Fish Passage Culvert Inspection (FPCI)

12 Sites on TFL 18 (FIA 444603)
1 Site on FL #A18688 (Thuya Creek) (FIA 450502)

Prepared for:

Canadian Forest Products Ltd.
Vavenby Division

Prepared by:

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Executive Summary

This project involved the identification of 12 non-natural barriers (culverts) to fish passage on status roads within TFL 18 and 1 site on FL #A18688.

As part of the pre-field planning phase, potential culvert sites were selected mainly on the basis of local knowledge, combined with existing inventory data such as Fish Stream Identification (FSID), Fish Habitat Assessments (FHAP), and Fish and Fish Habitat Inventory (FFHI). As a result of the pre-field review, 13 culvert crossings were selected for further field assessment.

Twelve (12) crossings assessed were metal or plastic culvert structures on known or suspected fish-streams and one (1) of the crossings assessed (Thuya Creek) was a wooden box culvert on an assumed or confirmed fish-stream.

<table>
<thead>
<tr>
<th>Status of sites assessed (n = 13)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of full barriers to fish passage</td>
<td>8</td>
</tr>
<tr>
<td>Number of partial barriers to fish passage</td>
<td>4</td>
</tr>
<tr>
<td>Number of sites determined to be non fish-streams</td>
<td>1</td>
</tr>
<tr>
<td>Number of sites where fish passage has been affected by beaver activity</td>
<td>6</td>
</tr>
<tr>
<td>Number of sites eliminated because natural barriers to fish movement were identified within 50m upstream of the culvert</td>
<td>2</td>
</tr>
<tr>
<td>Number of sites that met the minimum FPCI score of 39 established by FIA</td>
<td>9</td>
</tr>
<tr>
<td>Kilometers of unrestricted fish habitat potentially gained if the culvert barriers were removed.</td>
<td>36.9Kms</td>
</tr>
</tbody>
</table>

Although every attempt is made to assess all crossings structures on known or suspected fish-streams within a given watershed, the selection of 13 crossings in this assessment does not suggest that there are no other problem culverts or vehicle fords within the target watershed. Rather, the number of assessments completed is governed by available funding.
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1.0 Introduction

Canadian Forest Products Ltd. (Canfor), Vavenby Division, contracted Snowy River Resources Ltd. to undertake Fish Passage Culvert Inspections (FPCIs) on selected status roads within TFL 18 and FL#A18688. The data collected will be used to prescribe measures to mitigate potential culvert barriers and to subsequently increase the area of accessible habitat for fish. All culverts assessed were installed prior to June 15, 1995 when fish passage at culvert installations was required under the Forest Practices Code of BC Act, Forest Road Regulation (see Section 3.0).

This project was undertaken with funding from the Forest Investment Account.

2.0 Types of Non-Natural Barriers to fish passage

Safe passage is defined as the “free movement of fish in and about streams, lakes and rivers; passage that is needed by fish in order to complete critical phases of their life cycles” (Poulin, 1997). Adult and young fish need to migrate throughout a stream system year-round in order to find suitable habitat. As stream flows increase and decrease, fish search for areas that meet their needs for feeding, resting, spawning and rearing young. Artificial structures in a stream channel, usually at road crossings, may restrict or eliminate the ability of fish to move up and downstream.

Typical obstructions to the free movement of fish at road crossings include:

A) Culverts in roads that cross fish-bearing streams. These obstructions can have negative impacts on fish habitat and fish populations, including sediment loading and reduction of habitat due to passage constraints. The three most common causes of fish passage problems at culverts are:

1. An outfall drop at the downstream end of a culvert which is too high for resident and/or migratory fish to jump (approximately 15 cm or greater in height for non-anadromous species);
2. Flow velocities in the culvert barrel too high to permit fish movement upstream. (0.6 m/s maximum for juveniles and 1.2 m/s maximum for adults – trout and char) and;
3. Water depth insufficient for fish passage (minimum water depth of 200mm for resident game fish and juvenile anadromous salmonids)\(^2\).

In addition, culverts are susceptible to debris build-up and/or turbulence at the culvert inlet, which can result in fish passage difficulties.

B) Vehicle fords on fish streams can result in velocity barriers due in part from increased gradient from culvert removal and the subsequent scour of the channel bed, and/or stream diversion due to sediment erosion influx from the channel banks.

\(^2\) The parameters for water velocity, depth and outfall drop for culverts were obtained from the Stream Crossing Guidebook for Fish Streams (Working Draft, 1997). The maximum water velocity criterion is similar in Washington (Bates, 1992) and Oregon (Roberson, 1995).
3.0 Legal Requirements to Provide Fish Passage

The legal requirement to ensure fish passage on Crown forest lands can be found in three statutes:

1. The federal *Fisheries Act*\(^3\) (S. 20) (applies to all stream crossing structures, irrespective of when they were installed). Section 20 reads as follows:

   **20. (1)** Every obstruction across or in any stream where the Minister determines it to be necessary for the public interest that a fish-pass should exist shall be provided by the owner or occupier with a durable and efficient fish-way or canal around the obstruction, which shall be maintained in a good and effective condition by the owner or occupier, in such place and of such form and capacity as will in the opinion of the Minister satisfactorily permit the free passage of fish through it.

2. The *Forest Practices Code of BC Act, Forest Road Regulation*\(^4\) (S. 9, 13 and 15) requires a person to maintain ‘safe fish passage’\(^5\) on stream crossing structures installed after June 15, 1995. The sections reads as follows:

   **9. (1)** A person required to construct or modify a road in compliance with section 62 (1) of the Act or to maintain a road in compliance with section 63 of the Act must do all of the following when building or installing the drainage system for the road:

   (h) build crossings of fish streams

   (ii) at a time and in a way that provides safe passage and protects fish habitat at the crossing and immediately upstream and downstream of the crossing;

   **13. (2)** A person required to comply with section 62 or 63 of the Act who modifies a road other than by relocating it, or maintains a road, must ensure that, for the road and included structures,

   (d) safe passage for fish is provided at fish stream crossings built after June 15, 1995

   **15. (1)** A person who deactivates a road in compliance with section 64 of the Act must ensure that the deactivation work provides for, or addresses, all of the following requirements:

   (d) safe fish passage and protection of fish habitat at stream crossings immediately upstream and downstream of the stream crossing structure, and the timing and description of the work to achieve these objectives

3. The *Forest and Range Practices Act, Forest Planning and Practices Regulation*\(^6\) [S.56(2)] (applies only to stream crossing structures installed after June 15, 1995). The FPPR will repeal the *Forest Road Regulation*. Section 56(2) reads as follows:

   **56. (2)** An authorized person who maintains a fish stream crossing built after June 15, 1995, must ensure that the crossing does not have a material adverse effect on fish passage.

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\(^4\) [http://www.for.gov.bc.ca/tasb/legsregs/archive/fpc/fpcaregs/forroad/froadr.htm#section8](http://www.for.gov.bc.ca/tasb/legsregs/archive/fpc/fpcaregs/forroad/froadr.htm#section8)

\(^5\) In the Forest Road Regulation, “safe fish passage” means safe passage of fish through culverts for the purposes of spawning, rearing or migration

\(^6\) See [http://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/forplanprac/fppr.htm](http://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/forplanprac/fppr.htm) for the full text of the FPPR.
4.0 Methodology for Assessing Known and Suspected Barriers to Fish Passage

British Columbia and, in particular, Washington State, both currently address fish passage problems through the use of guidebooks and regulations. While guidelines for Washington State and British Columbia are different in structure, both offer the premise that improper installation and maintenance of a crossing structure can result in fish passage problems.

Procedures described in the Fish Passage Culvert Inspection (FPCI) procedure (Parker, 2000), have been developed to identify culverts which may be a barrier to fish passage. Other assessment procedures, such as the Fish Habitat Assessment Procedure (Johnston and Slaney, 1996), Sediment Source Surveys (Moore, 1994), Fish-stream Crossing Guidebook, and recently, Fish Passage Design at Road Culverts (Washington State Department of Fish and Wildlife, 1999) include an evaluation of culverts.

The FPCI procedure ensures that all culverts in a watershed are inspected, that there is direct assessment of the degree to which a culvert acts as a barrier to fish movement, and that preliminary prescriptions to address problem culverts are produced. FPCI Procedures include a description of culvert characteristics, stream characteristics, fish presence or absence, barrier evaluation, and preparation of preliminary prescriptions (FPCI Form A – Appendix 1). The FPCI procedure can be found at [http://wlapwww.gov.bc.ca/car/env_stewardship/wrp/manuals/covr2000.pdf](http://wlapwww.gov.bc.ca/car/env_stewardship/wrp/manuals/covr2000.pdf).

4.1 Pre-field selection of potential culvert barriers

Twelve potential culvert sites were selected on the west side of TFL 18 and 1 site was selected on FL#A18688 (Site 13). The field sites were selected by several Canfor staff and approved by Dave Dobi, RPF (FIA Coordinator, Canfor, Vavenby Division) and Snowy River Resources Ltd. Only culverts on known, suspected or default fish-streams (refer to the FSID Guidebook) were considered for field assessment. No additional fish inventory was undertaken at selected culvert sites.

Potential culvert barriers on stream reaches greater than 20% gradient were not assessed. During the pre-field overview, however, a maximum gradient of 25% was used (based on TRIM). This difference in gradient (5%) allows for a margin of error between TRIM and actual reach gradients.

If available, existing fisheries information for the target watersheds was collected through several sources including Fish-stream Identification (FSID), Sediment Source Surveys (SSS), Fish Habitat Assessments (FHAP), Fish and Fish Habitat Inventory (FFHI) reports, and the Fisheries Information Summary System (FISS) database. As a result of the pre-field review, 13 sites were selected for further field assessment.

4.2 Field assessment of culvert barriers

Utilizing Form A from the FPCI procedure, a field crew evaluated each of the 13 sites identified in the pre-field component of the project; compiling a data set that was used to set priorities for planning mitigative work.

Field inventory work began on October 26, 2005 and was completed on October 28, 2005. All sites were assessed in snow-free or near snow-free conditions.
The field data collection portion of the FPCI (Form A) is composed of the following key parameters:

- Culvert Water Velocity - Global Flow Probe FP101 (velocity meter)
- Culvert size, length, material and shape
- Culvert slope - Clinometer and stadia rod
- Stream channel measurements - Measuring Tape (30 meter), Suunto PM-5 Clinometer
- Culvert outfall drop
- Fish observation
- Pool depth at outfall
- Feature identification
- Water parameters in the culvert: depth, wetted width, high water mark
- Photography – Canon digital camera
- Habitat quality assessment
- Culvert maintenance

4.3 Assessing habitat value
Subjective values of habitat conditions found within each survey site were used to rate habitat types as poor, moderate or good (Table 1). A survey length ranging from 200-300 m, located upstream from the culvert inlet was used to reference habitat quality.

Holding pool criteria was determined for streams accessible to adfluvial fish populations (Johnston and Slaney, 1996). However, an adaptation to interior BC streams and stream resident fish was made to more accurately assess holding/overwintering pool requirements. A measurement of 0.5 m in depth for pools was used to represent good overwintering habitat.

Table 1: Criteria used for fish habitat quality references

<table>
<thead>
<tr>
<th>Fish Habitat Type</th>
<th>Site Card Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rearing</td>
<td></td>
</tr>
<tr>
<td>(average water depth&lt;sup&gt;11&lt;/sup&gt;)</td>
<td>&lt; 10cm = poor</td>
</tr>
<tr>
<td>Spawning</td>
<td>Comments regarding spawning habitat were based on the availability of appropriate sized gravels (6-52 mm) present within the survey site as well as compaction of the substrate.</td>
</tr>
<tr>
<td>Overwintering</td>
<td></td>
</tr>
<tr>
<td>(residual pool depth&lt;sup&gt;12&lt;/sup&gt;)</td>
<td>&lt; 30 cm = poor</td>
</tr>
<tr>
<td>Cover</td>
<td>&lt; 10% = poor</td>
</tr>
<tr>
<td>(instream, &lt; 2m height &amp; &gt;2m height)</td>
<td></td>
</tr>
</tbody>
</table>

<sup>10</sup> For a detailed description of how site information was collected, refer to the FPCI procedure manual.
<sup>11</sup> Keeley and Slaney, 1996.
<sup>12</sup> Johnston and Slaney, 1996
4.4 FPCI Scoring matrix

A priority table of assessed stream crossings requiring mitigative measures was established using the FPCI scoring matrix as a baseline guide (Table 2). This table provides an objective approach to prioritize work based on, but not limited to, fish species presence, length of new habitat gained upstream from the crossing, cost-benefit analysis, and construction feasibility.

Prescriptions for culvert retrofits were not developed for culverts that were: 1) damaged (i.e. severe rusting along the culvert barrel or compression along the length; 2) observed to be significantly undersized in meeting the hydraulic demands of anticipated peak flows \(Q_{100}\); and 3) Culverts located on roads maintained by the Ministry of Transportation.

Table 2: FPCI scoring matrix

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish species</td>
<td></td>
</tr>
<tr>
<td><em>Multiple or Significant</em> - More than one Code species &amp;/or regionally specific R/B-listed sp.</td>
<td>10</td>
</tr>
<tr>
<td><em>Single</em> – Single Code species (e.g. rainbow trout)</td>
<td>6</td>
</tr>
<tr>
<td><em>Other</em> – Non-Code species (e.g. sculpins) and/or non-confirmed Code species presence.</td>
<td>3</td>
</tr>
<tr>
<td>Habitat value (see Section 4.3 and Table 1 for habitat criteria)</td>
<td></td>
</tr>
<tr>
<td><em>Good</em></td>
<td>10</td>
</tr>
<tr>
<td><em>Moderate</em></td>
<td>6</td>
</tr>
<tr>
<td><em>Poor</em></td>
<td>3</td>
</tr>
<tr>
<td>Barrier</td>
<td></td>
</tr>
<tr>
<td><em>Full</em> – Obstruction to fish at all times of the year</td>
<td>10</td>
</tr>
<tr>
<td><em>Partial</em> – Obstruction to certain life stages of fish and/or at select periods throughout the year</td>
<td>6</td>
</tr>
<tr>
<td><em>Undetermined</em> – Unable to determine if culvert is a barrier based on one site visit.</td>
<td>3</td>
</tr>
<tr>
<td>Length of habitat gained – Length of habitat to be gained by mitigating the obstruction</td>
<td></td>
</tr>
<tr>
<td>(\geq 1\text{km})</td>
<td>10</td>
</tr>
<tr>
<td>(&lt;1\text{km}) (\geq 500\text{m})</td>
<td>6</td>
</tr>
<tr>
<td>(&lt;500\text{m})</td>
<td>3</td>
</tr>
<tr>
<td>Percent of stream barred – Total distance of the mainstem (fish-bearing) divided by the mainstem distance obstructed.</td>
<td></td>
</tr>
<tr>
<td>(&gt;70%)</td>
<td>10</td>
</tr>
<tr>
<td>(51-70%)</td>
<td>6</td>
</tr>
<tr>
<td>(\leq 50%)</td>
<td>3</td>
</tr>
<tr>
<td>Have other culvert barriers (full/partial/undetermined) been assessed upstream on the same stream?</td>
<td></td>
</tr>
<tr>
<td><em>Yes</em></td>
<td>5</td>
</tr>
<tr>
<td><em>No</em></td>
<td>0</td>
</tr>
<tr>
<td><strong>Maximum FPCI score</strong></td>
<td>55</td>
</tr>
<tr>
<td><strong>Minimum FPCI score</strong></td>
<td>15</td>
</tr>
</tbody>
</table>
4.5 Priority ranking of culvert and ford sites

Once a score is applied to each criteria and summed, an assessed site is given its final priority rank based on the scoring classes listed below (Table 3). The ranking priority from highest (1) to lowest (3) is then recorded with the total score recorded in the ‘Summary table of assessed stream crossings requiring mitigative measures’ (Table 4).

Table 3: FPCI priority ranking categories (Rank 1 to 3)

<table>
<thead>
<tr>
<th>Priority Rank</th>
<th>FPCI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>46-55</td>
</tr>
<tr>
<td>2</td>
<td>39-45</td>
</tr>
<tr>
<td>3</td>
<td>15-38</td>
</tr>
</tbody>
</table>

5.0 Results

This project involved the identification of 12 non-natural barriers (culverts) to fish passage on status roads within TFL 18 and 1 site on FL #A18688.

As part of the pre-field planning phase, potential culvert sites were selected mainly on the basis of local knowledge, combined with existing inventory data such as Fish Stream Identification (FSID), Fish Habitat Assessments (FHAP), and Fish and Fish Habitat Inventory (FFHI). As a result of the pre-field review, 13 culvert crossings were selected for further field assessment.

Twelve (12) crossings assessed were metal or plastic culvert structures on known or suspected fish-streams and one (1) of the crossings assessed (Thuya Creek) was a wooden box culvert on an assumed or confirmed fish-stream.

Table 4 presents the scores applied to each of the 13 sites assessed. The crossings are given a priority ranking based on scores allocated from Table 2, with the recommended preliminary prescription provided for each site. Where sites have the same total FPCI scored they should be prioritized based on a full assessment of fish habitat available upstream of the site.

1 Although every attempt is made to assess all crossings structures on known or suspected fish-streams within a given watershed, the selection of 13 crossings in this assessment does not suggest that there are no other problem culverts or vehicle fords within the target watershed. Rather, the number of assessments completed is governed by available funding.
Map 1: Overview map of TFL 18 showing FPCI field sites

Culvert status
- ✅ Not a barrier to fish passage
- 🔁 Partial barrier to fish passage
- 🔴 Full barrier to fish passage
- ⬤ Not a fish-stream at the crossing

Note: Site 13 is not shown. The site is located on the Thuya Rd (Rd. 2350), FL#18688
Table 4: FPCI score by site

<table>
<thead>
<tr>
<th>Site</th>
<th>Stream name</th>
<th>Stream class</th>
<th>Crossing structure</th>
<th>Fish species</th>
<th>Habitat value</th>
<th>Barrier</th>
<th>Habitat to be gained (m)</th>
<th>% Stream barred</th>
<th>Add'l sites upstream</th>
<th>Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inlet trib. to White Lk.</td>
<td>NFNC</td>
<td>500mm CMP</td>
<td>Not a fish-stream (note: this is a final determination certified by the author of this report)</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Inlet trib. to Boundary Line Lk.</td>
<td>FNC</td>
<td>500mm CMP</td>
<td>RB (6)</td>
<td>Mod (6)</td>
<td>Full (10)</td>
<td>1,600 (10)</td>
<td>83 (10)</td>
<td>No (0)</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Outlet from Boundary Line Lk.</td>
<td>(S2)</td>
<td>3 x 900mm CMP</td>
<td>RB (6)</td>
<td>Good (10)</td>
<td>Full (10)</td>
<td>6,100 (10)</td>
<td>75 (10)</td>
<td>No (0)</td>
<td>46</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Trib. to the outlet of Boundary Line Lk.</td>
<td>(S4)</td>
<td>500mm plastic</td>
<td>RB (6)</td>
<td>Poor (6)</td>
<td>Full (10)</td>
<td>25 (3)</td>
<td>2 (3)</td>
<td>No (0)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Trib. to Canimred Cr.</td>
<td>(S3)</td>
<td>600mm CMP</td>
<td>RB (6)</td>
<td>Mod (6)</td>
<td>Full (10)</td>
<td>4,200 (10)</td>
<td>91 (10)</td>
<td>No (0)</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Inlet trib. to Double Lk. (South)</td>
<td>(S4)</td>
<td>1200mm CMP</td>
<td>RB (6)</td>
<td>Mod (6)</td>
<td>Partial (6)</td>
<td>4,800 (10)</td>
<td>99 (10)</td>
<td>Yes (5)</td>
<td>43</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Inlet trib. to Double Lk. (North)</td>
<td>(S4)</td>
<td>2 x 500mm plastic</td>
<td>RB (6)</td>
<td>Mod (6)</td>
<td>Full (10)</td>
<td>1,200 (10)</td>
<td>99 (10)</td>
<td>No (0)</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Inlet trib. to Double Lk. (North)</td>
<td>(S4)</td>
<td>600mm CMP</td>
<td>RB (6)</td>
<td>Poor (3)</td>
<td>Full (10)</td>
<td>50 (3)</td>
<td>5 (3)</td>
<td>No (0)</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Outlet trib. to Sicily Lk.</td>
<td>S3</td>
<td>1000mm CMP</td>
<td>RB (6)</td>
<td>Good (10)</td>
<td>Partial (6)</td>
<td>5,000 (10)</td>
<td>100 (10)</td>
<td>No (0)</td>
<td>42</td>
<td>2</td>
</tr>
</tbody>
</table>

14 Site Number - culvert assessment site number from Form A “Site Number”.
15 The stream class is for information purposes only, therefore, no score is added. When shown in brackets, the presence/absence of fish has not been confirmed.
16 Barrier - degree of culvert barrier from Form A “Barrier”.
17 Habitat to be gained - the number of meters of mainstem stream length to be gained by replacing the barrier culvert as measured with a map wheel.
18 Percent of Stream Barred – total distance of the mainstem (fish-bearing) divided by the mainstem distance obstructed.
19 Add’l sites upstream - should be scored if there is another culvert upstream that has also been assessed as a full, partial or undetermined barrier.
20 Priority Rank – 1 (46 to 55 pts.); Priority Rank 2 (39-45 pts.); Priority Rank 3 (less than 39 pts.).
21 NFNC - no fish but not classified.
22 CMP - corrugated metal pipe.
23 FNC - fish presence confirmed but not classified.
Table 4 cont’d: FPCI score by site

<table>
<thead>
<tr>
<th>Site</th>
<th>Stream name</th>
<th>Stream class</th>
<th>Crossing structure</th>
<th>Fish species</th>
<th>Habitat value</th>
<th>Barrier</th>
<th>Habitat to be gained (m)</th>
<th>% Stream barred</th>
<th>Add’l sites upstream</th>
<th>Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Outlet trib. to Ejas Lk.</td>
<td>S3</td>
<td>1 x 1000mm &amp; 1 x 600mm CMP</td>
<td>RB (6) Good (10) Partial (6)</td>
<td>5,000 (10)</td>
<td>100 (10) No (0)</td>
<td>42</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Inlet trib. to Kitty Ann Lk.</td>
<td>Not available</td>
<td>Culvert flooded – no access</td>
<td>RB (6) Mod (6) Full (10)</td>
<td>2,300 (10)</td>
<td>95 (10) Yes (5)</td>
<td>47</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Inlet trib. to Kitty Ann Lk.</td>
<td>(S4)</td>
<td>600mm CMP</td>
<td>RB (6) Mod (6) Partial (6)</td>
<td>1,700 (10)</td>
<td>90 (10) No (0)</td>
<td>38</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Thuya Creek</td>
<td>(S2)</td>
<td>Box culvert</td>
<td>RB (6) Good (10) Full (10)</td>
<td>5,000 (10)</td>
<td>30 (3) Yes (5)</td>
<td>44</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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25 Site Number - culvert assessment site number from Form A “Site Number”.
26 The stream class is for information purposes only, therefore, no score is added. When shown in brackets, the presence/absence of fish has not been confirmed.
27 Barrier - degree of culvert barrier from Form A “Barrier”.
28 Habitat to be gained - the number of meters of mainstem stream length to be gained by replacing the barrier culvert as measured with a map wheel.
29 Percent of Stream Barred – total distance of the mainstem (fish-bearing) divided by the mainstem distance obstructed.
30 Add’l sites upstream - should be scored if there is another culvert upstream that has also been assessed as a full, partial or undetermined barrier.
31 Score - numeric score based on the sum of all Table 2 scoring classes.
32 Priority Rank – 1 (46 to 55 pts.); Priority Rank 2 (39-45 pts.); Priority Rank 3 (less than 39 pts.).
Site 1: Inlet tributary to White Lake, Road 10

**Recommendations/Comments:**

- This watercourse is a non fish-stream commencing from a point 50m upstream of White Lake. At that point, the channel flows subsurface for 30m, resulting in a full and permanent barrier to the upstream movement of fish. The watercourse was determined to be a non fish-stream in accordance to the LAA (Kamloops Forest Region, 2001).

**Culvert status**

- Not a barrier to fish passage
- Partial barrier to fish passage
- Full barrier to fish passage
- Not a fish-stream at the crossing

Photo 1: Site 1, culvert inlet. This watercourse is a confirmed non fish-stream, therefore, fish passage is not required.
Site 2: Inlet tributary to Boundary Line Lake, Road 10

**Why is this culvert a full barrier?**

- The culvert has an outfall drop of 0.3m and there is no pool at the culvert outlet. Culvert water velocities (1.3m/s) exceed the swimming capacity of fish. Note: the culvert is **315% undersized** to meet Q100 flows.
- Conditions at the culvert outlet, including the outlet jump height (0.3m), do not enable fish movement.

**Fish presence/absence:**

- RB were observed 30m upstream of the culvert inlet.
- Downstream of the culvert, the watercourse is a confirmed S4. However, the watercourse upstream of the culvert was not classified.

**Recommendations/Comments:**

- The extent of available fish habitat upstream of the culvert should be determined before the culvert is considered for replacement.
- The culvert inlet is damaged, resulting in the minor backwatering of flows. There is evidence of a minor amount of piping at the outlet. As well, the outlet shows evidence of scouring (Photo 2).

---

**Culvert status**

- ![Not a barrier to fish passage](image)
- Partial barrier to fish passage
- Full barrier to fish passage
- ![Not a fish-stream at the crossing](image)

**Photo 2:** Site 2, culvert outlet. There is evidence of scouring around the outlet pipe as well as culvert piping.
Site 3: Outlet tributary to Boundary Line Lake, Road 7B (3 culverts)

**Why is this culvert a full barrier?**
- Culvert water velocities (culvert A = 2.6m/s; culvert B = 2.49m/s) far exceed the swimming capacity of fish. Note: when combined, the culverts are **309% undersized** to meet $Q_{100}$ flows. This provides supporting evidence that culvert velocities are likely to be problematic at all flow periods.

**Fish presence/absence:**
- RB are known to occur in Boundary Line Lake (FISS), therefore, it is assumed that RB occur in the outlet stream as well. Provision of fish passage will enable the return of stream RB spawners to Boundary Line Lake.

**Recommendations/Comments:**
- Replacement of culvert structures with a bridge structure is a high priority. During removal of the culvert structures, it may be possible to divert flows through the overflow culvert but only if flows are sufficiently low enough.

**Culvert status**
- Not a barrier to fish passage
- Partial barrier to fish passage
- Full barrier to fish passage
- Not a fish-stream at the crossing

**Site UTM:** 669296E, 5734162N, Zone 10

**Photo 3:** Site 3, culvert outlet. There are three 900mm CMPs at this location. All are full barriers to fish passage.
Site 4: Tributary to the outlet of Boundary Line Lake, Road 10

Why is this culvert a full barrier?
- Culvert water velocities of 2.44m/s far exceed the swimming capacity of fish. Note: the culvert is 385% undersized to meet Q₁₀₀ flows. This provides supporting evidence that culvert velocities are likely to be problematic at all flow periods. The outlet jump height of 0.2m presents an obstruction to fish passage, however, velocity is the leading cause of the barrier.

Fish presence/absence:
- Rainbow trout were observed 5m downstream of the culvert structure. At approximately 25m upstream of the culvert, a 0.7m high boulder falls was identified. The falls is a permanent barrier to the upstream movement of fish. As accessible habitat is limited upstream of the culvert, it is strongly recommended that fish passage not be restored at this site.

Recommendations/Comments:
- Armor the culvert outlet to reduce fill slope erosion. Consider installing a second overflow culvert to increase effective culvert area.

Photo 4: Site 4, culvert outlet. This 500mm plastic pipe is a full barrier to fish movement. A rock falls was identified 25m upstream, therefore, replacing the culvert will provide little benefit for fish.
**Site 5: Tributary to the outlet of Boundary Line Lake, Road 10**

### Culvert status

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>Not a barrier to fish passage</td>
</tr>
<tr>
<td>☑️</td>
<td>Partial barrier to fish passage</td>
</tr>
<tr>
<td>⚫️</td>
<td>Full barrier to fish passage</td>
</tr>
<tr>
<td>⬤️</td>
<td>Not a fish-stream at the crossing</td>
</tr>
</tbody>
</table>

### Why is this culvert a full barrier?
- Culvert water velocities of 1.7m/s, coupled with the 0.36m outlet jump height, likely prevent all fish movement upstream. The culvert is **342% undersized** to meet Q100 flows. This provides supporting evidence that culvert velocities are likely to be problematic at all flow periods.

### Fish presence/absence:
- The presence of rainbow trout is assumed.

### Recommendations/Comments:
- Prior to considering options for restoring fish passage, an assessment should be undertaken, upstream of the crossing, to determine the extent and quality of accessible fish habitat.
- Retrofitting is not a suitable option at this site. The culvert is susceptible to blockage with debris by beavers. Therefore, only a bridge structure should be considered.

**Photo 5: Site 5, culvert outlet. This 600mm CMP is a full barrier to fish movement.**
Site 6: Inlet tributary to Double Lake (South), Road 20

**Why is this culvert a partial barrier?**
- The culvert inlet is damaged (bent upwards) resulting in a hydraulic jump. At the inlet, culvert velocities are 1.87m/s whereas, at the outlet, the velocities dropped to 0.99m/s. It is likely that adult RB would be able to migrate the hydraulic jump, however, it may pose a barrier for juveniles.
- Although the cross sectional area of the channel was not obtained, the culvert appears to be considerably undersized for Q100 flows.
- The culvert has obvious signs of beaver activity that are likely to continue despite maintenance efforts. Blockage of the culvert will result in the partial loss of the road and subsequent damage to fish habitat (i.e. the culvert structure is located within 30m of Double Lake).

**Fish presence/absence:**
- The presence of RB is confirmed in Double Lake. As the culvert is located only 30m upstream from the lake, RB are confirmed in the tributary as well.

**Recommendations/Comments:**
- Replace culvert structure with a bridge structure.

Photo 6: Site 6, culvert inlet. This 1200mm CMP is a partial barrier to fish movement because the inlet is damaged. The culvert is also susceptible to blockage with debris by beavers.
Site 7: Inlet tributary to Double Lake (North), Road 20

Why is this culvert a full barrier?
- The original culvert structure is 100% blocked (and buried) with debris by beavers. Road surface erosion has occurred as a result of flooding. In 2005, two overflow culverts (500mm plastic culverts) were installed as an emergency measure. Both overflow culverts have jump heights that exceed the ability of RB.

Fish presence/absence:
- The presence of rainbow trout is confirmed in Double Lake. As the culvert is located only 30m upstream from Double Lake, RB are likely confirmed in the tributary as well.

Recommendations/Comments:
- This site is a high priority. Replace culvert structure with a bridge structure.
- When determining the span of the bridge structure, consider a) the natural channel width downstream and; b) that work will be required upstream to construct a new channel.

Fish Passage Culvert Inspection, TFL 18 and FL #A18688
Site 8: Inlet tributary to Double Lake (North), Road 20

Why is this culvert a full barrier?
- The outlet jump height of 0.44m exceeds the jumping height of all life stages (i.e. fry, parr, juvenile, adult).

Fish presence/absence:
- The presence of rainbow trout is confirmed in Double Lake. Fish presence is assumed up to the culvert as no barriers to fish movement were identified within the site survey area (150m downstream of the culvert).
- Accessible habitat is limited upstream of the culvert. At approximately 50m upstream of the culvert, a 0.7m high boulder falls was identified. The falls is a permanent barrier to the upstream movement of fish (fish sampling must be conducted upstream of the falls to verify fish absence).

Recommendations/Comments:
- Due to the limited accessible habitat upstream, do not restore fish passage at this site.
- Consider installing an overflow pipe as the current 600mm CMP is approximately 240% undersized for Q100 flows.

Photo 8: Site 8. Although this culvert is a full barrier to fish movement, replacement with a passable structure is not recommended. A permanent barrier has been identified 50m upstream.
Site 9: Inlet tributary to Double Lake (North), Road 20

Why is this culvert a partial barrier?
- The culvert inlet is partially blocked by debris from beaver activity. During the assessment, the blockage was resulting in a hydraulic jump at the inlet. Passage for fish might be possible, but is challenging.
- The culvert is 365% undersized for Q_{100} flows. Culvert velocities are likely to be problematic at all flow periods.
- The culvert has obvious signs of beaver activity that are likely to continue despite maintenance efforts. Blockage of the culvert will result in the partial loss of the road and subsequent damage to fish habitat.

Fish presence/absence:
- Fish presence is confirmed in Sicily Lake. The crossing is located at the edge of the lake, therefore, fish presence is confirmed.

Recommendations/Comments:
- Due to the proximity of the barrier to a fish-bearing lake, fish passage should be restored as a priority. Replace culvert with a bridge.

Photo 9: Site 9. The culvert is partially blocked by debris. However, it is likely that the culvert will become completely blocked by the end of 2006.
Site 10: Outlet tributary to Ejas Lake, Road 9

Why is this culvert a partial barrier?
- There are two culverts at this location. Culvert water velocities at the inlet of culvert A (1,000mm CMP) were 2.6m/s, however, they had dropped to 0.76m/s at the outlet (adult RB should be able to navigate the short section of high culvert velocity). Velocities at culverts B were not problematic. Note that culvert A and B combined are 548% undersized to meet Q100 flows. This provides supporting evidence that culvert velocities are likely to be problematic at high to moderate flow periods.
- The inlet extension is creating a hydraulic jump, affecting the inlet velocity.
- Culvert B appears to be passable to fish. However, there is a minor outfall drop (5cm) and culvert velocities may be too high during spawning (late spring to early summer) when fish movement is expected.

Fish presence/absence:
- Fish presence is confirmed in Ejas Lake. The crossing is located at the edge of the lake, therefore, fish presence is confirmed.

Recommendations/Comments:
- Replace with a bridge structure. Consider using the old alignment just downstream.
Site 11: Inlet tributary to Kitty Ann Lake (Road 232)

Why is this culvert a full barrier?
- This culvert is completely blocked by debris from beaver activity.
- Water is being impounded and has flooded over the road, resulting in the loss of the road surface.

Fish presence/absence:
- Fish presence is confirmed in Kitty Ann Lake. However, fish presence between Kitty Ann Lake and Site 11 is not known, but assumed.

Recommendations/Comments:
- Remove culvert with a bridge structure.

Photo 11: Site 11. Culvert inlet below water. The culvert at this location is 100% blocked with debris. The culvert should be removed and replaced with a bridge structure.
Site 12: Inlet tributary to Kitty Ann Lake (Road 232)

Why is this culvert a partial barrier?
- This culvert structure is not a barrier during low to moderate flows, but may be a velocity barrier at high flows.
- The culvert is 285% undersized for Q₁₀₀ flows. Culvert velocities are likely to be problematic at high flow periods (from spring freshet until flows stabilize).

Fish presence/absence:
- Fish presence is confirmed in Kitty Ann Lake. However, fish presence between Kitty Ann Lake and Site 12 is not known, but assumed.

Recommendations/Comments:
- Do nothing. Monitor culvert for potential blockage by debris. Remove culvert if access is not required with 5 years.

Photo 12: Site 12. Culvert outlet. Fish passage at this site may be affected by high velocities between spring and early summer.
Site 13: Thuya Creek, Rd. 2350

Why is this culvert a full barrier?
- The existing box culvert structure was 85% blocked by debris from beavers. In its current condition (as observed during the FPCI assessment) fish passage was not possible. The blockage had resulted in flooding of the approaches with fish being stranded in an adjacent forest stand.

Fish presence/absence:
- Fish presence is confirmed in Thuya Creek. RB were observed during the FPCI assessment.

Recommendations/Comments:
- The box culvert was removed on November 14, 2005 (note: the project was approved in accordance to FIA criteria). A bridge structure will be installed during 2006.

Culvert status

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>Not a barrier to fish passage</td>
</tr>
<tr>
<td></td>
<td>Partial barrier to fish passage</td>
</tr>
<tr>
<td>✗</td>
<td>Full barrier to fish passage</td>
</tr>
<tr>
<td>🔄</td>
<td>Not a fish-stream at the crossing</td>
</tr>
</tbody>
</table>

Photo 13: Site 13. Upstream view inside the Thuya Creek box culvert. This structure has now been removed.
## 6.0 Additional site comments and recommendations

<table>
<thead>
<tr>
<th>Site</th>
<th>Comments/tasks to finalize recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Not a fish-stream. Update Canfor’s operational fish inventory dataset, if applicable.</td>
</tr>
</tbody>
</table>
| 2    | • This culvert should be replaced with a bridge or arch structure if there is sufficient habitat available upstream.  
   • If available, Canfor staff could assess the extent of upstream fish habitat by walking the stream and observing barriers (rock falls etc.) or obstructions (beaver dams) to fish movement. GPS the obstructions and note the type of obstruction. Provide this information to assist a biologist in reassessing the priority of replacing the culvert structure with a bridge structure. |
| 3    | • A site plan is being prepared for this site (bridge structure). An environmental monitor should be on-site to direct culvert removal. Prior to removal, a brief plan on steps for removing the culvert in an effort to minimize downstream sedimentation should be prepared. Culvert removal should be completed during a period of low flow. |
| 4    | • Monitor culvert for maintenance issues. The culvert outlet should be armored to reduce fill slope erosion that was observed at the time of the assessment (low to moderate risk).  
   • A permanent barrier to upstream fish movement was identified, 25m upstream of the culvert. If required for operational purposes, apply the LAA to confirm fish absence upstream of the barrier. If the stream does not meet the criteria under the LAA, the stream will need to be sampled by a biologist. If the stream channel does meet the requirements of the LAA, obtain site information from the lake at the headwaters of the stream (site photos, estimated lake depth) and provide information to a biologist. Based on this evidence, it may be possible for a biologist to make a non fish-lake determination without having to complete a formal field assessment.  
   • Advise the range tenure holder that cattle are affecting fish habitat downstream of the crossing location. Fish (RB) were observed during the FPCI assessment. |
| 5    | • If available, Canfor staff could assess the extent of upstream fish habitat by walking the stream and observing barriers (rock falls etc.) or obstructions (beaver dams) to fish movement. GPS the obstructions and note the type of obstruction. Provide this information to assist a biologist in reassessing the priority of replacing the culvert structure with a bridge structure. |
| 6    | • A site plan has been prepared and a new bridge structure will be installed during 2006.  
   • An environmental monitor should be on-site to direct culvert removal. |
<p>| 7    | • Replace culvert structure with a bridge structure. Do not consider an arch structure or low profile bridge as these may be susceptible to debris jams created by beavers. Even if a regular profile bridge is considered, then the overall height of the approaches may have to be increased. An environmental monitor should be on site during culvert removal. |</p>
<table>
<thead>
<tr>
<th>Site</th>
<th>Comments/tasks to finalize recommendations</th>
</tr>
</thead>
</table>
| 8    | • A permanent barrier to upstream fish movement was identified, 50m upstream of the culvert. If required for operational purposes, apply the LAA to confirm fish absence upstream of the barrier. If the stream does not meet the criteria under the LAA, the stream will need to be sampled by a biologist.  
• Update Canfor’s operational fish inventory dataset, if applicable, by mapping the location and height of the barrier. |
| 9    | • Replace culvert structure with a bridge structure. Do not consider an arch structure or low profile bridge as these may be susceptible to debris jams created by beavers. Even if a regular profile bridge is considered, then the overall height of the approaches may have to be increased (i.e. by 1.5 meters). An environmental monitor should be on site during culvert removal. |
| 10   | • Replace culvert structure with a bridge structure. Suggest installing a bridge structure at the deactivated crossing (just downstream) and completely remove the approaches at the current crossing location. If this approach is accepted, deactivate the existing crossing after the new bridge structure has been installed. |
| 11   | • This culvert should be replaced with a bridge structure. An environmental monitor should be on-site during culvert removal. A considerable amount of water is impounded behind the culvert inlet. Therefore, removal of the structure without qualified professional advice may result in adverse harm to downstream fish habitat. |
| 12   | • No action required other than regular culvert maintenance. |
| 13   | • The box culvert structure has been removed as of November 2005. A site plan has been prepared and a new bridge structure will be installed during 2006. Installation of the bridge structure does not require environmental monitoring. Site specific recommendations have been provided for the site by Snowy River Resources Ltd. (sent to Dave Dobi, RPF). |
7.0 References


Washington Department of Fish and Wildlife Habitat and Land Program, March 3 1999. *Fish Passage Design at Road Culverts*. Olympia, WA.
8.0 Additional Site Photos

Additional site photos are labeled by site on the attached CD.

9.0 FPCI Field Forms

The field forms are available on the attached CD.