Gitanyow Fisheries

Authority

The 2006 Kitwanga River Fish Passage-Culvert Inspection and the Stream Crossing Quality Index Project

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April 10, 2007

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1. INTRODUCTION

The purpose of the 2006 Kitwanga River Fish Passage - Culvert Inspection (FPCI) and Stream Crossing Quality Index (SCQI) Project was to identify stream crossings within the Kitwanga River Watershed that could impede fish movement into upstream reaches and to assess the degree of sedimentation entering the stream from the surrounding roadway. For this project the Gitanyow Fisheries Authority (GFA) attempted to combine two independent assessments with the objective of compiling a large amount of data from a stream crossing in a single visit. The scope of this project only included Forest Service Roads under the B.C. Ministry of Forests jurisdiction.

The Kitwanga River is a major tributary of the Skeena River and is located within the Gitanyow Traditional Territory. Since its establishment in 1994, the GFA who represents the Gitanyow Hereditary Chiefs on fisheries related issues has been active in the stewardship of the Kitwanga River Watershed through a variety of fish and fish habitat assessment and enhancement initiatives.

The first component of the assessment was the FPCI, which documented the connectivity status at road crossings between important habitats such as tributary streams, lakes, and ponds. The FPCI assessment procedures were based on standards described by Parker (2000). Poorly placed culverts can restrict fish movement by creating excessive water velocity within a culvert and extreme plunge falls at the outlet. Culverts can be categorized into three fish-passage scenarios:

1. Full barrier - stops all fish at all flow stages,
2. Partial barrier - stops certain fish species or individual life stages, or stops movement at certain time of the year,
3. No barrier - allows fish passage year-round.

A velocity barrier exists when the water velocity exceeds the swimming capability of fish at any or all life stages according to the guidelines cited in Parker (2000, adapted from Katopolis and Gervais, 1991). Culverts without baffles should not have slopes exceeding 0.5 percent for culverts greater than 24 meters in length, and 1.0 percent for culverts less than 24 meters in length. Juvenile salmonids generally cannot swim through water flowing in excess of 0.5 meters/second. Most adult salmonids would have difficulty swimming at burst speed (maintained

for up to 165 seconds) through water flowing in excess of 6 meters/second, with the exception of adult steelhead trout that can swim through water flowing at 8 meters per/second. Height barriers exist when they exceed the jumping ability of fish at any or all life stages according to the guidelines cited in Parker (2000, adapted from Whyte et. al., 1997). In general, pool depth must be at least 1.3 times greater than the jump height. Juvenile salmonids would have difficulty jumping heights exceeding 0.5 meters. The maximum jump height for adult salmonids depends on species: steelhead trout (3.4 meters), coho and chinook salmon (2.4 meters), sockeye salmon (2.1 meters), chum and pink salmon (1.5 meters).

The second component of the assessment was the SCQI, which documented the degree of sediment input from the crossing including the road surface, ditchlines, and road fill. The SCQI survey procedures were based on standards described in Beaudry et. al. (2006), which is a modification of the original version developed by Beaudry et. al. (2004). The survey systematically assesses the sediment delivery potential of a road crossing by evaluating the size and characteristics of road related sediment sources and the likelihood of the eroded material reaching the stream.

A maze of road networks have been created in the Kitwanga River Watershed since logging began in the mid 1960's (Hampshire and Torunski, 2001). A total of 229 stream crossings on Forest Service Roads (FSR's) were identified on 1:20,000 TRIM mapsheets. Most of these roads were built to minimal standards prior to the implementation of the Forest Practices Code in 1995 that introduced more fish-friendly protocols to road building activities. In addition to FSR's, 71 road crossings were identified on public and private road systems. Prior to this FPCI/SCQI survey, the most recent stream crossing survey was completed in 1999 by GFA. GFA decided it worthwhile to amass a current and comprehensive watershed-wide inventory of stream crossing structures in the Kitwanga River Watershed. This project was an initial phase leading to potential remedial works and follow-up monitoring of all crossings deemed as fish barriers and/or potential sediment sources.

Field crews were able to cover the majority of the watershed through access from 12 FSR's. Problematic crossings were then prioritized based on benefits gained by remediation in opening new habitat and/or by reducing sedimentation impacts. In addition to culvert crossings, bridge and deactivated crossings were visited and assessed for potential maintenance problems and sedimentation sources. An early onset of winter prevented several crossings from being assessed

that were shown in previous studies to have high erosion potential; these should be assessed in the 2007 field season: Deuce Creek / Deuce Creek FSR (Hampshire and Torunski, 2001) and Tributaries 64, 68,70, 71, and 73 / Ronald MacDonald FSR [also referred to as Dog Main FSR; Biolith (1999)].

Results of this assessment will be used to initiate funding of remedial works in 2007 and beyond from the various stakeholders responsible for road maintenance within the Kitwanga River Watershed.

2. DESCRIPTION OF THE STUDY AREA

The Kitwanga River Watershed is bounded to the west by the Nass Mountain Range, to the east by the Kispiox Mountain Range, and to north by the Cranberry River Watershed. The Kitwanga River drains towards the south into the Skeena River near the village of Kitwanga, B.C. (UTM 09055840 N, 6106300 E). It is a fifth order stream with a mainstem length of approximately 61 km and an average channel width of 15 m (5-40m). The river is comprised of the Upper Kitwanga River and the Lower Kitwanga River, with the divide being Gitanyow Lake (also referred to as Kitwancool or Kitwanga Lake). The Lower Kitwanga River has a mainstem length of approximately 36 km and receives drainage from four major tributaries: Tea Creek, Deuce Creek, Kitwancool Creek and Moonlit Creek (Figure 1). The bed material in the lower Kitwanga River mainstem is comprised predominantly of cobble and gravel, which provides high quality spawning habitat for salmonids. The Upper Kitwanga River has a mainstem length of approximately 25 km and has no major fish-bearing tributaries. A barrier falls is located approximately 12.5 km upstream of Gitanyow Lake and all reaches above these falls are considered non-fish bearing. The reach directly above Gitanyow Lake is a wetland complex that provides high quality habitat for beavers. Beavers in this area significantly influence the system by restricting water flow and fish passage. Beaver dams cause extensive flooding, which has frequently altered the mainstem channel (McCarthy et. al. 2003). Gitanyow Lake is located to the north of Gitanyow Village. It has a surface area of 780 hectares and drains a watershed area of approximately 169 km². It receives flow from the Upper Kitwanga River and several other smaller streams mostly concentrated on its west side. Gitanyow Lake is considered one of the ten important Skeena sockeye salmon producers (Cox-Rogers et. al. 2003).

Biologically the Kitwanga Watershed is extremely rich, with an abundance of high valued fish habitat. It supports the following species of salmonids (Gottesfeld et al. 2002):

- Sockeye / Kokanee Salmon (*Oncorhynchus nerka*)
- Chinook Salmon (*O. tshawytscha*)
- Pink Salmon (*O. gorbuscha*)
- Chum Salmon (*O. keta*)
- Coho Salmon (*O. kisutch*)
- Steelhead / Rainbow Trout (*O. mykiss*)
- Cutthroat Trout (*O. clarki*)
- Dolly Varden (*Salvelinus malma)*
- Bull Trout (*Salvelinus confluentus*)
- Mountain Whitefish (*Prosopium williamsoni*).

A total of 12 Forest Services Roads (FSR's) were assessed for problematic stream crossings. This survey excluded crossings along Highway 37 N and East Kitwancool Lake Road, as they were not under MOF jurisdiction. The 12 FSR's and their locations are as follows:

- Kitwancool (26 Mile) FSR – access west of Highway 37 N (Km 42) or west of the north access road to Gitanyow Village, parallels the west side of Kitwancool Lake,
- Kitwanga FSR - access from Kitwancool FSR (Km 1); parallels the south side of the Upper Kitwanga River,
- Jackson Main FSR – access from Kitwanga FSR (Km 11); crosses the Upper Kitwanga River 500 meters from junction,
- Ronald MacDonald FSR (also referred to as Dog Main FSR)– access from Jackson Main FSR (Km 0.8); parallels the north side of the Upper Kitwanga River,
- Weber FSR - access north of Kitwancool FSR (Km 1), crosses the upper Kitwanga River at Km 3.0 before entering the Cranberry River Watershed,
- 27 Mile FSR - access east of Hwy 37 N (Km 43),
- 25 Mile FSR - access east of Hwy 37 N (Km 41),
- 24 Mile FSR - access east of Hwy 37 N (Km 39),
- 13-Mile FSR - access east of Hwy 37 N (Km 22),
- Mill Lake FSR - access west of Highway 37 North (Km 16), crosses the lower Kitwanga River at Km 1 then runs northerly towards Deuce and Kitwancool Creeks,
- Tea Lake FSR - access east of Highway 37 N (Km 9),
- Canoe Creek FSR –access north of Tea Lake FSR (Km 4.2).

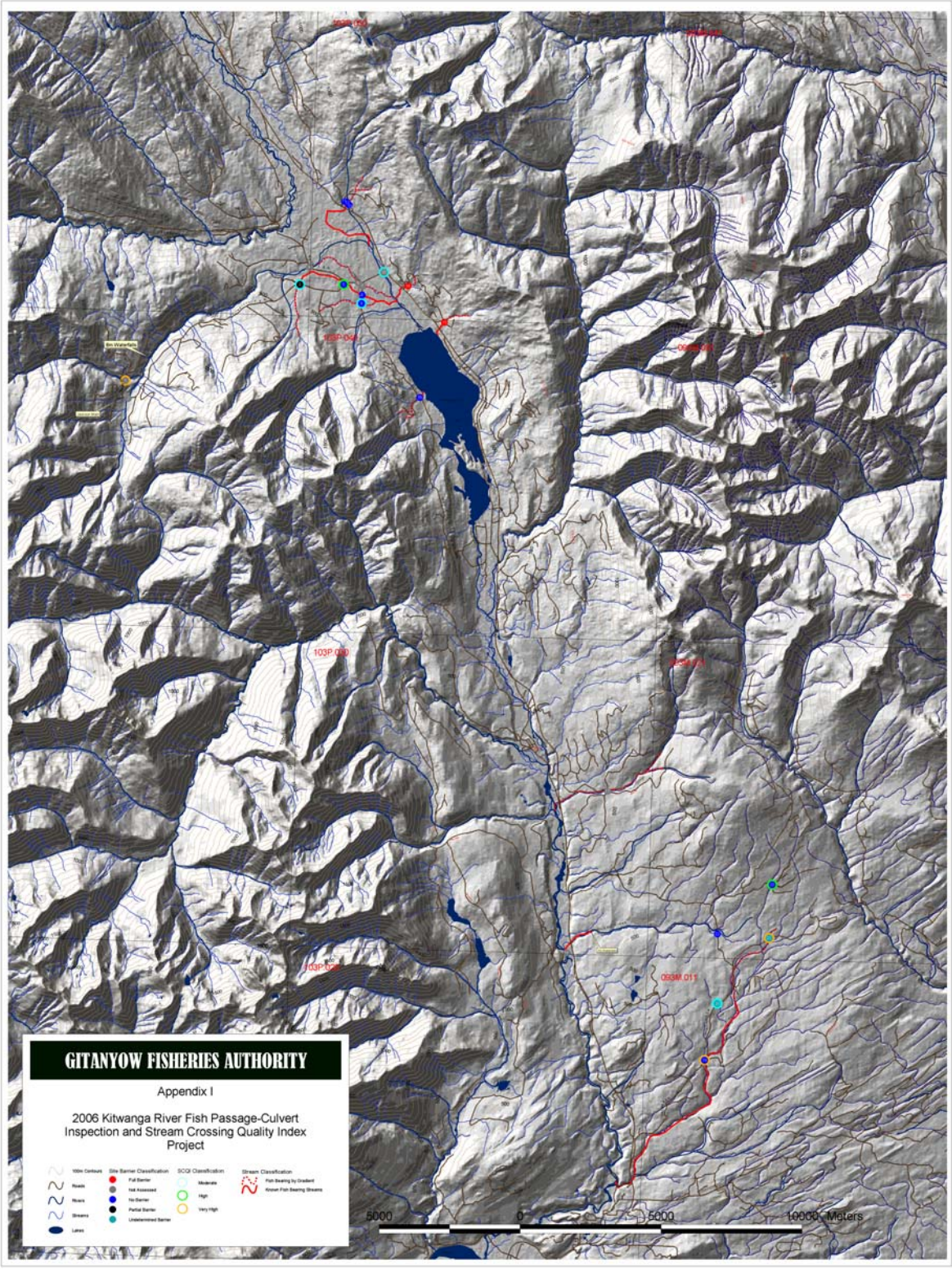

Figure 1: Map of the Kitwanga River Watershed Study Area

3. METHODS

Two independent assessments were carried out at 23 stream crossings. The first assessment, the Fish Passage - Culvert Inspection (FPCI) Procedures was carried out according to the guidelines described in Parker (2000). The second assessment, the Stream Crossing Quality Index (SCQI) was carried out according to the guidelines described in Beaudry et al. (2006). For the purposes of this report, the FPCI was considered the primary survey and the SCQI was considered as supplemental survey that complements the FPCI.

The FPCI and the SCQI was undertaken between October 12 and November 11, 2006 when young-of-the-year salmonids were of sufficient size to be captured by Gee trapping and electrofishing. The objective was to characterize stream-crossing structures and nearby fish habitat in an attempt to identify barriers based on water velocity and outflow drop (FPCI) and to identify sedimentation sources that could degrade fish habitat (SCQI). Barrier sites were sampled for fish presence and fish habitat quality near the crossing structure. The intention of this survey was to assess all roads that cross potential fish bearing waters, therefore this survey focused mainly on year-round streams with a wetted width of one meter or greater.

All stream crossings in the Kitwanga River watershed were identified on 1:20,000 TRIM mapsheets including Forests Service roads, MOT highways and roads, and private roads. These sites were assigned unique identifier numbers to be used in a GIS database. The database includes all fields in the FPCI and the SCQI field data forms.

Tributary streams with gazetted names include Tea Creek, Earl Creek, Deuce Creek, Ace Creek, Kitwancool Creek, Ten Links Creek, Moonlit Creek and Cher Nobel Creek. Approximately 80 streams are unnamed. For the purpose of this report tributaries were assigned the same identifier numbers used in WRP Level I surveys by Biolith (1998; South Kitwanga River - Tributaries 1 to 23) and Biolith (1999; North Kitwanga River – Tributaries 32 to 80). Unnamed tributaries draining into the west side of the Kitwanga River between Kitwanga Lake and the Skeena River confluence were not assessed under WRP and remain unnamed in this report.

3.1 Pre-Field Planning

Prior to entering the field, 1:20,000 TRIM mapsheets were produced for the entire watershed showing waterways, road networks, and 20-meter contour intervals. All stream crossings were identified on the maps and given temporary site numbers. On these maps, stream reaches with gradients exceeding 20 percent were highlighted and all reaches downstream were considered as potentially fish bearing unless a confirmed fish barrier existed. Literature was reviewed for information relating to streams with confirmed fish presence and locations of impassable barriers then noted on field maps.

3.2 Field Assessment

At each site, data was collected on the geographical location, crossing structure characteristics, fish habitat quality, and fish usage. In addition, the roadway on either side of the crossing was assessed for sedimentation potential including the road surface, ditches, and road fill. Afterwards the site was designated as either a full or partial barrier or as no barrier at all, and all sedimentation sources were identified. Other information collected included road and stream name, GPS location, 1:20,000 mapsheet number, and the watershed code. In addition, photographs were taken of the crossing structure, stream channel, and immediate roadway.

In the field, information was recorded on two independent data forms adopted from Parker (2000) for collecting FPCI data and from Beaudry et al. (2006) for collecting SCQI data. The FPCI survey was considered the primary information base, with the SCQI survey as the supplemental information base. The two surveys were linked by inserting the sediment score from the SCQI data form into the Sediment Source/Degree field on the FPCI data form. The final report outline used the FPCI format, with the SCQI information presented in the section "Other Priority Crossings" which details any sedimentation or maintenance issues at the crossing.

3.2.1 FPCI

Data as recorded on Form A field cards provided by Parker (2000). The culvert was measured for dimensions, flow rate, slope, and outflow drop. Streams were measured for flow rate, gradient, habitat quality, and pool depth at outflow. In addition any sedimentation sources and maintenance problems were identified. If the crossing structure was deemed a full or partial barrier according to the Parker (2000) guidelines, the site was sampled for fish presence using

baited "Gee" traps. A backpack electrofisher was made available if "Gee" trapping was unsuccessful.

3.2.2 SCQI

The SCQI is a relative measure of the sediment delivery potential of a road crossing by evaluating the size and characteristics of road related sediment sources and the likelihood of the eroded material reaching the stream. A sediment score value was calculated and the transferred to the Sediment Source/Degree field of the FPCI. The FPCI defined sedimentation sources as either present or absent and the degree was defined subjectively as high, medium, or low. By replacing this field with the results of the SCQI, a more quantitative representation of the sediment delivery potential is achieved.

The portion of roadway that draws water into a stream was divided into eight distinct elements: left road running surface, left back ditch, left front ditch, right road running surface, right back ditch, right front ditch, back fill, and front fill. Left and right road is relative to the observer facing downstream. For each element, score modifiers were assigned and entered onto site cards designed by GFA based on Beaudry et al. (2006) guidelines.

Sediment Score Modifiers (Beaudry et al., 2006) are defined as follows:

1. Sediment Source Area (m^2)– total area of the individual element; score increases as sediment source area increases; score is calculated as 0.02 times the area,
2. Effective Sediment Area (%) – the percentage of the sediment source area not comprised of non-erodible material such as bedrock, forested floor with developed litter, fermentation, and humus (LFH) layer, and 100% grass layer with developed humus layer; score increases as effective sediment area increases,
3. Percent Erosion Control (%) – the percentage of non-erodible cover comprised of grass, shrubs, stones, and gravel,
4. Soil Texture – dominant soil particle size; the score increases as soil particle size decreases (i.e. fine textured soil is more erodible than course textured soil); note: guidelines in Beaudry et al. (2004), and Beaudry et al. (2006) classified soil texture classes into 3 compaction level categories, however there appeared to be an error in the scoring system as low compaction soil was given a lower value than moderate compaction soil – low compaction soil is more erodible therefore should be assigned a

higher value. For the purpose of this report, all soil texture values are derived from the medium compaction column, which gives the highest score of all the compaction classes.

5. Road-use Level – range from active to deactivated; score increases as road use level increases; assigned to road surface elements only (this may differ from Beaudry et. al. (2006) who may have assigned this modifier to all elements),
6. Slope (%) – gradient of the element draining into the stream; score increases as slope increases,
7. Ditch shape – trench shape (V or U) and side slope gradient (flat to very steep); score increases when ditch is "V" shaped and as the side slope gradient increases; assigned to ditch elements only.
8. Sediment Control Size/Type/Effectiveness – sediment delivery potential of ditches that may be affected by the presence and density of sediment control features such as retention ponds and filters; score decreases if sediment control features are present.
9. Sediment Control Location – location of the sediment control structure in relation to the stream; score increases as the distance of the sediment control feature from the stream increases.

Note: three additional modifiers were included in Beaudry et al. (2006) that were not mentioned in the original procedures described in Beaudry et al. (2004): effective sediment area, sediment control size/type/effectiveness, and sediment control location.

3.3 Data Analysis

Fish passage status was determined using the Parker (2000) guidelines and sediment deliver potential was determined in an independent survey using the Beaudry et al. (2006) guidelines. Steam crossing sites were then ranked according to the benefits gained by remediation. A 1:50,000 TRIM mapsheet was produced showing the site location along with its FPCI/SCQI classification.

3.3.1 FPCI

After completing the field assessments, a site were grouped into one of the following five categories:

1. Full or Partial Barrier - based on excessive water velocity inside the culvert and/or jump height at the culvert outlet for a salmonid at any life stage.
2. Well-Placed Culverts - culverts that allow year-round passage of salmonids of all life stages.
3. Other Priority Crossings - crossing structures that are not barriers but have maintenance issues such as bent, broken, or plugged culverts or have erosion and sedimentation issues (i.e. high SCQI score),
4. Bridges or deactivated crossings not requiring full FPCI survey, but underwent the SCQI survey,
5. Undetermined Barrier - Full or Partial Barriers with no confirmed fish presence,

Crossing sites consisting of culverts deemed as full or partial barriers were analyzed in detail including Q100 (100 year flood potential) calculations and proper culvert dimensions that will accommodate a 100 year flood event. The Q 100 and optimal Q100 culvert diameter formulae is as follows (Parker, 2000):

$$\mathbf{A = ((Ww+Wbf) * Dbf) / 2}$$

Where A = bankfull area at average annual peak
Ww = mean wetted width
Wbf = mean bankfull width
Dbf = mean bankfull depth,

Then Q100 is calculated as:

$$\mathbf{Q100 = 3 * A}$$

Then optimal culvert diameter is calculated as:

Total round culvert diameter required = Q100 * 1.16

Total elliptical culvert diameter required = Q100 * 1.25

Barrier sites were given a ranking score based on fish species presence, full or partial barrier, habitat quality, amount new habitat gained by remediation, and the percentage of stream barred (priority ranking classes- High 55-39, Moderate 38-26, Low 25-15). A list of barrier sites was then compiled in order of their ranking score to be used later for prioritizing future remedial works.

Fish Species		Habitat Value		Barrier Type		Length of New Habitat		Stream Barred		Limiting to Upstream Barrier	
Multiple or Significant	10	H	10	Full	10	>1 km	10	>70%	10	Yes	5
Single	6	M	6	Partial	6	0.5 to 1 km	6	51 to 70%	6	No	0
Other	3	L	3	Undeter.	3	< 0.5 km	3	<50%	3		

Multiple or significant species refers to either two or more salmonid species, or a regionally significant blue or red listed species; single species refers to a single salmonid species; other species refers to course fish species. Limiting to upstream barrier refers to a barrier crossing located upstream.

3.3.2 SCQI

An element score was calculated as the product of each modifier:

Element Score = SS x %E x EC x TC x RU x SL x DS x D

Where: SS = Sediment Source Area
%E = Effective Sediment Source
EC = % Erosion Control
TC = Textural Class
RU = Road Use Level
SL = Slope
DS = Ditch Shape
D = [1-(Sediment Control Size/Type/Effectiveness x Sediment Control Location)]

The total SCQI score was calculated as the sum of the element scores, then ranked into five groups ranging from none to very high degree of sedimentation (Beaudry et. al., 2006): None = 0 - 0.1, low = 0.1 - 0.3, moderate =0.3 - 0.7, high = 0.7 - 1.6, and very high = >1.6. Finally, the crossing score and its ranking was entered into the Sediment Delivery/Degree field if the FPCI data sheet.

3.4 Reporting

The outline for this report was based on the FPCI guidelines. Results describe firstly, the culvert crossings identified as fish barriers, and secondly, other priority crossings that exhibited sedimentation and/or maintenance problems. In the section Culvert Crossings- Full or Partial Barriers, information from FPCI site cards from barriers crossings is summarized including priority ranking, fish presence, nature of the barrier, and fish habitat quality. In the section Other Priority Crossings, information from the SCQI site cards is summarized for crossings ranked as moderate to very high degree of sedimentation, including the road elements that contribute the most to the sediment score. Maintenance issues include blocked, bent, collapsed, and rusted culverts and problematic beaver activity all of which has the potential for creating a fish barrier or causing a road washout.

4. RESULTS

A total of 23 stream crossings were assessed in the Kitwanga River Watershed including 14 culverts, 8 bridges, and 1 deactivated crossings. A 1:50,000 TRIM in is presented in Appendix I showing site locations, mapsheet index; waterways, road networks, 100 meter contour intervals, barrier status, and sediment degree. The final report, data forms in Excel format, 1:50,000 TRIM, and site photos are presented digitally on CD in Appendix IV.

Complete FPCI assessments were not required at bridge and deactivated crossings. However, general information was collected at a total of eight bridges and 1 deactivated crossing including site photographs, GPS coordinates, stream and road name, sedimentation sources (SCQI rating) maintenance issues, and problematic beaver activity.

4.1 Fish Passage-Culvert Inspection (FPCI)

Three culvert crossings were identified as either a full barrier (two sites) or a partial barrier (one sites) on fish bearing streams. An additional two culvert crossings were deemed as fish barriers but were located on suspected non-fish bearing streams (suspected non-fish bearing streams require further assessment for confirmation). Nine culvert crossings were assessed as suitable for fish passage, however six of these were in need of maintenance or sedimentation control.

4.1.1 Culvert Crossings - Full or Partial Barriers

Three culvert sites were ranked according to FPCI score (Table 2) and of these, to sites were classed as moderate priority (ranking score of 28) and one site was classed as low priority (ranking scores of 25). The following section provides a brief description of each barrier site in order of priority ranking.

Table 1: Form B - FPCI Summary Table

Site Number	Road Name	Priority Rank	Score	Barrier	Stream Length Gained (m)	% Stream Barred	MOF Eligible	Q100 Culvert Diameter Required	
								Round	Oval
3	Kitwanga FSR	Moderate	28	Partial	1800	31	Yes	1600	2130x1400
14	25 Mile FSR	Moderate	28	Full	800	50	Yes	1200	1350x870
15	24 Mile FSR	Low	25	Full	300	38	Yes	1200	1350x870

Site 3 (Cher Nobel Creek / Kitwanga FSR - Km 3.3)

Site 3 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 28; Photos 1 and 2). The road crosses Cher Nobel Creek approximately 4 kilometers upstream of the Upper Kitwanga River confluence. Three cutthroat trout was captured in "Gee" traps below the culvert, while 2 cutthroat trout were captured upstream.

This twin culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered steep (3 percent) creating high water velocity (1.57 meters/sec). The water velocity exceeded the swimming capability of juvenile salmonids. A deep scour pool below the culvert provided good fish habitat. The Q100 culvert diameter was calculated to be 1600 millimeters for a round culvert, which is the same as the combined diameters of the two culverts currently in place (800 millimeters each). The fill depth above the culvert was 0.5 meters.

The stream habitat value was considered poor since the stream was comprised mainly of shallow riffles with minimal deep pool habitat (average 14 percent gradient / 1.63 meter wetted width). Upstream and downstream of the culvert, the stream descends down a moderate grade through an old cut blocks that were logged to the steam banks. The total length of stream barred was estimated at 1.8 kilometers, representing 31 percent of the total stream length. The average gradient of the barred section is moderately steep at approximately 10 percent.

Photo 1: Site 3 looking downstream at culvert inlet – velocity barrier to juvenile salmonids.

Photo 2: Site 3 looking upstream at culvert outlet – velocity barrier to juvenile salmonids.

Site 14 (Unnamed Stream / 25 Mile FSR – 0.3 km)

Site 14 was assessed as a full fish barrier and classified as a **moderate priority** crossing (FPCI Score = 28; Photos 3). The road crosses an unnamed tributary (WRP Tributary 54) approximately 800 meters upstream of the Upper Kitwanga River confluence. Twelve cutthroat trout were captured in "Gee" traps downstream of the culvert, and three cutthroat trout were captured upstream. It is possible that a self-sustaining population exists upstream of the barrier crossing.

This crossing was considered a full barrier due an absence of water in the culvert (water was flowing under culvert through log corduroy) and a suspended culvert outlet. The culvert slope was considered steep (5 percent), and would likely create excessive water velocity if it actually contained water. The culvert outlet drop was unsuitable for fish passage (71 centimeter drop / 11 centimeter outfall pool). The Q100 culvert diameter was calculated to be 1200 millimeters for a round culvert, which is twice the size of the 600-millimeter diameter culvert currently in place. The fill depth above the culvert was 0.75 meters.

The stream habitat value was considered poor since the stream was comprised mainly of shallow riffles downstream of the culvert and a cascade/riffle/shallow pool complex upstream (average 7 percent gradient / 1.2 meter wetted width). The riparian area has been logged to the stream bank at numerous points both upstream and downstream of the crossing. Approximately 200 meters downstream of this crossing is Hwy 37 and further downstream is a slow moving low gradient reach containing a series of beaver ponds. The condition of the Hwy 37 N crossing is unknown. Upstream of the culvert the gradient increases sharply and small rock/wood debris jams occur frequently, which may limit the upstream movement of juvenile salmonids on a temporary basis. The total length of stream barred was estimated at 800 meters (50 percent of the total stream length). The average gradient of the barred section was moderately steep at approximately 12 percent.

Photo 3: Site 14 looking at dry suspended culvert and water flow through log corduroy below – barrier to all fish.

Photo 4: Site 14 looking at cross ditch flagging. Road was scheduled for deactivation but had not been carried out.

Site 15 (Unnamed Creek / 24-Mile FSR - Km 0.4)

Site 15 was assessed as a full fish barrier and classified as a **low priority** crossing (FPCI Score = 25, Photos 5). 24-Mile FSR crosses this unnamed creek (WRP Tributary 53) approximately 500 meters upstream of the Kitwanga River confluence. Two cutthroat trout were captured in "Gee" traps downstream and one cutthroat trout was captured upstream. It is possible that a self-sustaining population exists upstream of the barrier crossing.

This crossing was considered a full barrier due to the excessive water velocity inside the culvert and an excessive outflow drop. The culvert slope was steep (9 percent), creating a water velocity of 1.16 meters/second over an 8-meter distance, which exceeded the swimming capability of most juvenile salmonids. Also, the culvert outlet drop was unacceptable for fish passage (40 centimeter drop / 14 centimeter outfall pool). The Q100 culvert diameter was calculated to be 1200 millimeters for a round culvert, which is twice the size of the 600-millimeter diameter culvert currently in place. The fill depth above the culvert was 1.5 meters.

The stream habitat value was considered poor since the stream was comprised mainly of shallow riffles above and below the culvert with minimal woody debris and deep pool habitat (average 9.5 percent gradient / 1.21 meter wetted width). The total length of stream barred was estimated at 300 meters, which represented 38 percent of the total stream length. Highway 37 crosses this stream approximately 250 meters downstream and the culvert was considered a barrier to juvenile salmonids due to a suspended outlet (Biolith, 1999). The average gradient of the barred section was very steep at approximately 19 percent.

Photo 5: Site 15 looking at suspended outlet – barrier to all fish (24-Mile FSR Km 0.4).

4.1.2 Problem Culverts on Suspected Non Fish-Bearing Streams

Two culvert crossings were identified as fish barriers, however the streams were suspected to be non-fish bearing. The intake was plugged at Site 20 (Tea Creek tributary, Canoe Creek FSR – Km 2.4) leaving the culvert near dry, however the 3% slope gradient of the culvert may create a velocity barrier during normal flows. "Gee" traps did not yield any fish either upstream or downstream. Electrofishing was planned for the downstream reach, however the early onset of winter prevented a more thorough assessment. At Site 21 (Tea Creek headwaters, Canoe Creek FSR – Km 4.0 - Branch 1.5 Km), the outlet was suspended on a wooden box culvert, however the stream was dry at the time of the survey.

4.2 Other Priority Crossings

Other Priority Crossings are those that exhibited sedimentation and/or maintenance problems. A total of nine crossings were identified in the moderate to very high SCQI category and a total of 11 crossings had maintenance problems (Appendix II).

4.2.1 Sedimentation Potential (SCQI Rating)

Sedimentation sources in the moderate to very high SCQI scoring category were encountered at six culverts, two bridges, and one deactivated crossing. The remaining sites were ranked as low degree of sedimentation due to advanced vegetative cover over most of the road elements and/or high sand and gravel content of the exposed ground.

4.2.1.1 SCQI Ranking: Very High

Three crossing sites were ranked in the very high SCQI category. Two of these roads crossed Tea Creek: Site 21 located near its headwaters (SCQI = 6.2; Canoe Creek FSR Km 4 - Branch 1.5 km), and Site 19 located 6 km downstream (SCQI = 5.0; Tea Lake Road Km 4.2). Site 21 ranked very high due to high soil exposure in the left back ditch, which is V shaped and moderately steep (6 percent, Photo 6). Site 19 ranked very high due to high soil exposure in the left back ditch, which has a steep gradient into the stream (13 percent) and a steep cut bank. The right front ditch, which comprises a large area with moderate vegetative cover, has a moderately steep gradient (5 percent). The third site with a very high SCQI ranking was Site 1 (SCQI = 1.75, Ronald MacDonald FSR Km 0.5), mainly due its right back ditch that has a large, mostly exposed cut bank (Photo 7). Although soil exposure is high, this cut bank appears stable, as there was no evidence of mass sediment transport into the stream.

4.2.1.2 SCQI Ranking: High

Two sites were ranked in the high SCQI category. The right back ditch at Site 23 received a relatively high element score due to its sparse vegetative cover over a large cut bank. This crossing has recently been deactivated, and while one element scored high, the remaining elements were well vegetated. The second crossing that ranked high, Site 5, received a high score mainly due to its moderately vegetated right back ditch that extended for 450 meters.

4.2.1.3 SCQI Ranking: Moderate

Four sites were ranked in the moderate SCQI category. Three crossings (Sites 3, 9, 10) are in close proximity to each other in the Upper Kitwanga River area and the fourth crossing (Site 20) is located on Canoe Creek FSR. Each crossing had only one or two relatively high scoring elements: Site 3 - left front ditch, Site 9 - both back ditches, Site 10 - right back ditch, and Site 20 – both left road ditches.

4.2.1.4 SCQI Ranking: Low or None

Fourteen sites were ranked in the low or none SCQI category. Generally these sites were well-vegetated or consisted of course textured soil over most of its elements and all were located on low-use roads. In most cases the only exposed soil was on the road surface, which consisted of course grain non-erodible material. A dense vegetative cover had become established along the road margins and centerline.

4.2.1.5 Seeding Requirements

The total area requiring grass seeding was calculated for the nine sites in the moderate to very high SCQI categories (excluding the road running surface; Table 2). In total, approximately 13,000 m^2 requires seeding to bring the SCQI scores down to low or none. The largest areas were at Sites 10, 19, and 21, which each requires approximately 3,000 m^2 of grass seed.

Table 2: Sites ranked in the moderate to very high SCQI categories and the area requiring seeding.

Site #	Location	Sedimentation (SCQI)	
		Ranking	Seeding Area (m^2)
1	Ronald McDonald FSR (Km 0.5)	Very high	400
3	Kitwanga FSR (Km 3.3)	Moderate	900
5	Kitwanga FSR (Km 1.7)	High	900
9	West Kitwancool Lake FSR (Km 1.8)	Moderate	600
10	Kitwancool FSR (Km 0.1)	Moderate	3,000
19	Tea Lake FSR (Km 4.2)	Very high	3,150
20	Canoe Creek FSR (Km 2.4)	Moderate	530
21	Canoe Creek FSR (Km 4.0-Branch 1.5 km)	Very high	2,950
23	Canoe Creek FSR - Deactivated (Km 7.5-Branch 1.1 km)	High	300
		Total	12,730

Photo 6: Site 21 looking at left road. SCQI = 6.2 (very high ranking).

Photo 7: Site 1 looking at large exposed cut bank on right back ditch. SCQI = 1.8 (very high ranking).

Photo 8: Site 23 looking at exposed cut bank on right back ditch.

Photo 9: Site 10 looking at stream flowing along right back ditch.

4.2.2 Maintenance Requirements

A wide variety of maintenance issues were encountered during this survey. Beaver dams were the major maintenance issues at five culvert crossings (Sites 5, 8, 9, 20, and 22; see Photo 10 and 11 – Site 20 and 22 respectively for examples) and one bridge crossing (Site 7), while culvert intakes plugged by mud/rock/woody debris jams were encountered at two culvert crossings (Sites 15 and 21). Beaver dams and plugged culvert intakes were given high priority status because of their potential to cause fish barriers or road washouts that could lead to sedimentation downstream. A secondary culvert was damaged at the intake at Site 9, likely from a hoe machine attempting to clear the blockage. The crossing at Site 16 had a partially collapsed culvert but did not appear to impede fish passage.

Photo 10: GFA technician cleaning culvert intake that was plugged by beavers at Site 20 (Canoe Creek FSR – Km 2.4).

Photo 11: GFA technician clearing culvert intake that was plugged by beavers at Site 22 (Canoe Creek FSR – Km 2.4).

Photo 12: GFA technician clearing back-ditch that was dammed by beavers at Site 9 (Kitwancool FSR – Km 1.8)

4.2.3 Watershed Inventory of Stream Crossings

A total of 300 stream crossings were identified in the Kitwanga River watershed including 229 crossings under MOF jurisdiction (including the 23 sites assessed in 2006) and 71 crossings under MOT jurisdiction or are located on private land (see map in Appendix I for site locations). A total of 67 FSR crossings were visited but not assessed due to poor fish habitat conditions or the structure did not impede fish passage:

a) Small size and steep gradient (<0.5 m wetted width and approaching 20% slope or greater– 17 sites),
b) Small size with acceptable gradient (<0.5 m wetted width - 17 sites)
c) Streams not located in the field - possible mapping errors (20 sites),
d) Dry channels (7 sites) or,
e) Bridge or deactivated crossing (2 sites).

An additional 4 sites were visited with a wetted width of greater than 0.5 meters, and although a FPCI/SCQI survey was planned, the early onset of winter prevented their assessment.

A total of 210 sites were not visited due to either poor access, insufficient time, or they were not under MOF jurisdiction. However, some information on site conditions was gathered on 110 stream crossings from WRP reports (Biolith 1988, 1999):

a) Small seasonal stream with no significant fish habitat (91 sites),
b) Stream not found in field - possible mapping error (15 sites),
c) Kitwanga River mainstem crossings (4 sites), and
d) Unknown condition (100 sites).

5. DISCUSSION

The Kitwanga River Fish Passage - Culvert Inspection project was successful in identifying three culverts that were either full or partial barriers and nine stream crossings that ranked from moderate to very high degree of sedimentation. Fortunately, these streams were classified mainly as poor quality fish habitat (small streams comprised mainly of shallow riffles with a minimal amount of deep pool habitat). During the survey the only fish species captured near crossing structures deemed as barriers were cutthroat trout. Although all fish species are considered valuable, the FPCI priority score for barrier sites ranked as either moderate or low priority suggesting that the benefits gained by remedial action would be marginal. In general, FSR crossings over the Kitwanga River mainstem and all its tributaries considered high value fish habitat was bridged. Numerous stream crossings along Highway 37 have been documented as fish barriers, however they were outside the scope of this survey since they were not under BC MOF jurisdiction.

Since 2003, logging activity in the watershed has been minimal following the collapse of Skeena Cellulose, the major forest development company operating in the watershed. At the time of this survey the only active logging road was Tea Lake FSR and its crossing over Tea Creek was ranked as very high sediment deliver potential. Other mainline FSR's such as the Canoe Creek FSR, Mills Lake FSR, Kitwancool FSR, Weber FSR were all in a poorly maintained condition (i.e. frequent ruts and potholes, downed trees, encroaching shrub growth). At the time of the survey by mushroom pickers, and hunters mainly used these roads.

Maintenance issues were evident at many stream crossings. These include culverts partially blocked by wood/dirt debris or by beaver dams, and culverts that are bent or collapsed. Blocked culverts can cause fish barriers through a structure that normally would allow for fish passage. In addition, blocked culverts have the potential to cause roadbed washouts and subsequently result in sedimentation of the stream. Since there is minimal commercial logging traffic on most of the road systems, maintenance problems leading to road washouts are likely to go unnoticed.

Sedimentation sources at stream crossings were minimal at 14 of the 23 sites assessed, consisting mainly of exposed patches of course sands and gravel. Nine sites received moderate to very high SCQI ranking and of these eight sites were located in the Tea Creek or the Upper Kitwanga River

drainages. For the most part, rehabilitation of these sites can be achieved by simple grass seeding. A steep cut bank at Site 1, and steep ditchlines at Sites 10, 19, and 21 may require a road engineer to prepare a stabilization plan.

6. CONCLUSION AND RECOMMENDATIONS

This survey identified three fish barriers in the moderate to low priority categories, and nine sedimentation sources in the moderate to very high categories. There are many worthwhile opportunities for future works that would greatly improve fish passage and reduce sediment delivery. Firstly, non-essential roads should be deactivated where they cross fish-bearing waters. Secondly, significant sediment sources should be seeded with grass to provide more erosion control. Thirdly, essential roads currently in use should be monitored periodically at all crossings on fish-bearing streams. Fourthly, future road should be designed to include only bridges or open-bottom culverts on all fish bearing streams. Lastly, information on fish distribution patterns in many unnamed streams is poorly documented, particularly in the Upper Kitwanga River basin. These streams should be assessed in detail in order to provide better protection to those streams deemed as fish bearing.

6.1 Deactivation of Non-essential Roads

Non-essential roads should be deactivated to reduce the overall road density and cumulative sedimentation impacts (Carmanah Research, 1999). Non-essential roads are located throughout the watershed, however they all differ in importance with respect to their proximity to fish-bearing streams. All FSR that cross the Kitwanga River mainstem are considered essential (Mills Lake FSR, Kitwancool FSR, and Weber FSR). Non-essential roads that cross fish bearing or potentially fish-bearing waters include 24-Mile FSR, 25-Mile FSR, and a branch road of Canoe Creek FSR (Km 4).

The 24-Mile FSR is a low-use road that also has a culvert crossing deemed as a full barrier to fish (Site 15) due to a suspended culvert, a plugged intake, and excessively fast water flowing inside the culvert. At the time of this survey, mushroom pickers were parked approximately 50 meters from the stream on the far side of the crossing. If this road was deactivated, ample space for parking is available in a clearing on the near side of the crossing.

The 25-Mile FSR is a low-use road that has a culvert crossing deemed as a full barrier to fish (Site 14). Currently, the unnamed stream flows underneath the culvert through the roadbed. Beyond this crossing, flagging tape labeled "X-DITCH" is affixed to trees at regular intervals along the road, however there was no cross ditches in place at the time of the survey. Deactivation of this road was obviously planned but not completed. GFA recommends deactivating this road by removing the culvert at Site 14, and completing the cross ditching already staked out.

A branch road of Canoe Creek FSR (Km 4) is a low-use road that was assessed as significant sediment source to Tea Creek. A wooden box culvert was deemed as a fish barrier due to a suspended culvert outlet, however the stream was dry and could not be assessed for fish presence at that time. The road was in poor condition with extensive rutting and frequent potholes.

GFA recommends deactivating these roads due to their close proximity to fish bearing waters, its low level of use, and its poorly maintained stream crossing structures. More assessment may be required to produce a detailed deactivation work plan based on the benefits to resident fish. The MOF ultimately has the authority to designate a road as "non-essential" based on harvesting plans submitted on an ongoing basis by the various forest licensee holders operating in the Kitwanga River Watershed.

6.2 Monitoring of Essential Roads

There are six major roads in the Kitwanga River Watershed that would be classed as essential roads, all of which cross fish-bearing waters: Tea Lake FSR, Mills Lake FSR, Kitwancool FSR, Kitwanga FSR, Weber FSR. These roads should be monitored on a regular basis depending on the level of road-use and beaver activity. This will allow for early detection of fish passage obstructions, maintenance problems, and sedimentation sources. It is recommended that the Gitanyow enter into a joint venture with agencies responsible for maintaining the various road systems to undertake regular stream crossing inspections with the aim of ensuring fisheries values are protected on an ongoing basis.

Apart from the 23 crossings assessed in 2006, there are approximately 273 stream crossings that require some form of assessment. It could be an FPCI and/or an SCQI survey, or a simple assessment to record GPS location, photographs and general stream and roadway characteristics. This number is obviously too large for regular monitoring; 100 crossings or less would be

feasible. High priority should be given to crossings on all fish bearing waters, tributaries that drain into Kitwanga Lake, and all active logging roads. Low risk-crossings should be identified and eliminated from the assessment schedule. These include stream not located on the ground due to mapping errors, chronically dry channels, and deactivated crossings.

6.3 Stream Crossing Standards for Future Roads

GFA recommends that all new crossings on fish-bearing streams be either bridged or consist of an open-bottom culvert. These structures will allow the original streambed to remain intact and normal water velocities to be maintained, and in addition, would require less maintenance and upgrading than round or oval culverts. Round culverts are prone to scouring at the outtake resulting in sedimentation of the stream and potentially the creation of a barrier-causing waterfall. This would require consultation between the BC Ministry of Forest, forestry companies, and the Gitanyow Hereditary Chiefs before any new roads are built in the Kitwanga River Watershed. GFA can provide the technical support to determine the fish-bearing status of all streams along a proposed road route. In addition, GFA technicians can gather useful information regarding stream flow rates, fish habitat value, local terrain conditions and other details valuable to a road engineer entering into the planning phase.

6.4 Fish Distribution Survey and Fish Habitat Assessment

Although fish distribution data is abundant for the Lower Kitwanga River mainstem and most of its high quality tributary streams (Tea, Deuce, Kitwancool, and Moonlit Creeks), information is sparse on the fish distribution in many tributary streams of Kitwancool Lake and the Upper Kitwanga River. Biolith Scientific Consultants undertook a Level 1 Watershed Restoration Assessment in 1998 and acquired valuable fish distribution information for the eastern valley tributaries of the Lower Kitwanga River. Biolith conducted a similar assessment in 1999 for Kitwancool Lake, Upper Kitwanga River, and their tributaries. However, in this assessment more emphasis was placed on logging impacts than on fish distribution patterns. Where information is lacking, data should be gathered showing the upstream limits of all fish-bearing streams in the watershed following the Forest Practices Code - Fish Stream Classification Guidelines. Results would prove valuable for all future watershed development planning in the Kitwanga River Watershed.

6.5 Data Management

For the purposes of this report, data from FPCI and SCQI field cards were transcribed onto Microsoft Excel spreadsheets. This survey produced a large amount of data from 23 sites including geographic location, fish species distribution, fish habitat quality, stream crossing structure characteristics, and road-based sediment sources. GFA created a database to manage all FPCI and SCQI data collected in the Kitwanga Watershed. GFA recommends using this database in other watersheds in the Gitanyow Territory. A comprehensive FPCI assessment was conducted by GFA earlier in 2006 on 71 stream-crossing sites in the Cranberry River Watershed. The field data forms from this survey were not digitized, however this data could easily be recorded into a similar database. In the future, GFA intends to conduct similar stream-crossing assessments in other areas of the Gitanyow Territory. This wealth of data must be managed in a way that allows for easy retrieval and analysis.

For this project data was hand-written, however it could be collected more efficiently using a hand-held data recorder programmed with popular software such as Microsoft Access and/or Excel. The number of variables is quite large when the FPCI and SCQI are combined into one data set. In total, there are approximately 163 data variables that must be organized into one database (83 FPCI and 80 SCQI data points). A data logger would save time if the program works in a logical sequence, is user-friendly, and can withstand harsh field conditions.

7. REFERENCES

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Appendix I

Appendix I: 1:50,000 TRIM showing site locations, barrier status (FPCI), and erosion potential (SCQI), 1:20,000 TRIM index, waterways, and road networks.

Appendix II

Sedimentation potential and maintenance requirements for a) culverts and b) bridges and deactivated crossings. (SCQI ranking: None = 0 - 0.1, low = 0.1 to 0.3, moderate =0.3 to 0.7, high = 0.7 to 1.6, very high ≥1.6).

a) Culverts

Site #	Location	Sedimentation (SCQI)		Maintenance Required	Fish Presence	Notes
		Score	Ranking			
3	Kitwanga FSR (Km 3.3)	0.58	Moderate	No	CT	Velocity barrier for juvenile salmonids; left front ditch requires seeding and diversions into forest.
5	Kitwanga FSR (Km 1.7)	0.95	High	Yes	Unconfirmed	Exposed soil from recent excavator traffic clearing plugged intakes (beavers); right back ditch is moderately vegetated - needs seeding.
8	West Kitwancool Lake FSR (Km 1.5)	0.00	None	Yes	Unconfirmed	Intake blocked by beavers creating fish barrier.
9	West Kitwancool Lake FSR (Km 1.8)	0.42	Moderate	Yes	Unconfirmed	Large beaver dam adjacent to back ditch, 3 culverts, only one functioning, other 2 were plugged by beavers-high potential for road washout.
11	27 Mile FSR (Km 0.6)	0.00	None	No	CT	Good crossing
12	27 Mile FSR (Km 0.5)	0.00	None	No	CT	Good crossing
13	27 Mile FSR (Km 0.3)	0.07	None	No	CT	Good crossing
14	25 Mile FSR (Km 0.3)	0.01	None	No	CT	Fish barrier - water flowing through roadbed under culvert, suspended outlet.
15	24 Mile FSR (Km 0.4)	0.06	None	No	CT	Velocity barrier for juvenile salmonids; suspended outlet, plugged intake.
16	West Kitwancool Lake FSR (Km 5.6)	0.15	Low	Yes	CT	Sedimentation sources on left back ditch - requires seeding; culvert bent midway.
19	Tea Lake FSR (Km 4.2)	4.99	Very high	No	CT	All elements need grass seeding, and the left back ditch should be reshaped.
20	Canoe Creek FSR (Km 2.4)	0.66	Moderate	Yes	Unconfirmed	Intake blocked by beavers, 0.5 m. debris jam below culvert, moderate veg. cover over left front and back ditch -needs grass seeding.
21	Canoe Creek FSR (Km 4.0-Branch 1.5 km)	6.18	Very high	Yes	Unconfirmed	Stream was dry when visited in October; intake plugged by debris; all elements need grass seeding, and left back ditch should be reshaped.
22	Canoe Creek FSR (Km 5.2)	0.03	None	Yes	No	Intake blocked by beavers; confirmed fish barrier downstream near Highway 37.

Appendix II (cont')

b) Bridges and deactivated crossings

Site #	Location	Sedimentation (SCQI)		Maintenance Required	Fish Presence	Notes
		Score	Ranking			
1	Ronald McDonald FSR (Km 0.5)	1.75	Very High	No	No	Large exposed cut bank on right back ditch needs reseeding; confirmed fish barrier downstream in Upper Kitwanga River mainstem.
2	Jackson Main FSR (Km 0.8)	0.04	None	Yes	No	Confirmed fish barrier downstream in Upper Kitwanga River mainstem; plugged x-ditch culvert on right road.
4	Weber FSR (Km 3.0)	0.00	None	No	CO, CT, DV	Good crossing
6	Kitwanga FSR (Km 1.1)	0.01	None	No	Unconfirmed	Beaver ponds up and downstream.
7	West Kitwancool Lake FSR (Km 1.1)	0.00	None	Yes	Unconfirmed	Beaver ponds up and downstream, recent evidence of beaver pond water flowing over left road.
10	Kitwancool FSR (Km 0.1)	0.48	Moderate	No	CO, CT, DV	Right back ditch provides important rearing habitat for juv. salmonids- fine textured banks sloughing into stream at numerous points.
17	13 Mile FSR (Km 2.3)	0.21	Low	No	Unconfirmed	Sedimentation sources on 3 elements - requires seeding
18	Mills Lake FSR (Km 0.3)	0.04	None	No	All resident salmonids	Good crossing
23	Canoe Creek FSR - Deactivated (Km 7.5-Branch 1.1 km)	1.00	High	No	No	Large exposed cut bank on right back ditch - needs reseeding; confirmed fish barrier downstream near Highway 37.

Appendix III

Digital Copies (CD) of Final Report, Maps, Site Photographs, and FPCI/SCQI Site Cards:

Folder \ Final Report
Digital copy of final report in PDF format

Folder \ Projects Maps
Figure 1: Study Area Map; Appendix II: 1:50,000 TRIM in PDF format.

Folder \ Site Photos
Digital copies of site photos grouped by 1:20,000 TRIM mapsheet number
Missing: Sites 5, 6, 16, and 17.

Folder \ FPCI-SCQI Site Cards
Digital copies of field forms in Excel format