Lakelse Lake Sockeye Rehabilitation Program
Upper Williams Creek Spawning Channel

Prepared for:
The Pacific Salmon Commission
600 - 1155 Robson Street
Vancouver, B.C.
V6E 1B5

Prepared by:
Department of Fisheries and Oceans Canada
Lana Miller – Restoration Biologist
James Powell – Engineering Technician
Sandra Devcic – Restoration Engineer
Terrace/Prince Rupert Offices

Project completed: June 2011

Executive Summary

Williams Creek is the largest of 13 Lakelse Lake tributaries historically supporting up to 80% of Lakelse Lake sockeye with returns recorded up to 50,000 in 1945 and averaging over 10,000 from 1933 to 1968. A decrease in returns to numbers averaging in the low thousands has been recorded since this time. This decline appears to be largely the result of extensive logging throughout the watershed including logging of riparian areas and active channel crossings (Rabnett, 2007). Large flood events occurred during and post logging which resulted in increased sediment accumulations of 73,000 ± 6,000m^3/yr (Weiland and Bird, 2007) and channel instability. While these excessive sediment loads have now largely been transported by natural river flows into Lakelse Lake and riparian recovery is ongoing, lack of suitable spawning habitat continues to be the main factor limiting sockeye production in Williams Creek.

Historical sockeye spawning in Williams Creek occurred predominantly in the lower 7km of the system and in the tributary, Sockeye Creek. Habitat degradation and poor returns have limited present-day spawning to the lower 2km of Williams and a few hundred meters of Sockeye Creek. The mainstem spawning areas are generally unstable, experiencing scour and aggradation of gravel. As a result, opportunities to develop more stable off-channel spawning habitat has been the main focus of habitat restoration efforts. Upper Williams Creek Spawning Channel in Reach 3 represented the most promising opportunity with flowing groundwater and flood-protected relic channels. The first phase of development included feasibility studies which lead to the construction of the first 470 meters of a 700 meter channel. The next phase (summer 2012) will involve the excavation of the remaining 200 meters and the installation of an intake and pipeline supplying 6-12 cfs of controlled river flows from Williams Creek to the restored off-channel. This report focuses on the successful completion of the first development phase which was funded by the 2010 Pacific Salmon Commission (PSC) Northern Fund in the amount of $42,000.

The excavation of the Upper Williams Creek Spawning Channel was carried out from May 30 to June 16, 2011. 470 lineal meters of spawning channel was excavated with an average slope of 1.2%, an average width of 3.5m, and an average depth from ground level of 2.5m. Channel complexities included large woody debris placement, boulder placement, pool and riffle construction, and three constructed undercut banks. The depth of the excavation was below ground water for much of the length of the channel. The excavation of the remaining 200m of channel and installation of an intake structure, pipeline and valve system to supply river water from Williams Creek main stem to the newly created off-channel spawning habitat is expected to begin in August of 2012.

Upon completion, the Upper Williams Creek Spawning Channel project will provide several hundred m^2 of stable spawning opportunities for Lakelse sockeye, coho and trout species as well as rearing habitat for juvenile salmonids.

Some additional progress was also made on the Scully Creek Flow Augmentation/Diversion Feasibility Study. Channel instability was discovered at the proposed diversion site near the fan apex in December, 2010. This occurrence would require the diversion site to be moved upstream above the instability to an area of bedrock which would be cost prohibitive. No further investigations are planned for a diversion near the Scully fan apex at this time. There is some interest in exploring a diversion further downstream in a stable reach near Highway 37 South.

Acknowledgements

This project was conducted by the North Coast Restoration Unit of Fisheries & Oceans Canada. DFO provided personnel, labour, travel, equipment, and technical expertise as 'in-kind' contributions to this Pacific Salmon Commission (PSC) funded project.
DFO personnel:
Sandra Devcic - Restoration Engineer, Resource Restoration Unit
Lana Miller - Restoration Biologist, Resource Restoration Unit
James Powell – Restoration Engineering Technician, Resource Restoration Unit
Mitch Drewes - Habitat Technician, OHEB
Additional assistance was provided by:
McElhanney Consulting Ltd.
Cypress Forest Consutants Ltd.
Allnorth Consultants Ltd.
Billabong Road and Bridge Maintenance Inc.

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1.0 INTRODUCTION

The Lakelse Lake Basin has historically been an important sockeye producing area. Salmon have been an integral part of the cultural history of the area as an abundant food source and are woven into the traditions and histories of First Nations people. The past century has been marked by an accumulation of pressures that have caused widespread degradation of ecosystem integrity and subsequent declines in sockeye abundance. Currently, sockeye recruitment in the Lakelse Lake basin hovers at a low level. Concerns about the long term viability of this population has led to the initiation of several habitat conservation and restoration projects aimed at aiding the recovery of Lakelse Lake sockeye stocks .

The primary spawning area for sockeye in Williams Creek starts just upstream of where Williams empties into the lake and continues for approximately 2.0km upstream to the confluence of Sockeye Creek (Reach 1). Historical spawning included reaches 2 and 3, extending an additional 5km upstream of Sockeye Creek to the Old Lakelse Rd bridge. The Lakelse Sockeye Spawning Habitat Rehabilitation Study (2007-08) explored off-channel habitat and groundwater opportunities in the lower 3 reaches of Williams Creek in the vicinity of historical and current spawning habitat. Reach 1 and 3 were determined to have developmental potential for off-channel spawning habitat pending further study. Reach 2 was considered too unstable. Upper Williams Creek Spawning Channel in reach 3 represented the most promising opportunity with flowing groundwater and flood-protected relic channels. The first phase of development included feasibility studies which lead to the construction of the first 470 meters of a ~700 meter channel in 2011.

To accomplish this phase of the Upper Williams Creek Spawning Channel Project, an existing site survey was first revised by North Coast DFO Resource Restoration Unit (RRU) staff and Allnorth Consultants to identify the preferred channel route. Documentation and permits were obtained, and the channel excavation was tendered.

The excavation of the Upper Williams Creek Spawning Channel was carried out from May 30 to June 16, 2011 by the successful bidder, Billabong Road and Bridge Maintenance Inc. under the direction of North Coast RRU staff. To minimise impacts, access to the channel site took advantage of two existing trails from a past selective logging operation beside Old Lakelse Lake road. The work began with the construction of an earthen dam at the downstream end of the channel. 470 lineal meters of spawning channel was excavated with an average slope of 1.2%, an average width of 3.5m, and an average depth from ground level of 2.5m. All excavated material was side cast to the extent of the reach of the excavator. The channel was complexed with large woody debris, boulders, pool and riffle sequences and three constructed undercut banks. The depth of the excavation was below ground water for much of the length of the channel. The excavation of the remaining 200m of channel and installation of an intake structure, pipeline and valve system to supply river water from Williams Creek mainstem to the newly created off-channel spawning habitat is expected to begin in August of 2012.

1.1 Study Area

Williams Creek drainage is located along the eastern margin of the Coast Mountains. With a mainstem length of 34.1 km, it is the largest tributary in the Lakelse Lake basin, draining approximately 207 square km of steep, high elevation terrain. Williams Creek and it's tributaries, Sockeye, Myron and Llewellyn creeks, comprise 25% of the total stream length in the Lakelse Lake basin and flow into the northeast corner of Lakesle Lake.

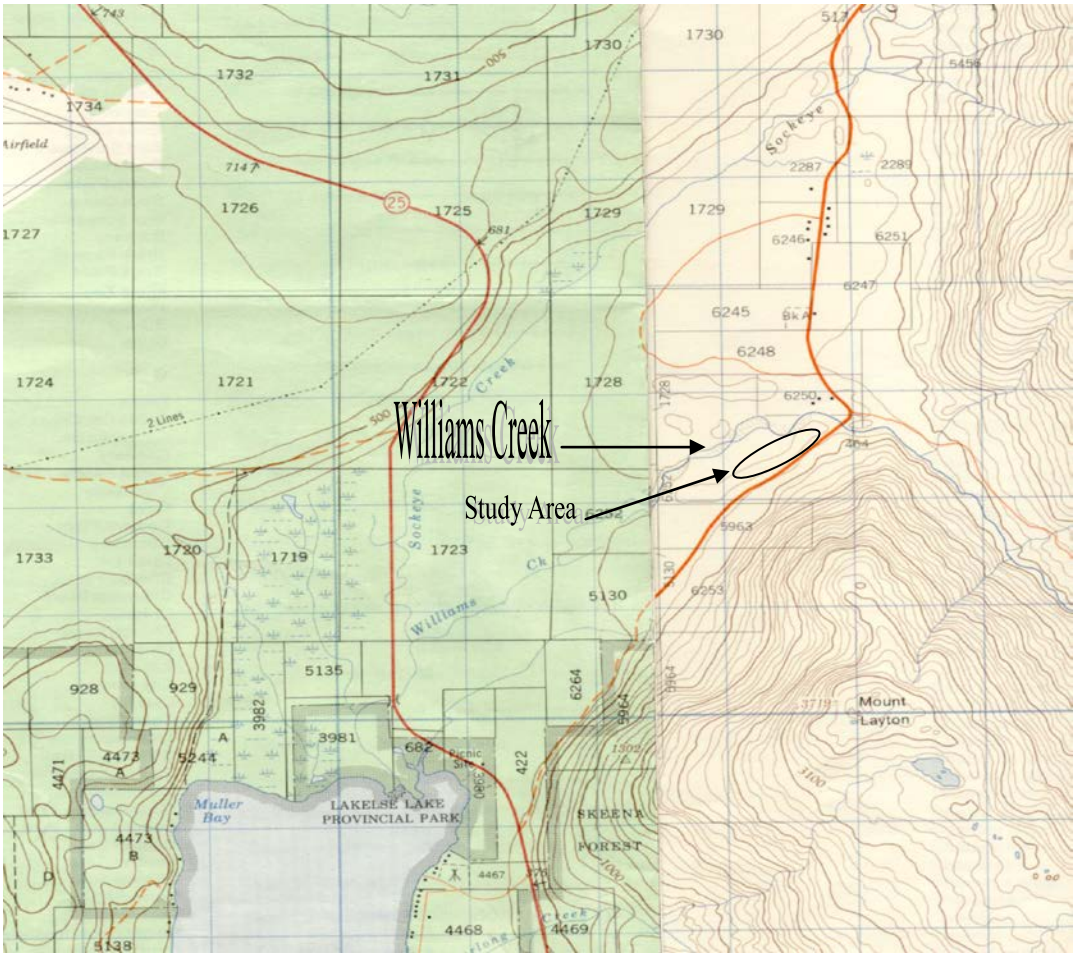


Figure 1: Map of Lakelse Lake Area Showing Location of Williams Creek

Upper Williams Creek Spawning Channel

The Upper Williams Creek Spawning Channel originates approximately 200 meters southwest of the Williams Creek Bridge on Old Lakelse Lake road. Historically this section of Williams Creek was made up of a complexity of side channels providing a large amount of spawning opportunity. Currently Williams Creek runs along a braided channel further north. The abandonment of the historic side channels has greatly reduced the spawning opportunities in Upper Williams Creek.

2.0 METHODS

The following section provides a summary of the methods employed in project pre-assessment (feasibility) work, pre-field planning and preparation, construction and post-assessment.

2.1 Pre-assessment/Planning

2.1.1 Feasibility Studies and Design

Feasibility studies leading up to the start of construction included test pit and test ditch construction in 2008/09 to examine substrates and monitor ground water quality, depth and quantity. Topographic surveys and flow monitoring were conducted between 2008 and 2011. The 2008/09 feasibility studies are detailed in an earlier report. Data collected such as groundwater elevations in test pits and topographic (ground) elevations as well as river levels were used to finalise channel specifications such as gradient and depth of excavation.

2.1.2 Permits, Applications and Statements

- Project Review Application 10-330 – Darren Chow – DFO – Nov. 2, 2010
- Notification of Works #93731– Chris Broster – B.C. Parks – Dec. 23, 2010
- Map Reserve R117006 – Jessica Taylor – MFLNRO Forests, Kalum – May 2, 2011
- Statement of Work – Bidding Contractors – May 12, 2011
- Free Use Permit 11794 – Christopher B. Lind RPF - MFLNRO Forests, Kalum – May 30, 2011
- Highway Use Permit 2011-03006 – L Voogd – MOTI – 23 June, 2011
- June 2011 - Water Management Plan for Water License application - McElhanney

2.1.3 Construction, Planning and Preparation

Equipment and Supplies

Equipment for Phase 2 was provided by the DFO North Coast RRU and the contractor. This included:

- Billabong -John Deere 200 excavator
- DFO - Survey equipment
  - Chainsaw and safety gear
  - 4" trash pump (rented)

Construction Tender

On April 29, 2011 a site visit was carried out by the North RRU with three prospective contractors in anticipation of the release of tender documents in early May. In attendance were Sandra Devcic, P.Eng, DFO North Coast Resource Restoration Engineer, James Powell, DFO North Coast Resource Restoration Eng. Tech., Scott Milne, Far-Ko Contracting Ltd., Stephen Salter, Billlabong Road and Bridge Maintenance Inc., Les Emerson for Terry Montague, Montague Contracting.

The site visit included an overview of the proposed Upper Williams Creek Spawning Channel Project and a more detailed description of the Phase 2 channel excavation. The proposed channel route was walked and channel features expected such as large woody debris and undercut banks were discussed. It was determined during this visit that the removal of the excavated material from

the site would be cost prohibitive and the statement of work would include a request for bids to excavate the channel with material side-cast to the extent of the reach of the excavator.

2.2 Channel Excavation

Construction of the Upper Williams Creek Spawning Channel took place from May 30th to June 16, 2011. Work began with a safety meeting to discuss general worksite safety as well as site specific issues such as presence of bears, power-lines, insects, heat, cold, uneven ground, working in and around the excavator, traffic control and fuelling.
Access to the channel site 80m above the downstream end (0+80m) was achieved using existing cat tracks from recent logging activity in the area. The excavator followed the anticipated path of the channel to reach the downstream end. A second access point was identified at 230m above the downstream end to be utilized when construction passed the 0+80m mark.
Construction began with the building up of a downstream earthen dam to ensure that in the case of excessive groundwater or flooding due to rain there would be no concern that silt-laden water from the construction of the channel would be able to flow into the downstream adjoining waterways. A 4" pump was also rented and retained on site as further preparation for possible flooding issues.
Depth and width of excavation varied from 1.5m deep and 5 meters wide at 0+5 meters to almost 3 meters deep and 2.5 meters wide at ~0+100. Attempts to keep stream banks to a 1:2 slope were made, however spoiling material on site and trying to maintain as much riparian vegetation as possible resulted in more vertical banks in some areas.

Photo 1. The Beginning of Channel Excavation.

Excavation of the spawning channel proceeded upstream to 0+110m.,including construction of an undercut bank at 0+85m. The undercut bank consisted of the excavation and complexing of an alcove pool adjacent to the channel. Horizontal logs were then placed just above water level on top of the alcove and material was backfilled over top of the logs. On June 2nd, the downstream earthen dam was reinforced due to the amount of ground water encountered upstream and the possibility of heavy rains causing overflow to downstream fish habitat. The excavator returned to the earthen dam site following existing cat tracks, excavated a deeper pool and utilised side-cast materials to build up the dam to a level above

surrounding ground elevations. This would ensure that in the unlikely event of extreme high water, silt-laden water from the newly excavated channel would be filtered by the surrounding forest duff before reaching fish habitat downstream.

Photo 2. Re-constructed Earthen dam @ 0+0m.

The rate of channel excavation was slower than anticipated, likely due to the depth of cut and time-consuming channel features as well as the expected learning curve for the operator. It was agreed that in order to finish the channel to the length desired, extra days of operation would have to be added to the contract.

The excavator returned to the main channel construction on the afternoon of June 2nd. The excavation continued upstream until June 9th to 0+250m, including a second undercut bank at 0+190m adjacent to the second channel access point. In order to maintain access to the 0+230m access point while minimizing stream bank disturbance, the excavator was moved to the upstream end of the channel (0+470m) and excavation continued in a downstream direction.

Photo 3. Undercut bank @ 0+190m.

Excavation continued until June 11 from 470m to 360m when excavation slowed due to the large amount of ground water being encountered and stored. This was due to the lack of downstream drainage resulting from working in an upstream-to-downstream direction. An access route was laid out along the south side of the channel and the excavator was walked back to 0+250m where excavation continued in an upstream direction until the channel was completed on June 13th,2011.

Photo 4. Looking Downstream @ 0+320m.

On June 16th, lock blocks were delivered to the earthen dam site to be used in the construction of the downstream weir and a third undercut bank was constructed at 0+305m.
The channel construction included the creation of many features intended to optimise the spawning and rearing capacity of the channel and to ensure sufficient spawner protection from predators such as bears. These features included pools, riffles, bends, large woody debris and boulder placements consistent with structures described in the Watershed Restoration Technical Circular No. 9 (Slaney and Zaldokas, 1997). Three undercut banks were also constructed by excavating pools of ~6m^2 at a depth of 0.5m below the ground water level. These pools were armoured with large boulders and logs were placed across the boulders and backfilled with material from the excavation.

Photo 5. Construction of Undercut Bank @ 0+305m.

Photo 6. Completed undercut bank

Photo 7: Upstream end of 2011 channel construction at 470m. Lots of groundwater evident.

2.3 Scully Creek Flow Diversion

Limited funds in 2010/2011 lead to a focus on the Williams Creek project and less attention on the Scully Creek Flow Augmentation/Diversion Feasibility Study. A site visit was conducted by DFO RRU staff in December 2010 to examine the proposed diversion location. Previous attempts to visit the site in 2010 had been hampered by high bear activity. The mainstem was walked from the BC Hydro ROW crossing on the lower fan approximately 1km upstream to examine the proposed diversion.

3.0 RESULTS

3.1 Pre-construction Planning and Preparation

The preparations for the Upper Williams Creek Spawning Channel excavation were successfully completed. All required permits were obtained and the contract for excavation tendered in May 2011. The successful bid was from Billabong Road and Bridge Maintenance Inc. for a lump sum price of $11,350.00. Delays in anticipated progress due to a deeper excavation and time-consuming channel features resulted in additional funds provided to a total of $25,000.00 for 470 lineal meters of channel excavated.

3.2 Channel Construction

Construction of the Williams Creek Spawning Channel was carried out as described in section 2.1 of this report. The channel as built includes three constructed undercut banks and large woody debris placements consisting of ~ 40 large conifer root wads and ~ 40 2-6m long logs. Boulders were placed along 80 % of the stream banks and randomly clustered throughout the middle of the channel. Cover and holding areas for spawning adults is

particularly important due to anticipated bear predation. The channel meanders throughout its entire length and the slope varies to create 3 main pools and 3 riffle sections. Average channel gradient is 1.2% and channel substrates were dominated by gravel/cobble/sand and are expected to provide good spawning habitat. The majority of the channel was excavated into the groundwater table with the exception of a few larger gradient riffles.

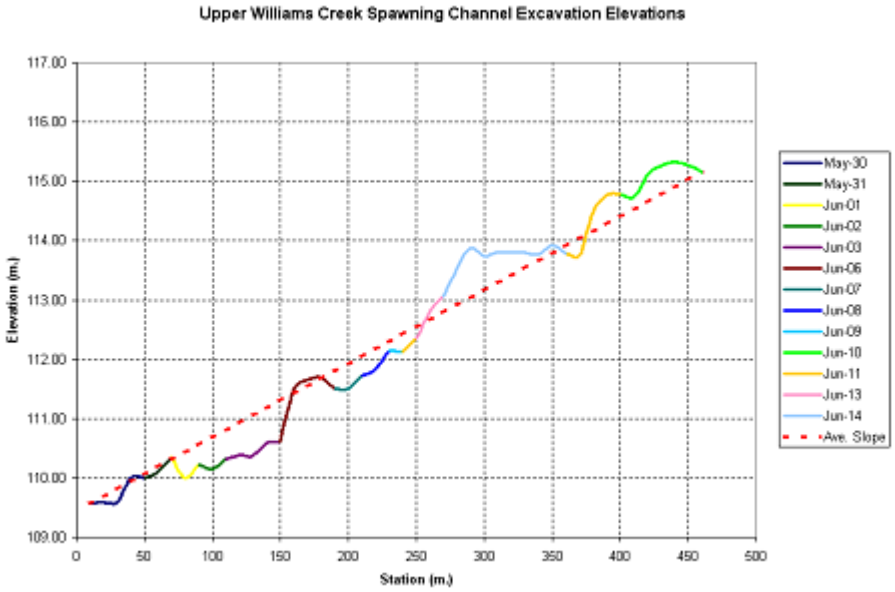


Figure 2. Upper Williams Creek Spawning Channel Elevations

3.3 Scully Creek Flow Diversion

Limited funds in 2010/2011 lead to a focus on the Williams Creek project and less attention on the Scully Creek Flow Augmentation/Diversion Feasibility Study. A site visit was conducted in December 2010 and recent gravel and woody debris accumulations in the channel were noted. The stream walk revealed significant channel instability at the proposed diversion site near the fan apex. This occurrence would require the diversion site to be moved upstream above the area of instability to a bedrock section of channel which would be cost prohibitive. No further investigations are planned for a diversion near the Scully fan apex at this time. See appendix 7 for a memo provided by Don Hjorth, former RRU Engineer. There is some interest in exploring a diversion further downstream in a stable reach near Highway 37 South. This may be explored in future years.

Photo 6. Proposed Scully Channel Diversion Location - unstable streambed and banks

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Channel Completion, Post-construction Assessment and monitoring

As-Built Survey

An as built survey to document completed works was completed by Allnorth Consultants Ltd. in late June, 2011. This survey will provide a record of the works completed and can also be used to monitor changes to the site over time.

In summer 2012, the remaining channel will be excavated and the intake from Williams Creek installed. A lower fence sill and abutments will be installed at the channel outlet for future monitoring.

Assessment and Monitoring

A monitoring schedule will be implemented after the completion of phase three of the Upper Williams Creek Spawning Channel Project to monitor flows, water quality fish utilisation and incubation success. The channel may be seeded with sockeye eggs, fry, adults or some combination in the first couple of years. Flows will be monitored and adjusted for optimal performance, taking into consideration channel stability, sufficient attraction flows, channel connectivity and optimal spawning velocities.

Signage will be developed at access points along the channel. This upper channel will be used as a demonstration channel of sorts and will hopefully lead to the construction of a similar channel in the lower river where sockeye spawning is concentrated but where adjacent land is owned and managed by BC Parks.

5.0 LIST OF REFERENCES

Kujat, M. 2009. Spawning Channel Feasibility Study – Year 2 – Lakelse Spawning Habitat Improvement Projects. PSC Northern Fund Final Report.

Powell, James. 2011a. Fisheries and Oceans Canada. Resource Restoration Engineering Technician. Unpublished field notes, April 29, 2011.

Powell, James. 2011b. Fisheries and Oceans Canada. Resource Restoration Engineering Technician. Unpublished field notes, May 30-June 6, 2011.

Rabnett, K. 2008. Lakelse Sockeye Spawning Habitat Rehabilitation Feasibility Program. PSC Northern Fund 2008 Final Report.

Slaney, P.A., D. Zaldokas. 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9. Ministry of Environment, Lands and Parks. Vancouver, BC.

Weiland, I., S. Bird. 2007. Sediment Source Mapping, Detailed Channel Assessment, and Reconnaissance Sediment Budget for Williams Creek for the Period 1949-2001. Prepared for the Fisheries and Oceans Canada

APPENDIX 1

Financial Report

APPENDIX2
Proponent Information

Proponent Information

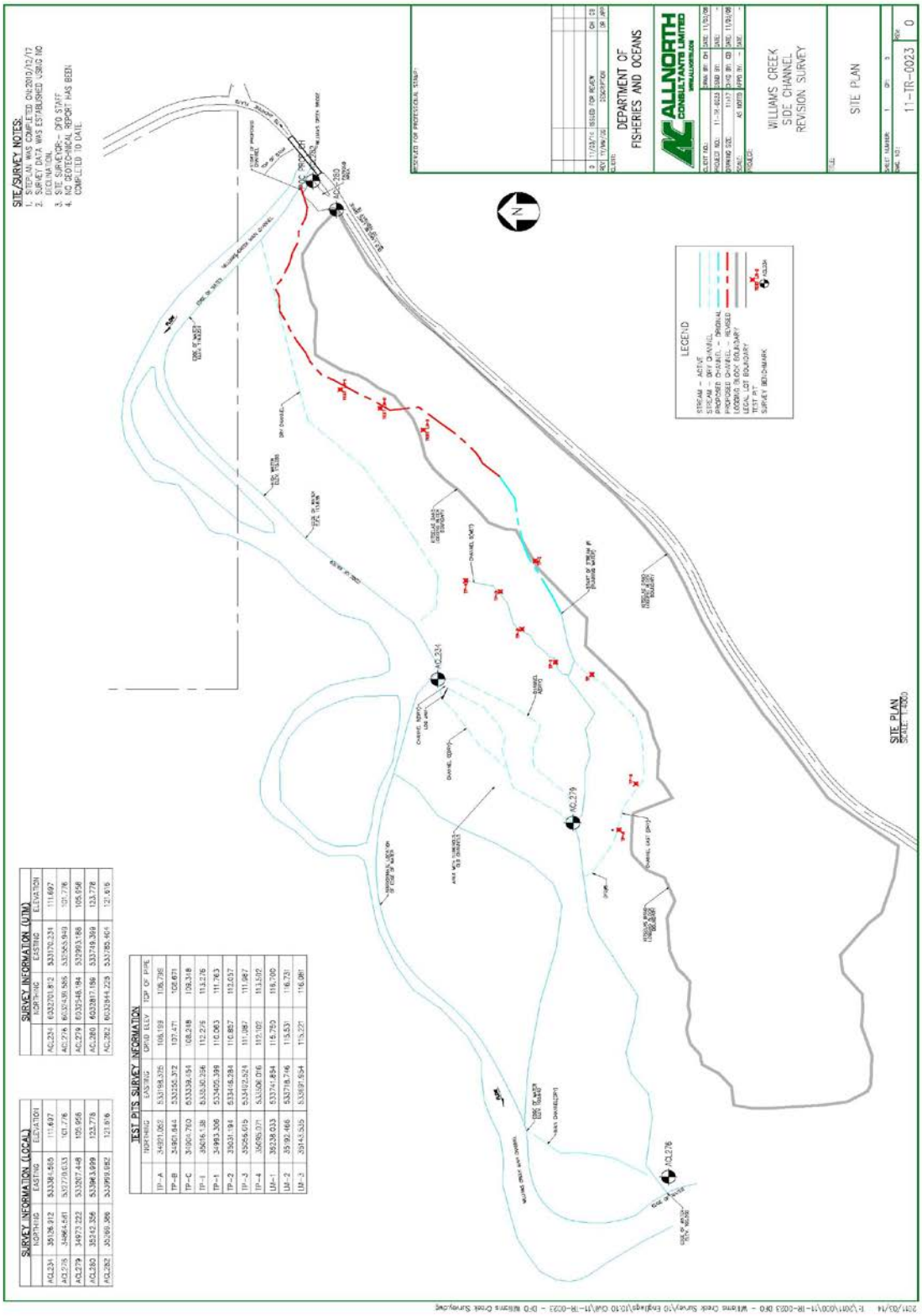
Partners:

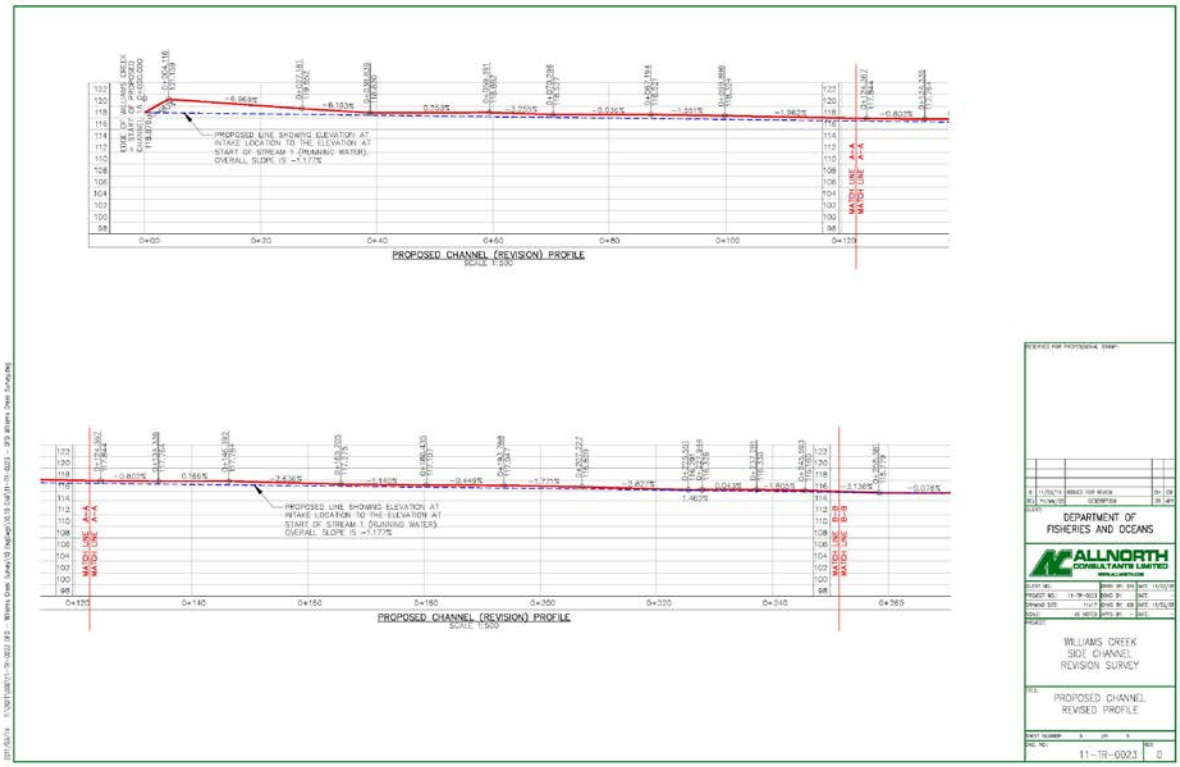
Pacific Salmon Commission
600 – 1155 Robson Street
Vancouver, British Columbia
V6E 1B5
604-684-8081
Angus MacKay – Fund Coordinator
MacKay@psc.org

Department of Fisheries & Oceans Canada
Oceans, Habitat and Enhancement Branch
5235 A Keith Avenue
Terrace, British Columbia
V8G 1L2
250-615-5353
Mitch Drewes –Habitat Technician
Drewesm@pac.dfo-mpo.gc.ca

Department of Fisheries and Oceans Canada
Habitat and Restoration Branch
417 2nd Avenue
Prince Rupert, British Columbia
V8J 1G8
250-627-3441
Lana Miller – Restoration Biologist
Sandra Devcic – Restoration Engineer
James Powell – Engineering Technician
MillerL@pac.dfo-mpo.gc.ca

APPENDIX 3
Original Site Plan Drawing

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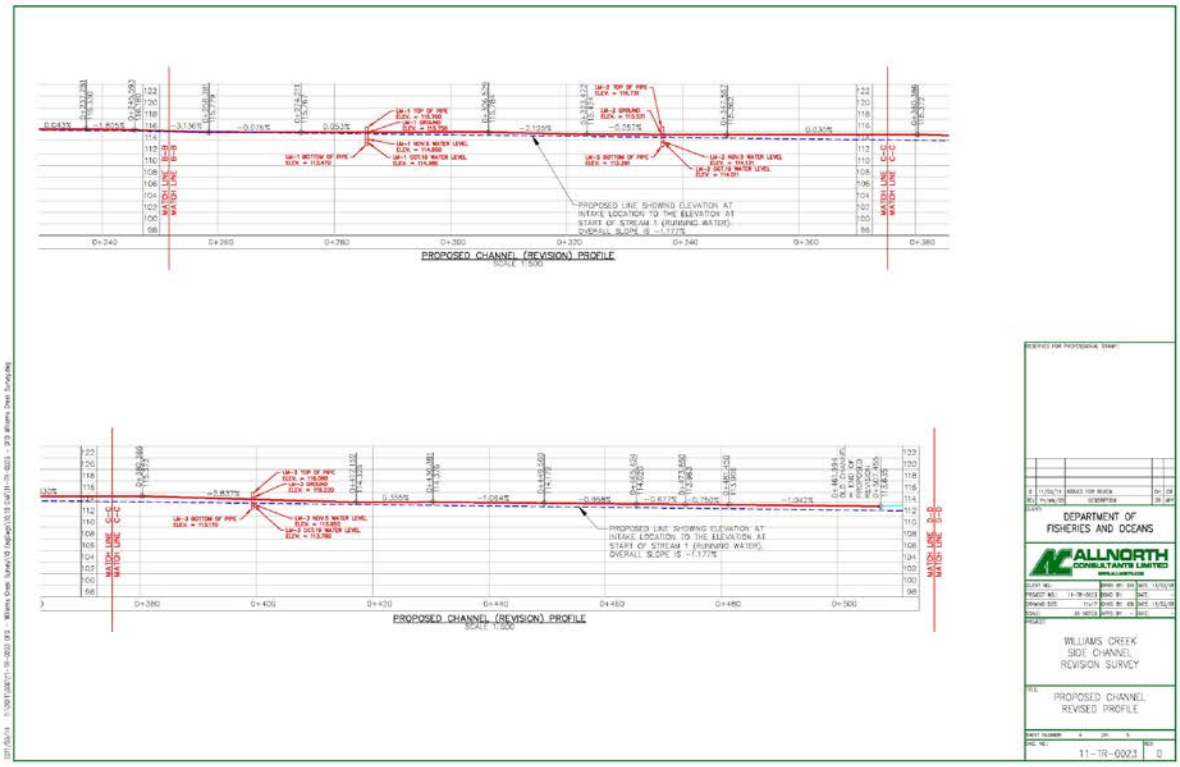
SCALE 1:500
PROPOSED LINE SHOWING ELEVATION AT INTAKE LOCATION TO THE ELEVATION AT START OF STREAM 1 (RUNNING WATER). OVERALL SLOPE IS -1.177%
DEPARTMENT OF FISHERIES AND OCEANS
ALLNORTH CONSULTANTS LIMITED
WILLIAMS CREEK SIDE CHANNEL REVISION SURVEY
PROPOSED CHANNEL REVISED PROFILE
11-TR-002.1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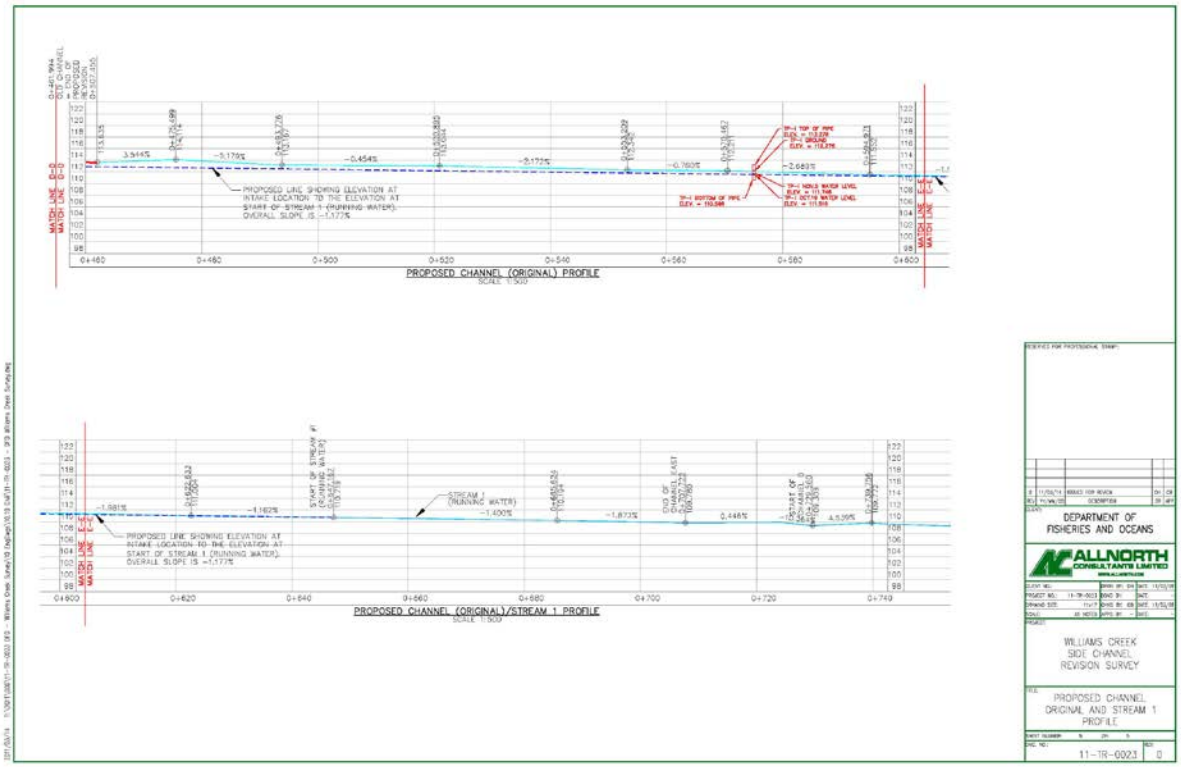
PROPOSED CHANNEL REVISED PROFILE
11-TR-002.1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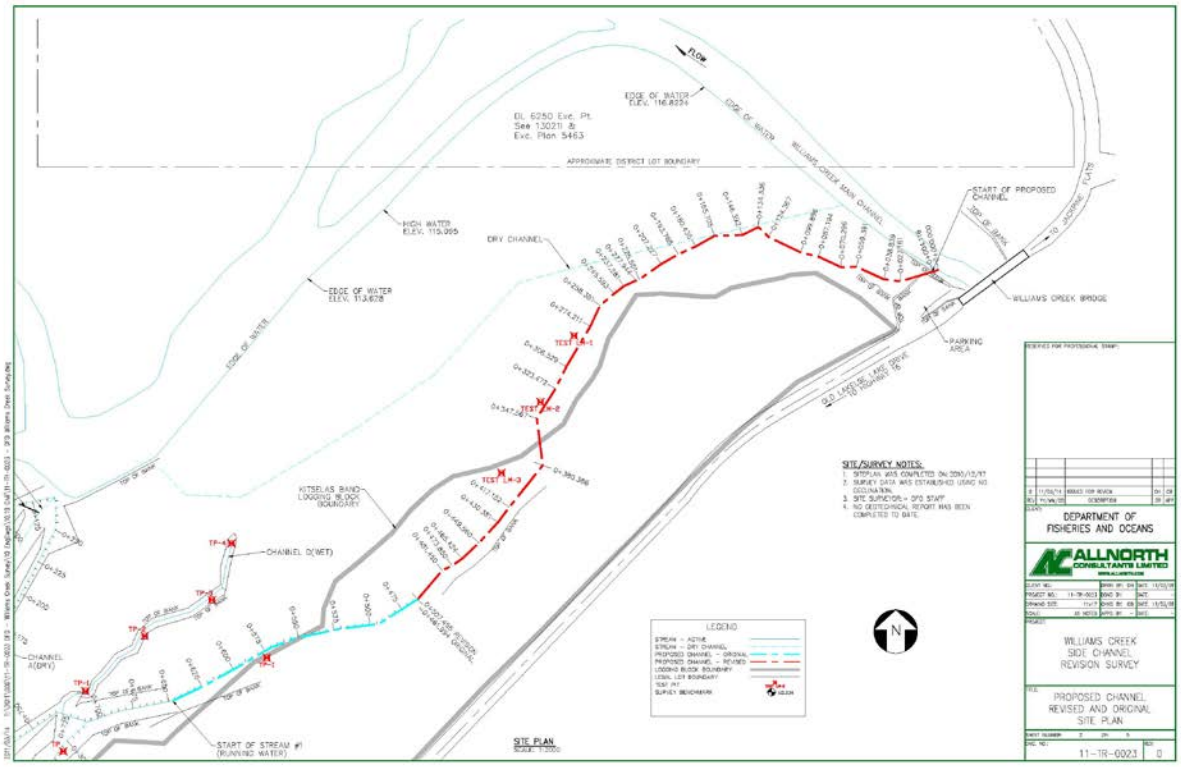
SCALE 1:500
DEPARTMENT OF FISHERIES AND OCEANS
ALLNORTH CONSULTANTS LIMITED
WILLIAMS CREEK SIDE CHANNEL REVISON SURVEY
PROPOSED CHANNEL ORIGINAL AND STREAM 1 PROFILE
11-TR-002.1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EDGE OF WATER ELEV. 113.678
START OF PROPOSED CHANNEL
WILLIAMS CREEK BRIDGE
PARKING AREA
KITSELAS BAND LOGGING BLOCK (BOUNDARY)
CHANNEL D(WET)
CHANNEL A(DRY)
START OF STREAM #1 (RUNNING WATER)
SITE/SURVEY NOTES:
LEGEND
SITE PLAN
DEPARTMENT OF FISHERIES AND OCEANS
ALLNORTH CONSULTANTS LIMITED
WILLIAMS CREEK SIDE CHANNEL REVISON SURVEY
PROPOSED CHANNEL REVISED AND ORIGINAL SITE PLAN
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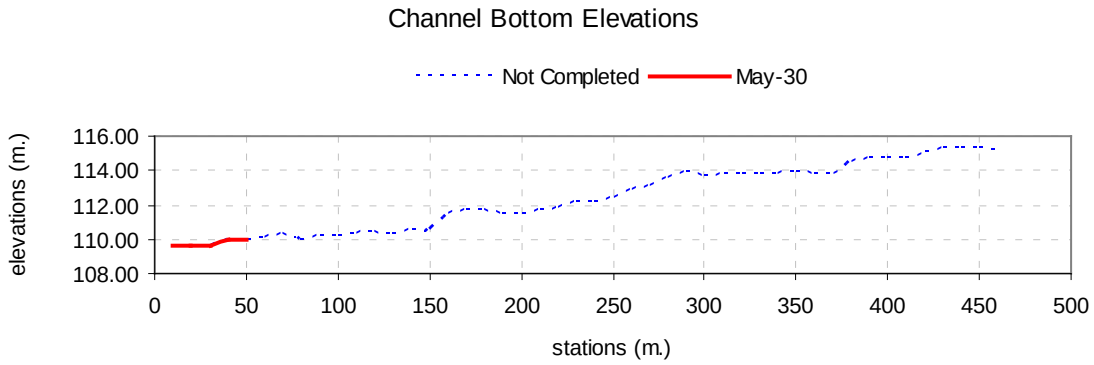
APPENDIX 4
Daily Progress Reports

May 30/2011



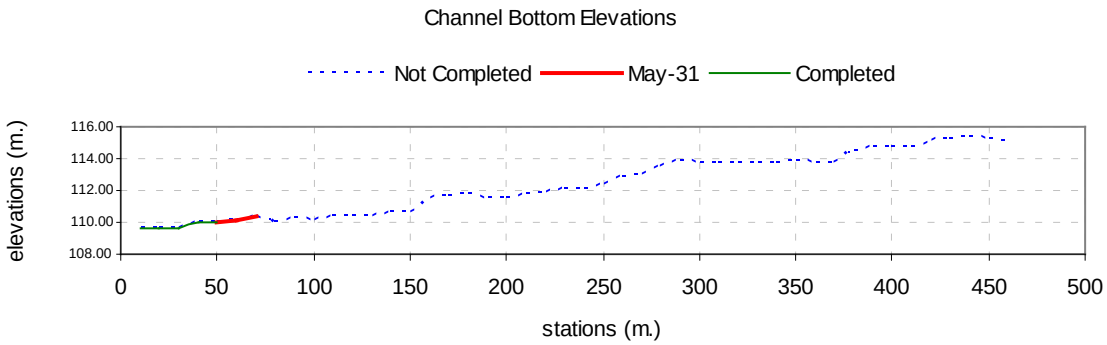
07:30 - Delivery of excavator to site, traffic control in place.
08:30 – Safety Meeting
09:30 – Excavator to downstream end of channel @ 0+0m.
10:30 – Construct earthen dam between wetted downstream area and 0+0m.
11:30 – Begin excavation of spawning channel
17:30 – excavation complete to 0+50m.

Upstream @ 0+0m.

Downstream @0+50m.

APPENDIX 4
Daily Progress Reports

May 31,2011



07:30 – Begin excavation @0+50m.
14:00 – Construct undercut bank @ 0+70m.
17:30 – Excavation complete to 0+70m.

Upstream @ 0+ 70m.

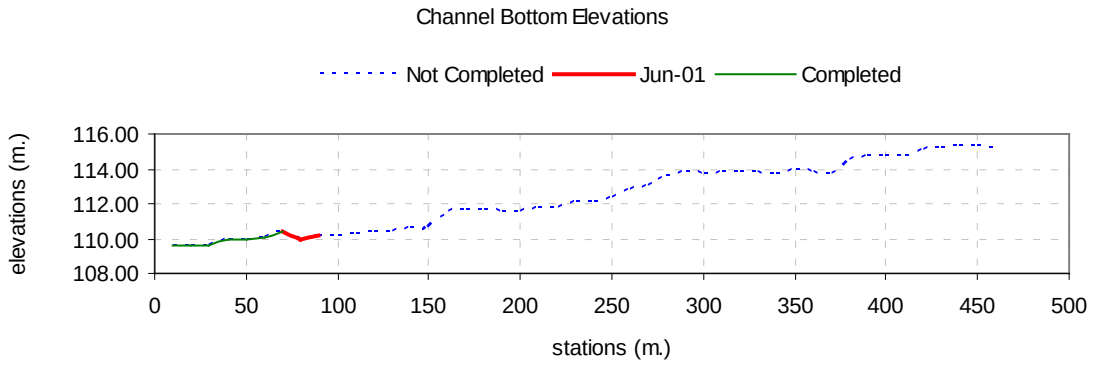
Undercut Bank @ 0+70m.

Downstream @0+ 80m.

APPENDIX 4

Daily Progress Reports

June 1, 2011



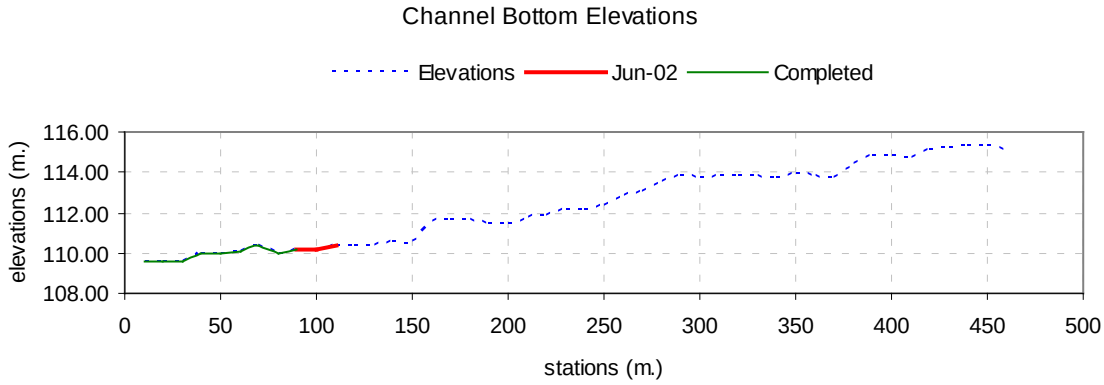
07:30 – Excavate deep pool at undercut bank 0+70m.
09:30 – Return to channel excavation @ 0+70m.
17:30 – Excavation complete to 0+90m.

Upstream @ 0+70m.

Downstream@ 0+90m

Daily Progress Reports

June2, 2010



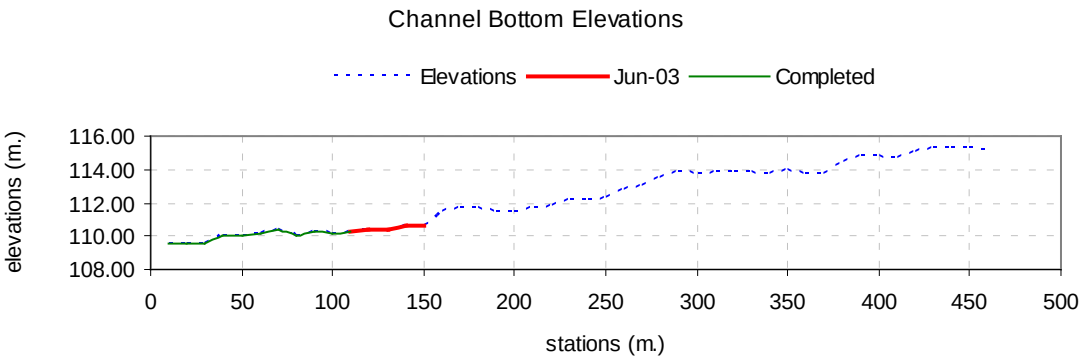
07:30 – Re-construct dam @ 0+0m.
12:30 – Return to channel excavation @ 0+90m.
17:30 – Excavation to 0+110m.

Re-Constructed dam @ 0+0m.

Upstream @ 0+90m.

Downstream @ 0+110m.

June 3, 2011

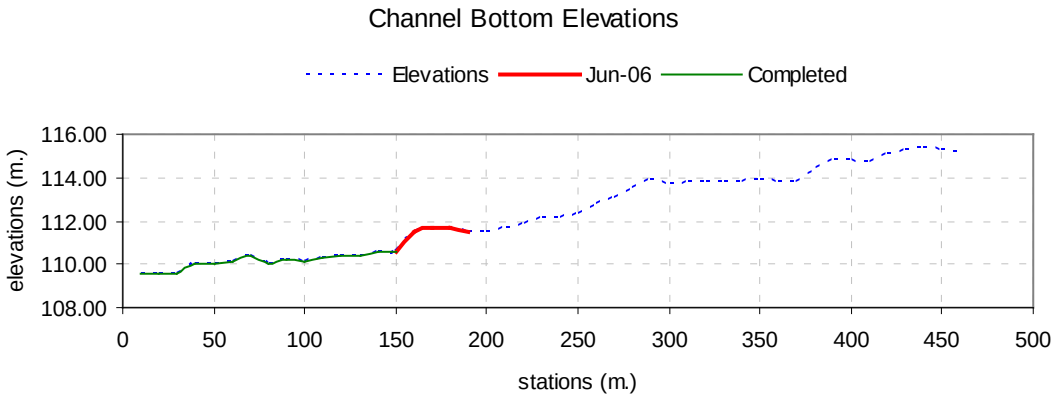


07:30 – Begin excavation @ 0+ 110m.
13:30 – Excavation above ground water @ 0+130m.
17:30 – Excavation complete to 0+150m.

Upstream @ 0+110m.

Downstream @ 0+150m.

June 6, 2011



07:30 - Begin Excavation @ 0+150m.
12:30 – Construct second undercut bank @ 0+190m.
17:30 – Excavation complete to 0+190m.

Upstream @ 0+150m.

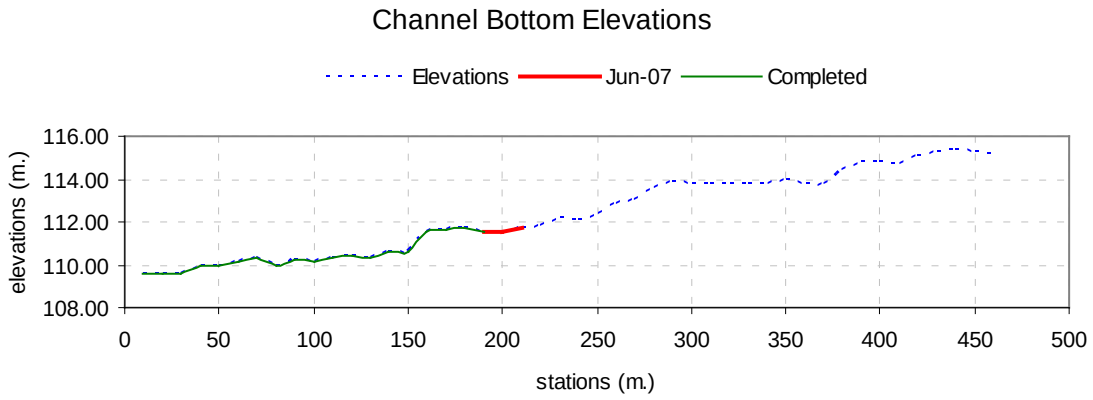
Downstream @ 0+190m.

Undercut Bank @ 0+190m.

APPENDIX 4

Daily Progress Reports

June 7,2011



07:30 – Begin excavation @ 0+190m.
13:30 – Site visit from Worksafe B.C.
17:30 - Excavation complete to 0+210m.

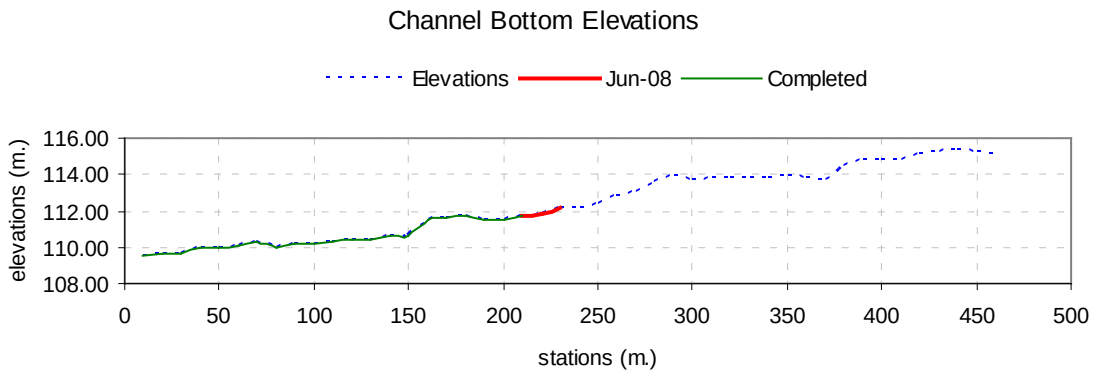
Upstream @ 0+190m.

Downstream @ 0+210m.

APPENDIX 4

Daily Progress Reports

June 8, 2011



07:30 – Excavator repair

13:30 – Begin excavation @ 0+210m.

17:30 – Excavation complete to 0+230m.

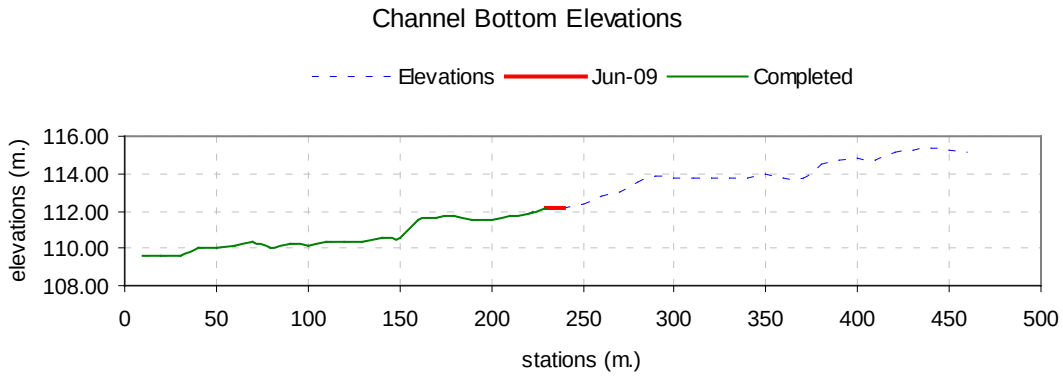
Upstream @ 0+210m.

Downstream @ 0+230m.

APPENDIX 4

Daily Progress Reports

June 9,2011



07:30 – Begin excavation @ 0+ 230m.
08:30 – Site visit from Cypress Forest Consultants.
11:30 - Determine upstream extent of channel @ 0+470m. approx. 250m. west of intake
13:30 – Descision move excavation from 0+240m. to upstream end of channel @ 0+470m. to maintain access point
15:30 – Clear path of channel from 0+240m. to 0+470m.
17:30 – Path cleared to 0+440m.

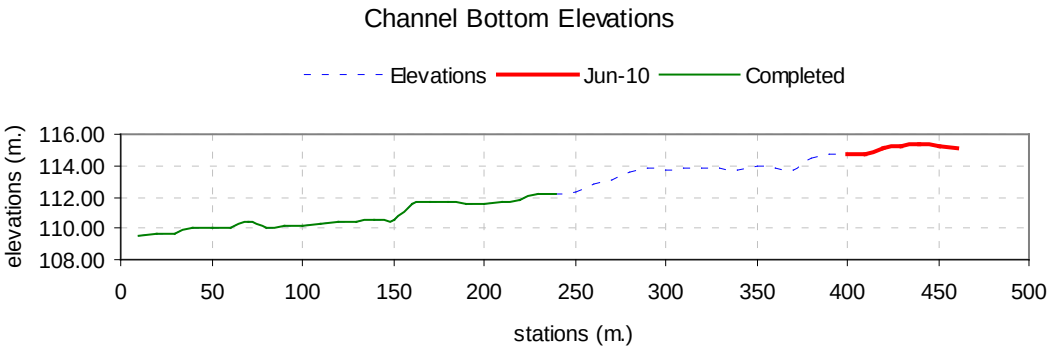
Upstream @0+230m

Clearing path for channel to 0+470m.

APPENDIX 4

Daily Progress Reports

June 10, 2011



07:30 – Finish clearing path upstream to 0+470m.
08:30 – Excavate upstream pool at 0+470m.
09:30 – Begin excavating downstream
17:30 – Excavation complete to 0+ 400m.

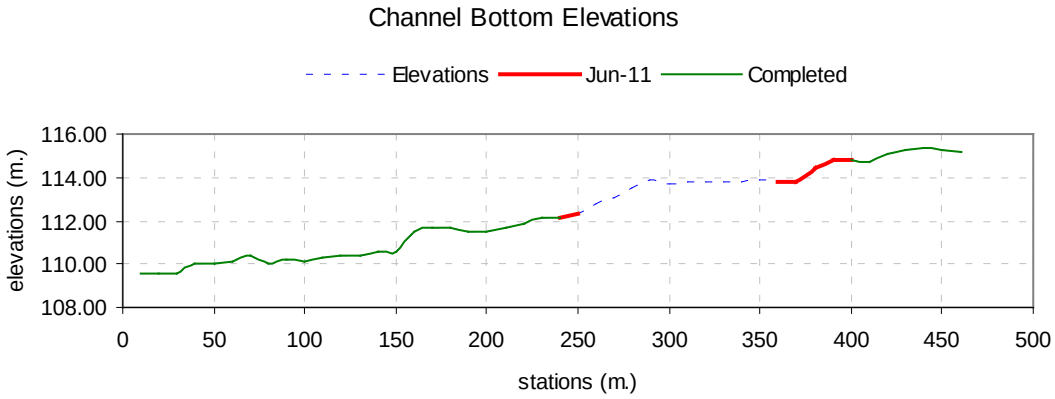
Downstream @ 0+470m.

Upstream @ 0+400m.

APPENDIX 4

Daily Progress Reports

June 11, 2011



07:30 – Begin Excavation @ 0+400m.

14:30 – Ground water elevation too high for continued excavation @ 0+360m
plan to start back at 0+250m. leaving roadway beside channel to get excavator off site after completion.

16:30 – Resume excavation @ 0+250m.

17:30 – Excavation complete to 0+260m.

Downstream @ 0+ 400m.

Upstream @ 0+360m.

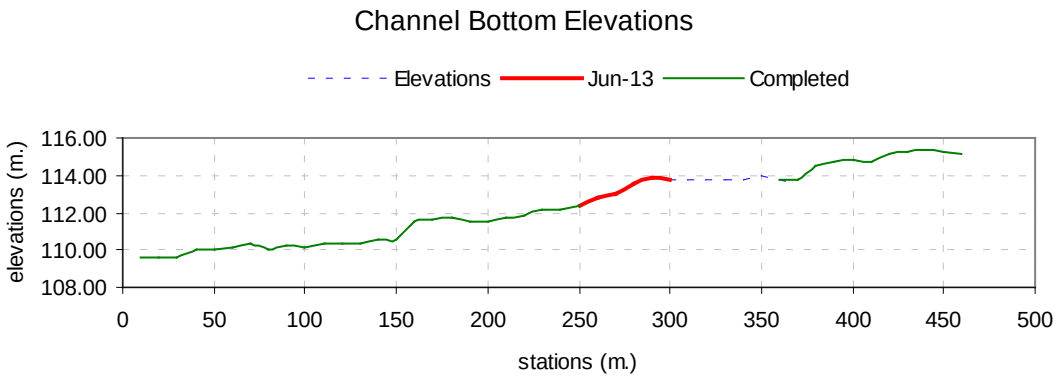
Upstream @ 0+250m.

Downstream @ 0+ 260m.

APPENDIX 4

Daily Progress Reports

June 13, 2011



07:30 – Begin excavation @ 0+250m.
10:30 – Excavating to ground water @ 0+270m.
17:30 – Excavation to 0+300m.

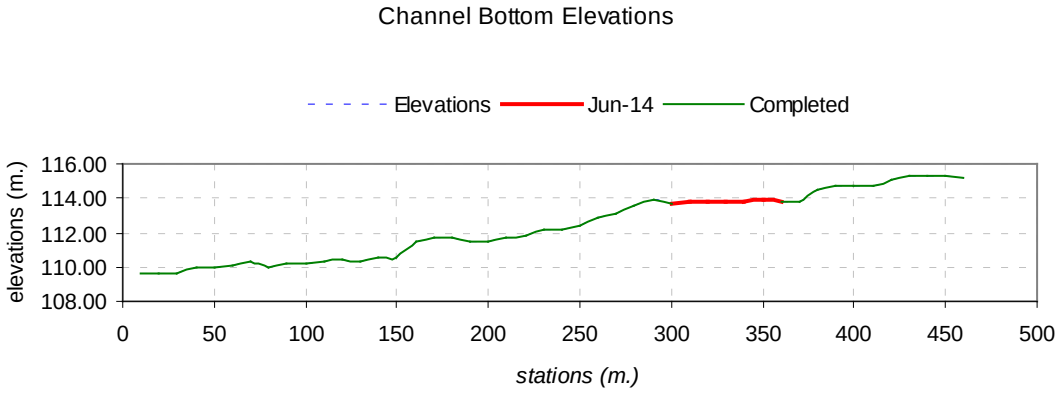
Upstream @ 0+250m.

Downstream @ 0+300m.

APPENDIX 4

Daily Progress Reports

June 14, 2011



07:30 – Begin excavation @ 0+300m.
15:30 – Excavation complete @ 0+360m.

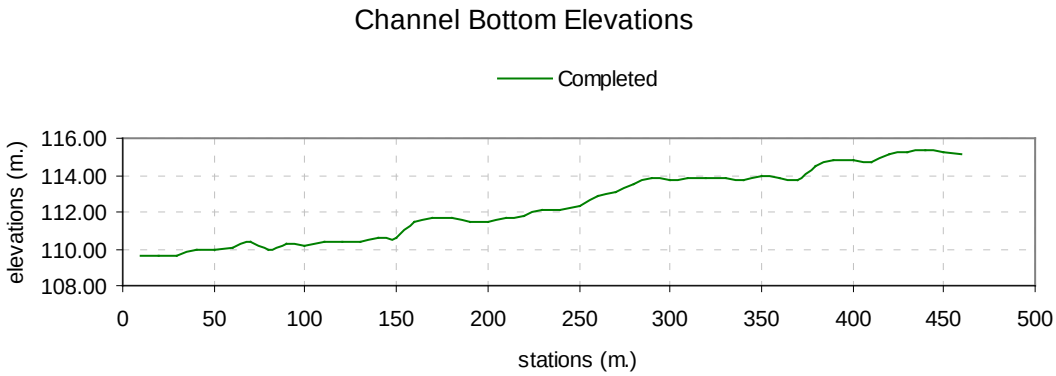
Upstream @ 0+300m.

Downstream @ 0+360m.

APPENDIX 4

Daily Progress Reports

June 16, 2011



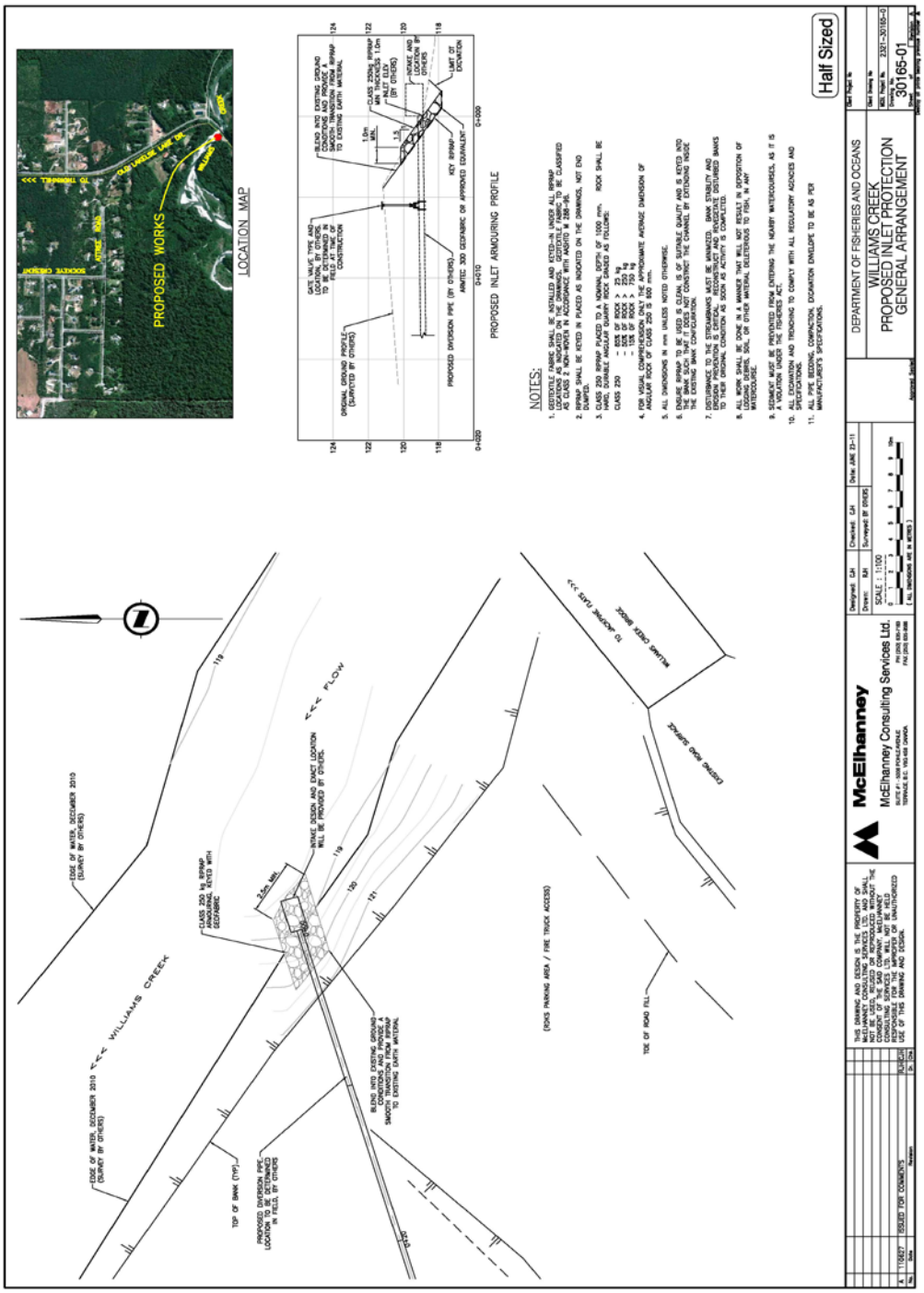
08:30 – Delivery of lock blocks to earthen dam @ 0+0m
13:30 – Constructio of undercut bank @ 0+305m.
15:30 – completion of undercut bank

Construction of Undercut Bank @ 0+305m.

Construction of Undercut Bank @ 0+305m.

Appendix 5

Williams Creek Proposed Inlet Location Dwg 30165-01 Rev



Appendix 6

Williams Creek Side Channel Asbuilt Dwg – June 2011

Appendix 7

Williams Creek Development Plan

McElhanney

WATER LICENSING: WATER DEVELOPMENT PLAN

WILLIAMS CREEK SPAWNING HABITAT DIVERSION CHANNEL, TERRACE, BRITISH COLUMBIA

Prepared for:

Fisheries and Oceans Canada
5235 A Keith Avenue
Terrace, BC V8G 1L2

Prepared by:

McElhanney Consulting Services Ltd.
Suite #1 5008 Pohle Ave.
Terrace, BC V8G 4S8

June 2011 2321-30165-0 Task 2000

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McElhanney

McElhanney

17.0 APPENDIX C – WATER DIVERSION INTAKE PIPE DESIGN

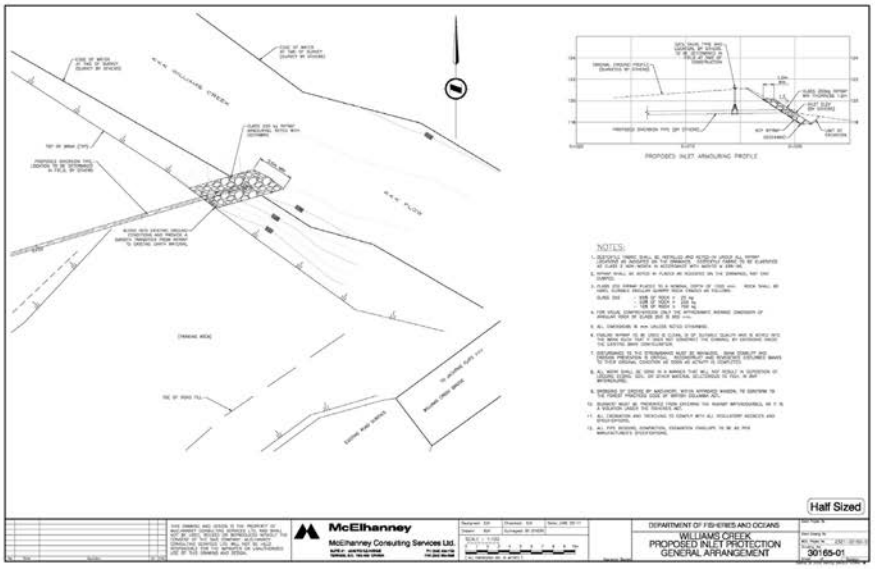

Figure 3. Construction drawings for the installation of the water diversion intake pipe.
McElhanney Consulting Services Limited, 2011.

1.0 INTRODUCTION

McElhanney Consulting Services Ltd. (MCSL) was retained by Fisheries and Oceans Canada to prepare the Water Development Plan as part of the Water License Application for the proposed diversion of water to improve spawning habitat on Williams Creek and Lakelse Lake, Terrace, BC. The Development Plan is required under the Ministry of Forests, Lands and Natural Resource Operations (MoFLNRO) *Water Act* because the intent is to divert more than 25,000 gal (94,635 L) of water.

In recent years, sockeye recruitment in the Lakelse system has fallen dramatically, due in part to reduced and degraded spawning habitat in the major spawning tributaries to Lakelse Lake (DFO, 2006). Sockeye fry recruitment is limited in Lakelse Lake and it is producing sockeye at well below potential production, as recent lake trophic studies indicate that the lake provides a favorable rearing environment for juvenile sockeye. Degraded or limited tributary spawning habitat, relative to historic levels, is believed to be restricting spawner access and spawning success (DFO, 2006). A recent sedimentation study of Williams Creek, the main sockeye spawning tributary, suggests that the causes of reduced spawning habitat are likely a combination of ongoing flood scouring each fall and continued sedimentation/siltation of historic spawning grounds from combined human (logging) and natural geological activity. Other tributaries are affected by flow diversions and beaver activity.

The Lakelse Sockeye Recovery Team (LSR Team) believes that spawning habitat enhancement maybe one of the most suitable options to increase fry recruitment to the lake. The LSR Team consists of representatives from various government agencies, community organizations and local First Nations. The team has embarked on a collaborative planning process aimed at identifying and addressing the causes of depressed sockeye escapements to Lakelse Lake. The Lakelse Sockeye Recovery Plan was completed in 2005 and outlined the status of stocks and habitat, identified limiting factors and prioritized potential projects that could begin to address those limiting factors. Year five of the top priority potential project candidates, the Lakelse Fry Outplant project is currently underway. The second highest priority is the Lakelse Spawning Channel/ Improved Spawning Habitat Project. This project will endeavor to systematically increase spawning habitat and the productive capacity of the Lakelse watershed over several years with the long term goal of providing quality spawning habitat to support 4-7 thousand adults in Scully Creek and 20-30 thousand adults in Williams Creek through a variety of projects.

Ministry of Environment (MoE) and Fisheries and Oceans Canada (DFO) require that work conducted in and around a watercourse must avoid harmful alteration, disruption or destruction of fish and fish habitat (HADD) (Ministry of Environment 2006a; Department of Fisheries and Oceans 1991). Both provincial and federal government agencies abide by a 'No Net Loss' guiding principle for fish habitat. As such, the quantity and productive capacity of the aquatic environment, including fish and riparian habitat at, and adjacent to any instream works, must be equivalent to or exceed that which existed prior to the commencement of works.

In addition, the Water Development Plan outlines the Best Management Practices (BMP's) for industry that will be used when working in or about a stream. It is intended to guide the construction manager, the contractor and the Environmental Monitor (EM) during the planned works, as well as, provide direction when unforeseen changes occur due to site specific conditions.

This report provides the Water Development Plan as part of the Water Licence Application for the proposed spawning habitat. The plan provides information on ecosystems, plants and wildlife potentially affected by the construction of a diversion channel and recommendations to ensure these abiotic and biotic values are protected. The recommendations contained within this report are, in the opinion of the author, sufficient to ensure the requirements of the MoE. These requirements are outlined under Section 9 of the *Water Act* (Changes In and About a Stream) and Part 7 of the *Water Act Regulations* (Ministry of Environment 2006a and 2006b). As well, these recommendations are sufficient to meet the 'No Net Loss' guiding principle of DFO (Department of Fisheries and Oceans 1991).

2.0 PROJECT LOCATION

The site of the proposed water diversion for spawning habitat enhancement on Williams Creek, Terrace BC was located immediately downstream of the Old Lakelse Lake Road bridge starting at the Regional District of Kitimat-Stikine fire pull-out (Figure 1). The intake pipe for the diversion would be situated on the left bank just downstream of the bridge while the channel restoration would utilize historic channels through the land on the left bank approximately paralleling the road (Figure 2). Williams Creek flows into Lakelse Lake at Grouchy's Beach. The proposed works was found within the Costal Western Hemlock (CWH) biogeoclimatic zone, specifically wet maritime subzone (CWHws1) (Ministry of Forests 1993).

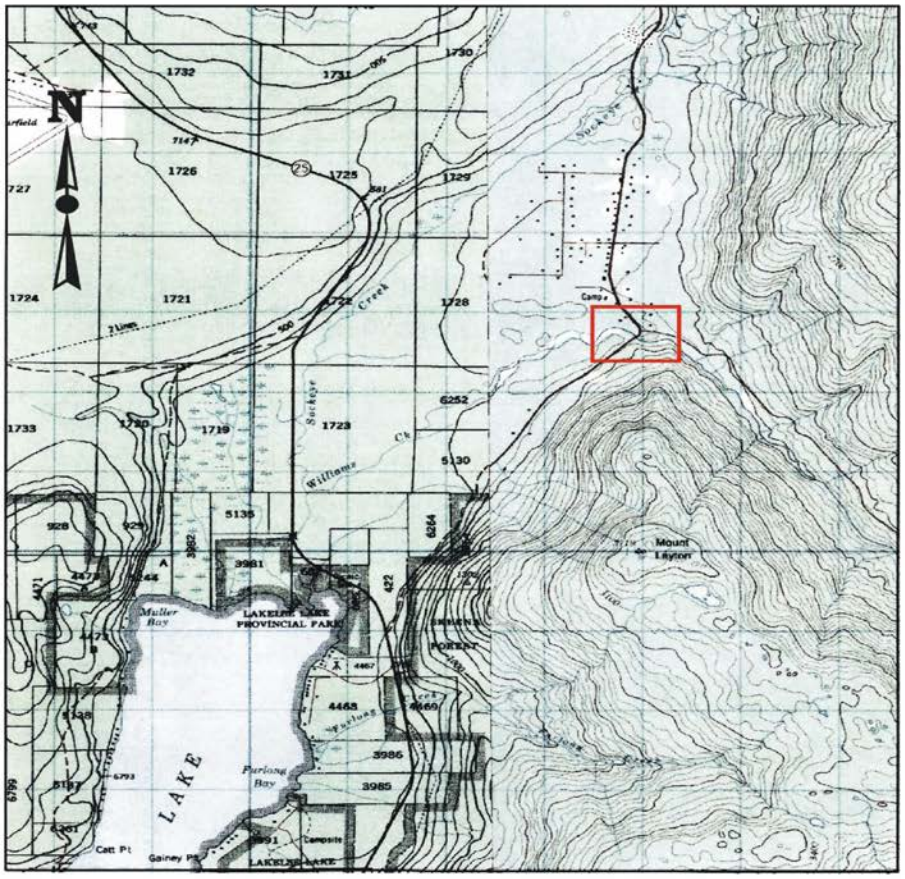

Figure 1: Project Site Location Map (general maintenance area boxed in red).

*SoftMap Plus Inc. (2001), map not to scale.

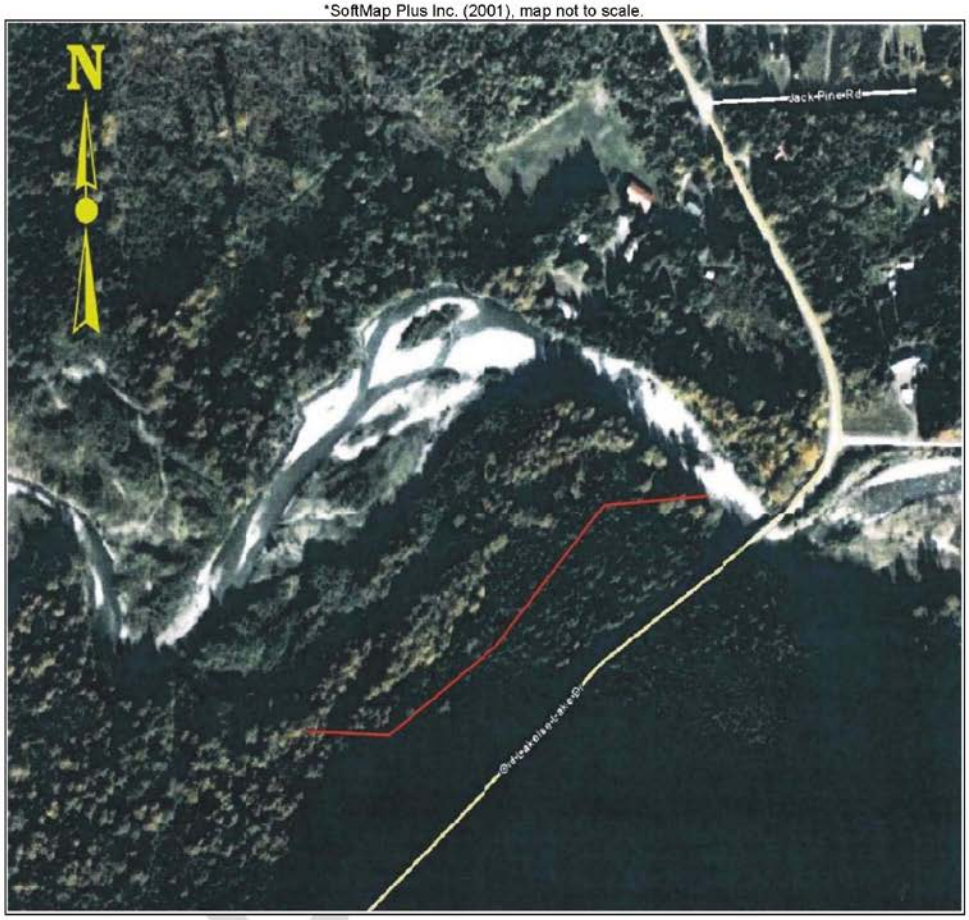

Figure 2: General overview of the proposed location of the Water Diversion route of the spawning channel.
*Google Earth (2011), map not to scale.

3.0 DESIGN ASPECT

This project was undertaken to meet the requirements of the *Water Act* and *Water Act Regulations* (Ministry of Environment 1996a, Ministry of Environment 1996b). As such, the data collected and methods used relate directly to those suggested in the *Users' Guide to Working In and Around Water* (Ministry of Environment 2007). The classification of a watercourse as a non classified drainage, S1 through S6 was based on definitions provided by the *Riparian Management Area Guidebook* (Forest Practices Code of British Columbia 1995).

For sampling purposes, the watercourse was divided into an 'upstream' portion and a 'downstream' portion. The upstream portion covered the area up to 100 m upstream of the upper end of the work location and will act as a control site for future reference assessments. The downstream portion of the work site covers the area from the upstream side of the work location to 300 m downstream.

The methodology used to undertake the fish and fish habitat assessment was adapted from the *Reconnaissance (1:20000) Fish and Fish Habitat Inventory: Standards and Procedures, version 2.0* (Resource Inventory Committee of British Columbia 2001). The assessment included recording: channel width measurements, and substrate and cover descriptions. Water quality parameters including pH, temperature and turbidity were measured where sufficient water was available.

Historical fish data for Williams Creek were obtained from the provincial Fisheries Information Summary System (FISS).

The information collected from background information and literature review were used to develop appropriate watercourse work plans. Plans were designed to meet the requirements of the *Standards and Best Practices for Instream Works* (Ministry of Environment 2004) and the requirements of DFO to ensure 'No Net Loss' of fish or fish habitat.

All survey information was provided by DFO, as such the engineered drawings for the proposed water diversion intake pipe that have been prepared by MCSL were based on the data that was gathered by a company other than ourselves.

Ecosystem, plant, wildlife and fish environmental values identified within the project area include species populations that have been identified as needing protection to sustain and encourage population growth within certain areas. These values are based on the Canadian Environmental Assessment Act (CEAA) Valued Ecosystem Components (VEC).

The resources that were consulted to determine species and ecosystems of concern that fall within the proposed water diversion channel development included:

- Species at Risk Act (SARA)

- The BC Conservation Data Center (CDC)
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
- Kalum Land and Resources Management Plan.

4.0 GEOTECHNICAL CONSIDERATIONS

The Sediment Source Mapping, Detailed Channel Assessment, and Reconnaissance Sediment Budget for Williams Creek for the Period 1949 to 2001 (2007) can be found in Appendix A. This document was prepared by Weiland Terrain Services and Fluvial Systems Research Inc, for Fisheries and Oceans Canada, BC Ministry of Forests, BC Timber Sales and Lakelse Watershed Society.

5.0 PROJECT RELATED CONSIDERATIONS

The diversion channel will be constructed within the historic floodplain of Williams Creek, on river left below the Old Lakelse Lake Road bridge. The proposed water intake, with an adjustable valve will be situated in Williams Creek in order to divert a minimum flow of 0.14 cubic meters per second (cms) or 5 cubic feet per second (cfs) into the channel year-round. Additional attraction flows of up to 1 cms or 35 cfs may also be utilised. Maximum diverted flows will never exceed 10% of existing flows in the mainstem. This channel will have approximate dimensions of 4 m base width and depth of 0.6 m. The sides will be angled sides with a slope of 2:1. Phase 1 of construction will involve excavation of a ground water channel. Natural gravel and cobble substrates found during test pit construction will form the channel bed. Only a small section of armouring is planned for the controlled flow channel where it comes close to an existing overflow channel of Williams Creek.

The side channel will have an armoured pool at the top end to dissipate energy where diverted water enters the constructed channel. Furthermore, due to spring freshet, there is the potential for flooding of Williams Creek but the selected channel location, in an area of mature forest, which is well flood-protected. Some additional protection at select locations may be created using excavated material and rock armouring as needed. Armouring specification will be addressed by the engineering component of this plan.

6.0 LAND RELATED ISSUES

The proposed works will be on Crown land. Other users in the area include a trapline (Interest ID 1314103), active quarrying (Interest ID 178083), a utility reserve (Interest ID 180196) and a request for an environment, conservation and recreation reserve has been submitted to the Ministry of Agriculture and Lands (Interest ID 2099795).

The Regional Districts fire pullout carries an Institution License ID 1364781.

An application for Crown land has been submitted.

7.0 WATER RELATED ISSUES

7.1 Water Quantity

Historical data for flow volumes was available from Mike Leggat's work in the area and the resulting hydrograph is from flow measurements taken during the snow free period in 2008 for Williams Creek (Figure 3 below). A Figure 4 and 5 is data taken from the hydrograph station at the mouth of Hirsch Creek.

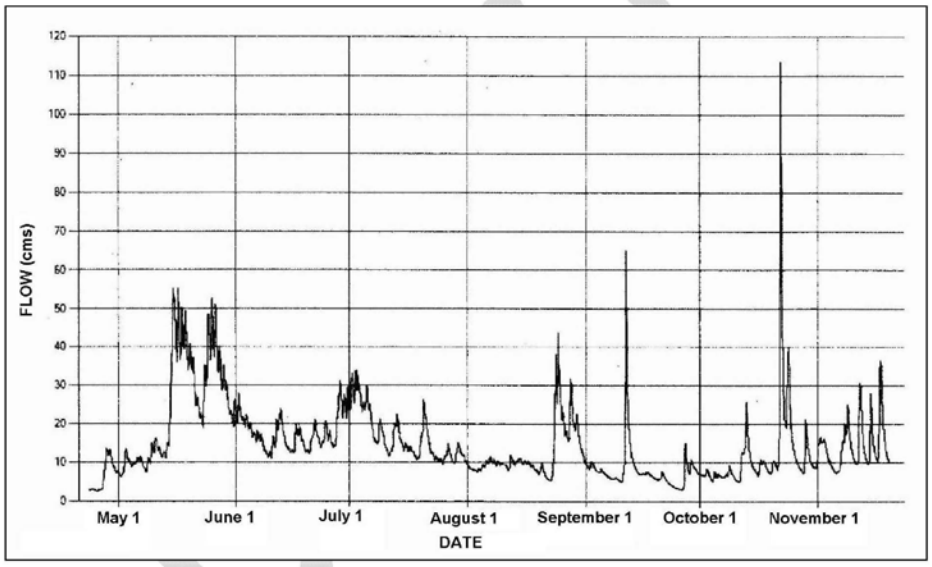

Figure 3. Hydrograph for Williams Creek from the snow free period in 2008.

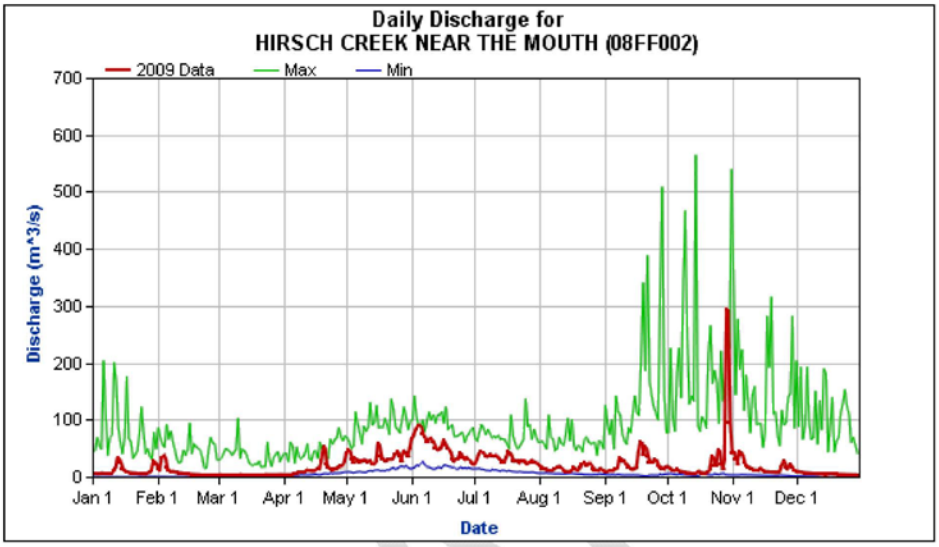

Figure 4. Hydrograph of daily measures from the mouth of Hirsch Creek in 2009.

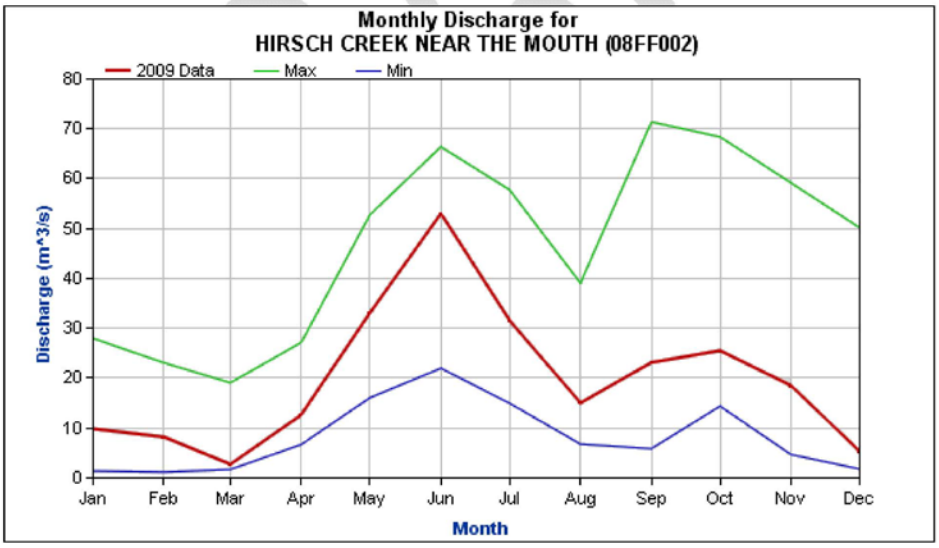

Figure 5. Hydrograph of monthly measures from the mouth of Hirsch Creek in 2009.

A test section of Williams Creek was measured on October 13, 2010 with an area of 3.4 m^2, approximately 8.5 m wide and 0.4 m deep. Three velocity tests were completed over 12 m with approximately 1% bed slope resulting in an average velocity of 0.5 m/s and discharge of 1.7 m^3/s. It should be noted that the streamslope was not measured; if it was only 0.5% the flows would be 1.7 m^3/s, so the assumptions would be the same. This work was done by DFO and Water Survey of Canada staff.

A hydrometric survey was completed on March 25, 2011 on Williams Creek at the Old Lakelse Lake bridge, by DFO and Water Survey of Canada staff. Method 0.6 was used with a perpendicular flow angle and no coefficient. The survey was completed within 10 m below the bridge and covered an area of 3.02 m^2 with a width of 9.10 m. The mean water velocity was 0.498 m/s and the discharge was 1.51 m^3/s. Flow rate was measured as 2.08 cms.

7.2 Water Quality

Water quality measurements were taken on February 27, 2008 within the Williams Creek watershed in the area along the main channel and the proposed channel; measurements included water temperature, percent saturation and dissolved oxygen (Table 1 below).

Table 1. DFO Water quality measurements from Williams Creek watershed on February 27, 2008*.

Location	Temp (°C)	Saturation (%)	Dissolved Oxygen (mg/L)	Comments
Test Pit 1	8.2	45	5.3	Proposed channel: 20 m N of flag at 0+620
LM Test Pit 1	8.6	50	5.9	Lower main channel: 8.5 feet for total length of pipe, 2.5 to 3 feet above ground.
LM Test Pit 2	8.8	57	6.5	Lower main channel: 8.5 feet for total length of pipe, 3 feet above ground.
LM Test Pit 3	8.7	45	5.4	Lower main channel: 7 feet for total length of pipe, 3 feet above ground.

*Data collected by DFO staff

Water quality data was also measured during a site visit on October 13, 2010 within a test ditch on Williams Creek below the Old Lakelse Lake Road bridge. Water temperature was measured as 9.1 °C (LANG) and 9.4 °C (MITCH) with 62% and 17% saturation and 7.1 mg/L and 2 mg/L for dissolved oxygen.

Water quality measurements on October 19, 2010, taken in a test ditch in the Williams Creek watershed, had a water temperature of 6.2 °C with 100% saturation and 12.4 mg/L for dissolved oxygen. The test ditch had values of 9.0 °C, 67% saturation and 7.7 mg/L.

7.3 Instream Requirements

7.3.1 Fisheries

The provincial Fisheries Inventory Summary System (FISS) database shows the following species present in the Williams Creek: Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*Oncorhynchus keta*), coho salmon *(Oncorhynchus kisutch),* sockeye salmon (*Oncorhynchus nerka*), cutthroat trout (*Oncorhynchus clarki*), Dolly Varden trout (*Salvelinus malma*), steelhead-ocean going RT *(Oncorhynchus mykiss*), rainbow trout (*Oncorhynchus clarki*), mountain whitefish (*Prosopium williamsoni*) and general sculpin (*Cottus* sp.).

The cutthroat trout and Dolly Varden trout are blue listed with the CDC.

Watercourse Summary
Watercourse Name: Williams Creek
Watercourse Type: S2
Instream Timing Window: N/A
Latitude and Longitude Co-ordinates: 54° 26.546' N and 128° 28.823' W
Construction Timing: Phase 1: Groundwater channel construction (no instream work) - late May to end of June, 2011
Phase 2: Channel finishing and intake installation (instream work component) - mid July to mid-September, 2011

Fish Habitat Summary:
Overall Fish Habitat: Good
Potential for Fish Presence: High

Historical Fisheries Information

The section of this watercourse from Lakelse Lake to the Old Lakelse Lake Road bridge, used to have good spawning habitat for sockeye (and other species) (documented in archival DFO files). Aerial photography dating from before the 1940's when compared to the same area in the 1990's showed large scale landscape changes due to logging in the watershed, especially within Reach 3 (in the vicinity of proposed diversion channel).

Reach 3 used to support sockeye spawning is highly unstable and dominated by braided channels, cobble-boulder substrate and a lack of riparian vegetation (BioLith, 1998). In the past 13 years since the BioLith report, however, I would note that the area is rehabilitating to some extent, somewhat less braided and regeneration of riparian vegetation (per comm Miller 2011).

Reach 3 likely still supports some limited (pockets) of spawning habitat for chinook, steelhead and coho as well as some rearing habitat, especially for species that prefer higher flows such as juvenile steelhead/rainbow trout and chinook. Also may support overwintering adult steelhead. Otherwise, it is more likely a migration route for species moving upstream and downstream to more suitable off-channel or tributary habitat (which is limiting).

Photograph 1. Reach 3: Immediately downstream of the Old Lakelse Lake Bridge, downstream view (DFO August 2005).

Photograph 2. Reach 3: Approximately 100 m downstream of the Old Lakelse Lake Bridge, upstream view (DFO August 2005).

Photograph 3. Reach 3: Approximately 100 m downstream of the Old Lakelse Lake Bridge, downstream view (DFO August 2005).

Photograph 4. Reach 3: Approximately 200 m downstream of the Old Lakelse Lake Bridge, upstream view (DFO August 2005).

Photograph 5. Reach 3: Approximately 200 m downstream of the Old Lakelse Lake Bridge, downstream view (DFO August 2005).

Photograph 6. Reach 3: Approximately 300 m downstream of the Old Lakelse Lake Bridge, upstream view (DFO August 2005).

Photograph 7. Reach 3: Approximately 300 m downstream of the Old Lakelse Lake Bridge, downstream view (DFO August 2005).

7.3.2 Recreational, Aesthetics and Cultural Uses

Through personnel communications with local individuals it has been determined that recreational activities on Williams Creek (i.e. kayaking) is confined to the upstream portion of Williams Creek, above the Old Lakelse Lake Road bridge. The bridge area is used as a 'take out' location for paddlers.

Aesthetically speaking, the diversion channel will be constructed in such a way that it blends into the natural surrounding.

There are no known cultural uses for this watercourse. The Kitselas First Nation has been informed of the proposed project and has no concerns. The Ministry of Forests has also been informed through DFO, with no response

7.4 Affected Water Users

There are no known water uses downstream of the proposed works (per comm S. Devcic 2011).

8.0 CONSTRUCTION ACTIVITES

8.1 Best Management Practices

Construction using the recommendations described below should have no serious impacts on the ecosystem, wildlife, vegetation, fish or habitat at the project site or downstream, satisfying the requirements of the Section 9 of the *Water Act* and Part 7 of the *Water Act Regulations* (Ministry of Environment, 2006a, 2006b) and the 'No Net Loss' requirements of DFO (Department of Fisheries and Oceans 1991).

Description of Proposed Works

Williams Creek is the main tributary to Lakelse Lake. The channel excavation will start approximately 650 meters southwest of the Williams Creek bridge on Old Lakelse Lake Road and will follow a relic side-channel that begins in the area downstream of the bridge on the south bank of Williams Creek. Access to the site follows previously disturbed paths across crown land, and should not require the removal of any trees. The channel is to be constructed from downstream to upstream.

The overall project is being developed as a multi-phase side channel development project on Williams Creek to create stable, off-channel spawning and rearing habitat for salmonids. The first phase was constructed in February 2009, and involved connecting a series of successful groundwater test pits together by excavating an open channel that tied into an existing wetted stream leading to Williams Creek. (The groundwater channel is in the vicinity of the proposed location for the new channel and provides some insight to the expected subsurface conditions.)

Due to the success of the first test channel constructed, the next stage of construction is to construct a longer, wider channel (3 m streambed), designed to provide spawning habitat and include features for holding and rearing.

A channel will be excavated approximately 3 m wide (at the streambed) and 700 m long starting from a natural groundwater channel and extending up to a proposed intake site near the Old Lakelse Lake Road bridge. The channel will have complexity added to it by constructing undercut banks, excavating rearing areas and adding boulder placements and large woody debris.

Specific details for the site include:

- Total possible length: 700 m
- Average width: 3 m (riffles~2 m, pools up to 6 m wide)
- 1 undercut bank every~150 m
- A minimum of 2 pools (with large woody debris structures)
- 2 riffles every 150 m.
- Also a meander every 50-100 m (this is not a straight channel).

Where necessary small berms are to be constructed to prevent flow from diverting onto depressions or areas not connected to the wetted channel. Riparian vegetation will be maintained as much as possible and excavated material will be placed adjacent to the channel where it will be allowed to revegetate naturally.

Timing
Construction is scheduled to occur for Phase 1: Groundwater channel construction (no instream work) - late May to end of June, 2011. Phase 2: Channel finishing and intake installation (instream work component) - mid July to mid-September, 2011, subject to approvals.

Pre-Construction Meeting
Prior to the start of the proposed works, a meeting will be held between DFO, the contractor and an EM to ensure that all parties are aware of the work plan and environmental practices to be followed.

Secondary Containment
Any gasoline powered equipment such as pumps and generators must be entirely enclosed or set within a secondary containment structure that is large enough to completely contain all harmful materials should a spill, leak or overflow occur.

Fish Salvage
Prior to the start of the intake pipe installation, a fish salvage might be required to remove all fish from the area, if logistically possible. If needed, a sediment curtain can be installed and maintained during the entire construction process to augment the isolation barriers in order to ensure fish do not re-enter the isolation area. Another option will be to conduct pre-work electro-shocking passes on a daily or hourly basis to keep fish away from the construction area, as required.

Cleaning of Vehicles, Equipment and Machinery Prior to Construction
Prior to the proposed works, all vehicles, equipment and machinery scheduled to work in and/or along a watercourse will be inspected and found to be clean, free of leaks and in good working condition. All foreign material must be removed, including dirt, mud, debris, grease, oil, hydraulic fluid, coolant or other substances that may negatively impact the water quality or the fish and fish habitat values of the watercourse at the crossing site or further downstream. All identified leaks must be repaired and then appropriately cleaned. Inspections, cleaning and/or servicing can occur either before the vehicle, equipment or machinery is transported into the field or can be conducted at the work site at a minimum distance of 100 m from the watercourse. All wash water runoff and/or harmful materials must be appropriately controlled to prevent entry into the watercourse including the riparian zone.

Construction Monitoring
During site works, onsite monitoring will be conducted for the duration of the water diversion installation. The major responsibilities of monitoring are to identify potential sedimentation and possible fluid leaks from vehicles, equipment and machinery that may not be observable to the

operator. A spill containment kit should be kept on site that is capable of handling twice the potential volume of a spill. Also, assist with any environmental issues, identify any emerging environmental issues, liaise with Regulatory Agencies as necessary, keep complete records and photograph documentation of works and inspections, monitor site clean-up and provide a post-construction monitoring report.

The monitor will liaise with government regulators to report details of site visits or any environmental concerns. If problems arise, they will be dealt with first on the ground to mitigate and minimize any identified impacts. Where impacts are outside the original scope of this plan, the intent will be to limit impacts to existing habitat and to ensure conditions are as good as or better than original conditions by the completion of the works. The monitor will have the authority to stop works if on-going operations are threatening this intent. Any events that result in impacts to fish and fish habitat will be immediately reported to DFO's PM and Environmental Advisor, in order to establish a single point for distribution of information.

Riparian Vegetation
During construction, care will be taken to disturb as little of the natural riparian vegetation along the banks and adjacent slopes as possible. Areas that are disturbed and are suitable will be revegetated as soon as possible.

Sedimentation and Erosion Control
All disturbed areas will be re-contoured to the natural pre-construction condition without causing excessive disturbance or creating large areas of exposed unstable soil. If required, temporary measures can be implemented to minimize potential erosion and sedimentation as well as aid in the re-establishment of natural vegetation. Disturbed areas will be allowed to naturally re-vegetate. A significant 'plug' of material will remain in place at the downstream end of the project between the constructed channel and fish habitat until any excessive erosion concerns are mitigated. When water is introduced to the channel through the intake, silt-laden water will be pumped away from the creek at the site of the 'plug' until water is of sufficient quality to be released into the downstream habitat.

Armouring
A general rip rapping prescription has been provided by MCSL, the drawings can be found in Appendix C. Due to the lack of survey data points and constricts on budget, specific rip rap sizing has been estimated, as well as depth and scour protection. Rip rap that is planned for the area around the intake in Williams Creek and the outlet of the pipe into the constructed channel. The remaining channel banks will be sloped, where possible to prevent erosion and boulders/cobble placed at the toe of slopes. Some erosion is expected in the new channel as it will be constructed to mimic a natural channel and will undergo natural stream processes as the water creates features such as pools and riffiles around placed rocks and large woody debris. We are not intending to create a channel that appears constructed and artificial. Armouring should consist of non-acid generating rock material ('rip rap'), that is cobble (64 to 256 mm) or preferably boulder (> 256 mm) sized and placed, at a minimum, along the bottom 1.5 m of the banks.

9.0 FUTURE MONITORING

Contractors are expected to leave the completed work area in a safe, clean and environmentally stable condition. Once the water intake installation is complete, the site should be revisited after high water levels in the spring to identify any sedimentation problems and determine the risk of erosion. If excessive sedimentation and/or erosion potential are identified, an EM should be consulted to assess the potential impacts to fish and fish habitat and provide additional recommendations.

DFO will have a long term monitoring plan in place to determine the success of the restoration project. This will include whether or not the channel is performing to expectations by the use of fish habitat. The surveys for the long-term monitoring will occur directly after the diversion channel is completed and after the first high water event. Monitoring will also occur during the first year after the completed works within the same month when the channel installation and following the subsequent high water event of that same year.

Monitoring for the diversion channel will include monitoring of fisheries values, fish habitat and the effectiveness of the mitigation measures and BMPs. Fisheries values include minnow trapping for juveniles and adult fish counts during spawning. Assessment of fish habitat will include analysis of the quantity and quality of spawning, rearing and over-wintering habitat during channel construction and post-high water events, and compare these results to the initial site assessment.

9.1 Monitoring of Fisheries Values

9.1.1 Minnow Trapping for Juvenile Fish Species

Minnow trapping for salmonid fry, as well as other fish species, known to occur within Williams Creek will occur post installation of the diversion channel and after the high water event following the completion of the works, and at the same times the first year following the completed works. Minnow traps will be set within the diversion channel, and upstream and downstream within the main stem of Williams Creek for a period of twenty-four hours. Traps will be set within a variety of habitats within each of these areas with a focus on deep pools, shallow areas and rubble/riffle areas. Monitoring of fish species will assist in the determination of the effect of the channel construction on juvenile presence/absence and as another metric to indirectly assess the effect on rearing habitat.

9.1.2 Spawning Adult Fish Counts and REDDs

Monitoring surveys will be completed to determine changes in the number of adult salmonid species utilizing the compensation area after the dredging works. These surveys will consist of two components: adult fish counts and observations and measurements of redds. Fisheries inventory data indicates that three species of salmon occur in Williams Creek: coho, steelhead and sockeye.; other species within this watershed include prickly sculpin, rainbow trout and Dolly Varden. It has been determined that there is minimal spawning by pinks actually occurring with few redds due to a lack of suitable spawning habitat. Local knowledge indicates that coho

spawn October to December, steelheads are spawning in late May early June and cutthroat trout spawn February to May. Since their lifecycle is such that populations can fluctuate every four years, monitoring surveys will have to be completed both in the first, second and fourth years following the completed diversion channel. The surveys to count adult coho and sockeye and observe for redds will assist in determining the effect and success of the diversion channel.

9.2 Fish Habitat

Fish habitat was assessed prior to the diversion channel works; monitoring surveys will be completed post construction and after the high water event the same year, and at the same times in the first year following the completed works.

Monitoring of fish habitat will include measurements of the quantity and quality of micro-habitats, water quality measurements and physical watercourse data. These surveys will occur within the area dredged, the compensation area and both upstream and downstream of these two locations. Assessments of micro-habitats will include estimates in the amount of available spawning, rearing, over-wintering and refugia habitat and comparisons to pre-diversion channel numbers. Water quality parameters include pH, turbidity and temperature. Physical watercourse data includes channel wetted width, gradient, depth, large woody debris, substrate type and cover distribution. Photographs will be taken to document each sub reach and cross-sections and the temporal and spatial changes for the dredged area and compensation area, as well as the surrounding habitat.

10.0 RELATED CONSIDERATIONS

10.1 Archaeological Assessment

Prior to the start of works; the engineer and contractor will discuss the procedure for dealing with the uncovering of any archeological or paleontological items.

10.2 Environmental Monitors

Prior to the start of construction, a meeting should be held between the client and contractor to ensure that all parties are aware of the work plan and environmental practices to be followed. The EM will address any new environmental issues that may arise and document construction activities.

Contact numbers for resources associated with the project are listed below:

Players	Contact	Title	Phone Number	Cell Number
DFO	Sandra Devcic	Resource Restoration Engineer	250 615-5363	250 638-6941
DFO	Lana Miller	Environmental Advisor	250 847-4892	250 615-7619
MoE	Emily Bulmer	Environmental Biologist	250 847-7350	N/A
MCSL	Chris Houston	Engineer	250 635-7163	N/A
MCSL	Patty Burt	Senior Biologist	250 635-7163	250 641-2462
Provincial Emergency Program	1-800-663-3456			

The major responsibilities of the EM are to:

- monitor the installation and effectiveness of any containment structures;
- ensure compliance with any Environmental Management Plan;
- assist with any environmental problems;
- identify any emerging environmental issues;
- if necessary, issue a stop work order to investigate any perceived impacts;
- record detailed notes and observations, including photographs and inspections;
- provide a post-construction monitoring report.

The EM will liaise with the contractor and if issues arise, they will be dealt with first on the ground to mitigate or arrest any identified impacts. The intent will be to limit impacts to existing habitat and to ensure conditions are as good as or better than original conditions at the end of the project. Any events that result in an impact to habitat will be reported to the appropriate agencies within 24 hours.

10.3 Other Environmental Considerations

Background information was collected from literature reviews and various digital and hardcopy sources pertaining to environmental values for ecosystems, plants, wildlife and fish values within the project area. Red and blue listed species were the focus for concerns associated with construction of the diversion channel.

10.3.1 Rare and Endangered Ecosystem Complexes

There are 10 rare and endangered ecosystems listed with the CDC that could occur in the study area, located on the historic floodplain of Williams Creek. The *Lemus mollis* ssp. *mollis* – *Lathyrus japonicas* (unclassified site series), *Picea sitchensis/Rubus spectabilis* Wet Submaritime 1 (site series 07) and *Pinus contorta/Arctostaphylos uva-ursi* (site series 08) are red listed while the other 7 are blue listed (Table 1 in Appendix B).

10.3.2 Rare and Endangered Plant Species

There are 9 species of vascular plants listed with the CDC that could occur within the Kalum Forest District. The stalked moonwart (*Botrychium pedunculosm*) has red status while the remaining 8 are blue listed (Table 2 in Appendix B). SARA and COSEWIC do not list any of the 9 vascular plants. The bog rush is seasonally submergent and grows in fine-textured and wet soils. Other listed plants have ecologies associated with undisturbed conditions or subhydric moisture regimes associated with wetlands. Given the site history and the preservation of the surrounding vegetation, there is little or no risk that any of the other listed plants identified as occurring in the Kalum Forest District would be threatened by the planned development of the diversion channel.

10.3.3 Rare and Endangered Wildlife

Wildlife

The 3 mammal species that are blue listed with the CDC for this area are the grizzly bear (*Urus arctos*), fisher (*Martes pennanti*) and wolverine (*Gulo gulo luscus*) (Table 3 in Appendix A). Both the Grizzly Bear and the Wolverine are listed as 'Special Concern' with SARA and COSEWIC, while the Fisher fails to be listed by both agencies. In addition to these species, ungulate winter range has been identified by the Kalum Land and Resource Management Plan (KLRMP) as wildlife habitat of concern.

All three of the listed species tend to avoid human contact. Given that the diversion channel is directly adjacent to an existing populated area and several roads, the risk of disturbing these species is very limited. However, habitat specific features known to appeal to these species, such as large cottonwood (fisher denning), skunk cabbage (spring grizzly foraging), salmon spawning (fall grizzly foraging) and wintering ungulate populations (wolverine scavenging) potentially occur in the area. Furthermore, moose winter range has been identified within the Kitimat River and Skeena River watersheds, therefore it is likely there is moose winter range within the project footprint.

Migratory Birds

There were 5 species of migratory birds that are listed with the CDC. The marbled murrelet (*Brachyramphus marmortus*) has a red status while the other 4 are blue listed (Table 3 in Appendix B). The murrelet is considered 'Threatened' by both SARA and COESWIC, while the Band-tailed Pigeon (*Patagioenas fasciata*), Great Blue Heron (*Ardea herodias fannini*) and the Screech Owl (*Megascops kennicottii kennicottii*) are of 'Special Concern' with both agencies.

In order to address nesting migrants there are two options. If harvesting is required, it should be completed prior to May 1 to ensure no nesting migrants will be disturbed. If delays are encountered and the wood is not removed by May 1, a breeding bird survey will be completed to determine if nesting has initiated and whether it involves migrants. If so, site specific protections, such as no disturbance buffers, will be used. If several nests are identified, there is a potential that harvesting would be delayed until after fledging has occurred (approximately July 15).

Of the listed species, there is very little risk that the proposed development would have any impact on the majority of the avian species. Goshawks nest in large, uninterrupted mature to old growth stands; the project is located approximately 150 m from Old Lakelse Road and a habituated area and consists of floodplain ecosystem. Herons tend to nest in large trees and usually in colonies; no suitable trees were identified anywhere in the development area. The marbled murrelet nests primarily in large trees within 50 km of the ocean. Although this area is approximately 50 km from Kitimat Arm, it does not likely contain any suitable nest trees. The breeding habitat for the olive-sided flycatcher is within coniferous forests; the project area is situated within a floodplain mixed forests and therefore this species should not be affected. Sooty grouse habitat is located within coniferous and mixed forests; this species likely occurs within the project area and could potentially be affected by the construction of the diversion channel. Rusty blackbirds nest within coniferous forests and muskeg in a tree or dense shrub, usually over water. This species could potentially be affected by the construction of the diversion channel. Barn swallow nests in buildings and other human-made structures; therefore the diversion channel is unlikely to affect this species. The screech owl prefers open fields or mixed forest stands, only the latter of which occurs in the area. Finally, the band-tailed pigeon forages locally almost exclusively along the rail bed, approximately 10 km east of the diversion channel site.

Amphibians

The Coastal Tailed Frog (*Ascaphus truei*) is a blue listed amphibian with the CDC (Table 3 in Appendix B). This amphibian is on the 'Special Concern' list with both SARA and COSEWIC.

Tailed frogs live in and adjacent to cold, high gradient streams. The juvenile stage lives amongst the cobble in the stream bed while the adult forages on the water's edge and in

decaying wood near riparian areas of those streams. Furthermore, tailed frogs tend to inhabit non-fish bearing streams due to predation on juvenile tadpoles.

The diversion channel development area does not contain any suitable habitat for tailed frogs, although the main stem of Williams Creek does provide the appropriate habitat characteristics, but does have resident fish.

11.0 SUMMARY AND CONCLUSION

MCSL is pleased to offer this Water Development Plan as part of the Water License Application for the proposed Williams Creek Spawning Habitat Diversion Channel.

The information that has been provided, the author believes is sufficient for MoFLNRO to proceed with granting DFO the required Water License. If more information is required, please contact the undersigned at 250 635-7163.

Regards,

Patty Burt, B.Sc.H., R.P. Bio., P. Biol.
Senior Project Manager
McElhanney Consulting Services Ltd.

Chris Houston, P. Eng
Project Manager

12.0 GENERAL RECOMMENDATIONS REGARDING WORKS IN AND AROUND A WATERCOURSE

13.1 Fisheries and Oceans Canada / Ministry of Environment

- All projects that occur in and around a water body and may potentially impact fish and/or fish habitat should be reviewed and approved by DFO and the MoE prior to the commencement of works. Depending on the nature of the project, the works will either be covered by the Operational Position Statement or will require review and/or approval through a DFO Letter of Authority. As well, the submission of a Section 9 application under the Water Act to the MoE would either be a Notice or reviewed for approval.
- All mitigation measures and/or compensation must be implemented to the satisfaction of DFO and MoE.
- All changes in plans, specifications, or operating conditions that have the potential to adversely affect fish or fish habitat should be re-submitted to DFO and MoE for review and approval in writing prior to implementation.

13.2 Machinery and Equipment

- All gasoline powered equipment such as pumps, generators and associated fuel should be stored entirely within a secondary containment structure area located at least 100 m from a watercourse. Containment should have 110% capacity relative to the volume of fuel being stored and be large enough to completely contain all harmful materials should a spill, leak or overflow occur. Trucks carrying large fuel containers should be parked within the containment area.
- Prior to entering within 100 m of a watercourse, all equipment and machinery scheduled to work in and/or along a watercourse should be inspected and found to be clean, free of leaks and in good working condition. As such, all equipment and machinery should have all foreign material removed including dirt, mud, debris, grease, oil, hydraulic fluid or other substances that may impact the water quality or the fish and fish habitat values of the watercourse. As well, all identified leaks will be repaired and then appropriately cleaned. Such inspections, cleaning and/or servicing can occur either before the equipment or machinery is transported into the field or at the work site. Any cleaning and/or servicing of equipment and machinery at the work site should not be conducted in or along a watercourse. Rather, all such works should occur at least 100 m from the watercourse with any runoff controlled to ensure wash materials and/or other substances do not enter the riparian zone or the channel of the water body.
- Machinery and equipment should not be located within the riparian zone or at a minimum of 10 m from the channel, to maintain an undisturbed vegetation buffer along the edge of the watercourse.

12.3 Construction

- All work activities should meet or exceed the construction standards outlined in 'Standards and Best Practices for Instream Works' (Ministry of Environment 2004).
- During construction, onsite monitoring will be conducted to identify potential sedimentation and possible fluid leaks from vehicles, equipment and machinery that may not be observable to the operator.
- An emergency spill response kit should be on site at all crossing locations prior to construction. The containment kit should be large enough to handle twice the maximum spill possible.
- Every reasonable effort should be made to minimize the duration of instream work within the proposed schedule of construction. Downstream flow should be maintained at all times.
- Disturbance to the bed and banks of the stream should be minimized and confined to the immediate work site. Any stream banks and approaches to the watercourse disturbed by any activity related to the work project should be stabilized, re-vegetated and reclaimed as soon as possible.
- Effective, short term and long term sediment and erosion control measures should be installed before starting work to prevent the entry of sediment into the watercourse. These measures should be inspected regularly during construction and afterwards to ensure that they are functioning properly and are maintained and/or upgraded as required until vegetation has been re-established on the disturbed area. Sediment should not be released into any waters frequented by fish.
- All spoil materials from construction activities should be deposited, whether temporarily or permanently, above the high water mark of the water body and in such a manner that does not allow entry into the riparian zone or the channel of any water body.
- Where water is pumped from fish habitat, water intakes must be appropriately screened according to DFO's 'Freshwater Intake End of Pipe Fish Screen Guideline' (1995) in order to prevent the entrainment or impingement of fishes during pump operation. Gasoline powered pumps or generators and associated fuel must be enclosed or set within secondary containment large enough to contain all harmful materials should a spill, leak or overflow occur.
- Should the need for dewatering arise, water should be released into a well vegetated area or settling basin and not directly into the watercourse. Water returning to the watercourse should be equal to or exceed the background water quality of the watercourse.

12.4 Reclamation

- All disturbed areas should be reclaimed. Reclamation measures can include use of geotextile fabrics, matting, sandbags, barriers or fences, as well as seeding and planting of disturbed areas with native vegetation.
- Good housekeeping should be practiced with all temporary structures and any equipment or materials associated with construction should be removed following construction completion.
- The bed and bank should be returned to their original pre-construction configuration. Any equipment involved in reclamation activities and operating near any watercourse should be free of external grease, oil, mud or fluid leaks. All fuelling, lubricating and servicing (including repairs and maintenance) of equipment and machinery should be conducted at least 100 m from a water body to ensure that deleterious substances do not enter any watercourse.
- Once construction and reclamation are complete, the bed and banks of the channel at the crossing site should be revisited after high water levels in the spring to identify any sedimentation problems and determine the risk of erosion. If excessive sedimentation and/or erosion potential are identified, additional recommendations maybe required.

13.0 GLOSSARY OF TERMS

Average Channel Width	Six measurements taken within the assessment area, from top of left bank to top of right bank, at right angles to waterflow and excluding vegetated islands. Banks are defined as the lowermost extent of permanent rooted terrestrial vegetation.
Average Wetted Width	Six measurements within the assessment area of water surface at right angles to the waterflow.
Bankfull Depth	Depth from the top of the bank to the channel bottom at crest of a riffle-pool. It is measured using a line drawn from the top of the left to the top of the right bank. A meter stick is then used to measure the distance from the string to the channel bottom at the crest of a pool-riffle.
Bankfull Width	Channel width between the tops of the most pronounced banks on either side of a stream reach
Bank Height	Elevation from surface water level to level of bankfull width
Boulder	Channel substrate > 256 mm in size.
Channel Morphology	Structure and form of a stream channel.
Channel Width	The distance across a stream or channel as measured from bank to bank near bankful stage.
Clay	Channel substrate < 0.002 mm in size.
Cobble	Channel substrate 64 to 256 mm in size.
Confinement	Degree to which the lateral movement of a river channel is limited by relic terraces or valley walls.
Crown Closure	The percentage of stream-side riparian vegetation that projects over the stream channel and is higher than 2 m above the water surface. This is estimated from ground survey.
Deep Pool	Pool of water within a watercourse with a residual depth greater than 50 cm that may provide potential overwintering habitat for fish.
Fines	Channel substrate < 2 mm in size.
Fisheries Inventory Summary System (FISS)	Stores fish and fish habitat data derived from various data collections within British Columbia.
Gradient	The slope or rate of drop per unit of land of the channel bed.
Gravel	Channel substrate 2 – 64 mm in size.
Left Bank	The bank on the left side of the watercourse when viewed downstream.
Organic	Partially decomposed animal and/or plant materials.
Residual Pool Depth	Difference between the maximum pool depth and the riffle crest depth. Measurements taken in six pools.
RIC Standards	Standards set by the BC Fisheries Information Service Branch for the Resources Inventory Committee as set in the *Reconnaissance (1: 20 000) Fish and Fish Habitat Inventory: Standards and Procedures* (April 2001).
Right Bank	The bank on the right side of the watercourse when viewed downstream.
Sand	Channel substrate 0.06 to 2 mm in size.

Silt	Channel substrate 0.002 to 0.06 mm in size.	
Stage	State of current discharge, amount of water passing through the channel at time of observation.	
Stream Cover	Any structure in the wetted channel or within 1 m above the water surface that provides hiding, resting, or feeding places for fish.	
Watercourse Classification	**S1**	Fish are present and the watercourse is >20 m wide.
	S2	Fish are present and the watercourse is >5 to 20 m wide.
	S3	Fish are present and the watercourse is 1.5 to 5 m wide.
	S4	Fish are present and the watercourse is <1.5 m wide.
	S5	Fish are not present and the watercourse is >3 m wide.
	S6	Fish are not present and the watercourse is < or equal to 3 m wide.
Wetland	Transitional lands between terrestrial and aquatic systems, where the water table is usually at or near the surface or the land is covered by shallow water.	
Wetted Width	Width of the wetted portion of the stream channel.	

14.0 REFERENCES

B.C. Ministry of Forests. 2002. Fish-stream crossing guidebook. For. Prac. Br., Min. For., Victoria, B.C. Forest Practices Code of British Columbia guidebook.

Canadian Environmental Assessment Act. www.ceaa-acee.gc.ca.

Conservation Data Center. www.env.gov.bc.ca/atrisk

Committee on the Status of Endangered Wildlife in Canada. www.cosewic.gc.ca

Department of Fisheries and Oceans, 1991: Canada's Fish Habitat Law. Ottawa, Ontario.

Department of Fisheries and Oceans, 1995: Freshwater Intake End-of-Pipe Fish Screen Guidelines. Ottawa, Ontario. Cat. No. Fs 23-270/1995E.

Devcic, Sandra, 2011. Personnel Communications.

Douglas, G.W, Del Meidinger and Jenifer L. Penny. 2002. Rare Native Vascular Plants of British Columbia. Province of British Columbia

McPhail, J.D. 2007. The Freshwater Fishes of British Columbia. The University of Alberta Press. Edmonton, Alberta.

Google Earth, 2011.

Miller, Lana, 2011. Personnel Communications.

Ministry of Environment, 2004: Standards and Best Practices for Instream Works. Water Stewardship Division. Victoria, British Columbia.

Ministry of Environment, 2006a: Water Act. Victoria, British Columbia.

Ministry of Environment, 2006b: Water Act Regulations. Victoria, British Columbia.

Species at Risk Act. www.sararegistry.gc.ca.

SoftMap Plus Inc., 2001: British Columbia Topo50. SoftMap Technologies Inc. Quebec, Quebec.

Resource Inventory Committee, 2001: Reconnaissance (1:20000) Fish and Fish Habitat Inventory for British Columbia: Standards and Procedures. 2001.

Weiland, I and Steve Bird. 2007. *Detailed Channel Assessment, and Reconnaissance Sediment Budget for Williams Creek for the Period 1949 to 2001*. Prepared for DFO, MoF, BCTS and the Lakelse Watershed Society.

15.0 APPENDIX A – SEDIMENT REPORT

16.0 APPENDIX B – CDC SEARCH RESULTS

Table 1. List of Rare and Endangered Ecosystem Complexes.

Scientific Name	Common Name	Biogeoclamatic Zone	BC Status CDC
Abies amabilis – Thuja plicata / Gymnocarpium dryopteris	Amabilis fir – western redcedar / oak fern	CWHws1/04	Blue
Abies amabilis – Thuja plicata / Oplopanax horridus Moist Submaritime	Amabilis fir – western redcedar / devil's club Moist Submartime	CWHws1/06	Blue
Carex limosa – Menyanthes trifoliate / Sphagnum spp.	Shore sedge – buckbean / peat-mosses	CWHws1/Wb13	Blue
Leymus mollis ssp. mollis-Lathyrus japonicas	Dune wildrye-beach pea	CWHws1	Red
Menyanthes trifoliate – Carex lasiocarpa	Buckbean – slender sedge	CWhws1/Wf06	Blue
Picea sitchensis / Rubus spectabilis Wet Submaritime 1	Sitka spruce / salmonberry Wet Submaritime 1	CWHws1/07	Red
Pinus contorta / Arctostaphylos uva-ursi	Lodgepole pine / kinnikinnick	CWHws1/02	Red
Populus balsamifera ssp. trichocarpa-Alnus rubus / Rubus spectabilis	Black cottonwood-red alder/salmonberry	CWHws1/08	Blue
Thuja plicata-Picea sitchens / Lysichiton americanus	Western redcedar-Sitka spruce/skunk cabbage	CWHws11/11	Blue
Tsuga heterophylla – Pinues contorta / Pleurozium schreberi	Western hemlock – lodgepole pine / red-stemmed feathermoss	CWHws11/03	Blue

Table 2. List of Rare and Endangered Plant Species.

Scientific Name	Common Name	Habitat (Douglas et al. 2002)	BC Status CDC
Botrychium pedunculosm	Stalked moonwort	Occurs in moist to wet meadows and margins of willow thickets in the montane zone.	Red
Eleocharis kamtschatica	Kamchatka spike-rush	Occurs in wet meadows and bog margins in the lowland zone. Rare on the north coast.	Blue
Epilobium hornemanni ssp. behringianum	Hornemann's willowherb	Occurs on wet rocks, cliffs, streambanks in low to subalpine elevations.	Blue
Epilobium leptocarpum	Small-flowered willowherb	Occurs in moist meadows and streambanks in the montane to alpine zones.	Blue
Juncus stygius	Bog rush	Found in very wet, calcareous, sedge-dominated areas in full sun. Occurs in bogs, marshes, shallow pools and patterned peatlands.	Blue
Malaxis brachypoda	White adder's-mouth orchid	Found in moist forests, mudflats, fens and streambanks in the lowland and montane zones.	Blue
Malaxis paludosa	Bog adder's-mouth orchid	Occurs in open, acidic, sphagnum bogs, very wet forests; and occasionally along stream edges on peaty mud and among grasses.	Blue
Pinus albicaulis	Whitebark pine	Occurs in the highest elevation, making the tree line.	Blue
Poa eminens	Eminent bluegrass	Occurs in coastal marshes and gravelly beaches in the lowland zone.	Blue

Table 3. List of Rare and Endangered Wildlife including Birds and Fish.

Scientific Name	Common Name	Habitat	BC Status CDC
Accipiter gentillis laingi	Northern goshawk	Wide ranging, breeding habitat is mainly within mature to old growth stands. Forages during short flights alternated with brief prey searches from perches. Also hunts by flying rapidly along forest edges, across openings, and through dense vegetation.	Red
Ardea herodias fannini	Great blue heron	They are colonial and return nesters. Nests are located and overlooking shorelines of oceans, marshes, wetlands, lakes and river areas.	Blue
Ascaphus truei	Coastal tailed frog	Tailed frogs are found within cold, fast flowing, and permanent streams with coarse substrates.	Blue
Brachyramphus marmoratus	Marbled murrelet	A seabird that comes ashore to nest in old-growth conifers on large, flat mossy branches. Nesting usually occurs within 30 km of the ocean.	Red
Contopus cooperi	Olive-sided flycatcher	They like coniferous woods and will perch on high branches to catch insects	Blue
Dendragapus fuliginosus	Sooty grouse	A large grouse that inhabits conifer and mixed forests.	Blue
Euphagus carolinus	Rusty blackbird	Nests in trees or shrubs adjacent to watercourses and non-breeding habitat consists of wooded wetlands and riparian areas, the latter of which is found at both locations.	Blue
Gulo gulo luscus	Wolverine	Wolverines prefer remote diverse forest areas and have large home ranges.	Blue
Hirundo rustica	Barn swallow	The barn swallow prefers open areas near water, they stay close to the nest and will reuse existing nest sites.	Blue
Martes pennanti	Fisher	Fishers have a large home range and den in large diameter trees (>0.35 to 0.40 m), preferable to cottonwoods with core rot.	Blue
Megascops kennicottii kennicottii	Western screech-owl	This owl likes open foraging ranges with adequate roosting sites, mostly in mixed forests near a water source.	Blue
Oncorhynchus clarkii	Cutthroat trout	Cold water species, the habitat requirements is influenced by life-history type and presence/absence of other species.*	Blue
Patagioenas fasciata	Band-tailed pigeon	Recently new to the area, exclusively tied to the existing the rail lines.	Blue
Salvelinus confluentus	Bull trout	Cold water species, the habitat requirements is influenced by life-history type and presence/absence of other species.*	Blue
Salvelinus malma	Dolly Varden trout	Anadromous or resident in freshwater, autumn stream spawners.*	Blue
Ursus arctos	Grizzly bear	Wide ranging, distinctive seasonal selections for foraging; spring found in low elevation and south exposure. Close to fish areas in the fall and hibernate at the toe of talus slopes in the winter.	Blue

*McPhail, 2007

Appendix 8
Scully Creek Flow Diversion Memo – D Hjorth

GRAYWOLF RESOURCES INC.
DON HJORTH, P. ENG.

1584 KENWORTH STREET
TERRACE B. C. V8G 3Y5
CANADA

TEL/FAX 250-638-8063

e-mail: drh@citywest.ca

December 3, 2010

DFO 10 12 01

DFO Resource Restoration Engineer
Terrace, B. C. Hand Delivery

Attn: Sandra Devcic P. Eng.

Re: ENGINEERING INSPECTION OF POSSIBLE DIVERSION SITES ON SCHULEBACHAND ("Scully") CREEK

As result of our field trip to a potential diversion site at Scully Creek and subsequent reviews of proposals advanced since 2001, I am confirming the following points as discussed in our last phone call (2010 12 07).

1, There has been extensive erosion at the site, possibly because of ice and/or log jamming.
2. The site we discussed briefly on 2010 12 03 that is located approximately 100 meters upstream should be disregarded as a future diversion point.
3. The only viable alternative left that will provide a safe site is the original 2004 proposal: that is located much further upstream and is set on bedrock. Estimated very approximate cost is $1,500,000. Until an exploratory drilling program can be completed and the results analysed, not even a class "D" estimate will be made. A drilling program will cost approximately $ 60,000 to $70,000.

At present, North Coast DFO Restoration Unit has done no construction work in the upper main Scully channel and proposes for that section, in future, any in stream works will be located on bedrock at the up stream falls.

If I have missed anything or have been unclear, please advise and I will be available for discussion.

Yours truly,

Don Hjorth, P. Eng.

cc: Lana Miller, B. Nixon