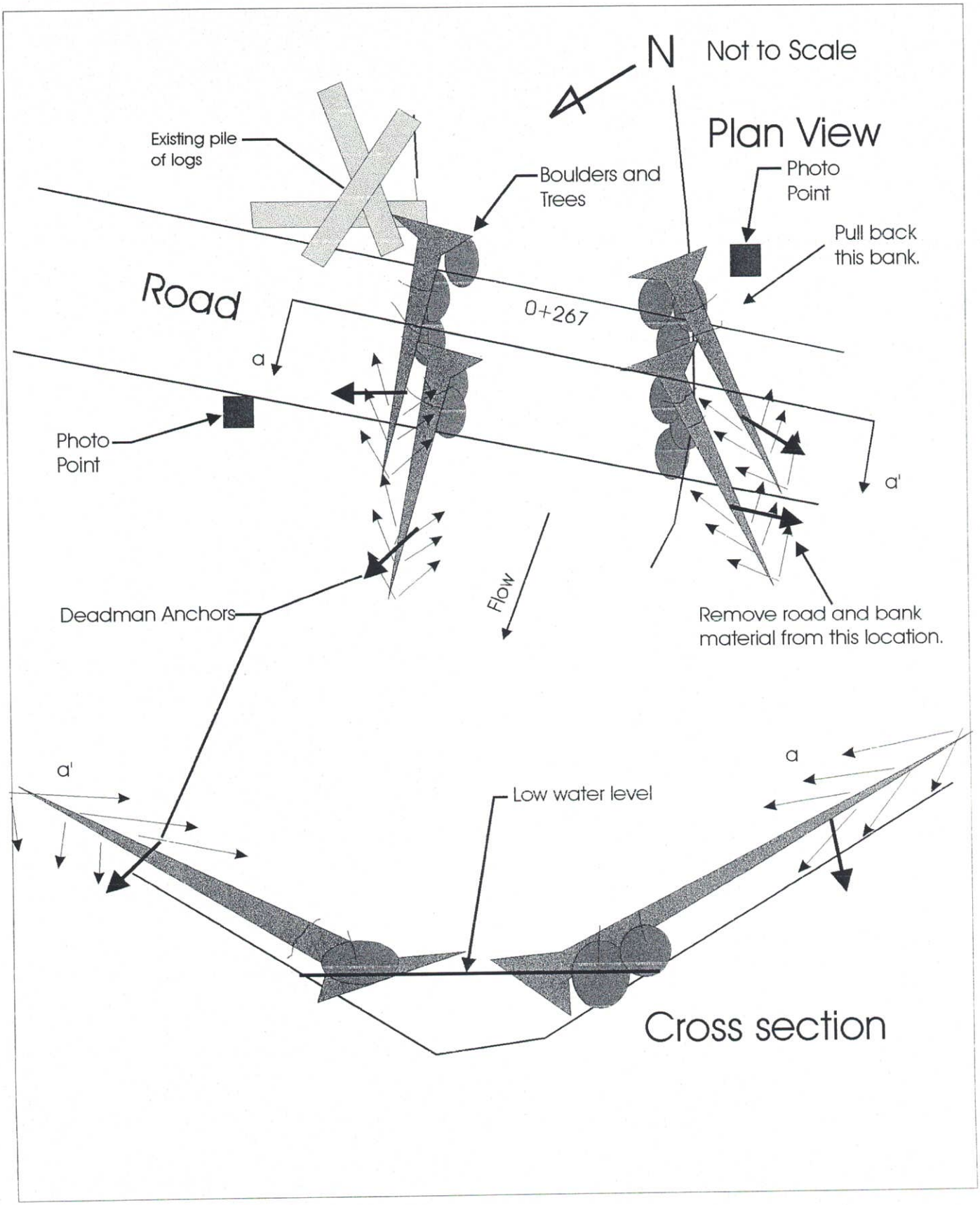

Figure 5. Sketch of construction required at Site C.

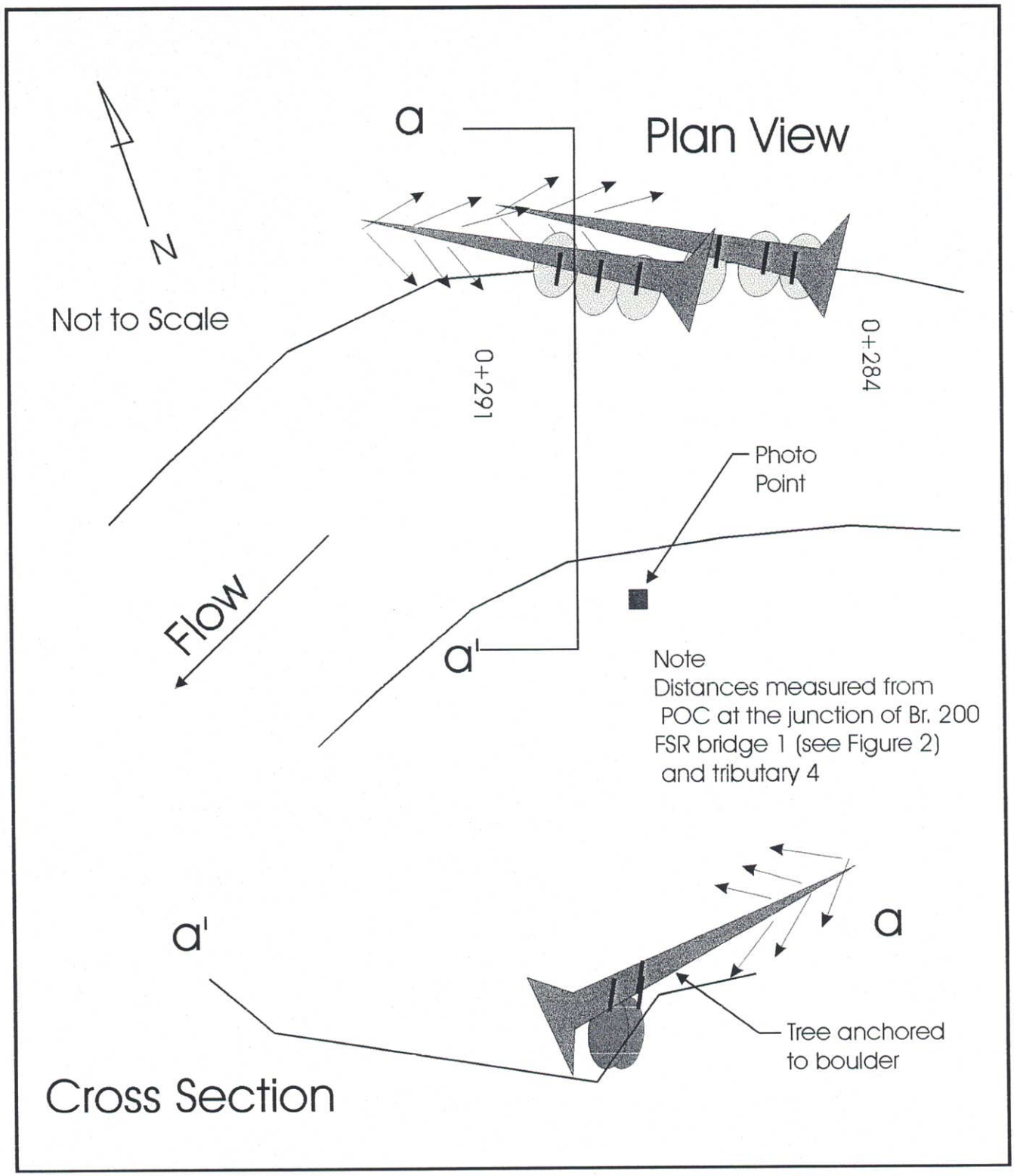

Figure 6. Sketch of construction required at Site D.

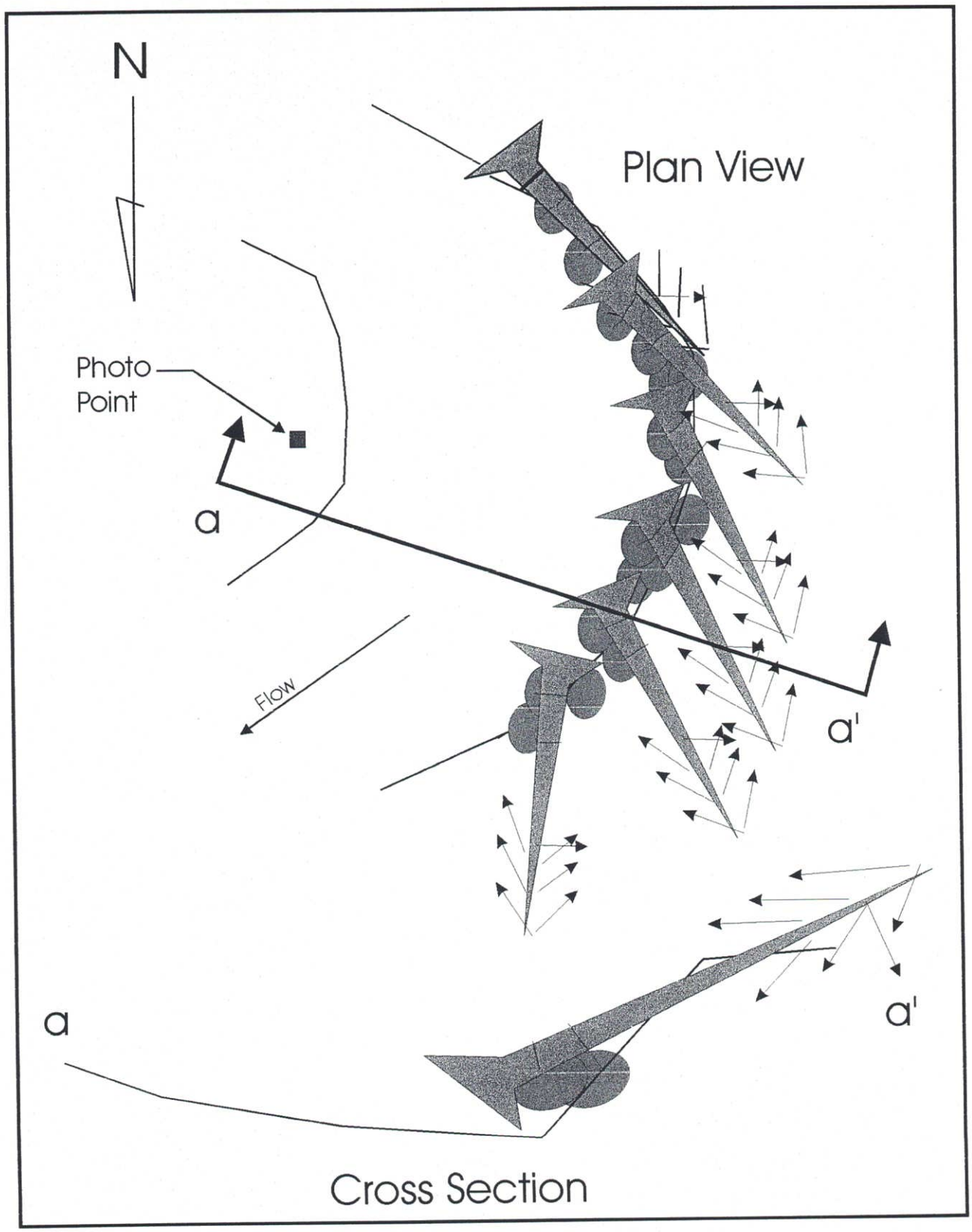

Figure 7. Sketch of the construction required at Site E.

TABLE 3. Overall Work Plan and Schedule

Work Plan and Schedule Overview.																
Work	Jun 1-7	Jun 8-15	Jun 16 - 23	Jun 24 - 30	Jul 1-7	Jul 9-15	Jul 16 - 23	Jul 2 - 30	Aug 1-7	Aug 8-15	Aug 16-23	Aug 24-31	Sep 1-7	Sep 8-15	Sep 16-23	Sep 24-30
Day																
Project Planning	PM															
Locating LWD			PM													
Locating Rock			PM													
Collecting LWD for transport					PM											
Collecting Rock for transport					PM											
Transport LWD to site							PM									
Transport Rock to site							PM									
Drill and install cable in rock									PM							
Remove fish and install stop nets at site A.											Bio,Tech					
Position LWD, Rock, in stream at site A.											PM					
Plant,cleanup site A											PM					
Remove fish and install stop nets at site B.											Bio,Tech					
Excavate site B											PM					
Transport Rock to site B											PM					
Position Rock at site B											PM					
Plant,cleanup site B											PM					
Remove fish and install stop nets at site C.											Bio,Tech					
Position LWD, Rock, in stream at site C.											PM					
Plant,cleanup site C											PM					
Remove fish and install stop nets at site D.											Bio,Tech					
Position LWD, Rock, in stream at site D.											PM					
Plant,cleanup site D											PM					
Remove fish and install stop nets at site E.											Bio,Tech					
Position LWD, Rock, in stream at site E.											PM					
Plant,cleanup site E											PM					
Monitoring LWD and rock placement											Bio,Tech					
Site Survey													Bio,Tech			
Site Topographical map preparation															Bio	
Report writing															Bio	
											*	*				

Note 1: Instream work is confined to August 15 - August 31 because of the beginning of spawning for Dolly Varden after September 1, and the presence of eggs for Rainbow and Cutthroat, and rearing Chinook. Although Chinook juveniles were found in the system in 1997, adults probably do not spawn in the project area. (see Appendix 6).

Note 2: Responsibilities are coded as PM (project manager), Bio (Biologist), Tech (Technician).

*Note 3: See page 2 for details of work schedule for August 15 to August 31 in stream work.

TABLE 4. Detailed Work Plan and Schedule for Work Window

Work Plan and Schedule for August 15 to 31 Instream Works.																	
Work	August Date																
Day	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Remove fish and install stop nets at site A.																	
Helicopter transport of LWD,Rock																	
Position LWD, Rock, in stream at site A.																	
Plant,cleanup site A																	
Remove fish and install stop nets at site B.																	
Excavate site B																	
Transport Rock to site B																	
Position Rock at site B																	
Plant,cleanup site B																	
Remove fish and install stop nets at site C.																	
Position LWD, Rock, in stream at site C.																	
Plant,cleanup site C																	
Remove fish and install stop nets at site D.																	
Position LWD, Rock, in stream at site D.																	
Plant,cleanup site D																	
Remove fish and install stop nets at site E.																	
Helicopter transport of LWD,Rock																	
Position LWD, Rock, in stream at site E.																	
Plant,cleanup site E																	
Monitoring LWD and rock placement																	

TABLE 5. Materials Required

Site Survey and Design Report for the Kitseguecla River Sites A,B,C,D,and E.										
Site	LWD Available	LWD Needed	LWD Length	LWD dia.	Root wad dia.	Rock Available	Rock Needed	Rock Size	Anchors	Cable
A	0	8	10m	0.5 m	1.5 - 2m	0	16 @ 2 per LWD	80cm	8	16 lengths
							or/ 24 @ 3 per LWD	73cm		
							or/ 32 @ 4 per LWD	64cm		
B	0	0					25 cubic metres	min dia. 10cm	0	0
C	0	4	10m	0.5m	1.5 - 2m	0	8 @ 2 per LWD	103cm	4	8 lengths
							or/ 12 @ 3 per LWD	84cm		
							or/ 16 @ 4 per LWD	74cm		
							and/ 6	min dia. 68cm		
D	0	2	10m	0.5m	1.5 - 2m	0	4 @ 2 per LWD	103cm	2	4 lengths
							or/ 6 @ 3 per LWD	84cm		
							or/ 8 @ 4 per LWD	74cm		
							and/ 2	min dia. 68cm		
E	0	6	10m	0.5m	1.5 - 2m	0	12 @ 2 per LWD	103cm	6	12 lengths
							or/ 18 @ 3 per LWD	84cm		
							or/ 24 @ 4 per LWD	74cm		
							and/ 6	min dia. 68cm		

Estimated Costs

The following cost estimates were produced assuming that each of the sites would be done separately. The summary table simply represents the sum of all of these costs. Very significant cost savings through economies of scale and logistic efficiencies if more than one site is done at a time.

TABLE 6. Cost Estimates

Cost Estimates for Sites ABCDE					
Category	Unit	Rate ($/Unit)	Total units	Days	Total Costs
Fees					
Biologist/Env. Monitor	hr	65	160	20	10400
Project Manager	hr	50	144	18	7200
Technician	hr	40	84	10.5	3360
Labourers	hr	35	366	45.75	12810
Expenses					
Helicopter	hr	4500	6	0.75	27000
Excavator	day	1200	4	4	4800
Mob/Demob	day	600	2	2	1200
Skidder/Cat	day	600	3	3	1800
Self Loading Logging Truck	day	600	2.5	2.5	1500
Small rock	cubic m	10	25		250
Gravel Truck	day	800	4.5	4.5	2900
Vehicle Rental	day	51	37	37	1887
Mileage	km	0.4	8050		3220
Trap rental	trap day	1	200	200	200
Stop Net rental	day	25	13	13	325
Electroshocker rental	day	125	5	5	625
Hand tool rental	day	20	12.5	12.5	250
Safety and fire equipment	day	25	14.5	14.5	362.5
LWD	piece	200	20		4000
Boulders	piece	200	70		14000
1.6 cm Steel Cable	m	3	175		525
Epoxy	per	25	4		200

Cost Estimates for Sites ABCDE					
Category	Unit	Rate ($/Unit)	Total units	Days	Total Costs
Generator-Rock Drill/Epoxy rental	day	125	5	5	625
Deadman	local	0	20		0
Chain saw winch	day	50	4	4	200
Chain saw	day	25	9	9	225
Silt Fencing Rental	project	100	7		700
Planting Stock	tree	2	81		162
Deciduous Seeds	litre	80	1		80
Grass Seed	kg	10	3		30
Camera Rental	day	10	9	9	90
Film and Processing	roll	35	12		420
Reports	report	30	40		1200
Drawings	11 x 17 sheet	5	10		50
Total Station rental	day	110	4.5	4.5	495
Permits	project	100	5		125
Communications	day	50	27	27	1350
Totals					104566.5
Administration @ 7%					7319.655
Contingencies @ 15%					15684.975
Site ABCDE Total					$127,571.13

TABLE 7. Cost Estimates for Site A

Cost Estimates for Site A														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construc-tion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report writing	Total units	Cost ($)
Fees														
Biologist -Env. Monitor	hr	65	8			8			4	8	16	8	52	3380
Project Manager	hr	50	8	8	8	8							32	1600
Techni-cian	hr	40	8	8	8	8			4	8	8		52	2080
Labourer	hr	35	8	16	48	48	8	8					136	4760
														0
														0
														0
														0
Exp-enses														
Heli-copter	hr	4500			3	1							4	18000
Excava-tor	day	1200		1									1	1200
Mob/De mob	day	600		2									2	1200
Skidder/ Cat	day	600		1									1	600
Logging truck	day	600			1								1	600
Small		0											0	0

Cost Estimates for Site A														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construc-tion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report writing	Total units	Cost ($)
rock													1	800
Gravel Truck	day	800			2								10	510
Vehicle Rental	day	51	3	3	1	1	1	1					1760	704
Mileage	km	0.4	390	160	40	390	40	40	350	350			40	40
Trap rental	trap day	1	20						20				6	150
Stop Net rental	day	25	2	4	3	0	0	0					2	250
Electro-shocker rental	day	125	1						1				4	80
Hand tool rental	day	20		1	1	1		1					5	125
Safety and fire equip-ment	day	25		3	1	1							8	1600
LWD	piece	200		8									16	3200
Boulders	piece	200		16									50	150
1.6 cm Steel Cable	m	3				50							1	50
Epoxy	per	50				1							2	250
Gener-	day	125				2								

Cost Estimates for Site A														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construc-tion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report writing	Total units	Cost ($)
ator-Rock Drill-Epoxy rental														
Dead-man	local	0				8							8	0
Chain saw winch	day	50				1							1	50
Chain saw	day	25		3									3	75
Silt Fencing Rental	proje ct	100				4							4	400
Planting Stock	tree	2					25						25	50
Decid-uous Seeds	litre	80					0.5						0.5	40
Grass Seed	kg	10					2						2	20
Camera Rental	day	10	1						1				2	20
Film and Process-ing	roll	35	2						2				4	140

Cost Estimates for Site A														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construc-tion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report writing	Total units	Cost ($)
Reports for all sites	report	30										8	8	240
Drawing	11 x 17 sheet	5				2							2	10
Total Station rental	day	110	1							1			2	220
Permits for all sites ABCDE	project	25	1										1	25
Com-munica-tions	day	50	1	3	1	1				1			7	350
														42969
Totals														
														3007.83
Administration @ 7%														6445.35
Contingencies @ 15%														
														52422.18
Site A Total														

TABLE 8. Cost Estimates for Site B

Cost Estimates for Site B														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construction Monitoring (Fishing, Photos)	Collect Materials	Deliver materials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	Total Units	Cost ($)
Fees														
Biologist-Env. Monitor	hr	65	8			8				4	8	8	28	1820
Project Manager	hr	50	8	8	8	8							32	1600
Technician	hr	40	8										8	320
Labourer	hr	35				16	4	4					24	840
														0
Expense														0
Helicopter		0												0
Excavator	day	1200				0.5							0.5	600
Mob-Demob	day	600											0	0
Skidder/Cat		0												0
Logging Truck		0												0
Small rock	cubic metre	10				25							25	250
Gravel Truck		600			2								2	1200
Vehicle	day	51	1	1	1	1	1	1					6	306

Cost Estimates for Site B														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	Total Units	Cost ($)
Rental													1640	656
Mileage	km	0.4	430	40	40	390		40	350	350			40	40
Trap rental	trap day	1	20						20				2	50
Stop Net rental	day	25	2										0.5	62.5
Electro-shocker rental	day	125	0.5										0.5	10
Hand tool rental	day	20				0.5							0.5	12.5
Safety and fire equipment	day	25				0.5								0
LWD	pce	200												0
Boulders	pce	200												0
1.6 cm Steel Cable	m	3												0
Epoxy		0												0
Generator/ Rock Drill/Epoxy rental	day	125												0
Deadman		0												0
Chainsaw winch		0												0

Cost Estimates for Site B														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	Total Units	Cost ($)
Chainsaw		0												0
Silt Fencing Rental	job	100												0
Planting Stock	tree	2					20						20	40
Deciduous Seeds	litre	80					0.5						0.5	40
Grass Seed	kg	10					1						1	10
Camera Rental	day	10	0.5						0.5				1	10
Film and Process-ing	roll	35	1						1				2	70
Reports	rep.	30										8	8	240
Drawings	11 x 17 she et	5	2										2	10
Total Station rental	day	110								1			1	110
Permits	job	25											1	25
Communic ations	day	50	1	1	1	1	1						5	250

Cost Estimates for Site B														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	Total Units	Cost ($)
			482	50	52	451	27.5	45	372	355	8	16	1851	
														8572
Totals														
														600.04
Administration @ 7%														1285.8
Contingencies @ 15%														
														10457.84
Total Cost														

TABLE 9. Cost Estimates for Site C

Cost Estimates for Site C														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Fees														
Biologist-Env. Monitor	hr	65	4						4	4	8	8	20	1300
Project Manager	hr	50	8	8	8	8							32	1600
Technic-ian	hr	40	4										4	160
Labourers	hr	35		16		16	2	4		4	4	8	54	1890
													0	0
													0	0
Expenses														0
Helicopter		0											1	1200
Excavator	day	1200		0.5		0.5							0	0
Mob-Demob	day	600											1	600
Skidder-Cat	day	600		1									1	600
Logging truck	day	600			1								0	0
Small rock													0	0
Gravel Truck														

Cost Estimates for Site C														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Vehicle Rental	day	51	1	2	1	1	1	1					7	357
Mileage	km	0.4	430	40	40	390		40	350	350			1640	656
Trap rental	trap day	1	20						20				40	40
Stop Net rental	day	25	1										1	25
Electro-shocker rental	day	125	0.5										0.5	62.5
Hand tool rental	day	20		1		1							2	40
Safety and fire equip	day	25		1		1							2	50
LWD	piece	200											4	800
Boulders	piece	200											16	3200
1.6 cm Steel Cable	m	3				50							50	150
Epoxy	tube	50				1							1	50
Generator/ Rock Drill/Epoxy rental	day	125				0.5							0.5	62.5

Cost Estimates for Site C															
			Quantity												
			Tasks												
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Deadman	local material	0				4							4	0
Chainsaw winch		50				1							1	50
Chain saw winch	day	25				1							1	25
Silt Fencing Rental	project	100				1							1	100
Planting Stock	tree	2					6						6	12
Deciduous Seeds	litre													0
Grass Seed	kg	10											0	0
Camera Rental	day	10	1						1				2	20
Film and Process-ing	roll	35	1						1				2	70
Reports	rep.	30										8	8	240
Drawings	11 x 17	5				2							2	10

Cost Estimates for Site C														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Total Station rental	day	110									0.5		0.5	55
Permits	job	25											1	25
Communic ations	day	50	1	1	1	1			1				5	250
Totals														13700
Administration @ 7%														959
Contingencies @ 15%														2055
Site Total														16714

TABLE 10. Cost Estimates for Site D

Cost Estimates for Site D															
			Quantity												
			Tasks												
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Fees														
Biologist-Env. Monitor	hr	65	4						4	4	8	8	28	1820
Project Manager	hr	50	8	4	4	4							20	1000
Technic-ian	hr	40	4										4	160
Labourers	hr	35		16		16	4	4					40	1400
													0	0
Expenses													0	0
Helicopter		0											0	0
Excavator	day	1200	0.5										0.5	600
Mob-Demob	day	600											0	0
Skidder-Cat	day	600		1									1	600
Logging truck	day	600			0.5								0.5	300
Small rock	cubic m	10											0	
Gravel truck	day	600		1	0.5								1.5	900

Cost Estimates for Site D															
			Quantity												
			Tasks												
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Vehicle Rental	day	51	1	1	1	1	1	1					6	306
Mileage	km	0.4	430	40	40	40		40	350	350			1290	516
Trap rental	trap day	1	20						20				40	40
Stop Net rental	day	25	2										2	50
Electro-shocker rental	day	125	1										1	125
Hand tool rental	day	20				1							1	20
Safety and fire equip	day	25				1							1	25
LWD	pce	200											2	400
Boulders	pce	200											8	1600
1.6 cm Steel Cable	m	3				25							25	75
Epoxy	kit	50				1							1	50
Generator /Rock Drill-Epoxy rental	day	125				0.5							0.5	62.5
Deadman	Loc	0				2							2	0

Cost Estimates for Site D														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Chainsaw winch		50				1							1	50
Chain saw winch	day	25		1									1	25
Silt Fencing Rental	job	100				1							1	100
Planting Stock	tree	2					6						6	12
Deciduous Seeds	litre	80											0	0
Grass Seed	kg	10											0	0
Camera Rental	day	10	1						1				2	20
Film and Process-ing	roll	35	1						1				2	70
Reports	rep	30										8	8	240
Drawings	11 x 17	5											0	0
Total Station rental	day	110								0.5			0.5	55
Permits	proj ect	25											1	25

Cost Estimates for Site D														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	As-Built Drawings & Summary	Report	total units	Cost ($)
Communi cations	day	50	1	1	1	1	1						5	250
														10896.5
Totals														
														762.755
Administration @ 7%														1634.475
Contingencies @ 15%														
														13293.73
Site Total														

TABLE 11. Cost Estimates for Site E

Cost Estimates for Site E														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construction Monitoring (Fishing, Photos)	Collect Materials	Deliver materials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	Report	As-Built Drawings & Summary	total units	Cost ($)
Fees														
Biologist-Env. Monitor	hr	65	8						4	4	8	8	32	2080
Project Manager	hr	50	8	8	8	4							28	1400
Technician	hr	40	8			8							16	640
Labourers	hr	35		72	16	16	4	4					112	3920
													0	0
													0	0
Expenses													2	9000
Helicopter	hr	4500			2								1	1200
Excavator	day	1200			1								0	0
Mob-Demob	day	600											0	0
Skidder-Cat	day	600											0	0
Logging truck	day	600											0	
Small rock													0	0
Gravel truck	day	800												

Cost Estimates for Site E														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	Report	As-Built Drawings & Summary	total units	Cost ($)
Vehicle Rental	day	51	1	3	1	1	1	1					8	408
Mileage	km	0.4	430	120	40	390		40	350	350			1720	688
Trap rental	trap day	1	20						20				40	40
Stop Net rental	day	25	2										2	50
Electro-shocker rental	day	125	1										1	125
Hand tool rental	day	20		3		1	1						5	100
Safety and fire equip	day	25		3	1	1	1						6	150
LWD	piece	200											6	1200
Boulders	piece	200											30	6000
1.6 cm Steel Cable	m	3					50						50	150
Epoxy	kit	50				1							1	50
Generator/ Rock Drill/Epoxy rental	day	125					2						2	250
Deadman	loc	0				6							6	0

Cost Estimates for Site E															
			Quantity												
			Tasks												
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	Report	As-Built Drawings & Summary	total units	Cost ($)
Chain saw winch		50				1							1	50
Chain saw winch	day	25		3		1							4	100
Silt Fencing Rental	proj	100	1										1	100
Planting Stock	tree	2					24						24	48
Deciduous Seeds	litre	80											0	0
Grass Seed	kg	10											0	0
Camera Rental	day	10	1						1				2	20
Film and Process-ing	roll	35	1						1				2	70
Reports	rep	30									8		8	240
Drawings	11 x 17	5	2			2							4	20
Total Station rental	day	110								0.5			0.5	55
Permits	proj	25											1	25

Cost Estimates for Site E														
			Quantity											
			Tasks											
Category	Unit	Rate	Pre-Construct-ion Monitoring (Fishing, Photos)	Collect Materials	Deliver mater-ials	Position Material	Planting	Cleanup	Post-Construction Monitoring (Fishing, Photography)	As-Built Topo. Survey	Report	As-Built Drawings & Summary	total units	Cost ($)
Communications	day	50	1	1	1	1	1						5	250
Totals														28429
														1990
Administration @ 7%														4264.4
Contingencies @ 15%														
														34683
Total site E														

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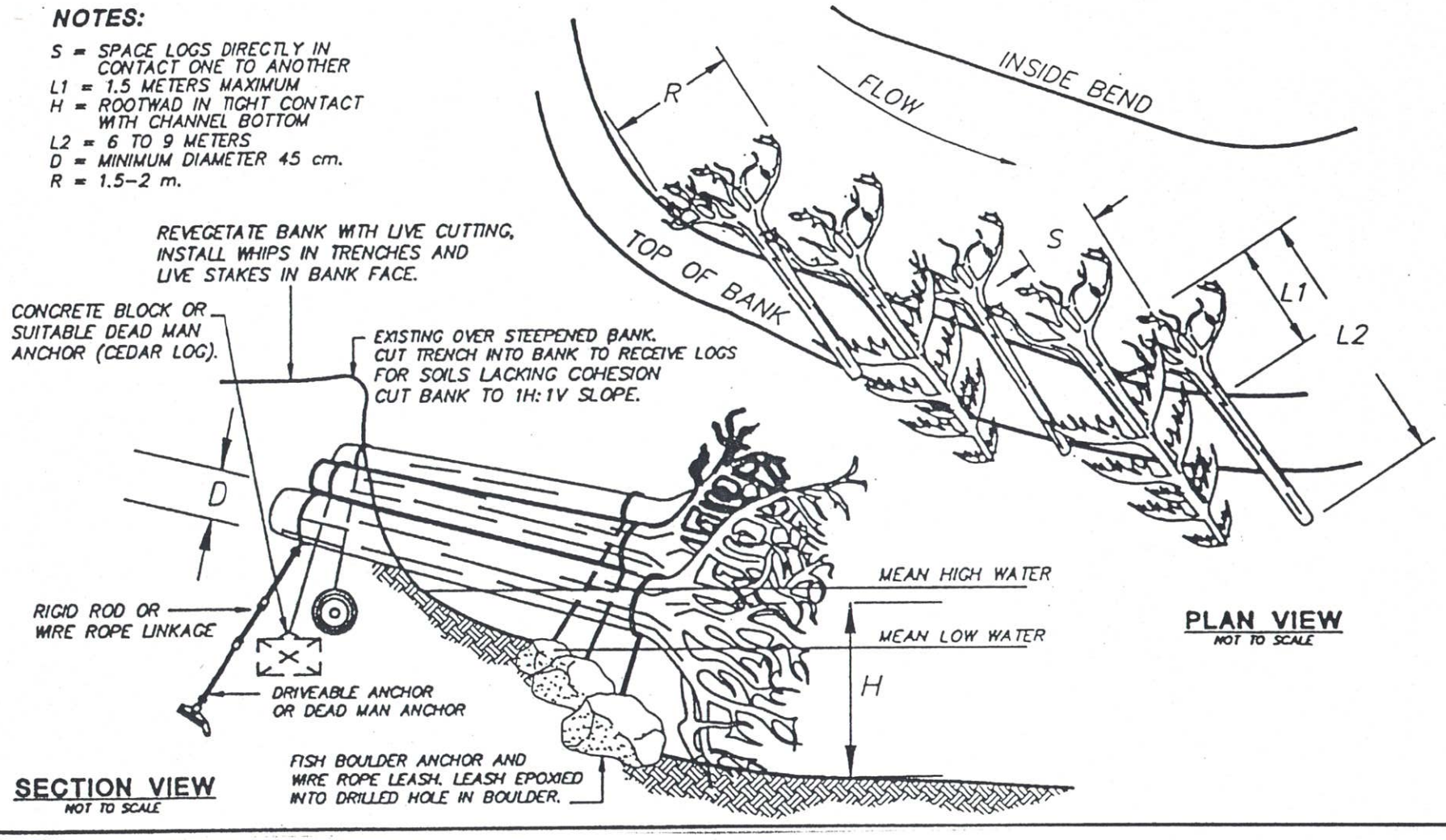
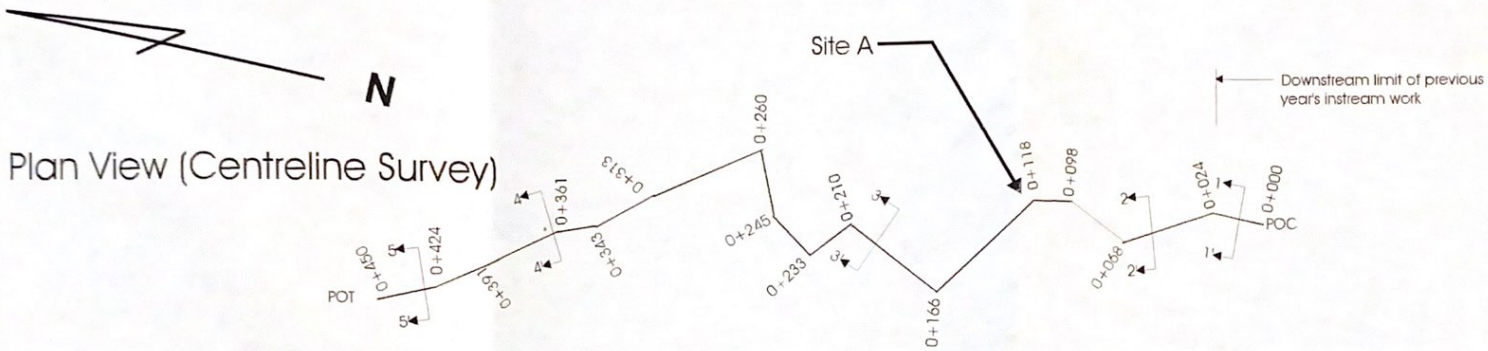
LARGE WOODY DEBRIS REVETMENT (LOW ENERGY SITES)

NOTES:

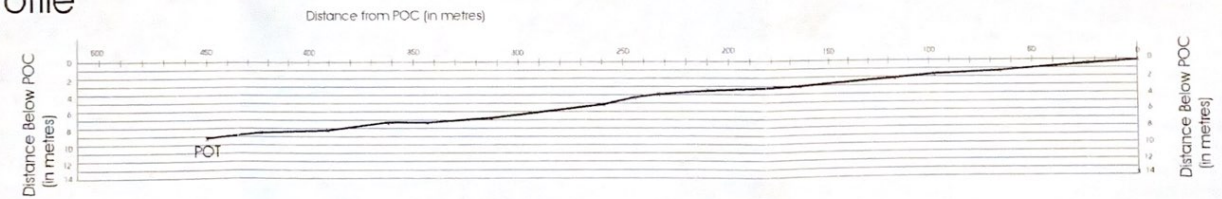
S = SPACE LOGS DIRECTLY IN CONTACT ONE TO ANOTHER
L1 = 1.5 METERS MAXIMUM
H = ROOTWAD IN TIGHT CONTACT WITH CHANNEL BOTTOM
L2 = 6 TO 9 METERS
D = MINIMUM DIAMETER 45 cm.
R = 1.5–2 m.





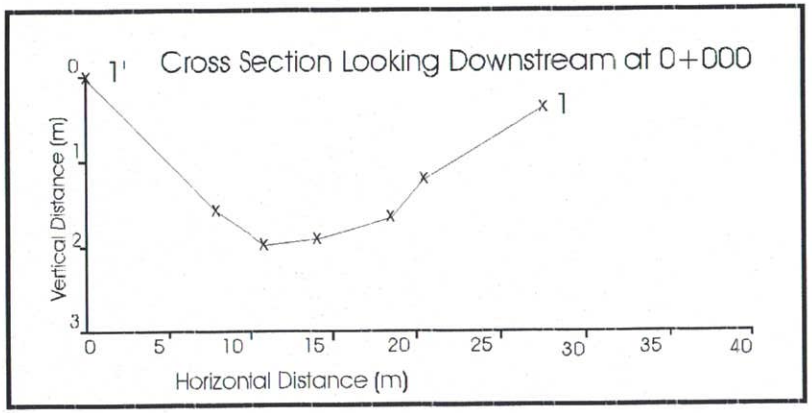
Plan View (Centreline Survey)

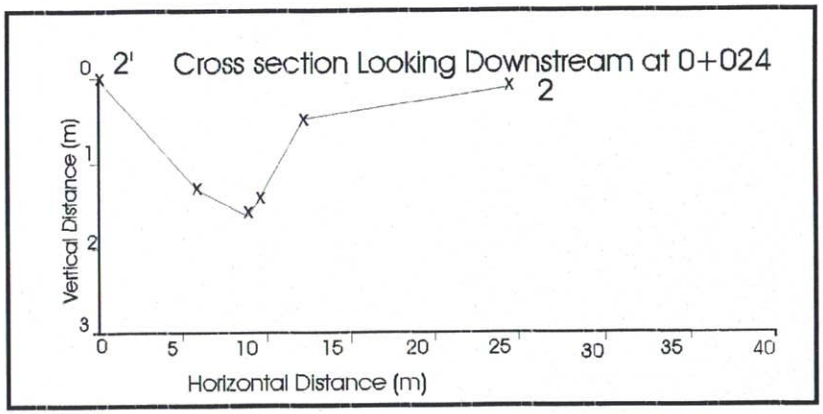
Longitudinal Profile

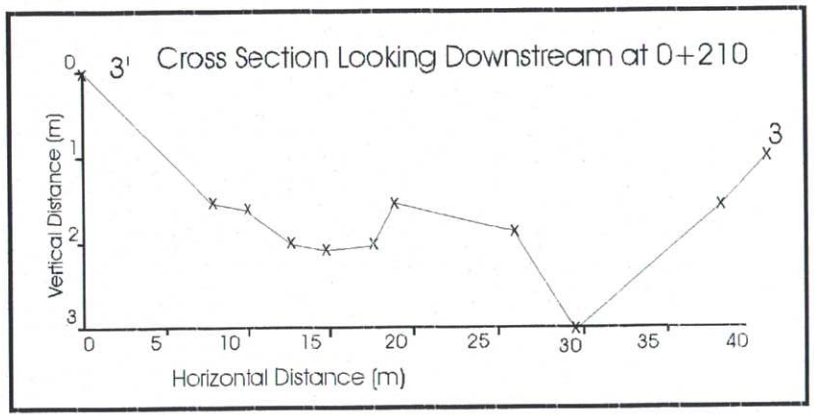


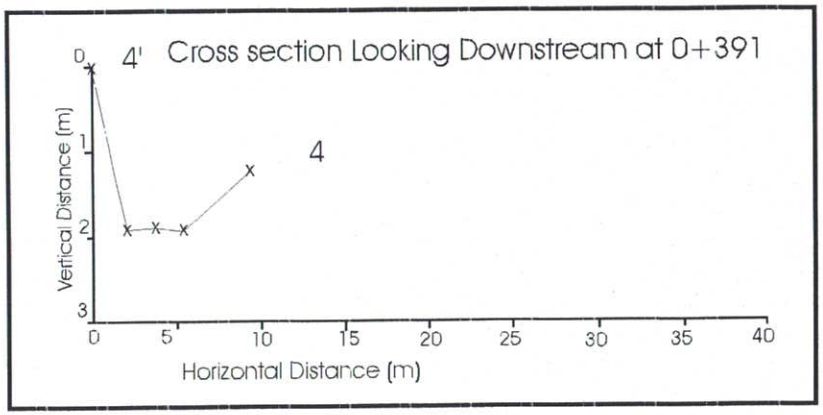
Survey Date: March 19, 1999	Gitsegukla River WRP
Equipment: Clinometer, Compass, Chain	Tributary 1
Crew: Doug Webb, Earl Williams	Site A
Scale: Plan View 1:1640	Site Survey and Design
BioLith Scientific Consulting Inc. Terrace, B.C.	

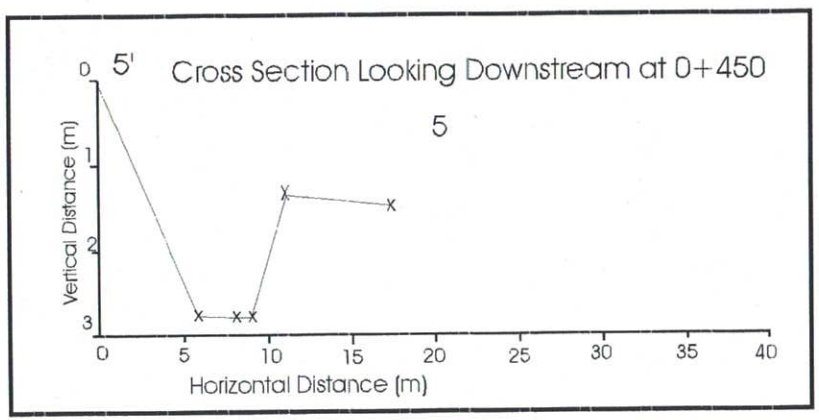
Appendix 2. Longitudinal plan and profile drawings of section of Trib 1 above and below construction Site A.



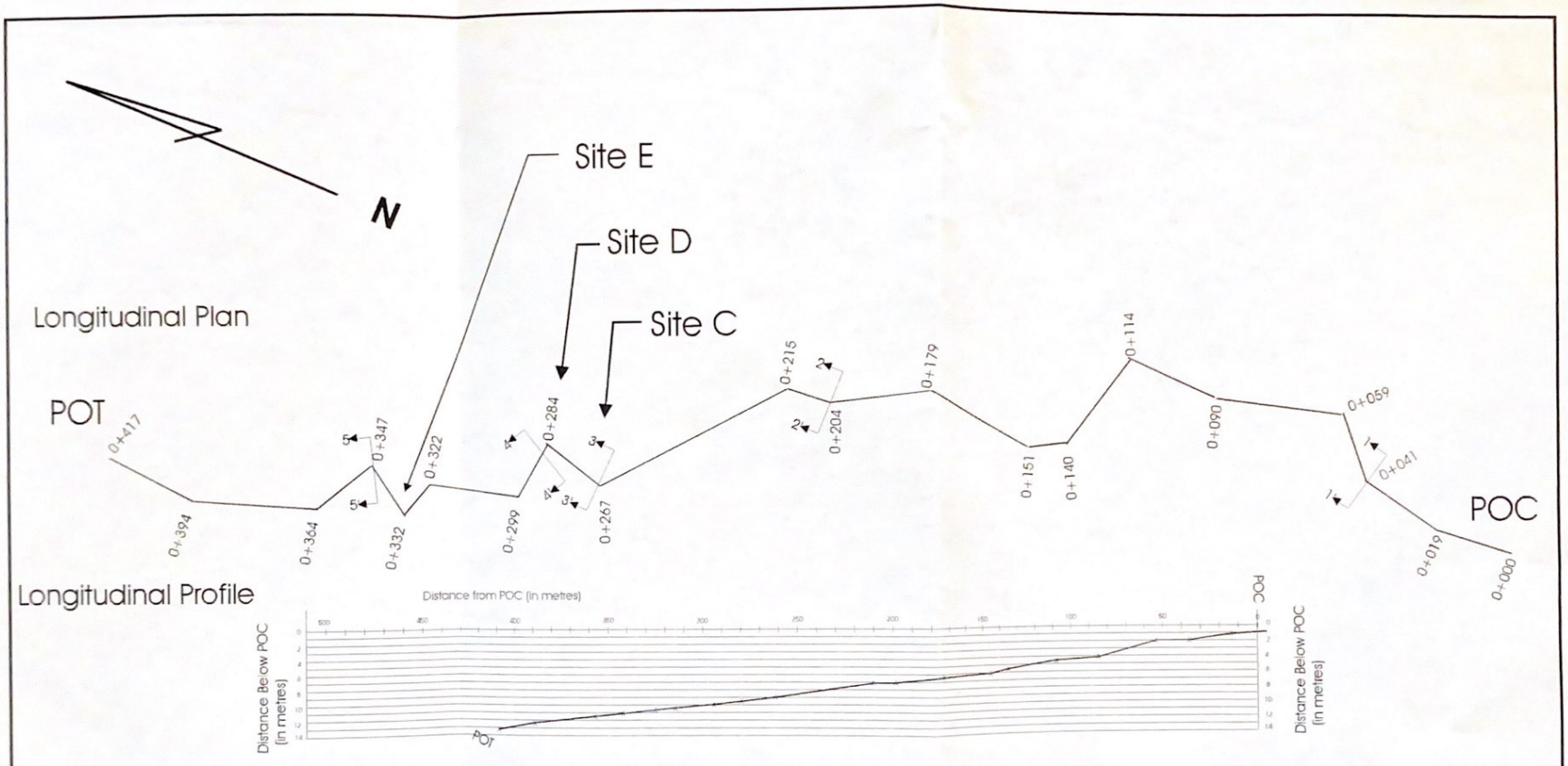








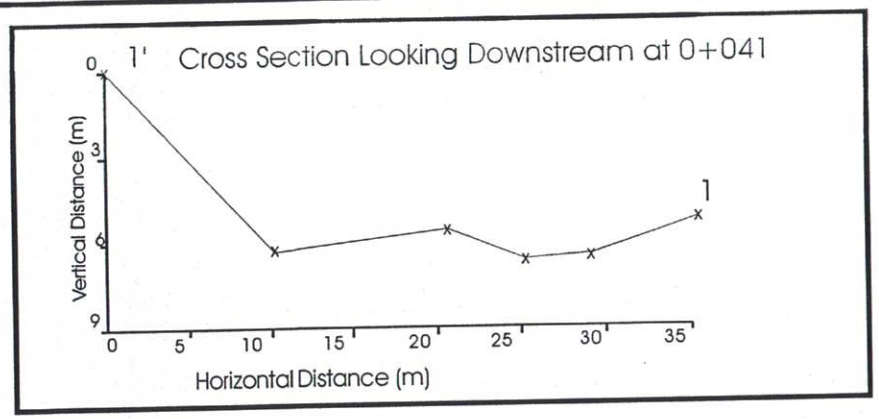
Appendix 3. Cross sections along traverse of Site A.

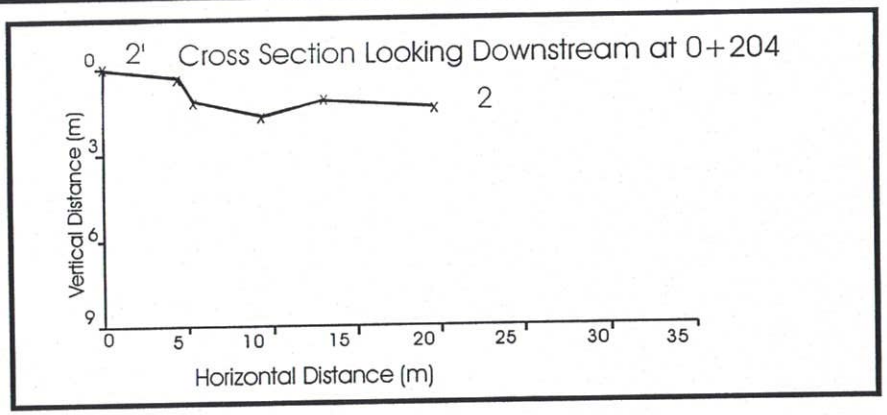


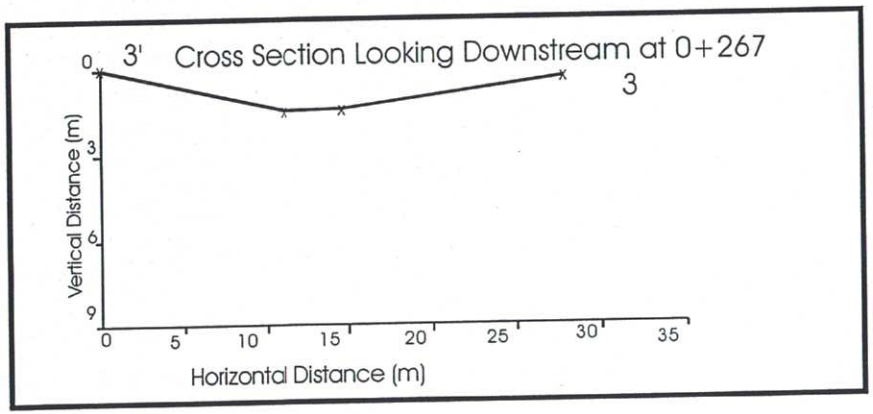
Notes:
POC is junction of tributary 4 and Br. 200 FSR Bridge (see Figure 2).
Cross sections are shown in Appendix 5

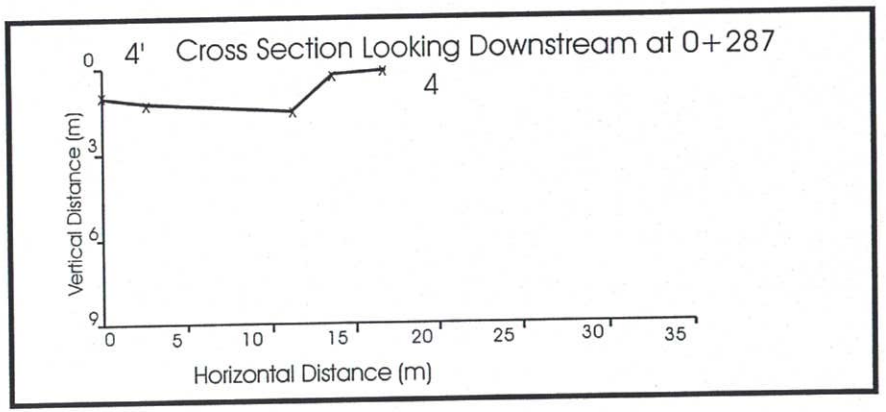
Survey Date: March 19, 1999	Gitsegukla River WRP
Equipment: Clinometer, Compass, Chain	Tributary 4
Crew: Doug Webb, Earl Williams	Sites C, D and E
Scale: Plan View 1:1000	Longitudinal Plan and Profile
BioLith Scientific Consulting Inc. Terrace, B.C.	

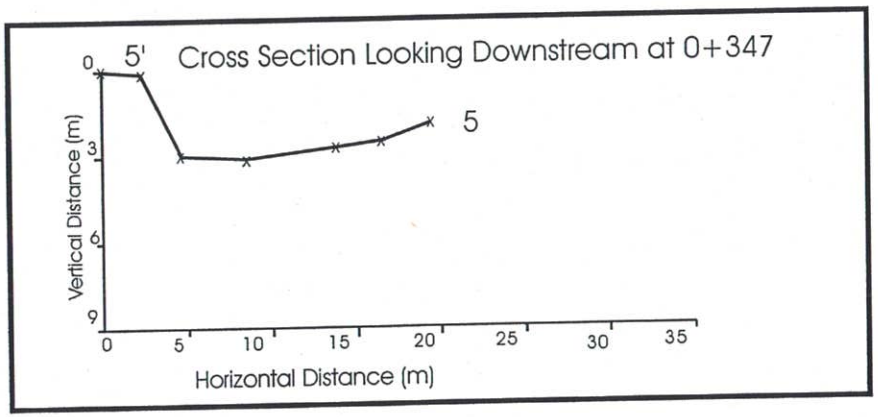
Appendix 4. Longitudinal plan and profile drawings for Trib 4 (sites C, D and E).











Appendix 5. Cross section diagrams along Tributary 4 transect (Sites C, D and E).

Timing Windows for Instream Work in MoELP FW Region 6

(after Chilibeck, 1992)

Species	CH	CO	PK	CM	SK	ST	RB	CT	DV
Date									
May 15-31									
June 1-15									
June 15-30									
July 1-15									
July 15-31									
Aug 1-15									
Aug 15-31									
Sep 1-15									
Sep 15-30									
Oct 1-15									
Oct 15-31									
Nov 1-15									
Nov 15-30									
Dec 1-15									
Dec 15-31									
Jan 1-15									
Jan 15-31									

CH	Chinook
CO	Coho
PK	Pink
CM	Chum
SK	Sockeye
ST	Steelhead
RB	Rainbow
CT	Cutthroat
DV	Dolly Varden
	Lower Risk
	Higher Risk

Chilibeck, B. 1992. Land Development Guidelines for the Protection of Aquatic Habitat. Co published by MoELP and DFO.