BRITISH COLUMBIA
The Best Place on Earth

General Disclaimer

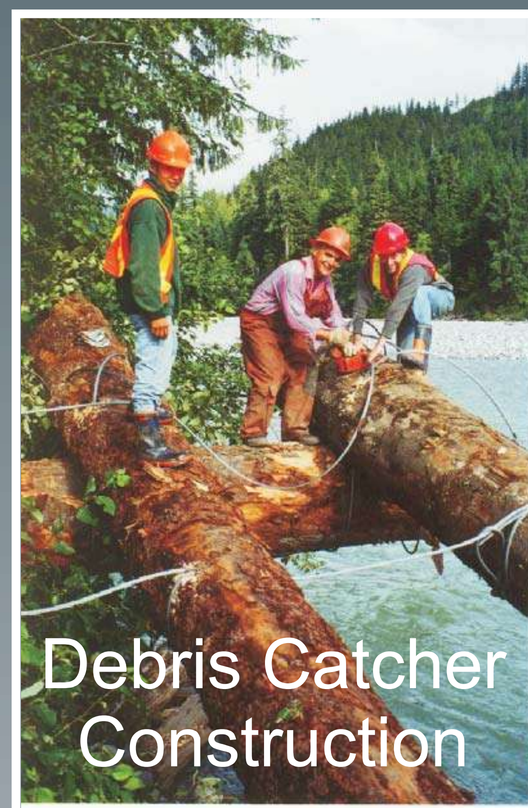
The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the Government of British Columbia of any product or service to the exclusion of any others that may also be suitable. Contents of this report are presented as information only. Funding assistance does not imply endorsement of any statements or information contained herein by the Government of British Columbia. Uniform Resource Locators (URLs), addresses, and contact information contained in this document are current at the time of printing unless otherwise noted.

Disclaimer of Liability

With respect to documents available from this server, neither the Government of British Columbia nor any of their employees, makes any warranty, express or implied, including the warranties of merchantability and fitness for a particular purpose, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

Copper River WRP

2000-2001 Instream Works Summary Report



TRITON
ENVIRONMENTAL CONSULTANTS LTD.

January 2001

Table of Contents

List of Figures

List of Appendices

Acknowledgments

The Copper River WRP projects were completed due to the efforts and input of many people; especially agency staff and local residents committed to habitat restoration. The following people worked on or provided input or donations to the project which is greatly appreciated:

- Skeena Cellulose Inc: Kim Haworth (FRBC Coordinator), Kevin Derow, Bud Southgate;
- Terrace Salmonid Enhancement Society: Mike Graham, Doug Webb, John Poussette;
- DFO, Terrace: Mitch Drewes, Barry Peters, Rob Heibein,
- BC Ministry of Environment, Lands and Parks: Chris Broster (Terrace), Jeff Lough (Regional WRP Specialist), Monty Miedreich (Water Management), Pat Slaney;
- BC Conservation Foundation: Rheal Finnigan, P. Eng.,
- BC Ministry of Forests, Kalum FD: Ralph Ottens,
- McElhanney Consultants Ltd.: Shawn Zettler, Cathy Lind, Rob Phillips, Clause Rioux;
- A&D Contracting Ltd: Al Shaefhowser, Brian Shaefhowser.
- Ed Moore Contracting: Jerry Wiebe operator.
- Terrace Wade Contracting: Dave Dams, donation of rocks and materials
- BC Hydro funding contribution: Gord Heenan
- Triton Environmental Consultants Ltd: Dave Gordon, Dave Taft, Jason Dorrey, Jennifer Lucke, Donavan Meierhoffer, Eamon Miyagi, Bruce Mattock, Heather Gall, Clyde Mitchell, Steve Bolton.

1. INTRODUCTION

This report summarizes instream construction activities implemented by the licensee and proponent Skeena Cellulose Inc (SCI) in 2000/01 in the lower Copper River watershed at three sites adjacent to 3 km along the Copper Forest Service Road (Figures 1 and 2). Triton Environmental Consultants Ltd. was retained to manage and implement the following three FRBC-funded projects under FRBC Activity # 716455:

- Site 9 Berm Removal (May, 2000),
- Construction of off-channel habitat between 2 and 3 km along the FSR,
- Construction of three debris catchers in the main river channel at 3 km (August and October, 2000).

The project objectives, construction activities, alterations from the plan, photos and monitoring recommendations are presented below for each project.

1.1 Prior Watershed Assessment and Restoration Work in the Copper (Zymoetz) Watershed

A Watershed Restoration Program was initiated in the Copper River watershed in mid-1995 to undertake upslope, riparian and fisheries assessments to identify impacts and rehabilitation opportunities. Between 1995 and 2000, site assessments, detailed designs and instream works were conducted to rehabilitate fish habitat (Triton, 2000). The dynamic processes and naturally unstable terrain limits the scope of WRP activities which can be implemented to benefit aquatic resources and resulted in focussing on off-channel habitat for coho salmon. Prioritization of off-channel rehabilitation sites was undertaken through 1999 and 2000 which led to the current projects for 2000/01 (Triton, 2000).

Fisheries values within the Copper River watershed include very valuable anadromous and resident salmonid populations which are important for recreational fisheries. The fisheries resources are well described in several recent documents; for detailed descriptions refer to Lewis and Buchanan (1998, steelhead overview), and Pollard *et al*, (1996, general fisheries overview).

In winter 2000/01, a four year Restoration Plan was developed to assist with priority setting and long-term project planning for three sub-basins (Clore, Lower Copper and Kitnayakwa sub-basins) within the Copper Watershed (Pollard and Haworth, 2000). Specific upslope, riparian and instream assessment and rehabilitation activities were identified and prioritized so that sub-basins can be effectively completed in a timely manner.

1.2 Watershed Objectives

Watershed-level objectives for projects within the Copper River include:

- Improving fisheries resources using off-channel habitat development to mitigate adverse impacts, particularly isolation of productive floodplain fish habitat, due to old floodplain logging and road construction.
- Rehabilitating existing upslope impacts or reducing risk of future upslope impacts to aquatic resources through assessment and works including road deactivation, gully and slide revegetation and rehabilitation.
- Rehabilitating impacted riparian habitat through assessment and stand treatment for long term benefit to aquatic resources and stream channels through improved bank stability and woody debris recruitment.

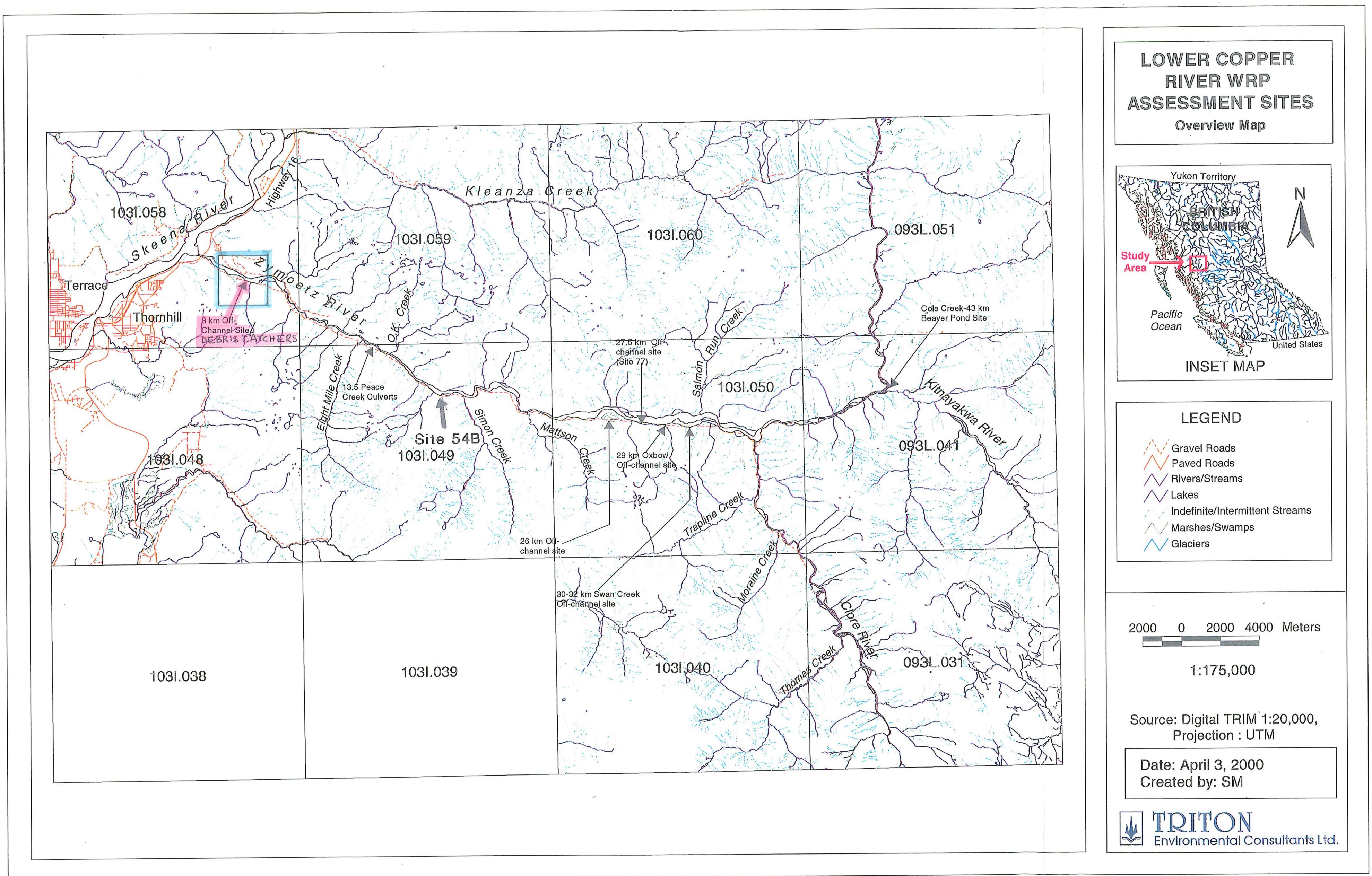
1.3 Implementing Partners

The WRP activities within the watershed are managed through the involvement of licensees, government agency staff, community representatives and consultants. The Copper River Watershed Restoration Committee decides on project priorities. Members include:

- Skeena Cellulose Inc (licensee and WRP proponent), represented by Kim Haworth, FRBC Coordinator;
- Ministry of Environment, Lands and Parks / Ministry of Fisheries Watershed Restoration Program, represented by Chris Broster,
- Department of Fisheries and Oceans, represented by Mitch Drewes, Habitat Technician,
- Terrace Salmonid Enhancement Society (TSES),
- Technical consultants.
-

Additional input or funding for proposed activities is sought from Water Management Branch, Ministry of Forests (Ralph Ottens), BC Hydro (Gord Heenan), PNG Gas (Dennis Towriss), MELP (Jeff Lough) and BC Conservation Foundation (R. Finnigan). BC Hydro and the provincial WRP program (Pat Slaney) contributed funding to the Debris Catcher project which enabled construction of three large structures.

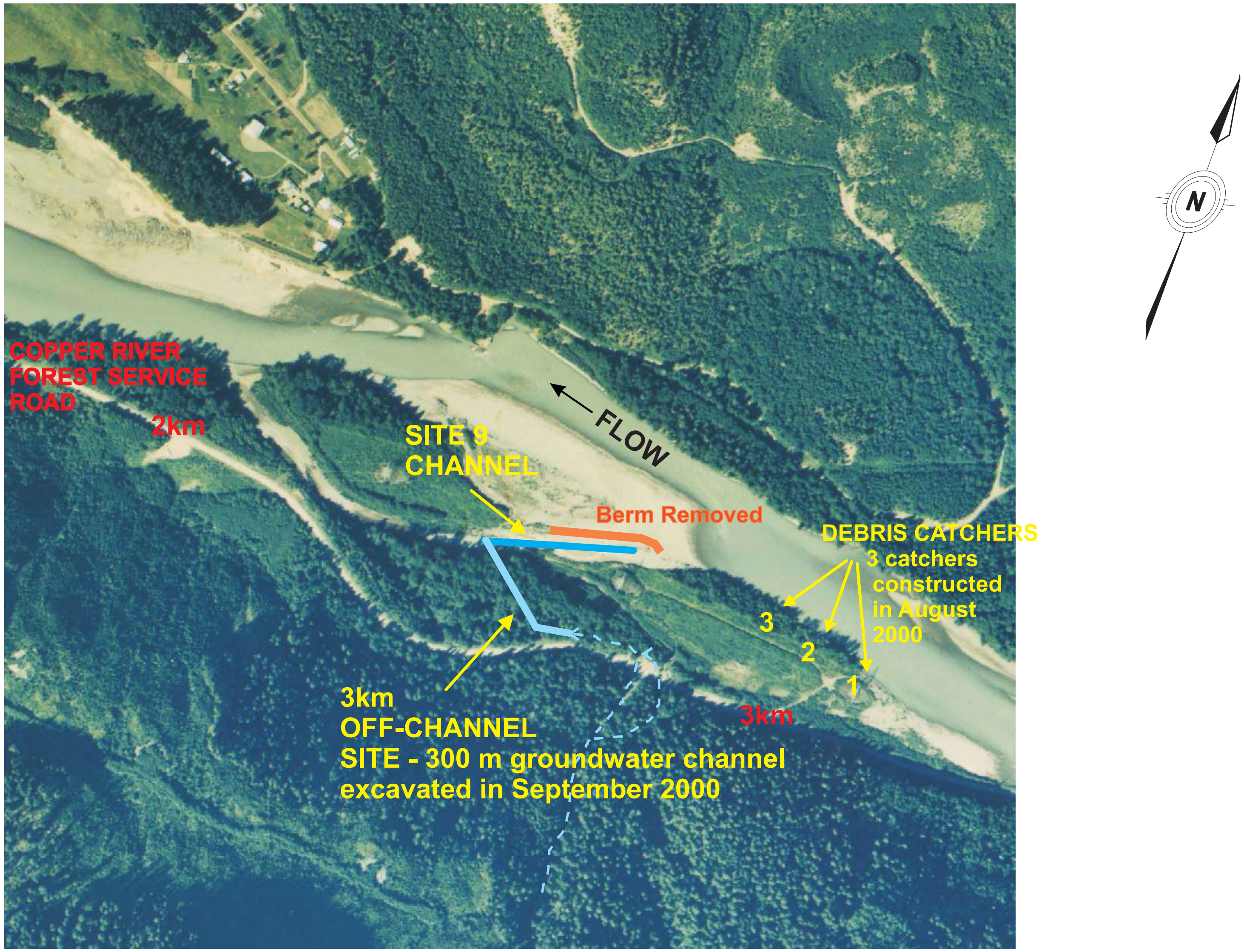
Figure 1. Lower Copper (Zymoetz) River Map: Construction Sites



LOWER COPPER RIVER WRP ASSESSMENT SITES
Overview Map
Yukon Territory
BRITISH COLUMBIA
Study Area
Pacific Ocean
United States
N
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.
103I.058
103I.059
103I.060
093L.051
103I.048
103I.049
103I.050
093L.041
103I.038
103I.039
103I.040
093L.031
Terrace
Thornhill
Skeena River
Highway 16
Kleanza Creek
Zymoetz River
OK Creek
Eight Mile Creek
Simon Creek
Mattson Creek
Salmon Run Creek
Trapline Creek
Moraine Creek
Thomas Creek
Clore River
Kitnayakwa River
8 km Off-Channel Site
DEBRIS CATCHERS
13.5 Peace Creek Culverts
Site 54B
26 km Off-channel site
27.5 km Off-channel site (Site 77)
29 km Oxbow Off-channel site
30-32 km Swan Creek Off-channel site
Cole Creek-43 km Beaver Pond Site
Map#: 2675.06.299

FIGURE 1

Figure 2. Lower Copper (Zymoetz) River Aerial Photo: Construction Sites



3149.01 - Copper River	Map # 31490001	Scale: 1:10000	Created By: Shawn Giesbrecht 1/01 Revised By: Source: Dec. 2000 Overflight
Figure 2: Locations of Instream Restoration Projects		TRITON ENVIRONMENTAL CONSULTANTS LTD.	

2. SITE 9 BERM REMOVAL (3 KM)

This project involved removal of a small berm and channel adjustment in May, 2000, to fulfill a Provincial Water Management Branch Order to remove the bermed material. A construction completion report was forwarded to DFO, MELP and SCI in June, 2000, and is summarized below.

2.1 Background

Site 9 is a 300 m long groundwater channel that was excavated in 1998 by TSES (implementing partner with SCI) within a flood channel to the Copper River, adjacent to 3 km along the Copper FSR (Figures 1, 2). This site was once a viable spawning area in the early 1970's (TSES, 1998) but recent channel changes do not permit the river to inundate the area at low discharge levels which preclude use by adult fish.

The biological objectives of the original channel excavation in 1998 were:

- to create a groundwater channel which coho and possibly chum salmon would spawn in, and,
- to provide rearing and overwintering habitat for juvenile coho salmon.

2.2 Site 9 Berm Removal

The excavated soil from the spawning channel were used as a low berm, 1m in height and 100 m in length, adjacent to the Site 9 channel for flood protection. Small amounts of riprap were used to protect the steeply sloping banks of the upstream end of the channel and along the berm. As seen in Figure 2, the channel and berm are located in the floodplain, midway between the valley walls. Groundwater seeped into the excavated channel at the upstream end and upwelling along the channel margins contributing substantial flow.

We examined the Site 9 channel and river from peak runoff in mid-June 1999 through the fall and winter of 2000 and monitored water quality, fish use and flows. We found that fish successfully spawned and reared in the channel but an assessment by both an engineer and hydrologist concluded that the berm was a substantial risk to stability of the mainstem channels and flow patterns (Hay and Company, 1999, Gilchrist, 1999).

The protective berm was ordered removed by the Ministry of Environment, Lands and Parks - Water Management Branch in September 1999 but could not be completed until spring, 2000, since incubating fry were present.

The objective of this project was to remove the Site 9 Berm and fill 40 % of the excavated channel to the original stream grade to prevent potential channel impacts to the mainstem. The pre-work planning, mitigation, daily construction work, and post-construction observations are summarized below.

Pre-Work Planning

A proposed work plan and compensation plan, dated April 11, 2000, (Reference# 3028.02/WP#T-945), for the Site 9 Berm removal and channel infilling was prepared by Triton and submitted on April 11, 2000, to the following individuals: Chris Broster (MoELP), Mitch Drewes (DFO), Ron Creber (MoELP), Monty Miedreich (MoELP), Doug Webb (TSES) and Kim Haworth at Skeena Cellulose Inc.(SCI). MoELP Water Management Branch did not want perforated pipe used in the floodplain so a buried log conduit was used to concentrate groundwater from the in-filled portion of the channel to the remaining channel. On May 8, 2000, DFO issued an Authorization (Appendix 1) to SCI to allow channel infilling, per Water Management Branch's orders, once incubating alevins had emerged from the gravel.

On May 9, 2000, a field visit of Site 9 and proposed Copper River WRP projects included Chris Broster (MoELP), Mitch Drewes (DFO), Jeff Lough (MoELP), Monty Miedreich (MoELP), Rheal Finnigan (BCCF), Steve Jennings (Triton), Bud Southgate (SCI) and Kim Haworth (SCI). The purpose was to view proposed WRP projects and to resolve outstanding issues surrounding the Site 9 Berm removal and channel infilling. A consensus was reached to install a pseudo "French drain" (bound logs over coarse rock) in the channel before filling to maintain water infiltration to the lower 60% of the excavated channel using donated logs (SCI). Mitch Drewes (DFO) expressed his concerns that coho fry may not have emerged from the gravel within the section to be filled. Shovel sampling of the gravel surrounding the redds indicated that a small proportion of fry had not emerged from the gravel and additional sampling with a hydraulic sampler the following week was required.

On May 16, 2000, a daily work plan for the Site 9 Berm removal and channel infilling was prepared and reviewed. In addition, instruction was provided on SCI's Standard Operating Procedures (SOP's), Fire Pre-organization Plan, Spill Response Contingency Plan, Erosion Control Plan, and Pre Work Forestry Checklist. Copies of all documents were received by Triton and reviewed with the equipment contractors (A&D Trucking and Dave Lavoie Contracting) prior to construction start-up on May 29, 2000. Prior to construction all the necessary paperwork and approvals were obtained including: BC Hydro Approval, Water Management Branch confirmation, DFO Authorization and Fish Collection Permits.

Mitigation & Construction Activities

Mitigation measures were outlined in the April 11 letter and May 16 work plan for Site 9 Berm removal and channel infilling. Mitigation measures included sediment control fences, fish salvage and discharge monitoring. Site photos 1 to 4 illustrate the onsite activities.

April 25, 2000

The entire Site 9 excavated channel was isolated with a fish exclusion fence which remained operational until May 12. Juveniles were allowed to out migrate from the excavated channel.

May 5, 2000

The total length of excavated channel was measured at 300 m. The length of excavated channel to be filled was calculated (40%) and marked 120 m from the upstream end of the channel. Twenty-five (25) pieces were identified for relocation to the lower 180 m of the excavated channel. A fry proof stop net was installed directly below the 120 m line. Sixteen minnow traps were placed in the area above the stop net to remove coho juveniles and checked regularly until May 29. A total of 233 coho juveniles were captured and relocated.

May 9, 2000

Shovel sampling of the existing redds within the section to be filled found fry still in the gravel. The redds were re-sampled with a hydraulic sampler on May 17 and alevins and fry were again observed in the gravel. The redds were shovel sampled on May 26 and no fry were found in the gravel. In addition, newly emerged coho fry were found in much higher numbers along the channel margins by May 26.

May 26, 2000

Two silt fences were installed downstream of the channel section to be filled. Approximately 50 m^2 of spawning habitat was measured in the channel to be filled. The dimensions of the outlet channel were measured and the discharge was determined to be 0.023m3/s (cross sectional area x surface velocity x 0.75). Discharge measurements were taken prior to the infilling to compare pre and post-construction flow. During the construction of the silt fences, 100 coho fry were captured and placed downstream of the excavated channel.

May 29, 2000

Silt fences were put into effect and the fish exclusion stop net was checked for effectiveness. Prior to construction, site specific issues and a Pre-Work Checklist were completed and excavator checked for biodegradeable hydraulic fluid and overall upkeep. The excavator removed and stockpiled LWD from the upper 40 % of channel. Fish were salvaged from the worksite using a beach seine and electrofisher. A total of 486 coho fry, 14 coho juveniles and 1 Dolly Varden juvenile were relocated. The excavator was placed adjacent to the Copper River

Mainline overnight and for re-fuelling to avoid potential spills into watercourses. A channel discharge of 0.038 m^3/s was measured in the morning and at day's end discharge was 0.059 m^3/s. The increased channel discharge was likely due to the increasing river discharge and higher groundwater table from snowmelt runoff.

May 30, 2000

A fourth pass with the seine net produced 39 coho fry. Visual observation of the channel after the fourth pass indicated that no fish were left in the work area and no fry were observed in the channel during subsequent infilling. After the fish salvage, the excavator placed a bed of coarse rock, approximately 0.6 m high and 1.4 m wide, along the middle of the excavated channel from the upstream end of the channel to the 120 m mark. Logs were placed into the channel and bound side by side with 1/2" Manila rope and fence staples then positioned over the rock bed and covered with berm material. The upper 40 % of channel was completely filled which covered the log raft (Photo 2).

The berm contained cobble, gravel, sand, and fine sediments which, once pushed into the wetted channel, were suspended and did not rapidly settle. Two additional silt fences were installed during the day to contain suspended sediments. This suspended particulate was mainly contained to the excavated channel but some suspended sediments were flushed downstream into the beaver ponds and the Copper River once the silt fences were dismantled on June 1. Water quality was visually monitored to ensure that construction upstream did not negatively impact downstream habitat. Beaver ponds directly below the excavated channel allowed much of the suspended sediment to settle out before entering the Copper River. Site specific issues and the Pre Work Checklist were discussed and filled out with the Cat contractor. The D8 Cat was checked for biodegradeable hydraulic fluids and overall upkeep. Discharge was calculated to be 0.013 m^3/s prior to infilling.

May 31, 2000

Groundwater sprung up through the filled channel, overnight and was flowing across the surface then dropping into the downstream 60 % section. A gravel berm was placed along the channel to contain the groundwater which surfaced overnight on the infilled channel section. The excavator and Cat backfilled the channel to the pre-construction grade and 16 logs were placed in the lower channel section. The logs were keyed into the channel banks from both sides and 25 pieces of stockpiled LWD from the upper 120 m were used in the lower section to benefit fish habitat. Upon completion, the equipment was moved off the floodplain and the stockpiled large boulders were used to block vehicle access to the floodplain. No problems were encountered and suspended sediment was mainly contained behind the series of silt fences.

June 1, 2000

The site was visited in the morning and silt fences were still intact, holding back the water and sediment. The silt fences were removed in the afternoon to allow flows to stabilize and flush the fine suspended sediments out of the channel. Groundwater had again surfaced in the upper 40 % channel. This water was running clear down into the remaining channel. No concerns were evident.

Post Project Observations

Post project discharge was not taken due to the onset of the freshet of the Copper River. Discharge should be monitored to track flow changes from the remaining section of the Site 9 channel. Table 1 provides a summary of the outlet discharge prior to infilling. The outlet discharge was found to fluctuate daily depending on the level of the water table and the amount of surface runoff in the river.

Table 1. Outlet Discharge Prior to Channel Infilling

Date	Time	Discharge
May 26, 2000	1400	0.023 m^3/s
May 29, 2000	0800	0.038 m^3/s
May 29, 2000	1600	0.059 m^3/s
May 30, 2000	0500	0.013 m^3/s

After the channel infilling was completed, substantial upwelling occurred at the outlet of the buried "French drain" indicating good water conveyance below ground. The additional LWD in the lower 180 m of the excavated channel increased the habitat complexity and available cover. The net result is a higher quality of rearing habitat to increase survival and productive capacity of the remaining channel.

Photo page

Photo 1: Copper River Site 9 Channel Downstream view of section of the channel to be infilled.

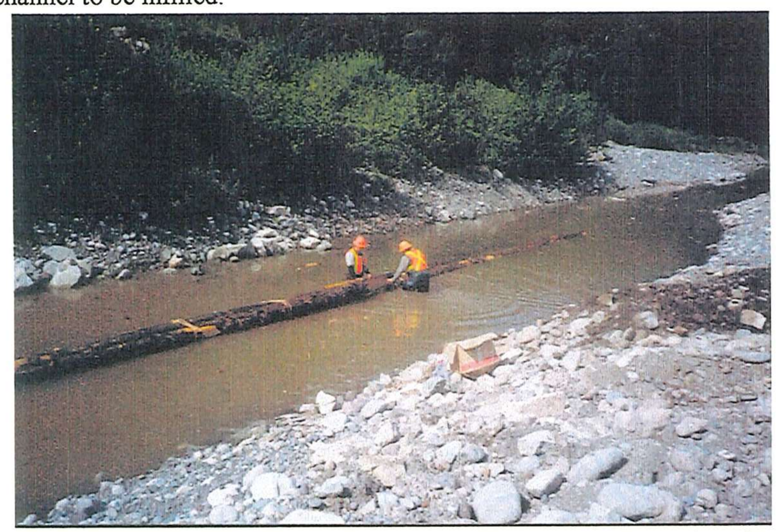


Photo 2: Copper River Site 9 Channel. After fish salvage and relocation of woody debris to lower section of channel, logs placed in the channel will enable groundwater to flow to the lower channel.

Photo 3: Copper River Site 9 Channel. Excavator backfilling the upper section of the channel.

Photo 4: Copper River Site 9 Channel. Upstream view after modifications. Channel inlet is returned to the natural contour.

3. CONSTRUCTION OF 3 KM OFF-CHANNEL HABITAT

3.1 Background and Description

The 3 km off-channel site is located adjacent to the Copper River FSR, between 2 and 3 km, in a stand of floodplain timber and carries hillslope runoff from two culverts into a flood channel of the river. Excavation and construction occurred in late August and early September 2000 using a LinkBelt 3400 tracked excavator and Moxy rock truck. Design and construction issues are described below followed by key drawings and photographs.

Prior to construction, the site was a 400 m long channel, averaging 2.5 m in width in the upper half and 7 m in width in the pond section, which was bisected by an old spur road (Figure 2, 3, Photos 5 to 10). The old spur road joins the FSR at 2.7 km and provides machine access to the site but, due to a blocked culvert, caused backflooding of the channel during spring and fall runoff. Water flowed north along the spur road into the flood channel adjacent to Site 9 channel (Photos 5, 6 and 8). During summer and winter low flow periods the upper half of the channel was dry and not suitable fish habitat nor accessible. A beaver pond occupies the undeveloped lower portion of the site and is 100 m in length by approximately 7 m in width with an average depth of 50 cm.

Six test pits were excavated in March 2000 then tested for water infiltration rates and monitored for groundwater table elevation. The pits had good infiltration during testing in late March, prior to spring snowmelt, with groundwater elevations 0.5 to 1.5 m below grade. A topographic survey in early April was used to plan the excavated channel boundaries and bed elevations (Figures 3 – 5) in conjunction with the monitoring of water levels.

3.2 Site Objective

The objectives at this site are:

- **To develop an existing ephemeral channel with poor fish access into productive off-channel spawning and rearing habitat for coho salmon, Dolly Varden char and trout.**
- **To develop an accessible and simple demonstration site of off-channel habitat rehabilitation for public stewardship, education and viewing.**
- **To achieve cost-efficient completion of two projects at the same location by reducing mobilization and transport costs.**
- **To address the loss of fish habitat due to berm removal and channel infilling at adjacent Site 9.**

3.3 Design Description

The conceptual off-channel design, shown in Figure 5, was developed in consultation with stakeholders, SCI, MELP, DFO, Triton and then engineered by Shawn Zettler, P. Eng., McElhanney Ltd. The conceptual plan for the site (Figure 5) incorporated a 250m long channel, 1 to 2m in width with 0.5% gradient, excavated into the ground water table for year round flow. The new channel is located between the existing Site 9 channel then follows a portion of the spur road and against the base of the hillslope. Overwintering and rearing habitat in pools (complexed by woody debris) were added to accommodate juvenile coho salmon while coho spawning habitat exists in the tailouts of pools in the gravel and cobble substrate. Since surface runoff to this channel is only seasonal (spring and fall), the channel bed depth was excavated below the lowest ground water table elevation to maintain groundwater infiltration and still carry flood flows (up to 5 m^3/s). The second component of the project involved stabilizing and strengthening the beaver dam at the outlet of the large beaver pond and excavating the pond 1 to 2 m deeper. The beaver dam and pond component was eliminated prior to construction after identifying poor site stability and machine access problems adjacent to the pond.

Agency approval was obtained in July 2000 (Appendix 2) based upon the conceptual design. Detailed hydrology and channel construction drawings, (attached drawing #: 497-1, 497-2, 497-3) were completed in August by McElhanney and show the excavation locations, channel and bank features, bed elevations and details.

The channel design incorporated the following considerations (see McElhanney, Appendix 3, for additional details and construction drawings):

- Due to the sand and gravel bank material, 1V:2H side slopes used.
- Channel bed width of one m (minimum), trapezoidal in shape, with design flows of 5.12 m^3/s for Q100 (based on full containment of gully and culvert flow).
- Recommended channel bed elevations approximately 10 cm or more below lowest groundwater elevation (50.55m) at Test Hole D.
- Gentle riffle-pool steps should be incorporated for deeper cover and for tailout spawning opportunities.
- Alcove ponds to be added where site conditions are appropriate and sufficient funding remains (see Figure 5). These will be added in 2001.
- Gentle channel bends recommended to reduce bank erosion and sedimentation.
- Hand placement of excavated cobble along channel margins to stabilize banks.
- Post-construction cleanup and site revegetation with grass seeding recommended.
- An inlet or settling pond immediately downstream of the culvert fan to capture fine sediments which originate from the gully upstream.

A key factor in the siting and construction planning was to minimize removal, damage or destruction of the mature trees (cedar, cottonwood, spruce) in the site with the exception of mature red alder which occupied the proposed channel location. A danger tree assessment (McElhanney, August 29, 2000) identified several mature cottonwoods and small alder adjacent to the channel which were removed for safety considerations and the wood used for complexing within the channel (Appendix 3).

Construction activity occurred over a 10 day period in late August and early September, in concert with work on the debris catchers (see following section). A Link Belt 3400 excavator (A&D Contracting) proceeded from the downstream confluence with the existing Site 9 channel upstream for 200 m with excavated soil side cast along the channel. Progress was slower than expected to avoid damaging trees, tight working space and equipment and operator limitations. A Moxy rock truck hauled 7 loads of angular rock (0.3 to 0.6 m diameter) to the site which was used to armour the inlets and outlets of the pools, channel outlet to Site 9 and cascade drop at 0+190m. Rock was donated by Dave Dams, Terrace Wade Contracting, from a pit located adjacent to the asphalt plant, 4 km away, and provided cost savings of several thousand dollars.

Channel bed elevations were surveyed in during excavation and match the design bed elevations (+/- 10 cm) between stations 0+020 and 0+140m (Photos 11 and 13). Between 0+140 and 0+195m in the channel, constructed bed elevations are 15 cm higher than designed to create backwatered run habitat (30 cm deep) with wood complexing added (Photo 12, 14) instead of shallower riffle habitat (5 to 10cm deep).

At station 0+190m, we altered the design in the field due to the deep layers of fine sand and silt substrate encountered. The lower 190 m of channel was excavated in gravel and cobble substrates but due to the rising bed elevation, the upper section would have been constructed in a layer of fine sand, which has little cohesiveness for bank stability. Consequently, we constructed a 0.8 m high cascade section using a bed layer of geotextile fabric covered with 20 cm of gravel and cobble at a gradient of approximately 15%. This enabled the water to flow off the fine sand substrate and cascade into the pool (excavated in the gravel/cobble layer). This rocky cascade is intended to armor the bed and prevent backcutting and significant erosion which would likely infill the pools downstream. Additional angular material (0.5 m diameter angular rock) must be added next year since high fall flows in October moved the smaller substrates covering the geotextile. Due to the fine sand substrate, we did not excavate the channel between 0+190m and the settling pond at 0+250m and we anticipate that this section will only be wetted during high runoff periods. Our excavation time was reduced due to this change.

Four pools, 1.5 to 2.5 m in diameter and 0.8 to 1m in depth, were constructed in the new channel and complexed with woody debris for cover. Approximately 30 pieces of unanchored woody debris was added to the channel for fish habitat and cover which were subsequently re-arranged during October rain events and will require some minor modification next year. Duckbill anchors might be used to anchor the larger wood pieces in place. As shown on the attached drawings, a settling pond was excavated in sandy substrate at the head of the channel (0+250m station) with a short overflow channel to carry excess flood flows into the adjacent Site 9 West flood channel. This proved a successful feature since high runoff from the gully in October was diverted into the Site 9 West channel and reduced potential damage to the newly constructed channel. Average water depth was approximately 70 to 80 cm in the lower 150m of the excavated channel during the peak runoff.

We employed two labourers for site cleanup, replanting trees and to place cobble as armoring along the lower 1 m of the channel banks. This proved very worthwhile as the 75 cm deep flood waters in October would have caused significant bank erosion without the cobble armoring. Additional armoring with angular cobble is needed along several sections to maintain bank stability and will be implemented in 2001. Hydro seeding (no fertilizer) occurred in October using a legume/clover seed mix that by late spring will provide a vegetative layer to bind surface soils and stabilize stream banks. A staff gauge pipe was installed at the 0+135m station to monitor groundwater table through the year.

Approximately 200 square meters of riffle/run habitat were created in the channel and includes 100 m^2 of spawning habitat in the lower section of channel. Approximately 75 m^2 of deeper rearing and overwintering habitat is found within the 4 pools and settling pond. The conceptual plan included construction of a large alcove pond, approximately 300 to 400 m^2, adjacent to the middle section of the excavated channel. Due to slower than expected progress during excavation and slightly higher costs for construction of the debris catchers, we postponed the alcove pond construction till 2001. The addition of overwintering ponds is a key project for 2001 which will provide good quality overwintering habitat.

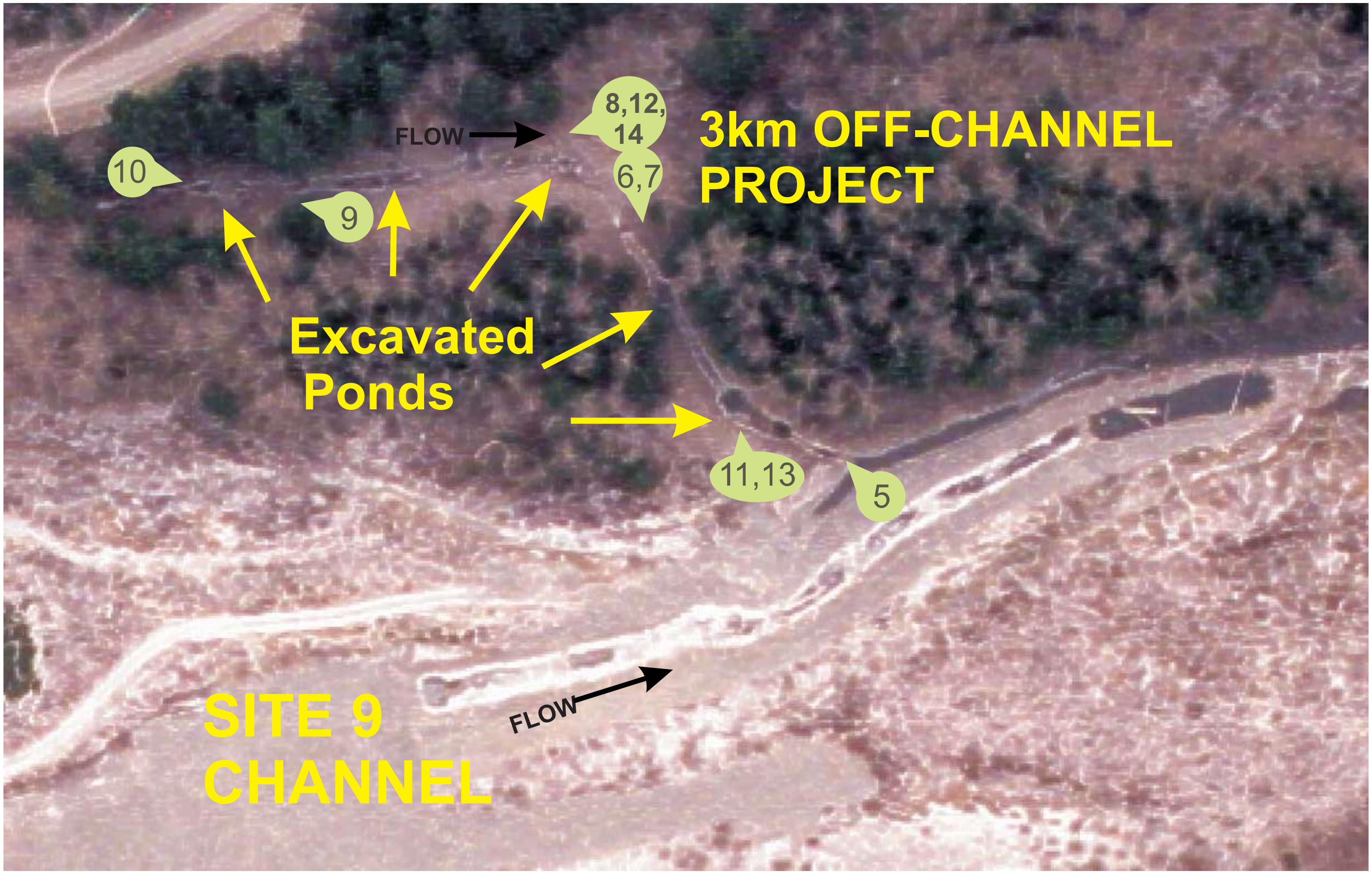
Through September and October, juvenile and adult fish moved into the channel. Juvenile trout and coho were observed under woody debris and in pools while about a dozen adult coho utilized the lower 100 m. Two coho pairs were observed spawning immediately adjacent to Pool 1 in early October. The viability of the incubating eggs is dependant on winter flows and will be monitored into the spring. Flow decreased within the channel in December, 2000, due to reduced surface runoff and will be monitored into spring to identify if modifications are required to maintain suitable water supply to incubating eggs. Cost savings were achieved by donations of rock from Terrace Wade Contracting, donation of one day of excavator use by A&D Contracting and close proximity to Terrace.

3.4 Monitoring and Activities for 2001

The following activities will occur to finish the project by fall 2001:

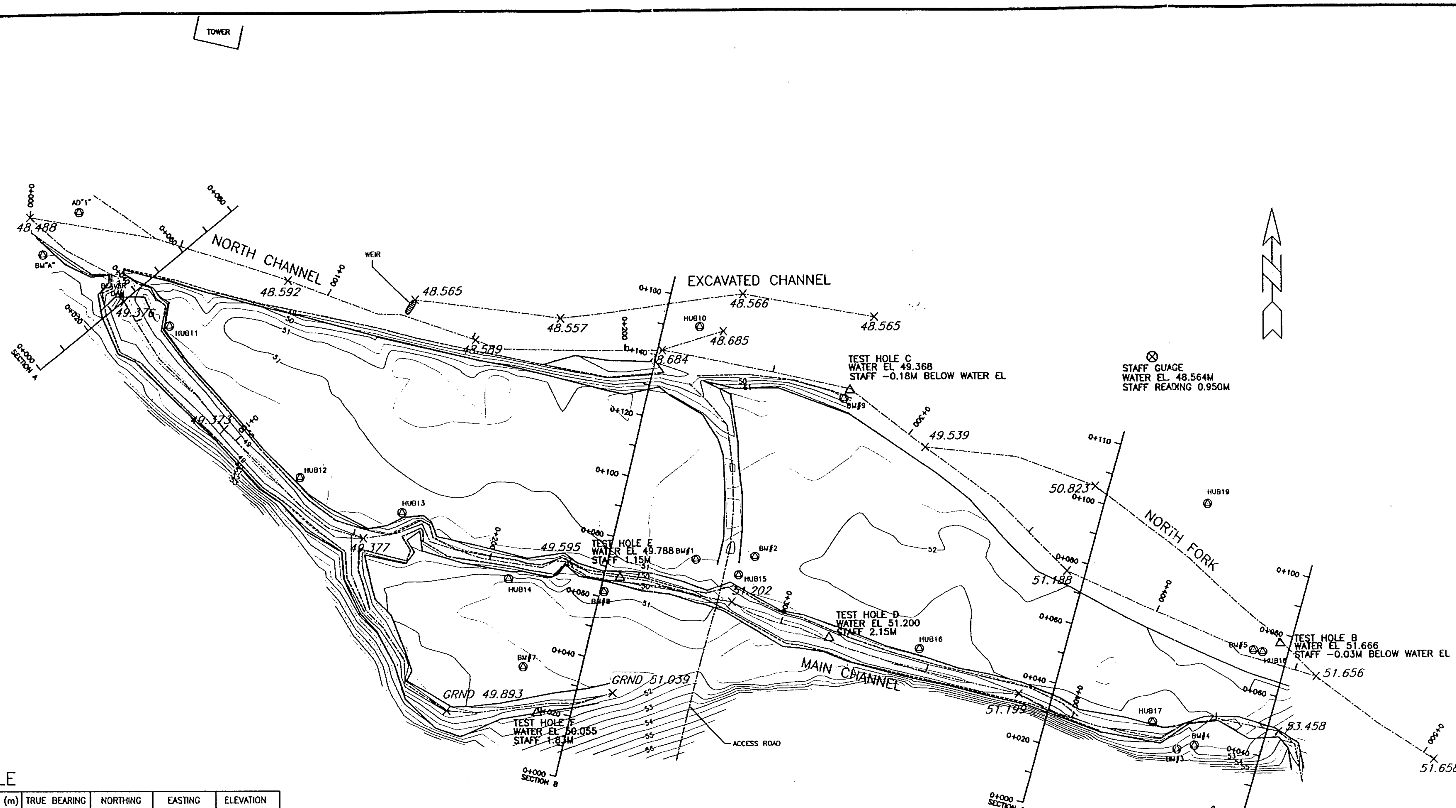
- Addition of alcove ponds along middle channel section to increase overwintering habitat in summer 2001,
- Addition of angular rock to the cascade at 0+190 m station and along key bank sections,
- Monitoring of fry production from channel in spring 2001,
- Year-round monitoring of groundwater infiltration to identify if the upper channel section should be excavated deeper to intercept more groundwater,
- Monitoring of beaver activity,
- Monitoring of adult coho spawning within the channel,
- Addition of shrub and conifer seedlings along banks for future stability.

Figure 3. December 2000 aerial view of 3 km off-channel site.



3149.01 - Copper River	Map # 31490002	Metres 10 20 30 40	Created By: Shawn Giesbreceht 1/01 Revised By: Source: Dec 2000 Overflight Photo
Figure 3: Aerial Photo of 3 km Off-Channel Project		TRITON ENVIRONMENTAL CONSULTANTS LTD.	

Figure 4. Plan view (Drawing 497-01 April 2000) Survey of 3 km off-channel site:



SURVEY TABLE

DESCRIPTION	H.D. (m)	TRUE BEARING	NORTHING	EASTING	ELEVATION
AD1	---	---	1000.000	5000.000	48.498
BM A	---	---	986.455	4988.254	50.020
BM 1	---	---	887.738	5200.814	51.903
BM 2	---	---	888.546	5220.483	52.094
BM 3	---	---	825.240	5358.048	52.550
BM 4	---	---	826.479	5363.872	52.813
BM 5	---	---	857.197	5383.695	51.941
BM 6	---	---	717.274	5499.878	52.060
BM 7	---	---	853.263	5143.700	52.051
BM 8	---	---	877.518	5170.274	51.445
BM 9	---	---	939.103	5249.972	49.934

GENERAL NOTES

1) SITE SURVEY PERFORMED APRIL 3, 2000 BY McELHANNEY CONSULTING SERVICES LTD. ROB PHILLIPS & ED McKENZIE.
2) ALL BEARINGS ESTABLISHED BASED ON COMPASS ASSUMING EAST DECLINATION OF 24.5°.
3) SITE COORDINATES/ELEVATIONS BASED ON ADAM ENGINEERING REFERENCE POINT.
AD1
N: 1000 M
E: 5000 M
ELEV. 48.498 M

REDUCED
not to scale

FIGURE 4

No.	Date	Revision	Dr.	Ch.		
					Designed	
					Drawn	RJH
					Checked	RJP

McElhanney Consulting Services Ltd.
Suite #1 – 5008 Pohle Avenue, Terrace, B.C., Canada, V8G-4S8
Telephone (250) 635 – 7163 Fax (250) 635 – 9586
McElhanney

TRITON ENVIRONMENTAL
COPPER RIVER SIDE CHANNEL
EXISTING SITE CONDITIONS
SITE PLAN

Job No. 2321-00497-0
Scale 1 : 750
Approved
Date APRIL 2000
Drawing No. 497-01
0

CANCEL PRINTS BEARING PREVIOUS NUMBER

Figure 5. Profile view (Drawing 497-02 April 2000) Survey of 3 km off-channel site:

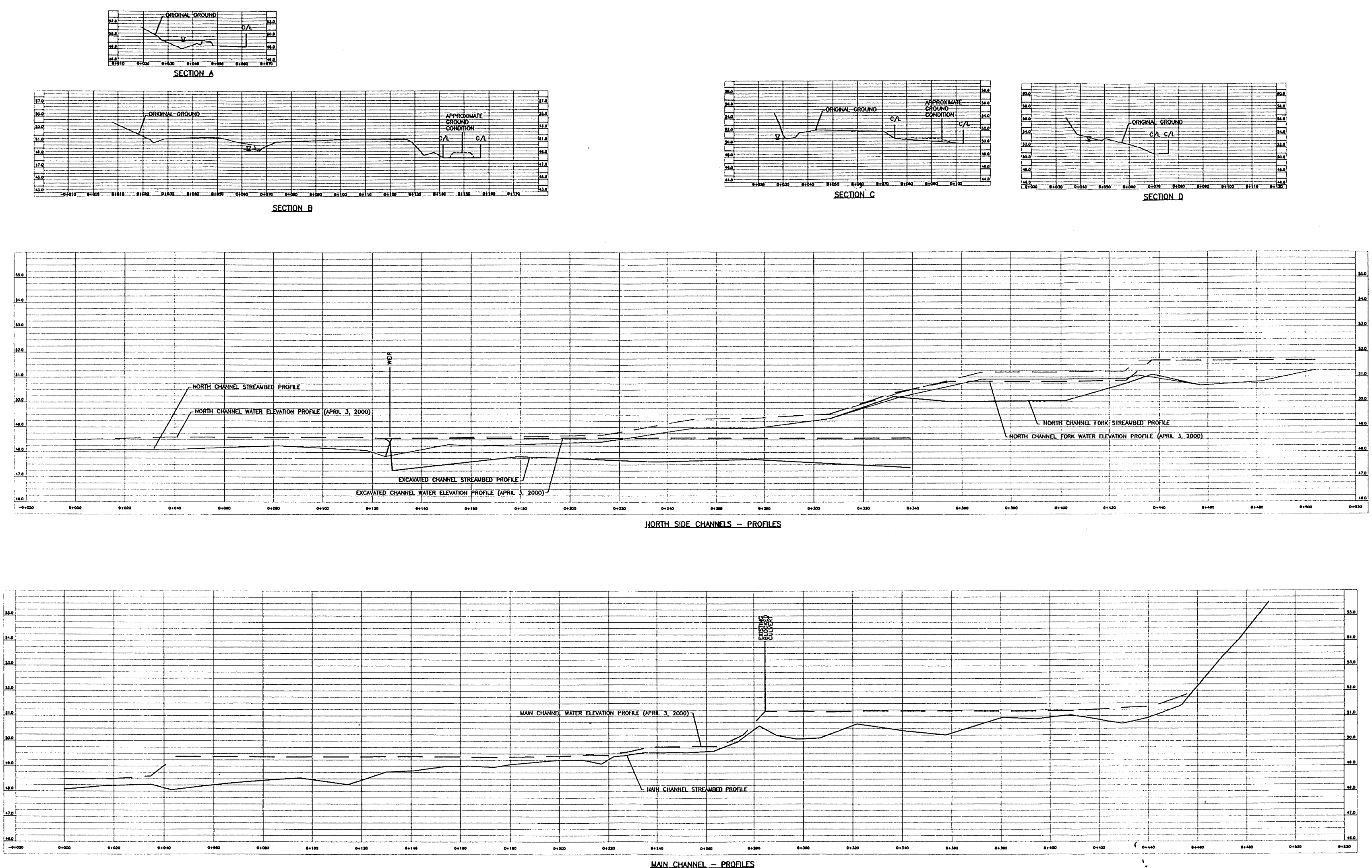


FIGURE 5

REDUCED
not to scale

No.	Date	Revision	Dr.	Ch.		
					Designed	
					Drawn	RJH
					Checked	RJP

McElhanney Consulting Services Ltd.

Suite #1 – 5008 Pohle Avenue, Terrace, B.C., Canada, V8G–4S8
Telephone (250) 635 – 7163 Fax (250) 635 – 9586

McElhanney

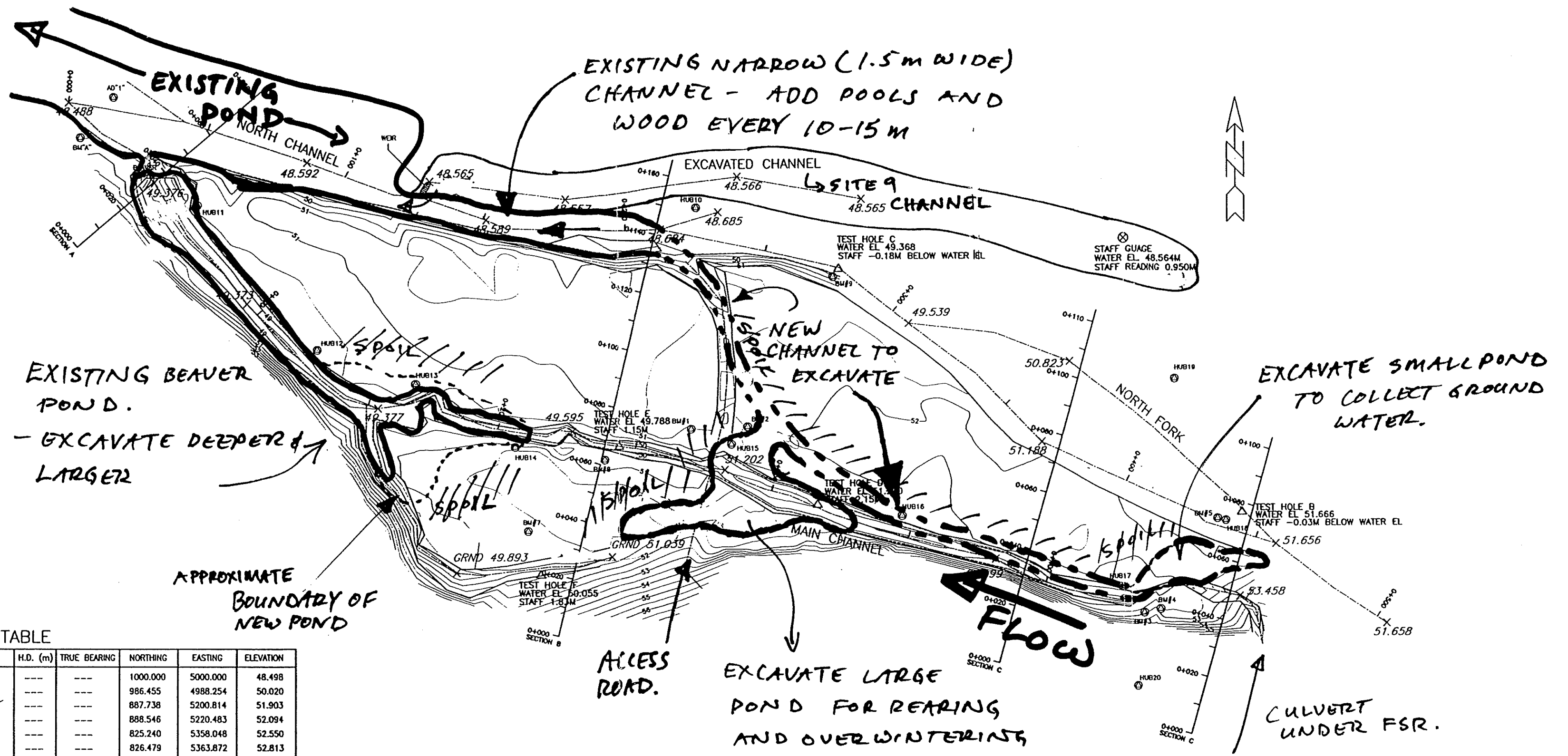
TRITON ENVIRONMENTAL

COPPER RVER SIDE CHANNEL
EXISTING SITE CONDITIONS
PROFILES & CROSS SECTIONS

Job No. 2321–
Scale Horizontal 1:750 Vertical 1:300
Approved
Drawing No. 497-02
Date APRIL 2000
0

CANCEL PRINTS BEARING PREVIOUS NUMBER

Figure 6. Plan view of proposed channel construction (Drawing 497-01-modified June 2000).



SURVEY TABLE

DESCRIPTION	H.D. (m)	TRUE BEARING	NORTHING	EASTING	ELEVATION
AD1	---	---	1000.000	5000.000	48.498
BM A	---	---	986.455	4988.254	50.020
BM 1	---	---	887.738	5200.814	51.903
BM 2	---	---	888.546	5220.483	52.094
BM 3	---	---	825.240	5358.048	52.550
BM 4	---	---	826.479	5363.872	52.813
BM 5	---	---	857.197	5383.695	51.941
BM 6	---	---	717.274	5499.878	52.060
BM 7	---	---	853.263	5143.700	52.051
BM 8	---	---	877.518	5170.274	51.445
BM 9	---	---	939.103	5249.972	49.934

GENERAL NOTES

1) SITE SURVEY PERFORMED APRIL 3, 2000 BY McELHANNEY CONSULTING SERVICES LTD. ROB PHILLIPS & ED McKENZIE.
2) ALL BEARINGS ESTABLISHED BASED ON COMPASS ASSUMING EAST DECLINATION OF 24.5'.
3) SITE COORDINATES/ELEVATIONS BASED ON ADAM ENGINEERING REFERENCE POINT.
AD1
N: 1000 M
E: 5000 M
ELEV. 48.498 M

CONCEPTUAL DESIGN
JUNE, 2000
FIGURE 6.

TEST HOLE A
WATER EL 51.200
STAFF 1.98M

REDUCED
not to scale

No.	Date	Revision	Dr.	Ch.	Designed	
					Drawn	RJH
					Checked	RJP

McElhanney Consulting Services Ltd.
Suite #1 – 5008 Pohle Avenue, Terrace, B.C., Canada, V8G-4S8
Telephone (250) 635 – 7163 Fax (250) 635 – 9586

McElhanney

TRITON ENVIRONMENTAL
COPPER RIVER SIDE CHANNEL
EXISTING SITE CONDITIONS
SITE PLAN

Job No. 2321-00497-0
Scale 1 : 750
Approved
Date APRIL 2000
Drawing No. 497-01
0

CANCEL PRINTS BEARING PREVIOUS NUMBER

Photo 5: Copper River Off-channel May 2000. Flow diverted down old spur road to Site 9 Channel due to blocked culvert. The outlet to Site 9 shown here.

Photo 6: Copper River Off-channel. Middle section of proposed channel with blocked culvert (foreground) which diverted flow down spur road.

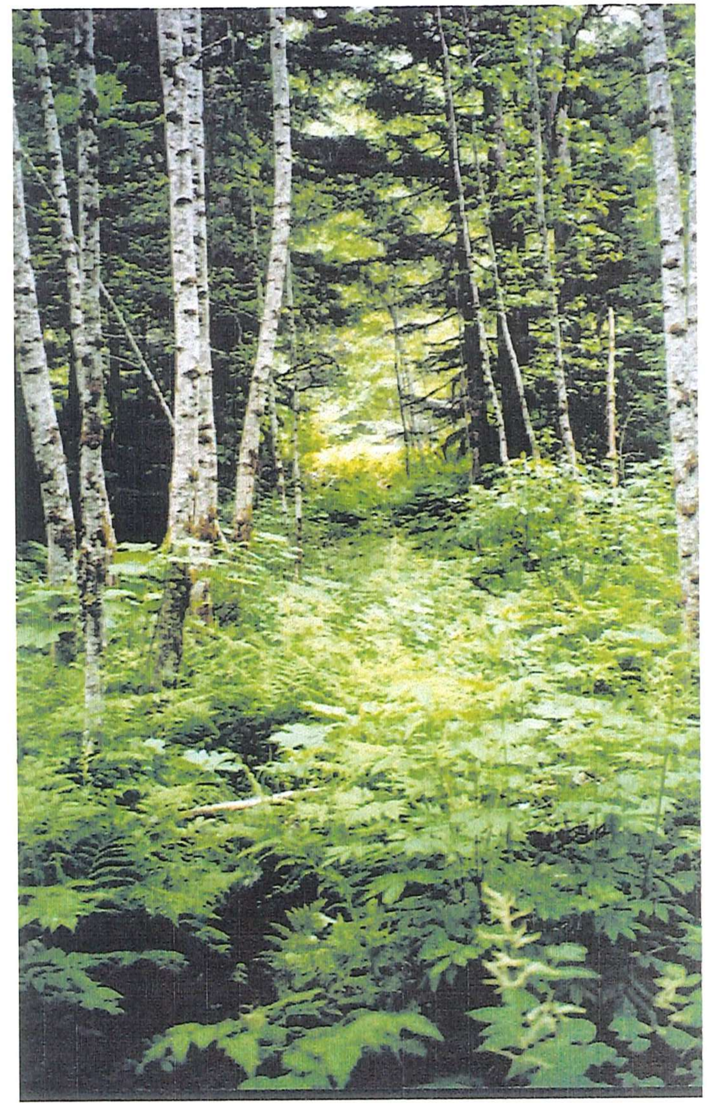


Photo 7: Copper River Off-channel. Middle section of proposed channel was old spur road which flooded when culvert blocked. Looking towards Site 9 Channel.

Photo 8: Copper River Off-channel. Upper 100 m of ephemeral channel. Ponded water was due to blocked culvert was diverted down old spur road. Upstream view at culvert.

Photo 9: Copper River Off-channel. Upper section of proposed site, upstream view. New channel excavated 1.5 m lower than the water level shown.

Photo 10: Copper River Off-channel. Uppermost section of the proposed channel. Excavator dug new channel 1 m lower than existing.

Photo 11: Copper River Off-channel Project. Lower section between pools 1 and 2 during excavation, looking upstream.

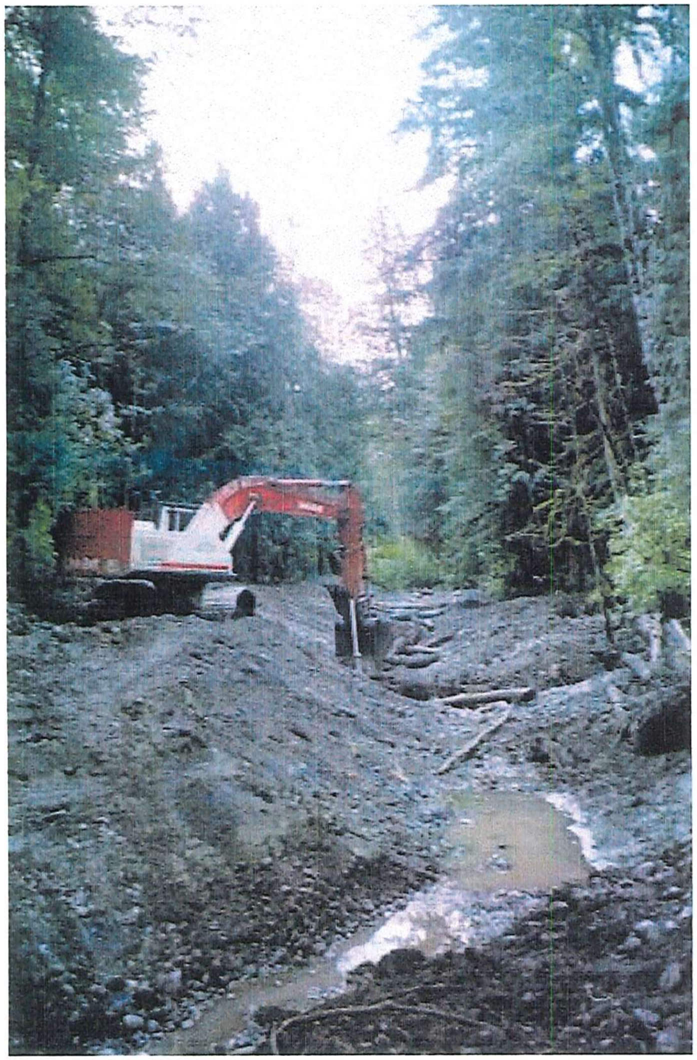


Photo 12: Copper River Off-channel. Upper section during construction, looking upstream from old culvert location..

Photo 13: Copper River Off-channel. Lower section of off-channel after excavation and complexing, looking upstream. Coho spawned immediately upstream of the pool in foreground.

Photo 14: Copper River Off-channel. Upper section of off- channel after excavation and complexing. Note cobble armoring along edges of channel which prevented flood damage in October.

4. CONSTRUCTION OF DEBRIS CATCHERS AT 3 KM

4.1 Background and Debris Catcher Concept

Floodplain logging, bank destabilization and increased sediment loading are three factors which can significantly impact stream channel stability, bank erosion and lateral channel migration. Due to development and road building on floodplains, people typically respond to natural river channel movement by dyking, riprapping and constricting stream channels which affects instream fish habitat quality and quantity. Since accelerated bank erosion and elevated sediment input can reduce instream habitat quality, new techniques, including bioengineering and woody debris bank revetments, were developed to help stabilize stream banks and channels while also benefiting or improving instream fish habitat quality.

Debris catchers were investigated and tested over the past 3 years by the WRP program under the guidance of Pat Slaney (MELP) and retired DFO engineer Rheal Finnigan. Mr. Finnigan designed and constructed several dozen debris catching structures over the past 2 years throughout the province with excellent success in terms of functioning (providing erosion protection and improved fish habitat) and durability (able to withstand large floods). Structures performed well in the Keogh (Vancouver Island), Alkolkolex (Kootenay), West Kettle (Okanagan), Chilliwack and Coquitlam (Lower Mainland) Rivers to create pools, catch floating debris and improve fish habitat and protect large eroding banks in very dynamic rivers. Based on the performance in other rivers and guidance from Mr. R. Finnigan, we anticipated that installation of debris catching structures in the Copper River would achieve bank protection and improvements to fish habitat. Consequently, we chose an eroding bank, 350m in length and 3 m in height, located adjacent to 3 km along the Copper FSR to test the effectiveness, durability and constructability of several debris catcher designs. The bank erosion at this site has accelerated recently due to the formation of a large mid-channel bar in the early 1990's after flooding moved sediment out of a large side channel 300 m upstream on the north river bank. The south channel is eroding the bank and migrating at 3 to 4 m per year southwards into the Hydro ROW as seen in Figures 2 and 7.

The debris catching structures act as a trash rack which accumulates small woody debris on the upstream face, slows the water velocity and enables substrate deposition in back eddies immediately upstream and downstream of the structure. A key factor for structural integrity of these structures is to overballast or increase, typically by a factor of two or three times, the minimum weight of rock attached to the logs to ensure that the structures do not become buoyant and shift. Figure 8 shows the basic design of the debris catchers with several base logs installed perpendicular to the bank on which upstream facing logs are installed to act as a 'trash rack' and catch floating debris (source: R. Finnigan) . As a result, less erosion of the bank will occur since the river thalweg is obstructed by the structure and a deep run or pool will scour along the river side of the structure. The scour will improve rearing habitat for juveniles and holding habitat for adult fish.

Basic Features of Debris Catchers or Debris Groins (By R. Finnigan, P.Eng)

Noteworthy items and features regarding debris groins or catchers:

- The structural members and necessary ballast can be easily maneuvered into place using available machinery.
- The structural members are positioned so as to capture submerged and floating debris carried by the stream during storm events.
- Properly constructed debris groins will eventually capture sufficient floating debris to function similar to natural large wood debris structures.
- In time, the smaller wood debris captured in debris groins will rot and become ineffective. However, subsequent floods will always bring a new supply of wood debris to the debris groins.
- The smaller wood debris captured by the structural members provides a significant degree of protection to the structural members themselves.
- The structural members are arranged in such a manner as to redirect the horizontal forces (created by the water pressure) downwards thereby significantly reducing the amount of ballasting required to stabilize the structures. This principle is similar to that employed when constructing typical "A-frames" which are frequently used to support fish fences.
- Vertical posts protruding below the anticipated scour depth can be used to provide vertical support and ensure that the debris groins are not undermined by the anticipated scour.
- Appropriately located and spaced debris groins in series can be used to provide bank protection where desirable and are a viable alternative to conventional shot rock.
- Debris groins should be constructed so as not to be overtopped during extreme flood events. Otherwise, smaller debris accumulated at lower discharges may be washed downstream during extreme floods and groins will not function as intended.

4.2 Objectives

General objectives for using debris groins or debris catcher structures include:

- Create desirable fish habitat through scour pool formation and woody cover.
- Protect the upstream ends of eroding gravel bars and islands.

- Protect eroding streambanks and riparian vegetation and reduce excessive sediment input to stream channels.

The objectives for installing three structures in the lower Copper River are:

- **To test the durability of large log and boulder debris catchers using three construction techniques in a large river subject to occasional large floods (100 year flood of approximately 3000 m^3/s),**
- **To test the effectiveness of these structures in substantially reducing the rate of gravel bank erosion and lateral channel migration which may protect the remaining second-growth riparian vegetation immediately downstream,**
- **To improve fish habitat by providing wood cover and scour pool formation,**
- **To develop an accessible and simple demonstration site showing debris catchers as alternatives to traditional riprap bank protection for public stewardship and education.**
- **To achieve cost-efficient completion of two projects at the same location by reducing mobilization and transport costs.**

4.3 Construction Activities

Once approvals were obtained from government agencies (Appendix 2) materials and equipment were mobilized during the last week of August and the third week in October (DC3). The three debris catchers (labelled DC 1, DC 2, DC3) are shown on Figures 2 and 7 while photos 15 to 34 show key activities during construction of each catcher. The structures are spaced such that the debris buildup on the ramp logs will create a backwater effect along the channel margin which should extend upstream to the next structure. The backwatering effect will encourage deposition and deflection of the thalweg (Photo 15).

A medium sized excavator (LinkBelt 3400) and rock truck were utilized onsite and three people were trained by Jack Mussel (Mussel Environmental Services), who is very experienced with epoxy anchoring technique, wood cabling, deadman construction, falling and bucking and debris catcher construction. SCI provided 24 large logs at cost and several truck loads of boulders while Dave Dams contributed several truck loads of large boulders. Approximately 25 boulders were used in total with DC 3 having only half as many as the other two structures. A Hilti T75 hammer drill and portable generator was used to drill 11/16" holes approximately 10 to 12 inches into the rocks. The Hilti "Hit" two-part epoxy was used to secure 5/8" galvanized wire rope into the rock with a chain link attached (Photos 25-26). This system enable field crews to tie wire rope with Cat's Paw knots and timber hitches instead of using more time-consuming cable clamps and was very cost effective. Logs were drilled and 5/8" galvanized wire rope (cable) threaded through to secure to the boulders.

4.3.1 Debris Catcher 1

Debris Catcher One is located adjacent to a hydro tower and comprised of 5 rack logs and one horizontal cross beam ballasted with boulders and anchored to a deadman (Photo 16). This structure is situated across from the riffle at the upstream end of the mid-channel bar (Figure 2, 7). This site was selected for a debris catcher to try to reinforce a log jam buried in the eroding bank, to protect the bank at the start of the meander bend and due to easy access.

The structure is 3 m in height with 5 spruce logs, 40 to 70 cm diameter and 10 to 14 m in length, supported by a cantilevered 90 cm diameter cross log (Photos 18-20). A key point regarding the cantilever cross-log is that two-thirds of the log was buried in the bank and anchored to two 6,000 pound boulders which were buried adjacent to the cantilever log. **This is a key design difference between the three debris catchers.** Each rack log is cabled to 3 to 5 boulders (1 to 1.4 m diameter, approximately 700 to 2000 kg/boulder) which assist with debris catching and bank protection. A 7 m long deadman, 50 cm in diameter, is buried 2 m below the surface and 5 m from the bank edge and cabled to the rack logs (Photo 16). Root wads and small trunks were loaded onto the structure upon completion to increase the effectiveness of debris catching (Photo 21). We anticipate that this catcher will load with debris at moderate to high flows only since, in contrast to the downstream catchers, the river thalweg at low discharge does not flow directly into the trash logs.

4.3.2 Debris Catcher 2

Debris Catcher 2 is located 50 m downstream of DC 1 and incorporates 6 large spruce logs. Boulder and log sizes are similar to catcher 1 but the key difference is the height of this structure (5 m) and use of crossed logs which extend from bank top into the channel to support the main cantilever cross-log. Four or five boulders were loaded onto each log for ballast. A key design difference at this catcher is the use of two 50 cm diameter logs, 13 m in length which are crossed over each other to form an X and cabled at the crossover (shown in Photo 23 installed in water). The ends of the X-logs were placed in the river while the tops of the logs rested on the bank top. A brace log was cabled onto the X-logs which supported the cantilevered horizontal cross-log that originated from the bank. This arrangement enabled us to support the horizontal cross-log approximately 4 m above the water level so that the debris catching logs were angled at 40 degrees downwards into the water (see photos 28 to 30). The debris logs were cabled to each other then one cable was extended to a 10 m long deadman, buried approximately 15m back from the edge of the river. Several large trees which had fallen from the eroding bank were loaded onto the debris catching logs after rock ballasting added (Photo 30–32).

4.3.3 Debris Catcher 3

Debris Catcher 3 is located 30 m downstream of Catcher 2 and incorporates three rack logs with much less boulder ballast than the previous structures per R. Finnigan directions. Unlike the fully cantilevered cross-log of DC1 or the X-frame support logs in DC2, the horizontal cantilever log in DC3 is supported by a 5 m long **post log** or 'jail poke' (90 cm diameter) which was buried 0.5 m in the stream bed (Photos 33 and 34). The post log rests directly underneath the middle trash log to bear the weight and is cabled to the cantilever log and trash log with suspended ballast boulders (Photos 33, 34). Less ballast was used on DC3 to evaluate the durability of this design. Only one or two boulders were placed on the outer two trash rack logs while four boulders were cabled to the third trash log against the bank. A deadman was buried 10 m from the bank edge and cabled to the main debris catching logs to provide lateral stability to the three debris logs. Small woody debris was loaded onto the structure upon completion.

The post log support system is considered superior by Mr. Finnigan than the cantilever (DC1) or X-frame (DC2) support mechanism. The post log system is less time-consuming and less costly to build since less rock ballast and machine time was required. A key monitoring task will be to evaluate each support mechanism of the structures and report on the effectiveness in future years since cost savings may be achieved using the DC3 support mechanism. Since the structures will be subjected to the same flows, we anticipate different durability responses by each structure in relation to the amount of ballast and accumulated woody debris. Our findings from future monitoring may be communicated to other WRP proponents at conferences or through technical publications like Streamline.

Funding from BC Hydro and MELP WRP Program Director Pat Slaney was timely and essential to completing the third catcher under the direction of R. Finnigan.

4.4 Monitoring and Activities for 2001

Monitoring of the structures through fall and winter 2000 found no significant shifts in orientation or location of wood or boulders and little additional debris accumulation on the ramps. Between DC1 and DC2, approximately 1 to 2 m of bank sloughed into the channel and contributed some woody debris to DC2. A helicopter overflight in December 2000 (Figure 7) and October 2000 (Appendix 7) can be used in future to monitor channel changes and rates of channel migration towards the spur road and Hydro tower. A moderate to large flood will provide a significant test of the durability and effectiveness of the structures.

Measurements were taken in February, 2001, of the distance between reference points along the access road and the edge of the river bank. Figure 9 shows these distances and can be used for future reference to track the rates of erosion. Photo points along the edge of the bank are indicated on Figure 9 for future monitoring tasks as well.

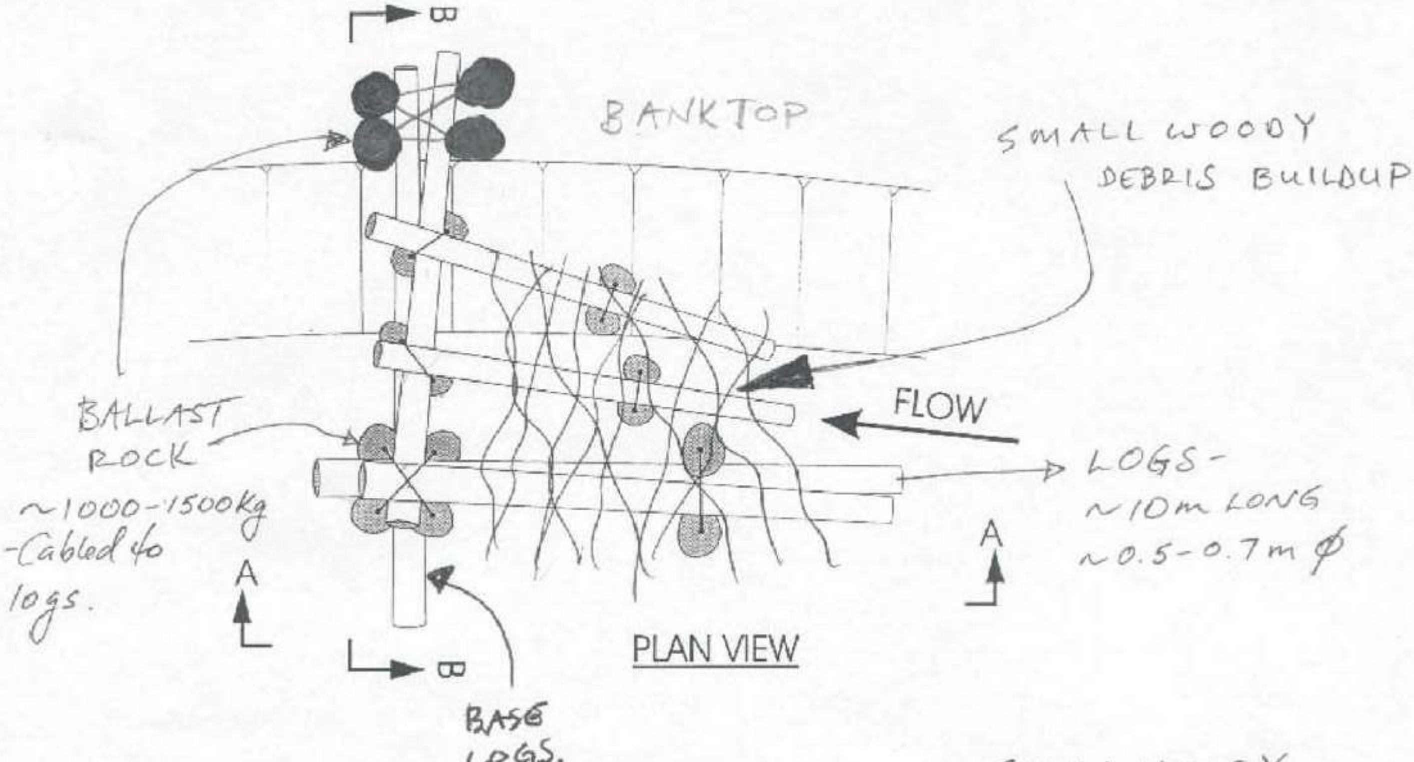
The following activities are recommended regarding the debris catchers:

- Monitoring of fish use and habitat changes adjacent to the structures,
- Monitoring of rates of erosion of bank by measurements from known points (spur road or tower) and documentation prior to and after flooding.
- Monitoring of debris accumulation on the ramp logs through photo documentation and possible addition if natural accumulation is too slow,
- Addition of shrub and conifer seedlings along banks for future stability.
- Completion of overflight for air photos in 3 to 5 years to document large scale channel changes.
- Installation of a fourth catcher adjacent to the natural wood jam approximately 100 m downstream of DC 3 since sufficient logs (5) and boulders (10) are onsite and unused.

Figure 7. December 2000 overflight of debris catchers.

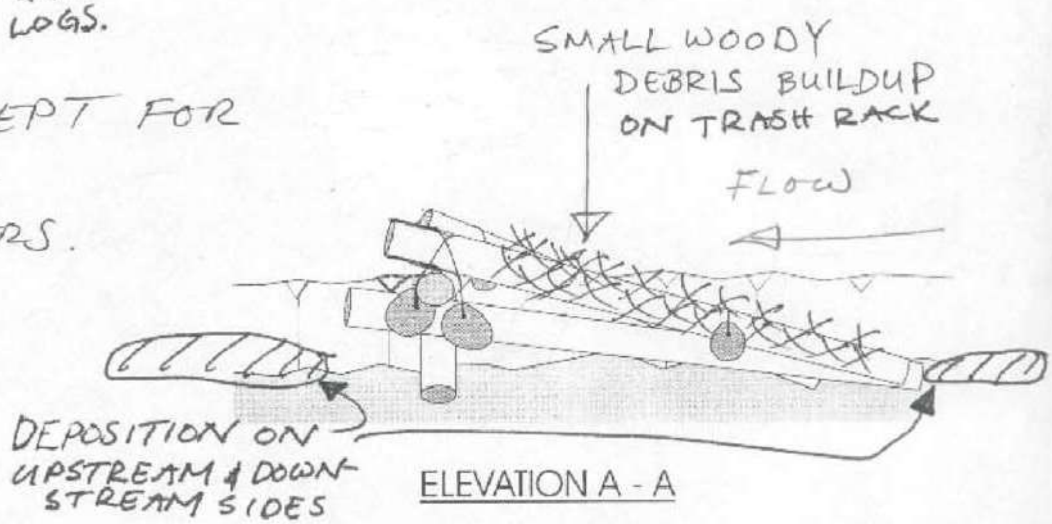
3149.01 - Copper River	Map # 31490003	Scale:	Created By: Shawn Giesbreceht 1/01 Revised By: Source: Dec. 2000 Overflight Photos
Figure : Aerial Photo of Debris Catchers		TRITON ENVIRONMENTAL CONSULTANTS LTD.	

Figure 8. Concept Drawing of Debris Catchers (R. Finnigan).

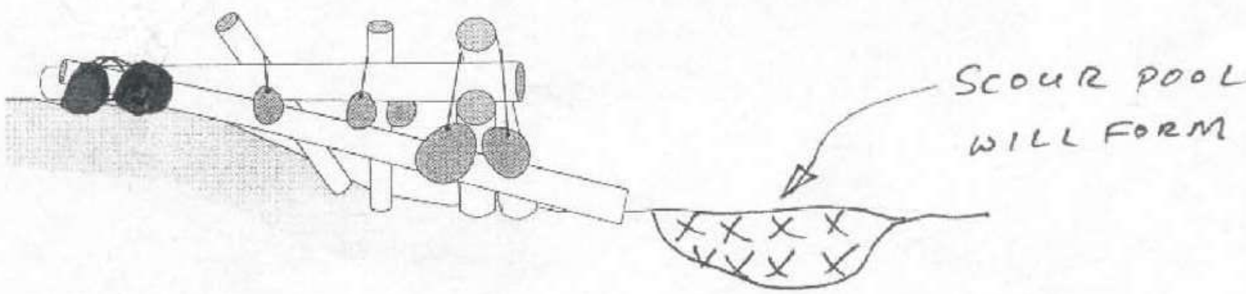


PLAN VIEW

DESIGN CONCEPT FOR
COPPER RIVER
DEBRIS CATCHERS.



ELEVATION A - A



ELEVATION B - B

Drawn by : R. Finnigan, P. Eng.
Date : July 31, 1998
Revised : September 25, 1998
Modified: July, 2000, by S. J.

WATERSHED RESTORATION PROGRAM
CONCEPTUAL DESIGN
LATERAL DEBRIS CATCHER
TYPE 1

FIGURE 8.

Figure 9. Bank measurements from reference line along road edge, February, 2001.

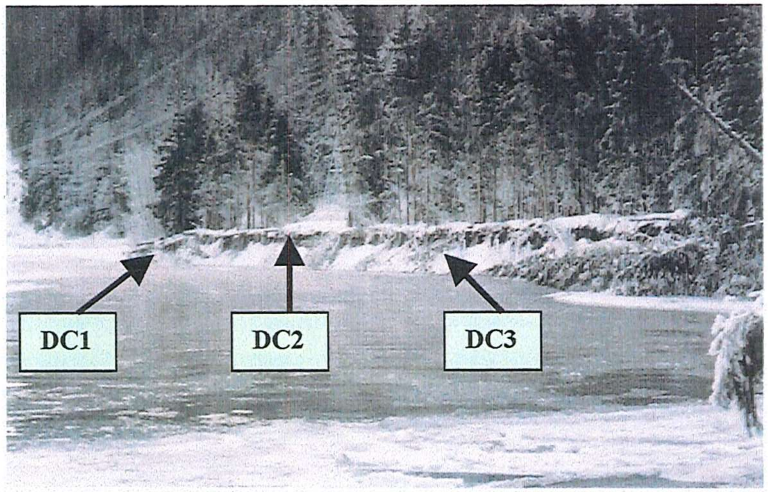


Photo 15: Copper River Debris Catchers. Looking upstream at eroding bank where the three debris catchers were constructed.

Photo 17: Copper River Debris Catcher 1. Secured cable hitched to log and joined to deadman.

Photo 16: Buried deadman log cabled to upstream logs for stability.

Photo 18: Copper River Debris Catcher 1. Upstream end of structure anchored to rock ballast.

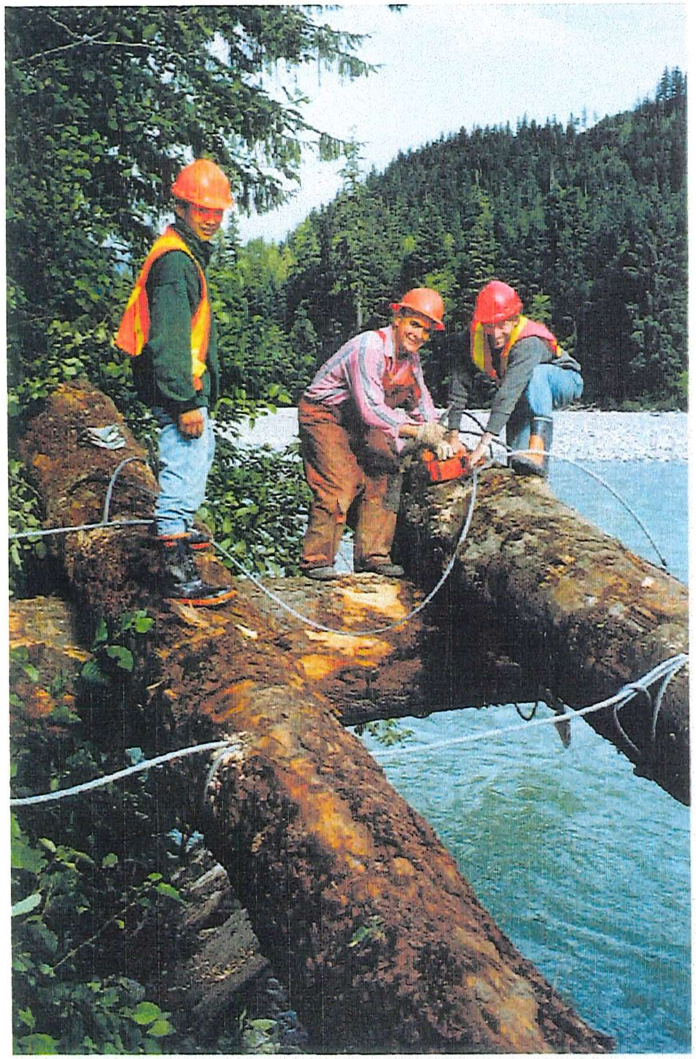


Photo 19: Copper River Debris Catcher 1. Cabling trash logs to support log. From left to right, Steve Bolton, Jack Mussel and Brian Schafhauser.

Photo 20: Copper River Debris Catcher 1. Rock ballast being anchored to trash logs to support the upstream end of the structure.

Photo 21: Copper River Debris Catcher 1. Debris piled on the upstream end of the catcher by a machine.

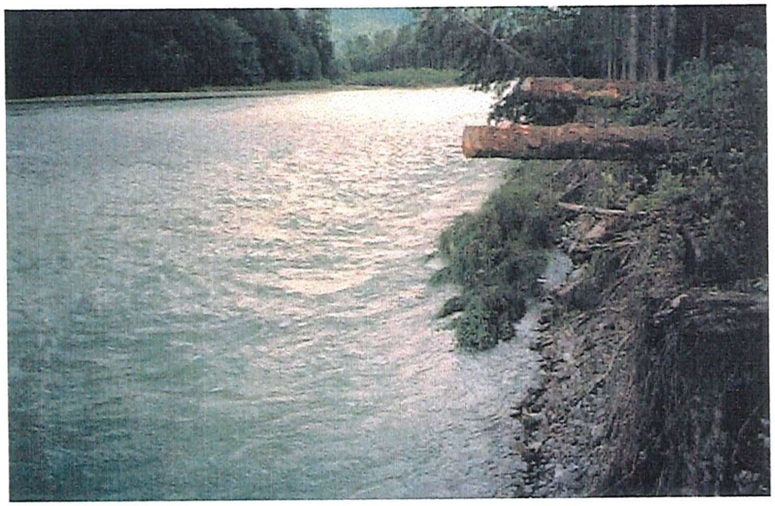


Photo 22: Copper River Debris Catcher 2. Upstream view prior to construction. Note the 3 m high eroding bank and thalwag approx. 2 m from the water edge.

Photo 23: Copper River Debris Catcher 2. X-frame logs are installed into channel to support horizontal-cross logs and debris catching (trash) logs.

Photo 24: Copper River Debris Catcher 2. Deadman log buried 6' below ground and cabled to debris logs to provide lateral stability and anchoring.

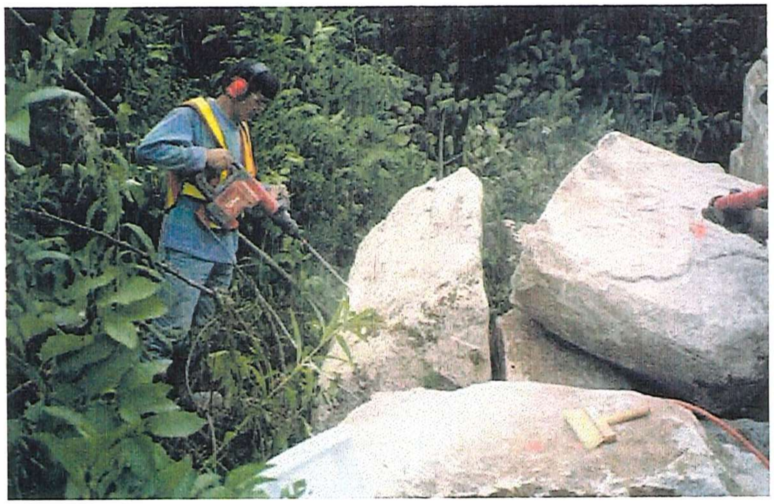


Photo 25: Copper River Debris Catcher 2. Rock is drilled then Hilti epoxy is used to secure 5/8" galvanized cable.

Photo 26: Copper River Debris Catcher 2. 5/8" cable is epoxied into rock 20 to 25 cm with a chain link added to connect the cable to the log.

Photo 27: Copper River Debris Catcher 2. Three rocks buried adjacent to cross log. The main cable to the buried deadman (bottom left) is joined to rock as well.

Photo 28: Copper River Debris Catcher 2. First trash log is placed on X-frame logs.

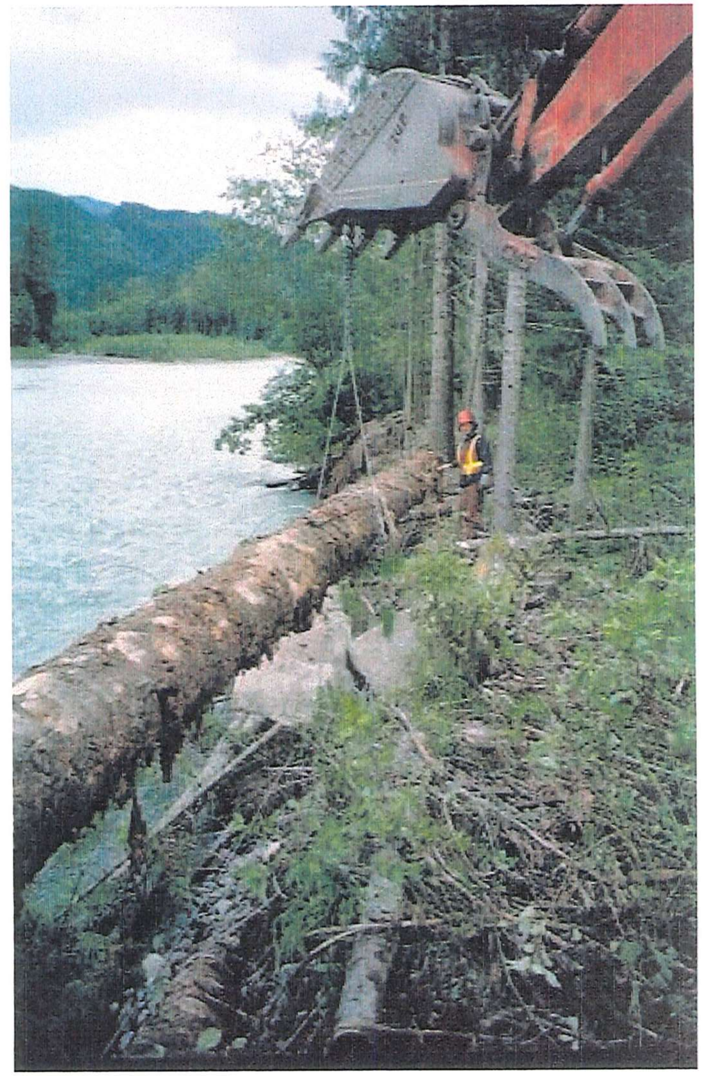


Photo 29: Copper River Debris Catcher 2. Rock ballast (approx. 3000 lbs pre rock) is hung on the second log then placed into stream channel.

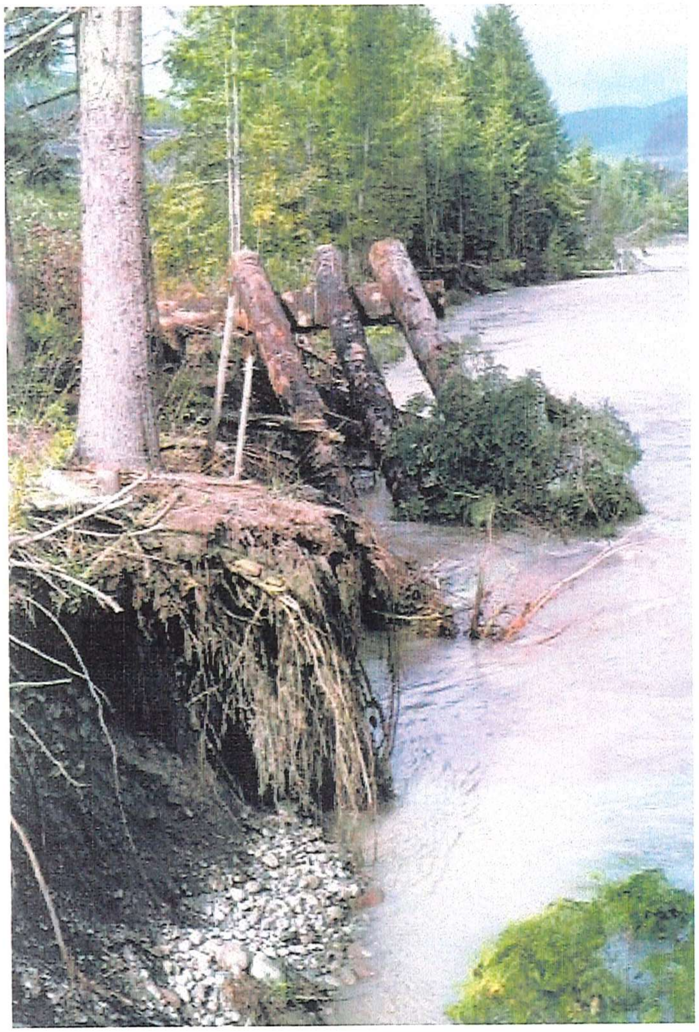


Photo 32: Copper River Debris Catcher 2. Downstream view during fall runoff (1m higher than summer). Floodwaters inundated the lower portion of the catcher. Fallen trees from eroding bank were loaded onto debris catcher in October.

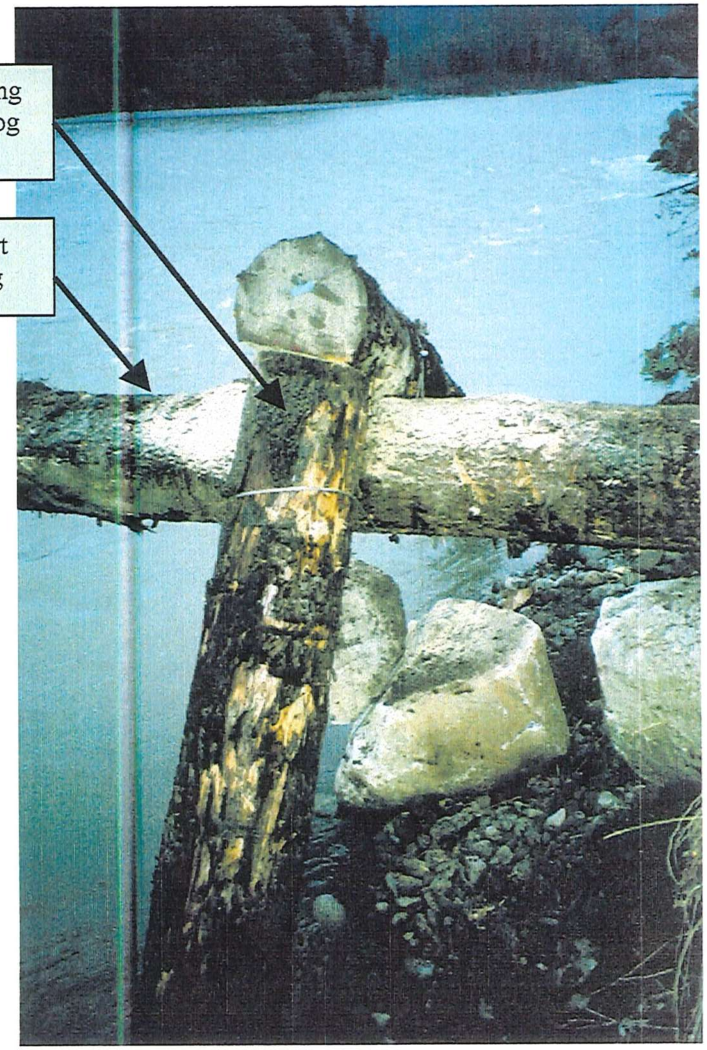


Photo 33: Copper River Debris Catcher 3. Downstream view of construction. Post is being placed under cross log.

Photo 34: Copper River Debris Catcher 3. Upstream view of post support log underneath trash log which is angled upstream into flow. Note that the boulders hang from cables and keep logs together.

5. REFERENCES

Culp, J., C. Culp and K. Sinkewicz. 1998. Fish Habitat Assessment and Selected Rehabilitiation Prescriptions within the Zymoetz Watershed. Report prepared by Terrace Salmonid Enhancement Society for Skeena Cellulose and the Ministry of Environment Lands and Parks, Smithers, BC.

Hydroglyphic Terrain Analysts. August 23, 1999. Letter prepared by A. Gilchrist, Ph. D., for Triton regarding field assessment of Site 9 excavated channel, Copper River Watershed.

Hay and Company Consultants Ltd. August 27, 1999. Letter prepared by R. J. Wallwork, P. Eng., for Triton regarding channel assessment of Site 9 excavated channel, Copper River Watershed.

Lewis, A. F. and S. Buchanan. 1998. Zymoetz River Steelhead: Summary of Current Data and Status Review, 1997. Skeena Fisheries Report SK-102.

McElhanney Consulting Services Ltd. August 29, 2000. Danger Tree Assessment for 3 km off-channel area. Summary letter prepared by Claude Rioux for Triton. (Reference file: 3147).

Pollard, B. T., Quigley, J. and Campagna, S. 1996. Level 1 Fisheries Assessment for the Zymoetz River. Prepared for: The Copper River Watershed Partnership Group, Terrace, BC.

Pollard, B. T and K. Haworth. 2000. Interim Restoration Plans for three sub-basins in the Copper (Zymoetz) River Watershed: Clore, Kitnayakwa and Lower Copper Sub-basins. Prepared for: Skeena Cellulose Inc and Forest Renewal BC. Terrace, BC.

Terrace Salmonid Enhancement Society. 1999. Zymoetz Watershed Restoration Program. Aquatic Habitat Site Survey and Design 1998/99. Prepared for MoELP.

Triton Environmental Consultants Ltd. 2000. 1999/2000 Monitoring and Instream Works Summary Report - Copper River WRP Program. Prepared for the Ministry of Environment Lands and Parks and Skeena Cellulose Inc. Terrace,
BC.

6. APPENDICES

Broster, Chris ELP:EX

From: Broster, Chris ELP:EX
Sent: February 09, 2001 11:26 AM
To: Kim Haworth (E-mail)
Cc: Atagi, Dana ELP:EX; Lough, Jeff ELP:EX
Subject: Review of the Copper River draft report for 2000 WRP Works.

Hi Kim, thanks for your draft submission. Due to the late submission date, I did not have the time to do as thorough a review as I would have liked, I have the following comments for you.

- the draft report was due Jan. 15 but was not received until Feb. 5.

- in the introduction section it states that debris catcher construction took place in Aug and Sept, this is incorrect as they took place in August and Oct.

- there are no as-built drawings in the package. On page 28, it states that " A key monitoring task will be to evaluate each support mechanism of the structures and report on the effectiveness since cost savings may be achieved using the DC3 support mechanism. The as-built drawings are critical baseline information for any future monitoring activities. All established photo reference sites need to be marked on the as-builts as well as in the field.

- follow up recommendations on page 28 make reference to monitoring rates of erosion by measuring from known points, these measurements should have been made upon completion of the structure as part of the as-built work to establish the baseline information.

- Appendix 4 5 and 6 were not included in the package.

- Although not a direct requirement of this draft report, there is a requirement in the Standards Agreement to submit to the Regional fisheries specialist a summary report (compendium report). This was due by Nov. 15, 2000 and as of this date has not been received.

I hope that my comments are of some use to you in finalizing the report, and I remind you that the final is due in to my office by Feb. 28th, 2001. Feel free to contact me if you have any further questions.

Cheers;

Chris Broster
Watershed Restoration Officer
BC Environment, Kalum District
ph: (250) 638-6536
Mailto:Chris.Broster@gems9.gov.bc.ca

TRITON
ENVIRONMENTAL CONSULTANTS LTD.
300 - 4546 Park Ave
Terrace, BC V8G 1V4
MAIL Box 88
Terrace, BC V8G 4A2
PHONE 250 635 1494
FAX 250 635 1495

Thursday, 01 February 2001

Reference: 3147/3149

Skeena Cellulose Inc.
4900 Keith Avenue
Terrace, B.C.
V8G 5L8

Attention: ~~Kim Haworth,~~ CHRIS BROSTER,
~~FRBC~~ Co-ordinator

Dear ~~Kim~~: CHRIS.

Re: Draft Report for 2000 Copper River WRP Works

I am pleased to submit to you the draft report for the 2000 Copper WRP instream works projects for your review. Please review the report and forward your comments so that I may finalize the report for distribution to agency and TSES members. A CD with final deliverables will be produced which contains the report, digital photo images, and the Compendium Report.

Please feel free to contact me should you have any questions.

Yours truly,

Triton Environmental Consultants Ltd.

Stephen Jennings

Stephen Jennings, B.Sc.
Biologist

Enclosed: Draft report

✓Cc: Chris Broster, MELP, for review as well

Appendix 1. DFO Authorization to remove Site 9 Berm.

Fisheries and Oceans | Pêches et Océans

3028.02

DFO File No.: 7930
Referral File No.: 00-HPAC-PA4-000-000136
Authorization No. / No de l'autorization

AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT
AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON

Authorization issued to:

KIM HAWORTH

SKEENA CELLULOSE INC.
WOODLANDS
4900 KEITH AVE.
TERRACE, BRITISH COLUMBIA
V8G 5L8
(250) 635-6550

Autorisation délivrée à :

KIM HAWORTH

SKEENA CELLULOSE INC.
WOODLANDS
4900 KEITH AVE.
TERRACE, BRITISH COLUMBIA
V8G 5L8
(250) 635-6550

Location of Project / Emplacement du projet

3km, Copper River

Valid Authorization Period / Période de validité

From / De
08-May-2000

To / À
01-June-2000

Description of Works or Undertakings (Type of work, schedule, etc.)
Description des ouvrages ou entreprises (Genre de travail, calendrier, etc.)

Infilling of 40% of an existing side channel restoration project

Conditions of Authorization / Conditions de l'autorisation

All procedures (perforated pipe as an exception) are followed as outlined in the document, Proposed Work Plan To Fill In Portion Of Site 9 Excavated Channel At 3km Along The Copper River (3028.02/ WP#T-945), by Triton Environmnetal Consultants.
Any loss of viable fish habitat in the bottom 60% of channel due to infilling the top 40% (loss of water), must be documented and also be compensated for .
A documented report must be given to the Department after completion of proposed restoration projects on the Copper River in the year 2000 showing which areas have compensated for site 9.

The holder of this authorization is hereby authorized under the authority of section 35(2) of the Fisheries Act, R.S.C., 1985, c.F. 14, to carry out the work or undertaking described herein.

This authorization is valid only with respect to fish habitat and for no other purposes. It does not purport to release the applicant from any obligation to obtain permission from or to comply with the requirements of any other regulatory agencies.

Failure to comply with any condition of this authorization may result in charges being laid under the Fisheries Act.

This authorization form should be held on site and work crews should be made familiar with the conditions attached.

Le détenteur de la présente est autorisé en vertu du paragraphe 35(2) de la Loi sur les pêches L.R.C. 1985, ch. F. 14, à exploiter les ouvrages ou entreprises décrits aux présentes.

L'autorisation n'est valide qu'en ce qui concerne l'habitat du poisson et pour aucune autre fin. Elle ne dispense pas le requérant de l'obligation d'obtenir la permission d'autres organismes réglementaires concernés ou de se conformer à leurs exigences.

En vertu de la Loi sur les pêches, des accusations pourront être portées contre ceux qui ne respectent pas les conditions prévues dans la présente autorisation.

Cette autorisation doit être conservée sur les lieux des travaux, et les équipes de travail devraient en connaître les conditions.

Date of Issuance : May 8, 2000
Approved by : Tom Olson
Title : Acting Area Chief

Date de délivrance : 8 mai 2000
Approuvé par : Tom Olson
Titre: Acting Area Chief

Canada

Appendix 2. Water Management Branch Section 9 Approval letter for instream works, August 25, 2000.

BRITISH COLUMBIA

File No: A6-783

August 25, 2000

TRITON ENVIRONMENTAL CONSULTANTS LTD
PO BOX 88
TERRACE BC V8G 4A2

Attention: Stephen Jennings, B. Sc.

Dear Sir:

Re: Approval Application –Zymoetz (Copper) River

Approval for the above has been granted and the approval document verifying this is attached.

A right of appeal from the decision of the Regional Water Manager lies to the Environmental Appeal Board. Notice of any appeal must (1) be in writing; (2). include grounds for the appeal; (3) be directed by registered mail or personally delivered to the Chair, Environmental Appeal Board, 4th Floor 836 Yates Street, Victoria, BC, V8V 1X5; (4) be delivered within 30 days from the date notice of the decision is given, and (5) be accompanied by a fee of $25.00, payable to the Minister of Finance and Corporate Relations.

If you have any questions or concerns regarding the document issued contact the Water Management Branch office at (250) 847-7347.

Yours truly,

L Williamson

Lynne Williamson
Supervisor, Licence and
Documentation Section

Phone: (250) 847-7280
Fax: (250) 847-7728

Enclosure
c.c. Conservation Officer Service - Terrace

Province of British Columbia

BC Environment

Ministry of Environment, Lands and Parks

Water Management Division
Box 5000 Smithers, B.C. VOJ 2NO
Phone: (250) 847-7347 Fax: (250) 847-7591

British Columbia Water Act

APPROVAL

WATER ACT - SECTION 9, SUB SECTION (1) & (2)

(Changes in and about a Stream)

TRITON ENVIRONMENTAL CONSULTANTS LTD

is hereby authorized to make changes in and about a stream as follows:

1. The name of the stream is Zymoetz (Copper) River.

2. The changes to be made in and about the stream are:

   i. placement of large woody debris at km 3;
   ii. off channel pond construction at km 3;
   iii. outlet channel construction at km 28;
   iv. outlet channel construction at Swan Creek

3. The land upon which the works may be constructed is Unsurveyed Crown Land, Range 5, Coast District.

4. The holder of this approval shall take reasonable care to avoid damaging any land, works, trees, or other property and shall make full compensation to the owners for any damage or loss resulting from the exercise of the rights granted with this approval.

5. This approval does not authorize entry onto privately held land nor does this approval provide tenure access to Crown land. The holder of this approval shall be responsible for obtaining authority (should be in writing) to enter upon any lands affected by the proposed works. The contact person for Crown land access is Ian Smythe (250) 847-7331.

6. All excavated materials and debris shall be placed in a stable area above the high water mark of Zymoetz (Copper) River and protected from erosion.

7. Vegetation along the banks of Zymoetz (Copper) River shall be disturbed as little as possible.

8. Any machinery operated in Zymoetz (Copper) River shall be free of excess petroleum based oil and grease.

9. Care shall be exercised during all phases of the work to minimize siltation of Zymoetz (Copper) River.

10. Work shall be done in accordance with all Federal and Provincial Statutes and Regulations.

11. Instream work shall be constructed to withstand a 1 in 50 year maximum instantaneous discharge.

12. Proponent must contact Habit Section of Ministry of Environment, Lands and Parks for variance to instream work window.

13. Instream work shall be undertaken during the period of August 28, 2000 to April 30, 2001.

14. The completion date for this approval shall be April 30, 2001.

Ron Creber
Regional Water Manager
Skeena Region

File No: A600783 Date: August 25, 2000 Approval No: A600783

Appendix 3. Design recommendations, McElhanney Ltd., August, 2000.

1 – 5008 Pohle Avenue
Terrace, British Columbia
Canada, V8G 4S8

Tel: 250 635 7163
Fax: 250 635 9586
e-mail: szettler@mcelhanney.com

McElhanney

PROJECT PLANNING

SUBJECT:	Copper River 3km Channel Design Issues	PROJECT: DATE:	2321-00499-0 8/1/00

Initial Concept:

1. Impound the beaver pond by rock dam to raise the water elevation approximately 1 – 1.5m. This would back water the pond to the culvert crossing on the access road.
2. Construct an access and spawning channel along the access road, from the North channel to the Main channel and along the main channel to the gully fan.
3. Collection channel would be constructed around the gully fan for long term, low maintenance water source.
4. Create an over flow structure immediately downstream of the gully fan to attenuate storm flow events and maintain a stable flow regime in the constructed channel.

Observed Site Constraints:

1. Soil is a fine silty-sand with low cohesive properties, and is highly erodible.
2. Unstable ground was found between the access road and beaver pond. Signs of sink hole formation and subsurface piping of water are present.
3. Numerous water springs are evident along the channel from the beaver pond east to the gully fan.
4. The hillside at the base of the channel east of the access road is sensitive with the sand layer extending into the toe of the hill and loose material above.
5. The site has a relatively low gradient.

Hydrology

1. Storm hydrology has been completed. The 100 year flow event is expected to have a flow of $5.12 m^3/s$.
2. Ground water data is limited, without a full year of observations. Numerous springs in the area make final flows an unknown.

Design Recommendations:

1. The lower beaver pond should not be impounded as originally planned. This will cause the collapse of the mature conifer forest north of the channel, and lead to an unpredictable avulsion of the channel.
2. No machinery must be allowed within proximity to the unstable ground area. The area is sensitive to weight and vibrations.
3. Channel cross section will have to have gentle slopes 2:1 (H:V) to maintain stable banks without having significant fine deposition over time. Channel will have a trapezoidal shape, flat bottomed, 0.5 – 1.0m wide

1 – 5008 Pohle Avenue
Terrace, British Columbia
Canada, V8G 4S8

Tel: 250 635 7163
Fax: 250 635 9586
e-mail: szettler@mcelhanney.com

SUBJECT:	Copper River 3km Channel Design Issues	PROJECT: DATE:	2321-00499-0 8/1/00

4. Energy loss must be minimized due to the low gradient. This limits the degree of channel bending.
5. Cross section will be relatively wide due to the gentle slopes, between 5 to 12 m wide. Final widths depend on completion of ground water analysis.
6. Data on ground water is limited with observations by test holes recorded over a 6 month period. This places an uncertainty on the placement of the channel's invert elevation. A minimum 10cm depth below the lowest recorded depth at Test Hold 'D' is recommended (50.55 m).
7. Final flow volume of the ground water is uncertain due to the numerous springs. On site engineering will be required for final placement of the channel invert.
8. Deepening of the channel along the main channel must be done off centre, along the north bank to avoid disturbing the hill side. This will increase the amount excavation over the initial expectation of the site.
9. Gentle riffle-pool steps will be appropriate for the constructed channel, that will provide spawning sites on the pool tail outs.
10. Alcove ponds can be constructed for rearing instead of developing the beaver pond. These ponds can be constructed as allowed in the budget and constructed in phases over time.
11. Access to the beaver pond should be developed at the dam site, by constructing a narrow channel and anchouring in wood to form small steps up to the pond. Wire fencing will be required for beaver control..

McElhanney

Suite #1 – 5008 Pohle Avenue
Terrace, British Columbia
Canada V8G 4S8

Tel: 250 635-7163
Fax: 250 635-9586
e-mail: szettler@mcelhanney.com

Fax Transmittal

DATE	DESTINATION FAX NO.	NO. OF PAGES (INC. THIS PAGE)	FILE NO.
18 July 2000		3	2321-00499-0

TO	FROM
Steve Jennings	Shawn Zettler
COMPANY	**ORIGINALS TO BE :**
Triton Environmental	
CITY	**COPY TO:**

MESSAGE

Steve:

Re: Copper River 3km Channel Design, Status Report

The design of the 3km site on the Copper River is underway. Recently we conducted a second site visit for the purpose of identifying design constraints. From this site visit, We have identified a few concerns that affect the design on the site:

1) Ground on the downstream side of the access road is unstable with numerous sink holes forming. A number of 'pistol handled' trees were observed as well as, small openings to sub-terrain caverns, sunken snags, and soft depressions. These observations are likely caused by piping of the fine non-cohesive sands by ground water.

   Based on these observations, the site is very unsuitable for impounding water to create rearing/over-wintering habitat. If water was impounded on the site, the mature conifer forest around the site would likely collapse and the channel would avulse and bypass the dam.

   We also do not recommend bringing equipment through the conifer stand or alongside the creek without substantial danger tree treatments. This would remove most of the conifer tree cover above the channel.

   Lastly, as a result of the poor ground conditions on the site, we believe that the channel below the access road not be developed, and that the project should focus on the channel above the access road.

2) Channel gradient may be an issue with the site, with the gentle profile of the ground and fine textured soils. Channel gradient will affect the design, and we will likely have to go with a narrow channel with appropriate rock structures to keep the gravel free of fine sand.
   Based on the low gradients, a new channel alignment has been proposed that has gentle bends that minimize energy dissipation and sediment deposition.

3) The channel above the access road, should not be deepened along side the steep hillside to the Copper River Road. The surfacial soils are loose, and may slough if the channel is excavated at the base of the slope. The new alignment runs along side the opposite bank to avoid issues with the hillside.

4) Pools that will be developed on site, may require maintenance, as they will likely accumulate sand and silt, especially if the Copper River floods the area.

Based on the above, attached is a revised conceptual plan for developing the Copper River 3km site. If you have any questions or comments, please do not hesitate to contact me.

Sincerely,

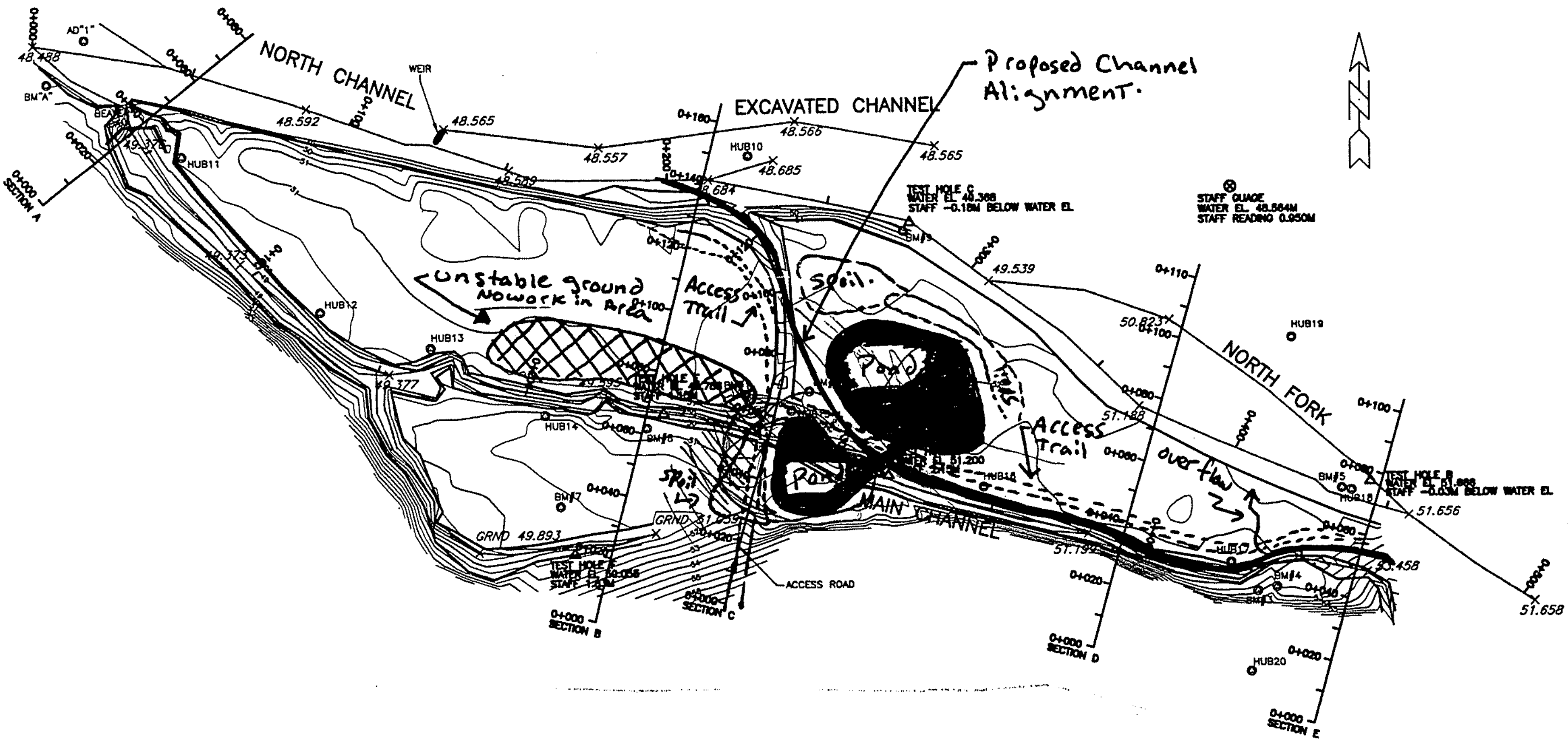
McElhanney Consulting Services Ltd.

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

Copper River 3km

Proposed Channel Development

NOT TO SCALE



Triton Environmental

August 29, 2000
Att: Mr Steve Jenning

Job# 2321-00499-0

Re: Copper River 3 km Danger Trees Assessment

On August 25, 2000 I was asked by Mr Steve Jenning of Triton Environmental to do a field assessment at the site: Copper River 3 km. The scope of work was to complete a Wildlife/Danger tree field assessment for the work area of a side channel development. The assessment done is for an old channel approximately 300 meters in length and the width of 2-tree lengths on each side of the channel. Completed assessment cards were done for 4 imminent danger trees. Another 5 trees were removed from the site, without filling out the data cards due to advance tree decay. The average diameter (dbh) for these trees range from 10 to 25 cm. For the other four trees with filled data cards only one cottonwood was retained. This tree leaned by 16% was found to be solid core and considered critical habitat. There are two other broken trees with fluorescent orange ribbon on the south side of the work site that should be pushed over with the hoe. These trees with roots attached can be used for habitat complexing in the channel.

The second phase of the work was the removal of these danger trees. All the above-indicated trees were felled. The tree # 3 card (cottonwood, 70cm dbh) was removed because of the location of the tree. This big leaner was too close to the edge of the channel.

On the south side near the creek there is a cedar (dbh+/_60cm) leaning over the creek. Care should be taken around this tree. If the root system is damage during excavation of the creek bed this tree will be too dangerous to leave standing while the work in the area take place.

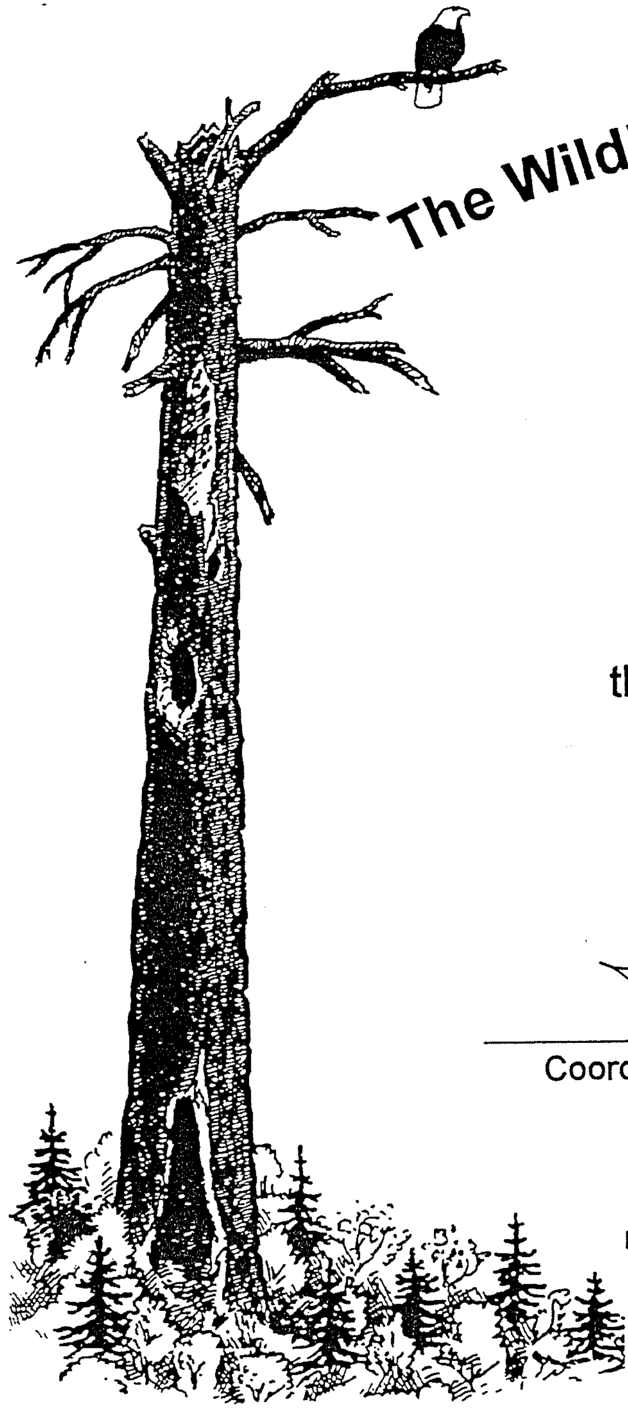
Although all trees within the proposed work area as identified by yourself, were assessed due care must be taken when working in this site.

- If trees are damaged during excavation (trunk, roots and branches) these trees may become a workplace hazard
- Overhead trees limbs on sound trees may present a falling hazard in windy condition. Proper protective equipment should be worn on site.
- Natural events (excessive wind, flooding, rainstorms or earthquakes) may cause the assessed and retained trees to topple.
- No work will be done within reach of the tree when wind speed exceeds 20 km/h (WCB 26.11 6 b)

Include with this report is a copy of the field data card, my assessment certification and my falling and bucking certificate for WCB purposes.

If you have any questions do not hesitate to call me at (635-7163)
Regards,

Claude Rioux
Field Technician
McElhanney Consulting Services Ltd.
Terrace B.C



The Wildlife Tree Committee of British Columbia

presents this certificate to

Claude Rioux

for successful completion of
the Wildlife/Danger Tree Assessor's Course,
thereby being qualified to
assess wildlife and danger trees
in the Province of British Columbia

Coordinator, Wildlife Tree Committee

April, 1998

Date

Ministry of Forests

Workers' Compensation Board

BC Environment

CERTIFICATE OF COMPLETION

This is to Certify that

CLAUDE RIOUX

Has successfully completed all the requirements of

THE FALLING & BUCKING TRAINING STANDARDS

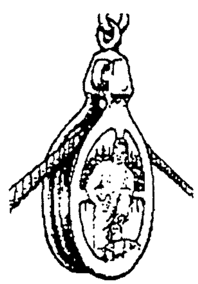
as recognized by

The Workers' Compensation Board of British Columbia

Date: SEPT. 28/97

Cert. No. 97·09·002

Certified Instructor: Thomas Brand



NORTHERN HEARING & SAFETY TRAINING

HIRE A LOGGER CONSULTING & TRAINING AGENCY

Registered as a Private Post-Secondary Institution in British Columbia.

Northern Hearing & Safety Training

DES : N :

CLAUDE RIOUX 00-08-25

KALUM DISTRICT GROUND VIBRATION excavation of stream channel.

WILDLIFE TREE #	SPECIES	WILDLIFE TREE CLASS	HAZARD A. Tree Defects	HAZARD B. Tree Lean	SOUNDNESS C. DSH (cm)	SOUNDNESS C. RST (cm)	SOUNDNESS C. AST (cm)	SOUNDNESS C. Stemwood Condition	SOUNDNESS D. Root Condition	OVERALL DANGER RATING	WILDLIFE TREE HABITAT RATING E. Tree Use Rating	F. Site Position	G. Decay Value	H. D.B.H. cm	H. D.B.H. Rat-ing	I. HEIGHT m	I. HEIGHT Rat-ing	J. Bark Condition	K. Wildlife Tree Use	WILDLIFE TREE VALUE	STRATUM / SAFETY PROCEDURES SAFE (RETAIN)	NO WORK ZONE	DANGEROUS (REMOVE)
1	AC	1,2	SCAR	16%	65	9.7	16	S	S	D	1	1	1	63	1	±25	[illegible]	2	PAK	7H	✓		
2	AC	5	DL, HT, TD, SB	5%	38	5.7	3	D	D	D	1	1	4	37	2	20	2	3	M	13L			✓
3	AC	2	DL, HT	22%	71	10.6	20	S	S	D	1	1	2	70	1	±25	1	2	P	8H			✓
4	AC	4	DL HT. TD SB	10%	43	6.4	5	D	S	D	1	1	4	42	2	±20	2	1	P	11M			✓

WILDLIFE TREE #	ADDITIONAL WILDLIFE TREE INFORMATION
#1	Heavy Leaner But will retain for wildlife Perching and Shade over New Channel.
#3	Heavy Leaner Will Be Removed Because too close from Stream Channel excavation will disturb Root system.

Appendix 4. Construction drawings Plan view (Drawing 497-01 rev. 1 August 2000)

Appendix 5. Construction drawings Plan view of new channel (Drawing 497-02 rev. 1 August 2000)

Appendix 6. Construction detail drawings (Drawing 497-03 rev. 0 August 2000)

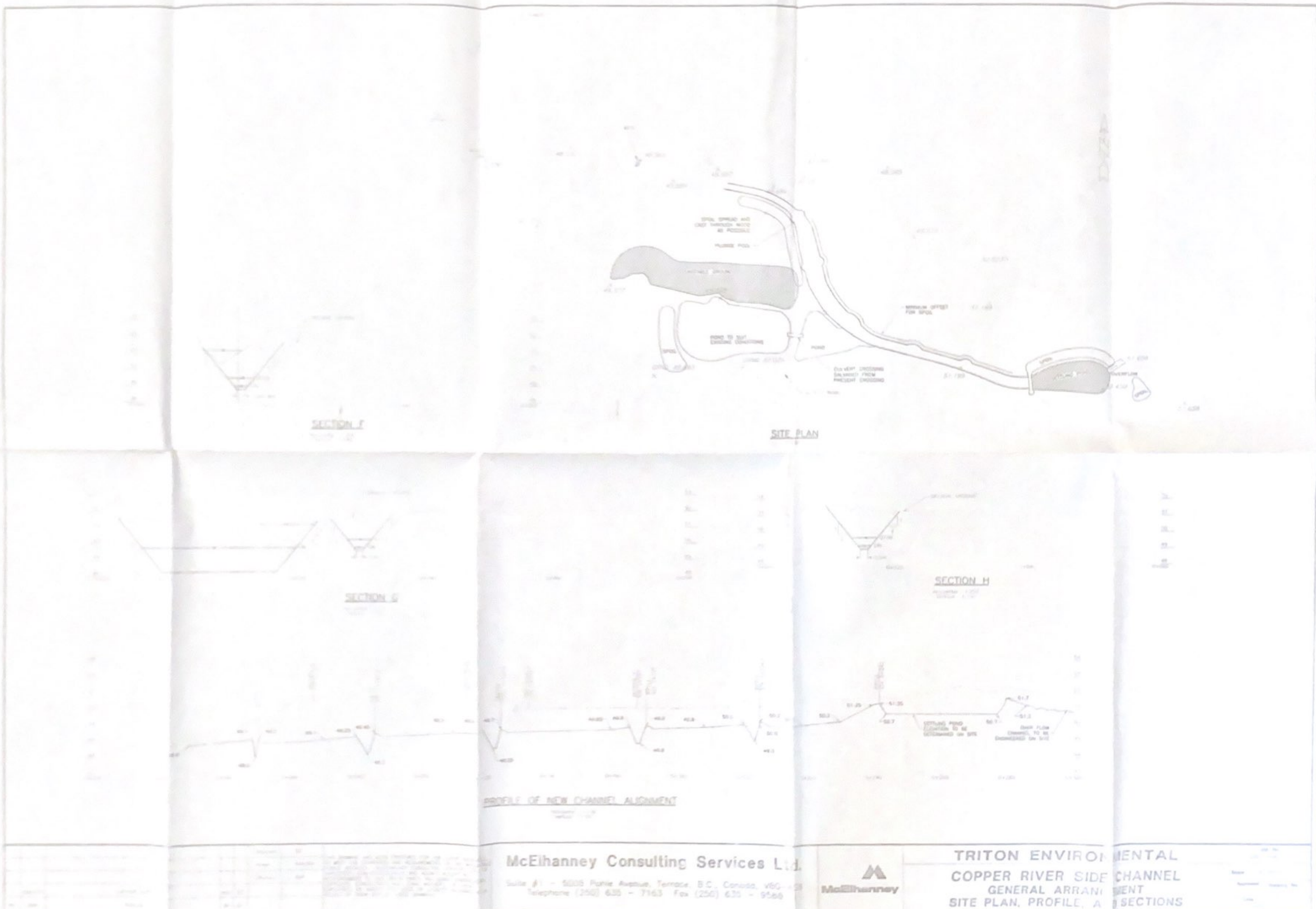
Appendix 7. Aerial photo mosaic, October, 2000 during construction and low river flows. Photos courtesy of Ministry of Forests.

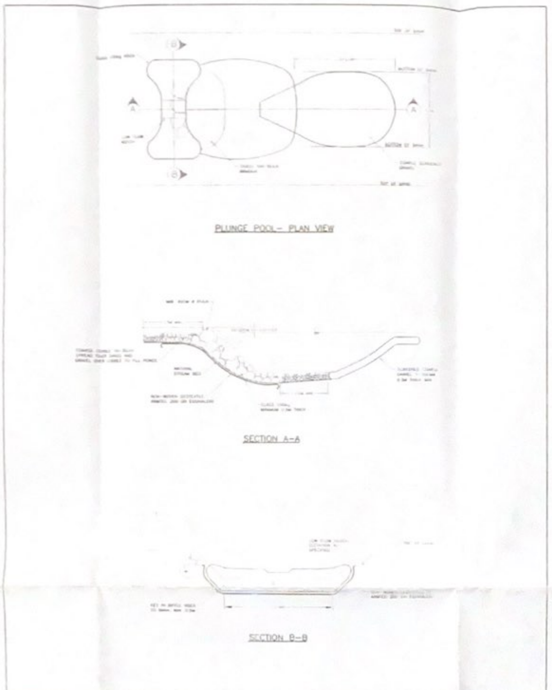
3147/3149 COPPER RIVER AIR PHOTO MOSAICS
OCT. 26/00

PHOTO SUPPLIED BY: MINISTRY OF FORESTS.

3147 /3149 COPPER RIVER AIR PHOTO MOSAICS
OCT 26/00

PHOTO SUPPLIED BY: MINISTRY OF FORESTS.

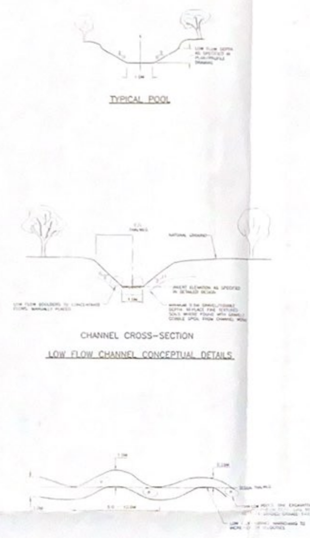

SITE PLAN
SECTION F
SECTION G
SECTION H
PROFILE OF NEW CHANNEL ALIGNMENT
McElhanney Consulting Services Ltd.
Telephone (250) 635 - 7163 Fax (250) 635 - 9566
McElhanney
TRITON ENVIRON MENTAL
COPPER RIVER SIDE CHANNEL
SITE PLAN, PROFILE,
SECTIONS



PLUNGE POOL– PLAN VIEW

SECTION A–A

SECTION B–B



TYPICAL POOL

CHANNEL CROSS–SECTION

LOW FLOW CHANNEL CONCEPTUAL DETAILS

THALWEG – FINAL SHAPING AND TEXTURING

GENERAL NOTES

GEOTECHNICAL AND SITE SAFETY CONCERNS

1. GEOTECHNICAL SITE INVESTIGATION WAS NOT INCLUDED IN THE SCOPE OF SERVICES PROVIDED FOR THE DESIGN. THE DESIGN IS BASED ON THE LIMITED SITE INFORMATION AVAILABLE. GROUND CONDITIONS MAY VARY. THE DESIGN MAY NEED TO BE MODIFIED TO ACCOMMODATE ACTUAL SITE CONDITIONS ENCOUNTERED DURING CONSTRUCTION. M.C.S.L. ASSUMES NO LIABILITY OR RESPONSIBILITY FOR DELAY OR ADDITIONAL COST WHICH MAY RESULT IF GROUND CONDITIONS VARY FROM THOSE ASSUMED.
2. THERE ARE AREAS OF KNOWN INSTABILITIES ON SITE (THESE OBVIOUS AREAS ARE INDICATED ON DRAWING 479–01). THESE SHOULD BE IDENTIFIED AND RIBBONED FOR MACHINE EXCLUTION ZONES. TREES SHOULD BE MONITORED IN THE AREA DURING CONSTRUCTION FOR VIBRATIONS. OTHER AREAS OF INSTABILITY MAY EXIST ON SITE. GEOTECHNICAL INVESTIGATION TO IDENTIFY OTHER AREAS IS BEYOND THE SCOPE OF SERVICES PROVIDED FOR THE DESIGN. THE ENTIRE SITE SHOULD BE ASSESSED BY A QUALIFIED GEOTECHNICIAL ENGINEER PROIR TO CONSTRUCTION.

CONSTRUCTION LAYOUT

1. CHANNEL INVERT AND STRUCTURES ELEVATION AND ORIENTATION ARE CRITICAL ASPECTS FOR PROPER CHANNEL FUNCTIONING.
2. SURVEY LAYOUT IS REQUIRED PRIOR TO CONSTRUCTION.
3. CHANNEL SIDEWALLS ARE SET TO 2:1 (H:V) SLOPE. INCREASING THE STEEPNESS OF THE SIDEWALLS WILL RESULT IN INCREASED BED LOAD, SEDIMENTATION, AND MAINTENANCE.
4. CONSTRUCTION WITHOUT REVIEWED AND STAMPED "FOR CONSTRUCTION" DRAWINGS IS DONE AT THE OWNERS RISK WITHOUT LIABILITY TO McELHANNEY.

EXCAVATION

1. TIME REQUIRED FOR EXCAVATION WILL DEPEND ON CONTRACTOR AND SIZE OF EQUIPMENT USED.

SPOIL MANAGEMENT

1. SPOIL SHOULD BE REPOSED AT 3:1 (H:V), COMPACTED AND LIGHTLY SCARIFIED. FOLLOWING CONSTRUCTION, SEED ALL SPOIL WITH COASTAL RECLAMATION SEED MIX. 80kg/Ha
2. IT IS RECOMMENDED THAT SPOIL BE END HAULED OFF SITE DUE TO LIMITED AREAS OF SUITABLE SPOIL DISPOSAL SITES IN THE PROJECT AREA.

DANGER TREES

1. DANGER TREES ON SITE SHOULD BE ASSESSED PRIOR TO CONSTRUCTION.
2. FALL AND REMOVE TREES THAT WILL HAVE THEIR ROOTS DISTURBED BY CONSTRUCTION.

GROUNDWATER POND AND POND DEEPENING

1. DESIGN IS BASED ON GROUND WATER MONITORING PROVIDED BY TRITON ENVORONMENTAL, WITH TEST HOLES AND STAFF GUAGES INSTALLED BY TRITON ENVIRONMENTAL.
2. ALCOVE PONDS TO BE LOCATED AND CONSTRUCTED BY ON SITE–DESIGN.

CHANNEL COMPLEXING AND FINE TUNING

1. PLACEMENT OF ROCK (>50kg) AND ANCHORED WOOD WILL BE REQUIRED FOR COMPLEXING THE CHANNEL TO CREATE SCOUR ZONES AND HABITAT HETEROGENEITY. THIS WILL BE DONE ON SITE BY QUALIFIED PROFESSIONALS FAMILIAR WITH CHANNEL HYDRAULICS.

MAINTENANCE

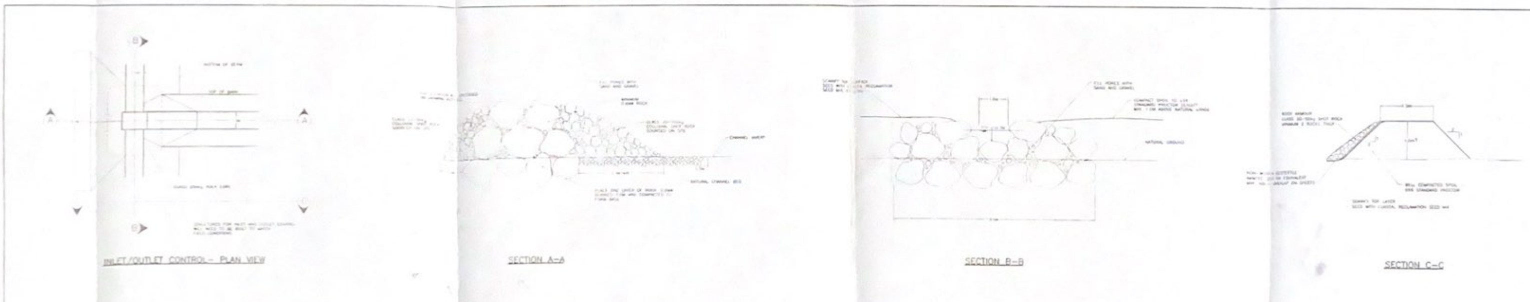
1. CLEANING FINE SEDIMENT ACCUMULATION FROM CHANNEL MAY BE REQUIRED IN THE FUTURE AS THE CHANNEL IS LIMITED TO A LOW GRADIENT DESIGN. STREAM BANKS CONSIST OF FINE SILTY SAND THAT MAY BE DEPOSITED IN THE CONSTRUCTED CHANNEL.
2. BEAVER CONTROL MAY BE REQUIRED ON SITE.

ENVIRONMENTAL

1. APPROVALS FROM DFO, MINISTRY OF ENVIRONMENT, [illegible] ARE REQUIRED PRIOR TO IMPLEMENTATION AND THEIR RECOMMENDATIONS ARE TO BE INCORPORATED.
2. EXCAVATOR AND MACHINERY SHOULD HAVE BIODEGRADABLE HYDRAULIC OIL.
3. BEST CONSTRUCTION PRACTICES SHOULD BE IMPLEMENTED, INCLUDING SILT SCREENS.
4. FISH SALVAGE MAY BE REQUIRED.
5. PRIOR TO DEMOBILIZING INSPECT THE SITE AND ENSURE THAT THE AREA IS LEFT IN A CLEAN, SAFE AND SANITARY STATE.
6. ALL DISTURBED AREAS ARE TO BE SEEDED WITH COASTAL RECLAMATION SEED MIX AND WATERED WEEKLY UNTIL END OF GROWING SEASON.

MISCELLANEOUS

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ACCESS ROAD MAY REQUIRE UPGRADING FOR [illegible]



INLET/OUTLET CONTROL– PLAN VIEW

SECTION A–A

SECTION B–B

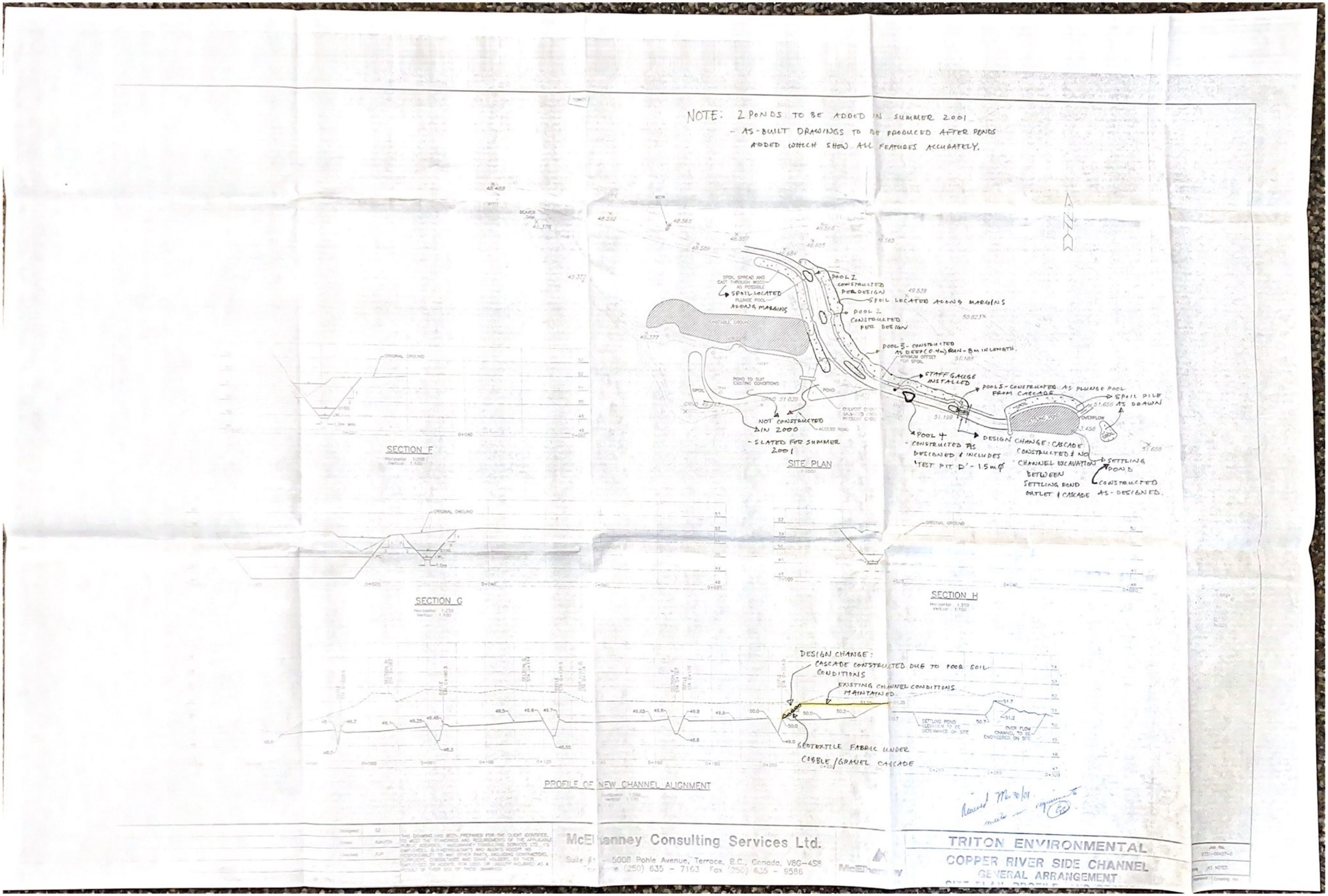
SECTION C–C

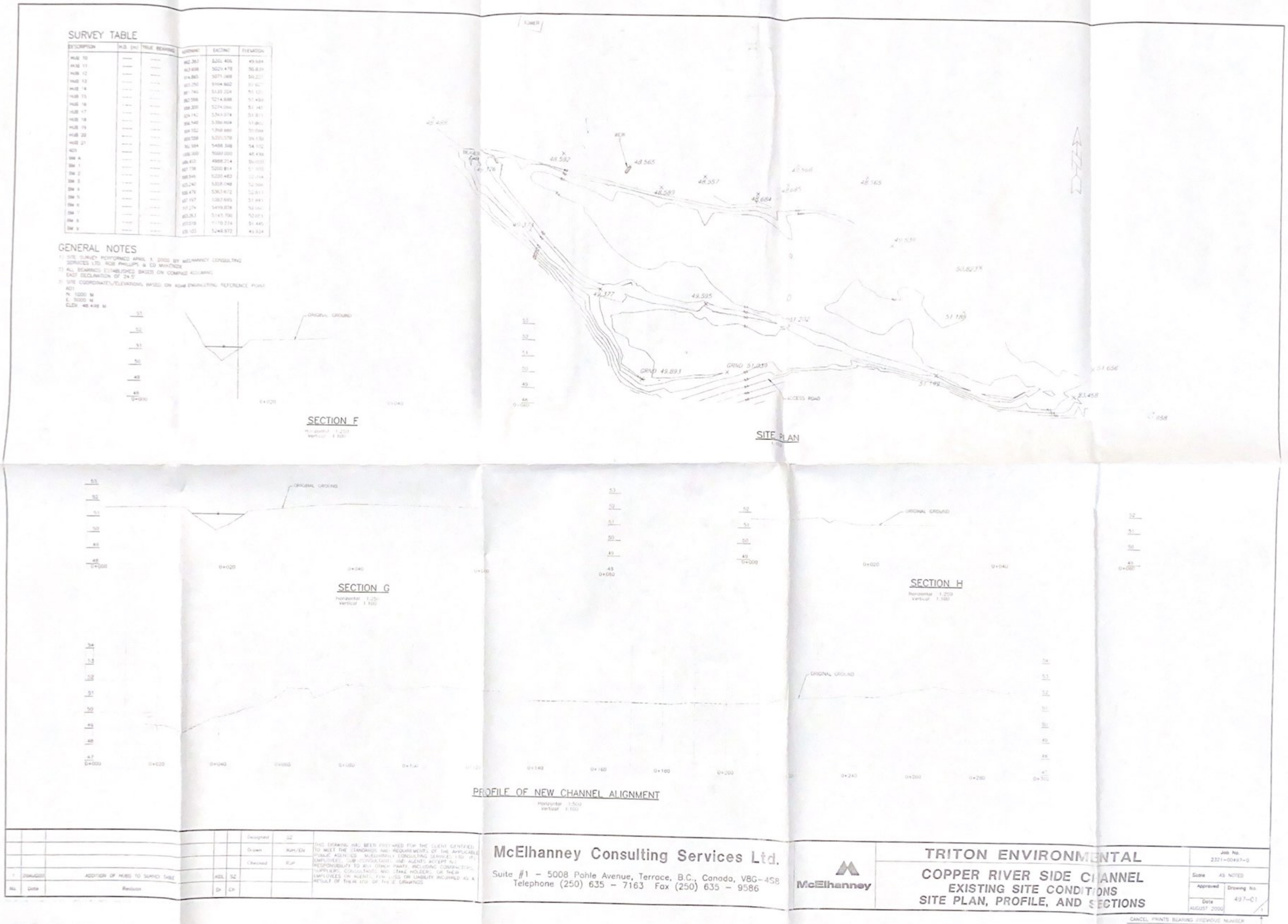
McElhanney Consulting Services Ltd.
Suite #1 – 5008 Pohle Avenue, Terrace, B.C., Canada, V8G–4S8
Telephone (250) 635 – 7163 Fax (250) 635 – 9586
McElhanney

TRITON ENVIRONMENTAL

COPPER RIVER SIDE CHANNEL DRAWING DETAILS

Drawing No. 497-03


NOTE: 2 PONDS TO BE ADDED IN SUMMER 2001
- AS-BUILT DRAWINGS TO BE PRODUCED AFTER PONDS ADDED WHICH SHOW ALL FEATURES ACCURATELY.
SPOIL LOCATED ALONG MARGINS
POOL 1 CONSTRUCTED PER DESIGN
SPOIL LOCATED ALONG MARGINS
POOL 2 CONSTRUCTED PER DESIGN
POOL 3 - CONSTRUCTED AS DEEP (0.4m) RUN - 8m IN LENGTH.
STAFF GAUGE INSTALLED
POOL 5 - CONSTRUCTED AS PLUNGE POOL FROM CASCADE
SPOIL PILE AS DRAWN
NOT CONSTRUCTED IN 2000
- SLATED FOR SUMMER 2001
POOL 4
- CONSTRUCTED AS DESIGNED & INCLUDES 'TEST PIT D' - 1.5m Ø
DESIGN CHANGE: CASCADE CONSTRUCTED & NO CHANNEL EXCAVATION BETWEEN SETTLING POND OUTLET & CASCADE
SETTLING POND CONSTRUCTED AS-DESIGNED.
SECTION F
SITE PLAN
SECTION G
SECTION H
DESIGN CHANGE:
CASCADE CONSTRUCTED DUE TO POOR SOIL CONDITIONS
EXISTING CHANNEL CONDITIONS MAINTAINED.
GEOTEXTILE FABRIC UNDER COBBLE/GRAVEL CASCADE
PROFILE OF NEW CHANNEL ALIGNMENT
McElhanney Consulting Services Ltd.
Suite #1 - 5008 Pohle Avenue, Terrace, B.C., Canada, V8G-4S8
(250) 635 - 7163 Fax (250) 635 - 9586
TRITON ENVIRONMENTAL
COPPER RIVER SIDE CHANNEL
GENERAL ARRANGEMENT


SURVEY TABLE
DESCRIPTION | H.D. (m) | TRUE BEARING | NORTHING | EASTING | ELEVATION
HUB 10
HUB 11
HUB 12
HUB 13
HUB 14
HUB 15
HUB 16
HUB 17
HUB 18
HUB 19
HUB 20
HUB 21
A01
BM A
BM 1
BM 2
BM 3
BM 4
BM 5
BM 6
BM 7
BM 8
BM 9
GENERAL NOTES
1) SITE SURVEY PERFORMED APRIL 3, 2000 BY McELHANNEY CONSULTING SERVICES LTD. ROB PHILLIPS & CD McKENZIE
2) ALL BEARINGS ESTABLISHED BASED ON COMPASS ASSUMING EAST DECLINATION OF 24.5°
3) SITE COORDINATES/ELEVATIONS BASED ON ENGINEERING REFERENCE POINT A01
N. 1000 M
E. 5000 M
ELEV. 48.438 M
SECTION F
SITE PLAN
ORIGINAL GROUND
ACCESS ROAD
GRND 49.893
GRND 51.059
SECTION G
SECTION H
PROFILE OF NEW CHANNEL ALIGNMENT
1 | 29AUG00 | ADDITION OF HUBS TO SURVEY TABLE | KDL | SZ
No. | Date | Revision | Dr | Ch
Designed SZ
Drawn KJH/EV
Checked RJP
THIS DRAWING HAS BEEN PREPARED FOR THE CLIENT IDENTIFIED TO MEET THE STANDARDS AND REQUIREMENTS OF THE APPLICABLE PUBLIC AGENCIES. McELHANNEY CONSULTING SERVICES LTD. ITS EMPLOYEES, SUB-CONSULTANTS AND AGENTS ACCEPT NO RESPONSIBILITY TO ANY OTHER PARTY, INCLUDING CONTRACTORS, SUPPLIERS, CONSULTANTS AND STAKE HOLDERS, OR THEIR EMPLOYEES OR AGENTS, FOR LOSS OR LIABILITY INCURRED AS A RESULT OF THEIR USE OF THESE DRAWINGS
McElhanney Consulting Services Ltd.
Suite #1 – 5008 Pohle Avenue, Terrace, B.C., Canada, V8G-4S8
Telephone (250) 635 – 7163 Fax (250) 635 – 9586
McElhanney
TRITON ENVIRONMENTAL
COPPER RIVER SIDE CHANNEL
EXISTING SITE CONDITIONS
SITE PLAN, PROFILE, AND SECTIONS
Job No. 2321-00497-0
Scale AS NOTED
Approved
Drawing No. 497-01
Date AUGUST 2000
CANCEL PRINTS BEARING PREVIOUS NUMBER