3299 / WP#T-1235

Copper River Watershed Restoration

2001-02 Constructed Works

Site 77 Outlet Channel 3 Km Ponds

Funded by Forest Renewal BC
FRBC Activity #: *725126*

Final Report: March, 2002

Submitted to:
Ministry of Water, Land and Air Protection
104-3220 Eby Street
Terrace, BC
V8G 5K8

Prepared for:

Kitsumkalum Band Council
PO Box 544, Terrace, BC
V8G 4B5

Prepared by: S. Giesbrecht, D. Tech, & S. Jennings, B.Sc.

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3 km pond Site

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Acknowledgements

The following supported or assisted with completion of the projects and their efforts and assistance is much appreciated:

- Contract monitor: Kim Haworth
- Kitsumkalum Band Watershed Restoration Program: Lyle Bolton, Lars Reese-Hansen and field crew
- Ministry of Water, Land and Air Protection: Chris Broster, Jeff Lough.
- Fisheries and Oceans Canada: Mitch Drewes
- Pacific Northern Gas: Dennis Towriss
- Vic Froese Trucking Ltd operators: Terry Montague, Jimmy Mantel
- A & D Trucking: Al Shaefhowser

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1. INTRODUCTION

This report summarizes the instream construction activities at Site 77 and the 3 km Pond site which were completed in November 2001 in the Copper River watershed. The project scope and timing, proponent and funding source, watershed description and project objectives are described below. The study area is described in Section 2 and the construction activities and materials are detailed in Section 3 for each site. Monitoring and maintenance recommendations follow in Section 4. Agency approvals and site photos are provided in the Appendices.

1.1 Study Area and Project Timing

The two sites are Site 77 at 27.8 km and the 3 km ponds between 2 and 3 km along the Copper River Forest Service Road (Appendix 1). Site 77 is a small off-channel pond located at 27.8 km on the mainline and an outlet channel was constructed in November 2001 to connect the culvert with the river. This report summarizes the outlet channel construction at Site which took one day in November 2001.

In August 2001 we excavated three additional ponds along the channel at the 3 km pond site under contract to the former proponent Skeena Cellulose Inc. We utilized manual labour at the 3 km pond site in November 2001 to install cobble along the banks of the 200 m long channel and ponds to prevent bank erosion and complete the project. This report only summarizes the manual labour work that was completed while working for the Kitsumkalum Band.

1.2 Proponent and Funding Source

Funding for these activities was provided by Forest Renewal BC through local proponents. The proponent for these two activities is the Kitsumkalum Band Council (KBC). Triton Environmental Consultants Ltd., Terrace, was contracted by Skeena Cellulose Inc. to implement this project in April of 2001. The KBC became the proponent within the Copper River watershed in October 2001 after SCI became unable to fulfill contractual obligations due to bankruptcy in September 2001. Without the dedicated efforts of the Kitsumkalum Watershed Restoration Coordinators and support from the Band Council several FRBC activities would not have been completed to the detriment of fish resources and the local community. Their efforts are much appreciated. Kim Haworth oversaw and administered the project on behalf of the Kitsumkalum Band.

1.3 Watershed Description

The Copper River drains a 3000 km^2 watershed which contains substantial fisheries values along with powerlines, pipelines, roads and forestry development. In conjunction with floodplain logging and road construction over the past 35 years in the lower watershed, large floods and natural landslides caused substantial channel changes and negatively impacted fish habitat. Juvenile coho overwintering habitat and coho access to spawning habitat in side channels were negatively impacted by road and pipeline development.

1.4 Watershed and Project Objectives

Watershed objectives for the Lower Copper River Priority Watershed Unit are listed in the Interim Restoration Plan (Pollard, 2001). In general, watershed objectives are to undertake cost effective method to address the limitations on spawning, rearing and overwintering habitat for salmon "through the rehabilitation of existing sites or through mitigating impacts through habitat creation" (Pollard, 2001, p. 6).

The project objectives for each site are to:

- Improve juvenile fish access in and out of the culvert and off-channel habitat at Site 77 by construction of a narrow armoured channel.
- Protect the excavated banks at the 3 km pond site to prevent erosion and conduct final site cleanup.

1.5 Recommended Works

The recommended works from Triton (2000) for Site 77 included the replacement of two perched and blocked culverts in August of 1999 and the design and construction of an armored access channel. The armoured access channel was designed to concentrate water exiting the new culvert and prevent the dispersal of the flow across the cobble bar. Fry and smolts were not able to migrate to the river due to the dispersed flow which was less than 5 cm deep. The channel design was prepared by McElhanney Consulting of Terrace and is included in the Appendix 1.

In August of 2001 Triton staff supervised the excavation of four ponds within the 3 km channel that was built in September, 2000. The ponds were completed while SCI was the proponent but final armouring of the toe of the channel sides was not completed. The hand placement of angular and round cobble along sections of the toe of the slope was

recommended by the author in September 2001 to prevent undercutting by flows and erosion of the banks. High fall flows in the 3 km channel, up to 0.8 m deep, were observed by the author in October 2000 and the cobble, placed in fall 2000 along sections of the channel, prevented erosion of the channel.

2 CONSTRUCTED WORKS

2.1 Site 77 outlet channel

2.1.1 Background

The pond at Site 77 is located at 28 km on the Copper River Mainline. The site is an isolated flood channel of the river, approximately 160 m in length and 6 m wide. A small tributary, 0.3 m in width, feeds water into the upstream end of the pond. Water exits the pond via a narrow channel adjacent to the logging road that is approximately 10 m in length with 10% gradient. The narrow channel carries water into the 1500 mm diameter culvert which was installed in August of 1999 under the Copper River Mainline. The water exits the culvert on the north side and flows into the Copper River 40 m downstream. Prior to construction of the outlet channel, the stream dispersed across 40 m of unvegetated cobble bar and dropped down the steep face of the bar (1 m in height) into the Copper River during low flows. When the river levels were moderate during spring and fall flooding the bar was inundated and the water exiting the culvert entered the river within 15m of the culvert. The problem for fish which exit the culvert is the dispersed flow would trap emigrating fish amongst the cobble on the bar. Another problem was the lack of defined channel and steep obstruction along the edge of the bar which fry could not ascend from the river during low flows.

Minnow trapping in 1999 in the pond captured several coho smolts (120 to 160 mm in length) which were likely 2 or 3 years old and not able to exit the pond due to dispersed flow through the road bed and perched culverts. During flood conditions the perched culverts were backwatered by the river which enabled fry to migrate into the pond. The perched culverts and a blocked wooden box culvert were replaced during Phase 1 in August 1999. A 1500mm diameter culvert was installed to ensure year round fish passage and maintain adequate water depth in the slough.

2.1.2 Construction Description

Agency approvals were obtained prior to construction and work occurred on November 2, 2001 when the Copper River was at low discharge. Under the supervision of Triton staff,

two excavators and a Moxy truck (Vic Froese Trucking Ltd. of Terrace) were used to excavate the gravel bar, haul riprap from the nearby pit and armor the channel. Water flow from the culvert was minimal during construction and did not impede excavation.

To provide access to the floodplain on the north side of the road, a 10 m long ramp and tote trail was constructed from the road so a machine could excavate the channel and place riprap (see as-built sketch in Appendix 2). This road was partially removed after construction and the ramp was left to allow future access for site maintenance. The ramp also provides protection for the east side of the channel when the Copper River inundates the surrounding gravel bars.

The constructed channel is 47m from the culvert outlet to the confluence of the Copper River and ranges from 0.5 to 1.0m wide at the channel bed. Excavation depths ranged from 2m at the downstream section to 0.2m immediately adjacent to the culvert. Design gradient was 3% while estimated final gradient ranges from 2% to 4% in short sections.

Approximately 25 Moxy truck loads (200-250 cubic meters) of large rock, 0.6m to 1.2 m in diameter, was transported to the site from a nearby quarry at 28.5 km. The excavator lined the banks of the excavated channel with large riprap as a foundation and then small rocks, up to 0.5m in diameter, and gravel spoil were used to pack the interstitial spaces of the boulders. This resulted in a low berm between the Copper River and the constructed channel (see as-built sketch in Appendix 2).

The constructed channel sides are 1 to 1.5 m high by 2.0 m wide. The rocks were placed in several layers with larger rocks buried under 0.3 to 0.5 m diameter rocks to ensure a solid foundation. Several rocks (1.5 m diameter) were placed at the channel outlet in the Copper River to deflect the thalweg from the toe of the road slope (see Appendix 2). In addition to the construction of the channel, additional riprap armouring was placed along the toe of the road slope near the confluence of the channel and river. The armored bank is approximately 30 m in length and required one half day with the machinery to haul and place the rocks among the vegetation.

We anticipate having to do hand adjustments to the channel after the fall and spring flow has moved material within the channel. The channel is designed to be self-cleaning should it become overtopped and fill with silt at higher flows. Once the water level recedes and silt is left within the channel we anticipate that the continuous outflow from the culvert will erode the fine silts and maintain a continuous waterway within the armored channel.

Photo points are shown on Appendix 2 and correspond to the March 2002 photos in Appendix 4. Unfortunately, our camera malfunctioned during the one day of construction and we did not obtain photographs. Consequently, the photographs show pre-construction conditions in fall and post-construction conditions in winter with one to two feet of snow and ice in the channel. Examination of the site in March 2002 found the channel frozen with 10 to 20 cm of ice which does not provide overwintering habitat. No changes were observed in the channel in March compared to immediately post-construction.

2.1.3 Field modifications

Four changes to the proposed plans by McElhanney Consulting Services (Appendix 1) were made:

- Original designs identified the use of on-site materials for channel construction but due to the larger than anticipated amount of material for channel and bank armoring we required substantial volumes of rock from a nearby quarry. The quarry rock ranged from 5 cm gravel to 1.5 m diameter boulders and sufficient quantity was available for free. Not enough large boulders were available from the gravel bar and most were embedded in the bar. Two excavators and a truck were required instead of our original plan of one excavator which increased costs per day but overall efficiency of machine time was achieved.

- The design proposed construction of five step-pools within the channel to create small holding pools and to step the vertical drop down to the Copper River. These structures were not built as specified in the plans but smaller steps of 5 to 10 cm in height were incorporated throughout the channel which will not prevent juvenile fish access.

- The culvert outlet pool was not constructed since we did not want to create a perched culvert outlet.

- The banks of the 10m channel between the pond and the culvert inlet on the south side of the road were left intact.

2.1.4 Equipment and Materials

A 320 Caterpillar excavator was used in the construction of the channel while a similar excavator loaded rock into the Moxy truck at the quarry. Approximately 25 loads of rock ranging from gravel to 1.5m diameter boulders were used.

2.2 3 km ponds and channel

2.2.1 Background

Off-channel habitat in the lower 4 km of the Copper River was negatively impacted over the past 30 years due to floodplain logging, road construction, bridge construction, large floods and dyke building along the floodplain. Rehabilitation of off-channel habitat was a priority activity of the Copper River Watershed Restoration Program under the proponent Skeena Cellulose Ltd. and projects occurred over the past 5 years. Triton staff oversaw excavation of a 180 m long groundwater channel at the 3 km site in the fall of 2000. The original 3 km site design included several alcove ponds adjacent to the groundwater channel for rearing and overwintering habitat for juvenile coho salmon. The alcove ponds could not be completed in 2000 and were a priority project for 2001 under Skeena Cellulose Ltd. The crew accessed the site from the adjacent logging road at 2.5 km.

2.2.2 Work Description

In August 2001 Triton oversaw the construction of 4 alcove ponds in the upper 100 m of the groundwater channel at the 3 km site. One excavator and two Moxy trucks were used to dig the channel and end haul the material over several days. Unfortunately Skeena Cellulose Inc. came under creditor protection in early September and could not fulfill their FRBC obligations to contractors who built the 3 km site. Reporting obligations are still outstanding on the construction of the 4 ponds but may be resolved with new ownership of SCI.

The Kitsumkalum Band became the proponent within the Copper River to facilitate completion of outstanding projects. The outstanding task at 3 km was armoring of the toe of the channel slope along the gravel banks at several spots to prevent erosion and failure of the banks into the channel.

Three Kitsumkalum watershed restoration crew members spent three days in November 2001 using hand tools and wheelbarrows to move approximately 3 truckloads of cobble. Rocks were 0.2 to 0.5 m in diameter and hand placed to interlock along the lower 0.5 m of the channel. The objective was to place the cobble along the channel sections most likely to erode (bends and outlets/inlets of pools). Approximate locations of hand armoring are shown in Appendix 4. Photos 13 to 20 show the pre-construction conditions in 1999, the excavated channel in fall 2000 and excavation activities in August 2001. No photos of the hand placed rock are available.

During construction in August 2001 we placed one Moxy load of rocks at the cascade at the head of the groundwater channel. The labour crew organized the rocks and packed the interstitial spaces such that the water flow was brought to the surface. This resulted in erosion protection of the downstream side of the cascade and protection of the flanks of the cascade. The side and outlet of ponds 1, 2, 3 and 4 were protected with the onsite cobble. The crew placed angular cobble at the outlet of the channel where cobble was also placed last year and minor amount of rock was added.

A detailed survey was not completed after construction. A field visit to the site in March 2002 found no groundwater flow from the channel. See Biolith (2002) for discussion of monitoring results.

2.2.3 Equipment and Materials

Three Moxy loads of angular cobble was deposited by machinery adjacent to the channel in August for hand placement in November. Hand tools and wheelbarrows were used.

2.3 Budget Summary

Estimated costs for each project are summarized in Table 1. No materials costs were incurred for either project since the rocks were onsite or in a nearby quarry. Labour costs reported below include coordination and onsite supervision, reporting and liaison. Kitsumkalum WRP crew worked on the 3 km project and are included in the estimated total below.

Table 1. Budget Summary (estimated costs).

Item	Site 77	3 km
Labour	$2,500	$3,000
Heavy Equipment	$4,500	$ 0
Materials	$ 0	$ 0
Totals	$7,000	$3,000

3 ROUTINE MONITORING RECOMMENDATIONS

Routine monitoring of Site 77 and the 3 km pond site should occur annually in fall after flooding or winter (after freeze up) to ensure biological and structural function are maintained and that any maintenance issues are addressed. Routine protocols set by agency staff and in WRP technical guidelines should be utilized (WRP Technical Circular #12). Routine monitoring should consider the following at Site 77 and 3 km:

- Evaluation of fish access through the outlet channel and culvert to ensure juvenile passage is maintained (Site 77).
- Documentation of any flooding damage to channels which require corrective action to maintain channel integrity.
- Documentation of spawning activity within the side channel at 3 km since previous spawning was considered possible and would be an added benefit.
- Monitor for beaver activity and remove any beaver dams.
- Sample dissolved oxygen levels within the ponds and outlet channel to identify if low oxygen may become a limitation.
- Annually sample for fish with minnow traps in each pond to track changes in use through time with a mark-recapture technique with overnight sets. Species composition, fish lengths and abundance are key data for monitoring. This should occur prior to fry emergence in April to document the overwintering survival of parr at each site.

Frozen conditions at site 77 will likely occur between December and March each year and will not reduce the effectiveness of the site since fry emerge in April and May and seek out suitable habitat till late fall. Coho smolt emigration from the site should occur between April and June. Monitoring of fish populations by minnow trapping within the pond and comparison between years is a suitable technique to measure success of fish access at Site 77. The age classes can be distinguished and no spawning habitat exists within the Site 77 pond or outlet streams so any changes in fish population structure are likely to be due to immigration and emigration with minor changes due to predation and competition.

A key outcome of the work at 3 km is the importance of a stable water supply into a groundwater channel. The 3 km site is situated at the base of a colluvial fan with a steep but small watershed upstream which feeds into the culverts and eventually the 3 km channel. The groundwater elevation drops 20 to 30 cm from the outlet elevation at the ponds in the 3 km site between November and January. Water seeps into the ponds slowly through the winter but should a prolonged cold snap reduce the groundwater flow, the ponds may be at

risk of drying up. Continued monitoring will determine the success of the project through years with varying winter conditions but future WRP projects should ensure that adequate groundwater flow exits at the margins of the floodplain prior to construction.

3.1 Project maintenance and future opportunities

Future maintenance may include the clearing of beaver dams and minor additions of cobble armoring (if erosion develops). To ensure surface erosion does not remove materials from the slopes additional seeding and shrub planting may be required. This will depend on the success of the treated materials.

Due to the limited groundwater at the site, no further opportunities exist at the 3 km site. Site 77 is now complete and may require minor hand tweaking of the rocks along the channel to maintain the thalweg and clear minor obstructions.

4 REFERENCES

Biolith Scientific Consultants Ltd. 2002. Routine Effectiveness Evaluation of the Watershed Restoration Program rehabilitation works at km 27.5 (Site 77), and at km 3 (3km Off-Channel Site) on the Copper (Zymoetz) River Forest Service Road. Report prepared for Kitsumkalum Watershed Restoration Program.

Pollard, B. 2001. Copper Lower Priority Watershed: Interim Restoration Plan. Report prepared for Forest Renewal BC and Skeena Cellulose by ACER Resource Consulting Ltd. Terrace, BC.

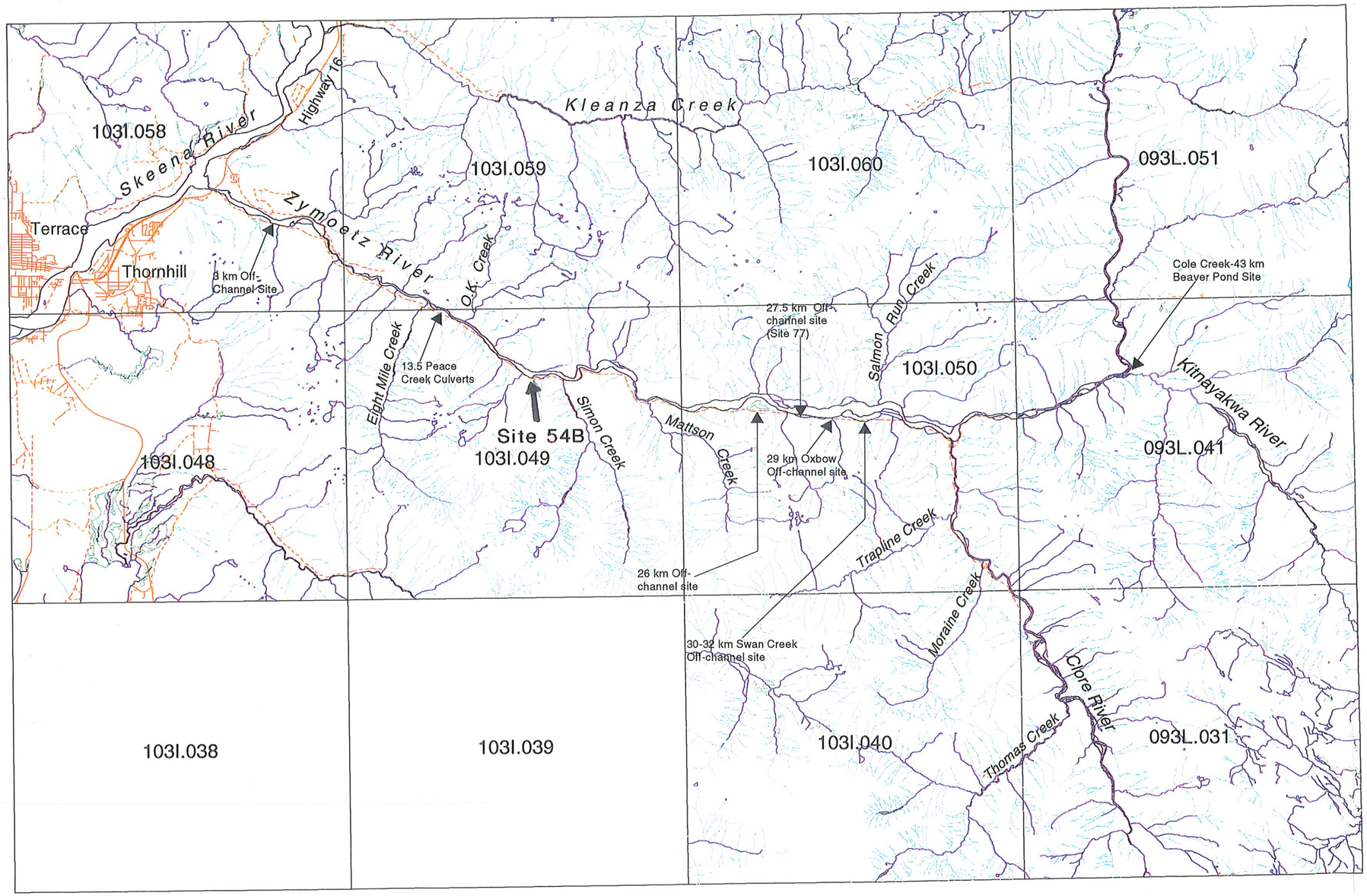
Triton Environmental Consultants Ltd. 2000. 1999/2000 Monitoring and Works Summary. Summary report for the Copper River Watershed Restoration Program prepared for Skeena Cellulose Ltd and Ministry of Environment, Lands and Parks. Terrace, BC.

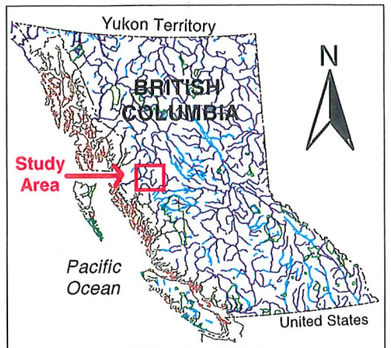
5 APPENDICES

Appendix 1. Study area map with location of Site 77 and 3 km pond site.

LOWER COPPER RIVER WRP ASSESSMENT SITES

Overview Map





INSET MAP

LEGEND

- Gravel Roads
- Paved Roads
- Rivers/Streams
- Lakes
- Indefinite/Intermittent Streams
- Marshes/Swamps
- Glaciers

2000 0 2000 4000 Meters

1:175,000

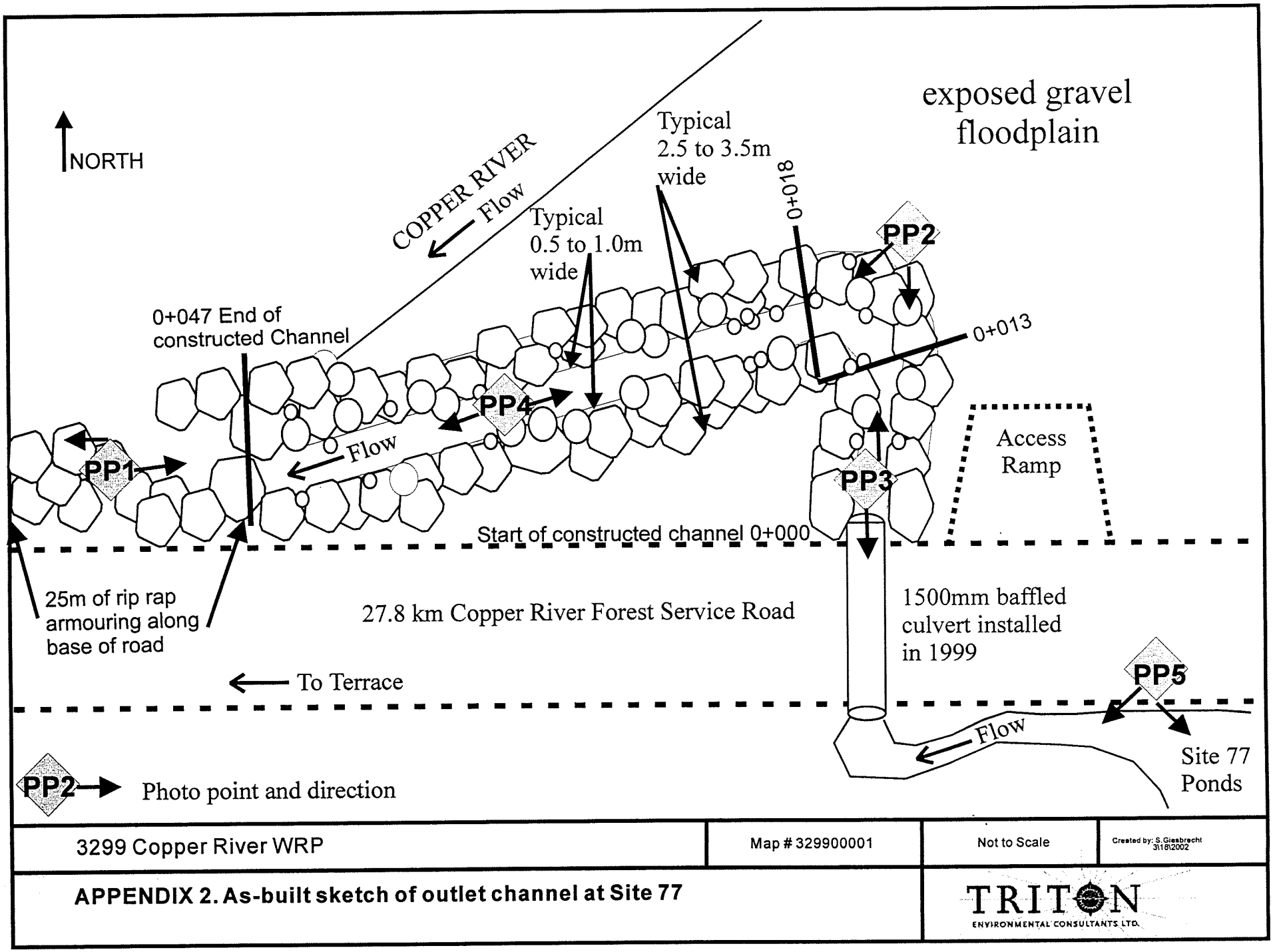
Source: Digital TRIM 1:20,000,
Projection : UTM

Date: April 3, 2000
Created by: SM

TRITON
Environmental Consultants Ltd.

Map#: 2675.06.299

Appendix 2. As-built sketch showing the constructed channel and photo points.



3299 Copper River WRP	Map # 329900001	Not to Scale	Created by: S.Giesbrecht 3\18\2002

APPENDIX 2. As-built sketch of outlet channel at Site 77

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Appendix 3. Site 77 design letter and sketches by McElhanney Consultants.

McElhanney

29 February, 2000

Our File:
2321-00492-0

Triton Environmental Consultants
P.O. Box 88
Terrace BC V8G 4A2

Attention: Steve Jennings

Dear Mr. Jennings:

Re: Copper River 27 km Fish Access Channel

Attached are the design sketches you requested, showing the fish access channel to the recently installed culvert, just past 27 km on the Copper River FSR. Based on our discussion of the design requirements, the following criteria were used for this channel design:

1) Low cost, low level of effort
2) 10 year design flow
3) Low visibility
4) Materials to be sourced on site.

Hydrology

The catchment area (based on TRIM 1:20,000 mapping) is 1.89 km^2. Based on this area, four hydrologic models were used to estimate a 10 year peak discharge of 6.8 m^3/s. Please refer to the attached table.

Channel:

A channel alignment was selected to follow the FSR as closely as possible, to reduce the risk of flood damage. Other alignments are possible on the site but, due to snow conditions, were difficult to identify. When the snow has cleared, the site can be re-assessed and an alternative alignment perpendicular to the road or angled to the Copper River upstream may be developed. The design provided can easily be field modified to fit these alignments.

The proposed channel has a 3% grade, with 5 steps and a culvert tail water control (to be designed and built on site). The channel has a 1.0m wide invert and 2H:1V banks. Based on

...2

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these parameters, the 10 year discharge will have a 0.70m depth with an estimated velocity of 3.4 m/s (based on Manning's open channel flow analysis and a roughness factor of 0.024). The geometry of the channel and site will cause the channel to be topped by this flow but this is not expected to harm the channel, as the flow will flood out across the point bar. The channel may also be flooded by the Copper River at the same time.

The channel will be lined with a layer of 15cm – 30cm (D_{90} +) stream cobble scraped from the point bar. This cobble should be compacted into the channel. Surfacing material of 1 cm – 10cm gravel scraped from the point bar can be placed over the larger cobble. If the infiltration is too great following placement of this material, finer gravel and sands can be added to cement the gravel/cobble. Spoil can be spread around the point bar by hoe chucking.

Channel Structures

5 channel structures will be required to step the channel down to the Copper River and allow reasonable fish passage at a 3% grade. Please refer to the attached rock step pool details. These will be constructed by having the excavator salvage approximately 20 to 25 large rocks from the top of the point bar (these rocks vary in size from 250 to >1500 kg). The rocks will be placed in the channel so that there is a 10cm sloped lift (10%-15%) past and over the rock. On the downstream side of the rock, a 30cm deep pool should be excavated.

Confluence at Copper River

Where the channel joins with the Copper River, it should be excavated 40cm (minimum) below the low water line of the Copper River. The channel invert will then be graded up to the low water line of the Copper River at station 0+045. Large rip rap salvaged from the top of the point bar should be used to line both banks of the channel. These rocks should be buried to a depth of 2/3rds their diameter. This aspect of the design is to prevent the channel from being perched above the river, when the point bar erodes.

Culvert

A tail water control will be required at the culvert's outlet to pond water back into the culvert. This will be designed on-site with available materials.

Cost:

We estimate that this channel will require 2 days of excavator time, 2 days of on-site supervision, and possibly 1 manual labourer.

...3

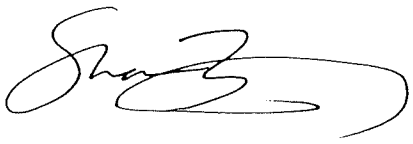
Disclaimer:

Both the site and the requested design are considered to be risky, with respect to building a channel within the Copper River and by using on site materials. The design will be as resilient as the as the Copper River allows but may last less than a year depending on storm flows.

If you have any questions about this design or would like further clarification, please do not hesitate to contact me.

Sincerely,

McElhanney Consulting Services Ltd.

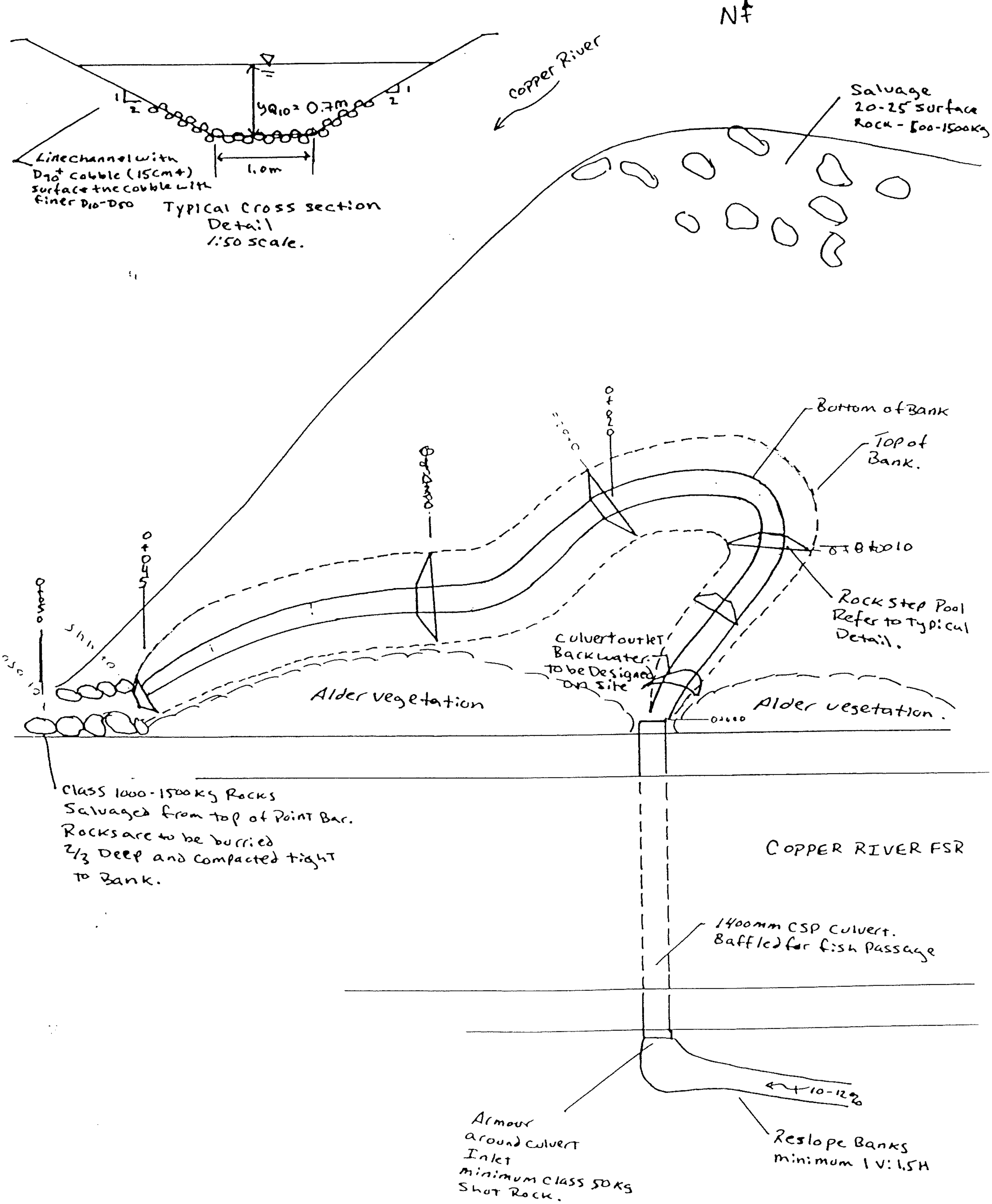


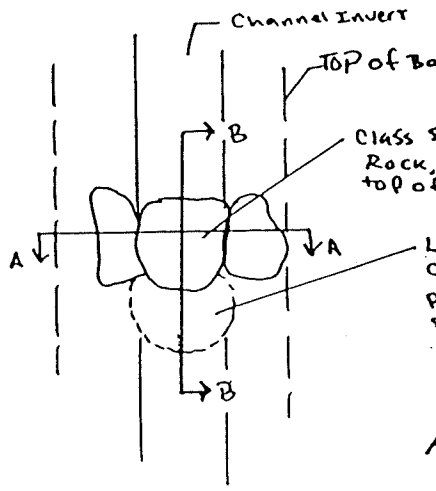
Shawn Zettler, B.Sc., B.Sc. (Eng.), E.I.T.
Project Engineer (Environmental)

McElhanney

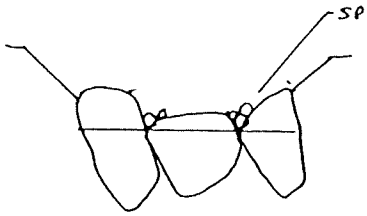
Design Sketch

SUBJECT	DESIGN	CHECK	JOB NO.	PAGE
Proposed Access Channel Plan view	DATE	DATE	2321-00492	1





Plan View of Rock Step Pool.
NOT TO Scale.



Section A-A
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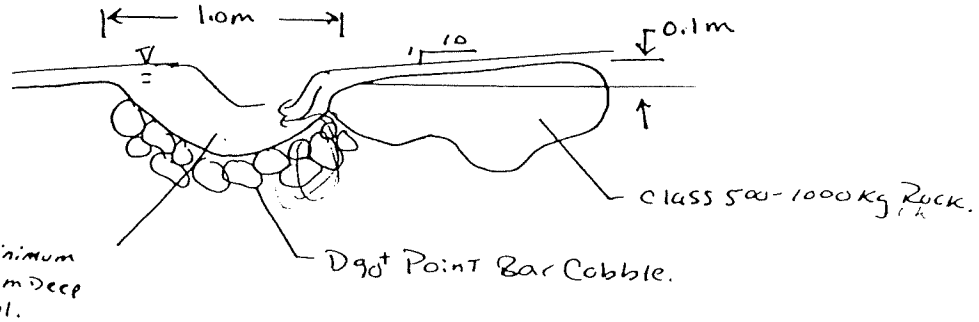

Section B-B
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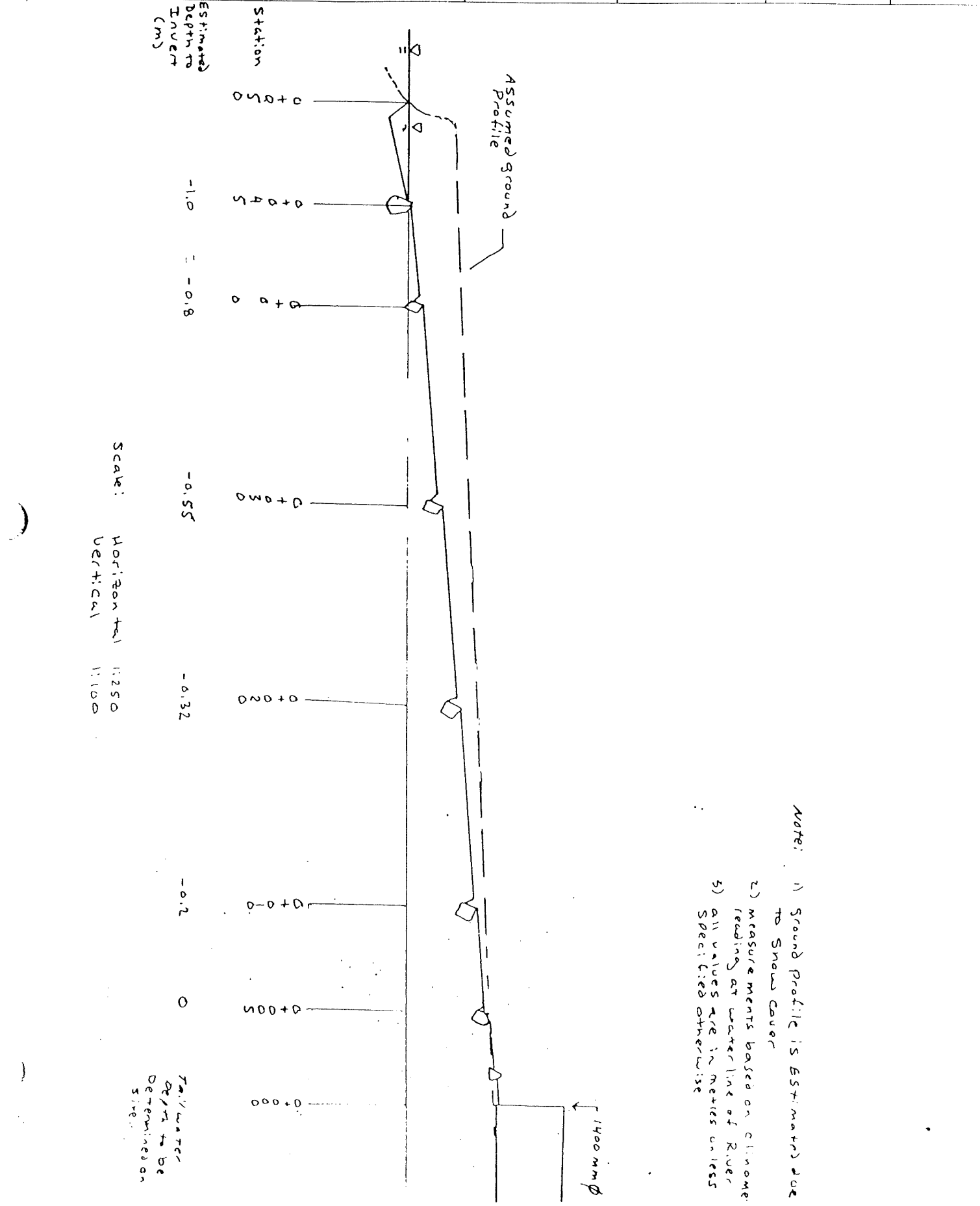
Design Sketch

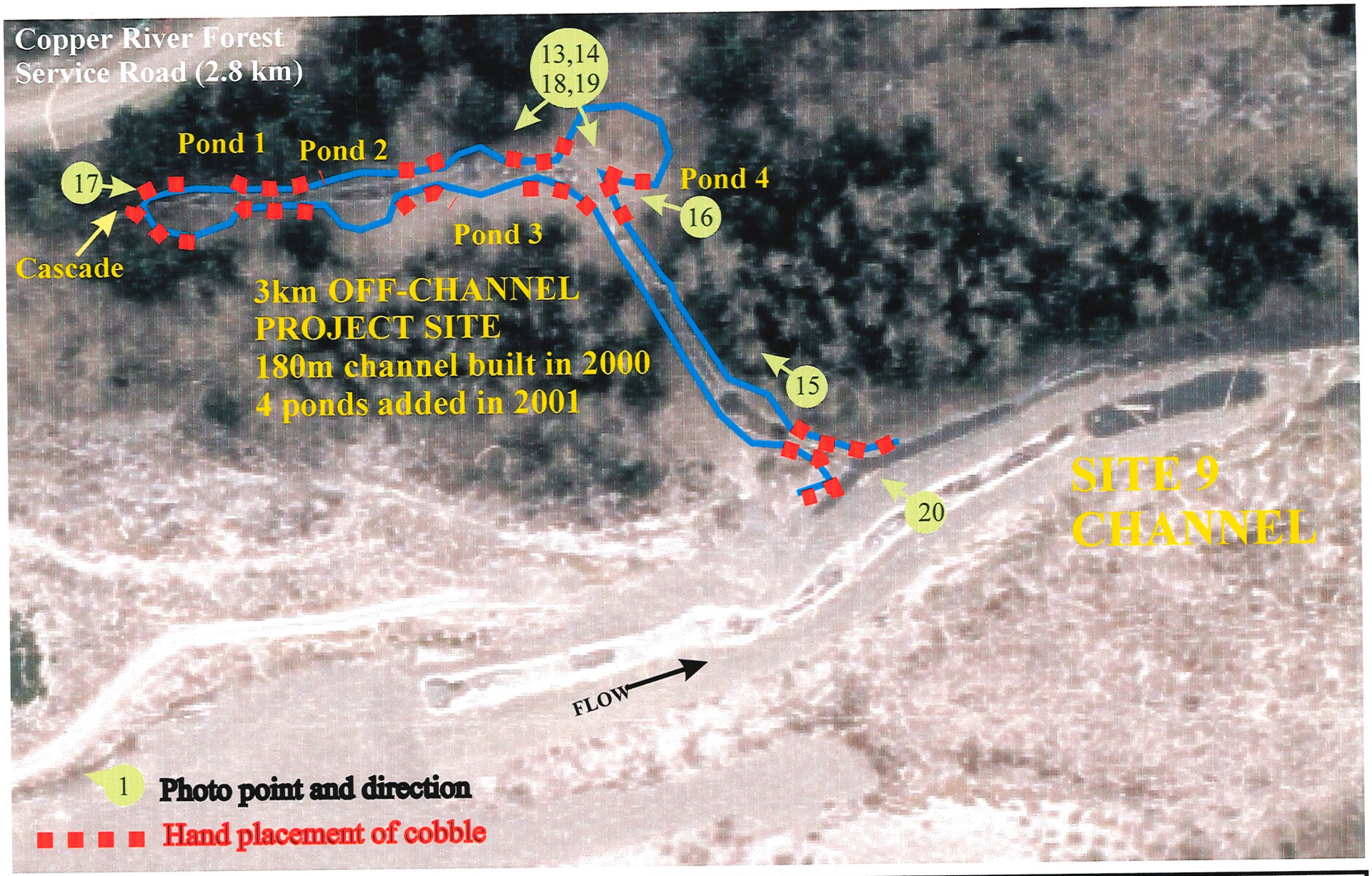
McElhanney

SUBJECT	DESIGN / DATE	CHECK / DATE	JOB NO	PAGE
Proposed Channel Profile.			2321-00492-0	3



Note:
1) Ground Profile is Estimated due to Snow Cover
2) Measurements based on clinometer reading at centerline of River
3) All values are in metres unless Specified otherwise

Appendix 4. 3 km pond site: location of 2001 works.



3299 - Copper River	Map # 32990001	Metres 10 20 30 40	Created By: Shawn Giesbrecht 1/01 Revised By: Source: Dec 2000 Overflight Photo
Appendix 4: 3 km pond site showing location of 2001 works		TRITON ENVIRONMENTAL CONSULTANTS LTD.	

Appendix 5. Report Photos

Photo 1. July 1999. Looking upstream into the pond from photo point 5. Prime rearing habitat during summer and good overwintering habitat.

Photo 2. March, 2002. Looking upstream from photo point 5 at frozen pond. Coho captured in minnow traps and good dissolved oxygen levels.

Photo 3. July 1999. Looking upstream from photo point 4 gravel bar downstream from the culvert. Person is standing at future corner in new channel.

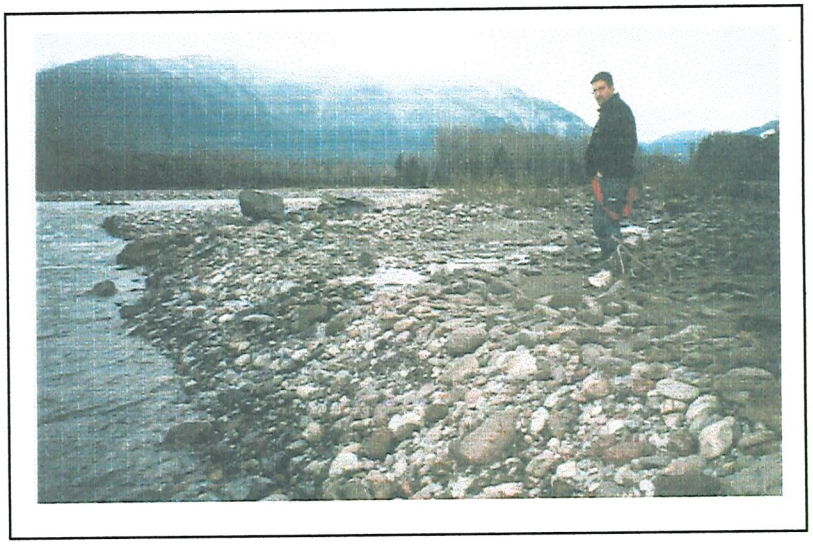


Photo 4. October 1999. Looking at the confluence of outflow creek from Site 77 and Copper River. Note drop into the Copper River, obstruction for fry.

Photo 5. November 2001. Ramp for access to floodplain from the Copper River Mainline. Culvert and channel at right of photo. photo point 2.

Photo 6. November 2001. Looking across gravel bar at outlet channel prior to excavation. Photo point 2.

Photo 7. November 2001. Looking downstream along the Copper River at the excavator placing rip rap along the toe of the road. The old outlet channel is in the foreground.

Photo 8. March 2002. Looking upstream at the confluence of the outlet channel with the Copper River from photo point 1. Note channel on right.

Photo 9. March 2002. Looking downstream on the outlet channel toward the confluence from photo point 2.

Photo 10. March 2002. Looking upstream along the outlet channel to the culvert installed in 1999 from photo point 2.

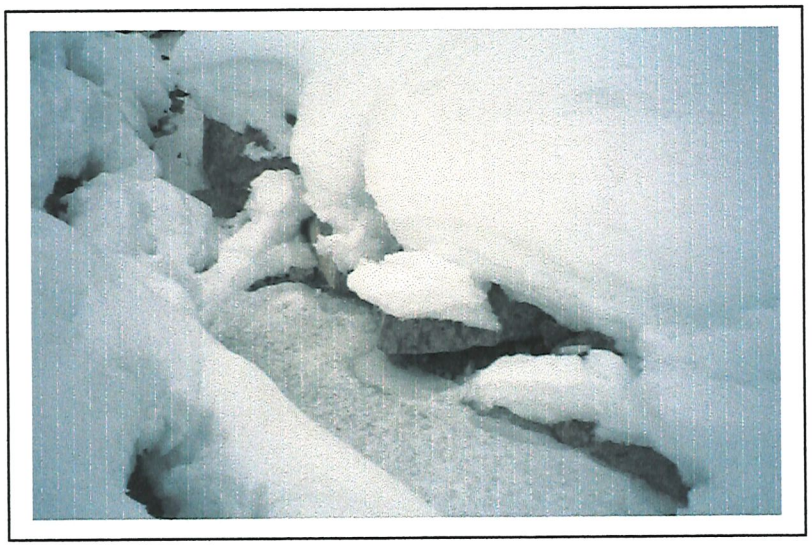


Photo 11. March 2002. Looking downstream from the culvert from photo point 3 to photo point 2.

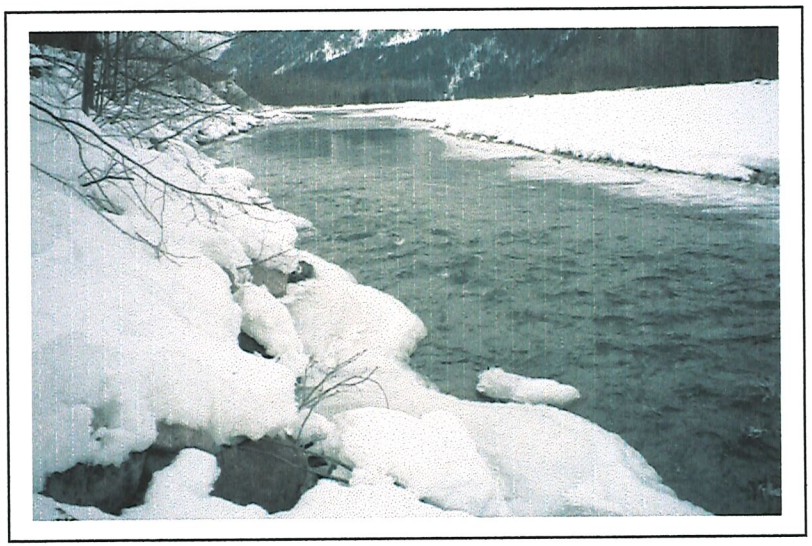


Photo 12. Looking downstream from the confluence of the outlet channel at additional bank protection installed as part of this project. Photo point 1.

Photo 13. Summer 1999. Middle section of channel before construction with blocked culvert (foreground) which diverted flow down spur road.

Photo 14. Summer 1999. Upper 100 m of ephemeral channel. Ponded water was due to blocked culvert was diverted down old spur road.

Photo 15. September 2000. Lower section of off-channel after phase 1 of excavation and complexing, looking upstream. Coho spawned immediately upstream of the pool in foreground.

Photo 16. September 2000. Upper section of off- channel after phase 1 of excavation and complexing. Note cobble armoring along edges of channel which prevented flood damage in October.

Photo 17. August 2001. 320 Caterpillar Excavator digging the head pond (Pond 1).

Photo 19. Looking downstream at constructed Pond 4 (alcove pond)

Photo 18. August 2001. Pond 3 after construction. Pond was isolated until the sediment settled out.

Photo 20. Looking upstream into the channel from Site 9. Location of cobble armouring to protect outlet from erosion.

Appendix 6. Compendium Report

Outlet Channel Construction at Site 77: Copper River

Objectives
The objective of this project was to construct a 50 m long rock access channel across a gravel bar to maintain permanent access for juvenile fish into an off-channel site. Two perched culverts were replaced in 1999 at this site and the access channel was the final completion step.

FRBC Region / MWLAP Region / MOF Region
Pacific / Skeena / Prince Rupert

Author
Steve Jennings. Triton Environmental Consultants Ltd, Terrace.

Proponent
Kitsumkalum Band Council, Terrace

Watershed / Stream
Zymoetz (Copper) River

Location
Site 77 is located at 28 km on the Copper River Forest Service Mainline, approximately 45 km southeast of Terrace.

Introduction
The Copper River drains a 3000 km^2 watershed which contains substantial fisheries values along with powerlines, pipelines, roads and forestry development. In conjunction with floodplain logging and road construction over the past 35 years, large floods caused substantial channel changes and impacted fish habitat, particularly off-channel habitat amount and fish access.

Assessments and Prescriptions
The pond at Site 77 is an isolated relic flood channel of the river, 160 m length and 6 m wide, located against the hillside and isolated from the river by the mainline road. A small tributary and groundwater seepage maintain water levels in the slough.

Phase 1 of the project involved replacement of two perched culverts in 1999 which enabled fish to access the pond. The outflow from the pond dispersed across a 50 m wide gravel bar before entering the river. Fry could not access the culvert at low flows due to the dispersed flow through cobble on the bar and lack of defined channel (obstruction to fish access).

Construction Work
A 47 m long cobble and boulder channel was constructed across the gravel bar using 0.3 to 1.2 m diameter rocks. The work was completed in one day using an excavator to dig the channel and lay in the boulders. The boulders were packed together and covered with excavated gravels and small cobble to seal the banks. Channel width is 0.5 to 1 m and up to 1.5 m in depth. This channel will concentrate the flow into one thalweg and enable juvenile coho to ascend to the culvert and upstream into the off-channel pond.

Cost Summary

Labour	$ 2,500
Machinery and materials	$4,500
Total	$7,000

Outputs
The channel construction was the second phase of the access improvement work at Site 77 and will enable permanent juvenile coho fry access. Approximately 1000 square meters of good quality off-channel rearing and overwintering habitat is permanently accessible.

Overall the slough appears suitable as off-channel rearing habitat and we anticipate high use of the slough by coho fry which will be monitored. Average production is estimated at 375 smolts, using 0.25 smolts/m^2, similar to Telkwa River off-channel habitat production figures.

For Further Information, Contact:
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Figure 1. Isolated off-channel slough located upstream of culverts at Site 77.

Figure 2. Gravel bar with dispersed flow prior to construction of access channel across bar.

Figure 3. Constructed access channel in March 2002. Downstream view of lower 25 m and confluence with Copper River (right).

UTM (NAD 83) Coordinates
Zone: 9
Northing: 6035200
Easting: 56400

Watershed Code
440-000000-00000- Copper River