Level I Detailed Field Assessment of Aquatic and Riparian Habitat for Coldwater Creek in the Lakelse River Watershed

Prepared for
Ministry of Environment

by

BioLith Scientific Consultants Inc.

March 31, 1999

Table of Contents

List of Tables

List of Figures

List of Photographs

List of Appendices and Attachments

The following items are located under separate cover.

Three Ring Binder with Appendices

- Appendix A. WRP Digital Entry System Forms (Forms 4, 5 and 6)
- Appendix B. Transcribed Field Notes
- Appendix C. Riparian Sample Site Data
- Appendix D. Cutblock Identifiers
- Appendix E. Timing Windows
- Appendix F. List of Photographs and Captions
- Appendix G. Site Surveys and Design Requirements
- Appendix H. Sample Tender Documents

The following are included as separate items

- Aquatic Habitat Map (1:20,000)
- Riparian Habitat Map (1:20,000)
- Photographs and Negatives in Three Ring Binder
- CD with all relevant digital files

A copy of the report, its appendices and other items are available in the Regional Library, Ministry of Environment, Lands and Parks, 3726 Alfred Ave., Smithers, B.C., V0J 2N0.

Executive Summary

A field based assessment of the streams in the Coldwater Creek watersheds in the Lakelse River system was conducted during the winter of 1998-1999. The assessment followed procedures prescribed by the British Columbia Watershed Restoration Program, with the objective of producing conceptual prescriptions for restoration of riparian and aquatic habitat damaged through past logging activities.

The Coldwater Creek system was considered to have once contained very good habitat for most species of salmonids. Its lower portion featured several low gradient tributaries that were likely highly productive as spawning, incubating and rearing habitat.

With the exception of Reach 3, Reaches 1 through 5 of the mainstem had been badly damaged through erosion. A large amount of sediment had been moved downstream, some of it having been deposited into the Lakelse River. In some areas, the floodplain had been widely denuded and the channel was apparently very unstable. It is recommended that these problems be addressed first in two apparently unstable tributaries to Reaches 5 and 6 and then by working sequentially downstream to correct the instability problems in Reaches 5, 4, 2 and 1.

Restorative measures prescribed mainly involved the placement of very large woody debris and boulders to direct water, dissipate energy, trap sediment, protect banks and provide habitat complexity and cover for fish. A risk of a major diversion of the mainstem in Reach 3 was addressed by prescribing protection of the southern banks using LWD and rocks. Another prescription suggested a detailed assessment of the area of the former mouth of the mainstem for its potential for development as restored habitat.

A flood channel had delivered water to a road bed in Reach 5, with the subsequent degradation of the road bed. It was suggested that this important area be the subject of a more detailed assessment.

Damage in the tributaries was mainly road related. Prescriptions for these problems mostly involved standard road de-activation methods of removal of old structures, bank pullback and planting and stabilization of eroding slopes.

1 Introduction

1.1 Proponent
Ministry of Environment

1.2 Implementing Partners
Ministry of Environment

1.3 Funding Sources and Technical Monitoring
Funding for the project was provided by Forest Renewal B.C. and technical monitoring was provided by the Ministry of Environment, Kalum Forest District, Terrace, B.C.

1.4 Watershed Description
Coldwater Creek was a 4th order stream (1:20,000) draining a watershed covering 90 km^2. Coldwater Creek generally flowed east out of the mountains and then northeast into the Lakelse River approximately 3.5 km downstream from Lakelse Lake. The lower five reaches of the watershed contained the majority of good fish habitat, being comprised of a wide basin with relatively low relief and low gradient tributary streams, whereas upper reaches were confined in a deeply incised valley.

1.5 Purpose of the Level I Detailed Aquatic and Riparian Assessment
The Watershed Restoration Program of British Columbia is a program whereby watersheds that have been damaged by past logging practices undergo restoration. The program involves a number of steps that commence with an overview study, followed by a detailed field assessment, generation of conceptual level prescriptions, implementation of the prescriptions and finally, monitoring of results. The process is divided into two components, one relating to upslope (roads, hill slopes and gullies) concerns and the other relating to stream and riparian concerns. This project was related to the stream and riparian areas.

This project was the second step in the process outlined above. This procedure was prescribed by the Watershed Restoration Program of B.C. and was described in Watershed Restoration Technical Circular No. 8 (WRTC#8). The first step was comprised of an overview assessment of fish and fish habitat conducted by Triton Environmental Consultants Ltd. (Triton, 1996) that was mainly an office-based analysis of large scale colour photographs and pre-existing information. The current project was comprised of a field-based analysis. The work generally consisted of walking the streams and assessing them according to a process outlined in WRTC #8. The objective was to describe the current condition of the aquatic and riparian habitat and the fish populations, and to produce conceptual level prescriptions for restoration.

2 Study Area
The areas included in this study are shown on the map in Figure 1 and on the large scale maps accompanying this report. They comprised those parts of the watershed that were downstream from any logged area. All significant tributaries were also assessed.

3 Methods

Methods employed included those specified in WRTC #8 (Watershed Restoration Technical Circular #8, Johnston and Slaney 1996), WRTC #6, (Anonymous 1998) and those judged reasonable through experience. The procedure prescribed in WRTC #8 was based on standards developed in other areas of North America's west coast. As a result, the ratings derived through this procedure cannot be relied upon for an accurate assessment of habitat condition. Prescriptions were developed using ideas presented in Watershed Restoration Technical Circular #9 (Slaney and Zaldokas 1997) as well as others considered reasonable through experience. Areas in the Riparian Management Area that had been logged were assessed for their need for treatment. Those polygons considered in need of treatment were described and listed in order of priority for detailed assessment. This priority list is given in Table 19 and the polygons assessed are outlined on the accompanying detailed map.

One crew, comprised of a biologist and one senior fisheries technician, spent a total of 21 days in the field investigating the watershed. The watershed was broken up into reaches based on the preliminary subdivision by Triton (1996) and refined during field work. This resulted in an increase in the number of reaches. Representative segments of every reach considered to contain habitat significant for fish were sampled according to the procedures outlined in Johnson and Slaney (1996).

A total of twenty two kilometres of the streams in the Coldwater Creek system were walked and assessed. Habitat Survey Data Forms (Form 4) were completed at each sampled site. A total of 24 sites were sampled. These sites were numbered from 1 to 24 on the accompanying aquatic map and digitized data forms. Photographs of the streams were taken and initial assessments and, where appropriate, preliminary prescriptions were recorded. As this project was conducted during the winter, and preliminary fishing resulted in no captures, no other fishing was conducted during this study. On two occasions fish were visually observed. This information was recorded on Fish Distribution Data Forms (Form 5). The locations of these observations were numbered 1 and 2 on the accompanying aquatic map and digital data forms. With these two exceptions, all other fish distribution information recorded in this report and on the accompanying aquatic map was derived from an interpretation of pre-existing information on the FISS map and the field crew's observations of barriers in the watershed.

FIGURE 1. Map showing the location of the study area.

The riparian areas were outlined as polygons on copies of aerial photo mosaics produced in the 1996 overview study. These were then used as the basis for establishing sample sites in the field. A total of 41 sample sites were visited and the data was recorded onto MSExcel spreadsheet forms copied from the Ministry of Environment's Riparian Assessment Procedure web page. These were later transcribed into a digital copy of the same form. Riparian areas that were considered in need of treatment were presented, along with their priority, in a list in Table 19.

Final prescriptions were developed after all data had been reviewed and discussed among all members of the biological and technical team.

3.1 Data

Significant photographs are included in the text. A complete set of indexed photographs and negatives are included in a separate three ring binder. Habitat Survey Data Forms (Form 4), Fish Distribution Data Forms (Form 5) and the Habitat Diagnosis Summary Report (Form 6) are included in Appendix A. Field notes were recorded and transcribed into a digital file and are included in Appendix B. Riparian impacts were assessed using information presented in the Forest Practices Code Riparian Management Guidebook (Anon. 1995) and Watershed Restoration Technical Circular #6 (Oikos Ecological Services Ltd. 1996) and experience. The data from these assessments can be found in Appendix C. Copies of the complete report are available in the Ministry of Environment Library in Smithers, B.C.

For the purposes of this study, rainbow trout were considered to be juvenile steelhead.

3.2 Impacts

All affected areas were assessed for impacts to stream channels, fish passage, substrate, bank stability, riparian areas and quantity, quality and distribution of large woody debris (LWD). UTM coordinates and distances from reference points were recorded to locate each impact.

3.3 Prescriptions

Prescriptions were based on the techniques described in Watershed Restoration Technical Circular #9 (Slaney and Zaldokas 1997) and experience. In addition, nearby pristine sites with similar gross characteristics were used as templates to guide prescription development. Prescriptions were developed after all data had been reviewed and discussed by the biological and technical staff.

Prescriptions for restorative works are described at the conceptual level. Each prescription addresses a complete reach. Specific techniques used to implement these works are given in Watershed Restoration Technical Circular #9. In unique situations, detailed descriptions are given in the prescription itself.

3.4 Prescription Objectives

Prescriptions are of five major categories, the objectives of which are described as follows.

- Riparian Treatment

The objectives in planting and fill planting are to accelerate the growth of large trees to stabilize banks, provide temperature stability to the water, provide large woody debris input to the stream when the trees fall over, to provide organic litterfall to the stream and to provide protective cover for fish. These trees will also benefit other species of wildlife including birds, mammals, amphibians and invertebrates.

- Bank Stabilization

The placement of stabilizing structures on eroding banks will encourage growth of riparian vegetation, provide cover for fish and will reduce input of possibly undesirable sediment to the stream channel.

- Removal of Old Bridge and culvert Parts

The objective of these removals is to prevent the possible formation of a debris jam and subsequent torrent. The materials may also be useful in adding complexity to the stream channel. Another objective in removal is to ensure public safety.

- Complexing

The placement of large woody debris (LWD) and large rock debris (LRD) is to increase the quantity, quality and variety of habitat types.

- LWD and Boulder Placements

The objectives of these placements include direction of flow pattern, creation of variety of habitat type, protection of bank from erosion, provision of growing refugia for colonizing plants on bars and dissipation of energy during floods.

3.5 Cost Estimates

Cost estimates for restorative works were based on experience in restoration in the Kitsumkalum, Kitwanga and Kitsegukla River watersheds. Estimates of the time required for the professional and technical personnel to complete Site Surveys and Designs are provided, as well as similar estimates for professional riparian assessments. In addition, estimates of the costs of eventual construction are provided, although these estimates will necessarily be altered as a result of any Site Survey and Design work. The estimates do not include the costs of 'As-Built' surveys or reports and do not include the cost of any monitoring program to measure effectiveness of treatments.

The relatively big trees required by this energetic stream were estimated to cost $200 delivered to a staging area. Likewise, a value of $50 was used to estimate the cost of the relatively large boulders required. Since only about 5 trees of this size can be accommodated in a self loading logging truck, and since each rock of 1 m^3 will weigh approximately 3,000 kg, thereby limiting the number that could be carried by a dump

truck, most of these estimated costs are made up of transportation costs and assume that the material will be obtained free of charge.

Estimates of the costs for helicopter transport of LWD and boulders were based on an assumption that a round trip for each piece would take 1.5 minutes, which is realistic if the staging area is higher than the delivery point, the staging area is within 500 m of the delivery point, chokers are not a limiting factor and the helicopter is not used for final positioning. The estimates also assume the use of an helicopter large enough to carry one complete tree with branches and root wad intact and with a dbh of at least 1 m, or two boulders at least 1 m along the intermediate axis.

Although the cost of a large helicopter may seem intimidating when compared to other methods of delivery of LWD and boulders, their use is usually far less damaging to the existing riparian and stream channel habitat than other methods.

Finally, the estimated costs of some of the prescriptions may also seem intimidating, but when compared to the value of the wood removed, the value of the wood that may grow on these sites once they reach a more stable state, and the value of the fish resources the treatments are intended to benefit, their apparent expense is justifiable.

3.6 Miscellaneous

This assessment was conducted from December, 1998 until the middle of February, 1999 during a winter that featured record snowfalls. The weather resulted in the loss of five days where the crew attempted to get into the watershed but could not. Deep snow conditions limited what was visible during assessment so that only gross damage could be observed. While the crew was satisfied that they found and assessed the majority of the significant sites, this limitation may have resulted in missing some problems and misinterpreting others. A quick reconnaissance on the ground, prior to finalizing future work plans should be conducted in order to confirm and refine the prescriptions.

Sample tender documents are given in Appendix H for prescriptions involving Riparian Assessment, Site Survey and Design and Restorative Works.

4 Results and Discussion

4.1 General Description

Coldwater Creek probably offered extensive and excellent habitat for fish in the past. The lower mainstem and associated tributaries in particular were likely highly productive. Although the area was logged extensively, beginning in the early 1970's, the riparian area had generally regenerated an adequate cover of regenerating trees. The mainstem featured extensive bank erosion, channel instability and lack of cover, whereas the tributaries suffered mainly from problems at road crossing.

4.2 Location

Coldwater Creek flowed into the west side of the Lakelse River at UTM 9.524000.6026900. Its location is shown on the map in Figure 1 and on the large scale maps accompanying this report.

4.3 Access

Coldwater Creek was reached by traveling south approximately 63 km from Terrace, past Onion Lake, to the turnoff at the Onion Lake Cross-Country Ski Trails. Proceeding west on the Upper Wedeene FSR across the valley, and then turning north onto the Lakelse FSR, took the crew to the main bridge over Coldwater Creek, a distance of approximately 11 km. The Lakelse FSR carried the crew to the Silvertip Creek area near the mouth of the Coldwater, an additional distance of approximately 10 km. The total distance from Terrace to the Silvertip area, the most distant part of the watershed, was approximately 84 km one way.

4.4 Mainstem

4.4.1 Reach 1 - Prescription 1

Length and Location

Reach 1 extended 7.6 km from its confluence with the Lakelse River at UTM 9.524000.6026900, upstream to a point approximately 1 km downstream from the main crossing of Coldwater Creek on the Lakelse FSR, at UTM 9.523480.6021560.

Access

This section of the stream was reached by snow machine on two roads that leave the Lakelse FSR. One road, the Trib 10 Road (see 1:20,000 map) provided access to the former lower Coldwater bridge site by traveling approximately 250 m east from 14.5 km on the Lakelse FSR. The other road, the Boot Creek Road, provided access to the lower central portion of Coldwater Creek. It left the Lakelse FSR at 11.5 km and traveled 1.6 km southeast to the old bridge site.

Habitat Assessment

The average channel gradient in Reach 1 was approximately 1.5% and the bankfull width was approximately 20 m. Reach 1 featured good off channel habitat for rearing salmonids and good variety of other habitat types. There were some deep pools for holding. There was bank erosion at a significant number of sites. An elevated bar at the mouth of Johnstone Creek and the gravel deposit at the mouth of Coldwater Creek at the Lakelse River were taken as evidence that there was a significant problem with excessive bedload sediment being transported. There were a number of likely sources of sediment above and in this reach. The sediment included a significant concentration of fines which appeared to fill in the interstitial spaces in the gravel, thereby likely making it difficult for fish to dig redds. There were also a number of sites where large log jams were apparently causing the stream to divert. These may be a natural and beneficial part of the dynamics of this reach.

The reach was formerly crossed at two locations by bridges that have since been removed, probably by floods. These two sites featured bank instability and the remains of the old bridges. The approaches to these bridges, composed of a mixture of course and fine materials, were unstable and were considered to pose a threat to fish habitat in the future.

A 200 m long former channel of Coldwater Creek at its mouth at the Lakelse River likely flowed southeast during higher water events (see Figures 2, 3 and 4). This channel apparently became abandoned through aggradation of sediments sometime in the last 50 years and the stream currently flows northeasterly into the Lakelse. This old channel may offer opportunity for development as improved fish habitat.

There was evidence of erosion problems along the Boot Creek Road, northwest of the old bridge site.

FIGURE 2. Aerial Photograph BC 47 Number 9 of the mouth of Coldwater Creek, taken sometime between 1936 and 1940.

FIGURE 3. Aerial Photograph 30BC88019 Number 031 of the mouth of Coldwater Creek, taken in 1988.

FIGURE 4. Aerial photograph of the mouth of Coldwater Creek from the photomosaic taken in 1995 (Triton 1996).

Fisheries Assessment

The FISS map records coho, chinook, sockeye, chum, pink, steelhead, cutthroat and Dolly Varden in this reach. It also reports critical spawning habitat for pink and chum salmon.

Riparian Assessment

Approximately 60% of this reach is bordered by an old growth coniferous forest. There were other portions of the reach where logging had encroached on the riparian management area. There were also a few places where either the logging occurred to the stream's bank or the stream had meandered into the cutblock. With one exception, all of these logged areas had grown back in conifers and did not appear to require any treatment. The exception was an approximately 200 m length of the right (east) bank between the lowermost former road bridge crossing and the railway bridge. This polygon is labeled B' on the accompanying riparian map and was part of opening polygon 52, number 143 on the Forest Cover Map.

Impact Descriptions

- There was significant bank erosion at a number of sites throughout the reach.

Photo 1. Looking east at a large eroding bank that was breaching through the buffer strip into the cut block.

- There was an excess of bedload sediment moving through Reach 1 and, in some places of deposition, aggrading the channel.

Photo 2. Looking northwest downstream at Coldwater Creek junction from Johnstone Creek. Note the elevated bar in Coldwater Creek.

There were some large log jams, especially in the upper part of the reach. These were likely increasing the channel instability downstream but contributed to creating good fish habitat at the jams.

Photo 3. Looking north downstream at logjam and main Coldwater channel at 702 meters below the second bridge site.

Two former bridge sites were considered unstable.

Photo 4. Looking east at bridge cribbing at second bridge site over the Coldwater.

- Some riparian areas had been logged but were apparently stable with newly regenerating coniferous forest. There was one exception, in Polygon B', that will require assessment and treatment.
- There were problems of erosion over a 500 m section of the Boot Creek Road adjacent to the northwest side of the old bridge crossing.

Limiting Factors
The following factors may limit fish production in this reach.
Sediment input rate and the quantities of sediment transported during high water events may harm fish habitat in this reach and further downstream in the Lakelse River.

Priority for Treatment
Since this reach supported all salmonid species, and since the sediment may have adversely affected not only Coldwater Creek but Lakelse River habitat, the treatment of this reach was accorded a high priority.

Conceptual Prescriptions for Restoration
- The majority of the sediment residing in and moving through this reach likely came from the reaches above. Prescriptions for treatment of these problems are given

under the appropriate reaches. These problems should be fixed first, beginning with Tributaries 660 and 670 that flow into the lower part of Reach 6.

- Prescription 1a. Bank erosion in this reach was not distributed uniformly throughout the reach as it was in Reaches 2, 4 and 5. As a result, the following estimates of the number of pieces of LWD and their associated rock anchors are based on estimates for the restoration of a number of specific sites.
  - Bank erosion at specific sites throughout this reach should be treated by placement of large logs, complete trees, root wads and boulders along the bases of eroding banks. The banks should then be planted with deciduous shrubs in the form of cottonwood (*Populus trichocarpa*) and alder (*Alnus spp*.) whips. At appropriate places, such as the outsides of bends in the stream, artificial log jams should be created. The exact number, size and placement of LWD and boulders will be determined during the Site Survey and Design. Approximately 75 pieces of wood (trees complete with root wads and branches intact, preferably cedar, >75 cm dbh and >15 m long) and 75 boulders (> 80 cm in intermediate diameter) will be required. No local sources of available wood or boulders were observed. Prior to performing this work, a Type II Site Survey and Design will be required. Please refer to Appendix G for a description of the requirements for this preliminary work.
- Prescription 1b. After removal of the old bridge abutments at the two former road crossings over Coldwater Creek, the bridge approaches and the banks in the immediate vicinity of the two old bridge crossings should be pulled back to a slope less than 100% with respect to the horizontal plane. Prior to performing this work, a Type I Site Survey and Design will be required for each site. Please refer to Appendix G for a description of the requirements for this preliminary work. This work should be eligible for funding from the Roads, Hillslopes and Gullies component of the WRP.
- Prescription 1c. The old channel near the mouth should be assessed for its potential for development as improved fish habitat to compensate for habitat irreparably damaged in the Coldwater system. This assessment should be conducted jointly by a geoscientist and a biologist. A Type III Site Survey and Design will be required. Please refer to Appendix G for a description of the requirements for this preliminary work. It is recommended that the assessment team spend a day on site first to decide whether to proceed before committing to the Site Survey and Design. The cost of development of this channel would be approximately $30,000.
- Prescription 1d. The Boot Creek Road should be permanently de-activated with the construction of suitable water bars to correct problems of erosion, at least along a 500 m section of the road adjacent to the northwestern side of the old bridge site on Coldwater Creek. This work should be eligible for funding from the Roads, Hillslopes and Gullies component of the WRP.

- The riparian area in Polygon B' should be assessed by a joint team of an RPF, a geoscientist and a biologist. The team should
  - determine whether it is feasible to reduce erosion into the riparian area, and, if so,
  - determine how to reduce erosion into the riparian area, and

- prescribe works to reduce the erosion and to re-populate the area with conifers.

Species and Life Stage Targets
These treatments may benefit all salmonid species, but in particular may benefit the chinook population.

Regulatory Agency Approval Required
- The placement of wood and rocks, and the removal of the old bridge sites will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from the MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- The Site Survey and Design work should include an assessment of fish species distribution and relative abundance at the Design Site. Any attempts to capture fish will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert.

Economies of Scale
The use of the helicopter and excavator should be coordinated with similar work elsewhere in the region so that the costs of ferry time are minimized.

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
Since there were major sources of eroding sediment upstream, those problems should be fixed before work is done in Reach 1. As the reach is known to contain critical habitat for chinook at least, the least risk to this species would occur if work was conducted between June 1 and July 31 and during low water conditions (see Appendix E). Steelhead and cutthroat eggs could be at risk at this time of year, so that care should be exercised when working in or around the stream.

Estimated Costs

TABLE 1. Estimated Costs for Prescription 1

Prescription 1. Reach 1				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Prescription 1a. Estimated Costs for the Type II Site Survey and Design in Reach 1				
Fees				
Biologist	day	500	16	8000
Geoscientist	day	600	6	3600
Technician	day	400	16	6400

Prescription 1. Reach 1				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Expenses				
Vehicle Rental	day	51	12	612
Mileage	km	0.37	3000	1110
Construction Drawings	sheet	25	10	250
Reports	report	20	10	200
Camera and Film	film roll	35	3	105
			Total Cost	$20,277
Prescription 1b. Estimated Costs for the Type I Site Survey and Design at the bridge site				
Fees				
Biologist	day	500	2	1000
Technician	day	400	2	800
Expenses				
Vehicle Rental	day	51	1	51
Mileage	km	0.37	400	148
Construction Drawings	sheet	5	10	50
Reports	report	10	10	100
Camera and Film	film roll	35	1	35
			Total Cost	$2,184
Prescription 1c. Estimated Costs for the Type III Site Survey and Design near the mouth				
Fees				
Biologist	day	500	12	6000
Geoscientist	day	600	6	3600
Technician	day	400	12	4800
Expenses				
Vehicle Rental	day	51	6	306
Mileage	km	0.37	2000	740
Survey Equipment	week	350	1	350
Survey Supplies	project			100
Mapping	topo map	50	3	150

Prescription 1. Reach 1				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Construction Drawings	sheet	25	10	250
Reports	report	50	10	500
Camera and Film	film roll	35	5	175
			Total Cost	$16,971
Prescription 1d. Estimated Costs for the road de-activation on Boot Creek Road				
Fees				
Geoscientist	day	600	2	1200
Technician	day	400	2	800
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	700	259
Excavator	day	1200	1	1200
Mob/Demob	day	600	1	600
			Total Cost	$4,161
Prescription 1e. Estimated Costs for the assessment of riparian Polygon B'				
Fees				
Geoscientist	day	600	2	1200
RPF	day	600	2	1200
Biologist	day	500	2	1000
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	700	259
			Total Cost	$3,761
Estimated Costs for Construction (Bridge removal and LWD and rock placement)				
Fees				
Biologist	day	500	15	7500
Technician	day	400	25	10000
Labour	day	300	40	12000
Expenses				
Helicopter	hr	8000	2.9	23200
Wood & Rock	project			18750

Prescription 1. Reach 1				
Category	Units	Rate ($/unit)	Qty	Cost ($)
50 kg Grass Seed & Local Planting Stock	project			500
Excavator	day	1200	5	6000
Mob/Demob	day	600	2	1200
Vehicle Rental	day	51	35	1785
Mileage	km	0.37	8000	2960
			Total Cost	$83,895

4.4.2 Reach 2 - Prescription 2

Length and Location

Reach 2 extended 1.5 km from a point approximately 1 km below the main bridge crossing of Coldwater Creek on the Lakelse FSR at UTM 9.523480.6021560, upstream, through a widely denuded section, past the bridge, to the downstream end of a section confined by bedrock, at UTM 9.523060.6020140.

Access

This section of the stream was reached from the Lakelse FSR at the bridge at 6.5 km.

Habitat Assessment

The average channel gradient in Reach 2 was approximately 2% with a bankfull width of from 40 to 90 m with an average of approximately 60 m. It featured minor braiding but the excessively wide denuded bars were taken as evidence of an highly unstable channel. The channel exhibited no pools but consisted mainly of riffle and glide habitat. This section was relatively shallow (~ <0.2 m) with no overwintering habitat. There were some large logs but these were generally approximately 2 m above the water level on bars and were not functional in creating habitat complexity. Cover was lacking, with the main cover in the form of boulders. Many of the banks were eroding and the bars were generally not vegetated, except for small refuge areas near LWD. There was an abundance of gravels suitable for spawning in the glides and in the elevated bars. The bridge crossing on the Lakelse FSR was recently built and in stable condition. The FISS map records a 2 m high bedrock falls at the lower reach boundary. The field crew described this as being 0.5 m high at low water, flowing into a 3 m deep pool, and did not consider it to be a barrier to most fish species. It may be a barrier to upstream migration of adult pinks. The stream was constricted at this point to a bankfull width of approximately 10 m.

To the south of the section below the FSR bridge, there was a network of flood channels that flowed into End Creek. Since the south side banks were eroded, there was a concern that the mainstem stream could breach through the banks and flow into End Creek. This would result in the loss of some critical chinook spawning habitat.

Fisheries Assessment

The FISS map records critical chinook spawning habitat just above the mouth of End Creek. Coho, rainbow and Dolly Varden are reported above this reach.

Riparian Assessment

Logging had occurred to both banks over the portion below the Lakelse FSR bridge. This area had grown in, mostly in conifers on the north side and mostly deciduous on the south side. Above the bridge, there was an adequate leave strip of old growth forest in the Riparian Management Area.

Impact Descriptions

- The channel in Reach 2 was very unstable.
- There was an excessive amount of bedload sediment in the channel and deposited in elevated bars.
- There was a general lack of cover for fish.
- The denuded bars were up to 90 m wide.

Photo 5. Looking downstream from the Lakelse FSR bridge over Coldwater Creek. Note the widely eroded channel.

- LWD in the reach was perched on the elevated bars and was non-functional.
- The riparian area had been logged to both banks below the main bridge.
- There was significant bank erosion throughout this reach.

Photo 6. Looking downstream and SE from approximately 200 m d/s from the main bridge. This photo shows the extend of erosion in this area, where the denuded floodplain was >80 m wide.

Priority for Treatment

Since this reach had been extensively damaged and contained critical spawning habitat, at least for chinook, its treatment was considered of high priority.

Limiting Factors

The following factors may limit fish production in this reach.

Channel and bank instability, excessive bedload sediment, lack of functional LWD and cover and lack of LWD recruitment potential over the next 100 years likely limit fish production.

Conceptual Prescriptions for Restoration

- Based on the assumption that the 1 km section of this reach from the Lakelse FSR bridge downstream should hold at least 2 LWD pieces/bankfull width (Johnston and Slaney 1996, Cedarholme et al 1997) in order to be classified as good habitat, and using the sample weighted mean bankfull width of 59 m, approximately 34 pieces are required as functional LWD in this reach. Sampling implied that 51 pieces were present. This notwithstanding, the evaluation team concluded that the reach probably held significantly more functional and very large LWD in the past and that this reach and the reaches downstream would benefit from having more LWD installed. In addition, the method of analysis used was not considered reliable as the observed bankfull width may have been an artifact of a one time flood event that resulted from a debris torrent when the main bridge collapsed upstream. Approximately 75 pieces

of LWD and an equal number of boulder anchors should be added to this reach. This added wood would increase the LWD/bankfull width ratio to 7.4.

- The LWD, in the form of complete trees with root wads intact, should be placed along the sides in the channel, with approximately 50% of the structures in the wetted channel during low flow conditions in order to stabilize it, provide cover, generate habitat complexity and dissipate energy during floods. As this reach is highly energetic at times, the LWD should be stacked and anchored together, with the root wad ends upstream. Each piece should be anchored to a boulder with steel cable. At least some of this LWD should be placed in the form of stacks to overcome buoyancy and as triangulated structures lodged against existing immobile features. The LWD should also not be distributed uniformly throughout the reach but should rather be placed to exploit natural 'jam' sites wherever possible.
- In addition, approximately 30 pieces of LWD anchored to 30 boulders should be placed on and along the bases of eroding banks to form revetments against erosion and then the banks should be planted with locally available cuttings of deciduous trees and shrubs and coniferous trees obtained locally along road edges.
- Another 20 pieces of LWD anchored to an equal number of boulders should be placed to minimize braiding in the reach and to increase water depth by concentrating normal flows into a single channel.
- A helicopter should be used to deliver the LWD and rock from a staging area in the Lakelse FSR bridge area. An excavator should be used for final placement of LWD and rocks. This would necessitate crossing the creek at two points with the machine. Although there would be less damage done to the bars by the machine working during frozen and snow covered winter conditions, the quality of the placements would be higher and the risk to coho and chinook eggs in the stream would be less if the work was done during low water conditions from July through October. Steelhead and cutthroat eggs would be at risk at this time of year, and therefore, care should be taken to avoid likely redd sites of these species.
- All of the above work will require very large LWD (>1 m dbh and > 15 m long) and generous use of large boulders (>1 m b axis) anchored to the LWD with galvanized steel cable (>1.5 cm diameter, ~ 5 m/anchor) using the Hilti Epoxy system.
- Prior to any of the work described above, a Type II Site Survey and Design will be required to determine the exact number and sizes of the materials to be used and to specify exact locations and orientations of the material. This Site Survey and Design should be conducted by a biologist with support from a geoscientist. Please refer to Appendix G for detailed requirements of the Site Survey and Design process and Figure 5 for a site plan map.

- The riparian areas of Polygon H should be assessed by an RPF for treatment prescriptions. Treatments that should be considered include thinning of the young conifers on the north side and fill planting and minor conifer release on the south side. The south side may also benefit from planting young deciduous trees to provide a cover for young conifers when the existing overstorey of deciduous trees decays. This assessment should be done in conjunction with the assessment of the riparian area around End Creek.

FIGURE 5. Diagram showing the conceptual plan for restorative works in Reach 2 of Coldwater Creek.

Species and Life Stage Targets

These treatments may benefit coho, chinook and steelhead during all freshwater stages in their life cycles, and would likely benefit cutthroat and Dolly Varden during all stages of their life cycles.

Regulatory Agency Approval Required

- The placement of wood and rocks will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- The Site Survey and Design work should include an assessment of fish species distribution and relative abundance at the Design Site. Any attempts to capture fish will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

The use of the helicopter and excavator should be coordinated with similar work elsewhere in the region so that the costs of ferry time are minimized.

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

Since there were major sources of eroding sediment upstream, those problems should be fixed before work is done in Reach 2. As the reach is known to contain critical habitat for chinook at least, the least risk to this species would occur if work was conducted between June 1 and July 31 and during low water conditions (see Appendix E). Steelhead and cutthroat eggs could be at risk at this time of year, so that care should be exercised when working in or around the stream.

Estimated Costs

TABLE 2. Estimated Costs for Prescription 2

Prescription 2. Reach 2				
Estimated Costs of Site Survey and Design				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	7	3500

Geoscientist	day	600	3	1800
Technician	day	400	10	4000
Expenses				
Vehicle Rental	day	51	6	306
Mileage	km	0.37	1200	444
Construction Drawings	sheet	25	10	250
Reports	report	20	10	200
Camera and Film	film roll	35	3	105
			Total Cost	$10,605
Estimated Cost of Riparian Assessment				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	4	2400
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	400	148
			Total Cost	$4,250
Estimated Cost of Construction				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	15	7500
Technician	day	400	30	12000
Labour	day	300	60	18000
Expenses				
Helicopter	hour	8000	4.7	37600
Wood & Rock	project			31250
50 kg Grass Seed & Local Planting Stock	project			500
Excavator	day	1200	5	6000
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	25	1275
Mileage	km	0.37	6000	2220
			Total Cost	$116,945

4.4.3 Reach 3

Length and Location

Reach 3 extended 0.5 km from UTM 9.523060.6020140, upstream through a canyon section to UTM 9.523060.6019740.

Habitat Assessment

This section of the stream was confined by and deeply incised into bedrock and was considered a canyon. It featured an average channel gradient at its upper end of approximately 7%. Much of it could not safely be walked and no habitat condition sampling was done. Only the bottom and the top of the reach were entered. At these locations there were deep pools and the habitat appeared to be in good condition. The substrate was mostly boulders and bedrock.. A falls over bedrock of approximately 1 m in height was observed from a helicopter but this was not considered a total barrier to anadromous adult salmonids at any flows.

Photo 7. Looking west upstream in Coldwater Creek canyon above main FSR bridge.

Fisheries Assessment

Both coho and rainbow were recorded on the FISS map above this reach, suggesting that at least these two species use this reach for migration. It was considered possible that this canyon section could offer overwintering habitat for cutthroat trout and Dolly Varden.

Riparian Assessment

The south side was bordered by an adequate leave strip of old growth coniferous forest. Logging had occurred close to the stream bank on the north side. Both sides, however,

featured high, bedrock banks rising approximately 15 m from the stream before breaking. The encroachment of the logging on the north side had not adversely affected the stream. The cutblock on the north side was covered by a healthy regenerating young forest of coniferous trees.

Impact Descriptions
No evidence of logging related damage was observed in this reach. No treatment was warranted.

4.4.4 Reach 4 - Prescription 3

Length and Location

Reach 4 extended 0.8 km from the top end of the canyon section, at UTM 9.523060.6019740, upstream through a widely eroded section to a point approximately 100 m above the Trib 30 mouth, at UTM 9.522406.6019500.

Access

Access to this reach was gained by walking from the eroded end of the Coldwater FSR. A trail had been cut around the eroding bank to provide ATV and snow machine access to the rest of the Coldwater FSR. There was an old logging road that approached the north bank from the north, but was likely impassable without upgrading.

Habitat Assessment

Reach 4 consisted of a widely denuded floodplain very similar to Reach 2. The stream morphology was homogeneous, consisting mostly of riffle, with a predominantly boulder and cobble substrate. The average channel gradient was approximately 2% and the bankfull width was up to 70 m. The channel appeared to be very unstable. Bank erosion was extensive. At one 15 m high eroding bank on the south side, the Coldwater FSR had been removed over a distance of approximately 70 m. An extensive off-channel area was observed on the north side of the mainstem and running parallel to it. This area had been logged over and was apparently occupied by beavers. It appeared to offer good rearing habitat. This area was not visited on the ground but was observed from a helicopter in late winter. Although the snow depth was approximately 1 to 2 m, there did not appear to be sufficient re-stocking of conifers.

Fisheries Assessment

The FISS map records critical coho spawning habitat in this reach. It also reports Dolly Varden and rainbow above this reach. This suggests that steelhead likely use this reach, at least for migration. It is likely that cutthroat trout also use this reach.

Riparian Assessment

Except for approximately 200 m along the northwestern end of this reach, which was covered in old growth coniferous forest, the majority of this reach had been logged, so that, either through the logging, or through bank erosion, most of the stream had no protective leave strip. Bank erosion appeared to be actively removing riparian vegetation. The logged riparian areas were covered in an apparently healthy young forest of conifers. The off channel habitat on the north side was not sufficiently re-stocked with conifers.

Impact Descriptions

- The channel was very unstable.
- There was a general lack of LWD.
- There was a lack of cover for fish.
- There was a lack of habitat variety.
- There was extensive bank erosion.
- There was a lack of large conifers in the majority of the riparian area.

- Existing riparian vegetation was being eroded.
- The FSR on the south side was eroded into the stream channel and was a danger to the public.

Photo 8. Looking west from the easterly edge of eroded road at the largest site of bank erosion in the watershed.

Priority for Treatment

Since this reach had been extensively damaged and contained critical spawning habitat, at least for coho, its treatment was considered of high priority.

Limiting Factors

The following factors may limit fish production in this reach.

Channel and bank instability, excessive bedload sediment, lack of functional LWD and cover, lack of LWD recruitment potential over the next 100 years and lack of habitat variety likely limit fish production.

Conceptual Prescriptions for Restoration

- Prescription 3a. The largest eroding bank, on the south side, is a special case. The rate of erosion of this bank was not considered likely to decrease without intervention. Further loss of the road and the regenerating forest above was considered likely. Since pulling back this high bank to a lower angle was not considered feasible, an alternative that would allow the bank to reach a stable state long enough for vegetation to become established is required. A retaining structure should be built of log and rock cribbing. It should run along the entire base of the eroding bank but be positioned approximately 10 m out from the toe of the slope. It should be approximately 2.5 m high and could be constructed by placement of two

rows of a stack of logs, three logs high, and will require a total of 30 logs. The two rows should be spaced approximately 0.5 m apart, all logs should be tied together with steel cable and the interstitial space filled with rock.

  - Logs could be delivered to the end of the eroded Coldwater FSR and then dropped down the bank by a self loading logging truck. Some such structures were used on the Kalum River log drive and are still in place after 45 years. This structure should exclude the highest energy flows of flood events from the bank while acting as a dam to impound sediment falling from the bank. This structure may require periodic maintenance by removal of impounded sediment as the bank erodes more until a stable angle of repose is reached (see Figure 6). Access to for a machine to effect this periodic maintenance could be gained from upstream at the Tributary 30 - Coldwater Creek confluence (see Figure 7).

- Prescription 3b. Based on the assumption that this 800 m long reach should hold at least 2 LWD pieces/bankfull width (Johnston and Slaney 1996, Cedarholme et al 1997) in order to be classified as good habitat, and using the sample weighted mean bankfull width of 17.5 m, approximately 92 pieces are required as functional LWD in this reach. Sampling implied that 82 pieces were present. This notwithstanding, the evaluation team concluded that the reach probably held significantly more functional and very large LWD in the past and that this reach and the reaches downstream would benefit from having more LWD installed. Approximately 50 pieces of LWD and an equal number of boulder anchors should be added to this reach. This amount of additional wood would increase the LWD/bankfull width ratio to 2.9.
  - The LWD, in the form of complete trees with root wads intact, should be placed along the sides in the channel, with approximately 50% of the structures in the wetted channel during low flow conditions in order to stabilize it, provide cover, generate habitat complexity and dissipate energy during floods. As this reach is highly energetic at times, the LWD should be stacked and anchored together, with the root wad ends upstream. Each piece should be anchored to a boulder with steel cable. At least some of this LWD should be placed in the form of stacks to overcome buoyancy and as triangulated structures lodged against existing immobile features. The LWD should also not be distributed uniformly throughout the reach but should rather be placed to exploit natural 'jam' sites wherever possible.
  - In addition, approximately 30 pieces of LWD anchored to 30 boulders should be placed on and along the bases of eroding banks to form revetments against erosion and then the banks should be planted with locally available cuttings of deciduous trees and shrubs and coniferous trees obtained from the margins of the road along the Coldwater FSR.
  - Approximately 25 pieces of LWD, each anchored to a boulder, should be placed on the elevated bars in this reach to provide shelter for colonizing plants. These areas should then be planted, mainly with locally available cuttings from cottonwood, willow and alder.

FIGURE 6. Sketch of the retaining structure for reducing sediment input at a large eroding bank in Reach 4.

- A helicopter should be used to deliver the LWD and rock from the Coldwater FSR. An excavator should be used for placement of LWD and rocks. This would likely necessitate crossing the creek, with the number of crossings dependent on the point of access. Two points of access may be possible (see Figure 7). The first is via a small spur road off the Coldwater FSR approximately 350 m west of the easternmost eroded end of the road. The second point of possible access is at the Coldwater FSR crossing of Trib 30. Although there would be less damage done to the bars by the machine working during frozen and snow covered winter conditions, the quality of the placements would be higher and the risk to coho eggs in the stream would be lesser if the work was done during low water conditions from July through October. Although steelhead and cutthroat eggs would be at risk at this time of year, they were not considered likely to be present in this reach.
- All of the above work will require very large LWD (>1 m dbh and > 15 m long) and generous use of large boulders (>1 m b axis) anchored to the LWD with galvanized steel cable (>1.5 cm diameter, ~ 5 m/anchor) using the Hilti Epoxy system.
- Prior to any of the work described above, a Type II Site Survey and Design will be required to determine the exact number and sizes of the materials to be used and to specify exact locations and orientations of the material. This Site Survey and Design should be conducted by a biologist with support from a geoscientist. Please refer to Appendix G for detailed requirements of the Site Survey and Design process. and Figure 7 for a site plan map.
- The FSR on the south side should be permanently deactivated. Berms and warning signs should be placed at least 100 m back from the eroded ends of this road to prevent vehicular access and accident by members of the public.
- Please refer to Figure 7 for a site plan map showing conceptual restoration sites.

- Polygon I' requires assessment by a team comprised of an RPF and a biologist to determine if treatment of the insufficiently re-stocked area surrounding the off channel habitat is a significant concern, and, if it is, what treatment is required. The assessors should consider limiting the area that beavers can exploit by placing guards around existing and newly planted trees, and methods for accelerating the re-colonization of the area by conifers.

FIGURE 7. Drawing showing conceptual plans for restoration in Reach 4.

Target Species and Life Stage

These treatments may benefit coho and steelhead during all freshwater stages in their life cycles, and would likely benefit cutthroat and Dolly Varden during all stages of their life cycles. The treatment of the road may benefit humans, especially adolescent recreational vehicle operators.

Regulatory Agency Approval Required

- The placement of wood and rocks will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- The Site Survey and Design work should include an assessment of fish species distribution and relative abundance at the Design Site. Any attempts to capture fish will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

The use of the helicopter and excavator should be coordinated with similar work elsewhere in the region so that the costs of ferry time are minimized.

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

Since there were major sources of eroding sediment upstream, those problems should be fixed before work is done in Reach 4. As the reach is known to contain critical habitat for coho at least, the least risk to this species would occur if work was conducted between June 15 and August 15 and during low water conditions (see Appendix E). Steelhead and cutthroat eggs could be at risk at this time of year, so that care should be exercised when working in or around the stream.

Estimated Costs

TABLE 3. Estimated Costs for Prescription 3

Prescription 3. Reach 4				
Estimated Costs for Site Survey and Design				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	7	3500

Geoscientist	day	600	3	1800
Technician	day	400	10	4000
Expenses				
Vehicle Rental	day	51	6	306
Mileage	km	0.37	1200	444
Construction Drawings	sheet	25	10	250
Reports	report	20	10	200
Camera and Film	film roll	35	3	105
			Total Cost	$10,605
Cost Estimates for Riparian Assessment				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	4	2400
Biologist	day	500	4	2000
Technician	day	400	8	3200
Expenses				
Vehicle Rental	day	51	3	153
Mileage	km	0.37	400	148
			Total Cost	$7,901
Estimated Costs of Construction				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	15	7500
Technician	day	400	20	8000
Labour	day	300	40	12000
Expenses				
Helicopter	hour	8000	4	32000
Wood & Rock	project			26250
50 kg Grass Seed & Local Planting Stock	project			500
Excavator	day	1200	5	6000
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	25	1275
Mileage	km	0.37	6000	2220
			Total Cost	$96,345

4.4.5 Reach 5 - Prescription 4

Length and Location

Reach 5 extended 3.5 km from a point 100 m above the mouth of Trib 30, at UTM 9.522406.6019500, upstream and past the uppermost collapsed bridge on the Coldwater FSR to the mouth of Trib 670, at UTM 9.519900.6020670.

Access

The Coldwater FSR provided access along the south side of this reach. This road was not passable by vehicles and would require upgrading to provide access. This road is dealt with separately in this report under its own heading. West Fraser Mills Ltd. plans to log areas on the south side upstream from the collapsed bridge crossing in 2001. Presumably, the company will have to upgrade the Coldwater FSR at least as far as the collapsed bridge.

Habitat Assessment

The average channel gradient in Reach 5 was approximately 2% and the bankfull width averaged 30 m but was up to 50 m wide in some places. The channel was unstable, there were denuded and elevated bars, extensive riffles and there was bank erosion. A significant amount of LWD was present but was clumped in distribution and tended to be located on the bars so that they were not functional at lower flow conditions. The channel substrate was mostly boulders and cobbles, with the boulders and limited amounts of LWD provided cover. There were some good deep pools present.
The remains of a collapsed bridge were still present at the uppermost former road crossing.

The upstream limit of this reach was defined at the mouth of Tributary 670 which enters from the north. This tributary and the next tributary upstream on the same side may be significant, if not ultimate, sources of destabilizing quantities of eroding sediments in the Coldwater system. It was not possible to fully assess this hypothesis due to snow depth. In any case, the road crossings of these two tributaries as well as others further upstream should be assessed and problems rectified before any of the treatments specified for Reaches 1,2, 4 or 5. Work associated with these tributaries should be eligible for funding from the 'upslope' part of the WRP.

Fisheries Assessment

The FISS map recorded Dolly Varden and rainbow in this reach. It likely also supported cutthroat trout.

Riparian Assessment

The north side riparian area was covered by an intact, old growth, coniferous forest upstream to the former bridge crossing. Upstream from there, the riparian area had been encroached on by logging from 1980 to 1987. A thin buffer strip of old growth forest remained intact along most of the stream. Approximately 60% of the length of the

stream's south side riparian area had been logged and had no buffering strip of old growth trees. These logged areas had since been recovered by a young coniferous forest approximately 5 m in height. The effects of leader weevil were observed in more than half of the regenerating spruce trees. The five year plan recorded this area as having undergone re-stocking and the trees as free to grow.

Impact Descriptions

- The channel was unstable.
- The channel was denuded over a wide area.
- There was significant bank erosion.
- The original stream would likely have contained more functional LWD in the wetted channel than was observed during this study.
- There was a collapsed bridge crossing on the Coldwater FSR.

Photo 9. Looking northwest from the southern side of the uppermost road crossing on Coldwater Creek.

- There were several places where water left the mainstem to flow through riparian areas on the south side of the stream.
- Some of the riparian area had been logged.

Priority for Treatment

Since this reach had been extensively damaged and may be the initiating source of instability downstream that affects habitat all the way down and into the Lakelse River, its treatment was considered of high priority.

Limiting Factors

The following factors may limit fish production in this reach.

Channel and bank instability, excessive bedload sediment, lack of functional LWD and cover, lack of LWD recruitment potential over the next 100 years and lack of habitat variety likely limit fish production.

Conceptual Prescriptions for Restoration

- Based on the assumption that this 3.5 km long reach should hold at least 2 LWD pieces/bankfull width (Johnston and Slaney 1996, Cedarholme et al 1997) in order to be classified as good habitat, and using the sample weighted mean bankfull width of 26.6 m, a minimum of approximately 263 pieces are required as functional LWD in this reach. Sampling implied that there were 259 pieces present. This notwithstanding, the evaluation team concluded that the reach probably held significantly more functional and very large LWD in the past and that this reach and those downstream would benefit from having more LWD installed. Approximately 100 pieces of LWD and an equal number of boulders will be required. This additional wood would bring the LWD/bankfull width ratio up to 2.8.
- The LWD, in the form of complete trees with root wads intact, should be placed along the sides in the channel, with approximately 50% of the structures in the wetted channel during low flow conditions in order to stabilize it, provide cover, generate habitat complexity and dissipate energy during floods. As this reach is highly energetic at times, the LWD should be stacked and anchored together, with the root wad ends upstream. Each piece should be anchored to a boulder with steel cable. At least some of this LWD should be placed in the form of stacks to overcome buoyancy during floods, and as triangulated structures lodged against existing immobile features. The LWD should also not be distributed uniformly throughout the reach but should rather be placed to exploit natural 'jam' sites wherever possible.
- In addition, approximately 50 pieces of LWD anchored to 50 boulders should be placed on and along the bases of eroding banks to form revetments against erosion and then the banks should be planted with locally available cuttings of deciduous trees and shrubs and coniferous trees obtained from the margins of the road along the Coldwater FSR.
- Approximately 50 pieces of LWD, each anchored to a boulder, should be placed on the elevated bars in this reach to provide shelter for colonizing plants. These areas should then be planted, mainly with locally available cuttings from cottonwood, willow and alder.
- A helicopter should be used to deliver the LWD and rock from a staging site near the collapsed Coldwater FSR bridge. An excavator should be used for placement of LWD and rocks. The excavator could get onto the bars at the former bridge site or at other points downstream where the stream approached the road. There would likely be a need to cross the stream.
- The collapsed bridge in Reach 5 should be removed. The logs removed could be used in adding complexity to the stream. The banks should be pulled back and planted with locally available cuttings from deciduous trees and shrubs and coniferous trees obtained from the margins of the road along the Coldwater FSR.

- All of the above work will require very large LWD (>1 m dbh and > 15 m long) and generous use of large boulders (>1 m b axis) anchored to the LWD with galvanized steel cable (>1.5 cm diameter, ~ 5 m/anchor) using the Hilti Epoxy system.
- Prior to any of the work described above, a Type II Site Survey and Design will be required to determine the exact number and sizes of the materials to be used and to specify exact locations and orientations of the material. This Site Survey and Design should be conducted by a biologist with support from a geoscientist. Please refer to Appendix G for detailed requirements of the Site Survey and Design process.

Target Species and Life Stage

These treatments may benefit coho and steelhead during all freshwater stages in their life cycles, and would likely benefit cutthroat and Dolly Varden during all stages of their life cycles.

Regulatory Agency Approval Required

- The placement of wood and rocks will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- The Site Survey and Design work should include an assessment of fish species distribution and relative abundance at the Design Site. Any attempts to capture fish will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

The bridge removal and remedial work could be done in conjunction with any road upgrading that West Fraser Mills Ltd. undertakes.

The use of the helicopter and excavator should be coordinated with similar work elsewhere in the region so that the costs of ferry time are minimized.

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

Since there were likely major sources of eroding sediment upstream in at least two tributaries entering from the north, those problems should be fixed before work is done in Reach 5. As the reach probably contains critical habitat for coho at least, the least risk to this species would occur if work was conducted between June 15 and August 15 and during low water conditions (see Appendix E). Steelhead and cutthroat eggs could be at risk at this time of year, so that care should be exercised when working in or around the stream.

The bridge removal and remedial work could be done in conjunction with any road upgrading that West Fraser Mills Ltd. undertakes.

Estimated Costs

TABLE 4. Estimated Costs for Prescription 4

Prescription 4. Reach 5				
Estimated Costs for Site Survey and Design in Reach 5				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	16	8000
Geoscientist	day	600	6	3600
Technician	day	400	16	6400
Expenses				
Vehicle Rental	day	51	12	612
Mileage	km	0.37	3000	1110
Construction Drawings	sheet	25	10	250
Reports	report	20	10	200
Camera and Film	film roll	35	3	105
			Total Cost	$20,277
Estimated Costs of Construction				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	20	10000
Technician	day	400	30	12000
Labour	day	300	60	18000
Expenses				
Helicopter	hour	8000	7.5	60000
Wood & Rock	project			45000
50 kg Grass Seed & Local Planting Stock	project			500
Excavator	day	1200	7	8400
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	35	1785
Mileage	km	0.37	8000	2960
			Total Cost	$159,245

4.5 Tributaries

4.5.1 Silvertip Creek - Prescription 5

Size and Location

Silvertip Creek was a 2nd order stream (1:20,000) that flowed south and then east into Coldwater Creek just above the Lakelse River at UTM 9.523800.6026560.

Access

Silvertip Creek was crossed on a bridge at approximately 15 km on the Lakelse FSR. It was also accessible via the upper Silvertip Road and from the Middle Silvertip Road.

Habitat Assessment

Silvertip Creek was mostly a series of beaver dams and was considered likely to have been similar before the area was logged. Its average channel gradient was approximately 1% and the average bankfull width was approximately 30 m, except near the mouth where it was more confined. The channel was stable with the substrate composed mostly of organic fines. None of the beaver dams observed was considered likely to be a barrier to upstream migration at all flow conditions. A road crossing at the upper end of the creek, may have been damaged through erosion. This stream offered good habitat, especially for rearing salmonids.

Fisheries Assessment

The FISS map records cutthroat and steelhead in this stream. The stream was also thought likely to support Dolly Varden and coho, and possibly also hosted chum, pink and sockeye as well, as it was a low gradient system close to the mainstem of the Lakelse River.

Riparian Assessment

Some of the riparian area surrounding approximately 45% of the stream length had been logged from 1970 to the late 1980's but the relatively wide wetland through which the stream traveled had apparently buffered the stream from any significantly adverse effects. The previously logged areas had regenerated a cover of coniferous trees at the young forest seral stage.

Impact Descriptions

The following factors may limit fish production.

- A road crossing in the headwaters of the mainstem may have eroded, contributing excess sediment into the system.
- The same road crossing may also offer a partial barrier to migration of fish.

Photo 10. Looking south along the old road and across the eroded crossing on Silvertip Creek.

Limiting Factors

The road crossing in the headwaters may be an impediment to fish migration upstream.

Priority for Treatment

Since the impediment at the road crossing was near the headwaters of this stream, so that the amount of habitat above this point was limited and the potential excess sediment source was within a beaver complex resulting in quick deposition, this treatment was accorded a low priority.

Conceptual Prescriptions for Restoration

Remove metal culvert and permanently de-activate the crossing with pull back of banks and planting of locally available cuttings from deciduous trees. This work should be done with a bobcat and/or by hand to minimize damage to the regenerating trees. Access to this site was gained on foot from the Middle Silvertip Road. Although not observed by the field crew, the aerial photomosaic suggests there were a number of old roads leading to this area from the east side. The road may also be an extension of the road system that approached from the north. Any fish in the area should be salvaged before construction work begins and stop nets should be used above and below the site.

Target Species and Life Stage

These treatments will mainly benefit cutthroat trout during all stages in their life cycle.

Regulatory Agency Approval Required

- The removal of the culvert will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available

from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested. The removal will also require written permission from the MOF.

- Any attempts to capture fish for salvage will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

This work should be done between August 15 and December 31 and during low water conditions when the risk to cutthroat trout is least significant.

Estimated Costs

This work should be eligible for funding from the 'upslope' component of the WRP.

TABLE 5. Estimated Costs for Prescription 5

Prescription 5. Silvertip Creek				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	1	500
Technician	day	400	4	1600
Expenses				
10 kg Grass Seed & Local Planting Stock	project			100
Small Excavator	day	600	1	600
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	3	153
Mileage	km	0.37	600	222
			Total Cost	$3,875

4.5.2 Tributary 720C - Prescription 6

Size and Location

Tributary 720C was a 1st order stream (1:20,000) that flowed east into Silvertip Creek at UTM 9.522400.6026400.

Access

This stream was reached at the crossing on the Upper Silvertip Road.

Habitat Description

The average channel gradient and bankfull width were approximately 3% and 2 m respectively. The substrate was mostly cobbles and boulders with some gravel pockets. The upper portion of the stream passed through an area that had been logged but then flowed through an intact old growth forest in its lower segment. There was a 4 m high falls over bedrock located approximately 500 m upstream from the mouth. The crossing at the Upper Silvertip Road was eroded. Below this crossing, the stream was considered good fish habitat and was in good condition, with adequate amounts of functional LWD and good variety of habitat types.

Fisheries Assessment

The FISS map recorded critical cutthroat trout spawning habitat in this stream above the Upper Silvertip Creek crossing. It also recorded critical pink salmon spawning habitat below the road crossing but above the 4 m high falls. This record was likely an error. Dolly Varden also likely utilize this stream.

Riparian Assessment

Most of the riparian area in the upper portion of this tributary's watershed had been logged in 1969, replanted in 1977 and thinned in 1994. The lower 500 m of the stream was in an intact old growth forest. The regenerating forest was in good condition.

Impact Descriptions

- The crossing on the Upper Silvertip Road was eroded.
- The riparian area in the upper watershed had been logged.

Photo 11. A view of the beaver dam associated with the eroding road on Trib 720C.

Limiting Factors

The following factors may limit fish production in this stream.

- Erosion of road bed material into the stream may degrade fish habitat and poses a risk of torrenting.
- The potential for recruitment of LWD to the upper portion of this stream was reduced.

Priority for Treatment

Due to the easy access and the risk to the stream this treatment was considered of high priority.

Conceptual Prescriptions for Restoration

The road crossing should be permanently de-activated through removal of the culvert, pull back of banks and planting with locally available young deciduous and coniferous trees. Stop nets should be installed both upstream and downstream from the crossing and fish should be salvaged before work starts.

Target Species and Life Stages

Cutthroat trout, during all phases of their life cycles, are likely to benefit from treatment of this stream.

Regulatory Agency Approval Required

- The removal of the culvert will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of

commencement of works. Written permission from the DFO should also be requested. The removal will also require written permission from the MOF.

- Any attempts to capture fish for salvage will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

This work should be done between August 15 and December 31 and during low water conditions when the risk to cutthroat trout is least significant.

Estimated Costs

This work should be eligible for funding from the 'upslope' component of the WRP.

TABLE 6. Estimated Costs for Prescription 6

Prescription 6. Tributary 720C				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	2	1000
Technician	day	400	6	2400
Expenses				
20 kg Grass Seed & Local Planting Stock	project			200
Excavator	day	600	1	600
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	3	153
Mileage	km	0.37	600	222
			Total Cost	$5,275

4.5.3 Middle Creek - Prescription 7

Size and Location

Middle Creek flowed northeast into Silvertip Creek immediately above the Lakelse FSR bridge over Silvertip Creek, at UTM 9.523200.6026300.

Access

The stream was reached at various points. The Lakelse FSR crossed the stream at 11.5 km and again at approximately 14.0 and 14.1 km. The Boot Creek Road crossed the stream approximately 100 m downstream from the first Lakelse FSR crossing and a spur road leading north from the Boot Creek Road provided access along the eastern bank heading downstream. Another road leading northeast toward the stream left the Lakelse FSR approximately 500 m north of the first crossing.

Habitat Assessment

This stream was comprised of a series of beaver impoundments in its lower 900 m. The Lakelse FSR crossed the stream in two shallow fords at approximately 14 km. Above these beaver impoundments, the creek traveled through an adequate buffer strip of old growth trees for approximately 500 m. A falls over bedrock approximately 3 m in height was considered a barrier at all flow conditions for upstream migration of anadromous salmonids.

Upstream from this point, approximately 400 m to the Boot Creek Road crossing, the old growth buffer strip had been recently logged with significant damage to the stream channel. Access for the logging appeared to have been via a road built along the edge of the creek's gully. This road had damaged the riparian area and erosion was likely compromising fish habitat in the stream.

The stream around the Boot Creek Road crossing and the Lakelse FSR crossing was impounded by a series of beaver dams. The Boot Creek Road crossing was eroded through with resulting deposition of fine road bed material in the channel downstream. The channel was incised approximately 2 m deep through the road bed. The Lakelse FSR crossed the stream between two beaver impoundments in a relatively stable and shallow ford.

A small tributary to this stream crossed under the Lakelse FSR in a culvert at approximately 13 km. This culvert may be blocked at times.

Fisheries Assessment

No information on fish in this stream was available. The stream was considered likely to support most of the salmonids at least for rearing and at least to the falls. Above the falls, it may also support resident Dolly Varden and cutthroat trout.

Riparian Assessment

Most of the area around this stream had been logged from 1984 to 1986, however, an adequate buffer of old growth trees was left along the majority of the stream. Approximately 400 m of this buffer strip had been logged recently, probably during 1997 or 1998. This logging had occurred within the channel gully and had disturbed the stability of this area. There was one recently logged setting on the southeast side of the stream that had encroached on the stream and required planting. Although logging had occurred along the lower kilometre of the stream, no evidence of adverse effects were observed. Some of the former riparian area around the beaver impoundments at the Lakelse FSR crossing at 11.5 km had been inundated with water after logging, so that there were partially submerged stumps visible.

Impact Descriptions

- Logging had occurred along most of the stream but a buffer strip of old growth trees were left along the majority of the stream's length.
- The Lakelse FSR crossed the creek in two shallow fords at approximately 14 km. These fords were frequently used by vehicles.

Photo 12. Looking downstream at the most westerly of the two shallow fords on the lower part of Middle Creek.

- A recently cut block in the middle section of the stream on the southeast side encroached on the stream.

Photo 13. Looking south upstream at Middle Creek in old growth section upstream of the road crossing . Note the logging close to the east bank and the resulting windfalls.

- Recent logging had occurred within the stream channel's gully along the 400 m below the Boot Creek Road.

Photo 14. Looking northeast at the area that was logged into the stream's gully.

The Boot Creek Road crossing of the stream had eroded through, contributing fine road bed material to the stream. This breach in the road blocked vehicular traffic.

Photo 15. Looking upstream at the Boot Creek Road crossing of Middle Creek. Note the depth of the eroded channel through the road bed.

- The Lakelse FSR crossing of the stream at 11.5 km was a shallow ford that was used frequently by vehicles.

Photo 16. Looking south across the shallow ford where the Lakelse FSR crosses Middle Creek.

- The culvert at 13 km on the Lakelse FSR may be blocked at times, preventing access for fish migration.

Limiting Factors

- The shallow fords at 14 km on the Lakelse FSR may block access to upstream migration of salmonids and contribute excess sediment to the stream when vehicles use it.
- The culvert at 13 km on the Lakelse FSR may block access to fish.
- Just below the Boot Creek Road, the freshly logged part of the channel and the road along the edge of the stream gully may be unstable and contribute excess sediment to the stream. This section may also be annexed by beavers as deciduous shrubs grow in response increased light levels.
- The Boot Creek Road crossing had been eroded into the stream, contributing excess sediment.
- The Lakelse FSR crossing at 11.5 km likely contributed excess sediment to the stream and, if used by residents for spawning, may be damaged by passing vehicles.

Priority for Treatment

Since the lower fords may limit spawner access to good habitat in the old growth section above and since all sites were easily accessible, the treatments prescribed were accorded high priority.

Conceptual Prescriptions for Restoration

- Prescription 7a. The main ford, at 14 km on the Lakelse FSR, should be altered to ensure access to adult upstream migrants. As the road surface is very close to the low water table in this area, it will be necessary to build the road surface up first and then install a large, open bottom, steel arch culvert on the largest of the two fords. The second ford may not require treatment if the main one is made larger and deeper. The placement of this culvert will require the services of a Professional Engineer to design an appropriate structure. It will be necessary to use stop nets and to salvage fish before work begins. It will also be necessary to salvage fish from the stream that crosses at the second ford if the main construction alters the water levels in this stream.
- Prescription 7b. The crossing at 11.5 km on the Lakelse FSR should be remedied though building up the road approaches and then installing a large, open bottom, steel arch culvert. The placement of this culvert will require the services of a Professional Engineer to design an appropriate structure. It will be necessary to use stop nets and to salvage fish before work begins.
- Prescription 7c. The culvert at 13 km on the Lakelse FSR should be replaced. It will be necessary to use stop nets and to salvage fish before work begins.
- Prescription 7d. The Boot Creek Road crossing should be de-activated by removal of structural debris, pullback of banks and planting of disturbed areas with locally available stock. Berms should be built on either side of the stream to prevent

vehicular traffic from crossing the stream. The beaver dam immediately upstream of this crossing should not be altered.

- Polygon EE, the recently logged setting on the southeast side of the stream in the middle section, should be assessed by an RPF.
- Polygon M, the logged riparian area on the southeast side of the stream below the lower road crossings, should be assessed by an RPF. The assessment should consider thinning.
- Polygon R, the recently logged 400 m section of channel below the Boot Creek Road, should be assessed by an RPF. The assessment should consider the following possible treatments. The riparian area should be planted with locally available young conifers in an effort to exclude deciduous vegetation and subsequent beaver colonization. Newly planted trees and existing trees should be protected from beavers by surrounding the base of the boles with steel wire fencing. Fencing should also be placed along the northern edge of the Boot Creek Road where it crosses the stream to discourage beavers from importing dam material into the stream below the road. This section of the stream should receive appropriate maintenance treatment every late October when beaver are most active in dam building. Maintenance should include hand removal of deciduous vegetation and damming structures and protection of trees.

Target Species and Life Stages

Adult migrating coho are likely to benefit from treatment of the lower fords. Other treatments may benefit rearing anadromous salmonids and resident salmonids.

Regulatory Agency Approval Required

- Alterations to the road crossings and replacement of the culvert will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested. The work will also require written permission from the MOF.
- Any attempts to capture fish for salvage will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

The stream work should be done between August 15 and 31 and during low water conditions when the risk to both coho salmon and cutthroat trout is least.

Estimated Costs

The installation of the two steel arch culverts, the replacement of the km 13 culvert and the de-activation of the Boot Creek Road crossing should be eligible for funding from the 'upslope' component of the WRP.

TABLE 7. Estimated Costs for Prescription 7

Prescription 7. Middle Creek				
Cost Estimates for Engineered Design of Steel Arch Culverts				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	2	1000
P. Engineer	day	600	4	2400
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	500	185
			Total Cost	$5,287
Estimated Costs for Riparian Assessments				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	2	1000
RPF	day	600	4	2400
Technician	day	400	8	3200
Expenses				
Vehicle Rental	day	51	5	255
Mileage	km	0.37	1500	555
			Total Cost	$7,410
Estimated Construction Costs				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	6	3000
Technician	day	400	20	8000
Expenses				
10 kg Grass Seed & Local Planting Stock	project			100

Steel arch Culverts	culvert	20,000	2	40,000
Pit run and crush	load	300	100	30,000
Rip-rap	load	300	10	3000
Excavator	day	600	6	3600
Mob/Demob	day	600	2	1200
Vehicle Rental	day	51	10	510
Mileage	km	0.37	2000	740
			Total Cost	$90,150

4.5.4 Tributary 10 - Prescription 8

Size and Location

Tributary 10 was a 1st order stream (1:20,000) that flowed northwest into Coldwater Creek at UTM 9.523350.6025000.

Access

This stream was reached on foot by walking up Coldwater Creek from the Trib 10 Road crossing. There was no road access to this stream.

Habitat Assessment

Trib 10 was a small stream with an average channel gradient of approximately 9% and an average bankfull width of about 1.5 m. Its substrate was mostly cobbles and boulders and it flowed through a clear-cut block. No barriers were observed. The only road crossing appeared to have recovered stability with a healthy cover of deciduous trees and young conifers in the understorey. It contained good habitat that was in reasonably stable condition.

Fisheries Assessment

No information was available on this stream. It was considered likely to support cutthroat trout and Dolly Varden.

Riparian Assessment

The area through which most of this stream flowed had been logged to the stream's banks in 1975 and 1985. The area had since re-grown a covering forest of alder near the stream, with an understorey of regenerating conifers.

Impact Descriptions

- The riparian area had been logged to both banks, however, the area had re-grown a young forest of alder with a conifer understorey.
- Although the road crossing could not be seen under the snow, the site was generally well populated with an overstorey of alder and an understorey of young conifers. Although the stream had been altered at this point by road construction, it was considered to have reached a stable equilibrium.

Photo 17. Looking southeast upstream at the road crossing of tributary 10, 175 meters above the Coldwater junction.

Limiting Factors

There was a lack of recruitment opportunity for LWD into this stream.

Priority for Treatment

Due primarily to the apparent stability of the crossing and the new forest, and difficulty of access, the treatment of this stream was considered of low priority.

Conceptual Plans for Restoration

The road crossing should be checked for its stability and improved if necessary. If the site does need de-activation the work should be done by a bobcat to minimize damage of the vegetation that has become established on the road. Stop nets should be installed and fish should be salvaged from the area before work begins.

Target Species and Life Stages

Cutthroat trout and Dolly Varden are likely to benefit from the treatment of this stream.

Regulatory Agency Approval Required

- Alterations to the road crossings will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested. The work will also require written permission from the MOF.
- Any attempts to capture fish for salvage will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and

should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale
This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
The stream work should be done between August 15 and 31 and during low water conditions when the risk to both Dolly Varden and cutthroat trout is least.

Estimated Costs
This work should be eligible for funding from the 'upslope' component of the WRP.

TABLE 8. Estimated Costs for Prescription 8

Prescription 8. Tributary 10				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	1	500
Technician	day	400	2	800
Expenses				
10 kg Grass Seed & Local Planting Stock	project			100
Bobcat Excavator	day	600	1	600
Mob/Demob	day	300	1	300
Vehicle Rental	day	51	3	153
Mileage	km	0.37	600	222
			Total Cost	$2,675

4.5.5 Johnstone Creek

4.5.5.1 Reach 1 - Prescription 9

Length and Location
Reach 1 extended 1.8 km from its mouth at Coldwater Creek at UTM 9.522960.6022450, upstream to a point approximately 600 m upstream from the Lakelse FSR bridge at UTM 9.521500.6022820.

Access
Access was available at the Lakelse FSR bridge at 8.5 km. A road that traveled downstream on the south side of the creek from the Lakelse FSR was brushed in and not useable by a regular vehicle.

Habitat Assessment
The average channel gradient was approximately 2% with an average bankfull width of 10 m. This reach featured good fish habitat, with a good variety of habitat types, including pools, riffles and glides. The channel substrate was mostly sand and gravels in the lower portion of the reach and gravels and cobbles in the upper section. There was a good variety of habitat types and adequate supplies of LWD in the channel. The stream offered good habitat that was considered in good condition.

The lower road crossing, approximately 200 m above the mouth, was damaged through erosion. There was a culvert located approximately 143 m above the Lakelse FSR bridge that should be removed from the south bank..

Fisheries Assessment
The FISS map shows steelhead and cutthroat trout present in this reach. Adult coho carcasses were observed throughout this reach. The reach was considered likely to also support Dolly Varden and it may support, chinook, sockeye, pink and chum salmon as well, at least in its lower portion. The stream offered good rearing habitat for all local salmonids.

Riparian Assessment
In the area below the Lakelse FSR bridge, the stream flowed through an intact old growth forest. Above that bridge, the stream flowed through an area that was logged in the early 1970's. It was mostly covered in a deciduous stand of trees that lacked young conifers.

Impact Descriptions
The lower road crossing was eroded.

Photo 18. Looking east across the eroded road crossing on lower Johnstone Creek.

There was a dysfunctional metal culvert above the FSR bridge.

Photo 19. Looking at the eroded culvert above the FSR bridge on Johnstone Creek.

- The area above the FSR bridge had been logged.
- A pile of logs on the east side of the Lakelse FSR approximately 100 m south of the FSR bridge was unstable and some of the logs had fallen onto the stream's floodplain. Some of these logs had been burned.

Limiting Factors

- The following factors may limit fish production.
- The lower road crossing was unstable and may contribute excess sediment to this reach.
- The potential for recruitment of coniferous LWD was limited in the area above the FSR.

Priority for Treatment

Due to the valuable habitat in this reach the prescribed treatment was considered of high priority.

Conceptual Prescriptions for Restoration

- Prescription 9a. De-activate the lower road crossing, located approximately 200 m upstream from Coldwater Creek, by removing debris, pulling back the unstable eastern approach and planting disturbed areas with locally available deciduous

cuttings and coniferous regen. The western bank should not be altered. A bobcat should be used for this work so that existing trees on the road are maintained. Stop nets should be used and fish should be salvaged from the site before work begins.

- Prescription 9b. The metal culvert located on the south side of the stream at 143 m above the Lakelse FSR bridge should be removed and any road related to it should be de-activated.
- Prescription 9c. The pile of logs southeast of the FSR bridge should be stabilized and logs that had fallen onto the floodplain from this pile should be removed. This work should be done with a medium sized excavator (eg. JD590).

- Polygon Z, the area above the Lakelse FSR bridge, should be assessed by an RPF.

Target Species and Life Stages

Cutthroat trout and Dolly Varden during all parts of their life cycles, and steelhead and coho during all freshwater stages of their life cycles are likely to benefit from the treatment of this stream.

Regulatory Agency Approval Required

- Alterations to the road crossing will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested. The work will also require written permission from the MOF.
- Any attempts to capture fish for salvage will require a permit from the MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

The stream work should be done between August 15 and 31 and during low water conditions when the risks to the target species are lowest.

Estimated Costs

TABLE 9. Estimated Costs for Prescription 9

Prescription 9. Reach 1, Johnstone Creek				
Estimated Costs for Riparian Assessment				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	2	1200
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	600	222
			Total Cost	$3,124
Estimated Costs of Construction				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	2	1000
Technician	day	400	4	1600
Expenses				
10 kg Grass Seed & Local Planting Stock	project			100
Excavator	day	1200	0.5	600
Mob/Demob	day	600	1	600
Bobcat Excavator	day	600	2	1200
Mob/Demob	day	300	1	300
Vehicle Rental	day	51	4	204
Mileage	km	0.37	800	296
			Total Cost	$5,900

4.5.5.2 Reach 2 - Prescription 10

Size and Location
This reach was a 3rd order stream (1:20,000) that flowed northeast and then southeast. Its lower boundary was at UTM 9.521800.6022400.

Access
This part of Johnstone Creek was reached by walking upstream from the Lakelse FSR and by two other roads. The Middle Johnstone Creek Road crossed the creek approximately 1.5 km above its turnoff at 10 km on the Lakelse FSR. The Upper Johnstone Creek Road also crossed the stream approximately 2.5 km from its turnoff at 11.5 km on the Lakelse FSR.

Habitat Assessment
The average channel gradient in this reach was approximately 3% and the bankfull width approximately 8 m. The channel substrate was comprised mostly of cobbles and gravel, but some fines as well, with a good variety of habitat types. The lower 800 m passed through an intact old growth forest and was in good condition with good quality habitat for fish. The Middle Johnstone Creek Road crossing was a box culvert in good condition. The next 600 m, above the Middle Johnstone Creek Road bridge and along the eastern side of the road, had been logged on the western side of the stream, and suffered from significant road related erosion problems that likely adversely affected fish habitat. This site may have been the source of the fines noted downstream. Above this section the stream passed through another 300 m of old growth and was in good condition. At the upper end of this section, where the Upper Johnstone Creek Road met the stream, there was a slide into the stream. This slide had some vegetation on it that suggested it may have been relatively stable. The road below this slide had water drainage problems that should be addressed. For the next kilometre upstream, to a point approximately 100 m above the Upper Johnstone Creek Road crossing the stream had been logged close to the banks but some old growth timber had been left. This segment of the stream was still in good condition. The uppermost crossing was a bridge in good condition.

Fisheries Assessment
Steelhead and cutthroat are recorded on the FISS map in Reach 2. Coho and Dolly Varden likely utilize habitat in Reach 2 as well.

Riparian Assessment
Most of this reach was bordered by an intact, old growth forest. A section along the Middle Johnstone Creek Road was logged to the southwestern bank in 1974-75 and was spaced in 1995. This bank was unstable, with road related drainage problems, and the slope will require further assessment by an RPF. The riparian area around the upper road crossing had been logged close to both banks in 1972 and spaced in 1995. It had since regenerated an apparently healthy young coniferous forest.

Impact Descriptions

The section above the Middle Johnstone Creek Road crossing and between the stream and the road was eroded into the stream and the riparian area in this vicinity was in poor condition.

Photo 20. Looking up the Middle Johnstone Creek Road approximately 500 m from its lower crossing. Note the erosion on the inside bank. This erosion was coupled to the stream below.

The slide on the eastern side of the stream from the Upper Johnstone Creek Road may have contributed excess sediment into the stream. The road below this point had water drainage problems.

Photo 21. Looking down the slide on the Upper Johnstone Creek Road.

Limiting Factors

The following factors may limit fish production.

The input of sediment from the eroding road along the Middle Johnstone Creek Road and the slide on the Upper Johnstone Creek Road may have damaged fish habitat.

Priority for Treatment

The erosion problems along the Middle Johnstone and Upper Johnstone Creek Roads were considered significant, so that their treatment was accorded a high priority.

Conceptual Prescriptions for Restoration

- Prescription 10a. A team comprised of a biologist, a geoscientist and a forester should assess the problems relating to the road drainage and the unstable slope along the Middle Johnstone Creek Road in Polygon AA. Treatments that could be considered include construction of waterbars, bio-engineering techniques to stabilize the failing road fill slope and planting with locally available deciduous cuttings.
- Prescription 10b. A team comprised of a biologist, a geoscientist and a forester should assess the problems relating to the road drainage and the unstable slope along the Middle Johnstone Creek Road. Treatments that could be considered include

construction of waterbars, bio-engineering techniques to stabilize the failing road fill slope and planting with locally available deciduous cuttings.

Target Species and Life Stages
Cutthroat trout and Dolly Varden during all parts of their life cycles, and steelhead and coho during all freshwater stages of their life cycles may benefit from the treatment of this reach.

Regulatory Agency Approval Required
The construction of waterbars and planting in the riparian area will require written approval from the MOF.

Economies of Scale
The construction of waterbars should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
The construction of waterbars could occur at any time during the field season. It would be valuable for the professional team to view the area during a rainfall event.

Estimated Costs
This work should be funded by the 'upslope' portion of the WRP, as the problems are road-related.

TABLE 10. Estimated Costs for Prescription 10

Prescription 10. Reach 2, Johnstone Creek				
Estimated Costs of Assessment				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	4	2000
RPF	day	600	4	2400
Geoscientist	day	600	3	1800
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	3	151
Mileage	km	0.37	900	333
			Total Cost	$8,284
Estimated Costs of Construction				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	4	2000

Technician	day	400	10	4000
Expenses				
30 kg Grass Seed & Local Planting Stock	project			300
Excavator	day	1200	4	4800
Mob/Demob	day	600	2	1200
Vehicle Rental	day	51	5	255
Mileage	km	0.37	1500	555
			Total Cost	$13,310

4.5.6 Tributary 710B - Prescription 11

Size and Location

Tributary 710B was a 1st order stream (1:20,000). It flowed into Johnstone Creek approximately 400 m upstream from Coldwater Creek at UTM 9.522500.6022300.

Access

This stream was reached by walking down Johnstone Creek from the Lakelse FSR bridge and via a road that provided access to the headwaters of the stream and left the Lakelse FSR approximately 300 m northwest of the same bridge.

Habitat Assessment

This small tributary had relatively little flow and an average channel gradient of 1.5%. The channel substrate featured abundant fines and the average bankfull width was approximately 2 m. It flowed south, draining a recently clear-cut block in its headwaters. The lower section of this stream passed through an adequate leave strip of old growth forest. It featured a number of beaver dams and their impoundments, which were probably not barriers to adults at all water levels. The lower few metres likely supported some anadromous salmonid spawning while the upper part of the stream likely supported juveniles. The upper part of this stream passed through a recent cutblock and was in poor condition. It featured very little cover, eroding banks, limited LWD and a high potential for colonization by beavers.

Fisheries Assessment

No fisheries information was available for this stream. It likely supported cutthroat and Dolly Varden and may also have supported rearing coho.

Riparian Assessment

The lower 300 m passed through an old growth leave strip approximately 35 m in width that appeared to be in good condition. A cutblock on the eastern side had been logged in the mid-1970's and supported a regenerating and apparently healthy young forest. Above this the riparian vegetation had been logged to the banks of the stream in 1994-95. No regenerating forest was observed.

Impact Descriptions

The riparian area, upstream from a point approximately 300 m above the mouth, had been logged to both banks of the stream. The stream in this area featured minor, incipient bank erosion, little cover or LWD and no potential for recruitment of LWD for at least a century.

Photo 22. Looking south and downstream on Trib 710B.

Limiting Factors

The following factors may limit fish production.

The productive capacity of the upper portion of this stream had been compromised through some reduction in bank stability and increased likelihood of sediment transport potential, and reduction in cover, LWD, habitat variety and LWD recruitment potential.

Priority for Treatment

As this stream offered good habitat for resident salmonids and possibly rearing anadromous salmonids, its treatment was accorded high priority.

Conceptual Prescriptions for Restoration

- The stream in the upper cutblock should be complexed with LWD to decrease the likelihood of bank erosion, increase habitat variety and provide cover. The complexing will require approximately 30 pieces of relatively small LWD (>25 cm dbh and > 5 m long, available locally) set firmly into position by digging with hand tools. This portion of the stream comprises the stream's headwaters and therefore does not experience high energies.
- Prior to any of the work described above, a Type II Site Survey and Design will be required to determine the exact number and sizes of the materials to be used and to specify exact locations and orientations of the material. This Site Survey and Design should be conducted by a biologist. Please refer to Appendix G for detailed requirements of the Site Survey and Design process and Figure 8 for an air photo of the area requiring treatment.

- The riparian area of Polygon X should be assessed by an RPF for treatment prescriptions. The following treatments of the riparian area could be considered. The riparian area should be planted with imported young conifers. Newly planted conifers should be protected from beaver by wrapping them in steel fencing. Deciduous shrubs and trees should also be protected in this way to try to prevent beaver colonization of this area until the conifers dominate once again. This will require yearly maintenance, particularly through protection of the trees and removal of dams, especially during late October when beavers are most active.

Target Species and Life Stages

Cutthroat trout and Dolly Varden during all parts of their life cycles, and coho during the rearing phase of their life cycle may benefit from the treatment of this stream.

Regulatory Agency Approval Required

- Complexing of the stream through the addition of LWD will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- Any attempts to capture fish for monitoring of effectiveness will require a permit from MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

The stream work should be done between August 15 and 31 and during low water conditions when the risks to the target species are lowest. The riparian assessment should be done in the spring so that prescriptions could be implemented by the same crew doing the complexing.

FIGURE 8. Air photo showing the area that requires complexing and riparian assessment on Tributary 710B.

Estimated Costs

TABLE 11. Estimated Costs for Prescription 11

Prescription 11. Tributary 710B				
Estimated Costs for Site Survey and Design				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	4	2000
Technician	day	400	2	800
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	500	185
Drawings	sheet	5	6	30
Report	copy	25	3	75
Photographs	roll	35	1	35
			Total Cost	$3,227
Estimated Costs for Riparian Assessment				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	2	1200
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	2	102
Mileage	km	0.37	500	185
			Total Cost	$3,087
Estimated Costs for Construction				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	8	4000
Technician	day	400	40	16000
Expenses				
10 kg Grass Seed & Local Planting Stock	project			100
Vehicle Rental	day	51	16	816

Mileage	km	0.37	4800	1776
Saw and Winch rentals	day	75	10	750
			Total Cost	$23,442

4.5.7 Tributary 710C - Prescription 12

Size and Location

Tributary 710C was a 1st order stream (1:20,000) that flowed south into Johnstone Creek at UTM 9.522100.6022200.

Access

Tributary 710C was reached via a road that provided access to the lower part of the stream. It left the Lakelse FSR approximately 300 m northwest of the main bridge over Johnstone Creek. The upper part of the stream was crossed by both the Lakelse FSR, at 10 km, and by the Middle Johnstone Creek Road at 0.1 km.

Habitat Assessment

This stream was comprised mainly of a series of beaver impoundments in a wetland complex that ran parallel and adjacent to the Lakelse FSR. The average channel gradient in the lower segment was approximately 2% and the bankfull width was approximately 3.5 m. Bed materials were dominated by fines with some gravel present. The channel was stable and probably never gets very energetic. Abundant cover in the form of pools, overhead vegetation and LWD was observed. At 130 m above the mouth there was a 1.2 m high beaver dam that was considered likely to be impassable by anadromous adult salmonids migrating upstream at all flow conditions. The habitat above may have been accessible to juvenile salmonids and was considered good rearing habitat.

A road crossing located approximately 300 m from the mouth was considered unstable. Water was observed running down the road on both sides of this structure and into the stream at the crossing, carrying road bed materials.

A series of road crossings of this stream and its tributaries above the Lakelse FSR on the Middle Johnstone Creek Road were in poor condition. At 100 m above the Lakelse FSR water was observed running across the road with no culvert. At 210 m the creek was eroding part of the road. At 283 m an abandoned metal culvert and bank erosion were observed. The road appeared to have collapsed, forming a 2 m wide gully which was occupied by another metal culvert.

Fisheries Assessment

No fisheries information was available for this stream. It likely hosted cutthroat trout and Dolly Varden and likely provided rearing habitat for coho.

Riparian Assessment

The riparian area around this stream had been logged extensively. The stream channel was apparently somewhat isolated from any adverse effects from this logging because it was buffered by a relatively wide wetland complex throughout most of the stream's length. Outside of this wetland, a young and apparently healthy riparian forest had since become re-established.

Impact Descriptions

- The road crossing, located approximately 200 m above the mouth, was eroded.

Photo 23. Looking upstream on Trib 710C and across the lower eroded crossing.

- The road crossings on the Middle Johnstone Creek Road were eroded.

Photo 24. Looking north at one of the eroded upper crossings of Trib 710C on the Middle Johnstone Creek Road approximately 283 meters from the Lakelse Main FSR. Note the abandoned culvert and the bank erosion.

- The riparian forest had been removed along most of the stream.

Limiting Factors

The following factors may limit fish production.

- Excess sediment from road crossings may reduce fish production.
- There was a loss of LWD recruitment potential in the area above the Lakelse FSR, but the area was sufficiently re-stocked with conifers.

Priority for Treatment

The easy access and the likelihood of continuing problems resulted in the treatment of the erosion problems being given a high priority.

Conceptual Prescriptions for Restoration

- Prescription 12a. The former bridge site should be appropriately de-activated, through removal of dysfunctional structures, bank pull back and planting with locally available deciduous cuttings. Stop nets should be installed and fish salvage conducted prior to any work in the stream.
- Prescription 12b. The crossings on the Middle Johnstone Creek Road should be replaced, removed or upgraded.

Target Species and Life Stages
Cutthroat trout and Dolly Varden during all parts of their life cycles, and coho during the rearing phase of their life cycle may benefit from the treatment of this stream.

Regulatory Agency Approval Required
- Road de-activation will require written approval from the MOF.
- Work in and around the stream will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- Any attempts to capture fish for salvage will require a permit from MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale
This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
The stream crossing work should be done between August 15 and 31 and during low water conditions when the risks to the target species are lowest.

Estimated Costs
This work should be eligible for funding from the 'upslope' component of the WRP.

TABLE 12. Estimated Costs for Prescription 12

Prescription 12. Tributary 710C				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	4	2000
Technician	day	400	7	2800
Expenses				
20 kg Grass Seed & Local Planting Stock	project			200
Excavator	day	1200	2	2400
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	5	255
Mileage	km	0.37	800	296
			Total Cost	$8,651

4.5.8 Tributary 710D

Size and Location

Tributary 710 D was a 1st order stream (1:20,000) that flowed east into Johnstone Creek at UTM 9.521500.6023000.

Access

This stream could be reached from the Middle Johnstone Creek Road.

Habitat Assessment

This stream could not be reached on the ground during this study due to snow depth. It was observed from an helicopter late in the winter. Although the stream channel was completely covered by snow, no evidence of damage due to logging was observed.

Fisheries Assessment

No information on fish populations in this stream were available.

Riparian Assessment

Interpretation of an older aerial photograph suggested that the lower 600 m of this stream's riparian area was an intact old growth forest. The next 600 m upstream had been logged on the northeast side of the stream but a buffer strip had been left. The lower cutblock was logged in 1974-75 and its regenerating young forest had been spaced in 1995. The upper cutblock had been logged in 1974. Above these two cutblocks, the stream flowed through a pristine forest. From the air, it appeared that the logging had terminated on the brow of a steep bank leading down to the stream itself, which afforded the stream a thin buffer strip of old growth forest that appeared to have functioned in protecting the stream.

Impact Descriptions

No evidence of damage requiring treatment was observed.

4.5.9 Tributary 710E

Size and Location

Tributary 710E was a 1st order stream (1:20,000) that flowed into Johnstone Creek at UTM 9.521300.6023200.

Access

This stream was reached at the crossing on the Middle Johnstone Creek Road, approximately 1.2 km from the Lakelse FSR.

Habitat Assessment

Tributary 710E was a very small stream with a bankfull width of approximately 1 m. This stream passed through an intact old growth forest through its entire length and was considered to be in pristine condition except at the Middle Johnstone Creek Road crossing. The channel gradient was steep at the Middle Johnstone Creek Road crossing and its substrate was mainly boulders and cobble. At this point the stream was confined by bedrock. The stream drained a small lake at its headwaters. The road crossing appeared stable.

Photo 25. Looking north and upstream in Trib 710E. This stream passed through an intact old growth forest.

Fisheries Assessment

This stream likely supported cutthroat trout and Dolly Varden.

Riparian Assessment

This stream was surrounded completely by an intact old growth coniferous forest.

Impact Descriptions

Other than at the road crossing, which appeared to be stable, no evidence of damage was observed.

4.5.10 Tributary 710F

Size and Location

Tributary 710F was a 1st order stream (1:20,000) that flowed east into Johnstone Creek at UTM 9.521000.606023800.

Access

This stream was reached by walking upstream along Johnstone Creek from the Middle Johnstone Creek Road. Its headwaters were also accessible via the Upper Johnstone Creek Road.

Habitat Assessment

The average channel gradient was approximately 14% and the bankfull width was approximately 2 m. There was adequate LWD and the substrate consisted of cobbles with boulder cover. At 200 m above the mouth there was a 4 m high bedrock falls that was likely a barrier at all flow conditions to fish migration upstream. This stream contained good fish habitat that was in good condition. The headwaters of this stream were shown on the TRIM map (103I037) as a small pond. The field crew found this pond drained to the northeast into what we have called Tributary 710G, which was not recorded on the map.

Photo 26. Looking upstream in Trib 710F.

Fisheries Assessment

No fisheries information was available for this stream. The lower section of this stream likely supported cutthroat trout and Dolly Varden.

Riparian Assessment

This stream passed through an area that had been logged in the early 1970's but the regenerating conifers were up to 10 m high with some remnant old growth trees. This area was included in the prescription for Reach 2 of Johnstone Creek.

Impact Descriptions

Although the area had been logged, it had recovered an adequate degree of stability. There was no evidence of damage that could benefit from treatment.

4.5.11 Tributary 710G - Prescription 13

Size and Location

Tributary 710G was a 1st order stream (1:20,000) that flowed northeast into Johnstone Creek at UTM 9.520600.6025000.

Access

This stream was crossed by the Upper Johnstone Creek Road approximately 3.5 km above the Lakelse FSR.

Habitat Assessment

This tributary was not shown on the TRIM map. It featured a series of beaver impoundments in its lower section where it passed through a cutblock. At the Upper Johnstone Creek Road crossing, the stream had eroded the culvert. Immediately below the crossing, the creek passed over a 10 m high bedrock falls that was considered a barrier to upstream migration under all conditions. The stream drained a small lake. Below the road crossing, the stream was considered to offer good habitat.

Fisheries Assessment

No fisheries information was available for this stream. The portion of the stream below the bedrock falls likely supported Dolly Varden and cutthroat trout and may contain excellent rearing habitat for coho.

Riparian Assessment

The stream passed through an area logged in 1972 and spaced in 1995. It was considered sufficiently restocked with conifers to 12 m in height. No buffer strip had been left.

Impact Descriptions

- The riparian area had been logged to the banks of the stream.
- The road crossing was eroded.

Photo 27.. Looking northeast and downstream on Trib 710G. The Upper Johnstone Creek Road is in the foreground.

Limiting Factors

The following factors may limit fish production.

Erosion of the road crossing may introduce excess sediment into this stream and may represent a torrenting risk to the stream.

Priority for Treatment

Due to its easy access and the risk of continuing to erode, the treatment of this road crossing was given high priority.

Conceptual Prescriptions for Restoration

The Upper Johnstone Creek Road crossing should be de-activated by removing structural debris from former crossings, pulling back banks and planting with locally available deciduous cuttings and conifers.

Target Species and Life Stages

Cutthroat trout and Dolly Varden during all parts of their life cycles, and coho during the rearing phase of their life cycle may benefit from the treatment of this stream.

Regulatory Agency Approval Required
Written approval for road de-activation will be required from the MOF.

Economies of Scale
This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
This work could be done at any time from July through October in low water conditions.

Estimated Costs
This work should be eligible for funding from the 'upslope' component of the WRP.

TABLE 13. Estimated Costs for Prescription 13

Prescription 13. Tributary 710G				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	3	1500
Technician	day	400	5	2000
Expenses				
10 kg Grass Seed & Local Planting Stock	project			100
Excavator	day	1200	2	2400
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	5	255
Mileage	km	0.37	800	296
			Total Cost	$7,251

4.5.12 Tributary 700 - Prescription 14

Size and Location

This was a 2nd order stream that flowed east into Johnstone Creek at UTM 9.522900.6022500.

Access

The two upper branches of this stream were crossed by the Lakelse FSR at two places, at approximately 8 and 8.5 km respectively. A road was shown on the Forest Cover Map (103I037) that paralleled the north branch (Trib 700B) and may provide access upstream, but this road was not observed by the field crew.

Habitat Assessment

This stream was incorrectly located on the TRIM map. It did not flow directly into Coldwater Creek but rather flowed into Johnstone Creek approximately 200 m above its confluence with Coldwater Creek. The stream was comprised of two branches. Trib 700A crossed the Lakelse FSR at approximately 8 km while Trib 700B crossed at 8.5 km.

Below the Lakelse FSR the average channel gradient was 2% with a bankfull channel width of approximately 4 m. It featured adequate cutbank, over stream vegetation, deep (up to 0.5 m deep) pools and LWD cover. It passed through an intact old growth forest. The channel substrate consisted of mostly gravels with some cobbles and fines. The two tributaries below the road had bankfull widths of approximately 2 m each. These two tributaries joined approximately 294 m below the FSR. This lower section of the stream was considered to contain good habitat in good condition.

Above the Lakelse FSR, Tributary 700B had an average channel gradient of 7% with a bankfull width of approximately 3.5 m. The channel was stable and its substrate consisted of mostly cobbles with gravel and boulders present. There was adequate cover. Many blown down trees were observed suspended across the channel. From approximately 36 to 71 m above the Lakelse FSR on Tributary 10B there was bank erosion on the south side. The stream offered good habitat, particularly for Dolly Varden and cutthroat and was in generally good condition.

Above the Lakelse FSR, Tributary 700A had an average channel gradient of 5% with a bankfull width of approximately 2m. The channel was stable with the dominant bed material fines with some gravel. It featured adequate cover with pools, cutbanks, over stream vegetation and LWD. The stream offered good habitat, particularly for Dolly Varden and cutthroat and was in good condition.

Riparian Assessment

Below the Lakelse FSR, the stream passed through an intact old growth forest buffer to a point 800 m downstream. At this point the stream passed 200 m through an area that had been logged in 1973 and treated for mistletoe in 1990, before meeting Johnstone Creek.

Above the Lakelse FSR the two streams, Tributaries 700A and 700B, had been logged over in 1989, in some places to the slope break above the stream and in other places to the stream bank. The logged areas had re-grown with approximately 4 m high young coniferous trees under a 10 m high alder forest, or they were covered by remnant old growth trees.

Impact Descriptions
A bank was eroding on Trib 700B at approximately 36 m above the Lakelse FSR.

Photo 28. Looking south at bank erosion on tributary 700B 38 meters above main FSR.

Priority for Treatment
Due to the limited instability of this bank this treatment was accorded a low priority.

Conceptual Prescriptions for Restoration
The eroding bank at Polygon DD should be assessed by an RPF. One treatment that could be considered is planting the bank with locally available cuttings from deciduous shrubs and trees and planting with locally available young conifers.

Target Species and Life Stages
Cutthroat trout and Dolly Varden during all parts of their life cycles, and anadromous salmon during the freshwater phases of their life cycles may benefit from the treatment of this stream.

Regulatory Agency Approval Required
No approvals are required for an assessment by an RPF.

Economies of Scale
This work should be conducted by a professional crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
The assessment work could be done at any time during the field season.

Estimated Costs

TABLE 14. Estimated Costs for Prescription 14

Prescription 14. Tributary 700B				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	2	1200
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	3	153
Mileage	km	0.37	500	185
			Total Cost	$3,338

4.5.13 Boot Creek - Prescription 15

Size and Location

This was a 1st order stream (1:20,000) that drained a small lake locally called Boot Lake. The stream flowed northwest into Coldwater Creek at UTM 9.522950.6023200. Another outlet stream was observed flowing from the southern end of the lake. It is discussed below.

Access

This stream could be reached from either the End Creek Road or the Boot Creek Road.

Habitat Assessment

This stream could not be reached on the ground during this study. It was observed from an helicopter. From the air it appeared that the main outlet of Boot Lake was at its southern end, and that the stream at the northern end, if in fact it did drain Boot Lake, was significantly smaller than the one at the southern end. Part of this stream may also drain into Ena Lake at some flow conditions. This southern outlet is shown as the main outlet on the Forest Cover Map (103I037), but this is not the case on the corresponding TRIM map. Both of these streams contained what appeared to be barriers to upstream fish migration just above the End Lake - Boot Creek Road.

Fisheries Assessment

No fisheries information was available on these streams. They likely supported Dolly Varden and cutthroat trout below the barriers.

Riparian Assessment

The riparian area in the middle section of the northern stream had been logged in 1976-77 and had been spaced in 1995. This stream's riparian area appeared to be sufficiently re-stocked with conifers. The stream at the southern end flowed through an area that had been completely logged in 1972 along its lower 2/3 and in 1989 along its upper 1/3. This stream appeared to drain into End Lake. The upper area did not appear to be sufficiently re-stocked with conifers.

Impact Descriptions

- The road crossings over these two streams were damaged.
- The riparian area around the upper 1/3 of the southern outlet stream was not sufficiently re-stocked with conifers.

Priority for Treatment

Due to the ease of access to the road crossing sites, their treatment was accorded a high priority. Since the insufficiently re-stocked riparian area was above a probable barrier, the assessment and treatment of this area was given a moderate priority.

Conceptual Prescriptions for Restoration

- The damaged road crossings of the two streams (Prescription Sites 15a and 15b on the accompanying aquatic map), and other associated streams, should be corrected

through normal road de-activation methods. There was at least one metal culvert under on the northern stream, but the southern crossing could not be seen very well under the snow. Stop nets should be installed and fish should be salvaged before work is begun.

- Polygon U', the riparian area around the southern outlet stream and above the End Lake - Boot Creek Road, should be assessed by a RPF. Treatments that could be considered include fill planting with locally available conifers and planting of sheltering deciduous trees and shrubs from locally obtained cuttings.

Target Species and Life Stages

Cutthroat trout and Dolly Varden during all parts of their life cycles, and coho during the rearing phase of their life cycle may benefit from the treatment of this stream.

Regulatory Agency Approval Required

- Road de-activation will require written approval from the MOF.
- Work in and around the stream will require notification of the Ministry of Environment under the Water Act of B.C. Notification must be provided on Form 9, available from MoELP, Smithers, and must be submitted at least 45 days prior to the date of commencement of works. Written permission from the DFO should also be requested.
- Any attempts to capture fish for salvage will require a permit from MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

The road de-activation work should be conducted between August 15 and 31 when the risk to the target species is smallest. The assessment work could be done at any time during the field season.

Estimated Costs

The work at road crossings should be eligible for funding through the 'upslope' component of the WRP. The eventual treatment of the riparian area along the upper part of the southern tributary may be eligible for funding from sources other than the WRP as the logging was done in 1989.

TABLE 15. Estimated Costs for Prescription 15

Prescription 15. Boot Creek				
Estimated Costs for Riparian Assessment of Boot Creek South				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	2	1200
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	3	153
Mileage	km	0.37	500	185
			Total Cost	$3,338
Estimated Costs for Road De-Activation				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	600	1.5	900
Technician	day	400	1	400
Expenses				
50 kg Grass Seed & Local Planting Stock	project			500
Excavator	day	1200	1	1200
Mob/Demob	day	600	1	600
Vehicle Rental	day	51	2	102
Mileage	km	0.37	500	185
			Total Cost	$3,587

4.5.14 End Creek - Prescription 16

Size and Location

This was a 1st order stream (1:20,000) that drained a series of lakes and flowed northwest into Coldwater Creek at UTM 9.523300.6021000.

Access

This stream was reached on foot by walking down Coldwater Creek from the Lakelse FSR bridge. An old road that was overgrown with alder paralleled Coldwater Creek and once provided access to the lower part of this stream.

Habitat Assessment

This average channel gradient of this stream was less than 1% with a bankfull width of approximately 30 m. The channel substrate was mostly fines, both clastic and organic. It consisted of a series of beaver impoundments and was also fed by a series of flood channels that may carry sub-surface water from Coldwater Creek under some conditions. The habitat in this stream was considered good for fish, but had been affected by logging of its riparian in places and possibly by floodwater from Coldwater Creek.

Fisheries Assessment

No fisheries information was available for this stream. It likely hosts cutthroat trout, Dolly Varden, steelhead and coho, and may also support sockeye, chum, pink and chinook salmon.

Riparian Assessment

The riparian area around the lower part of the stream had been logged in 1971 and 1984. The upper part of the stream, nearest the lake, featured some old growth on the southwest side. The area that had been logged was covered by a deciduous forest of cottonwoods and alder with an understorey of widely spaced conifers.

Impact Descriptions
The riparian area around the lower part of the stream had been logged.

Photo 29. Looking east upstream at the L bend in End Creek 320 meters above junction.

Limiting Factors
The following factors may limit fish production.
The riparian area along the lower southwestern side of the stream had been logged, thereby limiting the future potential for recruitment of LWD.

Priority for Treatment
The area of concern was part of a larger area along the Coldwater that requires a professional assessment, and the area was at risk of being taken over by the Coldwater Creek mainstem. It was therefore accorded a high priority for treatment.

Conceptual Prescriptions for Restoration
Polygon H, the riparian area on End Creek, and on both sides of the Coldwater mainstem, should be assessed by an RPF. Treatment that could be considered include fill planting with conifers, minor conifer release, pruning back of interfering deciduous brush away from existing young conifers and planting of younger deciduous species to replace the older trees when they die off. The cost estimates for the assessment of Polygon H are also included in the estimates for Reach 2 of the Coldwater mainstem, so that if they are done together, significant savings could be realized.

Target Species and Life Stages
Cutthroat trout and Dolly Varden during all parts of their life cycles, and anadromous salmon during the freshwater phases of their life cycles may benefit from the treatment of this stream.

Regulatory Agency Approval Required
None required for an assessment by an RPF.

Economies of Scale
This work should be a professional crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing
The assessment work could be done at any time during the field season.

Estimated Costs
If the prescribed assessment of Polygon H includes the similar prescription detailed under Reach 2 of the mainstem of Coldwater Creek, significant savings could be realized.

TABLE 16. Estimated Costs for Prescription 16

Prescription 16. End Creek				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
RPF	day	600	4	2400
Technician	day	400	4	1600
Expenses				
Vehicle Rental	day	51	3	153
Mileage	km	0.37	600	222
			Total Cost	$4,375

4.5.15 Tributary 30 and 40 - Prescription 17

This area was characterized by some major erosion problems and the stream channels in the area were very complex. This discussion therefore covers the entire complex, consisting of not only Trib 30 but also Trib 40, some distributary channels from Coldwater Creek and the Coldwater FSR.

Size and Location

This 2nd order stream (1:20,000) flowed northeast into Coldwater Creek at UTM 9.522200.6019600, the most easterly and furthest downstream point of concern. Tributary 40, a 2nd order stream, was shown on the TRIM map as flowing into Coldwater Creek at UTM 9.521600.6020150, the most westerly and furthest upstream point of concern.

Access

This stream was reached at the Coldwater FSR crossing.

Habitat Assessment

This tributary was considered together with Tributary 40 and at least two distributary channels from the mainstem of Coldwater Creek, as all of these likely contributed water to the Tributary 30 system. This was the area where the Coldwater FSR had been pirated by a stream and had undergone major erosion. The accompanying Aquatic Map, based on the TRIM map and modified after field observations, shows our preliminary view of the relationship between the various channels in this complex area.

Tributary 30 was fed from the southeast by a stream draining a small lake and a stream flowing east that probably carried water from Coldwater Creek and the Tributary 40 system. The average channel gradient was approximately 1.5% and the bankfull width was about 10 m. The channel substrate was mainly cobbles and gravels with some boulders. The stream was surrounded mostly by old growth trees and there was an adequate variety of habitat types. The Coldwater FSR crossing of this stream had been damaged and there was extensive bank erosion and channel degradation in the vicinity of this crossing and downstream to the confluence with Coldwater Creek. This stream was considered to offer excellent habitat for fish and, where it passed through the old growth forest, it was in good condition. It was a low gradient, low energy system that likely offered a refuge from the higher gradient, higher energy mainstem in this area. It featured extensive and excellent habitat for spawning, incubation and rearing for most of the local salmonid species.

The area along the Coldwater FSR in this vicinity had been logged in the early 1980's. Tributary 40 exited the mountains to the south and entered one of these cutblocks. In the cutblock, the stream had been impounded by a series of beaver dams but crossed the Coldwater FSR in what appeared to be a dysfunctional wooden box culvert. From this point the water may have entered either Coldwater Creek, as was shown on the TRIM map, or it may have entered the westernmost of the two distributary channels from Coldwater Creek that fed into the Tributary 30 system.

Up to 70% of the water in the Coldwater Creek mainstem left the main channel at UTM 9.521800.6020100 in two distributary channels. Most of this water was returned to Coldwater Creek approximately 200 m downstream but some continued to flow south through the mainstem's buffer of old growth forest, across the Coldwater FSR and into old growth again at the Tributary 30 system.

The Coldwater FSR crossings of both of the distributary channels had been damaged. At the Coldwater FSR crossing of the easternmost of these two distributary channels from Coldwater Creek, water had eroded through the road and onto the road surface, flowing southeast down the road bed. This had resulted in erosion of the road surface, degrading it up to 2 m below the former surface. This erosion extended approximately 400 m before dissipating. At this point the water apparently had run south into the Tributary 30 system and off the road, leaving a metal culvert eroded and dysfunctional. The erosion appeared to have continued cutting the surface down until it had reached an elevation that was a few centimetres below the elevation of the water table at normal low water conditions, so that, during most of the year this channel has some flow. The erosion also likely progressed headward and laterally and probably does so during every high water event. During extremely low water conditions, this channel likely dries up, stranding fish in isolated pools.

Photo 30. Looking downstream and southeast along the eroded road in the Trib 30 system.

Fisheries Assessment

No fisheries information was available on any of these systems. Juvenile salmonids, probably Dolly Varden, were visually observed in the water on the degraded road bed.

Riparian Assessment
The area within approximately 100 m of the Coldwater FSR had been logged in the early 1980's. It had since become populated with an apparently healthy young forest of regenerating conifers. The majority of the length of this complex system, however, was in old growth forest.

Impact Descriptions
- At least four of the Coldwater FSR crossings of this complex of streams had been damaged.
- Tributary 30, below the lower Coldwater FSR crossing featured channel degradation and bank erosion.
- Approximately 400 m of the Coldwater FSR had been eroded and fish utilized this habitat.
- Logging had occurred over much of the lower Tributary 40 system.

Limiting Factors
The following factors may limit fish production in this system.
Continued erosion in this system will likely degrade fish habitat through contribution of excess fines.

Priority for Treatment
Since the continuation of the erosion in this area is likely to damage very good habitat in the old growth segment of the stream, and since the Licensee may upgrade the road anyway, the treatment of this system was given a high priority.

Conceptual Prescriptions for Restoration
This important and badly damaged complex requires a more detailed professional assessment. It should be assessed by a team comprised of a biologist, geoscientist and forester. The team should
- accurately map the channels in the horizontal and vertical planes and determine the path of water in the area
- determine the absolute and relative discharges in the various channels
- examine the relevant portion of Coldwater Creek to determine the nature of the changes it will likely undergo in the near future
- determine the nature of the avulsions from Coldwater Creek, including their stability and their potential for control of flow
- determine the Licensee's future plans regarding the road and the nature of potential cooperation on improving this area
- assess the costs and benefits of exploiting the water flowing down the road by developing it as fish habitat and compare these with the costs and benefits of other alternatives
- determine the system's species composition and distribution
- determine the nature of the use of the former road bed by fish and assess the options of improving this as habitat, leaving it alone, or blocking water from the road

- assess the need for riparian treatment in the area, especially the Trib 40 wetlands shown as Polygon Y on the accompanying riparian map.
- If the assessment team considers restorative measures warranted, prescribe methods and describe a comprehensive plan for rehabilitating the entire area. This plan should be in the form of a Type III Site Survey and Design (see Appendix G for detailed requirements). Figure 9 shows the area to be assessed.

Target Species and Life Stages

Cutthroat trout and Dolly Varden, during all phases of their life cycles, and coho, steelhead and chinook salmon during all freshwater phases of their life cycles, are likely to benefit from treatment of this area. Sockeye, pink and chum salmon, during spawning, incubation and migration phases of their life cycles, may benefit from the treatment of this area.

Regulatory Agency Approval Required

- The assessment of fish population characteristics will require a permit from MoELP and another separate permit from the DFO. The MoELP permit will cost $25.00 and should be applied for at the Smithers regional office. The DFO permit can be applied for in Prince Rupert and is free of charge.

Economies of Scale

This work should be conducted by a professional crew doing similar work throughout the watershed so that expertise, experience, equipment, scheduling and stability of employment are optimized.

Timing

The assessment work could be done at any time during the field season. Fishing should be done both at high water as the spring freshet is subsiding and again during late summer, low flow periods.

FIGURE 9. Air photo mosaic showing the area around Tributaries 30 and 40 to be assessed in detail.

Estimated Costs

Since the major problems in this area were road related, some of the work may be eligible for funding from the 'upslope' portion of the WRP.

Given that the resulting prescriptions for treatment of this area could range from doing nothing further, to major improvement of the eroded road as fish habitat, with controlled intake of water from the mainstem creek, the estimated range of costs for eventual construction range from no cost up to approximately $300,000.

TABLE 17. Estimated Costs for Prescription 17

Prescription 17. Detailed Assessment of Tributary 30 and 40				
Category	Units	Rate ($/unit)	Qty	Cost ($)
Fees				
Biologist	day	500	20	10000
Geoscientist	day	600	8	4800
Technician	day	400	20	8000
Expenses				
Survey Instrument Rental	week	350	2	700
Vehicle Rental	day	51	18	918
Mileage	km	0.37	4500	1665
Drawings/Maps	sheet	25	3 sheets x 8 reports	600
Reports	report	30	2 draft, 6 final	240
Film	roll	35	5	175
			Total Cost	$27,098

4.5.16 Reaches 6, 7 and 8 - Prescription 18

- Reach 6 extended 1.7 km from the mouth of Tributary 30, at UTM 9.519900.6020670, upstream through a section of lower average channel gradient to UTM 9.518620.6020130.
- Reach 7 extended 3.9 km from UTM 9.518620.6020130 upstream to UTM 9.515050.6019320.
- Reach 8 extended 0.6 km from UTM 9.515050.6019320 upstream through a section of cascades and falls to UTM 9.514520.6019520.

Access
The Coldwater FSR paralleled the north shore but the bridge leading to this had collapsed (see discussion under Reach 5).

Habitat Assessment
These sections of the stream could not be reached by ground travel due to snow conditions. Reach 6 was viewed late in the winter from an helicopter. Although the snow depth was too great to see any open water or the stream channel itself, no evidence of significant damage was observed.

Priority for Treatment
Since the apparent problems at these two streams were thought to be at the upstream limit of logging related erosion problems in the entire system, correcting the problems was accorded the highest priority among all of the treatments prescribed.

Conceptual Plans for Restoration
It will first be necessary to conduct a professional assessment of these two streams, with particular attention paid to the road crossings. As neither of the streams are likely to contain significant fish habitat, the focus of the assessment should be on determining whether they are a source of de-stabilizing or excess sediment input to the mainstem Coldwater, and, if so, what can be done to correct the problem. As the majority of timber appeared to have been logged on this side of the Coldwater, permanent de-activation of the road crossings should be considered.

Cost Estimates
As these sites were not clearly visible, cost estimates are necessarily vague. The assessment of these two stream crossings would cost approximately $2000, although including their assessment into an assessment of all of the stream crossings on this side of Coldwater Creek should be considered for economy of scale savings. The eventual permanent de-activation of the road crossings of these two streams would likely cost about $10,000. As these sites were related to road construction, their repair should be eligible for funding from the 'upslope' portion of the WRP.

5 Recommendations

5.1 General Prescriptions

Problems associated with road crossings on Tributaries 660 and 670 should be addressed first. This work should be eligible for funding from the 'upslope' portion of the WRP. When these problems have been fixed, then the work of stabilizing the mainstem should progress downstream through Reaches 5, 4, 2 and finally, Reach 1.

A site visit should be scheduled as soon as possible to look at Coldwater Creek from reach 4 upstream. It is recommended that the visit involve the participation of local and Regional MoELP representatives, DFO representatives, BioLith staff and, perhaps most importantly, representatives of Skeena Sawmills Ltd. The purpose of the site visit would be to observe the problems and solutions detailed in this report, and to work together with the Licensee to refine solutions and cooperation.

A summary of the recommended treatments is given in Table 18. Their relative priority for treatment is given in this table. They are not listed in order of priority but are grouped by reach, as it may be more economical to treat a group of problems that are located together.

5.2 Prescription Summary

TABLE 18. Summary of Prescriptions

Prescription Summary					
Tributary or Reach Identifier	Prescription Number	Prescribed Work (Category 1)	Further Assessment (Category 2)	Priority	Estimated Cost
		Description	Description		
Tributaries 660 & 670	18		Assess and stabilize road crossings	highest	$12,000
Mainstem-R1	1a	Placement of LWD and Rock throughout Reach 1	Type II Site Survey and Design	High	$20,277
Mainstem-R1	1b	De-activate two old crossings	Type I Site Survey and Design	Moderate	$2,184
Mainstem-R1	1c	Assess feasibility of development of old channel	Type III Site Survey and Design	Low	$16,971
Mainstem-R1	1d	De-activate road		High	$4,161
Mainstem-R1	1e		Riparian Assessment - Polygon B'	High	$3,761
Mainstem-R1	1	Eventual Construction Estimate			$83,895
Mainstem-R2	2	Placement of LWD and Rocks	Type II Site Survey & Design	High	$59,995
Mainstem-R2	2		Riparian Assessment - Polygon H	High	$4,250
Mainstem-R2	2	Eventual Construction Estimate			$116,945
Mainstem-R4	3	Place LWD and Rock, build retaining wall, de-activate road, build berms on road.	Type II Site Survey & Design	High	$10,605
Mainstem-R4	3		Riparian Assessment - Polygon I'	High	$7,901
Mainstem-R4	3	Eventual Construction Estimate			$96,345
Mainstem-R5	4	Place LWD and Rock, remove collapsed bridge	Type II Site Survey & Design	High	$20,277

Prescription Summary					
Tributary or Reach Identifier	Prescription Number	Prescribed Work (Category 1)	Further Assessment (Category 2)	Priority	Estimated Cost
		Description	Description		
Tributaries 660 & 670	18		Assess and stabilize road crossings	highest	$12,000
Mainstem-R5	4	Eventual Construction Estimate			$159,245
Silvertip	5	De-activate crossing		Low	$3,875
Trib 710C	6	De-activate crossing		High	$5,275
Middle	7a-d	2 Steel arch culverts, replace old culvert, de-activate crossing	Engineering Design	High	$5,287
Middle	7		Riparian Assessment - Polygons EE, M & R	Moderate	$7,410
Middle	7	Eventual Construction			$90,150
Trib 10	8	de-activate road crossing	Check in spring	Low	$2,675
Johnstone-R1	9	deactivate lower road crossing, remove culvert, stabilize log pile		High	$5,900
Johnstone-R1	9		Riparian Assessment - Polygon Z	High	$3,124
Johnstone-R2	10	Treat road drainage, slope stability and erosion problems	Assessment by RPF, geoscientist, biologist	High	$8,284
Johnstone-R2	10	Eventual Construction Estimate			$13,310
Trib 710B	11	Complexing, exclusion of beavers	Type II Site Survey & Design	High	$3,227
Trib 710B	11		Riparian Assessment - Polygon X	High	$3,087
Trib 710B	11	Eventual Construction Estimate			$23,442
Trib 710C	12	De-activate road crossings		High	$8,651
Trib 710G	13	De-activate road crossing		High	$7,251

Prescription Summary					
Tributary or Reach Identifier	Prescription Number	Prescribed Work (Category 1)	Further Assessment (Category 2)	Priority	Estimated Cost
		Description	Description		
Tributaries 660 & 670	18		Assess and stabilize road crossings	highest	$12,000
Trib 700	14		Riparian Assessment - Polygon DD	Low	$3,338
Boot Cr.	15	Repair road crossings		High	$3,587
Boot Cr.	15		Riparian Assessment - Polygon U'	Moderate	$3,338
End Cr.	16		Riparian Assessment - Polygon H (should be included in Prescription 2)	High	$4,375
Trib 30	17		Type III Site Survey & Design	High	$27,098
Trib 30	17	Eventual Construction Estimate			$0 to $300,000

5.3 Riparian Assessment

A summary of the results of the overview assessment of the Riparian Management Areas in the Coldwater Creek watershed is given in Table 19. Data describing these Polygons is presented in Appendix C, cutblock identifiers associated with these polygons are listed in Appendix D and the polygons are shown on the accompanying 1:20,000 scale riparian map.

TABLE 19. Riparian Assessment Summary

Table B-1 Riparian Overview Assessment Coldwater Creek Watershed						
Stream	Reach ID	Riparian Polygon ID	Stream Class	~Area (ha)	Rehabilitation Objective(s)	Priority/Comments
Coldwater	1	B'	S1	2	Stabilize bank and re-vegetate with conifers	H
Coldwater	2	H	S1	25	- alleviate degraded conditions so that vegetation can be established -stream bank plantings to increase bank stability; bar stabilization; long term planting schemes to re-establish channel stability	H
Coldwater	4	I'	S1	14	-ensure satisfactory re-stocking of conifers around off channel habitat	H
Trib 710B	1	X	S3	12	- to restock a variety of shrubs and trees to provide stream shade and Small Organic Debris -to restock conifer trees to provide future LWD and Coarse Woody Debris	H
Trib 700B	1	DD	S3	1	-stream bank plantings to increase bank stability; site to be checked by RPF when snow absent	H

Table B-1 Riparian Overview Assessment Coldwater Creek Watershed						
Stream	Reach ID	Riparian Polygon ID	Stream Class	~Area (ha)	Rehabilitation Objective(s)	Priority/Comments
Middle	1	R	S3	1.5	-to restock conifers to provide stream shade, future LWD and Coarse Woody Debris -stream bank plantings to increase bank stability	H
Middle	1	EE	S3	2	- stream bank plantings to increase bank stability	M
Johnstone	1	Z	S2	12	-to restock conifers to provide future LWD and Coarse Woody Debris	M
Boot	southern outlet	U'	S5*	20	-re-establish a denser coniferous cover to provide LWD and organic debris input and shading	M
Middle	1	M	S3	6	- to accelerate growth of conifers for future LWD and Coarse Woody Debris ; site to be checked by RPF	L
Johnstone	2	AA	S2	8	-to stabilize slopes failing into stream	H**
Trib 30,40	1	J	S2	14	-ensure satisfactory re-stocking of conifers around potentially good rearing habitat	H**

* Fish bearing status of this stream is unknown and therefore, the stream classification is tentative.

** Polygons AA and J are included as components of multidisciplinary, comprehensive assessments described in Prescriptions 10 and 17 respectively.

6 References

Anonymous. Draft, March, 1998. Riparian Assessment and Prescription Procedures. Watershed Restoration Technical Circular No. 6. Ministry of Environment and Ministry of Forests.

Anonymous. Draft, March, 1998. Habitat Restoration Prescription Guidebook. Ministry of Environment, Lands and Parks (Vancouver Island Region 1), Nanaimo.

Cedarholme, C.J., L.G. Dominguez and T.W. Bumstead. 1997. Rehabilitating Stream Channels and Fish Habitat Using Large Woody Debris. In WRTC #9.

Department of Fisheries and Oceans and Ministry of Environment. 1990. Fish Habitat Inventory and Information Program: Stream Information Summary (FISS) Map, 103I07.

DFO/MoELP. 1990. FISS Map. 103I7

Johnston, N.T. and P.A. Slaney. 1996. Fish Habitat Assessment Procedures. Watershed Restoration Technical Circular No. 8. Ministry of Environment and Ministry of Forests.

Ministry of Forests. 1997. Forest Cover Map, 103I037.

Newbury, R.W. and M.N. Gaboury. 1993. Stream analysis and fish habitat design. Manitoba Department of Natural Resources, Winnipeg.

Slaney, P.A. and D. Zaldokas, Ed. 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9. Ministry of Environment and Ministry of Forests.

Triton Environmental Consultants Ltd. 1996. Lakelse WRP Project: Level I Fisheries Assessment. Prepared for the Lakelse WRP Steering Committee.

Triton Environmental Consultants Ltd. 1996. Lakelse WRP Project: Lakelse Watershed Volume II: Photos and Maps. Prepared for the Lakelse WRP Steering Committee.

West Fraser Mills Ltd. 1997. Five Year Development Plan