

**Audit of Stream Riparian Management  
Chilliwack Forest District**

**Audit Report**



**FPB/ARC/67**

**November 2004**

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# Key Concepts and Terms

**Criterion:** a category of conditions or processes by which sound forest management may be assessed, underpinned by a set of indicators.

**Indicator:** a measure of a criterion to assess the condition of a forest resource, which may be monitored periodically to assess change.

**Stream:** a watercourse, having an alluvial sediment bed, formed when water flows on a perennial or intermittent basis between continuous definable banks.

**Stream Reach:** a section of a stream with relatively consistent characteristics, including the structure of the stream and fish habitat type.

**Stream Classification:** under the Code, streams must be classified based on the width of the stream and the presence or absence of fish. See adjacent table for details.

**Fish Stream:** a portion of a stream that, a) is frequented by fish, or b) has a gradient less than 20 percent (and flows into fish bearing waters), unless a fish inventory has shown the absence of fish.

**Hydrologically Linked:** areas connected in such a fashion that flowing water can transport material from one area to the other.

**Riparian Management Area (RMA):** an area that is adjacent to a stream, wetland or lake consisting of a riparian management zone and, depending on the riparian class of the stream, a riparian reserve zone.

**Riparian Reserve Zone:** that portion, if any, of the riparian management area located adjacent to a stream, wetland or lake. Harvesting of trees is not permitted normally in the reserve zone unless approved by government in specific circumstances.

**Riparian Management Zone (RMZ):** that portion of the riparian management area that is outside any riparian reserve zone or if there is no riparian reserve zone, that area located adjacent to a stream. Harvesting of trees is permitted in the management zone.

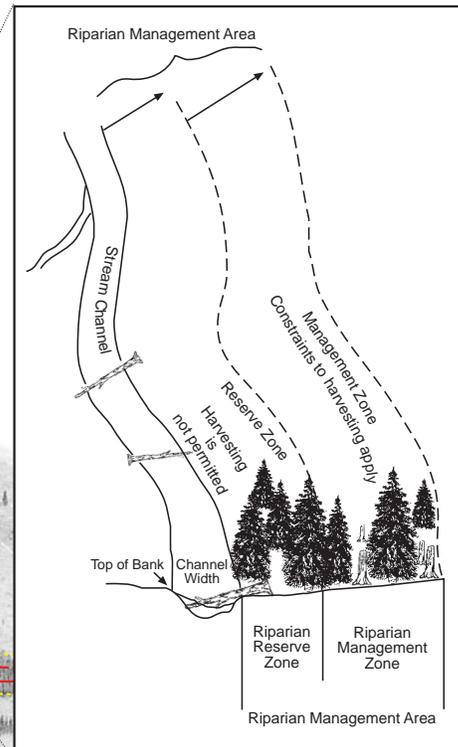
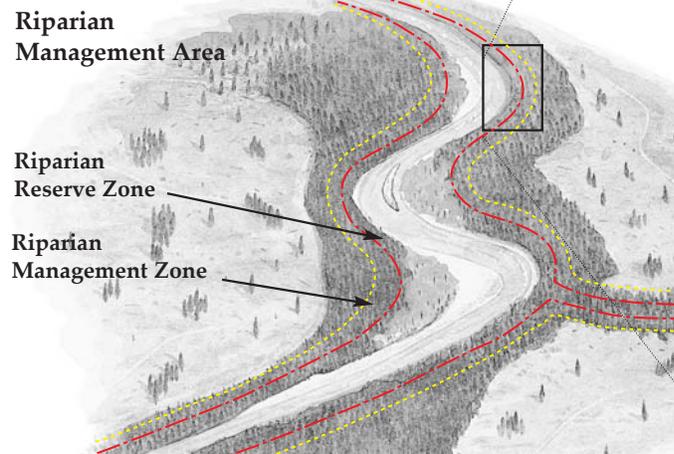
**Stream Channel Morphology:** the form and structure of the stream channel.

## Specified minimum RMA slope distances for stream riparian classes

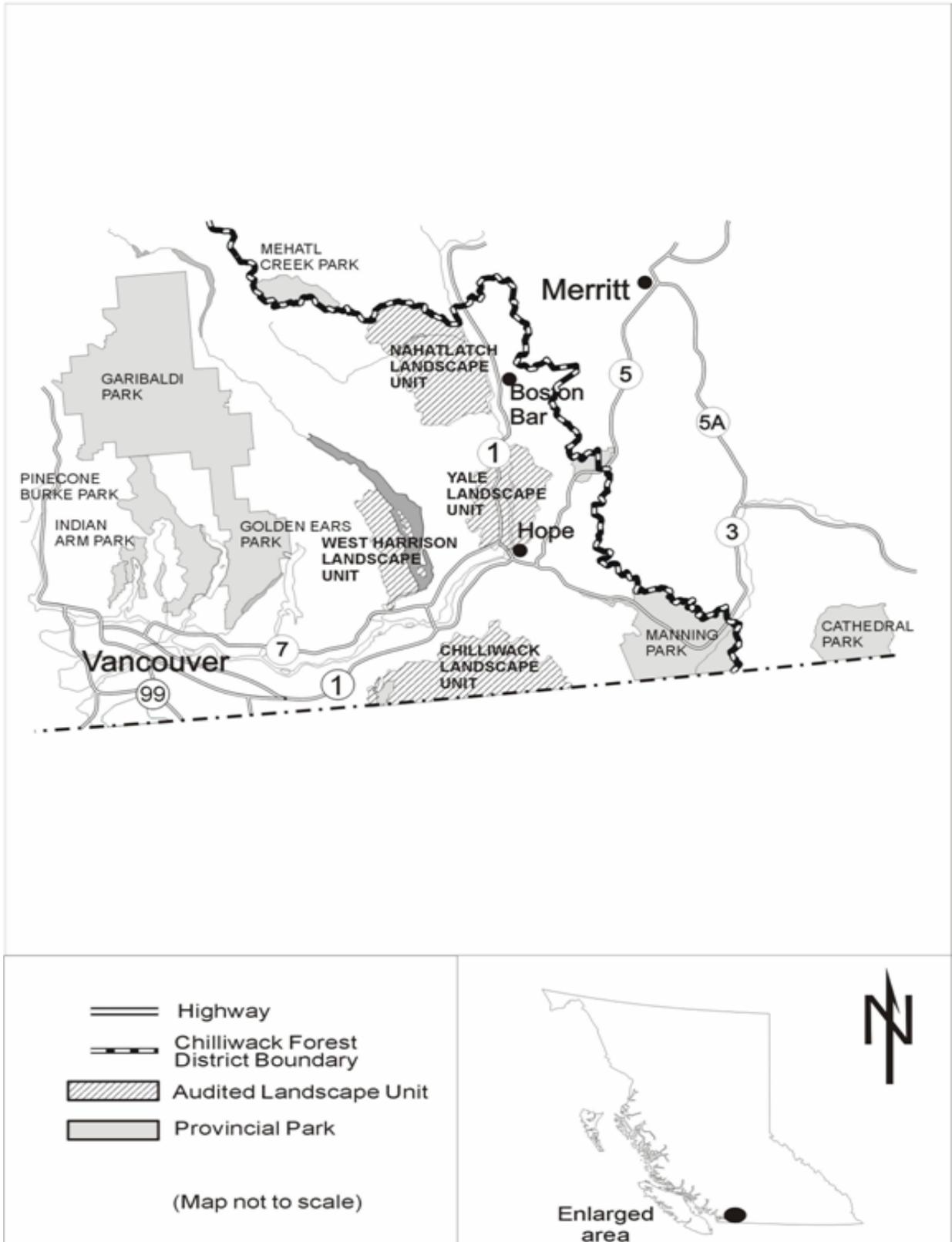
The Code defines riparian management areas, which consist of a management zone and, for fish streams of 1.5 metres in width or greater, a riparian reserve zone. Each of the zones has width requirements based on the stream classification. Constraints to forest practices are applied within these zones, with the most stringent requirements applied to the reserve zones.

Riparian class	Average channel width (m)	Reserve zone width (m)	Management zone width (m)	Total width (m)
S1 large rivers	≥ 100	0	100	100
S1 (except large rivers)	> 20	50	20	70
S2	> 5 ≤ 20	30	20	50
S3	1.5 ≤ 5	20	20	40
S4	< 1.5	0	30	30
S5	> 3	0	30	30
S6	≤ 3	0	20	20

 Fish stream or community watershed  
 Not fish stream and not in community watershed



Audit of Stream Riparian Management  
Chilliwack Forest District



# Introduction

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The Forest Practices Board conducted a pilot audit of stream riparian management practices in the Chilliwack Forest District in the fall of 2003. The audit was one of two pilot audits<sup>1</sup> that were designed to explore the Board's approach to auditing forest practices under results-based legislation in anticipation of the new *Forest and Range Practices Act* (FRPA). Recognizing that broader assessments of the results of forest practices in relation to government objectives would be required under FRPA, the Board is interested in the extent to which audits can facilitate such assessments and how to best report audit results.

In January 2004 the *Forest and Range Practices Act* (FRPA) replaced the Forest Practices Code as British Columbia's forest practices legislation. FRPA will be phased in over a two year period ending on December 31, 2005. FRPA will require the Forest Practices Board to take a new approach to forest practices audits.

The audit assessed forest practices for compliance with the *Forest Practices Code of BC Act* and regulations (the Code) and in relation to criteria and indicators of effective stream riparian management.

The major requirements in the Code applicable to stream riparian management include:

- correctly classifying streams according to their riparian classification;
- prescribing activities in a manner that will manage and conserve the riparian values;
- completing forestry activities in a manner that protects riparian values.

Under FRPA, the objective set by government for water, fish, wildlife and biodiversity within riparian areas is to, without unduly reducing timber supply, conserve at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas.

The Board is working in cooperation with the FRPA Resource Evaluation Working Group (a joint project of the Ministry of Forests and the Ministry of Water, Land and Air Protection) to facilitate the development of effectiveness indicators for each of the forest values identified in FRPA. The indicators used in the audit were developed by a team of riparian experts independent from the Board and relate primarily to minimizing detrimental impacts to streams from forest practices. The Board adapted the indicators as necessary to facilitate an audit (Appendix A describes the indicator development process).

Criteria and indicators provide an objective basis to assess and report on licensees' forest planning and practices in relation to the achievement of government objectives.

The audit used the criteria and indicators in Table 1 to assess those forest practices related to stream riparian management. The criteria relate mostly to FRPA's objective to conserve fish habitat, not FRPA's objectives for wildlife habitat, biodiversity or water quality

associated with riparian areas. The audit also reviewed the requirements of FRPA in consideration of the stream riparian effectiveness indicators and the findings of this audit.

**Table 1: Criteria and indicators employed in the stream riparian management audit.**

Criteria	Indicators
The physical and biological characteristics of streams have not been altered, or put at risk, as a result of forest practices.	<ul style="list-style-type: none"> <li>• channel beds are not disturbed</li> <li>• channel banks are not disturbed</li> <li>• large woody debris processes have not been changed</li> <li>• channel morphology has not been changed</li> <li>• introduction of fine sediments into streams has been minimized</li> <li>• movement of fish, organic debris and sediments has not been impeded</li> </ul>
Downstream resources have not been put at risk as a result of forest practices.	<ul style="list-style-type: none"> <li>• the potential for debris or exposed sediments to enter the stream is remote</li> <li>• steep slopes adjacent to the stream are stable and unlikely to fail and enter the stream</li> <li>• bare ground subject to surface erosion and movement to the stream is less than one percent of total area hydrologically linked to the stream</li> <li>• the number of stream crossings has been minimized</li> <li>• temporary stream crossings have been appropriately deactivated</li> <li>• permanent stream crossings are appropriately placed and armoured</li> </ul>
S1 to S3 streamside reserves are of appropriate size considering the physical and biological characteristics of streams.	<ul style="list-style-type: none"> <li>• sufficient streamside vegetation has been retained to provide shade, reduce bank microclimate change, and maintain an adequate root network and large woody debris supply</li> </ul>
Streamside reserves are adequately safeguarded from windthrow <sup>i</sup> .	<ul style="list-style-type: none"> <li>• the incidence of windthrow, or risk of windthrow, in reserve zones is appropriately minimized</li> <li>• riparian reserve zones are intact within 10 metres of the stream channel</li> </ul>
For S4, S5 and S6 streams, sufficient vegetation has been retained in streamside management zones considering the physical and biological characteristics of streams.	<ul style="list-style-type: none"> <li>• non-merchantable conifer trees (less than 30 centimetres DBH<sup>ii</sup>), understorey deciduous trees, shrubs, and herbaceous vegetation have been retained to the fullest extent possible within five metres of the stream channel</li> <li>• further retention is evident as necessary to accommodate stream values (including landscape-level RMZ retention objectives)</li> <li>• the incidence of windthrow, or risk of windthrow, in management zones is appropriately minimized</li> </ul>
Soil disturbance in streamside management zones has been minimized.	<ul style="list-style-type: none"> <li>• total soil disturbance directly linked to the stream in the first 10 metres of the management zone is less than one percent</li> <li>• total soil disturbance directly linked to the stream in the first 10 metres of the management zone plus all other areas hydrologically linked to the stream is less than five percent</li> </ul>

<sup>i</sup> **Windthrow:** trees blown down by wind.

<sup>ii</sup> **Diameter at Breast Height (DBH):** the diameter of the stem measured at breast height—generally 1.3 metres from the ground.

The audit was conducted in accordance with the auditing standards of the Forest Practices Board. Appendix B describes the audit objectives and methodology. Such an audit includes examining sufficient forest planning and practices to support overall conclusions about forest practices in relation to the criteria and indicators applied.

The audit team comprised:

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## Forest Practices Board Commentary

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### The Role of Criteria and Indicators

FRPA is results-based legislation, so compliance with FRPA is expected to involve achievement of results that are consistent with government's forest management objectives. FRPA establishes objectives for various forest values and requires licensees to develop forest stewardship plans<sup>2</sup> that set out strategies and results consistent with these objectives. With the introduction of FRPA, new terminology and concepts are emerging that will in time become established in practice.

Provincially, there is considerable work underway through various initiatives, such as the FRPA Resource Evaluation Working Group and forest certification programs, which share a common need to interpret and explain FRPA's objectives in a way that can be understood and put into practice. The development of criteria and indicator sets in relation to objectives appears to be the preferred approach.

The Board intends to conduct broader assessments of licensees' forest planning and practices in relation to the achievement of government objectives. Some of the key changes in the Board's audit approach will be the use of criteria and indicators, examination of systems and longer form reporting. The new approach embodying all these elements could be considered a form of effectiveness auditing.

The Board considers that the application of criteria and indicators is the appropriate means to interpret and explain FRPA's objectives. The Board is revising its audit approach to be consistent with the results-based approach of FRPA. The Board anticipates applying criteria and indicators to facilitate results-based assessments and to explain audit findings in a way that can be understood by the general public and by forestry professionals. This pilot audit is a part of the process.

Through this pilot audit of stream riparian management, the Board has successfully completed an audit of the effectiveness of forest practices in British Columbia, using criteria and indicators

adapted for the audit. The audit has confirmed the application of criteria and indicators as a practical approach to such broader audit assessments, as an effective basis for discussing audit findings with the parties audited, for fostering improved practices and for reporting audit results. The experience gained from this pilot audit will be used in designing the Board's approach to audits under FRPA, so that future Board audits can provide assurance about the results of forest practices in relation to government's forest management objectives.

Some of the highlights of interpreting and applying riparian indicators in this audit include:

- The stream riparian indicators closely parallel the requirements of the Code—for example, both the indicators and the Code dictate that sedimentation be minimized during road construction and deactivation.
- Different classes of streams have different treatment expectations—for example S5 and S6 streams are typically not managed for fish habitat. These differences in management expectations were not always reflected in the indicators.
- The indicators are stream-reach specific. Cumulative impacts could be evaluated by adding the results from individual reaches, however this may not be the best approach to assessing cumulative impacts on a stream system—for example, landscape-level assessments encompassing the number of crossings over fish streams, amount of bare ground directly connected to streams via road networks, measurement of riparian vegetation lost through road crossings, etc. would benefit a results-based effectiveness assessment.
- The indicators focus on attributes of streams and not explicitly on the forest practices that could be impacting streams. The use of control sites is important to assessing impacts from forest practices. Data were collected in relation to each indicator at a control site (generally a representative stream reach directly upstream where no forestry activity was evident) and compared to the stream characteristics adjacent to forest activity to assess the level of change to streams from the forest practices.

The Board is conducting three further pilot audits focusing on FRPA's objectives for biodiversity, visual quality, as well as another stream riparian management audit. These audits will build on the experience gained from this audit, applying criteria and indicators, and will also examine aspects of licensees' systems and controls important to ensuring that forest practices are achieving the results intended.

## **Audit Results**

The results of the audit demonstrate that forest practices were substantially in compliance with the riparian provisions of the Code and are effective in managing stream riparian areas. There is an area for improvement relating to sediment entering streams from road crossings. Most of the audit field work was conducted during an extremely heavy rainfall event, where many areas in the Lower Mainland were subject to flooding.

These results confirm that the Code's riparian requirements and licensees' harvesting practices are effective in protecting riparian values. Licensees are often avoiding streams altogether or leaving effective reserves around streams where required. In many instances, more trees are being reserved than required by legislation. Because the default riparian requirements in FRPA closely parallel the retention requirements in the Code, the Board expects this level of protection should continue under FRPA.

However, the audit results also demonstrate that road construction and deactivation practices require improvement to appropriately protect streams. In particular, licensees need to exercise more care when constructing and deactivating stream crossings to minimize the amount of sediment introduced into streams. Too frequently these practices introduced more sediment into streams than the auditors determined was necessary in the circumstances, resulting in impacts to the streams. It is important that licensees minimize sedimentation into streams in order to achieve FRPA's objectives for riparian values.

Also, as harvesting moves back into areas that have already seen extensive activity, more old pre-existing roads will be used for access. Often these roads are immediately adjacent to significant fish-bearing streams. The Board recognizes that, in the majority of cases, re-opening old roads in riparian reserve areas, rather than building a new road outside the area, will result in less impact to the stream. However, there needs to be recognition of the heightened risk associated with these practices. Licensees' practices need to be planned and managed such that impacts on adjacent streams are minimized.

## **Recommendations**

As provided by section 131 of FRPA, the Board makes the following recommendations:

1. During road construction, licensees should ensure that all stream crossing structures are located, placed and armoured to minimize sedimentation.
2. When completing deactivation activities, licensees should determine what steps are necessary to minimize sediment at stream crossings and complete those steps. Rather than considering a crossing adequately deactivated once the culvert is removed and then grass seeding, determine if further action can be taken while the machinery is still on-site. This can include removing road fill down to the original stream channel and sloping the fill back after the culvert has been removed to a more natural angle of repose, thereby increasing the likelihood of minimizing sedimentation at stream crossings.
3. At all phases of road management (construction, maintenance and deactivation), licensees should make consistent use of water management techniques to keep water (and therefore road sediment) away from the stream crossing. Much of the sediment that enters streams comes from road surfaces directly connected to the stream crossing. Use of swales, water bars, cross drain culverts, etc. greatly reduce the amount of sediment from the roads that can enter streams.

4. Licensees should implement 'higher standard' operating procedures when re-building and utilizing pre-existing roads that are in riparian reserve zones. In the majority of cases, it makes more sense to re-open 'old roads' that are within riparian reserve zones than to build new roads outside the RMA of streams, but additional measures should be taken to minimize the impact of activities on the stream. Examples include ensuring that armouring material is available and placed concurrent with drainage structure placement, immediate re-vegetation of exposed soils, as well as considering potential impacts from other road users and employing access control measures where required.

These recommendations could serve as guidance to all licensees concerning stream riparian management. The Board will continue to assess riparian management in subsequent audits.

The Board thanks the auditees for their participation and cooperation in this pilot audit. The Board would also like to commend the licensees on their work in relation to stream riparian management. Although stream crossing practices require improvement, licensees' harvest planning and practices reflect effective stream riparian management according to the criteria and indicators employed.



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Chair, Forest Practices Board

November 16, 2004

# Detailed Findings and Conclusions

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## Background

Four draft landscape units within the Chilliwack Forest District with sufficient levels of harvest to facilitate the audit were selected. These landscape units, Chilliwack, Yale, West Harrison and Kookipi, comprise the audit area (see map on page 2).

International Forest Products Ltd. (Forest Licence A19203), Teal Cedar Products Ltd. (Forest Licence A19201) and the Chinook Business Area BC Timber Sales (collectively 'the licensees') each operates in the area subject to audit. The scope of the audit included the licensees' operational planning, harvesting, road construction and road deactivation for the period October 1, 2001 to October 24, 2003.

Approximately 940,000 cubic metres and 74 cutblocks were harvested in this area during the audit period, predominantly upslope of fish-bearing streams. In recent years the amount of second growth timber being harvested in the area has increased considerably, resulting in very few new crossings over larger streams being required to access harvest areas. The majority of the operating areas have an extensive history of harvesting over many years with a considerable existing old road network.

There are no higher level plans<sup>3</sup> applicable to the audit area; therefore, the stream riparian management requirements set out in the Code represent the primary direction to licensees with respect to forest practices in the vicinity of streams.

## Overall Conclusions

Overall, with one significant exception, the licensees' forest planning and practices are consistent with the criteria and indicators applied in this audit. Licensees completed riparian assessments and appropriately identified and classified the streams applicable to their areas of operation, prescribed appropriate harvesting activities in riparian areas, maintained riparian reserves consistent with Code requirements (and in many cases exceeding the requirements of the Code) and conducted harvesting in accordance with operational plans and site plans.

These practices adequately conserved riparian values. Channel beds and banks were not adversely impacted as a result of harvesting practices in proximity to streams. Large woody debris processes were preserved, where required. There were no observed changes to stream channel morphology, no increased sedimentation into streams from harvesting, and the movement of fish, organic debris and sediment had not been impeded as a result of harvesting practices.

The exception relates to sediment control at stream crossings. The physical and biological characteristics of streams have been impacted as a result of crossing practices—specifically the

introduction of fine sediments into streams was not minimized. The audit examined 109 stream crossings and found that:

- On 18 of 49 stream crossings constructed, the road construction practices had not minimized the amount of sediment introduced into streams. Crossing structures were frequently observed on road fill and not adequately armoured, thereby introducing sediment directly to the streams.
- On 10 of 60 stream crossings permanently deactivated (i.e., the crossing structure has been removed) the road deactivation practices had not minimized the amount of sediment introduced into the streams. Deactivation at stream crossings consisted of removing the drainage structure, armouring<sup>4</sup> if material was available, and re-vegetating where considered necessary. However, armouring the crossings was inconsistent. In many cases, after removing culverts the road fill was not excavated down to the original stream channel and stream banks were frequently left un-vegetated. In one instance, the deficient practices occurred despite the road deactivation prescription recognizing important downstream resources.
- In all cases, these practices were on small, mainly S6 class streams crossed using wood box culverts and round culverts.

The sedimentation resulted in local impacts on streams such as covering stream beds with fine sediments. Cumulative downstream impacts were not determinable; however, many of the stream crossings where sedimentation was not minimized are directly connected to fish bearing streams and streams with water users.

These practices are not consistent with the criteria and indicators of effective stream riparian management and were also determined to be in non-compliance with the requirements of the Code. The main sections of the Code to which the non-compliance relates are Forest Road Regulation sections 9 and 15.

The introduction of FRPA does not create any significant gaps in legislation that could impact on stream riparian management if the default requirements and general practice requirements are followed. The default regimes in FRPA essentially mirror the riparian retention requirements of the Forest Practices Code. However, the results-based nature of FRPA does not specifically require sedimentation to be minimized; rather, FRPA establishes the objective to protect water quality and fish habitat at the landscape level.

**Criterion: The physical and biological characteristics of streams have not been altered, or put at risk, as a result of forest practices.**

**Indicators:**

- **channel beds are not disturbed**
- **channel banks are not disturbed**
- **large woody debris processes have not been changed**
- **channel morphology has not been changed**
- **introduction of fine sediments into streams has been minimized**
- **movement of fish, organic debris and sediments has not been impeded**

These indicators of this criterion for effective stream riparian management relate to the level of disturbance or change to stream channels. Stream channels should not be altered or put at risk as a result of forest practices.

There is a strong correlation between the Code riparian requirements and these effectiveness indicators in that both are to minimize impacts to streams. The major Code requirements aimed at protecting stream channels require licensees to:

- Complete riparian assessments (to determine the riparian class of the streams) prior to the conduct of harvesting and road activities.
- Propose harvesting and road practices that are appropriate for the riparian class of each stream, including measures for debris management, protecting stream banks and maintaining shade over temperature sensitive streams.
- Avoid removing stable natural material that is in a stream or embedded in a stream bank, or a root system that contributes to stream bank stability and fish habitat.
- Locate, construct, use and remove temporary stream crossings in a manner that protects the stream channel and stream bank immediately above and below the crossing, and mitigates disturbance to the stream channel and bank at the crossing.
- Avoid falling timber into streams and depositing slash or debris into streams.
- For certain classes and characteristics of streams, retain sufficient streamside trees to prevent stream temperature from increasing.
- Retain sufficient streamside trees to maintain stream bank and channel stability.
- Not operate ground-based machinery within five metres of stream banks.

**Harvesting**

The audit examined 74 of 231 stream reaches directly adjacent to or within harvest areas. The audit collected data in relation to each indicator at a control site (generally a representative reach directly upstream where no forestry activity was evident), and then compared the stream characteristics and assessed the level of change to streams that resulted from the harvesting.

The audit found that harvesting practices adequately protected stream channels.

- Channel beds and banks were not adversely impacted as a result of harvesting practices in proximity to streams.
- Large woody debris processes were preserved, where required.
- There were no observed changes to stream channel morphology, no increased sedimentation into streams, and the movement of fish, organic debris and sediment had not been impeded as a result of harvesting practices.

The audit identified one S5 stream where trees that had been reserved were blown down resulting in disturbance to the stream's channel beds and banks. There had been no windthrow-prevention measures employed on this site. However, reserving trees in this situation exceeds the minimum requirements of the Code and also exceeds the *Riparian Management Area Guidebook* best management practice. Although the windthrow impacted the stream channel, reserving trees around larger S5 streams is desirable and the impacts were considered relatively minor.

## **Roads**

Road construction and deactivation activities are a high risk to streams because roads cross directly over streams and require the installation of culverts and bridges. Construction and deactivation of crossings creates a substantial source for sediment that can be introduced into streams. If the introduction of fine sediments is not minimized, the channel bed can become infilled, spawning beds entombed, and water quality affected. Improperly installed crossing structures can also impede the movement of fish, debris, sediment and water.

The Code sets out requirements for road construction and deactivation activities aimed at minimizing the impact on riparian features. These include:

- Avoiding building roads in riparian management areas wherever possible.
- Designing crossing structures so that stream flow is not impeded.
- Ensuring water is not re-directed onto unstable slopes.
- Ensuring fish passage is maintained.
- Minimizing sediment introduced into streams.
- Carrying out in-stream work during approved work windows.

The audit examined 109 stream crossings and found that, with one significant exception, licensees' road construction and deactivation practices were consistent with the indicators assessed. The exception relates to road practices not minimizing sediment delivery into smaller streams, when utilizing wood box culverts and round culverts, and is applicable to all three licensees' practices.

- At 18 of 49 crossings constructed, sedimentation into streams had not been minimized. Crossing structures were frequently observed on road fill and not adequately armoured, thereby introducing sediment directly to the streams.
- At 10 of 60 stream crossings deactivated, erodible soils were not sufficiently armoured or pulled back from the stream channel to minimize sedimentation into the streams. Stream banks were frequently left un-vegetated. In many cases, after removing culverts the road fill was not excavated down to the original stream channel. In one instance, the deficient practices occurred despite the road deactivation prescription recognizing important downstream resources.

These practices are not in compliance with the Code requirement to minimize the amount of sediment introduced into streams.



**Example of a crossing structure perched on road fill and not adequately armored, introducing sediment directly to the stream.**



**Example of a deactivated crossing where the road fill was not excavated to the original stream channel. Erodible soils were not sufficiently armored or pulled back from the streams channel to minimize sedimentation into the streams.**

## Conclusions

Based on the indicator data collected, harvesting practices have not altered, or put at risk, the physical and biological characteristics of streams adjacent to and within the harvest areas.

With one significant exception, road practices have not altered, or put at risk, the physical and biological characteristics of streams crossed.

Licenses' road construction and deactivation practices did not minimize sediment delivery into smaller streams when utilizing wood box culverts and round culverts. The sedimentation off roads altered the physical and biological characteristics of several streams.

These road construction and deactivation practices are not in compliance with the Forest Road Regulation sections 9 and 15, which requires the amount of sediment introduced into streams be minimized.

## **Criterion: Downstream resources have not been put at risk as a result of forest practices.**

### **Indicators:**

- **the potential for debris to enter the stream is remote**
- **steep slopes adjacent to the stream are stable and unlikely to fail and enter the stream**
- **bare ground subject to surface erosion and movement to the stream is less than one percent of total area hydrologically linked to the stream**
- **the number of stream crossings has been minimized**
- **temporary stream crossings have been appropriately deactivated**
- **permanent stream crossings are appropriately placed and armoured**

These indicators extend the objective to not impact streams to include preservation of downstream resources. The Code focuses on practices in the direct vicinity of streams with the intent of protecting downstream resources.

The audit found that:

- where temporary stream crossings were utilized, they were subsequently deactivated;
- where permanent stream crossings were utilized, they were appropriately placed. However, armouring was restricted to bridges and major culverts (see previous section);
- the potential for debris to enter streams was remote. Any steep slopes adjacent to streams were fully forested, and the ground subject to surface erosion and movement to the stream was less than one percent of total area hydrologically linked to the stream.

The audit observed that harvesting is occurring in areas of second-growth forest. This can enable licensees to utilize older existing road networks, which helps to minimize the amount of new road construction. However, these old roads are often directly adjacent to large (S1 and S2) fish bearing streams. Under the Code, new roads must be constructed outside of riparian management areas unless there is no other practical alternative. When access is required into second-growth areas, it is usually more practical to re-open an existing road than to construct a new road. If re-opened appropriately, this can result in significantly less impact to the streams.

The audit examined two old roads that were re-opened. In one instance crossing structures were replaced but armouring was not completed in a timely fashion, resulting in sediment introduction into an S1 stream.

## Conclusions

Road construction and deactivation practices have not put downstream resources at risk (except for the sedimentation discussed in the preceding section).

Road re-construction practices within riparian management areas did not adequately consider the increased risks to high value streams.

### **Criterion: S1 to S3 streamside reserves are of appropriate size considering the physical and biological characteristics of streams.**

#### **Indicator:**

- **sufficient streamside vegetation has been retained to provide shade, reduce bank microclimate<sup>5</sup> change, and maintain an adequate root network and large woody debris supply**

Streamside reserve zones help to manage and conserve a variety of values such as wildlife habitat. For this reason, streamside reserves are often larger than is required to maintain the physical and biological characteristics of streams. Generally, maintaining the integrity of the first 10 metres width from the stream will achieve the indicator attributes applicable to effective stream riparian management (i.e., provide sufficient shade, protect bank microclimate and maintain an adequate root network and large woody debris supply).

The Code requires that larger fish bearing streams (S1 to S3) have riparian reserves. The width of the reserve varies by the classification of the stream. The audit examined all of the 20 stream reaches that were directly adjacent to harvest areas and required streamside reserves and found that forestry practices maintained riparian reserves of an appropriate size. On all streams a reserve of at least the minimum prescribed by the Code was retained.

#### **Conclusion**

Based on the indicator data collected, forest practices have maintained streamside reserves of appropriate size considering the physical and biological characteristics of S1-S3 streams.

### **Criterion: Streamside reserves are adequately guarded from windthrow.**

#### **Indicators:**

- **the incidence of windthrow, or risk of windthrow, in reserve zones is appropriately minimized**
- **riparian reserve zones are intact within 10 metres of the stream channel**

It is important that streamside reserves be adequately safeguarded from windthrow because extensive windthrow can compromise the integrity of the stream and streambank environment.

The Code does not have specific requirements relating to windthrow management. Every stream has a riparian management zone with a width designated in the Code. For streams requiring streamside reserves, the primary objective of the riparian management zone is to protect the riparian reserve from windthrow. However, the Code does not prescribe specific measures to protect the streamside reserve.

For the 20 stream reaches examined, the audit found that the amount of windthrow and the potential for windthrow were minimized. On 17 of the reaches, the riparian management zone had 100 percent tree retention. The other three reaches had approximately 30 percent retention.

These levels of retention outside the streamside reserve provide a high probability of maintaining the integrity of the first 10 metre area adjacent to the streams.

## **Conclusions**

Forest practices appropriately minimized the incidence and risk of windthrow in streamside reserves.

Retention levels in stream riparian management zones often reflected best management practices and exceeded the minimum required under the Code.

**Criterion: For S4, S5 and S6 streams, sufficient vegetation has been retained in streamside management zones considering the physical and biological characteristics of streams.**

### **Indicators:**

- **non-merchantable conifer trees (less than 30 centimetres DBH), understorey deciduous trees, shrubs, and herbaceous vegetation have been retained to the fullest extent possible within five metres of the stream channel**
- **further retention is evident as necessary to accommodate stream values (including landscape-level RMZ retention objectives)**
- **the incidence of windthrow, or risk of windthrow, in management zones is appropriately minimized**

Retention along smaller streams is important in order to meet riparian objectives including fish habitat, channel stability and downstream water quality.

The Code does not require a riparian reserve zone for S4, S5 or S6 streams. However, S4 streams are fish-bearing, and best management practices suggest that a sufficient number of streamside trees should be retained to maintain streambank stability, protect fish habitat, provide a source of future large woody debris and prevent downstream impacts.

## S4 Streams

There were only three S4 stream reaches in the audit area with forest practices associated. The audit examined all three and found that two had approximately 30 metre reserves and one retained 75 percent of the basal area<sup>6</sup> alongside the streams. These retention levels exceed the Code requirements for S4 streams and have achieved the effectiveness indicators.

## S5 and S6 Streams

Although not required by the Code, best management practices also suggest desirable retention levels for S5 and S6 class streams—for example, best management practices for valley-bottom S5 streams dictate at least 50 percent retention.

There were 205 S6 stream reaches and 23 S5 stream reaches in the audit area with associated forest practices. The audit found that best management practices for harvest activities were generally followed for these reaches.

- Most S5 streams had full tree retention on both sides of the streams, most notably where the streams ran through gullied terrain. Typically full forest cover was maintained to the height of land.
- There were three valley-bottom S5 streams examined; these streams are recognized to have values that closely follow the values associated with fish streams. The riparian management area of the valley-bottom S5 streams were managed as per the best management practices in the *Riparian Management Area Guidebook*, with approximately 50 percent tree retention on both sides of the stream.
- 28 S6 stream reaches were reserved from harvesting, either by placing on the outside of the block or retaining an area around the stream inside the block, often in conjunction with a wildlife tree patch. These tended to be the larger S6 streams. Many of the other S6 streams were small (30 to 50 centimetres-wide) and/or ephemeral.
- Often, the harvest area boundaries were located in such a fashion as to leave streams outside the block boundary—a ‘stream avoidance’ strategy. This effectively maintained the streams in their pre-harvest condition.

## Conclusions

Forest practices retained sufficient vegetation in streamside management zones for S4, S5 and S6 streams considering the physical and biological characteristics of the streams. Retention levels often reflected best management practices and exceeded the minimum required under the Code.

**Criterion: Soil disturbance in streamside management zones has been minimized.**

**Indicators:**

- **total soil disturbance directly linked to the stream in the first 10 metres of the management zone is less than one percent**
- **total soil disturbance directly linked to the stream in the first 10 metres of the management zone plus all other areas hydrologically linked to the stream is less than five percent**

Soil disturbance in streamside management zones can result in sediment delivery to the stream. At all sites examined, the audit found that total soil disturbance directly linked to the stream in the first 10 metres of the management zone was less than one percent, and total soil disturbance directly linked to the stream in the first 10 metres of the management zone plus all other areas hydrologically linked to the stream was less than five percent. These results are in large part linked to the high levels of retention around the streams.

**Conclusion**

Forest practices have minimized soil disturbance in streamside management zones.

## **Response from the Auditees**

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Prior to finalizing this report, a draft was sent to all three auditees, as well as the Chilliwack Forest District and the Ministry of Water, Land and Air Protection, Lower Mainland division, to allow for review and comment.

Responses were received from all three auditees, as well as the Chilliwack Forest District. All comments were reviewed and considered in the completion of this report. The responses were consistent in that there was general agreement with the audit findings and the criteria and indicators used. Refer to Appendix C for comments received.

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<sup>1</sup> The Board also conducted a pilot audit of forest soil conservation in the Mackenzie Forest District.

<sup>2</sup> Under the *Forest and Range Practices Act* and its regulations, all major tenure holders – companies with logging rights on Crown land and the timber sales manager, BC Timber Sales – must prepare a forest stewardship plan. Government must approve this plan before forestry operations take place. The forest stewardship plan is a cornerstone of the results-based approach governing forest practices under the Act. In their plans, tenure holders must state explicitly how they will address government objectives for key forest values, such as soils and wildlife. The forest stewardship plan may be in place for up to five years and may be extended for a further 5 years while its counterpart under the Code, the forest development plan, could be in place for only up to two years. The new plans are intended to encourage longer-term planning, contribute to sound forest management, reduce paperwork and encourage innovation.

<sup>3</sup> A higher level plan is a forest resource management objective that is established as legally binding by a written order. The objective applies to a resource management zone, landscape unit, sensitive area, recreation site, recreation trail, or interpretive forest site.

<sup>4</sup> Armouring involves placing erosion resistant material at the inflow and outflow of crossing structure (culvert or bridge) to prevent sediment erosion.

<sup>5</sup> Microclimate generally means the climate of small areas, especially insofar as this differs significantly from the general climate of the region.

<sup>6</sup> Basal area refers to the area of the cross section of a tree trunk near its base, usually 1.3 metres above the ground. Basal area is a way to measure how much of a site is occupied by trees.

# Appendix A: Development of the Riparian Management Indicators

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This appendix provides an overview of the process undertaken by the Board in designing an audit program for stream riparian management, and highlights how the development of the audit program incorporated the draft indicators developed by the riparian scientists.

## Overview of the Indicator and Audit Program Development Process

- In 2003, a team of riparian experts, independent of the Board, developed riparian indicators that could be considered generally accepted indicators of effective riparian management. These indicators were provided to the Board.
- The auditors attended two field sessions with one of the indicator development experts, where the riparian expert reviewed and discussed the indicators with the auditors.
- The auditors developed the audit approach and methodology, including adapting the indicators as necessary to facilitate the audit (see below).
- The indicators, the approach and methodology to the audit were reviewed and approved by the Board Chair.
- An audit program based on the approved approach and methodology was developed by the audit team (note: the audit team included one member from the riparian experts' team).

## Incorporating the Indicators into an Audit Program

In general, the changes described below stemmed from the need to ensure that the measurement and assessment processes employed would facilitate the Board's substantive-based audit approach (as opposed to the need to change the indicators themselves). Such an approach relies primarily on the examination of the results of forest practices in order to draw conclusions about the practices themselves. As such, the assessment procedures must, to the highest extent possible, include consideration of the underlying forest practices that led to the observed site conditions.

- The indicators as provided to the Board were described as riparian effectiveness indicators. The Board review of the indicators determined they are focused on streams, and do not include lakes and wetlands. Therefore, the audit was one of stream riparian management.
- The indicators were grouped by the auditors into three categories: channel beds, channel banks and riparian areas. This was done to facilitate analysis and discussion of forest practice impacts on specific stream components.
- The measurement process was adapted to increase reliance on professional judgment, with detailed quantification of impacts to streams' physical and biological characteristics.

# Appendix B: Forest Practices Board Audit Objectives and Methodology

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The Forest Practices Board is an independent public watchdog that reports to the public about compliance with the Forest Practices Code of British Columbia Act and regulations (the Code). The board's mandate has been retained under the new FRPA, which will fully replace the Code effective December 31, 2005. The Board's main roles are:

- Auditing forestry practices of government and licence holders on public lands.
- Auditing government enforcement of the Code and FRPA.
- Investigating public complaints.
- Undertaking special investigations of forestry issues.
- Participating in administrative appeals.
- Providing reports on board activities, findings and recommendations.

## Auditing Forestry Practices

### Background

The Forest Practices Board conducts audits of government and agreement-holders for compliance with applicable forestry and range legislation, including the achievement of its intent. The Board has the authority to conduct these periodic independent audits under FRPA and the Code.

### Objective

The objective of Board audits of forestry practices has changed with the introduction of FRPA. FRPA is more results-based legislation than the Code. It focuses on setting forest management objectives and relying on licensees and their professionals to achieve those objectives. It does not direct specifically how forestry activities are to be performed. Instead it requires licensees to ensure that results consistent with objectives are achieved. Thus compliance with the legislation is expected to mean achievement of results. Board audits therefore examine and provide assurance whether forest practices are achieving government's objectives. These assessments could be considered a form of effectiveness auditing, but include compliance assessments also.

### Criteria and Indicators

To facilitate the assessment of forest practices in relation to the achievement of government objectives Board audits use criteria and indicators. Criteria and indicators provide an objective basis for evaluating the impact of forest practices on forest resources and assessing and reporting on the compliance of forest practices in relation to the achievement of objectives.

Indicators are measures or descriptions of the condition of a forest resource. For example, one indicator for soil conservation is the percentage of a logged area that is occupied by permanent access structures. This is an indicator of the extent to which the amount of growing sites has been reduced due to construction of roads and landings. This could be one of a number of indicators used to assess whether forest practices are consistent with criteria related to government's objective to conserve the productive capacity of forest soils.

The Board uses criteria and indicators as a basis for gathering audit evidence, assessing practices in relation to objectives and reporting findings.

The Board uses indicators developed by other credible sources, independent from the Board. The Board does, though, select the indicators it can use and in some cases may adapt indicators from other sources to facilitate audit.

For the purposes of audits, the Board uses indicators that enable it to assess the impact of forest practices and that are capable of being evaluated with the resources of an audit (e.g. the personnel and the time available).

## **Audit Standards**

Audits by the Forest Practices Board are conducted in accordance with the auditing standards developed by the Board. These standards are consistent with generally accepted auditing standards.

The audits determine compliance with forestry legislation based on criteria derived from the legislation and its related regulations. Audit criteria are established for the evaluation or measurement of each practice regulated by legislation. The criteria reflect judgments about the level of performance that constitutes compliance with each requirement.

The standards and procedures for compliance audits under the Code are described in the Board's *Compliance Audit Reference Manual*. The standards and procedures for audits of forestry practices under FRPA are intended to include the use of criteria and indicators, and are currently under development.

## **Audit Selection**

The Board determines how many audits it will conduct in a year, and what type of audits (limited or full scope), based on budget and other considerations. The Board audits agreement-holders who have forest licences or other tenures under FRPA. The Board also audits government's BC Timber Sales program, which is administered by Ministry of Forests' timber sales offices. Selection of audit units is done randomly, using a computer program, to ensure a fair, unbiased selection of auditees.

## **Conducting the Audit**

Once the Board selects an audit and decides on its scope, the audit period and the resources required to conduct the audit are determined. Board audit standards require that the audit team be comprised of professionals who have the knowledge and competence necessary to carry out the particular audit.

Representatives of the audit team meet with the party(s) being audited to discuss the logistics of the audit before commencing the work.

All the activities carried out during the period subject to audit are identified; for example, harvesting or replanting sites and building or deactivating road sections. The items that make up each forest activity are referred to as a 'population'. For example, all sites harvested form the 'timber harvesting population' and all road sections constructed form the 'road construction population'. The populations are then sub-divided based on factors such as characteristics of the sites, criteria applicable, and potential severity of the consequences of non-compliance on the sites.

For each population within each criteria applied by the audit, the auditors choose the most efficient means of obtaining information to conclude whether the forestry practices have achieved the criteria applied, including compliance with the legislation. Because of limited resources, auditors usually rely upon sampling to obtain audit evidence, rather than inspecting all activities.

Individual sites and forest practices within each population have different characteristics, such as the type of terrain or type of yarding. Each population is divided into distinct subpopulations on the basis of common characteristics (e.g., steep ground versus flat ground). A separate sample is selected for each population (e.g., the cutblocks selected for auditing timber harvesting). Within each population, more audit effort (i.e., more audit sampling) is allocated to the sub-population where the risk of ineffective practices is greater.

Audit work in the field includes assessments from the air using helicopters and intensive ground procedures, such as measuring specific features like road or riparian reserve zone width. The audit teams generally spend one to two weeks in the field.

## **Evaluating the Results**

The Board recognizes that assessing the effectiveness of forestry practices, including compliance with the many requirements of forestry legislation, is more a matter of degree than absolute achievement. Determining effectiveness and assessing compliance requires the exercise of professional judgment within the direction provided by the Board.

Auditors collect, analyze, interpret and document information to determine the audit results. The audit team, composed of professionals and technical experts, first determines whether forest practices are in compliance with the applicable legislation. For those practices considered

to not be in compliance, the audit team then evaluates the degree to which the practices are judged not in compliance. The significance of the non-compliance is determined based on a number of criteria, including the magnitude of the event, the frequency of its occurrence and the severity of the consequences.

As part of the assessment process, auditors categorize their findings into the following levels of compliance:

**Compliance**—where the auditor finds that practices meet Code or FRPA requirements.

**Not significant non-compliance**—where the auditor, upon reaching a non-compliance conclusion, determines that a non-compliance event, or the accumulation and consequences of a number of non compliance events, is not significant and is not considered worthy of reporting.

**Significant non-compliance**—where the auditor determines that the event or condition, or the accumulation and consequences of a number of non-compliance events or conditions, is, or has the potential to be significant, and is considered worthy of reporting.

**Significant breach**—where the auditor finds that significant harm has occurred, or is beginning to occur, to persons or the environment as a result of the non-compliance. A significant breach can also result from the cumulative effect of a number of non-compliance events or conditions. Identification of a possible significant breach requires the auditor to conduct tests to confirm whether or not there has been a breach. If it is determined that a significant breach has occurred, the auditor is required by the Forest Practices Board Regulation to immediately advise the Board, the auditee, and the Minister of Forests.

The audit team then determines whether forest practices have achieved the criteria applied. The data collected for each of the indicators is analyzed in relation to each criterion applied by the audit. Board audit standards require sufficient appropriate audit evidence be collected to support an overall conclusion about forest practices in relation to each criterion applied.

Where necessary, depending on the complexity and magnitude of findings of the audit, the audit team will facilitate a discussion of the audit results with the auditee. This discussion can take several forms and is intended to ensure that the auditee is fully aware of the results of audit findings, and provides an opportunity for the auditee to present further information about the audit findings and to ensure the audit team has complete and correct information.

## Reporting

The first step in the audit reporting phase is facilitating a workshop attended by the parties audited, local resource agency managers, the auditors and the Board Chair. The workshop includes discussing the audit results and focuses on improving forest practices in relation to the criteria and indicators applied. Also, feedback about the criteria and indicators and their application in audits is collected.

Based on the above evaluations, the audit team then prepares the draft audit report for review by the Board Chair. The auditee is given a draft of the report to review and provide comments to the audit team. A final draft report is then prepared and given to the auditee. Based on the final draft report, the auditee may submit comments to the Board.

For this pilot audit, The Board utilized a long-form report model comprising four main sections—Board commentary, recommendations, detailed findings and conclusions, and auditee response. This long-form reporting model is designed to provide comprehensive information about the results of forest practices.

In the Board commentary section, the Board’s comments about the results of the audit are reported. For example, the Board may wish to comment on the results of an audit in relation to other audits conducted or developing trends.

In the recommendations section, the Board may make recommendations it considers appropriate. The Board may be asked to be notified of the steps that have been taken to implement a recommendation. If the Board believes that adequate or appropriate action has not been taken, the Chair can provide a further report to the ministers and make a report to the Lieutenant Governor in Council.

In the detailed findings and conclusions section, detailed findings and conclusions are reported about licensees’ forest practices in relation to criteria applied, including overall assessments about the practices audited in relation to each of the criterion applied. Audit findings may include the impact of forest practices on forest resources, findings in relation to indicators, findings in relation to government’s objectives and comments on licensee management systems. This section will also include a description of any non-compliance observations that are considered significant.

The Board determines if the audit findings may adversely affect any party or person. If so, the party or person must be given an opportunity to make representations before the Board decides the matter and issues a final report to the public and government. The representations allow parties that may potentially be adversely affected to present their views to the Board.

At the discretion of the Board, representations may be written or oral. The Board will generally decide on written representations, unless the circumstances strongly support the need for an oral hearing. The Board then reviews the report from the auditor and the representations from parties that may potentially be adversely affected before finalizing its report.

Before releasing its audit reports, the Board will provide auditees an opportunity to review and make comments about the results of the audit. A summary of these comments may be included in the Board’s audit report. In conjunction with the opportunity to review the draft report, this will fulfill the Board’s requirement to provide for auditees to make representations to the Board.

For third parties, the Board will provide for representations where they are determined to be potentially adversely affected by the content of a Board audit report.

Once the representations have been completed, the report is finalized and released: first to the auditee and then to the public and government.

## **Appendix C: Comments Received on Draft Report**

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### **International Forest Products Ltd. Response**

The report is well written and gives the reader a good perspective on the desired direction and scope of the audit. The report clearly states that it is a pilot for auditing procedures to be used in the future.

It is now a full year since the actual field component of the audit was conducted. It would be more effective to have a faster turn around time.

Interfor notes that several areas of focus for the audit were found to have been well managed in the field and were duly noted in the report. These included:

- Downstream resources were found to not have been put at risk.
- S1 to S3 streams had appropriate size buffers and reserves applied to them.
- S4, S5 and S6 stream all had appropriate reserves. In fact it was found that more trees were usually protected than required by the FPC.
- There was no increased sedimentation from harvesting.
- Soil disturbance has been minimized.

The report should reference the time period for much of the audit was during an extremely heavy rainfall event ( there was several areas in the Lower Mainland subject to flooding; the Squamish/Pemberton area was particularly hard hit; rainfall exceeded the 100 year flood level).

The report did find fault with the introduction of sediments into the streams as a result of road construction and road deactivation. This concern was discussed at length during the exit meeting in Chilliwack. Our company's conclusion at the end of the meeting was that:

- This concern relates to all stream sizes but primarily smaller S6 streams.
- The audit team and board members present at the meeting did not sound alarmed at the findings and in fact suggested with very little change to current practices the concern could be easily eliminated.

Interfor will await the final report and develop and implement any action plans required.

### **British Columbia Timber Sales Response**

No major comment. I assume the rebuild comments are on our project along the Chilliwack River. If so, it is important to note that we were under DFO and an environmental monitor's direction and that we were hit with a 100 year rain event during the project.

## **Teal Cedar Products Ltd. Response**

The report is well written and concise. Teal agrees with combining the report into an all licensee format focused on a common issue. Teal would like you to know that we have repaired the areas of concern that were noted during the review.

## **Chilliwack Forest District Response**

Thank you for providing us with an opportunity to comment on the subject "DRAFT". Overall, the audit report was good. Comments are as follows:

### **Audit Results**

In reference to the third sentence, paragraph 3 suggest "impacts" be qualified i.e., minor, major.

### **Recommendations**

# 1, 2, 3 - Given the increase in sediment delivery that occurs in most coastal streams during periods of sustained rainfall and on occasion, intense rainfall, is not the issue of sediment delivery associated with stream crossings over emphasized especially when the vast majority of sediment delivery into a stream can be attributed to upstream natural sediment delivery processes. Do not get me wrong in that the issue of sediment delivery associated with stream crossings is indeed important.

#1 - Question as to whether "armouring" is needed in all situations. Suggest a standardized stream crossing risk assessment be used to determine the need.

### **Overall conclusions**

Not sure what is meant by the third sentence, second paragraph " Large woody debris processes were preserved, where required." especially the last two words "where required". The sentence also appears on page 11 under Harvesting i.e., second bullet. Perhaps something like "Large woody debris processes appeared to not have changed." is more appropriate.

### **Overall conclusions and Conclusions**

Reference is made to the sentence "The main sections of the Code to which the non-compliance relates are Forest Road Regulation sections 9 and 15." As there are a number of subsections under those sections, consideration should be given to being more specific as to which subsections apply.

### **First Bullet**

As a better fit, suggest the word "conduct" be replaced with the word "commencement".

### **Third Line**

As a better fit, suggest the word "entombed" be replaced with the word "buried".