PLACER CREEK WATERSHED

Reconnaissance Channel Assessment and Summary Overview Assessment

Prepared for:
Weyerhaeuser Company Limited
Princeton, BC

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Integrated ProAction Corp.
1.0 INTRODUCTION

Integrated ProAction Corp. was commissioned by Weyerhaeuser Company Limited to complete a channel assessment on the Placer Creek watershed. The watershed is located east of Manning Park, south of Princeton. The intent of the assessment is to review the current channel conditions and compare them to previous assessments, including The Overview Hydrologic Assessment of the Similkameen Above Whipsaw Sub-basin (#54), prepared for Weyerhaeuser Canada Limited by Henderson Environmental Consulting Ltd., March 1999.

Table 1: Assessed Sub-basins in Placer Creek Watershed

<table>
<thead>
<tr>
<th>Sub-Basin</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placer Creek</td>
<td>7,239.92</td>
</tr>
</tbody>
</table>

The objectives of the Reconnaissance Channel Assessment were to:

1) Field assess the current stream channel conditions,
2) Assess the sensitivity of the stream channels to impacts from land-use activities,
3) Identify sediment sources within the sub-basins coupled to the streams,
4) Expand on previous assessments,
5) Determine the effects of the current harvesting.

2.0 METHODOLOGY

2.1 OFFICE COMPONENT

A review of existing information included the following report:

- Overview Hydrologic Assessment of the Similkameen Above Whipsaw Sub-basin (#54) (Henderson Environmental Consulting Ltd., 1999)

2.1.1 ECA Calculations

The Equivalent Clearcut Area (ECA) is the area that has been harvested, cleared, or burned with consideration given to the silviculture system, regeneration, growth, and location within the watershed. The Peak Flow Index is often referred to as the weighted ECA as it multiplies the harvesting in the upper elevations by a factor.

The Peak Flow Index (PFI) is a useful hydrologic analysis tool to establish the balance of harvesting between the upper and lower elevations. The index also accounts for the cumulative impact that results when harvesting occurs in higher elevations where increased snow accumulations are expected in BC’s interior (BC Government, 1995). In a typical spring snowmelt governed watershed, low areas are usually snow-free while snow is actively melting at middle and higher elevations at the time that peak flows occur. Utilizing the PFI enables a measure of the harvested area that is contributing to snowmelt when the creeks are at their
peak runoff. The PFI accounts for this by weighting disturbed openings above the $H_{60}$ line\(^1\) by a factor of 1.5 (BC Government 1995).

Weyerhaeuser Company Limited completed the calculations in November 2006. The ECA and PFI calculations include all existing cut blocks identified in Weyerhaeuser’s Forest Development Plan. The results of these calculations were utilized to assist in developing the probability of a peak flow increase in each sub-basin.

2.2 FIELD COMPONENT
The channel assessment was completed utilizing methodologies that satisfy the requirements of the Channel Assessment Procedure Guidebook (Government of British Columbia, 1996). Field assessments were conducted exclusively on the ground. The channel assessments occurred in September and October 2006, and the locations are identified on the map in the Appendix. The stream reaches assessed in the field were determined by channel characteristics, riparian condition, proximity to known or suspected sediment sources and/or accessibility. The Channel Assessment Procedure (Government of BC, 1996) and the Rosgen (1996) Classification System were utilized to classify stream channel morphology and to evaluate channel sensitivity, while the Channel Assessment Procedure (CAP) was used to classify the stream channel disturbance levels. The longitudinal profiles, watershed report cards and channel assessment maps are presented in the Appendices.

3.0 WATERSHED CHARACTERISTICS

3.1 WATER LICENSES
There are no water licenses in the Placer Creek watershed.

3.2 SURFACE EROSION (from Henderson Report, 1999)

Road density in Placer Creek basin is considered low. There were three sediment sources in the Placer Creek basin identified during the field survey. The sediment sources were related to concentrated flow along the ditch, over the road, and an eroding fillslope.

3.3 RIPARIAN ASSESSMENT (from Henderson Report, 1999)

There were no riparian impacts identified during the field survey, however, a large portion of the riparian area in Placer Creek was burned by a wildfire located at the lower portion of the sub-basin in 1974. The area was later salvage logged. Placer Creek and both of the main tributaries have limited conifer growth in riparian areas. The lack of large trees has facilitated access to creeks by cattle resulting in accelerated bank slumping.

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\(^1\) The “$H_{60}$” line is defined as that elevation above which 60% of the watershed lies
3.4 MASS WASTING (from Henderson Report, 1999)

There were two mass wasting sites identified during the field survey. A large streambank failure is an active sediment source to Placer Creek while a slightly smaller streambank failure is not considered an active sediment source to Placer Creek as sediment does not reach the creek due to a bench between the toe of the slide and the creek.

4.0 CHANNEL ASSESSMENT

4.1 GOVERNING CONDITIONS FOR STREAM CHANNELS

There are five primary conditions governing stream channel morphology. These conditions, identified by Church and Ryder (2001), are:

1) the amount and timing of water delivered to the channel,
2) the amount and calibre of sediment delivered to the channel,
3) the supply of wood to the channel (in forested ecosystems),
4) the condition of stream banks (including riparian vegetation), and
5) the gradient over which the stream flows.

Also, streambed materials, local climate, watershed geomorphology and land-use activities make up the secondary factors that govern stream channel morphology. The morphology of stream channels change over time in response to natural or human-influences variations in bank conditions and supply of water, sediment and/or debris.

4.2 PLACER CREEK MAINSTEM

Placer Creek was divided into five reaches based on gradient, channel morphology and tributary influence. The reach breaks are identified on the longitudinal profile and map within this report. Following is a brief description of each reach.

Placer Creek Reach 1

Reach 1 was surveyed at two locations on the mainstem. The channel morphology, as assessed by Henderson Consulting 1999, at the confluence of Placer Creek and the Similkameen River was step pool and the bed material was mainly boulder. Farther up the reach the bed material is comprised of mossy, dirty rocks indicating little signs of disturbance. The banks were identified as being in good condition, however there was a small sediment source identified at an undercut bank where the stream had a small diversion.

Placer Creek enters the Similkameen River on a riffle. At the confluence of Placer Creek and the Similkameen River, there is a very small gravel bar. However, it is evident that Placer Creek is not carrying material larger then what is in the Similkameen River. The amount of sediment transported by Placer Creek was not observed to be altering channel conditions in the river.
Placer Creek Reach 2

Reach 2 of the mainstem was not assessed in the field however the eastern tributary into reach 2 (tributary 1) was surveyed twice. The channel morphology ranged from riffle pool to cascade pool and the bed material ranged from gravel to cobble. The channel is comprised of mossy rocks and had functioning Large Woody Debris (LWD). The stream banks are a sandy loam that had riparian vegetation intact. There is an area of recent logging that has been setback from the stream.

Placer Creek Reach 3

Reach 3 of the mainstem was assessed in one location and the eastern tributary (tributary 2) into reach 3 was assessed in three locations. The channel morphology of the mainstem was riffle pool, the bed material was primarily gravel and there was LWD present. The channel was partially aggraded in the section surveyed. The banks were composed of gravel and sand and the riparian in the section assessed was intact. The banks in the section surveyed were considered sensitive to disturbance indicating that the riparian needs to be kept intact.

The channel morphology in the headwaters of the tributary was cascade pool, the bed material was mainly cobble and there was LWD present. The channel contained mossy rocks and logs indicating no signs of disturbance. The banks of the stream were mossy and contained large boulders indicating the stream is stable.

Placer Creek Reach 4

Reach 4 was not assessed in the field.

Placer Creek Reach 5

Reach 5 was not assessed in the field.
Table 2: Placer Creek Watershed Channel Data

<table>
<thead>
<tr>
<th>Site</th>
<th>Slope</th>
<th>Depth</th>
<th>Diameter</th>
<th>Wb</th>
<th>Morphology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reach 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 7 (Confluence of Placer Creek and Similkameen River)</td>
<td>1.5%</td>
<td>-</td>
<td>&lt;10 cm</td>
<td>-</td>
<td>SPb</td>
</tr>
<tr>
<td>CH 5</td>
<td>-</td>
<td>27 cm</td>
<td>8 cm</td>
<td>5.8 m</td>
<td>RPG</td>
</tr>
<tr>
<td><strong>Reach 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 4</td>
<td>5%</td>
<td>25 cm</td>
<td>3 cm</td>
<td>3.3 m</td>
<td>CPC-w S</td>
</tr>
<tr>
<td>CH 6 (Tributary 1)</td>
<td>3%</td>
<td>45 cm</td>
<td>1 cm</td>
<td>2.1 m</td>
<td>RPg-w</td>
</tr>
<tr>
<td><strong>Reach 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 8</td>
<td>2%</td>
<td>22 cm</td>
<td>10 cm</td>
<td>3.3 m</td>
<td>RPg-w A1</td>
</tr>
<tr>
<td>CH 3 (Tributary 2)</td>
<td>4%</td>
<td>28 cm</td>
<td>8 cm</td>
<td>2.9 m</td>
<td>CPC-w</td>
</tr>
<tr>
<td>CH 2 (Tributary 2)</td>
<td>-</td>
<td>18 cm</td>
<td>7 cm</td>
<td>1.59 m</td>
<td>CPC-w</td>
</tr>
<tr>
<td>CH 1 (Tributary 2)</td>
<td>6-8%</td>
<td>26 cm</td>
<td>12 cm</td>
<td>4.4 m</td>
<td>CPC-w</td>
</tr>
<tr>
<td><strong>Reach 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Assessed</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Reach 5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Assessed</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Morphology:
- C – Cascade
- P – Pool
- R – Riffle
- S – Step
- c – cobble
- g – gravel
- b – boulder
- w – LWD present
- D2 – moderately degraded
- D1 – partially degraded
- A2 – moderately aggraded
- A1 – partially aggraded
- S – Stable

4.3 ECA TABLES AND MOUNTAIN PINE BEETLE IMPACTS

The following tables indicate the levels of Equivalent Clearcut Area (ECA) that are currently observed in the watershed, and are expected to occur in 2011 if the proposed harvesting in the forestry plans is completed accordingly.

Table 3. ECA Calculations

<table>
<thead>
<tr>
<th></th>
<th>Placer Creek Watershed ECA 2006</th>
<th>Placer Creek Watershed ECA 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watershed</td>
<td>ECA</td>
<td>Peak Flow Index (pfi)</td>
</tr>
<tr>
<td>Placer Creek</td>
<td>21.3%</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>ECA</td>
<td>Peak Flow Index (PFI)</td>
</tr>
<tr>
<td></td>
<td>25.6%</td>
<td>0.33</td>
</tr>
</tbody>
</table>

A review of the proposed harvesting and the location of pine leading stands were completed. The review indicates that pine leading stands are being targeted in the proposed harvesting (See Table 4). The harvesting of a pine leading stand that is expected to have a high mortality
rate caused by the mountain pine beetle, should have less hydrologic impact relative to harvesting a healthy Douglas fir or spruce leading stand.

Research on hydrologic effects of mountain pine beetle in the interior pine forests of British Columbia has resulted in many recent publications. In general they all indicate that peak and annual flows will increase, and the timing of peak flows may move forward a couple weeks (Unila, Guy and Pike, 2006). The results of the research also indicate there are some concerns that have answers, while others remain unknown and have only been addressed by theory:

“Changes in forest structure resulting from beetle-kill could modify key hydrologic process (MacDonald and Stednick, 2003). In the interior pine forest of BC, the annual accumulations and melt of the snowpack principally drive the hydrologic regime. This accumulation and melt are modified by hydrologic processes such as interception, evaporation, transpiration, snowpack redistribution (i.e. wind patterns) and melt (i.e. energy absorption), and groundwater storage. The effects of beetle-kill on these processes, with or without salvage harvesting, is unknown (Maloney, 2005) and may mimic that of conventional timber harvesting of similar size and extent. While transpiration is expected to be similar between beetle-killed stands and recent harvested areas (since trees do not transpire), the effects of beetle-kill on hydrologic processes may be different than the effects of timber harvesting. Beetle-killed trees retain their needles and branches, stay standing, and potentially affect forest regeneration after they have been killed. Furthermore, beetle-killed stands may retain live understory vegetation and are not necessarily impacted by road development, unlike conventional harvested stands” (Unila, Guy and Pike, 2006).

“The presence of a multi-storied stand may mitigate the hydrologic effects of beetle-kill (Schmid, Matam Martinez, and Troendle, 1991) supports the recent recommendation of BC’s chief forester to increase retention levels when salvaging beetle-killed stands (Snetsinger, 2005). Retaining structure such as live trees (including understory) and standing and fallen dead trees may reduce the risks of large-scale salvage, particularly until watersheds have reached hydrologic recovery (Snetsinger, 2005; Unila et al., 2006).

A research project on harvesting in drier climates similar to some parts of the assessed watershed indicates the following:

“A review of paired watersheds by Bosch and Hewlett (1982) noted that annual precipitation must exceed 450 mm in order to detect an increase in runoff as a result of removing a larger fraction of the vegetation cover in a watershed” (Helie; Peters, Tattrie and Gibson, 2005).

This supports the theory that harvesting drier parts of the watershed will contribute less to hydrologic changes than wetter parts.
Table 4: Placer Creek Watershed Pine Levels

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>Area of proposed harvesting (ha)</th>
<th>Area less proposed harvesting (ha)</th>
<th>Total area Pl leading (ha)</th>
<th>% Pl (total area)</th>
<th>% Pl (net area)</th>
<th>Area of Pl stands within proposed harvesting (ha)</th>
<th>Area of Pl leading stands age class 2 or greater after proposed harvesting (ha)</th>
<th>% Pl leading stands after all proposed harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,239.9</td>
<td>676.9</td>
<td>6,563.0</td>
<td>3157.2</td>
<td>43.6</td>
<td>48.1</td>
<td>467.1</td>
<td>2690.1</td>
<td>37.2</td>
</tr>
</tbody>
</table>

5.0 CONCLUSIONS FROM CHANNEL ASSESSMENT

The Reconnaissance Channel Assessment of Placer Creek Watershed included 8 channel sections distributed through the watershed. Water quality and quantity, and the downstream fisheries resource were considered the primary resource values.

The reconnaissance channel assessment has identified the channel has no to partial disturbance levels throughout the basin. There was a section in reach 2 that had been burnt and then subsequently logged.

The Reconnaissance Channel Assessment of the Placer Creek Watershed included four channel sections distributed through the watershed. Water quality and quantity, and the fisheries resources within the watershed were considered the primary resource values.

The ECA levels are currently a low hazard with an ECA of 21%. A possible increase to 26% in 2011 based on the proposed harvesting would pose as a low to moderate hazard.

The mainstem is greater than 1.5m wide in almost all sections, but the tributaries may be smaller where harvesting is proposed. Under the Forest Practices Code of British Columbia Act, that is being replaced, the mainstem stream is considered an S3. This classification results in a 20m riparian reserve, and a 20 metre riparian management zone. This degree of riparian management should be adequate to maintain channel conditions relative to the influence of riparian vegetation. Channel sections dependent on large woody debris for stability, will need some future potential recruits to be maintained along their edge.

The reaches are similar to other watersheds in the area which are generally considered to have the following sensitivities:

- **Low to moderately sensitivity** to increased peak flows,
- **Low to moderate sensitivity** to increased sediment supply, and
- **Moderate** sensitive to decreased LWD Supply.

The road conditions and existing harvesting were not observed to have a significant impact on the channel conditions in the Placer Creek Watershed. Future management needs to ensure the roads continue to be a minimal source of sediment.
The Equivalent Clearcut Area will be increasing to 26% if the proposed harvesting is completed. However, the watershed is identified to have Lodgepole Pine as a leading species in 37% of the residual stands in the watershed following the proposed harvesting. If the mountain pine beetle were to result in 80% mortality of the susceptible pine stands, the ECA could increase from the 26% to near 55%. The potential for the ECA to increase to 55% as a result of mountain pine beetle is a concern that could result in increased disturbance in the channel if peak flows were to increase. An increase in LWD is not a concern, as it is identified as generally assisting in channel stability.

In summary, the sensitivity of the channels to existing and proposed levels of development is considered to be low if existing management strategies continue. However, if the mountain pine beetle infestation results in 80% mortality of the pine stands (age class 2 or greater) there would be an expected increase in peak flows and channel disturbance.
6.0 RECOMMENDATIONS

The following recommendations should be considered when planning future forestry related activities:

1) Any new in-block roads should be a focus for deactivation where future use is unlikely or not required. Stream crossings should be deactivated and minimized where possible to reduce the potential for sediment delivery.

2) Trees in riparian areas are a source of functioning large woody debris and will assist in minimizing future channel disturbance in the watershed. Placer Creek is considered to be fish bearing. Any new harvesting on streams greater than 1.5 m in width need a 20 meter riparian reserve, and a 20m riparian management zone (this is typical S3 management as per the existing Forest Practices Code). Leaving future LWD recruits should be included in the management strategy for smaller streams where a channel depends on LWD to maintain its integrity. Weyerhaeuser’s current riparian strategies for smaller streams (1.5m - 3m) are appropriate. They are the following:

   “Weyerhaeuser generally consider reserves of variable widths on the larger confirmed S4’s as well as larger S6 streams (1.5m - 3m). They allow variance due to harvest method i.e. cable, but consider this acceptable as the majority of the ground adjacent to streams is conventional ground where reserves can be left. Variable width reserves are preferred as it provides more flexibility during layout in reacting to what the ground dictates. If the slope break into the riparian draw occurs at 15 m then place the reserve there and if the ground allows harvesting within 5m then take the boundary to that location. Also, increase retention of reserve trees through the RMZ.”

3) Do not remove post-harvesting large woody debris in stream channels without completing a professional assessment.

4) Channel conditions should continue to be monitored if future harvesting levels are proposed to increase. A subsequent reconnaissance channel assessment should be completed in 2011.

5) The mountain pine beetle infestation may result in more wood available for salvage harvest than can be accommodated. If this occurs there will be some non recoverable losses that could result in cutblock abandonment. The selection of cutblocks for abandonment need to consider watershed values. This would include abandoning cutblocks that are: in close proximity to creeks or riparian areas, in areas with sensitive terrain, and/or areas with advanced regeneration or an established secondary structure. Current research has shown that targeting such areas can mitigate the effects of a mountain pine beetle infestation on water resources and watersheds (Winkler, Maloney, Teti & Rex, 2007).
6) Future harvesting plans should target pine leading species and focus on controlling the expected mountain pine beetle infestation. Where feasible in Total Chance Planning, non-pine tree species should be reserved from harvest.

Yours truly,
Integrated ProAction Corp.

Stephen Henderson, FMIBC, RPF
Forester and Hydrologist
### 7.0 OVERVIEW ASSESSMENT

<table>
<thead>
<tr>
<th>Watershed:</th>
<th>Placer Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub basin:</td>
<td>Placer Mainstem</td>
</tr>
<tr>
<td>Area (ha):</td>
<td>7,239.92 ha</td>
</tr>
<tr>
<td>Tenure:</td>
<td>Majority is Crown Land</td>
</tr>
</tbody>
</table>

| Equivalent Clearcut Area (ECA) % | 21.3%                     |

<table>
<thead>
<tr>
<th>Channel</th>
<th>Type (CAP)</th>
<th>SPb to RPe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (m)</td>
<td>1.59m to 5.8m</td>
<td></td>
</tr>
<tr>
<td>Gradient (%)</td>
<td>1.5% to 8%</td>
<td></td>
</tr>
</tbody>
</table>

| Watershed Type: | The stream varies from coupled to decoupled. |

| Channel Conditions | Mostly not disturbed with isolated sections where a disturbed channel was observed. |

| Riparian Condition | Good, generally not disturbed. |

| Road Condition | Good condition, not affecting downstream reaches. |

| Hillslope Conditions | Good condition, few instabilities identified |

| Fish Target | Placer Creek is Fish Bearing |

| Habitat Conditions | Not Available |

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Integrated ProAction Corp.
8.0 LITERATURE CITED


Henderson Environmental Consulting Ltd., 1999. Overview hydrologic assessment of the Similkameen above Whipsaw Sub-basin (#54)


9.0 APPENDICES

Appendix A: Longitudinal Profile

![Placer Creek Longitudinal Profile](image)

- Reach 1
- Reach 2
- Reach 3
- Reach 4
- Reach 5

Integrated ProAction Corp.
Appendix B: Placer Creek Watershed Photos

Photo AA - Placer Crossing 1 - Upstream

Photo AB - Placer Crossing 1 - Downstream

Photo AC - Placer Crossing 2 - Upstream

Photo AD - Placer Crossing 2 - Downstream

Photo AE - Placer Crossing 3 - Upstream

Photo AF - Placer Crossing 3 - Downstream
Appendix C: Watershed Maps