
Fish Passage Culvert Assessment
for Cahilty Creek Watershed
FIA Project # 4602004

Prepared for

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Two handwritten signatures in black ink. The first signature on the left is a stylized 'H' followed by a flourish. The second signature on the right is a cursive signature that appears to be 'C. Blott'.

November 24th, 2006

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1 INTRODUCTION

ARC Environmental Ltd. (ARC) was retained by Weyerhaeuser Company Ltd. to complete a culvert and fish passage assessment at 40 sites in the Cahilty Creek watershed (WSC 129-175200-54700) within their operating area. The field portion of the assessment was conducted June - August 2006. Of the 40 sites assessed, 38 were crossing sites that were either associated with non-fish-bearing streams, non-classified drainages (NCD) and/or fords. The remaining 2 culvert crossing sites were assessed since they were associated with fish-bearing streams. Assessment methodology adhered to Parker (2000).

Barrier status of culverts was determined based on several parameters. A culvert was considered a partial barrier if there was indication that some age-classes are able to pass the culvert while others are not, or if passage is only possible at certain times of the year and likely not possible at other times. A culvert was considered a full barrier if it was determined that fish passage of all age-classes at all times of the year is likely not possible.

Initial interim reports were submitted throughout the period of field investigations and a final initial interim report was submitted to Weyerhaeuser Company Ltd. and Forsite August 14, 2006 followed by a digital mapping product August 30, 2006. These interim reports summarized the status of the watercourses assessed, including the assessment of the 2 culverts associated with fish bearing streams. This report represents the final required submission to Weyerhaeuser Company Ltd. and provides a summary of the field data and locations, assessment calculations, Prioritization Calculations (FPCI Scoring Matrix), and appropriate photo-documentation for each assessed site.

2 METHODS

2.1 BACKGROUND INFORMATION

2.1.1 Cahilty Creek Fish and Fish Habitat Inventory Program

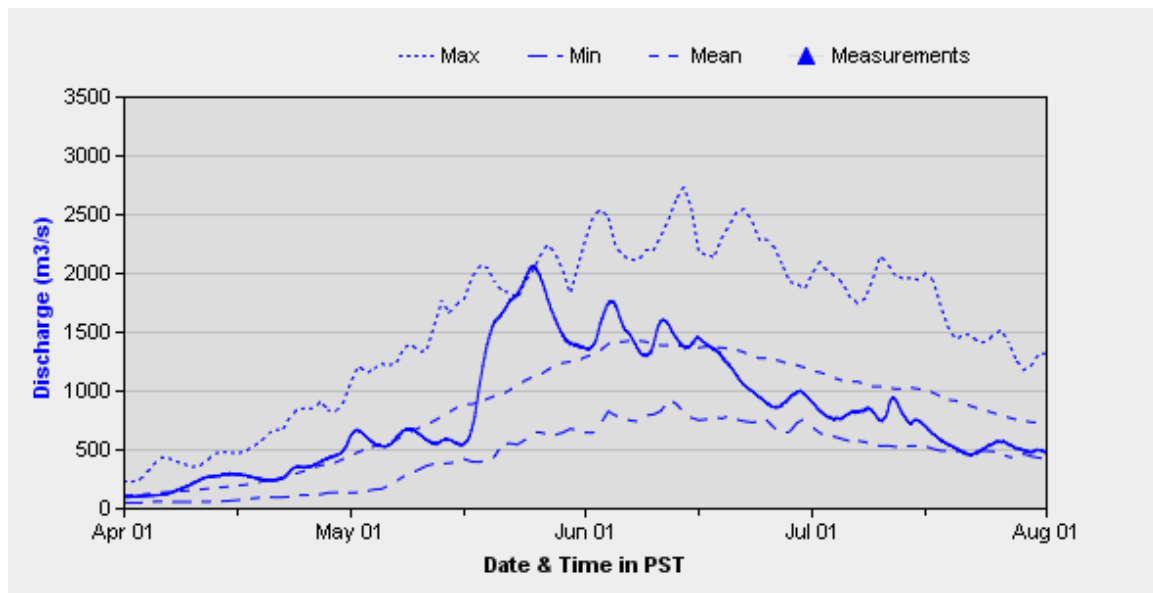
ARC Environmental (2000) conducted a Fish and Fish Habitat Inventory Program (FFHIP) assessment of Cahilty Creek and its tributaries in 1999. Data from the FHHIP report was used as background information to assist in the determination of fish bearing status and stream classification for the culvert assessment. Based on fish sampling in this study and previous sampling efforts (ARC Environmental 2000), the sport and salmonid fisheries resources of Cahilty Creek, especially within the study area, is likely limited to rainbow trout (*Oncorhynchus mykiss*). Rainbow trout are not considered a regionally significant species.

2.1.2 North Thompson 2006 Hydrograph

The North Thompson 2006 hydrograph (Figure 1) shows the 2006 discharge rates in the North Thompson River compared to the maximum, minimum and average discharge rates for the period of record (1958 – Present). The 2006 data shows that North Thompson River discharge, for the period of record, reached maximum levels in late May 2006. Assuming that the North Thompson discharge reflects conditions in the Cahilty Creek watershed, it is assumed then that the Cahilty Creek tributaries were also high during this period. Although, at the time of the field assessments (late June - August, 2006) discharge rates were possibly below the mean rates for the period of record, the historically high discharge in late May suggest that fish access from the mainstem of

Cahilty Creek into its tributaries was apt to be near optimal and therefore supporting the fish bearing status determined for the Cahilty tributaries.

Figure 1: North Thompson River 2006 Hydrograph (Stn No. 08LB064)



2.2 FIELD INVESTIGATION

Forty sites were investigated. Stream reach site description followed methodologies provided in Resource Inventory Committee (RIC) (1998) for site cards and fish collection forms. The designation of fish bearing status, including stream classification, adhered to methodologies provided in RIC (1998), and BC Ministry of Forest (1998 and 2001). Culvert assessments adhered to Parker (2000). Fish sampling, where possible, was done with a battery powered Smith-Root 12B electroshocker. If no fish were captured by electroshocking, minnow traps were set or pole seining used where practical. Fish sampling was done to confirm absence and presence only and did not make any measure of abundance or individual fish size and weight.

As part of the deliverables associated with the Fish Collection Permit (Ministry of Environment Permit No.: KA06-23265), the FDIS data-base was completed for all applicable sites and submitted to the Ministry of Environment, as well as provided to Weyerhaeuser Canada for their records.

Of the assessed sites, those designated to be barriers were scored to determine priority for future repair or replacement, and eligibility for funding under the Forest Investment Account Land Based Investment Program.

3 RESULTS

Of the 40 sites investigated, 2 were assessed barriers; site 13 was a full barrier and site 32 a partial barrier. The remaining sites were not assessed for barrier status because the field investigation identified; fords, culverts on non fish bearing streams, or culverts on non-classified drainages (NCD) (Appendix 1).

All 40 sites investigated are located below in Figure 2 showing the site number, the channel crossing type with the FPCI result, and the stream classification. Sites 7L, 10L, 12L, 19L, 24L and 25L are all ford crossings and are presented on the map for reference, but were not part of the scope of work and are otherwise not part of the assessment report. Figures 3 and 4 provide insets of sites 13 and 32.

3.1 SECTION I – BARRIER CULVERT INFORMATION

3.1.1 Site 13 – unnamed Cahilty Creek tributary (WSC 129-175200-54700-60821)

UTM: 11 294645, 5647590

Stream Classification: S3, rainbow trout captured.

Culvert Characteristics: round corrugated steel pipe, 12.1 m length x 900mm diameter, 5% slope

Culvert Status: Full Barrier.

FPCI Score = 39

Rainbow trout were captured downstream of the culvert, but not above the culvert in 1999 (ARC 2000), similarly, rainbow trout were captured July 19, 2006 in a minnow trap set 70m downstream of the culvert. A barrier (Falls) to upstream migration was identified approximately 1.6km upstream of the culvert (ARC Environmental 2000).

Several parameters indicate that the culvert is a barrier to all rainbow trout age-classes throughout the year, the most pivotal ones being the outfall drop (jump height), and the plunge pool depth:outfall drop ratio. The culvert outfall drop of 0.78m in combination with the plunge pool depth of 0.5m does not provide the required 1.25 plunge pool depth:outfall drop ratio required for rainbow trout of any age-class to make the jump up into the culvert. Additionally the jump height of 0.78m is greater than jumping capability of juvenile rainbow trout, regardless of pool depth.

The culvert wetted width (0.5 m) was only 23% of the creek wetted width (2.13 m), and consequently the culvert water velocity (1.5 m/s) was approximately 4 times the velocity measured in the creek (0.38 m/s). Culvert water velocity was greater than the burst speed of juvenile rainbow trout $\leq 125\text{mm FL}$ (i.e. maximum burst speed 1.1m/s), preventing their upstream passage through the culvert. At the time of the assessment (June 27 2006), discharge may have been near historical low flows suggesting that culvert water velocities may regularly be beyond the swimming capabilities of juvenile rainbow trout. In addition, the culvert slope of 5% exceeds the recommended 1% slope recommended for non-baffled culverts <24m long (Parker 2000). As well the culvert water depth recorded was less than the recommended 15cm depth for upstream passage of adult rainbow trout (Parker 2000).

Site card information characterized the channel upstream and downstream of culvert as predominantly cascade pool morphology that limits access in the reach, and where habitat is characterized with limited to no over-wintering and spawning habitat, and minimal rearing habitat.

Figure 2: Cahilly Creek Fish Passage Culvert Inspection Results

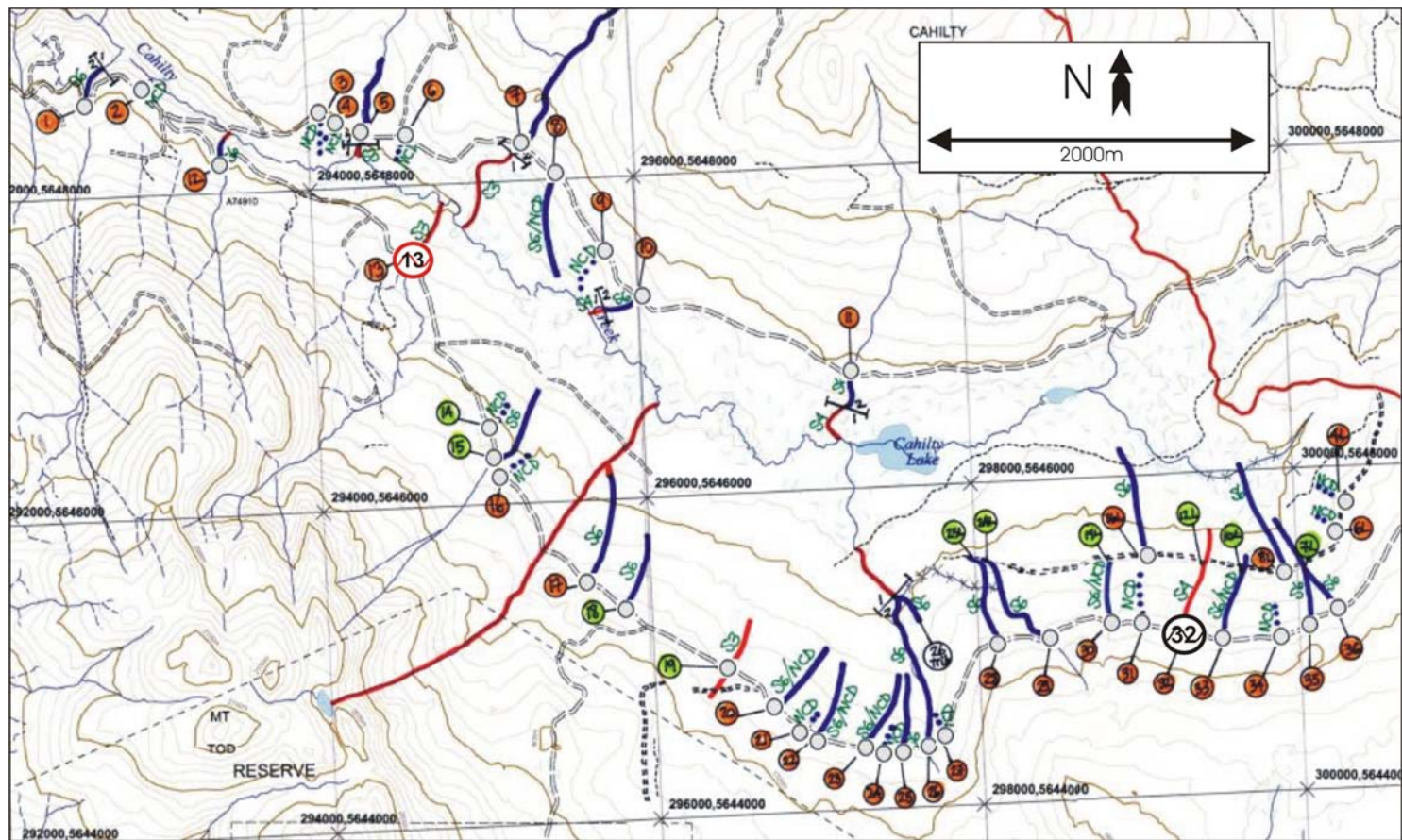


Figure 3: Site 13

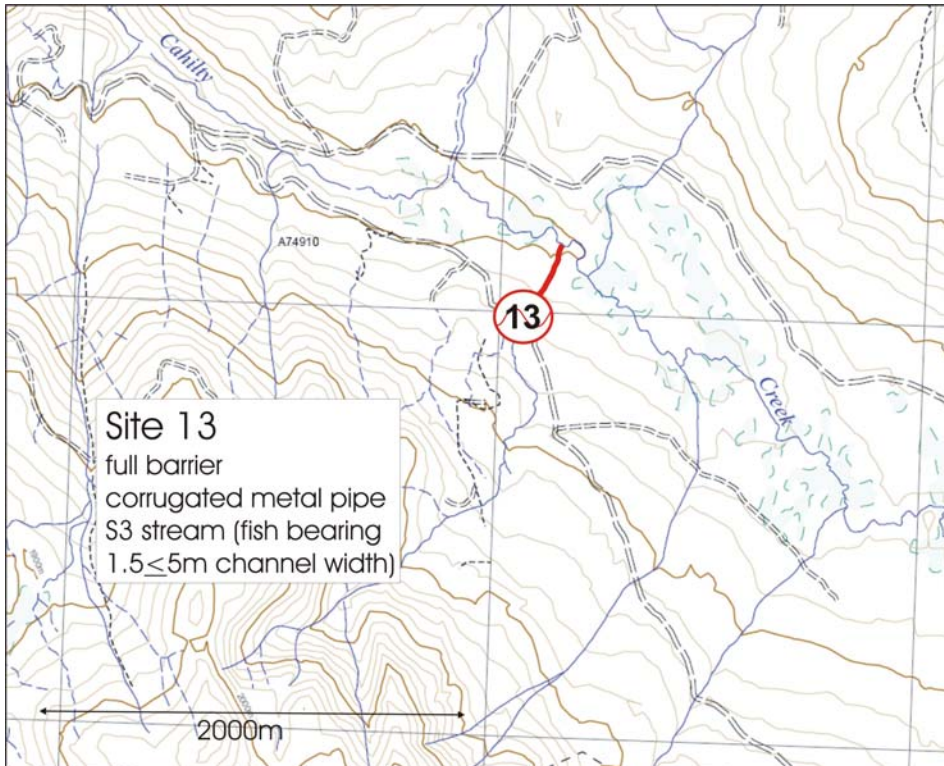
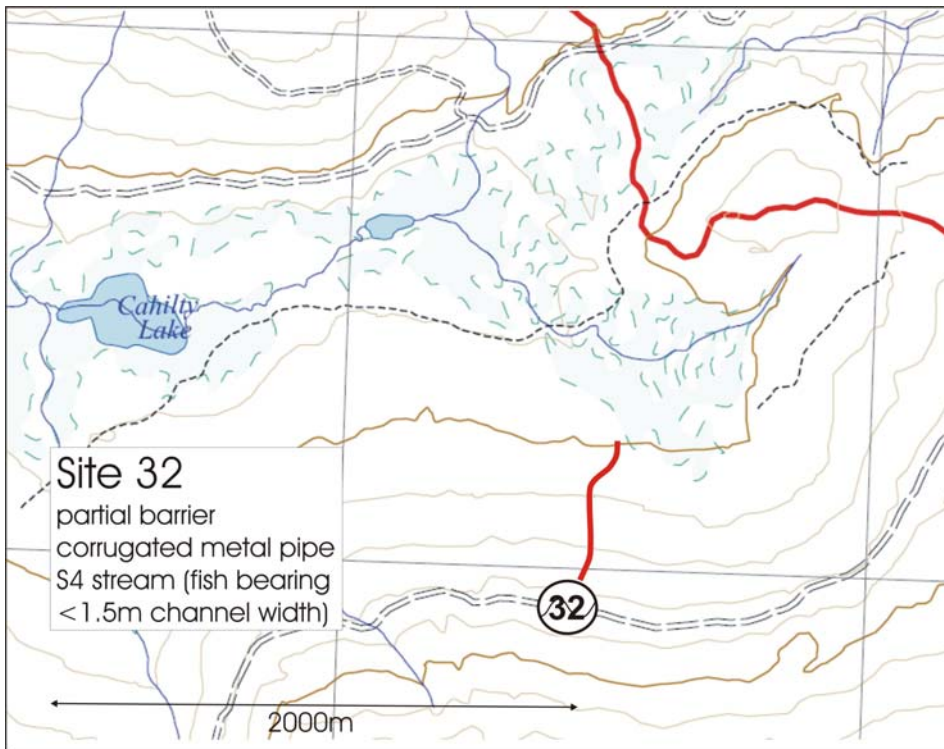


Figure 4: Site 32



Watershed mapping indicates the culvert located approximately 350 m upstream from the confluence with Cahilty Creek limits access to approximately 1.6km of upstream habitat. The natural falls located 1.6km upstream of the culvert is an identified barrier to further fish passage upstream (ARC Environmental Ltd. 2000).

Although the culvert is a barrier to fish passage, it did not appear to require maintenance nor did it contribute to downstream sedimentation. Photographs 1 – 4 present the upstream and downstream view at both ends of the culvert. The results of the culvert assessment are provided in Table 1.



Photograph 1 – Site 13 Inlet Upstream View (Roll 1:9)



Photograph 3 – Site 13 Outlet Upstream View (Roll 1: 11)



Photograph 2 – Site 13 Inlet Downstream View (Roll 1 10)



Photograph 4 – Site 13 Outlet Downstream View (Roll 1: 12)

Table 1 Form A Fish Passage Culvert Inspection - Site 13

Date	6/27/2006	Stream Name	Cahilty Creek
Road name		Road Location (MoF District)	Kamloops Forest District
UTM	11 294645, 5647590	Watershed Code	129-175200-54700-60821
1:20,000 Map Sheet	82L 091	Recorder	HG/ BH
Site #	13		

Culvert Characteristics				
Culvert Diameter (mm)	900	Culvert Slope %	Us 2.5	Ds 3.1
Culvert Length (m)	12.1	High Water Mark (cm)	27	
Culvert Material	Corrugated Steel	Culvert Water Depth (cm)	9	
Culvert Water Velocity (m/s)	1.50	Culvert Outfall Drop (cm)	78	
Culvert Shape	Round	Culvert Maintenance	No	
Culvert Wetted Width (cm)	53	Fill Slope Depth (m)	0.6	

Stream Characteristics					
Stream Reach	1	Stream Classification	S3		
Pool Depth at Outfall (cm)	50	Blue Listed/Significant	None		
Sediment Source/Degree	no				
Measure	Below Culvert		Above Culvert		Average
Wetted Width (m)	2.6	2.2	1.7	2.0	2.13
Bankfull Width (m)	2.8	2.4	2.1	2.1	2.35
Water Depth (cm)	9.0	9.7	14.7	18.7	13.0
Bankfull Depth (cm)	28	33	26	32	29.8
Stream Water Velocity (m/s)	0.33		0.43		0.38
Stream Gradient (%)	16		5.5		10.8
Fish Presence	yes		no		
Fish Sampling Method	MT		see comment		
Sampling Effort (sec)					
Species Present	RB		none		
Beaver Activity/Type	no		no		

Barrier Evaluation:	
Barrier	Full
Barrier Type	Jump height of 78 cm is greater than jumping capability of juvenile rainbow trout. Culvert pool depth of 50cm is less than 1.25times the culvert outfall depth of 78cm and so fish of all age classes can not make the jump up into the culvert. Culvert slope of 5% is greater than the recommended 1% for culverts without baffles and less than 24m in length. Culvert diameter is 38% of channel width increasing velocity through the culvert. Culvert water velocity in low flow period at 1.50m/s (more than 3 times channel velocity of 0.38m/s) and is greater than the burst speed of both juvenile class sizes. Culvert water depth of 9cm is below the recommended 15cm for adult upstream passage.

Site Photos:

Roll#	1		
Inlet Upstream Photo	9	Inlet Downstream Photo	10
Outlet Upstream Photo	11	Outlet Downstream Photo	12

Comments:	Site card information indicates channel upstream and downstream of culvert is predominantly cascade pool morphology that limits access in the reach. Habitat is characterized by limited to no over-wintering and spawning habitat, and minimal rearing habitat. Extensive fish sampling during 1999 sampled the entire tributary up to a natural falls/barrier approximately 1.6km upstream of the culvert and found rainbow trout below the culvert only (ARC Environmental 2000). Similarly, sampling July 19, 2006 (MT) captured RB 70m below culvert
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Office Calculations:

Q100 Diameter Estimate (mm)	1800	Stream Length Above Barrier (m)	1600
Road Responsibility	Weyerhaeuser	%Stream Barred	84

Prioritization Calculations - FPCI Scoring Matrix:

Fish Species	Habitat Value	Barrier	Length of New Habitat	Stream Barred (%)	Limiting to Upstream barrier
Multiple or significant	High	Full	≥1km	>70%	Yes
Single	Medium	Partial	<1km	51-70%	No
Other	Low	Undetermined	≥500m <500m	<50%	0

TOTAL SCORE	39
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Note: Stream Classification S3 = fish bearing, 1.5 ≤5m channel width

3.1.2 Site 32 – Unnamed Cahilty Creek Tributary (no WSC)

UTM: 11 299276, 5645020

Stream Classification: S4, rainbow trout captured.

Culvert Characteristics: round corrugated steel, 10 m length x 600mm diameter, 3.2% slope

Culvert Status: Partial Barrier.

FPCI Score = 21

Rainbow trout were captured downstream of the culvert. Sampling above the culvert was limited to visual observation because the channel was generally poorly defined, and water availability and depth were insufficient for efficient sampling. The channel upstream of the inlet of the culvert is characterized initially by the vertical ditch wall which is a full barrier to upstream fish passage. Above the ditch wall, the channel is poorly defined and in some sections discontinuous; at 85m upstream the channel splits into multiple channels where those on the right end at 130m upstream of the culvert and those on the left end within 235m upstream of the culvert. No fish

were observed in these upstream sections and the habitat is characterized by no spawning or over-wintering habitat and very poor rearing habitat.

The culvert at this site was determined to be a partial barrier that may allow passage of some age classes of rainbow trout at some times of the year. The culvert water velocity at the time of the assessment was 0.50m/s, more than 4 times the average channel velocity of 0.09m/s, and greater than the burst speed of juvenile rainbow trout <50mm FL. And the culvert water depth of 9cm was below the recommended 15cm for adult rainbow trout upstream passage. In addition, the culvert slope of 3.2% is greater than the recommended 1% for culverts without baffles and less than 24m in length (Parker 2000). However, the culvert plunge pool depth of 31cm is greater than 1.25 times the culvert outfall drop of 18cm and therefore juvenile to adult rainbow trout are able to access the culvert (Parker 2000). However, the vertical ditch wall immediately upstream of the culvert inlet is a full barrier to fish passage. Therefore the culvert acts presents a partial barrier to a short (<250m) and limited amount of habitat, which is likely not accessible due to the vertical ditch wall immediately upstream of the culvert.

Photographs 5 – 8 show the upstream and downstream views of the culvert inlet and outlet. The field worker is standing at the base of the vertical ditch wall immediately upstream of the culvert inlet in Photograph 5.

The culvert did not appear to require maintenance or to contribute to downstream sedimentation. The results of the culvert assessment are provided in Table 2.



Photograph 5 – Site 32 Inlet Upstream View (Roll 5 Photo 25)



Photograph 7 – Site 32 Outlet Upstream View (Roll 6 Photo 4)



Photograph 6 – Site 32 Inlet Downstream View (Roll 6 Photo 1)



Photograph 8 – Site 32 Outlet Downstream View (Roll 6 Photo 3)

Table 2 Form A Fish Passage Culvert Inspection - Site 32

Date	7/6/2006	Stream Name	Unnamed	Cahilty
Road name		Road	Creek Trib	
UTM	11 299276, 5645020	Location	Kamloops	forest
1:20,000 Map	82L 091	Watershed	na	
Sheet		Code		
Site #	32	Recorder	HG/ BH	

Culvert Characteristics

Culvert Diameter (mm)	600	Culvert	Us	Ds	3.2
Culvert Length (m)	10	Slope %	1.66	1.98	
Culvert Material	Corrugated Steel	High Water Mark (cm)			15
Culvert Water Velocity (m/sec)	0.50	Culvert Water Depth (cm)			6
Culvert Shape	Round	Culvert Outfall Drop (cm)			18
Culvert Wetted Width (cm)	35	Culvert Maintenance			No
		Fill Slope Depth (m)			0.3

Stream Characteristics

Stream Reach	1	Stream Classification	S4		
Pool Depth at Outfall (cm)	31	Blue Listed/Significant	None		
Sediment Source/Degree	no				
Measure	Below Culvert	Above Culvert	Average		
Wetted Width (m)	0.55	0.66	0.43	0.7	0.59
Bankfull Width (m)	0.90	0.97	0.70	0.75	0.83
Water Depth (cm)	12.2	7.3	9.7	12.3	10.4
Bankfull Depth (cm)	25.5	25	14	27	22.9
Stream Water Velocity (m/s)	0.03	0.08	0.22	0.03	0.09
Stream Gradient (%)	14			14	14.0
Fish Presence	yes	no			
Fish Sampling Method	EF	see comment			
Sampling Effort	389 s	750m			
Species Present	RB	none			
Beaver Activity/Type	no	no			

Barrier Evaluation:

Barrier	Partial
Barrier Type	Culvert slope of 3.2% is greater than the recommended 1% for culverts without baffles and less than 24m in length. Culvert diameter is 72% of channel width increasing velocity through the culvert. Culvert velocity in low flow period at 0.50m/s is more than 4 times the average channel velocity of 0.09m/s, and is greater than the burst speed of the 50mm juvenile class size. Velocity can be overcome by larger juveniles with a burst speed of 0.7 - .11m/s. Culvert water depth of 9cm is below the recommended 15cm for adult upstream passage. Culvert pool depth of 31cm is greater than 1.25 times the culvert outfall drop of 18cm so jump height and pool depth are adequate for all age classes of rainbow trout, but culvert

velocity and water depth mean that in low flow, only larger juveniles are able to pass the culvert. However, although the culvert is a partial barrier the vertical ditch wall immediately upstream of the culvert's inlet is a full barrier to all age-classes of RB at all times of the year.

Site Photos:

Roll # 5 and 6			
Inlet Upstream Photo	25	Inlet Downstream Photo	1
Outlet Upstream Photo	4	Outlet Downstream Photo	3

Comments: Channel downstream of culvert is characterized by a cascade pool morphology. The habitat is characterized with limited to no over-wintering and spawning habitat, and poor rearing habitat. Rainbow trout were captured ~ 200m downstream of culvert. The channel upstream of the inlet of the culvert is characterized initially by the vertical ditch wall which is a full barrier to upstream fish passage. Above the ditch wall, the channel is poorly defined and in some sections discontinuous; at 85m upstream of the culvert, the channel splits into multiple channels where the right channel ends at 130m upstream of the culvert and the left channel ends within 235m upstream of the culvert. No fish were visually observed in these upstream sections and the habitat is characterized by no spawning or over-wintering habitat and very poor rearing habitat.

Office Calculations:

Q100 Diameter Estimate (mm)	900	Stream Length Above Barrier (m)	235
Road Responsibility	Weyerhaeuser	%Stream Barred	24%

Prioritization Calculations - FPCI Scoring Matrix:

Fish Species	Habitat Value	Barrier	Length of New Habitat	Stream Barred (%)	Limiting to Upstream barrier
Multiple or significant	High	Full	≥1km	>70%	Yes
Single	6 Medium	Partial	<1km	51-70%	No 0
Other	3 Low	Undetermined	≥500m <500m	3 <50%	3

TOTAL SCORE 21

Note: Stream Classification S4 = fish bearing, <1.5m channel width

3.1.3 FPCI Summary

Table 3 presents all barrier sites grouped in order of priority based on FPCI scoring results. In summary the culvert at site 13 is a full barrier to fish passage and its score of 39 designates it as a high priority and eligible for funding. The culvert at site 32 was assessed as a partial barrier where its score of 21 designates it as a low priority, however, even if it is considered as a full barrier due to the upstream vertical ditch wall its score would be 25 and it would remain a low priority.

Table 3 Form B FPCI Summary

Priority Rank	Score	Site Number	Barrier	Stream Length Gained (m)	% Stream Barred	X Reference Number	FIA Eligible
H	39	13	Full	>1km	>70	-	Y
L	21	32	Partial	<500m	<50	-	N

3.2 SECTION 2 ALL NON-BARRIER CULVERT SITES OF SIGNIFICANCE

No culverts were identified as a non-barrier status and therefore *Form C: Other Priority Culvert Crossings Summary* was not completed.

3.3 SECTION 3 SITES NOT ASSESSED

Thirty-eight sites were not assessed since barriers to fish passage were not associated with them. These 38 sites were characterized as either;

- exhibiting non-classified drainages (NCD) downstream of the culverts (14 sites),
- non-fish bearing channel sections downstream of culverts (20 sites), or,
- fords (4 sites).

A conservative approach was used in designating the channel as a non-classified drainage (NCD), hence the designation S6/NCD was used to ensure that although the channel may be poorly defined in sections and likely not have a well defined confluence with Cahilty Creek it was >500m long and there was a continuous channel section >100m that allowed for a site card and stream classification to be completed.

Table 4 Form D Sites Not Assessed Summary Table

Site Number	Assessment	Crossing Type	Crossing UTM	Notes
1	S6	CMP	11-292633-5648617	1
2	NCD	CMP	11-293000-5648748	1
3	NCD	CMP	11-294082-5648456	1
4	NCD	CMP	11-294173-5648409	1
5	NF	CMP	11-294341-5648309	1
6	NCD	CMP	11-294598-5648266	1
7	NF	CMP	11-295295-5648211	1
8	S6/NCD	CMP	11-295504-5648016	1
9	NCD	CMP	11-295834-5647499	1
10	S6	CMP	11-296003-5647216	1
11	S6	CMP	11-297311-5646700	1
12	S6	CMP	11-293486-5648201	1

Site Number	Assessment	Crossing Type	Crossing UTM	Notes
14	NCD	ford	11-295044-5646474	install culvert that meets engineering requirements
15	S6	ford	11-295090-5646284	install culvert that meets engineering requirements
16	NCD	CMP	11-295113-5646202	1
17	S6	CMP	11-295639-5645474	1
18	S6	ford	11-295850-5645300	install culvert that meets engineering requirements
19	S3	ford	11-296438-5644913	S3 fish bearing channel: install a culvert that meets requirements of BC Fish-Stream Crossing Guidelines (BC MoF 2002)
20	S6/NCD	CMP	11-296737-5644676	1
21	NCD	CMP	11-296902-5644540	1
22	S6/NCD	CMP	11-296980-5644503	1
23	S6/NCD	CMP	11-297310-5644396	1
24	NCD	CMP	11-297423-5644369	1
25	S6	CMP	11-297513-5644367	1
26	S6	CMP	11-297650-5644382	1
27	NCD	CMP	11-297725-5644409	1
28	S6	CMP	11-298115-5644997	1
29	S6	CMP	11-298451-5645010	1
30	S6/NCD	CMP	11-298827-5645087	1
31	NCD	Log CV	11-299048-5645076	log culvert: consider replacing with an appropriate culvert that meets engineering requirements
33	S6/NCD	CMP	11-299532-5644952	1
34	NCD	CMP	11-299888-5644962	1
35	S6	CMP	11-300084-5645041	collapsed culvert partially filled with sediment requires maintenance, ensure culvert meets engineering requirements
36	S6	CMP	11-300267-5645118	1
4L	NCD	Log CV	11-300280-5645825	log culvert: consider replacing with an appropriate culvert that meets engineering requirements
6L	NCD	CMP	11-300251-5645563	1
8L	S6	CMP	11-299927-5645360	1
16L	S6	CMP	11-299062-5645497	1

Notes:

In Notes Column '1' = ensure existing culvert meets engineering requirements

In Assessment Column 'S3' = Stream Classification: fish bearing 1.5≤5m channel width

'S6' = Stream Classification: non-fish bearing, ≤3 m channel width

NCD' = Non Classified Drainage

NF = Non-fish bearing. Natural barriers are located immediately downstream of culverts and the lake indicated on TRIM mapsheet 82L091 is non-fish bearing and does not have a defined outlet channel.

4 CONCLUSIONS

Of the 40 sites investigated, 2 were determined to be barriers; 1 full barrier at site 13 and 1 partial barrier at site 32. The remaining 38 crossing sites were determined not to be barriers; where 4 were fords, 14 were non-classified drainages (NCD) associated with culverts, and the remaining 20 were determined to be on non-fish bearing watercourses.

5 RECOMMENDATIONS

At the time of the field assessment the road was in a deactivated state. Given that the road is being upgraded and reactivated, it is recommended that all crossings should meet engineering requirements, and where applicable, BC MoF (2002) BC Fish-Stream Crossing Guidelines.

6 REFERENCES

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- Parker, M.A. 2000. Fish passage: Culvert inspection procedures. Ministry of Environment, Lands and Parks, Williams Lake, BC. Watershed Restoration Technical Circular No.11. 52 pp.
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Appendix 1: Completed site card and fish forms