

2009/10 Water Quality Effectiveness Evaluations

Performed under FIA Contracts:

Kalum TSA 10: NOTSA108005 FIA Project 8005001

Kispiox TSA 12: NOTSA128008 FIA Project 8008001

2009/10 Fish Passage Culvert Inspections

Performed under FIA Contracts:

Kalum TSA 10: NOTSA108090 FIA Project 8005001

Kispiox TSA 12: NOTSA128008 FIA Project 8008002

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1.0 EXECUTIVE SUMMARY

In the summer and fall of 2009, 111 crossings in the Big Cedar, 79 in the Lakelse River and 82 in the William Creek watersheds stream crossings were assessed for sediment delivery risk. These crossings were rated and assessed using the WQEE ratings system. In the Big Cedar system ; 11 were found to have a 'Very Low' rating; 55 were found to have a 'Low' rating; 38 were rated 'Moderate', 6 rated 'High' and 1 rated 'Very High' (Figure 1). In the Lakelse watershed, 20 were found to be 'Very Low', 36 were rated 'Low'; 25 were rated 'Moderate'. 1 rated 'High' and none rated 'Very High' (Figure 2). In the Williams Creek watershed 15 rated 'Very Low'; 33 rated 'Low'; 26 rated 'Moderate'; 4 rate 'High' and 1 rated 'Very High' (Figure 3). In the Hazelton area 64 sites were assessed for sediment delivery. 10 have a 'Very Low' rating, 36 have a 'Low' rating. 18 have a 'Moderate' rating, and none have a 'High' or 'Very High' rating (Figure 4).

Remedial recommendations include cross-ditching, permanently deactivating roads, re-vegetating exposed slopes, armouring drainage structures, bridge deck cleaning, engineered grading of road surfaces and continued monitoring. For site with fish crossing and habitat values actions such as replacing culverts with open bottom structures, permanently deactivating the crossing or embedding the culvert have are recommended.

2.0 Background

2.1 WQEE Background

Water Quality Effectiveness Evaluations arose out of the Forest and Range Practices Act as a way of measuring the effectiveness of the Act in accomplishing its forest stewardship objectives. The field procedure for Water Quality Effectiveness Evaluation (WQEE, Carson et al, 2007) is accepted as a standard methodology by the Forest Investment Account for the Land Base Investment Program (Zapisocki, 2008).

The focus of the methodology concentrates on turbidity and identification of point sources of sedimentation. Turbidity is a measurement of the clarity of water and may be affected by forestry related disturbances. Point source sedimentation is easily identified and measured as it impacts water quality. Forestry operations near natural drainages can generate sediment which may enter adjacent water courses (WQEE, Carson et al, 2007).

The evaluation methods described the field guide were designed such that an efficient evaluation may be conducted effectively by non-specialists. Using the measurements of the sites road, drainage

structure and bank contributions to sediment transport and supply, the site can be categorized into low, moderate, high, very high and extreme classifications for impacts (Zapisocki, 2008).

2.2 Project Area Background

The Big Cedar, Williams Creek and Lakelse rivers are located within the Kalum T.S.A. The Kispiox watershed is located within the Kispiox T.S.A.

The Big Cedar River is located approximately 80 kilometres north of the City of Terrace. It runs westward into Kitsumkalum Lake which drains via the Kitsumkalum River for 50 kilometres into the Skeena River.

Williams Creek is located near Lakelse Lake approximately 20 kilometres south of the City of Terrace in northern British Columbia. It drains a westward facing basin and flows into Lakelse Lake which, in turn, flows into the 18 kilometre long Lakelse River.

The Lakelse River is a Skeena River tributary that enters the Skeena approximately 90 kilometres from its mouth.

The Hazelton areas are drained by several major fish bearing rivers. The largest of these is the Skeena River which captures the flow from secondary area rivers such as the Kispiox, Babine and Bulkley Rivers. Most of the streams assessed flow into one of these rivers.



3.0 Introduction

B.C. Timber Sales conducted Water Quality Effectiveness Evaluations to assess sediment input from forest roads at drainage and stream crossings. The purpose of this evaluation was to identify stream crossings, road surfaces and structures that are depositing excessive sediment into streams and degrading water quality in streams. Funding for this project was provided by the Forest Investment Account. The project areas are each funded through separate funding codes. The Lakelse watershed Fish Passage Culvert Inspections were funded through NOTSA108090 FIA Project # 8090001, Kispiox (Hazelton) Fish Passage Culvert Inspections were funded through NOTSA128008 FIA Project # 8008002, Kispiox Water Quality Effectiveness Evaluations were funded through NOTSA128008, FIA Project # 8008001, and the Big Cedar Water Water Quality Effectiveness Evaluations were funded through NOTSA 108005, FIA Project # 8005001.

The scope of the project included roads and crossings within the Lakelse River, William Creek, Big Cedar and Hazelton area drainages. The project area consisted of all accessible FSRs and non-permitted forest roads in the four mentioned drainages. In many cases, streams or crossings were not accessible due to restrictions such as completely brushed in roads or the stream or crossing is located on or accessed through private property. For others the stream or crossing no longer existed either through channel

abandonment by the stream or the crossing was completely removed. All areas which were accessible by either 4x4 truck, quads, or by foot were assessed.

The project was divided into four areas:

Project Area 1: Big Cedar Drainage.

This area included all accessible FSRs and non-permitted forestry roads in the drainage and all streams draining into the Big Cedar River.

The Big Cedar River, Lakelse River and Williams Creek drainages have been severely impacted by forest development. An intense network of roads has been built since logging began in the 1950's. Many of the roads were built to minimal standards before the implementation of the Forest Practices Code in 1995 that brought forth stricter guidelines for road building. Many of the roads do not have records indicating the construction dates. Research shows that most of the roads and crossing were built pre-Code. The data collected in 2009 will be used to prioritize work of roads and crossing identified as moderate to very high risk of sedimentation. Many of the branch roads are completely grown in with large alder trees or else have been severely deactivated with bridges removed.

Project Area 2: Lakelse River Drainage.

This area includes all streams flowing into the Lakelse Lake and Lakelse River drainages. The Lakelse area has also been heavily impacted by forestry operations. Harvesting and road building activities have occurred in the area since the beginning of the century. A very intensive network of roads and bridges exist in the area. Most of the roads and crossing were also built pre-Code. There have been little in the way of forest development in the Lakelse area for the last twenty years and as a result few of the roads are maintained. Most, if not all, of the main roads are maintained frequently but a large percentage of existing roads are secondary or tertiary roads and they have not been maintained. As a result, many of the secondary drainages feeding into the Lakelse River or lake are totally inaccessible. Many of the branch roads are completely grown in with large alder trees or else have been severely deactivated for much of their length. In many cases major crossings (bridges) have been removed entirely thereby eliminating access to many side drainages.

Project Area 3: Williams Creek Drainage.

The Williams Creek drainage has a forest development history going back to 1940. As with the previous areas this valley too has an extensive road network. Most of the roads are also pre-Code and many of the secondary and tertiary roads are also completely grown in or severely deactivated. Access to many of the sites was severely limited or impossible.

Project Area 4: Hazelton Drainage.

The Hazelton area also has a forest development history back to the early part of the century. As with the above drainages, most roads were built pre-Code and have been minimally maintained. The main-

lines have been well maintained but many secondary and tertiary roads have not. As with the above, there roads are heavily over-grown or have been heavily deactivated.

4.0 Methods

The water quality evaluations were carried out in between July 8th and November 10th of 2009. The objective was to assess and rate the crossings and structures for sediment delivery risk. Further to the assessment, site specific remediation recommendations where necessary were also performed. The intention of this survey was to identify all roads and crossing which pose a significant sediment delivery risk to downstream water quality and fish habitat.

Sediment (particles of material suspended in the water column or deposited in the stream bed) is a natural component of rivers and streams. Natural erosion and decay processes constantly deliver sediment to streams, so that all waterways carry some level of sediment. Artificially increased loads of sediment, resulting from human activity, can have adverse effects on both the physical form of the river, and aquatic flora and fauna.

Increased levels of sediment can adversely affect all aspects of freshwater ecosystems and fish by: reducing light penetration, increasing loads of soluble nutrients and toxic substances attached to sediment particles, clogging gills and causing asphyxiation, causing illness and reduced growth rates or death through ingestion, reduced visibility, filling spaces in the river bed and destroying important habitat, working its way into the stream bed, interfering with feeding by organisms that filter food from the water column, destroying attachment sites for animals and eggs and smothering plants.

The major effect of sedimentation is the blanketing of the stream bed (substratum) and the filling of pools and scour holes. Clogging of the stream bed removes spaces between particles which are used as rearing and habitat areas by juvenile fish, small species and stream invertebrates. Silt smothers the bed of the river and kills algae growing on rocks. Deposited silt can suffocate and kill fish eggs. High turbidity levels can be lethal to fish fry and juveniles.

All of the above rivers support very highly diverse and abundant fish populations. They support all anadromous fish populations native to British Columbia (BC Ministry of Environment FISS database) and include:

- Coho Salmon
- Chum Salmon
- Pink Salmon
- Chinook Salmon
- Sockeye Salmon
- Steelhead/Rainbow Trout
- Cutthroat Trout
- Dolly Varden
- Bull Trout

- Mountain Whitefish

Fish passage was also evaluated at sites classified as fish bearing. Field procedures for fish passage were conducted as per Field Assessment for Fish Passage Determination of Closed Bottomed Structures 2nd Ed. (B.C. Ministry of Environment, 2008).

Stream crossings are generally grouped into two main types—open bottom structures (OBS) and closed bottom structures (CBS). Open bottom structures include bridges and open bottom culverts (log and arch culverts). The most common closed bottom structures used on fish streams are corrugated pipes (primarily metal), which are ideally embedded to retain stream substrate and to provide fish habitat and passage.

If CBS are not embedded and are placed on excessive slopes or where they constrict the natural stream channel, then one or more of the following conditions may jeopardize fish passage:

- a) An elevation drop at the outlet (downstream end of the culvert)
- b) Excessive velocities and (or) turbulence inside the culvert
- c) An area of high water velocity acceleration at the inlet

Crossing structures such as culverts which are placed incorrectly severely restrict fish passage by creating either excessive water velocities within the structure and/or plunge falls at the outlets. Velocity barriers exist when the speed of the moving water in the culvert or structure is greater than the swimming ability of fish at any or all life stages (Parker 2000, adapted from Katopolis and Gervais, 1991). Open culverts should not have slopes exceeding 0.5% for culverts greater than 24m in length and 1.0% for culverts less than 24 m.

Salmonid juveniles cannot swim through water flowing in excess of 0.5 m/sec (McCarthy, 2009). Adult salmonids have difficulty swimming in velocities of 6 m/sec.

Barriers caused by excessive height exist when it exceeds the ability of the fish to jump it at any or all life stages (Parker 2000, adapted from Whyte et. al., 1997). General guidelines state that the pool at the outfall must be at least 1.3 times the jump height. Juvenile salmonids would have difficult jumping heights over 0.5 meters (McCarthy, 2009). Adult salmonid maximum jump heights vary with species and vary from 1.5 to 3.4 meters.

Evaluation methods outlined in the field guide focuses more on closed bottomed structures because of problems associated with these structures if they are not properly designed and installed (Slaney and Zaldokas, 1997). The assessment is based on the water flow dynamics within, above and below the crossing structure that are necessary to provide safe fish passage. Fish passage presence cannot be proved with these assessments but they do provide the information necessary to determine the effectiveness of fish passage and the impact of the structure on fish passage at the locations.

4.1 Pre-work Planning

Before entering the field, 1:20,000 map-sheets were produced for the entire project area detailing the stream crossings and roads. Site numbers were assigned to each site in numerical order. Knowing that every site may not be captured on the map, it was determined that crossings not located on the map would be assigned an alphabetical designation with the number of the last mapped stream crossing. Example: if the last stream number was 54 then the not mapped stream up the road from stream 54 would be labelled stream 54A.

4.2 Field Assessment

Field equipment consisted of a GPS unit, hip chain, digital camera, field cards, and the WQEE field guide.

At the site, the evaluator first establishes the drainage area which feeds into the stream assessed. Specifically, the evaluator establishes:

- a) Identify the boundaries of the shared drainage area (ditches, cut-banks, disturbed surfaces, side-casts, failures, etc.)
- b) Determines the connectivity of the artificial and natural drainage pattern.
- c) Determine the component of fine sediments in erodible material
- d) Determine the mass wasting and fine sediments associated with wasting.
- e) Determine the area, depth and volume of surface erosion.
- f) Determine the effect on water quality
- g) Assess management practices associated with the site and record conditions leading to sedimentation.
- h) Summarize and make recommendations.

At each site, data was collected on the geographical location (GPS coordinates), crossing structure type and characteristics, stream morphology and characteristics as well as any site specific information (slides/failures or other damage) were collected. Data was collected and recorded on the Water Quality Sample Site Field Cards. (See Figure 1).

Figure 1 - Sample Site Card for WQEE

- Right road upper and lower ditches
- Right road upper and lower cut and fill slopes
- Front and back fill banks, and
- Crossing surface

Each road crossing was evaluated and rated based on;

- Stream connectivity (Column 2)
- Portion of fine sediment in erodible material (Column 3)
- Fine sediment from mass wasting (Column 4)
- Fine sediment contribution from surface erosion (Column 7 and 8)

4.3 Data Interpretation:

Data from the field cards were summarized and displayed on graphs using Microsoft Excel. Crossing score was calculated as the total of the fine sediments of each site (in cubic meters). Calculations are outlined in the field form. Each site is then graded based on the total volume of sediment produced at the site and ranked according to the WQEE rating system.

- Very Low - $<0.2 \text{ m}^3$
- Low – $0.2 \text{ to } 1.0 \text{ m}^3$
- Moderate – $1.0\text{-}5.0 \text{ m}^3$
- High – $5.0\text{-}20 \text{ m}^3$

4.4 Fish Passage Determination

At sites pre-determined to be fish bearing an Assessment for Fish Passage Determination assessment was done. Using the same field equipment and the Field Assessment for Fish Passage Determination of Closed Bottom Structures field Guide, the assessor performed the following:

At sites determined to be fish-bearing, the evaluator:

- a) Records date, site identification, crew, GPS coordinate (UTM), stream name, road name and distance marker, Forest District, and crossing type.
- b) Determines extent of embedment of structure, amount of substrate in culvert (percent of length), and determine if material is representative of that found in the natural channel.
- c) Record structure dimensions such as diameter and length.
- d) Records culvert slope to nearest percent and if less than 4% then record slope to nearest 0.1% with a level
- e) Measures downstream channel widths as per Fish Stream Identification Guidebook (B.C. Ministry of Forests, 1998).
- f) Records outlet drop (in cm).

Further information is recorded in order to identify possible remedial actions and to assist in prioritization. This information is:

- a) Outlet Residual pool depth. Recorded as the depth of the pool created at the outfall of the structure.
- b) Record downstream slope.
- c) Evaluate and rate the habitat value of the crossing site and record as High, Moderate or Low. Note also the value of the habitat upstream of the structure as this will allow the value of the habitat gained by improving fish passage at the structure.
- d) Depth of fill above the structure. This measurement is used to estimate the cost of removal.
- e) Record the valley fill. This measure of stream bed composition allows for determination in whether an open or closed bottom structure is suitable for replacement.
- f) Record where or not beaver activity is present.
- g) Record whether or not inlet drop is present.
- h) Record backwatering (damming up).
- i) Record if fish sighted.
- j) Recommend appropriate fix or remediation to the site.
- k) Photo documentation
- l) Record any relevant comments appropriate to the site.

Figure 2 – Sample Site Card for Fish Passage

Closed Bottom Structure (CBS) Field Measurement Form							
1	Date:		13	Culvert Length			
2	Crossing ID #:		14	Outlet resid.	Invert ToP (A)	ToP BoC (B)	OD

					Pool Depth (cm) (C-B)					
3	Crew Name:				15	Stream Slope (%)				
4	GPS Coordinates:	Grid			16	Habitat Value	Low	Med	High	
5	Stream Name:				17	Depth of Fill (m)				
6	Road Name & km:				18	Valley Fill	DF	SF	BR	
7	MoF District:				19	Beaver Activity	Yes	No		
8	Crossing Type:	RC	PA	EC	EA	other	20	Inlet Drop	Yes	No
9	Embedded (mark x)	None	Partial	Full		21	Backwatered?	0 25 50 75 100		
10	Outlet Drop (A+B):	Invert ToP (A)	ToP BoC (B)	OD	22	Fish Sighted?				
11	Stream Width Ratio: (Channel Widths)	Channel Width	Culvert Width	SWR	23	Culvert Fix	RM OBS SS EM BW			
12	Culvert Slopes (%):				24	Photo (circle)	D/S Out Bar In U/S #’s-			
Comments:										

5.0 Results

A total of 307 sites in the Big Cedar, Lakelse, Williams Creek and Hazelton watersheds were fully assessed for sedimentation potential using the WQEE method. Sites of Very Low ranking were found at 52 sites ($< 0.2 \text{ m}^3$). Sites which rated Low ($0.2\text{-}1.0 \text{ m}^3$) were found at 142 sites. Sites which rated moderate ($1.0\text{-}5 \text{ m}^3$) were found at 100 sites. Sites which rate High ($5\text{-}20 \text{ m}^3$) were found at 11 sites, and sites rated Very High ($>20 \text{ m}^3$) were found at 1 site. (See Tables 1-4 and Figures 3-6).

Figure 3 show that there is a high proportion of Very Low, Low and Moderate risk sites. Much of the forest development in the Big Cedar drainage occurred over fifty years ago. Since that time many of the roads and areas have over grown and self-stabilized. While the heavily over-grown roads created access problems for much of the project, they have effectively stabilized the cut and fill slopes along the roads. As well, many of the streams have stabilized into their new channels and any fine sediment has long since eroded away.

The same can be said for the Lakelse, Williams Creek and Hazelton drainages. The higher proportion of Moderates in the Lakelse areas is attributed to the high level of recreational and private development occurring in and around the lake and river. Many of the FSR's are well maintained to provide access for recreational and private users.

5.1 Rankings

Figure 3 – WQEE rating for 111 sampled streams in Big Cedar Drainage

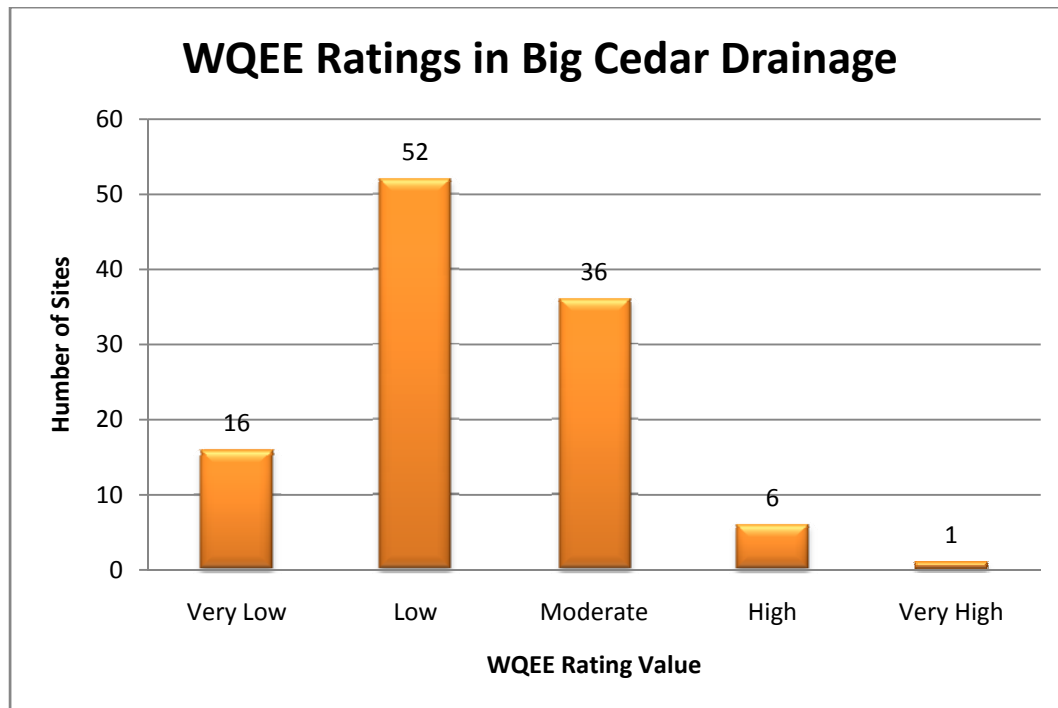


Figure 4 – WQEE rating for 73 sampled streams in Williams Creek Drainage

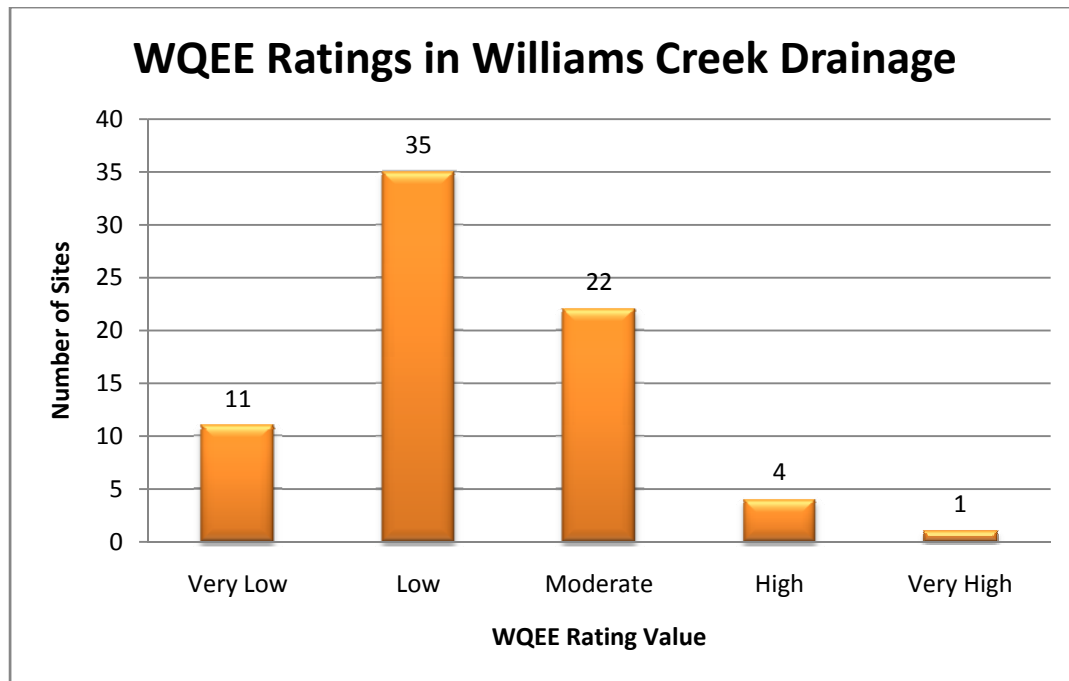


Figure 5 – WQEE rating for 54 sampled streams in Lakelse River Drainage

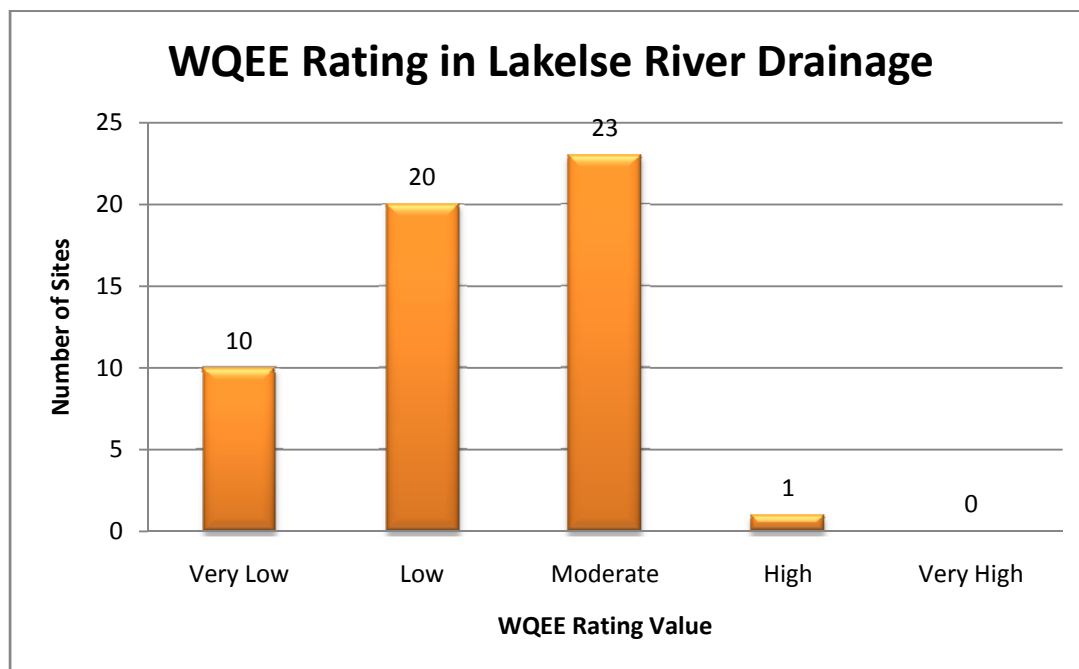


Figure 6 – WQEE rating for 69 sampled streams in Hazelton Drainage

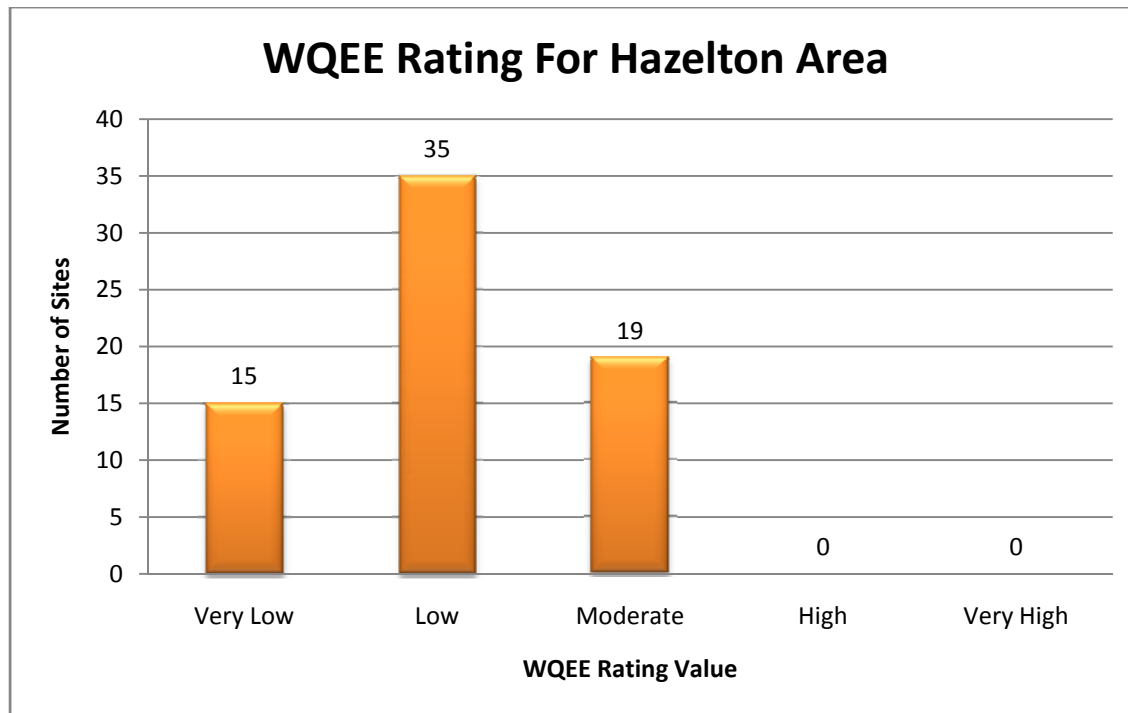


Table 1: Big Cedar Drainage: Site descriptions.

<u>Site ID#</u>	<u>WQEE Score (m3</u>	<u>Rating</u>	<u>Crossing Type</u>	<u>Road Reference</u>	<u>Watershed</u>	<u>Easting</u>	<u>Northing</u>	<u>Recommendations</u>
3	N/A	Very Low	Culvert	N. Beaver		N/A	N/A	No Stream
4	N/A	Very Low	Culvert	N. Beaver		N/A	N/A	No Stream
5	N/A	Very Low	Culvert	N. Beaver		N/A	N/A	No Stream
75	0.39	Very Low	1x4 WBC	Big Cedar 13 km	Cedar R.	0512634	6094015	None
121	0.82	Very Low	Culvert	Big Cedar	Cedar R.	0519501	6100925	None
168	0.18	Very Low	Culvert	Big Cedar		0518194	6110918	None
163	0.169	Very Low	Pulled bridge	Big Cedar	Cedar R.	0517200	6108901	None
161	0.06	Very Low	Culvert	Big Cedar	Cedar R.	0517058	6108072	None
150	0.17	Very Low	Culvert	Anweiler	Cedar R.	0521896	6104471	None
157B	0.05	Very Low	Culvert	Anweiler	Cedar R.	0522113	6107340	None
150A	0.02	Very Low	Culvert	Anweiler	Cedar R.	0521906	6104496	None
37	0.01	Very Low	Culvert	Big Cedar	Cedar R.	0510770	6089817	None
37C	0.5	Very Low	Culvert	Big Cedar	Cedar R.	02510829	6089588	None
125	0.11	Very Low	Culvert	Anweiler	Cedar R.	0520928	6101418	None
46A	0.14	Very Low	Culvert	Meadow	Cedar R.	0507949	6091093	None
152A	0.078	Very Low	Culvert	Anweiler	Cedar R.	0521783	6105840	None
152	0.66	Low	Culvert	Anweiler	Cedar R.	0521795	6105771	None
156	0.88	Low	Culvert	Anweiler	Cedar R.	0521884	6106656	None

157A	0.22	Low	Culvert	Anweiler	Cedar R.	0522064	6106954	None
158	0.37	Low	Culvert	Anweiler	Cedar R.	0522179	6106679	None
55 O	0.35	Low	WBC	Big Cedar	Cedar R.	0512977	6091930	None
55 P	0.53	Low	Culvert	Big Cedar	Cedar R.	0513011	6091956	None
55Q	0.56	Low	Culvert	Big Cedar	Cedar R.	0512976	6091801	None
56	0.60	Low	Culvert	Big Cedar	Cedar R.	0511533	6093061	None
79	0.33	Low	Culvert	Big Cedar	Cedar R.	0512526	6095296	None
89	0.56	Low	Culvert	Big Cedar	Cedar R.	0512233	6096321	None
113	0.95	Low	Culvert	Big Cedar	Cedar R.	0513081	6099381	None
129	0.64	Low	WBC	Big Cedar	Cedar R.	0515457	6101769	None
130	0.48	Low	Culvert	Big Cedar	Cedar R.	0515382	6101913	None
155A	0.43	Low	Culvert	Big Cedar	Cedar R.	0518925	6106200	None
155	0.32	Low	Culvert	Big Cedar	Cedar R.	0518901	6106231	None
165A	0.88	Low	Culvert	Big Cedar	Cedar R.	0577354	6109531	None
164	0.94	Low	Culvert	Big Cedar	Cedar R.	0517324	6109031	None
164A	0.22	Low	Culvert	Big Cedar	Cedar R.	0517284	6108873	None
167	0.24	Low	Culvert	Big Cedar	Cedar R.	0518194	6100918	None
166	0.48	Low	Culvert	Big Cedar	Cedar R.	0517739	6110522	None
162	0.33	Low	Culvert	Big Cedar	Cedar R.	0517084	6108071	None
55L	0.49	Low	Culvert	Big Cedar	Cedar R.	0512854	6091959	None
55K	0.55	Low	Culvert	Big Cedar	Cedar R.	0513406	6092597	None
55J	0.29	Low	Culvert	Big Cedar	Cedar R.	0513619	6092846	None
37A	0.33	Low	Culvert	Big Cedar	Cedar R.	0511289	6089283	None
34	1.04	Low	Culvert	Big Cedar	Cedar R.	0510230	6089555	None
34A	0.31	Low	Culvert	Big Cedar	Cedar R.	0510343	6088802	None
51	0.83	Low	Culvert	Big Cedar	Cedar R.	0510876	6092432	None
53	0.72	Low	Culvert	Big Cedar	Cedar R.	0511406	6092634	None
55 B	0.97	Low	Culvert	Big Cedar	Cedar R.	0512677	6092991	None
55 C	0.69	Low	Culvert	Big Cedar	Cedar R.	0512778	6093056	None
55 G	0.25	Low	Culvert	Big Cedar	Cedar R.	0512923	6092578	None
55 D	0.84	Low	Culvert	Big Cedar	Cedar R.	0512908	6092992	None
61	0.58	Low	Culvert	Meadow	Cedar R.	0509589	6093359	None
31	0.86	Low	Culvert	Meadow	Cedar R.	0509031	6088734	None
47	0.69	Low	Culvert	Meadow	Cedar R.	0509326	6091312	None
32	0.54	Low	Culvert	Meadow	Cedar R.	0508824	6088842	None
124	0.62	Low	Culvert	Anweiler	Cedar R.	0520907	6101395	None
120	0.65	Low	Culvert	Anweiler	Cedar R.	0520842	6101386	None
18	0.38	Low	Culvert	Ross Rd	Cedar R.	0511201	6083169	None
15	0.50	Low	Culvert	Ross Rd	Cedar R.	0510559	6082891	None
18A	0.43	Low	Culvert	Ross Rd	Cedar R.	0510770	6083038	None
49A	0.23	Low	Culvert	Meadow	Cedar R.	0508159	6091228	None
46	0.28	Low	Culvert	Meadow	Cedar R.	0507914	6091073	None
19 A	1.19	Low	Culvert	N.Beaver	Cedar R.	0509151	6082551	None
6	0.64	Low	Culvert	N.Beaver	Cedar R.	0509702	6079861	None
25	0.43	Low	Culvert	Clear Ck	Cedar R.	0511339	6084959	None
160	0.89	Low	Culvert	Big Cedar	Cedar R.	0517146	6107832	None

148	0.53	Low	Culvert	Big Cedar	Cedar R.	0518842	6104197	None
146	0.15	Low	Culvert	Big Cedar	Cedar R.	0514128	6103400	None
140	0.69	Low	Culvert	Big Cedar	Cedar R.	0514388	6107188	None
138A	0.77	Low	Culvert	Big Cedar	Cedar R.	0516775	6102840	None
138	0.75	Low	Culvert	Big Cedar	Cedar R.	0516641	6102747	None
157	2.67	Moderate	Bridge	Anweiler	Cedar R.	0524895	6106659	Cross-ditch steep road surface
157C	1.5	Moderate	Wooden Box Culvert	Anweiler	Cedar R.	522116	6107510	2 water bars on right road surface spaced 100 m.
55M	1.71	Moderate	Culvert	Big Cedar	Cedar R.	512796	6091866	Water bar left and right road surface. Grass seed upper road cut.
55N	2.17	Moderate	Wooden Box Culvert	Big Cedar	Cedar R.	512903	6091839	Water bar right road mid slope, grass seed right road cut.
55R	1.13	Moderate	Culvert	Big Cedar	Cedar R.	512888	6091484	Water bar left road surface every 50 m and grass seed left road cut.
55S	1.98	Moderate	Culvert	Big Cedar	Cedar R.	512881	6091297	Water bar left road surface and grass seed left road cut.
54	1.18	Moderate	Culvert	Big Cedar	Cedar R.	511018	6092696	Water bar left and right road surfaces.
62	1.33	Moderate	Bridge	Big Cedar	Cedar R.	511784	6093476	Water bar mid-slope left and right road surfaces. Grass seed right road cut.
107	1.426	Moderate	Bridge	Big Cedar	Cedar R.	518235	6098628	Water bar left and right road surface. Grass seed right road cut.
114	2.427	Moderate	Bridge	Anweiler	Cedar R.	515141	6099908	Cross-ditch road
154	2.62	Moderate	Bridge	Big Cedar	Cedar R.	516927	6105955	Grass Seed right road cut.
159	3.196	Moderate	Culvert	Big Cedar	Cedar R.	518989	6107280	Cross ditch right road surface.
126	3.04	Moderate	Culvert	Big Cedar	Cedar R.	518151	6101464	Water bar left and right road surface.

								Grass seed left and right road cut.
165	3.7	Moderate	Culvert	Big Cedar	Cedar R.	517391	6109708	Water bar steep sections
163A	1.44	Moderate	Culvert	Big Cedar	Cedar R.	517282	6108764	Grass seed disturbed fills
149	1.83	Moderate	Culvert	Anweiler	Cedar R.	521952	6104368	Grass seed
150B	1.11	Moderate	Culvert	Anweiler	Cedar R.			Grass seed cut slope
152B	1.6	Moderate	Culvert	Anweiler	Cedar R.	521781	6105879	Stabilize and re-vegetate cut slope
36	3.44	Moderate	Wood box culvert	Big Cedar	Cedar R.	510608	6090134	Water bar left road surface mid-slope.
37B	1.15	Moderate	Culvert	Big Cedar	Cedar R.	510892	6089551	Water bar left road surface mid-slope.
55A	1.5	Moderate	Culvert	Big Cedar	Cedar R.	512161	6093013	Water bar right road surface and grass seed right road cut.
55	2.06	Moderate	Bridge	Big Cedar	Cedar R.	512503	6092848	Water bar road
55H	3.01	Moderate	Culvert	Big Cedar	Cedar R.	513063	6092862	Clean out ditch and grass seed right road cut and water bar right road surface.
55E	2.48	Moderate		Big Cedar				Grass seed LRCU-Clean ditch
55I	1.96	Moderate	Culvert	Big Cedar	Cedar R.	513421	6092900	Water bar mid-slope right road surface.
58	2.1	Moderate	Culvert	Meadow	Cedar R.	509679	6093072	Two water bars 50 m apart on left road surface.
50	2.63	Moderate	Bridge	Meadow	Cedar R.	509519	6091541	2 water bars 50 m apart on left and right road surface.
128	1.14	Moderate	Culvert	S.Anweiler	Cedar R.	521374	6101884	Clean out pipe; water bar 20m town side road
147	2.99	Moderate	Bridge	S.Anweiler	Cedar R.	523029	6104089	Grass seed upper cut slopes.
49	1.42	Moderate	Culvert	Meadow	Cedar R.	508450	6091456	Water-bar road
7	2.21	Moderate	Bridge	N. Beaver	Cedar R.	509636	6080516	Pull back gravel piles, re-contour

								and seed.
23	1.77	Moderate	Wood box culvert	Big Cedar	Cedar R.	510426	6083431	Log culvert has been pulled. Water bar road surface.
27	1.33	Moderate	Culvert	Big Cedar	Cedar R.	510125	6087787	Water bar mid-slope left and right road surfaces. Grass seed R. road cut.
9	1.93	Moderate	Culvert	S.Anweiler	Cedar R.	522378	6102878	Water bar road surfaces.
151	1.09	Moderate	Culvert	Big Cedar	Cedar R.	516864	6104628	Grass seed right road cut.
144	2.37	Moderate		Big Cedar	Cedar R.	515176	6103699	Grass seed left road cut; water bar left and right road surface every 100 m.
52	3.52	High	Bridge	Big Cedar	Cedar R.	512497	6092861	Replace culvert 230m bush side of bridge with 800x10 cmp.
64	6.07	High	Bridge	Big Cedar	Cedar R.	512376	6093921	No work needed. Bridge new and banks freshly armoured and seeded.
127	7.9	High	Culvert	Big Cedar	Cedar R.	518013	6101488	Clean ditch sump
122	4.9	High	Bridge	Big Cedar	Cedar R.	518859	6101057	Plant willow in cut-bank-clean out ditch and build sump to collect silt.
125A	12.6	High	Bridge	S.Anweiler	Cedar R.	521009	6101470	Clean ditches (both sides), water bar road (camp side) and grass seed cut banks.
145	5.53	High	Wood box culvert.	S.Anweiler	Cedar R.	522478	6102935	Water bar road surfaces every 100m.
55F	112.63	Very High	Culvert	Big Cedar	Cedar R.	512832	6092616	Slope failure blocking ditch.

								Clean out ditch and re-vegetate cut slope.
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Table 2: Williams Creek Watershed: Site descriptions.

Site ID#	WQEE Score (m3)	Rating	Crossing Type	Road Reference	Watershed	Easting	Northing	Recommendations
270	0.11	Very Low	Culvert	Williams	Williams	0546608	6026012	
575A	0	Very Low	N/A	N/A	N/A	N/A	N/A	No Connectivity
289	0.20	Very Low	Culvert	Williams	Williams	0544210	6026691	No Action
575	0.19	Very Low	Culvert	Williams	Williams	0541819	6028519	No Action
557	0.08	Very Low	Culvert	Williams	Williams	0540785	6029195	No Action
317	0.16	Very Low	Culvert	Williams	Williams	0541009	6026699	No Action
464	0.02	Very Low	Culvert	Williams	Williams	0539038	6029294	No Action
242	0.0	Very Low	Culvert	Williams	Williams	0553496	6026299	No Action
243	0.17	Very Low	Culvert	Williams	Williams	0552399	602649	No Action
255	0.0	Very Low	Culvert	Williams	Williams			No Action
234	0.2	Very Low	Culvert	Williams	Williams	0546070	6025323	No Action
217	0.71	Low	Culvert	Williams	Williams	0550530	6026551	No Action
245	0.82	Low	Culvert	Williams	Williams	0552042	6026511	No Action
213	0.27	Low	Culvert	Williams	Williams	0553004	6026478	No Action
210	0.0	Low		Williams	Williams	0552775	6026506	Fish Assessment Required.
211	0.44	Low	Culvert	Williams	Williams	0553412	6026326	No Action
254	0.45	Low	Culvert	Williams	Williams	0551285	6026426	No Action
224	0.64	Low	Culvert	Williams	Williams	0549002	6026157	No Action
263	0.57	Low	Culvert	Williams	Williams	0548672	6026032	No Action
604	1.42	Low	Culvert	Br.17-4	Williams	0547127	6026151	No Action
269	1.05	Low	Culvert	Br.17-4	Williams	0547202	6026130	No Action
222	0.60	Low	Culvert	Williams	Williams	0549307	6026253	No Action
604	0.29	Low	Culvert	Williams	Williams	0547146	6025889	No Action
268	0.24	Low	Culvert	Williams	Williams	0547056	6025903	No Action
239	0.31	Low	Culvert	Br.15-5	Williams	0546618	6025066	No Action
577	0.42	Low	Culvert	Williams	Williams	0542821	6027785	No Action
288B	0.91	Low	Culvert	Williams	Williams	0544196	6026493	No Action
556	0.22	Low	Culvert	Williams	Williams	0540661	6029239	No Action
631	0.73	Low	Culvert	Williams	Williams	0540878	6029395	No Action
172	0.34	Low	Culvert	Br.08-5	Williams	0540927	6029386	No Action
547	0.33	Low	Culvert	Williams	Williams	0539904	6029418	No Action
528	0.41	Low	Culvert	Williams	Williams	0535399	6030835	No Action
532	0.29	Low	Culvert	Williams	Williams	0535928	6031214	No Action
153	0.28	Low	Culvert	Williams	Williams	0536311	6030557	No Action

540	1.50	Low	Culvert	Williams	Williams	0537327	6029594	No Action
596A	0.28	Low	Culvert	Williams	Williams	0540851	6026607	No Action
473A	0.23	Low	Culvert	Br.9000	Williams	0539678	6028970	No Action
606	0.33	Low	Culvert	Br.9000	Williams	0541270	6025816	No Action
572	0.27	Low	Culvert	Williams	Williams	0541715	6028621	No Action
604	0.41	Low	Culvert	Williams	Williams	0547184	6025878	No Action
269	1.42	Low	Culvert	Williams	Williams	0547127	6026151	No Action
563	0.63	Low	Culvert	Williams	Williams	0541485	6028860	No Action
171	0.23	Low	Culvert	Williams	Williams	0538994	6029481	No Action
290	0.95	Low	Culvert	Br.7000	Williams	0543427	6027801	No Action
471	0.83	Low	Culvert	Br.7000	Williams	0542362	6028473	No Action
570	0.78	Low	Culvert	Br.7000	Williams	0542231	6028578	No Action
215	1.46	Moderate	Culvert	Williams	Williams	0549807	6026438	Water bar left and right road surface mid-slope; Grass seed left and right road cuts.
245B	1.8	Moderate	Wood box culvert.	Williams	Williams	0551933	6026470	Spur permanently deactivated. No structure
209	1.57	Moderate	Bridge	Williams	Williams	0552706	6026295	Water bar right road surface mid-slope.
267	1.48	Moderate	Culvert	Williams	Williams	05477331	6026095	Grass seed left and right road cuts.
271	1.28	Moderate	Culvert	Williams	Williams	0547078	6023162	Grass seed left and right road cuts.
247	2.41	Moderate	Culvert	Williams	Williams	0548237	6023031	Grass seed left road cut; water bar left road surface mid-slope.
289B	2.7	Moderate	Bridge	Williams	Williams	0543921	0626804	Water bar left and right road surface mid-slope; Grass seed right road cut.
270C	1.26	Moderate	Bridge	Williams	Williams	0546180	6025599	Water bar left and right road surfaces.
270B	1.13	Moderate	Bridge	Williams	Williams	0546435	6025947	Pull guard log out of creek.
288	1.12	Moderate	Culvert	Williams	Williams	0544568	6026535	Water bar left road surface mid-slope. Grass seed right road cut.

603	1.18	Moderate	Bridge	Williams	Williams	0545119	6026290	Water bar left road surface; grass seed right road cut.
565	1.15	Moderate	Culvert	Williams	Williams	0541340	6028799	Water bar left and right road surfaces.
549	1.8	Moderate	Wood box culvert	Williams	Williams	0540389	6029350	Water bar left road surface.
630	4.4	Moderate	Culvert	Williams	Williams	0540805	6029419	Place large boulders at base of slope, grass seed and hay bales.
176	3.78	Moderate	Culvert	Williams	Williams	0541865	6029159	Unplug culverts.
596	1.26	Moderate	Culvert	Williams	Williams	0540801	6026725	Unplug culverts.
473B	1.81	Moderate	Bridge	Williams	Williams	0539351	6029261	Water-bar left road surface.
302	2.08	Moderate	Culvert	Williams	Williams	0541724	6026631	Water bar right road surface; Grass seed right road cut.
568	2.8	Moderate	Culvert	Williams	Williams	0541569	6028834	Add cross-drain pipe 100m up from crossing on road.
204	2.2	Moderate	Ford	Williams	William	0541566	6026780	Water bar left and right road surfaces; Grass seed left road cut.
566	1.15	Moderate	Culvert	Williams	Williams	0542047	6028676	Cross ditch left road surface.
560	2.7	Moderate	Culvert	Williams	Williams	0541575	6028886	Water bar left road surface; grass seed left road cut.
237	12.48	High	Culvert	Williams	Williams	0547714	6023882	Change pipes to 2x1400mm. Water-bar road
238	21.66	Very High	Culvert	Williams	Williams	0548112	6023126	Water-bar roads, need retaining wall (logs/fabric), fill lower side of road and seed.
180	5.7	High	Culvert	Williams	Williams	0541602	6029268	Install pipes on LR with ditch block

								on mid to upper slope (2x800mm)
207	12.6	High	Culvert	Williams	Williams	05410250	6026768	Clean ditch, boulders at base of cut-slope, grass seed and replace pipe with armoured ford.
291	6.9	High	Culvert	Williams	Williams	0543660	6027889	Grass seed left and right road cuts.

Table 3 – Lakelse Watershed: Site descriptions.

Site ID#	WQEE Score (m3)	Rating	Crossing Type	Road Reference	Watershed	Easting	Northing	Recommendations
54A	0.0	Very Low	Culvert	Mt. Johnstone	Lakelse	-	-	No Connectivity
92	0.0	Very Low	Bridge	White Ck	Lakelse	0516297	6032046	None
94	0.0	Very Low	Bridge	White Ck	Lakelse	0515602	6032020	None
187	0.0	Very Low	Bridge	White Ck	Lakelse	0519778	6028631	None
1	0.0	Very Low	Bridge	White Ck	Lakelse	0519547	6030298	Bridge Removed
105	0.0	Very Low	None	Thunderbird	Lakelse	N/A	N/A	No structure
458	0.16	Very Low	Culvert	White Ck	Lakelse	0519749	6028493	None
94A	0.04	Very Low	WBC	Whitebottom	Lakelse	0514586	6032383	None
102	0.19	Very Low	Culvert	Thunderbird	Lakelse	0521181	06032710	None
122	0.0	Very Low	Removed	Thunderbird	Lakelse	0523344	06031804	Removed
54B	1.08	Low	Culvert	Mt. Johnstone	Lakelse	0521086	6024225	None
101	0.14	Low	WBC	Thunderbird	Lakelse	0520712	06030092	None
510	0.61	Low	WBC	Thunderbird	Lakelse	0524058	06032166	None
121	0.27	Low	WBC	Thunderbird	Lakelse	0523443	06031842	None
104	0.24	Low	WBC	Thunderbird	Lakelse	N/A	N/A	None
168	0.42	Low	WBC	White Ck	Lakelse	0519002	6029242	None
166A	0.80	Low	Culvert	White Ck	Lakelse	0518894	6029638	None
166B	0.59	Low	Culvert	White Ck	Lakelse	0518889	6029595	None
166	0.92	Low	Culvert	White Ck	Lakelse	0518890	6029097	None
168A	0.85	Low	Culvert	White Ck	Lakelse	0519112	6029147	None
183	0.87	Low	Culvert	White Ck	Lakelse	0520131	6027869	None
92A	0.27	Low	Culvert	White Ck	Lakelse	0515913	6032111	None
92B	0.41	Low	Culvert	White Ck	Lakelse	0515843	6032088	None
97	0.80	Low	Culvert	White Ck	Lakelse	0516577	6031940	None

107	0.79	Low	WBC	White Ck	Lakelse	0516577	6030358	None
107A	0.71	Low	Culvert	White Ck	Lakelse	0517361	6031351	None
110	0.53	Low	Culvert	White Ck	Lakelse	0517200	6031426	None
110A	0.48	Low	Culvert	White Ck	Lakelse	0516948	6031523	None
480	0.72	Low	Culvert	White Ck	Lakelse	0519085	6030263	Remove Pipes
480A	0.32	Low	Culvert	White Ck	Lakelse	0519864	6030089	None
98	3.01	Moderate	Culvert	Thunderbird	Lakelse	0525802	6033022	Grass seed and water bar road surfaces.
54C	3.9	Moderate		Mt. Johnstone	Lakelse	0521653	6021310	Water bar right road surface.
54	2.37	Moderate	Bridge	Mt. Johnstone	Lakelse	0520788	6024955	Water bar right road surface.
9	1.7	Moderate	Culvert	Schulbuckhand	Lakelse	0532367	6020766	Water bar right road surface.
67	2.5	Moderate	Culvert	Powerline	Lakelse	0529701	6021772	Cross-ditch either side of crossing.
65	1.4	Moderate	Culvert	Schulbuckhand	Lakelse	0529271	6020040	Armoured ford at crossing, 2x cross ditches left road cut 50 and 100 m from crossing.
350	4.0	Moderate	Culvert	End Lake	Lakelse	0524046	6021705	Install 600mm cmp at low area to intercept ditch flow on right road surface.
10A	2.29	Moderate	Culvert	End Lake	Lakelse	0523983	6024140	600 mm cmp 200 m up road on camp side from crossing to divert flow.
632	5.14	Moderate	Bridge	Coldwater	Lakelse	0523353	6020723	Grass seed right road cut.
19	1.5	Moderate	Culvert	Coldwater	Lakelse	0522026	6024883	Change out undersized pipe. Install 800 mm. Build up road fill 1m.
20	1.5	Moderate	Culvert	Coldwater	Lakelse	0522123	6024922	Install 1x3 box culvert. Pipe inadequate.
88	3.74	Moderate	Culvert	Schulbuckhand	Lakelse	0532020	6021146	Grass seed right road cut.
350A	1.14	Moderate	Culvert	End Lake	Lakelse	0524336	6021028	Water bar right road surface mid-slope.

175	1.08	Moderate	Culvert	White Creek	Lakelse	0519504	6028852	Water bar right road surface; grass seed right road cut.
488A	1.1	Moderate	Culvert	White Creek	Lakelse	0520128	6028110	Water bar right road surface mid-slope.
480B	1.3	Moderate	Culvert	White Creek	Lakelse	0518851	6030265	Pull plugged pipe. Install 0.5 m x-drain on upper road side
100	3.038	Moderate	Bridge	Thunderbird	Lakelse	0524808	6032664	Water bar left and right road surfaces mid-slope.
117	1.765	Moderate	Culvert	Hai Lake	Lakelse	0524035	6029964	Water bar left and right road surfaces mid-slope.
115	1.135	Moderate	Wood box culvert	Thunderbird	Lakelse	0523947	6031624	Water bar left and right road surfaces mid-slope.
118	1.663	Moderate	Culvert	Thunderbird	Lakelse	0523871	6031750	Water bar left and right road surfaces mid-slope.
123	2.972	Moderate	Bridge	Thunderbird	Lakelse	0522942	6031364	Water bar left and right road surfaces mid-slope.
512	1.046	Moderate	Culvert	Thunderbird	Lakelse	520410	6031137	Water bar left and right road surfaces mid-slope.
116	1.448	Moderate	Culvert	Thunderbird	Lakelse	0523889	6031965	Water bar left and right road surfaces mid-slope.
399A	6.9	High	Culvert	Schulbuckhand	Lakelse	0532302	6020855	Grass seed left and right road cuts.
399	6.2	High	Bridge	Schulbuckhand	Lakelse	053281	6020737	Grass seed eroded cut-banks.
174	N/A				Lakelse	N/A	N/A	Road Deactivated
169	N/A				Lakelse	N/A	N/A	Road Deactivated
193	N/A				Lakelse	N/A	N/A	Road Deactivated
489	N/A				Lakelse	N/A	N/A	Road Deactivated

Table 4 – Hazelton Watershed : Site descriptions.

Site ID#	WQEE Score (m3)	Rating	Crossing Type	Road Reference	Watershed	Easting	Northing	Recommendations
1	0.29	Very Low	Culvert	14.8 km Helen		0564436	6154593	None
5	0.162	Very Low	Culvert	Br.2000 Helen		0560518	6156771	None
2	N/A	N/A	Culvert	Br.2000		N/A	N/A	No Stream
7	0.1	Very Low	Culvert	Br.2000 Helen		0560947	6155090	None
8	0.25	Very Low	Culvert	Br.2000 Helen		0561050	6154784	None
11A	0.14	Very Low	Culvert	Br.2000 Helen		0560385	6152514	None
14	0.08	Very Low	Culvert	Br.2000 Helen		0560589	6152682	None
15	0.08	Very Low	Culvert	Br.1200 Helen		0565594	6152813	None
18	N/A	Very Low	Culvert	Kuldo M/L		0562318	6177569	No Stream
20	N/A	Very Low	Culvert	Kuldo		0561763	6180645	No Stream
22	N/A	Very Low	Culvert	Br.2300 0.3 km		N/A	N/A	No Stream
23	0.13	Very Low	Culvert	Br 2300 Helen		0562820	6178215	None
26	N/A	Very Low	Culvert	Br.2300 Helen		N/A	N/A	No Access
37	0.09	Very Low	Culvert	Br.2600 Kuldo		05635358	6178462	None
43	N/A	Very Low	Culvert	Suskwa		N/A	N/A	No Stream
46	N/A	Very Low	Culvert	Br.5400 Suskwa		N/A	N/a	No Stream
4	0.59	Low	Culvert	21.3 km Helen		0559968	6157598	None
6	0.257	Low	Culvert	Br.2000 Helen		0560528	6156812	None
3	0.30	Low	Culvert	18.9 km Helen		0561705	6156979	None
9	0.51	Low	Culvert	Br.2000 Helen		0561224	6154412	None
10	0.26	Low	Culvert	Br.2000 Helen		0561494	6154078	None
11	0.23	Low	Culvert	Br.2000 Helen		0560385	6152514	None
13	0.88	Low	Culvert	Br.2000 Helen		0561460	6155077	None
21	0.84	Low	Culvert	26.5 km Kuldo		0561654	6180969	None
24	0.42	Low	Culvert	Br.2300 Helen		0563329	6178212	None
27	0.87	Low	Culvert	Br.2700 Kuldo		0561196	6181210	None
28	0.61	Low	Culvert	Br.2700 Helen		0560722	6180942	None
29	0.33	Low	Culvert	Br.2600 Kuldo		0561845	6180614	None
30	0.53	Low	Culvert	Br.2600 Kuldo		0562965	6181133	None
31	0.44	Low	Culvert	Br.2600 Kuldo		0564550	6179737	None
32	0.23	Low	Culvert	Br.2600 Kuldo		0564078	6179399	None
33	0.37	Low	Culvert	Br.2600 Kuldo		0564947	6179179	None
34	0.28	Low	Culvert	Br.2600 Kuldo		0565239	6178577	None
35	0.52	Low	Culvert	Br.2600 Kuldo		0565314	6178523	None
36	0.86	Low	Culvert	Br.2600 Kuldo		0565402	6178441	None
39	0.44	Low	Culvert	Itzul 610A		0602940	6136349	None
40	0.96	Low	Culvert	Itzul 610A 1.8 km		0602824	6136756	None
42	0.54	Low	Culvert	Suskwa M/L		0616999	6147860	None
47	0.78	Low	Culvert	Br.5500		0620831	6156348	None

49	0.30	Low	Culvert	Br.5500		0621484	6155217	None
56	0.52	Low	Culvert	Nichyeskwa		0606696	6145830	None
57	0.47	Low	Culvert	Nichyeskwa		0617171	6145932	None
58	0.83	Low	Culvert	Nichyeskwa		0617519	6146104	None
60	1.05	Low	Culvert	Nichyeskwa		0621095	6148549	None
69	1.0	Low	Culvert	Nichyeskwa		0623094	6146451	None
68	0.22	Low	Culvert	Nichyeskwa		0620464	6147610	None
66	0.25	Low	Culvert	Nichyeskwa		0624935	6147638	None
65	1.03	Low	Culvert	Nichyeskwa		0623270	6148192	None
63	0.3	Low	Culvert	Nichyeskwa		0622209	6148402	None
62	0.34	Low	Culvert	Nichyeskwa		0621909	6148576	None
61	0.85	Low	Culvert	Nichyeskwa		0621404	6148650	None
73	2.6	Moderate	Culvert	Nichyeskwa		0624978	6145902	Grass seed both cut banks.
72	4.5	Moderate	Culvert	Nichyeskwa		0624506	6146090	Grass seed both cut banks.
71	1.16	Moderate	Culvert	Nichyeskwa		0624351	6146027	Grass seed both exposed cut banks.
70	3.6	Moderate	Culvert	Nichyeskwa		0623904	6145918	Grass seed exposed cut banks.
67	1.79	Moderate	Culvert	Nichyeskwa		0619707	6147245	Water bar spur above main creek.
64	1.7	Moderate	Culvert	Nichyeskwa		0622578	6148372	Growing in on own. No action required.
59	2.77	Moderate	Culvert	Nichyeskwa		0620582	6148220	Stabilize cut on RCu by rip rap or bioremediation.
53	1.1	Moderate	Culvert	Suskwa 5800		0621028	6157722	Deactivate road or replace culvert with 1x4 wooden box culvert.
52	1.04	Moderate	Culvert	Suskwa 5800		0620649	6158113	Deactivate road.
51	1.23	Moderate	Culvert	Suskwa 5500		0621378	6154546	No remedial action required.
50A	3.1	Moderate	Culvert	Suskwa 5500		0621560	6155025	No remedial action required.
48	1.6	Moderate	Culvert	Suskwa 5500		0620995	6156202	No remedial action required.
45	1.33	Moderate	Culvert	Suskwa 4600		0618032	6152423	Replace with wood box culvert.
44	2.7	Moderate	Culvert	Suskwa M/L		0620404	6158117	No remedial action required.
41	3.8	Moderate	Culvert	Suskwa M/L		0617088	6147731	No remedial

								action required.
40A	2.45	Moderate	Culvert	6010A 2.2 Km		0602605	6137057	No remedial action required.
38	1.16	Moderate	Culvert	Itzul 610A		0603474	6136385	No remedial action required.
12	5.11	Moderate	Culvert	Kuldo M/L 20 km		0562221	6175343	Repair outlet of pipe for fish passage.
19	2.4	Moderate	Culvert	Kuldo M/L		0561803	6180436	Replace with 1200 mm embedded pipe.

Table 5 – Big Cedar Fish Stream Evaluations

<u>Site ID#</u>	<u>Crossing Type</u>	<u>Road Reference</u>	<u>Easting</u>	<u>Northing</u>	<u>Fish Assessment Recommendations.</u>
N/A	N/A	N/A	N/A	N/A	No fish streams assessed.

Table 6 – Williams Creek Fish Stream Evaluations

<u>Site ID#</u>	<u>Crossing Type</u>	<u>Road Reference</u>	<u>Easting</u>	<u>Northing</u>	<u>Fish Assessment Recommendations.</u>
N/A	N/A	N/A	N/A	N/A	No fish streams assessed.

Table 7 – Lakelse River Fish Stream Evaluations

Site	Site Unit	Result	Crossing Type	Road Reference	Easting	Northing	Recommendations
556			Culvert	Williams	540602	6709225	No assessment needed.
97		B	1200 mm culvert	White Creek	516565	6031942	Replace pipe with 1x4 m box culvert
110	A	B	2x800 mm culverts	White Creek	516946	6031530	Discontinuous embedment. Place gravel in pipe.

20		B	2x400 mm culverts	Lower Coldwater	522121	6024920	Install 1x3 m box culvert to reduce beaver activity and create natural stream channel.
563		B	Culvert	Williams M/L	541485	602886	No action needed.

Table 8 – Hazelton Area Fish Stream Evaluations (WQEE Values listed in Tables above)

<u>Site</u>	<u>Site Unit</u>	<u>Result</u>	<u>Crossing Type</u>	<u>Road</u>	<u>Easting</u>	<u>Northing</u>	<u>Recommendations</u>
1		B	Culvert	Helen M/L	564436	6154593	Culvert is perfect for embedding material 30cm within pipe.
2			Culvert	Helen M/L	562846	6155961	No assessment required
3			Culvert	Helen M/L	561705	6156979	Not a fish stream. Rated seasonal stream. No assessment required.
4		B	Culvert	Helen FSR	559866	6157599	Clean inlet to create pool inlet.
5		B	Culvert	Helen Br 2000	560518	6156771	Embedded pipe; no action.
6		B	Culvert	Helen Br 2000	560529	6156821	No Action
7		B	Culvert	Helen Br 2000	560947	6155090	Remove pipe. Install 800mmx10m embedded pipe. Pool needed downstream. 2% slope on pipe
8			Culvert	Helen Br 2000	561051	6154784	No fish stream. Seasonal stream.
9		B	Culvert	Helen FSR	561226	6154414	Natural fish barrier upstream.
11	A		Culvert	Helen Br 1200	560390	6154515	No assessment required.
12	A	B	Culvert	Kuldo M/L 20 km	562221	6175343	Conduct Fish Stream Survey to confirm fish presence and value. If fish found replace structure with 1200mm arch pipe.
12			Culvert	Helen Br 2000A	561418	6155184	No assessment required.

13			Culvert	Helen FSR	561456	6155088	No assessment required
14			Culvert	Helen FSR	565817	6153041	No assessment required
15		P	Culvert	Helen Br 1200	565504	6152813	No Action
19		B	Culvert	Kuldo M/L	561803	6180436	Repair outlet of pipe for fish passage. Conduct Fish Stream Survey to confirm fish presence (80 cm fall 15m downstream of crossing.
21		PB	Culvert	Kuldo	561654	6118969	Low priority fish stream. Conduct Fish Assessment. Install arch pipe if fish present.
23		B	Culvert	Kuldo	562820	6178215	1200mm pipe bedded. No Action.
24		P	Culvert	Kuldo	563327	6178212	No action.
25		P	Culvert	Kuldo	563217	6180114	No action.
27		P	Culvert	Kuldo	561196	6181210	No action.
28		P	Culvert	Kuldo	560722	6180942	No action.
29		B	Culvert	Kuldo	561845	6180614	3 x 1-1.5m waterfalls downstream.
30		B	Culvert	Kuldo	562965	6181133	Embed if fish survey finds fish. Place gravel at outlet.
31		B	Culvert	Kuldo	564550	6179737	Flows into swamp/ pipe bent in middle.
32		B	Culvert	Kuldo	564078	6179399	No channel above inlet.
33		B	Culvert	Kuldo	564947	6179179	Conduct stream assessment. If fish observed embed pipe.
34		PB	Culvert	Kuldo	565237	6178577	1.5m Drop - 4m Downstream - stream goes underground
35		B	Culvert	Kuldo	565314	6178503	Stream assessment required. Embed culvert if fish above pipe.
36		B	Culvert	Kuldo	565402	6178441	Stream assessment required. 2-1 m exists at pipe. Embed pipe if fish found.
37		B	Culvert	Kuldo	565352	6178462	Several barriers above CK assess. Remove pipe if fish present.
38		B	Culvert	Itzul 610A	603474	6136385	Conduct Fish Stream Survey to confirm fish presence. If fish found embed pipe to provide passage.
39		B	Culvert	West	602940	6136349	Perform Stream Assessment

				Itzul			Replace with WBC (2x4m) if fish found.
40	A	B	Culvert	West Itzul	602605	6137057	No Action. Needs Fish stream survey.
40		P	Culvert	West Itzul	602824	6136756	Fish stream survey needed. If fish found embed pipe.
41		B	Culvert	Suskwa M/L	617088	6147731	Conduct Fish Stream Survey to confirm fish presence and value. No remedial action required.
42		P	Culvert	Suskwa	616999	6147860	No action, fish stream assessment
43		PB	Culvert	Suskwa	620469	6156894	No action NCD stream
44		B	Culvert	Suskwa M/L	620404	6158117	Conduct Fish Stream Survey to confirm fish presence and value.
45		B	Culvert	Suskwa 4600	618032	6152423	Replace structure with 1x2.5 m wood box culvert. Conduct Fish Stream Survey to confirm fish presence and value.
47		B	Culvert	Suskwa	620831	6156348	No action needed
48		B	Culvert	Suskwa 5500	620995	6156202	Replace structure with 1400 embedded culvert.
49		PB	Culvert	Suskwa	621484	6155217	1400 Pipe embedded, fish assessment required
50	A	PB	Culvert	Suskwa	621560	6155025	No Action
51		P	Culvert	Suskwa 5500	621378	6154546	Not a fish barrier. No action required.
52		PB	Culvert	Suskwa 5800	620649	6158113	Option 1: Complete deactivation of crossing. Option 2: Embed 2 x 1000 mm x 10 m pipes. Fish observed in stream.
53		B	Culvert	Suskwa 5800	621028	6157722	Option 1: Replace pipe with open bottom structure (wood box) or; Option 2: Deactivate crossing. Conduct Fish Stream Survey to confirm fish presence and value.
56		B	Culvert	Nichyes kwa	616690	6145830	Perform stream assessment.
57		B	Culvert	Nichyes kwa	617171	6145932	Perform fish stream assessment and embed pipe if fish found.
58		P	Culvert	Nichyes	617519	6146104	Looks & works well _ 100%

				kwa			embedded
59		B	Culvert	Nichyes kwa	620582	6148220	Replace present pipe with 1x4 m wood box culvert. Conduct Fish Stream Survey to confirm fish presence and value.
60		B	Culvert	Nichyes kwa	621095	6148549	1 Meter drop 20m downstream - drop inlet to 2%. Embed pipe. Fish Stream assessment required
61		PB	Culvert	Nichyes kwa	621404	6148650	Culvert disconnected. Erosion into pipe, upstream barrier exists.
62		PB	Culvert	Nichyes kwa	621909	6148575	Perform fish stream assessment.
63		B	Culvert	Nichyes kwa	622209	6148402	Fish (15cm long) in residual pool - 57 cm outlet drop forms fish barrier. Perform Fish assessment needed upstream. Replace culvert with WBC if fish found.
64		B	Culvert	Nichyes kwa	622578	6148372	No remedial action required. Structure is not a barrier.
65		B	Culvert	Nichyes kwa	623270	6148192	No Action
66		PB	Culvert	Nichyes kwa	624935	6147638	No Action
67		B	Culvert	Nichyes kwa	619707	6147245	No fish passage. Stream gradient >50% for 40 m downstream of crossing.
68		B	Culvert	Nichyes kwa	621464	6147010	No fish
69		B	Culvert	Nichyes kwa	623094	6146451	Perform Stream Survey. If fish found lower pipe to reduce outlet drop
70		B	Culvert	Nichyes kwa	623904	6145918	Install 1x4 m wood box culvert or 1400 mm open bottom culvert.
71		B	Culvert	Nichyes kwa	624351	6146027	Install 2 x 1400 mm embedded pipes.
72		B	Culvert	Nichyes kwa	624506	6146090	Install 1200 x 12m embedded pipe and conduct Fish Stream Survey to confirm fish presence and value.
73		B	Culvert	Nichyes kwa	624978	6145902	Install 1600mm x 16m embedded pipe. Conduct

							Fish Stream Survey to ensure fish presence and value.
40	A		Culvert	6010A 2.2 Km	602605	6137057	Conduct Fish Stream Survey to confirm fish presence and value.
50	A		Culvert	Suskwa 5500	621560	6155025	Replace structure with 1200 mm embedded culvert. Conduct Fish Stream Survey to confirm fish presence and value.

6.0 Discussion and Recommendations

6.1 Discussion

One of the major problems encountered in the completion of this project was that many of the sites listed to be visited were completely inaccessible. Maps showing the sites to be visited were compiled as a result of photo interpretation and historical road data. Unfortunately, many of the roads and sites were not able to be reached. Many times spur or branch roads had deteriorated so badly due to heavy ingrown brush or washed out that sites further up the road were not practical to access. Also, in many locations identified as stream crossings, the stream had completely changed location, dried up or was in fact a minor cross drain. As a result only 111 of the 170 sites in the Big Cedar drainage were visited. In the Williams Creek drainage 73 of the 235 sites were assessed. In the Hazelton drainage 69 of the 239 sites were able to be assessed. And in the Lakelse drainage 54 of the 348 sites were assessed. The Lakelse drainage proved to be the most difficult area to gain access mainly due to the large amount of private property surrounding the lake. The area has been heavily developed over the last 15 years and as a result much of the land around the lake is now private. Very little forestry activity has occurred in the Lakelse River valley in the last 20 years. As a result, most of the forest roads in the valley have grown in very heavily severely limiting access.

6.2 Recommendations

It was found that for most of the sites (those rated Very Low, Low, Moderate and High) that minimal effort would be required to mitigate these sites. Most of them would require mainly seeding or reinforcing by armouring the cut banks and ditch lines. In many places a maintenance schedule involving a road patrol and cleaning out plugged culverts to prevent road erosion and drainage diversions would suffice. Others (as described in the Tables) would require a more intensive effort such as replacing damaged or collapsed structures or building cross ditches across roads with long sloping erodible surfaces.

With the fish passage assessments it was determined and identified in the field data that many of the streams should have fish surveys completed on them before work begins. This is necessary in order to determine the fish values present in the stream before work begins.

7.0 References

Carson, B., Maloney, D., Chatwin, S., Carver, M., and Beaudry, P. 2007. Protocol for Evaluating the Potential Impacts of Forestry and Range Use on Water Quality (Water Quality Routine Effectiveness Evaluation). Forest and Range and B.C. Ministry of Environment, Victoria, B.C.

Carmanah Research Ltd., 1999. Integrated Watershed Plan including the Interior Watershed Assessment Procedure (IWAP), Sediment Source Survey (SSS), and Access Management Strategy (AMS) for the Cranberry River Watershed Report Prepared for Kispiox District Ministry of Forests. 58 pp.

Department of Fisheries and Oceans. 2000. Effects of sediment on fish and their habitat. DFO Pacific Region Habitat Status Report 2000/2001.

McCarthy, M., 2009. The 2008 Nass River Water Quality Effectiveness Evaluation (WQEE) Project (FIA Project # 2813006). 2009.

Parker, 2000. Fish Passage-culvert inspection procedures. Ministry of Environment and Lands and Parks. Watershed Restoration Technical Circular No. 11. 42 pp.

Zapisocki, Ryan. 2007. Water Quality Effectiveness Evaluations Nass TSA 2007/2008. Silvicon Services Inc.

8.0 Appendix I – Maps (attached as pdf.)

9.0 Appendix II – Digital Photos (attached as compact disc)

10.0 Appendix 10 – Fish Data Submission Form Spreadsheet (attached as Pdf.)