Gitanyow Fisheries

Authority

The 2007 Upper Kitwanga River Stream Crossing Assessment and Stream Crossing Deactivation Project

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1. INTRODUCTION

The purpose of the 2007 Upper Kitwanga River Stream Crossing Assessment Project was to identify stream crossings within the Gitanyow Lake and the Upper Kitwanga River Watersheds that could impede fish movement into upstream reaches and to assess the degree of sedimentation entering the stream from the surrounding roadway. A second component to this project was the deactivation of three culvert crossing found to be barriers in 2006 (two sites in the Cranberry River watershed, and one site in the Kitwanga River watershed. Funding for this project was made available through the Northwest Forest Restoration and Enhancement Program (NWFREP, Contract # 10005-40/FS08Q7G010).

For this project the Gitanyow Fisheries Authority (GFA) utilized two independent assessments, the Fish Passage-Culvert Inspection Procedure (FPCI, Parker 2000) and the Water Quality Effectiveness Evaluation (WQEE, Carson et. al. 2007) with the objective of compiling a large amount of data from a stream crossing in a single visit. The scope of this project included roads under both the B.C. Ministry of Forests and the BC Ministry of Transportation jurisdiction that cross all streams flowing into Gitanyow Lake and the Upper Kitwanga River.

The Kitwanga River is a major tributary of the Skeena River and is mostly 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.

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 118 stream crossings on Forest Service Roads (FSR's) were identified on 1:20,000 TRIM mapsheets for the Upper Kitwanga River and its tributaries and tributaries of Gitanyow Lake. 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 2006, GFA undertook a stream crossing survey that included detailed assessments of 23 stream crossings and reconnaissance surveys of an additional 67 sites. A map was generated showing all stream

crossings and each site was assigned a unique identifier number. Concurrent with this 2007 assessment, a FPCI/WQEE survey was undertaken in the Lower Kitwanga River Watershed under a Forest Investment Account (FIA) program (Kitwanga River South Fish Passage Culvert Inspection and Water Quality Effectiveness Evaluation Project, Koch and McCarthy 2008). Data collected in 2006 and 2007 will be used to identify potential remedial works of all crossings deemed as fish barriers and/or potential sediment sources.

The first component of the assessment was the FPCI, which documented the ability of a culvert to provide unimpeded fish passage. Poorly placed culverts can restrict fish movement by creating excessive water velocity within a culvert and extreme plunge falls at the outlet. The FPCI assessment procedures were based on standards described by Parker (2000) and were performed on streams with confirmed or documented fish presence. Culverts can be categorized into three fish-passage scenarios:

- Full barrier - stops all fish at all flow stages,
- Partial barrier - stops certain fish species or individual life stages, or stops movement at certain time of the year,
- 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 (*Oncorhynchus mykiss*; 3.4 meters), coho (*O.*

kisutch) and chinook salmon (*O. tshawytscha*; 2.4 meters), sockeye salmon (*Oncorhynchus nerka*; 2.1 meters), chum (*O. keta*) and pink salmon (*O. gorbuscha*; 1.5 meters).

The second component of the assessment was the WQEE, which documented the amount of sediment input from the crossing including the road surface, ditchlines, and road fill. In 2006, GFA carried out a sedimentation survey using the Stream Crossing Quality Index (SCQI) method (Beaudry 2006) on 23 sites in the Kitwanga River watershed. In 2007 under the direction of MOF, GFA implemented a simpler method, the WQEE survey, with the hope of acquiring meaningful data in less time and cost compared to the SCQI survey. Methodology and results of the 2006 SCQI survey can be found in The 2006 Kitwanga River Fish Passage-Culvert Inspection and the Stream Crossing Quality Index Project (McCarthy, 2007) and is on file at Kispiox Forest District MOF Office in Smithers, B.C.. Both the SCQI and the WQEE surveys systematically assess 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.

The purpose of the WQEE is to measure the effects of forestry related activities on stream water quality (Carson et. al., 2007). Of primary interest is water turbidity, which is a measure of the cloudiness or clarity of water. This method assumes that all forestry related sedimentation originates from a point source that can be easily identified and quantified on the ground. WQEE inspections are undertaken in locations with the highest likelihood of generating sediment, including road crossings and harvested areas in close proximity to a watercourse. For this project the focus of the WQEE was on road crossings over streams with definable channels (presence of scouring or alluvial deposition). Streams that mainly flow subsurface, and wetlands such as alder swales, peat bogs, and unconnected depressions were excluded from detailed FPCI/WQEE evaluation.

Field crews were able to cover the majority of the watershed by pick-up truck, ATV, or on foot. 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. Poor access and time constraints prevented five crossings from being assessed; access to these sites should be attempted in the 2008 field season.

Results of this assessment will be used to initiate funding of remedial works in 2008 and beyond from the various stakeholders responsible for forestry and public road maintenance within the Gitanyow Lake and Upper Kitwanga River Watersheds.

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 right bank of the Skeena River near the village of Kitwanga, B.C. (UTM 09.55840.6106300). 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 Upper Kitwanga River has a mainstem length of approximately 25 km and has only a few fish-bearing tributaries concentrated in the lower reaches. A barrier falls is located approximately 12.5 km upstream of Gitanyow Lake and all reaches above these falls are considered non-fish bearing (Biolith 1999). The reach directly above Gitanyow Lake is a wetland complex that provides high quality habitat for salmonids and 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 location of 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 km^2. 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
Chinook Salmon
Pink Salmon
Chum Salmon

Coho Salmon
Steelhead / Rainbow Trout
Cutthroat Trout (*Oncorhynchus clarki*)
Dolly Varden (*Salvelinus malma)*
Bull Trout (*Salvelinus confluentus*)
Mountain Whitefish (*Prosopium williamsoni*)
Pygmy whitefish (*Prosopium coulterii*)

In addition to salmonid species several course fish species inhabit the Kitwanga Watershed (from BC Ministry of the Environment FISS database) including white sucker (*Catostomus commerconii*), longnose sucker (*Catostomus catostomus*), northern pikeminnow (*Ptychocheilus oregonensis*), prickly sculpin (*Cottus asper*), slimy sculpin (*Cottus cognatus*), peamouth chub (*Mylocheilus caurinus*), and red-side shiner (*Richardsonius balteatus*).

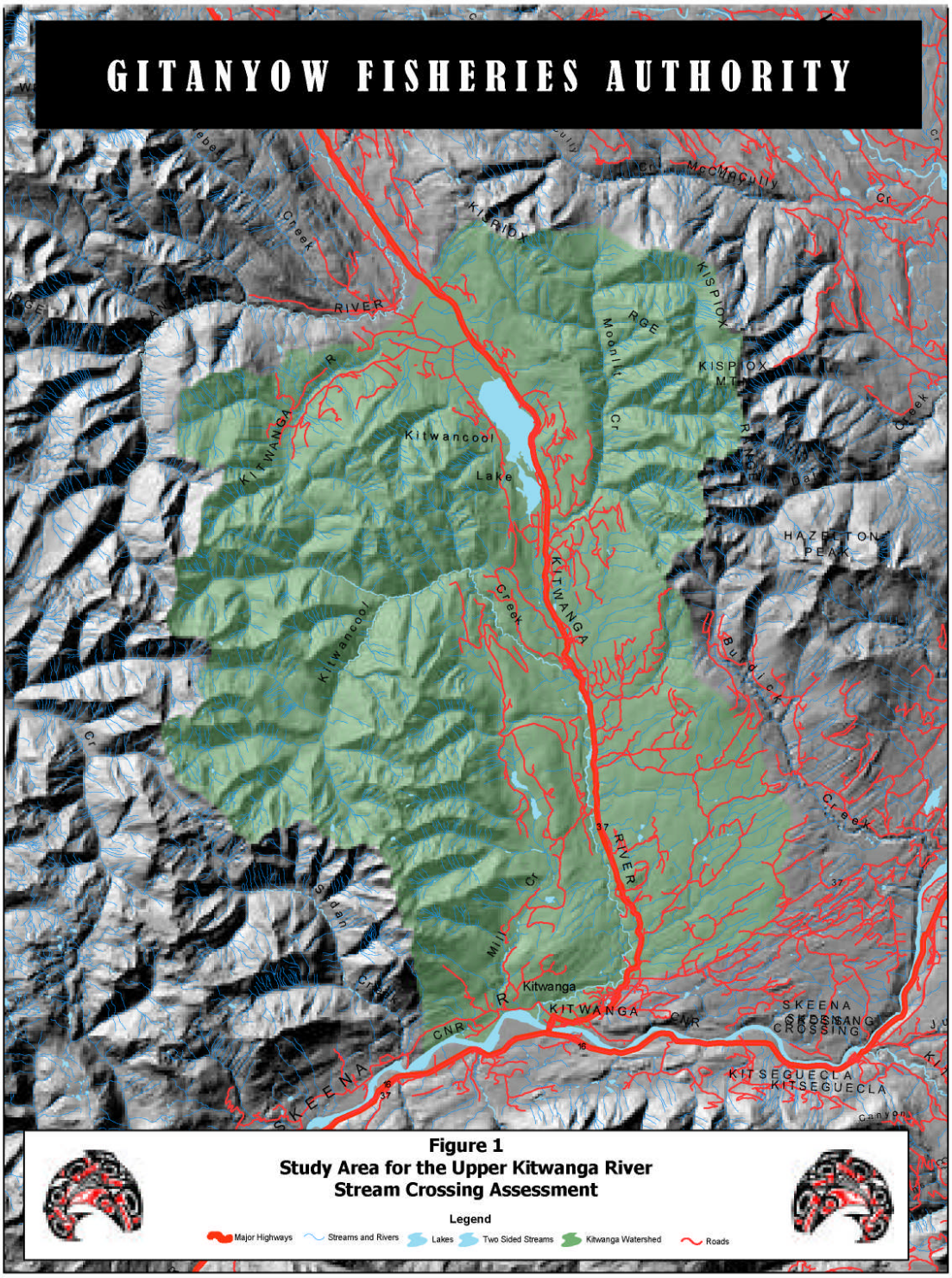

Figure 1
Study Area for the Upper Kitwanga River Stream Crossing Assessment

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 Water Quality Effectiveness Evaluation (WQEE) was carried out according to the guidelines described in Carson et al. (2007).

The FPCI and the WQEE was undertaken between July 7 and October 10, 2007. 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 (WQEE). 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 using the FPCI and WQEE, and to assess all roads that cross known-fish bearing waters using the WQEE only.

All stream crossings in the Kitwanga River watershed were identified on 1:50,000 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 WQEE field data forms in addition to the SCQI field data collected in 2006. For the purpose of this report Upper Kitwanga Watershed tributaries were assigned the same identifier numbers used in a WRP report prepared by Biolith (1999; Upper Kitwanga River – Tributaries 32 to 80).

3.1 Pre-Field Planning

Prior to entering the field, 1:20,000 TRIM mapsheets were produced for the entire watershed showing stream crossings (waterways and road networks), and 20-meter contour intervals. All stream crossings were identified on the maps and assigned the identifier number created in 2006. 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. Upstream of a gradient barrier is considered fish bearing if a lake or pond is present. It is important to note that detailed habitat assessments are required to determine the true upstream

limits of fish distribution on any given stream. Literature was reviewed for information relating to streams with confirmed fish presence and locations of impassable barriers were 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 cutbanks. Afterwards the site was designated as either a full or partial barrier or as no barrier at all, and all notable 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 adjacent roadway.

In the field, information was recorded on two independent data forms adopted from Parker (2000) for collecting FPCI data and Carson et al. (2007) for collecting WQEE data. The two surveys were linked by inserting the barrier ranking from the FPCI data form into the WQEE form and by inserting the WQEE score into the Sediment Source/Degree field on the FPCI data form.

3.2.1 FPCI

Data was 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.

3.2.2 WQEE

Sites were evaluated for fine sediment contribution from mass wasting that occurred in the past and from surface erosion that is ongoing. Stream crossings were divided into 11 road elements (Column 1 on the WQEE field form; the left/right designation is relative to the evaluator facing downstream):

Left road surface (LRS),
Left road upper and lower ditches [LRD (u), LRD (l)],
Left road upper and lower cutbanks [LRC (u), LRC (l)],
Right road surface (RRS),
Right road upper and lower ditches [RRD (u), RRD (l)], and
Right road upper and lower cutbanks [RRC (u), RRC (l)].
Mass wasting contribution over the culvert.

In the field, each road element was assessed and scored according to a series of characteristics:

Connectivity to the stream (Column 2),
Portion of fine sediment in erodible material (Column 3),
Fine sediment contribution from mass wasting (Column 4),
Fine sediment contribution from surface erosion (Columns 7 and 8).

A series of calculations were undertaken to arrive at the sediment contribution of each element and instruction are clearly provided in the field data form (Carson et. al. 2007).

3.3 Data Analysis

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

3.3.1 FPCI

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

- Full or Partial Barrier – fish bearing streams with excessive water velocity inside the culvert and/or jump height at the culvert outlet for a salmonid at any life stage.
- Well-Placed Culverts - culverts that allow year-round passage of salmonids of all life stages.

- 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 WQEE score),
- Bridges or deactivated crossings not requiring full FPCI survey, but underwent the WQEE survey,
- Undetermined Barrier - Full or Partial Barriers with no confirmed or documented 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 based on guidelines presented in Parker (2000). 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	Score	Habitat Value	Score	Barrier	Score	Length of new habitat	Score	Stream Barred	Score	Limiting to upstream barrier	Score
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 coarse fish species. If no fish were captured during the FPCI on barrier sites, but fish presence is documented or suspected, then the stream was considered fish bearing and

crossing was considered a barrier. Length of stream barred was an estimate and was subjectively chosen as the upstream distance to stream gradient exceeding 20 percent over 200 meters based on 1:20,000 TRIM, however ground surveys are required to determine the actual upstream limit of fish presence for all streams described in this report. Limiting to upstream barrier refers to whether or not another barrier crossing exists upstream.

3.3.2 WQEE

The total fine sediment contribution from mass wasting and surface erosion of each road element was added together to arrive at a total crossing score. A series of calculations were undertaken to arrive at the sediment contribution of each element and instructions are clearly provided in the field data form (Carson et al, 2007). Each site was classified based on their degree of sedimentation according to the WQEE ranking guidelines as either low (<1 m^3), moderate (1-5 m^3), high (5- 20 m^3), very high (20-50 m^3), or extreme (>50 m^3). A GFA biologist assessed the validity of a ranking for any given site based on photos and professional judgment.

3.4 Reporting

The outline for this report is to first address FPCI concerns, then other priority crossings including sedimentation and maintenance issues. 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 WQEE site cards was summarized for crossings ranked as moderate to extreme degrees 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

In 2006, a total of 111 stream crossings were identified on tributaries of Gitanyow Lake and the Upper Kitwanga River and its tributaries (based on 1:20,000 TRIM). A total of 16 sites were surveyed in 2006 leaving 95 sites scheduled for assessment in 2007. Of these 95 sites, 27 sites were not found in the field and were presumed to be mapping errors. However, an additional 10 sites were found on the ground but were not shown on a map. This left an assessment schedule of 78 actual crossing sites to be assessed in the 2007 field season. Of these 78 sites, five sites were not visited due to difficult access. Therefore, 73 sites were surveyed on the ground in 2007 all of which were assessed for sedimentation using the WQEE. An FPCI survey was carried out at 25 of these sites, which were culvert crossings on suspected fish bearing streams, while the remaining crossing were considered either bridged, deactivated or considered non-fish bearing (see map in Appendix I showing site locations, 1:20,000 mapsheet index; waterways, road networks, barrier status, and sediment degree). Crossing structure types that currently exist (73 sites assessed in 2007 plus 16 sites assessed in 2006 = 89 confirmed crossings) including 73 culverts, 12 bridges, and 4 deactivated crossings. Of the confirmed crossings, 62 sites were under MOF jurisdiction and 27 sites were under MOT jurisdiction. The crossing structure types for the five sites not visited is unknown (all under MOF jurisdiction), however four of these sites are located on logging roads near the stream's headwaters and are likely culverts. The final report, data forms, 1:20,000 TRIM, and site photos are presented digitally on a CD in Appendix II.

Complete FPCI assessments were not required at bridge and deactivated crossings.

4.1 Fish Passage-Culvert Inspection (FPCI) - Full or Partial Barriers

Sixteen culvert crossings were identified as either a full barrier (3 sites) or a partial barrier (13 sites) on fish bearing streams. These crossings were located on Highway 37 N (10 sites – 1 high and 9 moderate priority), East Kitwancool Lake Road (5 sites - all high priority) and Kitwanga FSR (1 site - moderate priority). The following section provides a brief description of each barrier site in order of priority ranking.

Table 1: Form B - FPCI Summary Table

Site #	Road Name	Priority Rank	Score	Barrier	Stream Length Gained (m)	% Stream Barred	MOF Eligible	Q100 Culvert Diameter (mm)		Actual culvert Diam. (mm)
								Round	Oval	
95	East Kitwancool Lake Rd.	High	43	Partial	700	82	No	1200	1350x870	500
96	East Kitwancool Lake Rd.	High	43	Partial	700	85	No	1200	1350x870	800
97	East Kitwancool Lake Rd.	High	43	Partial	650	87	No	1000	1350x870	600
98	East Kitwancool Lake Rd.	High	43	Partial	600	91	No	1400	1880x1260	600
334	East Kitwancool Lake Rd.	High	43	Partial	900	88	No	1000	1350x870	600
67	Hwy. 37 N	High	39	Full	800	73	No	1400	1630x1120	900
335	Hwy. 37 N	Mod.	35	Partial	720	71	No	700	800x580	900
81	Hwy. 37 N	Mod.	36	Partial	400	67	No	1400	1880x1260	600
31	Hwy. 37 N	Mod.	35	Full	950	90	No	1800	2130x1400	2000
80	Hwy. 37 N	Mod.	35	Partial	1000	27	No	2280	2690x2080	1200
85	Hwy. 37 N	Mod.	34	Partial	550	65	No	800	910x660	900
86	Hwy. 37 N	Mod.	34	Partial	550	65	No	800	910x660	1200
87	Hwy. 37 N	Mod.	31	Partial	500	63	No	800	910x660	900
88	Hwy. 37 N	Mod.	31	Partial	550	73	No	700	800x580	900
61	Kitwanga FSR	Mod.	31	Partial	1500	68	Yes	1400	1630x1120	800
284	Hwy. 37 N	Mod.	29	Full	250	45	No	1200	1350x870	1000

Site 95 (Tributary 43 - East Kitwancool Lake Road)

Site 95 was assessed as a partial barrier and ranked as a **high priority** crossing (FPCI Score= 43). The road crosses Tributary 43 approximately 150 meters upstream of its confluence with Gitanyow Lake. Nine cutthroat trout (6-8 centimeters) were captured in "Gee" traps below the culvert, while 1 cutthroat trout (5 centimeters) was captured upstream.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered steep (2 percent) creating high water velocity (1.15 meters/second), which 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 1200 millimeters. The 500-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 0.8 meters.

Fish habitat value was considered moderate. Although this stream was comprised mainly of shallow riffles with some deep pool habitat (1.6 meter bankfull width; 20 centimeter bankfull

depth; 5 percent gradient) it could potentially provide important spawning and rearing habitat. Downstream of the culvert, the stream descends down a shallow grade through dense deciduous vegetation. Upstream of the culvert the stream consists of 3 smaller streams that converge at the culvert inlet with the main flow running down the left road upper ditchline for a distance of approximately 70 meters. Approximately 150 meters upstream of this crossing is 3 culvert crossings on Hwy 37 N (Site 85), one culvert for each stream that converges at the Site 95 inlet. The main flow passes Hwy 37 N through the most southerly culvert, which was also deemed as a partial velocity barrier due to excessive velocity for juvenile salmonids (Site 85 is discussed later in this section). The total length of stream barred was estimated at 700 meters (approximately 1,100 m^2), representing 82 percent of the total stream length.

Photo 1: Site 95 – stream flowing along ditchline.

Site 96 (Tributary 42 - East Kitwancool Lake Road)

Site 96 was assessed as a partial barrier and ranked as a **high priority** crossing (FPCI Score= 43). The road crosses Tributary 42 approximately 120 meters upstream of its confluence with Gitanyow Lake. Two cutthroat trout (6-8 centimeters) and one rainbow trout (7 centimeters)

were captured in "Gee" traps below the culvert, while 1 cutthroat trout (12 centimeters) was captured upstream.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered steep (5 percent) creating high water velocity (1.30 meters/second), which exceeded the swimming capability of juvenile salmonids. A deep scour pool (35 centimeters) below the culvert provided good fish habitat and sufficient depth for jumping into a 22 centimeter suspended culvert outlet. The Q100 culvert diameter was calculated to be 1200 millimeters. The 800-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 1.5 meters.

Fish habitat value was considered moderate downstream due to its close proximity to Gitanyow Lake and low upstream due to steep gradient (16 percent). The downstream reach was comprised mainly of shallow riffles with some deep pool habitat (1.4 meter bankfull width; 20 centimeter bankfull depth; 9 percent slope) and could provide important rearing habitat for juvenile salmonids. Habitat upstream of the culvert was comprised of shallow cascades and pools and although the gradient was measured at 16 percent immediately above the culvert, the gradient lessens near the Highway 37 N crossing (9 percent) approximately 150 meters upstream (Site 86). The Highway 37 N crossing was also deemed as a partial barrier due to excessive velocity for juvenile salmonids (Site 86 is discussed later in this section). If the Highway 37 crossing was fixed, the total length of stream barred was estimated at 700 meters (approximately 975 m^2), representing 82 percent of the total stream length. However, without replacing the Highway 37 N crossing, the length of new habitat would be approximately 150 meters or 240 m^2.

Photo 2: Site 96 – culvert outlet.

Site 97 (Tributary 41 - East Kitwancool Lake Road)

Site 97 was assessed as a partial barrier and ranked as a **high priority** crossing (FPCI Score= 43). The road crosses Tributary 41 approximately 100 meters upstream of its confluence with Gitanyow Lake. One cutthroat trout (5 centimeters) was captured in "Gee" traps below the culvert, while no fish were captured upstream.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered steep (4 percent) creating high water velocity (1.06 meters/second), which exceeded the swimming capability of juvenile salmonids. A deep scour pool (35 centimeters) below the culvert provided good fish habitat and sufficient depth for jumping into a 15 centimeter suspended culvert outlet. The Q100 culvert diameter was calculated to be 1000 millimeters. The 600-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 0.5 meters.

Fish habitat value was considered moderate due its close proximity to Gitanyow Lake. The downstream and upstream reaches were comprised mainly of shallow riffle and pool habitat (1.3 meter bankfull width; 20 centimeter bankfull depth; 5 percent slope) and could it provide

important spawning and rearing habitat. Approximately 200 meters upstream of this crossing, another culvert crosses Hwy 37 N (Site 87), which was also deemed as a partial velocity barrier due to excessive velocity for juvenile salmonids (discussed later in this section). If the Highway 37 N crossing was fixed, the total length of stream barred was estimated at 650 meters (820 m^2), representing 87 percent of the total stream length. However, without replacing the Highway 37 N crossing, the length of new habitat would be approximately 200 meters or 250 m^2.

Photo 3: Site 97 – culvert outlet.

Site 98 (Tributary 40 - East Kitwancool Lake Road)

Site 98 was assessed as a partial barrier and ranked as a **high priority** crossing (FPCI Score= 43). The road crosses Tributary 40 approximately 60 meters upstream of its confluence with Gitanyow Lake. One cutthroat trout (12 centimeters) was captured in "Gee" traps below the culvert, while 1 cutthroat trout (13 centimeters) was captured upstream.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert and excessive jump height into the culvert outlet. The culvert slope was considered steep (3 percent) creating high water velocity (0.85 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert was suspended 39 centimeters with a 30 centimeter scour pool below exceeded the jumping capability of juvenile salmonids. The Q100 culvert diameter was calculated to be 1400 millimeters. The 600-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 1.0 meter.

Fish habitat value was considered moderate. The downstream reach was comprised mainly of shallow riffle and pool habitat (1.6 meter bankfull width; 33 centimeter bankfull depth; 7 percent slope) and it could provide important spawning and rearing habitat. Upstream of the culvert the stream consists of 2 smaller streams that converge at the culvert inlet. Approximately 150 meters upstream of this crossing, another culvert crosses Hwy 37 N (Site 88), which was also deemed as a partial velocity barrier due to excessive velocity for juvenile salmonids (Site 88 is discussed later in this section). If the Highway 37 N crossing was fixed, the total length of stream barred was estimated at 600 meters (980 m^2), representing 91 percent of the total stream length. However, without replacing the Highway 37 N crossing, the length of new habitat would be approximately 150 meters or 250 m^2.

Photo 4: Site 98 – culvert outlet.

Site 334 (Unnamed/ Unmapped Stream - East Kitwancool Lake Road)

Site 334 was assessed as a partial barrier and ranked as a **high priority** crossing (FPCI Score= 40). The road crosses an unnamed stream approximately 120 meters upstream of its confluence with Gitanyow Lake. This stream appeared to be recently formed as it had tunneled under several large trees upstream of the crossing. No fish were captured during the time of this survey, however fish presence is highly suspected due to its close proximity to Gitanyow Lake.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered steep (5 percent) creating high water velocity (0.51 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was not suspended. The Q100 culvert diameter was calculated to be 1000 millimeters. The 600-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 0.8 meters.

Fish habitat value was considered moderate. The upstream and downstream reach was comprised mainly of shallow cascade/riffle/pool habitat (1.4 meter bankfull width; 17 centimeter bankfull depth; 9 percent slope) and it could provide important spawning and rearing habitat. Approximately 120 meters upstream of this crossing, another culvert crosses Hwy 37 N (Site

335), which was also deemed as a partial velocity barrier due to excessive velocity and jump height for juvenile salmonids (Site 335 is discussed later in this report). If the Highway 37 N crossing was fixed, the total length of stream barred was estimated at 900 meters (1300 m^2), representing 88 percent of the total stream length. However, without replacing the Highway 37 N crossing, the length of new habitat would be approximately 120 meters or 200 m^2.

Photo 5: Site 334 – culvert outlet.

Site 67 (Tributary 54 – Highway 37 N)

Site 67 was assessed as a full barrier and ranked as a **high priority** crossing (FPCI Score= 39). Highway 37 N crosses Tributary 54 approximately 300 meters upstream of its confluence with Tributary 55. Due to an oversight, an FPCI was not completed, however data was extracted from a previous study completed in 2002 and was used to calculate an FPCI score (Johnston and Saimoto, 2002; Site # 10430). Fish trapping was not conducted at this site however Dolly

Varden, bull trout, cutthroat trout, rainbow trout, and juvenile coho were suspected to exist in this stream due to its close proximity to the Upper Kitwanga River [connected by wetland habitat through Tributary 55 (Biolith 1999, Johnston and Saimoto 2002)].

This culvert crossing was considered a full barrier due to the excessive water velocity inside the culvert and excessive outflow drop (Johnston and Saimoto, 2003). The culvert slope was considered steep (7 percent) creating high water velocity (1.41 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was suspended 92 centimeters and dropped into a 24-centimeter outlet pool, which would exclude all fish from entering the culvert. The Q100 round culvert diameter was calculated to be 1400 millimeters. The 900-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 3 meters.

Fish habitat value was considered good downstream due to its close proximity to the wetland habitat leading to the Upper Kitwanga River (Biolith 1999) and was shown to contain good spawning gravel (Johnston and Saimoto 2002), while upstream habitat offered little significant fish habitat (Biolith 1999). The average bankfull width and bankfull depth was 1.7 meters and 23 centimeters respectively. The gradient was measured at 30 percent downstream and 12 percent upstream (Johnston and Saimoto 2002), which suggests that fish migration may be limited or nonexistent between the wetland located downstream and the culvert crossing. This site should be revisited in 2008 to determine if fish can reach this culvert crossing. The total length of stream barred was estimated at 800 meters (1300m^2), representing 73 percent of the total stream length.

Photo 6: Site 67 – culvert outlet (Source: Johnston and Saimoto 2002).

Site 335 (Unnamed/Unmapped Stream– Highway 37 N)

Site 335 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 38). Highway 37 N crosses this unmapped tributary approximately 300 meters upstream of its confluence with Gitanyow Lake. This stream appeared to be recently formed as it tunneled under several large trees downstream of the crossing. No fish were captured during the time of this survey but presence is highly suspected due to its close proximity to Gitanyow Lake.

This culvert crossing was considered a partial barrier due to excessive water velocity inside the culvert and excessive outflow drop at the outlet. The culvert slope was considered steep (10 percent) creating high water velocity (1.0 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was suspended by 57 centimeters and dropped into a pool with an insufficient depth of 37 centimeters. The Q100 round culvert

diameter was calculated to be 700 millimeters. The 900-millimeter culvert currently in place should accommodate a 100-year flood event. The fill depth above the culvert was 3.5 meters.

Fish habitat value was considered moderate overall. The upstream and downstream reach was comprised mainly of shallow riffle/pool habitat (0.6 meter bankfull width; 17 centimeter bankfull depth; 15 percent slope), and could provide important rearing habitat for juvenile salmonids. Approximately 150 meters downstream of this crossing, another culvert crosses East Kitwancool Lake Road (Site 334), which was also deemed as a partial velocity barrier due to excessive velocity. The total length of stream barred was estimated at 720 meters (430 m^2), representing 71 percent of the total stream length.

Photo 7: Site 335 – culvert outlet.

Site 81 (Tributary 44 – Highway 37 N)

Site 81 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 36). Highway 37 N crosses Tributary 44 approximately 200 meters upstream of its confluence with Gitanyow Lake. Six cutthroat trout (6-11 centimeters) were captured below the culvert while one cutthroat trout was captured upstream (8centimeters). The 24-Mile Road

crosses Tributary 44 approximately 300 meters upstream of Hwy 37 N (Site 15) and was found to be a full barrier in 2006 due to a suspended culvert and excessive water velocity inside the culvert (McCarthy 2007).

This culvert crossing was considered a partial barrier due to the excessive water velocity inside two inline culverts (Site 81_1 is the downstream culvert under the old Hwy. 37 roadbed and 81_2 is the upstream culvert under the current Hwy. 37 roadbed). These culverts are separated by approximately a 1-meter gap. The culvert slopes were considered steep creating high water velocity (5 percent slope / 1.71 meters/second for Site 81_1, and 8 percent slope / 1.59 meters/second for Site 81_1), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was suspended by 15 centimeters, however a 50-centimeter deep scour pool below the culvert allowed access for most fish into the culvert. The Q100 round culvert diameter was calculated to be 1400 millimeters. The culverts currently in place (1000-millimeter culvert under the current highway and the 600 millimeter culvert under the old highway) are insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above Site 81_1 and 81_2 was 1.0 and 3.0 meters respectively.

Fish habitat value was considered good downstream of Site 81 due to its close proximity to the Gitanyow Lake, while upstream habitat was considered poor due to minimal amounts of deep pools and LWD (1.7-meter bankfull width; 27 centimeter bankfull depth; 7 percent slope). A barrier falls was found 400 meters upstream of Hwy 37 N (100 meters upstream of Site 15). The total length of stream barred was estimated at 400 meters (660 m^2), representing 73 percent of the total stream length.

Photo 8: Site 81 – culvert outlet.

Site 31 (Tributary 37 – Highway 37 N)

Site 31 was assessed as a full barrier and ranked as a **moderate priority** crossing (FPCI Score= 35). Highway 37 N crosses Tributary 37 approximately 100 meters upstream of its confluence with Gitanyow Lake. Four cutthroat trout (4-11 centimeters) were captured in "Gee" traps below the culvert, while 2 cutthroat trout (10 and 13 centimeters) were captured upstream. Downstream near the lake outlet (below Site 281 located 50 meters downstream) trapping yielded 14 juvenile coho (5-8 centimeters), 11 cutthroat trout (4-8centimeters), 7 sculpin sp. (6-7 centimeters).

This culvert crossing was considered a full barrier due to the excessive water velocity inside the culvert. The culvert slope was considered extremely steep (18 percent) creating high water velocity (1.3 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was not suspended, however there was no outlet pool due to an accumulation of cobbles and boulders transported from upstream. The Q100 round culvert diameter was calculated to be 1800 millimeters. The 2000-millimeter culvert currently in place should accommodate a 100-year flood event. The fill depth above the culvert was 10 meters.

Fish habitat value was considered moderate downstream due to its close proximity to Gitanyow Lake and poor upstream of the crossing due to the steep gradient. The upstream and downstream

reach was comprised mainly of shallow cascade/riffle/pool habitat (2.0-meter bankfull width; 33 centimeter bankfull depth; 22 percent slope). The Site 281 culvert that crosses East Kitwancool Lake Road was deemed as a non-barrier. The total length of stream barred was estimated at 950 meters (1850m^2), representing 90 percent of the total stream length. The average gradient of the barred section is considered steep at approximately 27 percent, however cutthroat trout were captured upstream indicating that usable habitat exists. Assuming that this culvert is a full barrier, a self-sustaining population likely exists upstream of the crossing given that the crossing was built around 1970.

Photo 9: Site 31 – culvert outlet.

Site 80 (Tributary 55 – Highway 37 N)

Site 80 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 35). Highway 37 N crosses Tributary 55 approximately 2.7 kilometers upstream of its confluence with the Upper Kitwanga River. Due to an oversight, an FPCI was not completed, however data was from a previous study completed in 2002 was used to calculate an FPCI score for this project (Johnston and Saimoto 2002, Site # 10450). Fish trapping was not conducted at this site however fish trapping upstream at Sites 12 and 13 in 2006 yielded cutthroat trout (McCarthy 2007). Dolly Varden/bull trout, cutthroat trout, rainbow trout, and juvenile coho

were suspected to exist in this stream due to its close proximity to the Upper Kitwanga River [connected by wetland habitat (Biolith 1999)].

This 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 (1.03 meters/second), which exceeded the swimming capability of juvenile salmonids (Johnston and Saimoto 2002). The culvert outlet was not suspended. The Q100 round culvert diameter was calculated to be 2280 millimeters. The 1200-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be replaced. The fill depth above the culvert was 5 meters.

Fish habitat value was considered good upstream and downstream due to its close proximity to the wetland habitat leading to the Upper Kitwanga River and its moderate gradient channel (Biolith 1999). The downstream reach was shown to contain good spawning habitat (Johnston and Saimoto 2002). Upstream of Hwy 37 N two small streams converge at the culvert inlet. The average bankfull width, bankfull depth, and gradient were 4.7 meters, 35 centimeters, 2.3 % respectively (Johnston and Saimoto 2002). The total length of stream barred was estimated at 1000 meters (4700 m^2), representing 27 percent of the total stream length.

Photo 10: Site 80 – culvert outlet (Source: Johnston and Saimoto 2002).

Site 85 (Tributary 43 – Highway 37 N)

Site 85 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 31). Highway 37 N crosses Tributary 43 approximately 300 meters upstream of its confluence with Gitanyow Lake. One cutthroat trout (5centimeters) was capture downstream near the East Kitwancool Lake Road, but no fish were captured upstream. Site 85 consists of 3 small stream crossings (85_1, 85_2, 85_3) with the majority flow passing through the most southerly culvert (85_1). These streams converge at the East Kitwancool Lake Road where they pass though a single culvert (Site 95).

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered steep (9 percent) creating high water velocity (0.49 meters/second), which may exceed the swimming capability of juvenile salmonids. The culvert outlet was not suspended. The Q100 round culvert diameter was calculated to be 800 millimeters; therefore the 900-millimeter culvert currently in place should be sufficient to accommodate a 100-year flood event. The fill depth above the culvert was 4.0 meters.

Fish habitat value was considered moderate upstream and downstream due to its close proximity to Gitanyow Lake. The upstream and downstream reach was comprised mainly of shallow riffle/pool habitat (1.3 meter bankfull width; 13 centimeter bankfull depth; 10 percent slope). The culvert that crosses East Kitwancool Lake Road (Site 95) was deemed as a partial barrier due to excessive velocity for juvenile salmonids. The total length of stream barred was estimated at 550 meters (730 m^2), representing 65 percent of the total stream length.

Photo 11: Site 85 – culvert outlet.

Site 86 (Tributary 42 – Highway 37 N)

Site 86 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 34). Highway 37 N crosses Tributary 42 approximately 300 meters upstream of its confluence with Gitanyow Lake. One cutthroat trout (6 centimeters) was captured in "Gee" traps below the culvert, while no fish were captured upstream. Further downstream near the Site 96 crossing on the East Kitwancool Lake Road, trapping yielded 3 cutthroat trout (6-12 centimeters) and 1 rainbow trout (7 centimeters).

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert and excessive outflow drop. The culvert slope was considered steep (3 percent) creating high water velocity (1.03 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was suspended 57 centimeters and the outlet pool was insufficiently deep (46 centimeters) to allow for fish passage. The Q100 round culvert diameter was calculated to be 1200 millimeters therefore the 1400-millimeter culvert currently in place should be sufficient to accommodate a 100-year flood event. The fill depth above the culvert was 2.5 meters.

Fish habitat value was considered moderate upstream and downstream due to its close proximity to Gitanyow Lake. The upstream and downstream reach was comprised mainly of shallow

riffle/pool habitat (0.8 meter bankfull width; 18 centimeter bankfull depth; 9 percent slope). The culvert that crosses East Kitwancool Lake Road (Site 96) was deemed as a partial barrier due to excessive velocity for juvenile salmonids. The total length of stream barred was estimated at 550 meters (460 m^2), representing 65 percent of the total stream length.

Photo 12: Site 86 – culvert outlet.

Site 87 (Tributary 41 – Highway 37 N)

Site 87 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 31). Highway 37 N crosses Tributary 41 approximately 300 meters upstream of its confluence with Gitanyow Lake. One rainbow trout (10 centimeters) was captured in "Gee" traps below the culvert, while no fish were captured upstream. Downstream near the Site 97 crossing on the East Kitwancool Lake Road, trapping yielded 1 cutthroat trout (5 centimeters).

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert and excessive outflow drop. The culvert slope was considered extremely steep (12

percent) creating high water velocity (1.27 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was suspended 58 centimeters and the outlet pool was insufficiently deep (16 centimeters) to allow for fish passage. The Q100 round culvert diameter was calculated to be 800 millimeters therefore the 900-millimeter culvert currently in place should accommodate a 100-year flood event. The fill depth above the culvert was 12 meters.

Fish habitat value was considered moderate downstream due to its close proximity to Gitanyow Lake and poor upstream due to steep gradient. The upstream and downstream reach was comprised mainly of shallow riffle/pool habitat (0.9 meter bankfull width; 16 centimeter bankfull depth, 11 percent slope downstream, 18 % slope upstream). The culvert that crosses East Kitwancool Lake Road (Site 97) was also deemed as a partial barrier due to excessive velocity for juvenile salmonids. The total length of stream barred was estimated at 500 meters (430 m^2), representing 63 percent of the total stream length.

Photo 13: Site 87 – culvert outlet.

Site 88 (Tributary 40 – Highway 37 N)

Site 88 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 31). Highway 37 N crosses Tributary 40 approximately 200 meters upstream of its

confluence with Gitanyow Lake. No fish were captured upstream or downstream, however fish presence is highly suspected due to its close proximity to Gitanyow Lake.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was considered extremely steep (10 percent) creating high water velocity (0.91 meters/second), which exceeded the swimming capability of juvenile salmonids. The culvert outlet was suspended 58 centimeters and the outlet pool was insufficiently deep (16 centimeters) to allow for fish passage. The Q100 round culvert diameter was calculated to be 700 millimeters therefore the 900-millimeter culvert currently in place should accommodate a 100-year flood event. The fill depth above the culvert was 10 meters.

Fish habitat value was considered moderate downstream due to its close proximity to Gitanyow Lake and poor upstream due to steep gradient. The upstream and downstream reach was comprised mainly of shallow riffle/pool habitat (0.9 meter bankfull width; 16 centimeter bankfull depth, 9 percent slope downstream, 22 percent slope upstream). The culvert that crosses East Kitwancool Lake Road (Site 98) was also deemed as a. partial barrier due to excessive water velocity and outflow drop for juvenile salmonids. The total length of stream barred was estimated at 550 meters (330 m^2), representing 73 percent of the total stream length.

Photo 14: Site 88 – culvert outlet.

Site 61 (Unnamed Stream– Kitwanga FSR)

Site 61 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 31). Kitwanga FSR crosses this unnamed tributary approximately 700 meters upstream of its confluence with the Upper Kitwanga River. One cutthroat trout (10 centimeters) was captured downstream while no fish were captured upstream.

This culvert crossing was considered a partial barrier due to the excessive water velocity inside the culvert. The culvert slope was 1 percent and created a high water velocity (0.62 meters/second), which may exceed the swimming capability of juvenile salmonids. The culvert outlet was not suspended. The Q100 round culvert diameter was calculated to be 1400

millimeters. The 800-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was 1.5 meters.

Fish habitat value was considered moderate upstream (shallow riffle pool, 1 percent slope, abundant cover) and poor downstream (cascade/riffle/pool complex, 20 percent slope, frequent debris jams). Located approximately 400 meters downstream is a deactivated crossing along an old grown-in logging road, which was visited in 2006 and deemed as passable to fish and well vegetated (McCarthy 2007). The total length of stream barred was estimated at 1500 meters (3,640 m^2), representing 68 percent of the total stream length.

Photo 15: Site 61 – culvert outlet.

Site 284 (Tributary 36 – Highway 37 N)

Site 284 was assessed as a partial barrier and ranked as a **moderate priority** crossing (FPCI Score= 29). Highway 37 N crosses Tributary 36 approximately 300 meters upstream of its confluence with Gitanyow Lake. Two cutthroat trout (6 and 10 centimeters) was captured in "Gee" traps below the culvert, while no fish were captured upstream.

This culvert crossing was considered a partial barrier due to the excessive water velocity. The culvert slope was considered extremely steep (8 percent) creating high water velocity (0.55 meters/second), which may exceed the swimming capability of juvenile salmonids. The Q100

round culvert diameter was calculated to be 1200 millimeters. The 1000-millimeter culvert currently in place is insufficient to accommodate a 100-year flood event and should be upgraded. The fill depth above the culvert was approximately 20 meters.

Fish habitat value was considered moderate downstream due to its close proximity to Gitanyow Lake and poor upstream due to steep gradient. The upstream and downstream reach was comprised mainly of shallow riffle/pool habitat (1.3 meter bankfull width; 23 centimeter bankfull depth, 3 percent slope downstream, 18 percent slope upstream). The total length of stream barred was estimated at 250 meters (330 m^2), representing 45 percent of the total stream length.

Photo 16: Site 284 – culvert outlet.

4.1.1 Confirmed and Suspected Non Fish-Bearing Streams

Forty sites were located on streams suspected to be non-fish bearing. These include 19 crossings sites located upstream of the 8-meter waterfalls on the Upper Kitwanga River considered upstream limit of fish distribution by Biolith (1999) and 21 sites where gradient downstream of the road crossing exceeds 20% over a minimum of 250 meter horizontal distance (Table 2, sorted by Tributary ID #). Although these sites should continue to be monitored for sedimentation concerns, they should be excluded from FPCI surveys in the future. It is important to note that the fish bearing status of the above streams has not been confirmed on the ground by GFA however Biolith (1999) noted that no fish were captured or observed above the 8-meter waterfall on the Upper Kitwanga River during their study, nor during a 1996 study of the area (Gilchrist et al, 1996). Gradient analysis was carried out using 1:20,000 TRIM topographic maps, and although gradients exceeding 20 percent were identified, it is possible that low-density fish populations may exist in what would be considered marginal fish habitat.

Table 2: List of crossing sites on suspected non-fish bearing streams (sorted by tributary ID #).

Site #	# of sites	Trib. #	Location	Gradient
114	1	32	Gitanyow Lake to West Kitwancool FSR (crossing to 500m downstream)	180 m rise / 500 m run = 36 %
107	1	36	Hwy 37 N to 19 Mile Road (300m to 650m downstream of Site 107 crossing)	100 m rise / 350 m run = 29 %
102	1	38	Hwy 37 N to 450 m upstream	120 m rise / 450 m run = 29 %
94	1	40	19-20 Mile FSR (Site 89) upstream to Site 94	280 m rise / 850 m run = 33 %
84	1	41	Site 271 crossing to Site 84 crossing	100 m rise / 450 m run = 22 %
83	1	42	Site 83 crossing to 450 m downstream	140 m rise / 600 m run = 29 %
58, 60	2	57	Upper Kitwanga River to Kitwanga FSR:	80 m rise / 300 m run = 30 %
54	1	64	Upper Kitwanga River to Kitwanga FSR	120 m rise / 400 m run = 30 %
55, 57, 58	3	65	Upper Kitwanga River to Kitwanga FSR	90 m rise / 250 m run = 36 %
52	1	67	Upper Kitwanga River to Kitwanga FSR:	120 m rise / 300 m run = 40 %
50, 51	2	68	Upper Kitwanga River to Kitwanga FSR	130 m rise / 400 m run = 33 %
48, 47, 332	3	69	Upper Kitwanga River to Kitwanga FSR	160 m rise / 300 m run = 53 %
49	1	70	Upper Kitwanga River to Kitwanga FSR	140 m rise / 450 m run = 31 %
46	1	71	Upper Kitwanga River to Kitwanga FSR	120 m rise / 300 m run = 40 %
44	1	72	Upper Kitwanga River to Kitwanga FSR	100 m rise / 250 m run = 40 %
1, 2, 24-30, 34-39, 41-44	19	73-80	All crossings upstream of 8 meter waterfalls on Upper Kitwanga River	n/a
Total	40			

4.2 Mapping Errors

A total of 19 sites were visited where no stream was present at a crossing shown to exist on 1:20,000 TRIM (Table 3). These sites do not need to be revisited for any fisheries surveys carried out in the future. Conversely, ten stream crossings were found that were not shown on 1:20,000 TRIM (Sites 330 to 335, Table 4).

Table 3: List of sites not found in the field (Sorted by Tributary ID#).

Site #	# of sites	Tributary #	Notes
112, 113	2	33	Not found in this survey or by Biolith (1999)
105, 106	2	38	Not found in this survey
70, 71, 72	3	45b	Not found in this survey or by Biolith (1999)
75, 76	2	47b	Not found in this survey or by Biolith (1999)
74	1	46	Not found in this survey or by Biolith (1999)
63	1	52	Not found in this survey
64	1	55	Not found in 2006 survey (McCarthy 2007)
56	1	63	Not found in this survey
53	1	66	Not found in this survey
40, 45	2	75	Not found in this survey
32, 33	2	77	Not found in this survey or by Biolith (1999)
78	1	Unnamed	Not found in this survey or by Hwy 37 report?
79	1	Unnamed	Not found in this survey or by Hwy 37 report?
Total	20		

Table 4: List of sites found on streams not mapped on TRIM (Sorted by Tributary ID#).

Site #	Road Location	Easting	Northing
326	32 Mile FSR	557253	6137929
327	32 Mile FSR	557243	6137929
328	Jackson Main FSR	543817	6135916
329	Jackson Main FSR	543802	6135852
330	Kurtass Main FSR (425m from junction)	544854	6136542
331	Jackson Main FSR (400m from Kurtass Jct.)	544740	6136615
332	Billy Main FSR (700m from junction)	546002	6137963
333	Kitwanga FSR	546434	6138970
334	E. Kitwancool Lake Rd.	556692	6137608
335	Hwy. 37 N	556757	6137742

4.3 Other Priority Crossings

Other Priority Crossings are those that exhibited sedimentation and/or maintenance problems. A total of eight crossings were identified in the moderate to extreme WQEE category and a total of 11 crossings had maintenance problems.

4.3.1 Sedimentation Potential (WQEE Rating)

Sedimentation sources in the moderate to very high ranking were encountered at eight culvert crossings. 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. All 15 crossings along Hwy 37 N were ranked as low degree of sedimentation due to its paved surface and well vegetated ditches and cutbanks.

4.3.1.1 WQEE Ranking: High to Extreme

Five crossing sites were ranked in the high to extreme WQEE category, all of which had a mass-wasting component in the total score. A brief summary of the issues contributing to the high-extreme ranking for each site is as follows:

Site 48 – Kitwanga FSR/Tributary 69

Site 48 received a WQEE score of 303 m^3 (extreme ranking). Downstream of this crossing multiple horizontal fractures measuring 20 to 30 meters in length extend down-slope for approximately 30 meters. The uppermost fracture has reached the stream 15 meters downstream of culvert crossing. Further down-slope of these fractures is an active landslide measuring approximately 100 meters long x 30 meters wide at a 55 percent slope (Photos 17 and 18). One vertical crack extends upslope across the road into the forest, which has created a 0.5-meter slump in the roadbed (Photo 19). This hillslope appears extremely unstable and there is a high potential for a massive landslide into the Upper Kitwanga River. Although it is uncertain if this slide is road related, it does deserve serious attention from the MOF.

This slide was report by Biolith (1999) at the confluence of Tributary 69 and the Upper Kitwanga River. Biolith (1999) noted that the slide appeared to carry sediment from the main road down into the important fish habitat in Reach 12 of the Kitwanga River and this slide may

have been related to construction of the Kitwanga FSR and at other road crossings further upstream as well as logging on its east side.

Photo 17: Site 48 – Massive landslide down-slope of Kitwanga FSR. Photo taken from across the valley facing south from Ronald McDonald FSR.

Photo 18: Site 48 – Massive landslide down-slope of Kitwanga FSR. Photo taken from top of slide facing downhill.

Photo 19: Site 48 – Road fracture on Kitwanga FSR above landslide.

Site 91 – West Kitwancool Lake FSR/Tributary 49

Site 91 received a WQEE score of 60 m^3 (extreme). Mass wasting has occurred on the right bank immediately upstream of the crossing and appears to be caused by water being backed up at the culvert inlet that is creating a scouring force on the stream bank (Photo 20).

Photo 20: Site 91 – Mass wasting upstream of crossing.

Site 332 – Billy Main/Tributary 69

Site 332 received a WQEE score of 25 m^3 (very high). Mass wasting has occurred in the road fill over the culvert outlet.

Photo 21: Site 332 – Mass wasting at culvert outlet.

Site 42 – Kitwanga FSR/Tributary 74

Site 42 received a WQEE score of 7.2 m^3 (high). Mass wasting has occurred on the left road cutbank adjacent to the stream channel.

Photo 22: Site 42 – Mass wasting on left-road cutbank adjacent to stream.

Site 35 – Kurtass Main FSR/Tributary 76

Site 35 received a WQEE score of 6.0 m^3 (high). Mass wasting has occurred on the left road cutbank adjacent to the stream channel.

Photo 23: Site 35 – Mass wasting on left-road cutbank.

4.3.1.2 WQEE Ranking: Moderate

Three crossing sites were ranked in the moderate WQEE category, one of which had a mass-wasting component in the total score. A brief summary of the issues contributing to the moderate ranking for each site is as follows:

Site 61 – Kitwanga FSR/Tributary 57

Site 61 received a WQEE score of 4.0 m^3 (moderate). Mass wasting has occurred in the road fill around the culvert outlet.

Photo 24: Site 61 – Mass wasting at culvert outlet.

Site 98 – East Kitwancool Lake Road/Tributary 40

Site 98 received a WQEE score of 1.4 m^3 (moderate). The roadbed and upper ditchline contain a relatively high proportion of erodible fine material.

Photo 25: Site 98 – Muddy right-road surface and upper ditch.

Site 96 – East Kitwancool Lake Road/Tributary 40

Site 96 received a WQEE score of 1.1 m^3 (moderate). Similar to site 98, the roadbed and upper ditchline contain a relatively high proportion of erodible fine material.

Photo 26: Site 96 – Muddy right road surface.

4.3.2 Maintenance Requirements

A wide variety of maintenance issues were encountered during this survey (Table 5). Beaver dams were the major maintenance issues at three culvert crossings: Sites 7 and 9 – West Kitwancool Lake FSR, and Site 285 – East Kitwancool Lake Road. During the time of this survey culvert inlets were plugged and water was flowing over the road at Sites 9 and 285. A beaver dam upstream of the bridge crossing at Site 7 had water backed up and was flowing over the left road surface. Culvert should be replaced at sites 9 and 285, including the incorporation of an effective beaver control device. Culvert intakes plugged by mud/rock/woody debris jams were encountered at Site 15 (24 Mile Rd), Site 77 (Highway 37), and Sites 95 and 281 (East Kitwancool Lake Rd). 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. Damaged or degraded culverts were encountered at Site 15 (24 Mile Rd), Sites 31, 85, 100, 284 (Hwy 37 N), and Sites 96, 98, 285 (East Kitwancool Lake Rd). A secondary culvert was damaged at the intake at Site 9, likely from a machine attempting to clear the blockage.

Table 5: Culvert Maintenance Issues

ID	Road Name	Stream Name	Jurisdiction	Crossing Issues
7	West Kitwancool Lake FSR	Unnamed	MOF	Water flowing over road from beaver dam upstream of bridge.
9	West Kitwancool Lake FSR	Unnamed	MOF	Intake plugged by beavers, water flowing over road, collapsed intake on secondary culvert.
15	24 Mile Rd.	Trib 44	MOF	Partially plugged intake, partially collapsed in the center.
95	E. Kitwancool L Rd.	Trib 43	MOT	Intake partially blocked with wood/rock debris.
96	E. Kitwancool L Rd.	Trib 42	MOT	Partially collapsed in center.
98	E. Kitwancool L Rd.	Trib 40	MOT	Partially collapsed in center.
281	E. Kitwancool L Rd.	Trib 37	MOT	Intake 2/3 plugged with gravel/cobble
285	E. Kitwancool L Rd.	Trib 36	MOT	Two culverts, both intakes plugged by beavers, water flowing over road on Nov. 1/07; bent inlets and outlets.
31	Hwy. 37 N	Trib 36	MOT	Offset at joint midway.
77	Hwy. 37 N	Trib 53	MOT	Intake partially blocked.
85	Hwy. 37 N	Trib 43	MOT	Bent in middle.
100	Hwy. 37 N	Trib 38	MOT	Offset at joint midway.
284	Hwy. 37 N	Trib 36	MOT	Partially collapsed in center.

5. DISCUSSION

The Kitwanga River Fish Passage - Culvert Inspection project was successful in identifying 16 culverts that were either full or partial fish passage barriers and eight stream crossings that ranked from moderate to very high degree of sedimentation. Except for one crossing on the Kitwanga FSR, all fish barriers were located on either Hwy 37 N or East Kitwancool Lake Road, which are under MOT jurisdiction. Conversely, most sedimentation issues were attributed to logging roads, with mass wasting as the main concern. For roads under MOT jurisdiction, Hwy 37 N was paved and well vegetated while the East Kitwancool Lake Road was generally muddy and in a deteriorating condition.

During the survey the main fish species captured near crossing structures deemed as barriers were cutthroat trout, while rainbow trout and coho juveniles were captured only incidentally. Cutthroat trout were not only abundant and widespread, they were the only species encountered in the uppermost reaches of most sites. The only exception to this was during a 2002 GFA study when Dolly Varden/bull trout was the only species captured in the Upper Kitwanga River mainstem approximately 4 kilometers downstream of the 8-meter waterfalls (McCarthy 2003). Rainbow trout were captured in small numbers in tributaries of Gitanyow Lake that cross Hwy 37 N and the East Kitwancool Lake Road. Coho juvenile were captured only in one stream near the confluence with Gitanyow Lake downstream of the East Kitwancool Lake Road. Red-sided shiner and slimy sculpin were captured at one site in a beaver pond that crosses the East Kitwancool Lake Road.

Since 2003, logging activities in the watershed have been minimal following the collapse of Skeena Cellulose, the major forest development company operating in the area. At the time of this survey the only active logging road was the Weber FSR via the 26-Mile FSR. All FSR's were in poorly maintained condition (i.e. frequent ruts and potholes, downed trees, encroaching shrub growth). Mushroom pickers and hunters were the main users of these roads.

Sedimentation sources at stream crossings were considered minimal at 65 of the 73 sites assessed, as they were well vegetated and consisted mainly of non-erodible material. Of the 8 sites remaining that received a moderate to very high WQEE ranking, six sites exhibited mass

wasting that led directly into the stream channel. The most significant mass wasting issue was at Site 48 where a massive landslide extends from the Kitwanga FSR down the Upper Kitwanga River mainstem. Horizontal and vertical fractures are evident immediately downslope of the Kitwanga FSR and across the road itself. There is potentially a high risk of a massive hillslope failure at this site, which could create a barrier within the Upper Kitwanga River mainstem and introduce a large amount of sediment into downstream reaches. A road engineer should address mass-wasting issues immediately.

Increased sedimentation into streams can result from road construction and timber harvesting activities. Fine sediment washing from unpaved roads surfaces is generally the most significant sediment source [Everest et al. 1987a; Reid and Dunn 1984 (In Meehan 1991)]. Several negative impacts can result from fine sediment entering into an aquatic environment. Egg-to-fry survival can be reduced as spawning gravel become clogged with fine sediment causing a reduction in water and oxygen flow and creating an impermeable layer that can trap emerging fry [Koski 1966; Meehan and Swanston 1977; Everest et al. 1987a (In Meehan 1991)]. Increased sediment will reduce stream visibility and thus reduce feeding efficiency of salmonids [Bisson and Bilby 1982; Sigler et al. 1984 (in Meehan 1991)].

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 unless a regular monitoring program is in place.

6. CONCLUSION AND RECOMMENDATIONS

There are many worthwhile opportunities for future works that would greatly improve fish passage and reduce sediment delivery in the Upper Kitwanga Watershed:

1. Non-essential roads should be deactivated where they cross fish-bearing waters.
2. Barrier culverts should be replaced on essential roads.
3. Significant sediment sources should be either seeded with grass to provide more erosion control, or in extreme cases, be assessed by a road engineer.
4. All active road crossings on fish-bearing streams should be monitored periodically for effectiveness at passing fish and potential for introducing sediment into the stream.
5. Future road should be designed to include only bridges or open-bottom culverts on all fish bearing streams.
6. Where information is lacking, fish distribution patterns and upstream limits should be studied on all fish bearing-stream to provide better protection from future developments.
7. A data management plan should be created for easy retrieval of the large amount of information collected in the Kitwanga River Watershed.

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. Barriers sites identified in this assessment were all located on essential roads (Highway 37 N, East Kitwancool Lake Road, Kitwanga FSR). The MOF ultimately has the authority to designate a logging 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.

One road that appears to be non-essential, which crosses a fish-bearing stream is 24-Mile FSR (Tributary 44). The 24-Mile FSR is a low-use road that also has a culvert crossing deemed in 2006 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 Kitwanga Lumber Company, based in Kitwanga B.C. is responsible for the maintenance of this road.

6.2 Culvert Replacement on Essential Roads

Culvert replacement is required for barrier sites located on essential roads. Since there is a large cost associated with culvert replacement, particularly those that cross Hwy 37 N, it is important to carry out a detailed FHAP beforehand to measure the potential benefits of structural replacement. GFA recommends detailed FHAP surveys for all fish-bearing tributaries that cross Hwy 37 N and the East Kitwancool Lake Road (11 streams in total, all under MOT jurisdiction: Tributary 34, 36, 37, 38, 39, 40, 41, 42, 43, 54, and 55). FHAP's were undertaken during this project at Tributary 44 and 53 to address culvert barriers found on the 24 Mile Road (Site 15) and the 25 Mile Road (Site 14) in 2006; results of this survey should be forwarded to the MOT as the Highway crossing downstream of Site 15 was deemed as a fish barrier, while the Hwy 37 N crossing downstream of Site 14 allowed for fish passage. GFA also recommends that round culvert be replace with bridges or open bottom culverts to retain the natural streambed though the crossing.

6.3 Sediment control

A road engineer should address the mass wasting concerns at Sites 35, 42, 48, 91 and 332 and sedimentation from the East Kitwancool Lake Road. Prescriptions could be as simple as grass seeding or more complicated such as bioengineering or cutbank stabilization (i.e. reduce slope).

6.4 Monitoring of Essential Roads

Essential roads should be monitored on a regular basis depending on their level of use. 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.

The following is a list of high priority projects that should be monitored:

Monitoring of beaver activity at 26 Mile Road FSR (Site 10, fish-bearing ditchline), West Kitwancool Lake FSR (Sites 7, 8, and 9), the first kilometer of the Kitwanga FSR (Sites 5 and 6), and the East Kitwancool Lake Road (Site 285).

Monitoring of the massive landslide at Site 48 along the Kitwanga FSR to document slide activity.

Monitoring of Site 90 (West Kitwancool Lake FSR) where a rock-debris torrent plugged the bridge crossing in the spring of 2007, which created a new channel down the right road upper ditchline, across the road, and into the forest below. The channel was reinstated in the summer of 2007, however this site has a history of debris torrents (Biolith 1999), and will likely occur again.

6.5 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 stakeholder groups including the Gitanyow Hereditary Chiefs, the BC MOF, forestry companies, and the BC MOT 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.

6.6 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 Gitanyow 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 Gitanyow Lake tributaries and the Upper Kitwanga River, and its tributaries. However, in this

assessment more emphasis was placed on logging impacts than on fish distribution patterns. Important fish distribution information was collected in the 2006 and 2007 stream crossing assessments, however efforts were focused near the actual crossings. Upstream fish distribution limits are largely unknown for most of the tributaries entering Gitanyow Lake and the Upper Kitwanga River. 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.

6.7 Data Management

For the purposes of this report, data from FPCI and WQEE field cards were transcribed onto Microsoft Excel spreadsheets. This survey produced a large amount of data from 73 sites surveyed in 2007 and 16 sites surveyed in 2006. This includes geographic location, fish species distribution, fish habitat quality, stream crossing structure characteristics, and road-based sediment sources. GFA created an Excel database to manage all FPCI, SCQI, and WQEE data collected in the Kitwanga Watershed. 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 manner 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, SCQI, and WQEE are combined into one data set. In total, there are approximately 192 data variables that must be organized into one database (83 FPCI, 80 SCQI and 29 WQEE 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. WORK PLAN

The following work plan is being proposed to both the MOF and the MOT for the 2008 field season. Stream crossing issues under MOF jurisdiction mainly involve sediment sources and nuisance beaver activity, while stream crossings under MOT jurisdiction mainly involve fish

barriers at culvert crossings on Highway 37 N and the East Kitwancool Lake Road and sedimentation sources along the East Kitwancool Lake Road.

7.1 Roads under MOF jurisdiction

7.1.1 Fish Passage Improvement

One culvert crossing was identified as a partial barrier due excessive at water velocity for juvenile salmonids (Site 61, Unnamed Tributary, Kitwanga FSR, UTM 9U.549762.6140303). In order to justify culvert replacement or modification, GFA recommends undertaking a FHAP (Johnston and Slaney 1996) on all 10 streams beforehand from their confluence upstream to the limit of fish distribution. In order to justify culvert replacement or modification, GFA recommends undertaking a FHAP (Johnston and Slaney 1996) from the confluence with the Upper Kitwanga River upstream to the limit of fish distribution. In close proximity to Site 61 is Site 3 (Chernobel Creek), which was identified as a partial barrier in 2006 due to excessive water velocity for juvenile salmonids. Because these crossings are located near each other, a FHAP should be carried out on both streams.

7.1.2 Sedimentation Reduction

A total of six sites were identified as having moderate to extreme sedimentation potential, all of which require a road engineer to develop a remediation plan. These sites should be visited in 2008 soon after snowmelt. Possible solutions include planting grass and shrubs, reducing cutbank slope, installing rock armoring, and repairing the roadbed. Sites locations and their sedimentation issues are as follows:

Table 6: List of sediment sources on roads under MOF jurisdiction.

Site #	Road Name	Stream Name	Easting	Northing	Crossing Issues
48	Kitwanga FSR	Trib 69	545773	6138329	Multiple horizontal cracks extending 20-30m, upper fracture has reached creek 15m downstream of culvert; vertical crack extends upslope across road into forest; active slide extents downslope for approx. 100mx30m; high potential for massive landslide.
91	W. Kitwancool Lake Rd.	Trib 49	555332	6133736	Mass wasting on right bank immediately u/s of crossing.
332	Billy Main FSR	Trib 69	546002	6137963	Mass wasting at culvert outlet (front fill) and RRC.
42	Kitwanga FSR	Trib 74	545079	6137168	LRC wasting beside stream.
35	Kurtass Main	Trib 76	544916	6136884	Mass wasting on LRC.
60	Kitwanga FSR	Trib 57	547942	6139470	Mass wasting at culvert outlet.

7.1.3 Road Maintenance

Three sites require maintenance to maintain fish passage and to avoid the risk of road washouts: These works should be carried out in 2008 soon after snowmelt.

Table 7: List of stream crossing requiring maintenance on roads under MOF jurisdiction

Site ID	Road Name	Stream Name	Northing	Easting	Crossing Issues and Recommendations
7	West Kitwancool Lake FSR	Unnamed	6140761	551853	Water flowing over road from beaver dam upstream of bridge. Recommend beaver dam breaching, trapping.
9	West Kitwancool Lake FSR	Unnamed	6140736	552529	Intake plugged by beavers, water flowing over road, collapsed intake on secondary culvert. Recommend installing effective beaver control device.
15	24 Mile Rd.	Trib 44	6143696	551778	Partially plugged intake, partially collapsed in the center. Recommend culvert replacement or deactivation.

7.2 Roads under MOT jurisdiction

7.2.1 Fish Passage Improvement

A total of 15 culvert crossings were identified on 10 streams as full or partial fish passage barriers due to excessive at water velocity, suspended outlets, and/or insufficient water depth. These sites were located along East Kitwancool Lake Road (5 sites) and Highway 37 N (10 sites). In order to justify culvert replacement or modification, GFA recommends undertaking a FHAP (Johnston and Slaney 1996) on all 10 streams beforehand from their confluence to the upstream limit of fish distribution.

Table 8: List of crossings that are fish passage barriers on roads under MOT jurisdiction.

Stream Name	Site #	Road Name	Northing	Easting	Crossing Issues
Trib 36	284	Hwy. 37 N	6134554	557303	Velocity barrier to juvenile salmonids, depth too shallow for large fish; mod. priority.
Trib 37	31	Hwy. 37 N	6134896	557158	Velocity barrier to juvenile salmonids, depth too shallow for large fish; mod. priority.
Trib 40	98	East Kitwancool Lake Rd.	6137348	556896	Suspended outlet, excessive velocity for juvenile salmonids, insufficient water depth inside culvert for adults; high priority.
	88	Hwy. 37 N	6137431	557004	Velocity barrier to juvenile salmonids, depth too shallow for large fish; mod. priority.
Trib 41	97	East Kitwancool Lake Rd.	6137501	556822	Excessive velocity for juvenile salmonids, insufficient water depth inside culvert for large adults; high priority.
	87	Hwy. 37 N	6137620	556864	Possible height and velocity barrier to juvenile salmonids, depth too shallow for large fish; mod. priority.
Trib 42	96	East Kitwancool Lake Rd.	6137874	556367	Velocity barrier to juvenile salmonids; high priority.
	86	Hwy. 37 N	6137988	556470	Possible height and velocity barrier to juvenile salmonids, depth too shallow for large fish; mod. priority.
Trib 43	95	East Kitwancool Lake Rd.	6138067	556134	Velocity barrier to juvenile salmonids; high priority.
	85	Hwy. 37 N	6138111	556340	Possible velocity barrier to juvenile salmonids; mod. priority.
Trib 44	81	Hwy. 37 N	6139371	555313	Velocity barrier to juvenile salmonids; mod. priority.
Trib 54	67	Hwy. 37 N	6142211	552910	Excessive jump height/ insufficient pool depth for all fish; velocity barrier for juvenile salmonids; high priority.
Trib 55	80	Hwy. 37 N	6143391	551975	Velocity barrier for juvenile salmonids; mod. priority.
Unnamed	334	East Kitwancool Lake Rd.	6137608	556692	Velocity barrier to juvenile salmonids; high priority.
	335	Hwy. 37 N	6137742	556757	Possible height and velocity barrier to juvenile salmonids, depth too shallow for large fish; mod. priority.
Unnamed	61	Kitwanga FSR	6140303	549762	Possible velocity barrier to juvenile salmonids; mod. priority.

7.2.2 Sedimentation Reduction

Two sites along the East Kitwancool Lake Road were identified as having moderate sedimentation potential, both of which requires a road engineer to develop a remediation plan. This road is muddy and in poor condition and should be inspected in 2008 soon after snowmelt. Possible solutions include planting grass in the ditchlines and repairing/resurfacing the roadbed adjacent to stream crossings.

Table 9: List of sediment sources on roads under MOT jurisdiction.

Site #	Stream Name	Northing	Easting
96	Trib 42	556367	6137874
98	Trib 40	556896	6137348

7.2.3 Road Maintenance

Ten culvert sites require maintenance or replacement to maintain fish passage and to avoid the risk of road washouts: Issues include plugged intakes and bent or collapsed culverts. It should be noted that only a road engineer can justify closing Highway 37 N for any extended period when considering culvert replacement. These works should be carried out in 2008 soon after snowmelt.

Table 10: List of stream crossings requiring maintenance or replacement on roads under MOT jurisdiction.

ID	Road Name	Stream Name	Northing	Easting	Crossing Issues and Recommendations
95	E. Kitwancool L Rd.	Trib 43	6138067	556134	Intake partially blocked with wood/rock debris. Recommend clearing intake.
96	E. Kitwancool L Rd.	Trib 42	6137874	556367	Partially collapsed in center. Recommend culvert replacement.
98	E. Kitwancool L Rd.	Trib 40	6137348	556896	Partially collapsed in center. Recommend culvert replacement.
281	E. Kitwancool L Rd.	Trib 37	6134869	557091	Intake 2/3 plugged with gravel/cobble. Recommend clearing intake.
285	E. Kitwancool L Rd.	Trib 36	6134565	557056	Two culverts, both intakes plugged by beavers, water flowing over road on Nov. 1/07; bent inlets and outlets. Recommend replacing culvert and installing effective beaver control device.
31	Hwy. 37 N	Trib 36	6134896	557158	Offset at joint midway. Recommend inspection by road engineer.
77	Hwy. 37 N	Trib 53	6140744	553927	Intake partially blocked. Recommend clearing intake.
85	Hwy. 37 N	Trib 43	6138111	556340	Bent in middle. Recommend inspection by road engineer.
100	Hwy. 37 N	Trib 38	6135793	556894	Offset at joint midway. Recommend inspection by road engineer.
284	Hwy. 37 N	Trib 36	6134554	557303	Partially collapsed in center. Recommend inspection by road engineer.

8. OTHER WORKS - SUMMARY OF FISH HABITAT ASSESSMENTS AND ROAD DEACTIVATIONS COMPLETED ON FOUR STREAM CROSSINGS IN THE CRANBERRY AND KITWANGA RIVER WATERSHEDS IN 2007

8.1 Introduction

This section is a summary of works completed on four stream crossings found to be fish barriers in 2006. In 2007, data was collected from these four streams using the Fish Habitat Assessment Procedures (FHAP; Johnston and Slaney 1996) and the Fish Passage Culvert Inspection Procedures (FPCI; Parker 2000). In July and September 2007, FHAP and FPCI data was collected from two fish barrier sites in the Cranberry River watershed (The 2006 Cranberry River Fish Passage-Culvert Inspection Project; McCarthy 2007; Sites 48 and 61) and from two sites in the Kitwanga River watershed (The 2006 Kitwanga River Fish Passage-Culvert Inspection and the Stream Crossing Quality Index Project; McCarthy 2007; Sites 14 and 15). FHAP's were undertaken to determine the fisheries value of these four streams and to estimate the benefit and cost of rehabilitation. Prescriptions and costs were developed for each site and then submitted to BC Ministry of Forests (MOF) for review and approval. Approval was granted for the deactivation of Sites 48 and 61 (Cranberry River Watershed) and Site 14 (Kitwanga River Watershed) as they were under direct responsibility of the MOF. These three sites were deactivated and rehabilitated in October 2007.

Site 15 (Kitwanga River Watershed) was under the Kitwanga Lumber Company license, however it was not deactivated because it was too late in the year to acquire funding from that company. A proposal will be submitted directly to the Kitwanga Lumber Company in 2008 to deactivate the Site 15 crossing. This project is in accordance with a contract awarded by the BC Ministry of Forests to Gitanyow Fisheries Authority (GFA) in 2007.

8.2 Methods

Prior to deactivating each site, they were surveyed for fish habitat quality and quantity using the Fish Habitat Assessment Procedures (FHAP; Johnston and Slaney 1996) and for fish passage status using the Fish Passage Culvert Inspection Procedures (FPCI; Parker 2000). The FHAP procedures were simplified to acquire specific information on reach breaks, channel morphology, and barrier locations. The FPCI involved collecting data on the culvert characteristics while focusing on outflow drop at the culvert outlet and water velocity inside the culvert. Also involved with the FPCI was a stream habitat survey immediately upstream and downstream of the crossing. A summary report was then prepared for the MOF to acquire funding for the deactivation of these crossings. Sampling dates and locations were as follows:

- Site 14 (Kitwanga River Watershed) - FHAP was carried out on July 12, 2007 from the Highway 37 crossing to the Site 68 crossing 700 meters upstream and an FPCI was completed for Sites 77 (Highway 37 N) and Sites 14 and 68 (25 Mile Road).
- Site 15 (Kitwanga River Watershed) - FHAP was carried out on July 11, 2007 from the confluence of Gitanyow Lake to a bedrock waterfall located 830 meters upstream and an FPCI was completed on Sites 81 (Highway 37 N) and Site 15 (24 Mile Road).
- Site 61 (Cranberry River Watershed) - FHAP was carried out on from the 29 Mile FSR to bedrock waterfalls located approximately 420 meters upstream and an FPCI was completed on the Site 68 crossing on 29 Mile FSR.
- At Site 48 (Cranberry River Watershed) a FHAP was completed from the Cranberry River confluence to the Site 47 crossing (Mitten Main FSR) located 1600 meters upstream.

8.3 Results

This section is a summary of FHAP and FPCI data collected from 4 stream crossings found to be barriers in a 2006 assessment. Also summarized is the deactivation works completed at Sites 14 (Kitwanga River Watershed) and Sites 48 and 61 (Cranberry River Watershed).

8.3.1 Site 14- Unnamed Tributary of the Upper Kitwanga River Tributary

Background and Site Description

In 2006, Site 14 was assessed as a full fish barrier and classified as a moderate priority crossing (FPCI Score = 28). 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 to an absence of water in the culvert (water was flowing under the culvert through log corduroy) and a suspended culvert outlet (Photo 27). 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. The 600-millimeter diameter culvert that was in place was insufficient to accommodate a 100-years flood and needed to be replaced or removed. The fill depth above the culvert was 0.75 meters.

The stream habitat value was considered poor within 50 meters of the crossing 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). 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. Upstream of the culvert the gradient increases sharply and small rock/wood debris jams occur frequently, which may limit the upstream movement of fish. The total length of stream barred was estimated at 800 meters (approximately 2400 m^2 of fish habitat), which represents 50 percent of the total stream length.

Photo 27: Site 14 culvert outlet prior to deactivation. Water was flowing mostly through the log corduroy in the underlying roadbed.

In July 2007, a FHAP was undertaken on five reaches upstream of the Site 14 culvert crossing to the Site 68 culvert crossing located approximately 700 meters upstream. Downstream habitat was considered good quality comprised mainly of shallow riffles/pools with abundant over-stream vegetation (OV) and small woody debris (SWD). The Highway 37 N crossing (Site 77) was deemed passable to all fish. A summary of each reach is as follows:

Reach 1 (0+000 to 0+026 meters) is a moderate gradient section (8 percent approximately) comprised mainly of cascades and riffles with SWD and boulders (B) as cover. This section provided moderate fish habitat.

Reaches 2 (0+026 to 0+160 meters) and 3 (0+160 to 0+250 meters) are steep gradient sections (20 % average gradient) comprised of cascades, riffles, and pools with abundant (OV), large woody debris (LWD) deep pools (DP), and boulders as cover. These reaches differ with respect

to their riparian zones: Reach 2 has a riparian zone comprised of a mixed stand of young trees and Reach 3 has a riparian zone comprised of a mature stand of conifers. Potential fish barriers consisting of 2-3 meter high cascades over 3-4 meter lengths were encountered at 0+115, 0+140, and 0+170 meters. These reaches provided marginal fish habitat.

The gradient of Reach 4 (0+250 to 0+300 meters) decreases to approximately 10 percent. Habitat consists of cascades, pools, and riffles. This section was logged to the stream bank sometime in the past few decades. At the upstream end of this reach is a small tributary that cascades over bedrock into the main channel and is likely non-fish bearing. This section provided moderate fish habitat.

Reach 5 (0+300 to 0+700 meters) is a moderate gradient section (approximately 12 percent slope) and is comprised mainly of riffles, pools, and small cascades with abundant over-stream vegetation (OV), small woody debris (SWD), and large woody debris (LWD). Deep pools (DP) were present but not abundant. At the upstream end of the reach is a culvert crossing along an old grown–over road. This culvert is suspended over the streambed by 35 cm and the intake is mostly plugged with mud and wood debris. This reach provided good fish habitat.

Seven "Gee" traps were set downstream three traps of the Site 68 culvert crossing in Reach 5 in what appeared to be good fish habitat, however no fish were captured after 24 hours of soak time. The cascades located in Reaches 2 and 3 may be the upstream limit of fish distribution in this stream, and if so, the removal of this culvert would add approximately 150 meters of additional habitat. The fish that were captured in 2006 upstream of the culvert crossing at Site 14 were obtained downstream of these cascades.

Deactivation

Site 14 was deactivated on October 25, 2007. Prior to deactivation, 2 dump-truck loads of riprap were delivered to the site. Deactivation began by isolating the work site using fish barrier nets, then fish were removed by electrofishing within the work area. A total of 8 cutthroat trout were removed from the site and held in aerated buckets until works were completed. Fill material and the underlying culvert were removed using a Hitachi EX-60 excavator equipped with biodegradable hydraulic oil (Photo 28). The stream channel and banks were covered with riprap

and large boulders were placed within the channel to create habitat cover and velocity breaks (Photos 29 and 30). A complete photo series for the FHAP and the deactivation is presented on CD in Appendix II in a Folder entitled Site 14 FHAP and Deactivation.

Photo 28: Removing culvert fill material at Site 14.

Photo 29: Site 14 with new channel near end of completion.

Photo 30: Site 14 on December 1, 2007 approximately 5 weeks following deactivation.

8.3.2 Site 48 – Unnamed tributary of the Cranberry River

Background and Site Description

In 2006, a log fjord was found in a stream that crossed the Lower Mitten FSR (2.2 kilometers west of Wagon Creek Road). This site was given high priority because the channel was completely filled with logs, and appeared to significantly impede fish passage (Photos 31 and 32). A culvert was still imbedded in the stream channel, however the stream had eroded a new channel beside the culvert that was later filled with logs to allow for vehicle access. Very little water was flowing through the culvert during this assessment.

Photo 31: Log fjord and culvert outlet before deactivation.

Photo 32: Log fjord and culvert inlet before deactivation.

The 2007 FHAP survey started at the Cranberry River confluence and proceeded upstream to the Mitten Main FSR (total distance of 1600 meters) where a rainbow trout had been captured

approximately 50 meters downstream of the crossing. The log fjord was located 277 meters upstream of the confluence and by removing the logs it would improve access to approximately 1,300 meters of useable fish habitat up to Site 47 on the Mitten Main FSR (approximate area of 3900m^2). The Mitten Main FSR culvert crossing is impassable to fish however it should be noted that the cost of replacement is beyond the budget allocated for rehabilitation works planned for this year (Photo 33). A FHAP was not conducted upstream of the Mitten Main FSR in this field season, but is recommended that it be performed in the 2008 field season to determine the fisheries benefits of replacing this culvert.

Photo 33: Suspended culvert at Site 47 located along the Mitten Main FSR.

Five reaches were identified during the FHAP between the Cranberry River confluence and the Mitten Main FSR. Overall, the fish habitat was considered excellent over most of the surveyed length. Mean bankfull and wetted width were approximately 3.0 meters and 1.2 meters respectively. Potential barriers were located in Reach 5 where rock/wood debris jams have created several 0.5 to 1-meter high waterfalls. A summary of each reach is as follows.

Reach 1 was a short section (0+40 meters) located at the stream mouth where fish habitat was comprised of mainly shallow riffles with minimal cover providing moderate habitat.

Reach 2 extends from 0+40 meters to the log fjord at 0+277 meters. Fish habitat was considered structurally diverse with riffles and pools as the dominant habitat type and an abundance of large and small woody debris, deep pools, over-stream vegetation, and undercut banks. The stream gradient was approximately 7 percent and was deeply entrenched within relatively flat terrain. This reach provided excellent fish habitat.

Reach 3 begins at the log Fjord at 0+277 meters and extended for approximately 185 meters to the start of a steep-walled canyon at 0+462 meters. Fish habitat was similar to Reach 2 and could be combined as one reach following the removal of the log fjord.

Reach 4 extends from 0+462 meters to 1+510 meters. This reach is located within a steep walled canyon. Gradient increases to approximately 11 percent and habitat was comprised of riffle, pools, and small cascades. With the gradient increase, boulders contribute to important habitat cover along with an abundance of LWD, SWD, DP, OV, and undercut banks (UCB). One rainbow trout juvenile was captured at the upstream end of this reach in 2006. This reach provides excellent fish habitat.

Reach 5 extends from 1+510 meters to the Mitten Main FSR at 1+600 meters. This reach is located within the same steep-walled canyon as Reach 4, however the stream gradient increases to approximately 17 percent. Habitat is comprised mainly of cascades and pools with several rock/wood debris jams that have created 0.5 to 1 meter high waterfalls that are potential fish barriers. Habitat cover is considered abundant, comprised of B, LWD, SWD, DP and OV. Due to the numerous cascades and steep gradient, this reach provides only marginal fish habitat.

Deactivation

Site 48 was deactivated on November 7, 2007. Deactivation began by isolating the work site using fish barrier nets. Electrofishing within the work site did not yield any fish. Logs surrounding the culvert were cut into moveable pieces and yarded out the channel using an ATV (Photo 34). The culvert was then winched out of the streambed (Photo 35 and 36), and then all remaining logs were removed except for two that served as erosion barriers on each side of the stream bank. A riffle/pool complex was created in the newly formed channel by installing three equally spaced pieces of LWD (15cm diameter) perpendicular to the stream flow (Photo 37). A

complete photo series for the FHAP and the deactivation is presented on CD in Appendix II in a Folder entitled Site 48 FHAP and Deactivation.

Photo 34: Removing logs over culvert during deactivation at Site 48.

Photo 35: Removing culvert using ATV during deactivation at Site 48.

Photo 36: Culvert and logs removed from streambed and placed on left road surface.

Photo 37: Completed deactivation at Site 48.

8.3.3 Site 61 – Unnamed tributary of the Cranberry River

Background and Site Description

In 2006, Site 61 was assessed as full barrier and classified as a low priority crossing (FPCI Score = 25). This stream received low priority ranking because only 1 salmonid species was captured, and the length of habitat gained was a low percentage of the total stream length. Twenty-nine Mile FSR crosses an unnamed tributary approximately 5 kilometers upstream of the Cranberry River confluence. "Gee" trapping downstream yielded five cutthroat trout downstream (8 to 15 centimeter fork length) and three cutthroat trout (6 to 10 centimeters) upstream. It is likely that a self-sustaining cutthroat trout population existed upstream of the culvert crossing.

This crossing was considered a full barrier due to the excessive water velocity and insufficient water depth inside the culvert, and an extreme outflow drop at the outlet (Photo 38). The culvert slope was considered steep (10 percent) creating high water velocity (1.05 meters/sec) and low water depth (7cm) inside the culvert. The water velocity exceeded the swimming capability of all juvenile salmonids. A suspended outlet was considered a barrier to all salmonids as it created 66-centimeter high plunge falls into a 35-centimeter deep pool. The intake was partially blocked with wood/rock debris creating a 20-centimeter waterfall over bare culvert. The culvert was partially collapsed midway creating a steeper gradient towards the intake. The Q100 culvert diameter was calculated to be 1970 millimeters for a round culvert. The 1000-millimeter diameter culvert that was in place was insufficient to accommodate a 100-year flood and needed to be removed or replaced. The fill depth above the culvert was 1 meter.

Photo 38: Site 61 culvert outlet prior to deactivation.

The stream habitat value was considered poor within 50 meters of the crossing since the stream was comprised mainly of shallow riffles with minimal deep pool habitat (average 3.5 percent gradient / 1.5 meter wetted width). Downstream of the culvert for the first 50 meters, the stream consists mainly of shallow riffles that fan over alluvial deposits into an abandoned beaver pond below. A beaver dam complex comprises the remaining downstream reaches to the Cranberry River. The total length of stream barred was estimated at 350 meters representing 5 percent of the total stream length. The average gradient of the barred section was considerably steep at approximately 11 percent. It is important to note that actual stream channel was different than stream shown on the 1:20,000 TRIM map, therefore the length of barred stream could only be crudely estimated based on contour line features.

In September 2007, a FHAP was completed on four reaches upstream of the Site 61 FSR culvert crossing to the first impassable barrier located at 0+420 meters. Three reaches of a tributary of near equal size were also surveyed for a total distance of 246 meters until an impassable fish barrier was located. Including these two streams, the total length of habitat that would be gained by replacing or removing the culvert is approximately 666 meters (total habitat area of approximately 1200m^2), approximately twice the estimated amount determined in the 2006 assessment. With this habitat increase, the FPCI Crossing Score totals 28, which increases the

ranking to a moderate priority crossing instead of the low priority crossing score of 25 determined in the 2006 FPCI project. A reach summary is as follows:

South Tributary

Reach 1 (0+000 meters to 0+184 meters) starts at the 29 Mile FSR crossing (Site 61) and was comprised of shallow riffles and pools. Habitat cover was mainly OV, LWD, and DP. The gradient was moderately steep averaging approximately 10 percent. The upstream boundary of this reach is the confluence of a tributary of near equal size and flow rate (either channel could be considered the primary channel). This reach provides moderate fish habitat.

Reach 2 (0+184 meters to 0+198 meters) was a short riffle section upstream of the confluence to a 1.2-meter waterfall that was mineral soil (clay-silt) based and not bedrock based (technically not considered a permanent barrier). This reach provides moderate fish habitat.

Reach 3 (0+198 meters to 0+360 meters) was a relatively steep section (17 percent average gradient) consisting of cascade-riffle-pool morphology. UCB, LWD, and DP were the main cover types. No barriers were found within this reach, however it provides only marginal fish habitat.

Reach 4 (0+360 meters to 0+420 meters) was a steep section (28 percent average gradient) consisting of cascade-pool morphology. DP and LWD were the main cover types. At the upstream end of this reach is a 30-meter high cascade-waterfall that was considered the upstream limit of fish distribution (Photo 39). This reach is considered marginal fish habitat.

Photo 39: Bedrock falls on the south tributary located 420 meters upstream of Site 61 crossing.

North Tributary

Reach 1 (0+000 to 0+123 meters) enters the south tributary channel at 0+184 meters on the right bank. Habitat type was mainly riffles and pools with an abundance of DP, LWD, and OV cover. The gradient is moderately steep at approximately 15 percent. Two 0.5-meter waterfalls were located at 0+86 and 0+91 meters that were created by rock/wood debris jams. This reach provides moderate fish habitat.

Reach 2 (0+123 to 0+186 meters) is relatively steep at approximately 21 percent gradient and is comprised of cascades, riffles and, and pools and an abundant amount of DP and LWD cover. No barriers were located in this reach. This reach provides marginal fish habitat.

Reach 3 (0+186 to 0+246 meters) is considerably steep at approximately 33 percent gradient. Habitat type is mainly cascades and pools with abundant DP and LWD cover. At the upstream end of this reach is a 30-meter high cascade-waterfall that was considered the upstream limit of

fish distribution (Photo 40). This waterfall is located along the same bluff as the waterfall found along the south tributary and are approximately 70 meters apart. This reach provides marginal fish habitat.

Photo 40: Bedrock falls on the north tributary located 246 meters upstream of the confluence with the south tributary.

Deactivation

Site 61 was deactivated on October 24, 2007. Prior to deactivation, 5 dump-truck loads of riprap were delivered to the site. Deactivation began by isolating the work site using fish barrier nets, then removing fish by electrofishing within the work area. Six cutthroat trout were removed from the site and the released in a beaver pond located approximately 50 meters downstream (see Photo 41 for specimen removed from the work site). Fill material and the underlying culvert were removed using a Hitachi EX-60 excavator equipped with biodegradable hydraulic oil (Photo 42 and 43). The stream channel and banks were covered with riprap and large boulders

were placed within the channel for habitat cover and velocity breaks (Photos 44, 45, and 46). A complete photo series for the FHAP and the deactivation is presented on CD in Appendix II in a Folder entitled Site 61 FHAP and Deactivation.

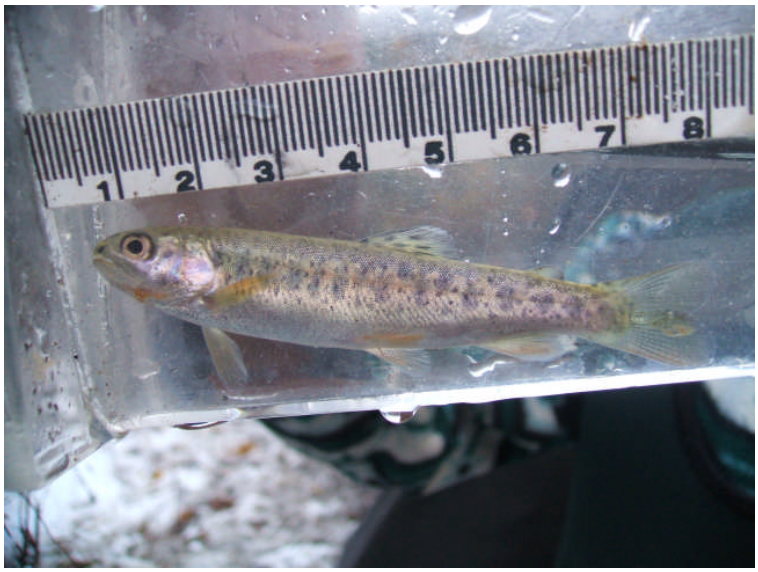

Photo 41: Cutthroat trout captured below Site 61 culvert outlet prior to deactivation.

Photo 42: Removing fill material over Site 61 culvert outlet.

Photo 43: Removing culvert from streambed at Site 61.

Photo 44: Riprap placement along new channel at Site 61.

Photo 45: Final riprap placement along new channel at Site 61.

Photo 46: Site 61 on December 1, 2007 approximately 5 weeks following deactivation.

8.3.4 Site 15 – Unnamed Tributary of Gitanyow Lake

In 2006, Site 15 was assessed as a full fish barrier and classified as a low priority crossing (FPCI Score = 25). This stream received low priority ranking because only 1 salmonid species was captured, and the length of habitat gained was a low percentage of the total stream length. 24-Mile FSR crosses this unnamed creek (WRP Tributary 53) approximately 500 meters upstream of the confluence with Gitanyow Lake. 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 eligible for MOF funding in 2007, as it the responsibility of the Kitwanga Lumber Company.

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.

Photo 47: Site 15 culvert outlet.

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.

In July 2007, a FHAP was conducted from the mouth (Gitanyow Lake) upstream to the first barrier located at 0+828 meters. Highway 37 N crosses this stream at 0+212 meters and 24 Mile FSR crosses at 0+564 meters. The total length of stream barred by the FSR culverts is 256 meters (approximately 400 m^2 of habitat), slightly less than was estimated during the 2006 assessment.

Reach 1 extends from Gitanyow Lake (0+000) to the Highway 37 N crossing (0+212 meters). It is a low gradient reach (4 percent average gradient) dominated by shallow riffles with a gravel/cobble substrate. Pool and LWD were present but not abundant. This reach provides moderate fish habitat.

Reach 2 (0+212 to 0+240 meters) was the Highway 37 N crossing consisting of two culverts placed end to end (28 meter total length). Water velocity inside both culverts exceeded the swimming capacity of juvenile salmonids (1.71 and 1.59 m/s for the downstream and upstream culverts respectively). Culvert outflow drop was acceptable (15 cm for both culverts).

Reaches 3 to 7 (0+240 meters to the FSR crossing at 0+564 meters) were mainly moderate gradient sections dominated by riffles (8 percent average) with two short reaches with 18 percent gradient (series of small cascades less than 1 meter in height). These reaches provide moderate fish habitat.

Reach 8 (0+564 to 0+572 meters) was the FSR culvert crossing. Conditions were similar to that observed in 2006 where excessive water velocity (1.91 m/s) and outflow drop (50 cm drop into 20 cm pool) created a barrier for most salmonids.

Reaches 9 and 10 (0+572 to 0+828 meters) were moderate to steep gradient reaches (11 and 18 percent respectively) with mainly cascade/pool morphology. Although the gradient was relatively steep, no significant barriers were found. At the upstream end of Reach 10 is a cascade/falls over bedrock and is considered the upstream limit of fish distribution (Photo 48). These reaches provide moderate to marginal fish habitat.

Photo 48: Bedrock waterfalls located approximately 256 meters upstream of the Site 15 crossing.

8.4 Discussion and Recommendations

The deactivation of Sites 48 and 61 (Cranberry River tributaries) created the most benefits in terms of the total habitat gained (Site 48 - approximately 1,300 linear meters or 3,900 m^2 of habitat; Site 61 - 666 linear meters or 1,200 m^2 of new habitat). The deactivation of Sites 14 provided significant benefits in terms of habitat gained (150 linear meters or 500 m^2 of habitat), and was restored at a reasonable cost. Site 15 was not deactivated in 2007 since it was not eligible for funding (responsibility of the Kitwanga Forest Products). The amount of new habitat that could be gained by deactivating Site 15 is approximately 256 meters or 400 m^2.

As a follow-up, GFA recommends seeding and follow-up monitoring of Sites 14 (Kitwanga River watershed and Sites 48 and 61 (Cranberry River watershed) immediately following snowmelt. GFA will propose the deactivation of Site 15 to the Kitwanga Lumber Company during the 2008 field season. GFA also recommends conducting a FHAP upstream of Site 47

(Mitten Main FSR) during the 2008 field season to assess the fisheries benefits of replacing this culvert.

9. OTHER WORKS: RE-EVALUATION OF SITES ASSESSED UNDER SNOW COVER IN 2006

In 2006, five sites were assessed under light snow cover. At the request of the MOF, these sites were revisited in 2007 to determine if any changes to the SCQI ranking were warranted.

Site 14 – This site was reassessed in July 2007, and then deactivated in October 2007. This site requires grass seeding in 2008 soon after snowmelt.
Site 15 – This site was reassessed in July 2007 during a FHAP survey and was ranked similar to the 2006 SCQI ranking as having low sediment potential according to the WQEE method. No further action is recommended.
Sites 16, 18 and 19 - These sites were reassessed in July 2007 and no changes to the 2006 survey were warranted. Each site was ranked as having low sedimentation potential. No further action is recommended.

10. OTHER WORKS: COMPARISON BETWEEN THE SCQI METHOD USED IN 2006 AND THE WQEE METHOD USED IN 2007 AT FOUR SITES

In 2006, four sites were assessed as having high to very high sedimentation potential using the SCQI method. These sites were re-evaluated in 2007 using the WQEE method and in all cases the WQEE method showed a lower ranking then the SCQI method (Table 6). The reason for different ranking is unknown, however GFA is of the opinion that Sites 19 and 21 deserve attention in 2008. Grass seeding ditchlines and possibly road resurfacing is recommended.

Table 11: Comparison between the SCQI and the WQEE methods for evaluating sedimentation potential at 4 sites.

Site #	Road Location	SCQI		WQEE	
		Score	Ranking	Score	Ranking
1	Ronald McDonald FSR	1.748	V. High	0.116	Low
19	Tea Lake FSR	4.987	V. High	16.125	High
21	Canoe Creek FSR (Branch)	6.181	V. High	4.038	Moderate
23	Canoe Creek FSR (Branch)	1.003	High	0.017	Low

11. REFERENCES

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Appendix I

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; 1:20,000 TRIM in PDF format.

Folder \ Site Photos
Digital copies of site photos

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