1999/2000 Forest Renewal BC Funded

SUMMARY REPORT FOR TOBOGGAN CREEK STREAM REHABILITATION and SILVERN LAKES ROAD DEACTIVATION

Prepared for:
Pacific Inland Resources
(A Division of West Fraser Mills Ltd)

Prepared by:

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Silvicon Services Inc.
December 2000

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1.0 Introduction

The Toboggan Creek ford crossing site and the Silvern Lakes Road deactivation are part of an ongoing watershed restoration project, funded by FRBC. The proponent of this project is Pacific Inland Resources (PIR), a division of West Fraser Mills Ltd. The Toboggan Creek crossing is located on the Silvern Lakes road. The Silvern Lakes Road begins at the end of the paved portion of the Glacier Gulch Road roughly 10km west of Smithers. This road is an old mining road that originated as a trail in the early 1900's. Evidence of this route in the form of a land survey has been found dating back prior to 1914. The road is currently used as a four-wheel drive/hiking recreational trail (photo 1), and accesses mountainous alpine terrain between Hudson Bay Mountain and Mt Evelyn.

Photo 1. Recreational users on Silvern Lakes Road

The road within the alpine terrain includes a network of drill and bulk soil sampling trails in the vicinity of Silvern Lakes and provides a spectacular view of Toboggan Glacier (photo 2) and the surrounding alpine meadows (photo 3).

Photo 2. Toboggan Glacier

Photo 3. Alpine looking west over Silvern Lakes

A level 1 assessment of the Toboggan Creek Watershed, produced by Sterling Wood Group Inc. has identified the Silvern Lakes road as qualifying for FRBC funding through the Watershed Restoration Program (WRP), now known as the Enhancing Environmental Values (EEV) program, and requiring a professional deactivation prescription due to it's location through Class IV and Class V terrain. Terrain Stability Mapping produced by Madrone Consultants Ltd. verified the terrain classification as class IV and V.

The Ministry of Environment, Lands and Parks (MELP) contacted PIR about the restoration of Toboggan Creek at the site of a washout of the Silvern Lakes road where it crosses Toboggan Creek (photo 4). Silvicon Services Inc. (Silvicon) visited the site of Toboggan Creek with MELP staff to review potential treatments for site rehabilitation. As the proponent of the project, PIR agreed to conduct works at the site providing that the works coincided with Bulkley Land and Resource Management Plan and that the existing four-wheel drive access was maintained.

Photo 4. Old bridge washed out causing channel change

Silvicon completed a site survey and design on Toboggan Creek and assisted with the field portion of the Silvern Lakes road professional deactivation prescription (See Appendix B of the Toboggan Creek Stream Rehabilitation Prescription and Silvern Lakes Road Deactivation Prescription) developed by Madrone Consultants Ltd.

A number of years ago an old bridge located at this site collapsed into the creek and seems to have diverted the main stream channel out of its natural course. Due to the new location of the stream channel, the stream washes over its banks and runs down the road surface during high water flows (photo 5 and 6). It is felt that overflowing of the banks at this point could cause excessive siltation and debris accumulations, which may adversely impact important salmon spawning grounds downstream of the crossing.

Photo 5. Road approach at nearing high water

Photo 6. Stream overflowing onto road at high water

The headwaters of Toboggan Creek consist of a collection of S5 and S6 streams that develop from Schufer Lake, Toboggan Glacier and the surrounding basin. The streams converge at a point roughly 1km below Schufer Lake. At this point Toboggan Creek

becomes classified as an inferred S2 stream. This classification continues for approximately 3.5km until it reaches a 5.0m high falls. Below the falls the stream is tested and anadromous and resident fish presence has been verified. The falls are located roughly 500m upstream of the Silvern Lakes Road crossing. Fish species in the mid to lower reaches of Toboggan Creek include Coho, Steelhead, Rainbow Trout and Dolly Varden. Triton Environmental Consultants Ltd produced the stream inventory information.

Upstream of the Silvern Lakes road crossing, Toboggan Creek is contained within a deep, steep-walled canyon until directly above the crossing. At this point the gully opens up on the west side of the stream. The steep sidewall continues on the east side of the stream until it reaches the Silvern Lakes Road. Below the road the ground spreads out on both sides of the stream into a large alluvial fan, making downstream options for crossing Toboggan Creek more susceptible to being damaged from natural stream channel changes.

Due to the streams connection and proximity to Toboggan Glacier there is a large sediment budget of glacial-fluvial material. The stream channel is affected by the steep sidewalls with little to no slope relief. Colluvium and till are deposited into the stream along with woody debris from small slides on the steep slopes. The stream contains numerous sediment wedges that have resulted from woody debris either partially or completely blocking the channel. These wedges have resulted in a natural process of frequent minor channel alterations.

Toboggan Creek has a relatively small watershed area of 1733ha above the Silvern Lakes Road crossing. As close to the headwaters of the stream as the crossing is, it can be expected that Toboggan Creek is quite resilient to disturbance and recovers quickly from streambed damage. Disturbances to the streambed are naturally occurring and quite frequent. This stream rises very quickly from runoff and heavy rainfalls and subsides just as quickly as the weather changes. Evidence of the flashy nature of Toboggan Creek is portrayed in the 35mm photographs of the site, located in Appendix A. Photos 4-9 were shot within a span of 48 hours after a heavy rainstorm in June 1999 and show the dynamics of Toboggan Creek, depicting the stream before, during and after high water. The photograph of the low clear water (photo 9) was taken the second day following the high water event.

Photo 7. Site during high water

Photo 8. High water is receding

Photo 9. Roughly 48 hours after high water

1.1 Objectives

The objectives of this project are to re-establish and maintain the original stream channel, protect fish habitat, maintain fish passage and maintain 4wheel drive recreational access.

Many ideas were discussed in regards to the treatment of this crossing before deciding on this prescription. The Option #1 discussed in the Toboggan Creek/Silvern Lakes Road Site Survey and Design Prescription Report was the option chosen to be the most suitable option for this project. Option #1 was developed on the basis that the original ford crossing would be sufficient for the purpose of a four-wheel drive recreational crossing. The development of an engineer designed ford structure was added to the option #1 for the final prescription. The decision to include a designed ford crossing was made because it was felt that without a professional design the stability of the structure would be questionable. Toboggan Creek is a strong, fast flowing stream and is expected to flow with greater velocity through the section of the ford crossing due to a steeper grade of roughly 6% or greater.

1.2 Methods

The immediate area around the old bridge site on Toboggan Creek was surveyed and a site plan developed from the survey data utilizing digital terrain modeling (DTM).

The information collected for this site plan includes the stream profile and cross sections, back channels and overflow channels, road location, general topography of the site, soil types, large standing timber around the site and rough location of LWD and log jams. A prescription option report (the Toboggan Creek/Silvern Lakes Road Site Survey and Design Prescription Report) was developed in conjunction with the site plan.

A number of 35mm photographs were taken of the site; 35 of which were labelled on the prescription base map. Most of the photos were incorporated in the prescription report.

A prescription based on Site Plan Option 1 of the Toboggan Creek/Silvern Lakes Road Site Survey and Design Prescription Report was developed utilizing much of the information from Site Plan Option 1. Several adjustments were made to streamline the option and incorporate input from Jeff Lough MELP Technical Monitor.

1.2.1 Prescription

The prescription developed for the rehabilitation of Toboggan Creek at the Silvern Lakes road crossing site consisted of an engineered ford structure at the original crossing to maintain four-wheel drive access across the stream. A riprap berm designed for the protection of the stream banks and including the design for approaches over the berm to maintain four-wheel drive access across the stream. The recommended structure and construction types as labeled on the Prescription map are:

A – ford crossing
B – riprap berm
C – riprap approach/west side of berm
D – stream deflector groin
E – approach to berm/east side of berm
F – placement of cottonwood stumps

Optional treatments were included in the prescription but were not implemented. For details of the prescription see the Toboggan Creek Stream Rehabilitation Prescription and Silvern Lakes Road Deactivation Prescription.

2.0 Modifications

Prior to the implementation of the prescription approvals were sought from the MOF District Manager, the MELP Environmental Monitor, the MELP Designated Environment Official (DEO), MELP Water Management Division and the DFO Habitat Biologist. Along with the approvals came certain recommendations for the alteration of the prescription.

2.1 Prescribed Treatment A

Tom Pendray, Habitat Biologist, DFO visited the site and was concerned that as the stream flows over the ford structure proposed for the site, the stream may scour the stream bed from below the ford creating a barrier to fish. Tom Pendray recommended that the structure be left out of the treatments and not to be constructed unless necessary. As a result, the ford structure was not constructed during the implementation of this project.

Rehabilitation Work

An excavator was utilized to sort and load rock from a quarry located on the Glacier Gulch Road (approximately 4 km away). Rock trucks transported the rock to the softer sections of the Silvern Lakes Road to armor the road surface.

Three 6m span temporary bridges were used between the Toboggan Creek crossing and the beginning of the Silvern Lakes Road to protect fish bearing streams while transporting rock to the berm construction site. The first bridge was placed over a stream that feeds into Lake Kathlyn. Two other bridges were used to cross Glacier Gulch Creek. A bridge was placed over each of the two channels of the creek and rock from the quarry was hauled in for the approaches. A low gap was left between the bridges as a safety precaution against a high water event.

A small gravel berm was created along the edge of the present water line of Toboggan Creek to keep the stream from flowing into the work site during construction. Behind the berm, an excavator was used to dig a trench so that large riprap (class 500) could be keyed in below the water line. The material removed to create the trench was utilized as the common fill portion of the berm and was mixed with rock from the quarry.

Two young cotton wood trees were pushed over with the excavator, cut up and transferred to the site to be used in the construction of the various structures to be built with the berm. A log cut from one of the trees was put in place to be part of the groin deflector and tied back with a cable to a log that was buried below the berm. A layer of filter fabric was rolled out over top of the common fill portion of the berm and beneath the groin deflector log.

The two root wads of the cottonwood trees were placed at the downstream end of the berm so that the roots would be roughly at the waterline and the stems would extend back into the berm. The stumps were left roughly 4m long, buried with the common fill and covered with the filter fabric so that only the root mass was exposed (Figure 1).

Large riprap was then trucked in and dumped at the site. The excavator placed the rock so that it was keyed in to the constructed trench and back over the fill.

An approach was fashioned from the riprap to create four-wheel drive access from the top of the berm down to the stream. This approach was constructed against the downstream side of the groin deflector log. Riprap was placed into the angle of the groin deflector to protect the approach from the direct force of the stream. The approach was then covered with finer material as coarse surfacing to make four-wheel drive access possible.

Figure 2. Cottonwood root wads buried into berm.

Following construction of the berm the temporary bridges were removed and the sites re-contoured to their original state. The quarry on Glacier Gulch Road was recontoured and slopes were left in a safe condition.

A parking area near the ford crossing was constructed for recreational use and a sign erected to describe the purpose of the construction.

Cost Summary

Road Deactivation	$20,000
Site preparation	$1,800
Sorting and transport of riprap	$8,170
Berm construction	$4,000
Dismantle temp crossings	$3,000
Total	$36,970

Outputs

10km road deactivated
0.1 km of stream was rehabilitated.

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UTM (NAD 83) Coordinates

Zone: 10
Northing: 6079500
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Toboggan Creek Stream Rehabilitation Project

Objectives
The objectives of this project are to re-establish and maintain the original Toboggan Creek stream channel at the Silvern Lakes Road crossing site, protect fish habitat, maintain fish passage and maintain four-wheel drive recreational access.

FRBC Region / MELP Region
Skeena-Bulkley / Skeena

Author
Ed Withers, AScT

Proponent
Pacific Inland Resources (a division of West Fraser Mills Ltd.)

Watershed / Stream
Toboggan Watershed / Toboggan Creek

Location
The Toboggan Creek road crossing site is located on the Silvern Lakes Road. The Silvern Lakes Road begins at the end of the paved portion of the Glacier Gulch Road roughly 10km west of Smithers BC.

Introduction
The Silvern Lakes road is an old mining road that originated as a trail prior to 1914. The road is currently used as a four-wheel drive/hiking recreational trail and accesses mountainous alpine terrain between Hudson Bay Mountain and Mt Evelyn.

Several years ago an old bridge located at this site collapsed into the creek and diverted the main stream channel out of its natural course. Due to this occurrence, the stream washes over its banks and runs down the road surface during high water flows. The overflowing of the banks at this point could cause excessive siltation and debris accumulations, which may adversely impact important salmon spawning grounds and the Toboggan Creek fish hatchery located downstream of the crossing.

The headwaters of Toboggan Creek consist of a collection of S5 and S6 streams that develop from Schufer Lake, Toboggan Glacier and the surrounding basin. Fish species in the mid to lower reaches of Toboggan Creek include Coho, Steelhead, Rainbow Trout and Dolly Varden. Triton Environmental Consultants Ltd produced the stream inventory information.

Figure 1. Final constructed berm.

Due to the streams connection and proximity to Toboggan Glacier there is a large sediment budget of glacial-fluvial material. The stream channel is affected by steep sidewalls with little to no slope relief. Colluvium and till are deposited into the stream along with woody debris from small slides on the steep slopes above the road crossing. The stream contains numerous sediment wedges that have resulted from woody debris either partially or completely blocking the channel. These wedges have resulted in a natural process of frequent minor channel alterations.

Toboggan Creek has a relatively small watershed area of 1733ha above the Silvern Lakes Road crossing.

Assessments and Prescriptions
The prescription developed by Silvicon Services Inc. for the rehabilitation of Toboggan Creek at the Silvern Lakes Road crossing site consisted of a riprap berm designed by McElhanney Consulting Services for the protection of the stream banks and including approaches over the berm to maintain four-wheel drive access across the stream, a stream deflector groin to protect the berm and approach from the full force of the stream, placement of cottonwood root wads at the waterline for fish habitat and potential revegetation.

The prescription also included a professional road deactivation prescription developed by Madrone Consultants Ltd. for 7km of the Silvern Lakes Road, between the ford crossing and the alpine and a road deactivation prescription developed by Silvicon Services Inc. for 3km of the Silvern Lakes Road, up to the ford crossing site. The road deactivation prescriptions for the Silvern Lakes Road are prescriptions for permanent deactivation.

2.2 Prescribed Treatment B

While marking out the site for the placement of the riprap berm it was felt that the design of the berm, which was part of the professional ford crossing design, left a gap at the end of the berm in which a high water event may find a way to flood the road surface. The area of the berm was extended roughly 10m further to safeguard against such an occurrence.

2.3 Road Deactivation

The prescription also included a professional road deactivation prescription for the section of the Silvern Lakes Road, between the ford crossing and the alpine and a road deactivation prescription for the Silvern Lakes Road, between the ford crossing back to the Glacier Gulch Creek Crossing. The road deactivation prescriptions for the Silvern Lakes Road are prescriptions for permanent deactivation.

James Cuell, DEO stated as part of his approval that material was not to be placed in the stream labelled in the road deactivation prescription as TX17. He suggested that a temporary span bridge be installed on the stream during the construction. Consequently, a large slab of concrete was placed on sill logs as a temporary bridge over this stream (photos 14 and 15).

During the deactivation works from the Alpine down to the Toboggan Creek crossing it was found that the narrow road width and steep terrain made it very difficult to follow the deactivation prescription. Coarse rock that was recommended for certain sites was not available and therefore not placed as per the prescription. A letter from Jack Whittles, M.Sc., P.Geo. of Madrone Consultants Ltd (Madrone), recognizes the difficulty of the terrain and as an alternative to the prescription, recommends removing the loose material from the cut slope to lower the risk of sloughing material transgressing the road and sliding down to the valley bottom.

3.0 Implemented Works

Following the receipt of approvals and recommendations the works were implemented. Through a select tender bidding process, Pidherny Contracting of Smithers BC was contracted to complete the project. The equipment used for this project included:

- 200 Hitachi excavator
- 300 Hitachi excavator
- Front end wheel loader
- Three A25 Volvo rock trucks

a) The first step was to walk the smaller excavator to the top of the Silvern Lakes Road to begin the road deactivation as per the professional prescription. While walking the machine in, the operator smoothed out a few trouble spots on the road so that a pick up could bring fuel to the excavator.

b) As the smaller excavator was working the upper elevations, the larger excavator was being utilized to load rock from a quarry located on the Glacier Gulch Road (photo 10). The rock trucks transported the rock to the softer sections of the Silvern Lakes Road to armour the road surface. The loader was used to spread the rock where it was dumped (photo 11).

Photo 10. Excavator at rock quarry

Photo 11. Loader spreading rock in soft road sections

c) Three 6m span temporary bridges were used between the Toboggan Creek crossing and the beginning of the Silvern Lakes Road to protect fish bearing streams while transporting rock to the berm construction site. The first bridge was placed over a stream that feeds into Lake Kathlyn. Two other bridges were used to cross Glacier Gulch Creek. Because of the low water, only two narrow channels flowed within the wetted perimeter of Glacier Gulch Creek. A bridge was placed over each channel and rock from the quarry was hauled in for the approaches. A low gap was left between the bridges as a safety precaution against a high water event (photos 12 and 13).

Photo 12. 6m span temporary crossing on Glacier Gulch Creek

Photo 13. Dip between bridges for high flow precaution

d) A small S4 stream labelled TX17 in the deactivation prescription was crossed using a large concrete slab on sill logs as a temporary bridge (photo 14 and 15).

Photo 14. Temporary bridge over TX17

Photo 15. Temporary bridge over TX17

e) In the time it took to place the bridges and fill in the soft sections of road up to Toboggan Creek the smaller excavator had finished the road deactivation from the Alpine down to Toboggan Creek. The small excavator was then used to prepare the site around Toboggan Creek for the construction of the berm.

f) Prior to construction of the berm, the site was marked using the original site plan benchmark as a reference guide to mark out the dimensions of the berm. Coarse material excavated from the quarry was stockpiled off to one side to be used in the construction of the berm.

g) A small gravel berm was created along the edge of the present water line of Toboggan Creek to keep the stream from flowing into the work site during construction. Behind the berm, the excavator was used to dig a trench so that large riprap could be keyed in below the water line. The material removed to create the trench was utilized as the common fill portion of the berm and was mixed with the stock piled material from the quarry.

h) Two young cotton wood trees were pushed over with the excavator, cut up and transferred to the site to be used in the construction of the various structures to be built with the berm (photo 16 and 17).

Photo 16. Transporting Cottonwood logs to construction site

Photo 17. Transporting logs

i) A log cut from one of the trees was put in place to be part of the groin deflector. A cable was attached to this log and tied back to another log that was then buried below the berm. A layer of filter fabric was rolled out over top of the common fill portion of the berm and beneath the groin deflector log.

j) The two root wads of the cottonwood trees were placed at the downstream end of the berm so that the roots would be roughly at the waterline and the stems would extend back into the berm (photo18 and 19). The stumps were left roughly 4m long, buried with the common fill and covered with the filter fabric so that only the root mass was exposed.

Photo 18. Cottonwood root wads buried into berm

Photo 19. 4m long stumps buried and covered with filter fabric

k) Large riprap was then trucked in and dumped at the site. The excavator placed the rock so that it was keyed in to the constructed trench and back over the fill (photo 20 and 21).

Photo 20. Large rock dumped at the site

Photo 21. Rock was keyed in

An approach was fashioned from the riprap to create four-wheel drive access from the top of the berm down to the stream. This approach was constructed against the downstream side of the groin deflector log. Large rock was placed into the angle of the groin deflector to protect the approach from the direct force of the stream. The approach was then covered with finer material as coarse surfacing to make four-wheel drive access possible.

l) As the construction of the berm neared completion, high daytime temperatures caused Toboggan Creek to rise slightly and the edge of the stream came up to the edge of the work zone, but even with the rise of the water level, very little of the stream was disturbed during the construction.

m) Following the completion of the berm, the equipment worked from Toboggan Creek back out to the beginning of the road. The temporary bridges were removed and the material that was used for the approaches loaded onto the rock trucks and removed. The sites where the bridges were placed were re-contoured to put them back as close to their original state as possible (photo 22 and 23). The quarry on Glacier Gulch Road was recontoured and slopes were left in a safe condition.

Photo 22. TX17 after bridge has been removed

Photo 23. Glacier Gulch Creek after bridges removed

n) The last piece of equipment to be removed was the 200 excavator. This machine was used to create a parking area near the ford crossing and deactivate the road from Toboggan Creek to Glacier Gulch Creek as per the road deactivation prescription. Also, the excavator was used to smooth the entire road where the rock trucks had damaged the soft sections.

3.1 Results and recommendations

Following the completion of the project the site was visited by Glen Furtado, EIT of McElhanney Consulting services Ltd of Terrace BC. Alan Hampshire, P.Eng of McElhanney Consulting services Ltd of Terrace BC provided professional certification that the works for the road deactivation and the berm construction have been completed in general conformance with the prescription. Appendix B includes a copy of the Prescription map used to conduct the works. The completed works varied only slightly from this drawing and therefore no further survey or mapping of the sight is necessary.

3.1.1 Silvern Lakes Road

The deactivation of the road is expected to increase the life expectancy of the road as many of the existing problems with this road have been corrected or improved (photo 24 and 25).

Photo 24. Blown culvert

Photo 25. Same as photo 24 after construction

Although most of the drainage areas are now controlled, natural drainage patterns restored and fill slopes stabilized, there are still a few areas where problems could occur. Due to the narrow road width (photo26 and 27), many of the areas where pullback was prescribed, it was found that the action would reduce the width of the road and possibly cutting off access. In this situation, the berm was removed from the edge of the road and loose fill material was removed to stabilize the slope.

Photo 26. Narrow road width

Photo 27. Narrow road made refuelling difficult

At the site labelled in the professional deactivation prescription as CBS 33 a dry sloughing cut bank may cause future problems. This is probably the most problematic site. The construction at this site was conducted according to an amendment to the original prescription detailed in a letter from Jack Whittles, M.Sc, P.Geo. of Madrone Consultants Ltd. The loose material was removed from the cut slope and the cut slope was recontoured to reduce the steep grade of the cut. The problem is that much of the loose material is out of reach of the excavator and was left above the cut. This material could eventually slough down onto the road blocking access or even transgress the road and slide further down into the valley (photo 28 and 29).

Photo 28. Sloughing cut slope at CBS33

Photo 29. Loose material was removed and slope recontoured

3.1.2 Toboggan Creek

The construction of the berm at the Toboggan Creek crossing on the Silvern Lakes Road is expected to protect the approach of the road from being flooded during high water events (photo 30). It is expected that the constructed berm will withstand any foreseeable natural changes to Toboggan Creek. The western side of Toboggan Creek is still susceptible to severe stream channel changes as is evident from the Prescription Map (Appendix B), but it is expected that downstream values will not be at risk of serious damage if such an event should occur.

Photo 30. Final constructed berm

4.0 Monitoring plan

Routine monitoring of this the Silvern Lakes Road and especially at site CBS33, is recommended. It may be necessary to perform a small amount of maintenance to keep four-wheel drive access open. This site should be visited twice a year for the first two years. The first visit should take place immediately following snow melt in the spring.

Routine monitoring of the constructed berm on Toboggan Creek is recommended to ensure the ford crossing provides access for four-wheel drive vehicle. If access becomes blocked the area should be assessed to determine what is required to restore access. The first visit should take place immediately following snow melt in the spring.

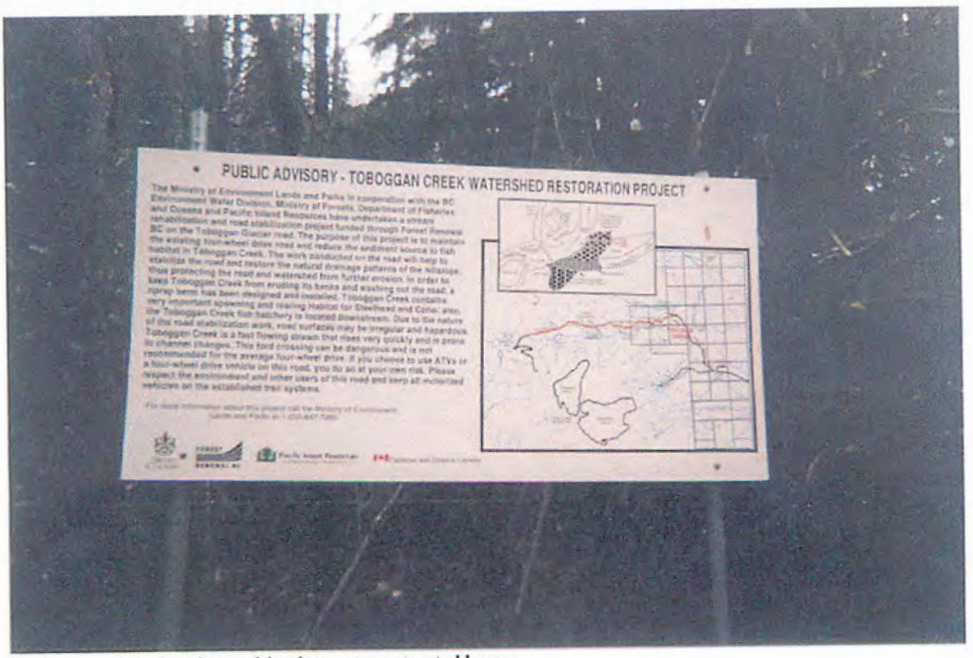

Photo 31. Sign placed at parking lot near constructed berm

Appendix A

Distribution List

This document has been distributed to the following individuals/agencies/companies:

- Two (2) copies to Jeff Lough – Regional Fisheries Specialist, Ministry of Environment Lands and Parks
- One (1) copy to Monty Miedreich – Water Management Division, Ministry of Environment Lands and Parks
- One (1) copy to Grant Marleau and Glen Buhr – Ministry of Forests, Bulkley/Cassiar Forest District
- One (1) copy to James Cuell – Designated Environment Official, Ministry of Environment Lands and Parks
- One (1) copy to Tom Pendray – Habitat Biologist, Department of Fisheries and Oceans
- One (1) copy to Alan Baxter – Pacific Inland Resources
- One (1) copy to Paul Perkins – Investment Officer, Forest Renewal BC

Appendix B

Prescription Map

WEST FRASER MILLS LTD.
PACIFIC INLAND RESOURCES

BULKLEY

GEOGRAPHIC LOCATION
TSIDDARSON CREEK

ENGINEERING SERVICES INC.

DRAWING

decl. 24.0° E

LEGEND

CROSS SECTION

PHOTO

BENCHMARK OR REFERENCE POINT

SOIL PIT

ROAD STATION

HWM - HIGH WATER MARK

PWL - PRESENT WATER LEVEL

THALWEG - STREAM CHANNEL DIRECTION AT DEEPEST PART OF STREAM

CHANNEL DESCRIPTION

ORGANIC	
FINES	
PEBBLES	15%
COBBLES	80%
BOULDERS	5%
BEDROCK	
GRADIENT AVG	5%
VELOCITY	Approx. 2.9-3.5 m/s at high water

SOIL DESCRIPTION

SOIL PIT 1	SOIL PIT 2
DEPTH	DEPTH
COARSE FRAGMENTS	COARSE FRAGMENTS
Boulders -	Boulders -
cobble -	cobble 30%
gravel 80%	gravel 45%
FINE FRAGMENTS	FINE FRAGMENTS
fine 20%	fine 5%
SAND	SAND
SILT	SILT
CLAY	CLAY

STRUCTURES AND EXCAVATION

A - engineer designed ford crossing
See design prepared by LANGFORD CONSULTANTS LTD

B - riprap berms

C - riprap approach bank side of berm

D - stream groin deflector

E - approach to berm/weir side of berm

F - constructed debris containment

OPTIONAL PRESCRIPTION TREATMENTS

0 - remove collapsed bridge deck

01 - excavate stream channel

02 - redirect side channel

03 - build gravel/cobble berm

KEY MAP SCALE 1:50 000 MAPSHEETS 93L/08

SILVERN LAKES ROAD
APPROX 10km TO SMITHERS

GRAVEL BAR

GRAVEL COBBLE DEPOSIT

COLLAPSED BRIDGE DECK

SMALL LOG JAM

RIPRAP BERM MIN CLASS 300

APPROXIMATELY 15m³ FILL ROCK GAP WITH COBBLE

APPROXIMATELY 20m³ FILL FOR APPROACH

LOG 40-50cm BUTT DIAMETER 12-16m LONG

IMBED LOG IN BERM

CLASS 300 RIPRAP

Soil Pit 1

Soil Pit 2

BM 1

bridge1.dgn Jul 05, 2000 11:09:33