

*Opportunity Harvesting
In British Columbia's
Coast Forest Region:

Options Paper for the
Ministry of Forest and Range*



Prepared by the Silviculture Working Group for the



Coast Regional Implementation Team



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Background

The Forest Practices Board, Special Investigation Report #20 titled "High Retention Harvesting and Timber Sustainability on the British Columbia Coast" (2008: revised January 2009) recommended that the Ministry of Forests and Range consider the following:

"The Ministry of Forests and Range should develop policy about 'opportunity cuts' with no expectation of future yield (and therefore no silviculture system) which should be considered, for example, in areas constrained from harvest due to other objectives, such as slope stability concerns"

No definition of 'opportunity cuts' or further operational context was provided by the Forest Practices Board (FPB) nor clarification on whether or not yield is the only consideration when implementing a harvest entry of this nature. For the purposes of this paper the term 'opportunity cuts' is replaced with 'opportunity harvesting'.

Forest Stewardship Plan (FSP) holders are proposing stocking standards, for areas referred to as 'opportunity harvesting', under section 16(4) of the *Forest Planning and Practices Regulation* (FPPR). The intent of *opportunity harvesting* is removal of individual or small groups of economically valuable trees from areas where, primarily due to inherent site productivity limitations, conventional forest management practices cannot reasonably be applied to. As a result many of these areas typically have not been previously considered for timber harvesting.

On October 3rd and 4th 2007, a "High Retention Harvesting in Coastal BC" workshop was hosted by the Coast Regional FRPA Implementation Team (CRIT) Silviculture Working Group (SWG) in Tofino. The workshop was attended by a large group of forest professionals from industry, government, and consulting firms (see Appendix A for a link to the report and the executive summary).

Recommendations related to *opportunity harvesting* were endorsed by the 36 workshop participants. As some level of professional consensus was reached on the topic sections of this paper draw directly upon some of the forestry related discussions or recommendations from the workshop.

It will be important to differentiate 'opportunity harvesting' in site-limited areas from other individual or small group harvest entries that may be proposed for areas constrained by other FRPA objectives (e.g., Riparian, VQO, etc.). Any harvest in these areas would be guided by the FRPA objectives and an approved FSP result or strategy would be required to implement an alternative stocking standard.

Purpose

The purpose of this options paper is to inform senior managers within the Ministry of Forests and Range (MFR) on the following:

1. Identify the risks (economic, environmental, and social) derived from *opportunity harvesting* to resource values on sites where conventional forest management practices cannot reasonably be applied to.

2. Identify the social and economic benefits to both Industry and government derived from *opportunity harvesting*
3. Provide a conceptual foundation to assist any policy development in the Coast Forest Region (CFR) for *opportunity harvesting*.
4. Identify options with respect to potential scope and scale of *opportunity harvesting* application.

This option paper and information has been collaboratively developed and is being presented by the SWG and associated resource specialists at the request of the CRIT.

Defining the Situation: Opportunity Harvesting

Currently partial-cut harvest entries with no free growing obligation are limited to intermediate cutting, commercial thinning, and more recently the high retention holdover cut¹. These partial-cut harvest entries have provided a myriad of social and economic benefits resulting from employment, taxes, revenue generation, and harvest innovation. They represent an economic activity prior to future harvest in the life of the stand.

Opportunity harvesting provides an ability to generate, on a one-time basis, many of the social benefits identified above that flow from a commercial forestry operation, perhaps to a lesser degree depending on the scale of harvest, on areas that otherwise would not be considered for harvesting. Forest professionals would not be obligated to manage the species and structural profile of eligible stands as they would for other partial-cut harvest entries where future harvesting and long term timber sustainability is presumed. Therefore the requirement to maintain a future economically viable stand is not an objective under *opportunity harvesting*.

Given environmental or legal constraints in today's operating environment, the principles of existing partial-cut harvesting cannot easily be applied or reasonably be expected to succeed in managing some areas. It should therefore be recognized that some stands do not offer any additional harvest opportunities due to a variety of site limiting factors and typically have been precluded from harvesting activities.

Opportunity harvesting is simply a means to remove some volume and value from some stands where, due to site limitations (very low growing site associated with rock or high water table, or unstable terrain) conventional forest management practices including application of a silvicultural system cannot be reasonably expected to succeed in achieving the objective of sustainable timber management.

¹ "The remaining stand post-harvest is being held over for a subsequent entry. A holdover varies from an "intermediate cut" in that a silvicultural system is not specified, but rather the resulting stand will be in suitable condition to apply a silvicultural system with another harvesting entry in the near future." (Defined by Industry and MFR professionals at the Tofino High retention workshop 2007)

Opportunity harvesting may vary depending on the management unit in which the polygon is located due to historic levels of harvesting, environmental constraints, or legal constraints imposed on the land-base. In the short term coarse filter biodiversity objectives are assumed to be considered among the risks to be managed by professionals (discussed further under the options section). Over the long term a more practice-specific biodiversity policy or development of Provincial guidelines may be necessary² to manage the quantity, quality, and distribution of species including superior form trees on areas potentially targeted for *opportunity harvesting*.

It is critical that anyone reading this paper maintain a clear understanding and distinction of how *opportunity harvesting* differs from other partial-cut harvest entries including those approved as part of a result or strategy to manage for non timber resource values in a manner consistent with the objectives set by government. Key to this concept is the consistent principle that no attempt to manage for sustainable timber production or other resource values is contemplated under *opportunity harvesting*.

Opportunity harvesting is therefore defined as follows:

- *Opportunity harvesting* is a onetime harvest entry to remove individual or small groups of trees.
- Stocking standards associated with *opportunity harvesting* fall under FPPR 16 (4) and 44 (4) and therefore have no free growing obligation under FRPA section 29. Any openings created as a result of harvesting will be small and would not create suitable conditions for a regeneration environment.
- There is no expectation of any future timber yield resulting from these stands.
- *Opportunity harvesting* is not considered to be part of a result or strategy to manage for non-timber resource values consistent with objectives set by government.
- *Opportunity harvesting* is not considered an intermediate cut, commercial thinning, or a high retention holdover cut as:
 - The residual stand may not be suited economically for a subsequent partial cut harvest entry in reasonable time frame (a normal rotation period) which also precludes any silvicultural system application, or
 - No future harvest of the site will occur due to the nature of the site limitations.

In comparison, both *opportunity harvesting* and high retention holdover cuts are not silvicultural systems, but rather partial-cut harvest entries that either leave the potential for a future harvest in a reasonable time period (holdover cut <250 years) or not (*opportunity harvesting* >250 years).

² This is dependent on the harvest scales achieved by management unit.

Moving Forward: The Concepts under FRPA

Appropriate Legislative Mechanism

First and foremost...*is there a plausible pathway for opportunity harvesting under the FRPA regime and regulations?* Under FRPA there is flexibility for forest professionals to develop new innovative approaches for managing various resource values by preparing results or strategies consistent with the objectives set by government. Developing these results or strategies is often carried out in consultation with other resource professionals to facilitate the timber removal where appropriate. For areas which are often excluded from timber harvesting due to site limitations there is generally no FSP result or strategy that would apply. In these instances harvesting is permitted, in accordance with the practice requirements, and subject to a stocking standard. The CRIT SWG has outlined the legislative avenue under professional reliance for *opportunity harvesting* as follows:

1. The *Foresters Act* obliges members of the Association of British Columbia Forest Professionals (ABCFP) to advocate and uphold the principles of forest stewardship, by balancing present and future resource values against the capacity of the land to provide those values.
2. The *Forest and Range Practices Act* (FRPA) is the vehicle for the management of forests and related resource values which are specified in the Act. The associated government objectives for these values are set out in FPPR sections 5 through 10.
3. The approval mechanism for harvesting within areas covered by an objective set by government is the result or strategy. The FSP establishes the result or strategy that is consistent with the objective set by government.
4. Stocking standards proposed as part of an FSP for areas subject to FPPR 16 (4) must meet the approval tests specified in FPPR 26 (4) or the delegated decision maker (DDM) must be satisfied that the stocking standards are reasonable having regards for future timber supply for the area.
5. Stocking standards are required where timber is harvested under an FSP including under the practice of *opportunity harvesting*. Stocking standards applicable to stands that do not have a regeneration objective (e.g., under FPPR 16 (4)) may be considered for application to areas under the practice of *opportunity harvesting* and where harvesting is approved as part of result or strategy consistent with an objective set by government.
6. When harvesting occurs under an approved FSP it must be done so in accordance with the FPPR practice requirements, stocking standards, or any approved R/S's.

In conclusion: there is a plausible pathway for *opportunity harvesting* under the FRPA regime. This pathway involves the development of stocking standards specific to the practice. It also involves specifying the situations and circumstances as to where and when the standards would be applied across the landbase.

Acceptability of Practice

The questions now becomes...*is opportunity harvesting an acceptable practice for coastal British Columbia?* These matters are discussed in the sections to follow.

Stewardship and Professionalism

From a professional standpoint for *opportunity harvesting* to occur, professional foresters must address their responsibility for stewardship, defined by the ABCFP as the “sustainable balancing of environmental, economic and social values”.

Stewardship for long term timber values can be a significant challenge for a professional forester as a result of current economics, provincial legislation and policy. It has been identified by industry that, in limited circumstances, *opportunity harvesting* may be desirable to meet local short term economic and social objectives, provided it does not negatively impact other resource values.

It was noted at the Tofino workshop that, in absence of government policy, some professionals do not feel comfortable prescribing harvesting without obvious future options on public lands. Conversely these professionals do not necessarily view *opportunity harvesting* as an unacceptable practice if based on clear planning and implementation.

Discussions related to scope and scale during the Tofino workshop suggested that *opportunity harvesting* be limited to a few clearly defined situations or circumstances to avoid compromising the principles of forest stewardship. Regardless of other objectives, it is recognized where over-story retention can be distributed and oriented such that a silvicultural system can be prescribed, that *opportunity harvesting* is not appropriate. *Opportunity harvesting* is not intended to apply to sites where silvicultural system has a reasonable chance of success and is plausible.

Timber Supply Implications

Despite the Tofino workshop discussion points noted above, the potential application of *opportunity harvesting* needs to be considered further. One possible method to do this is through a strategic stewardship overview of the applicability of the practice across the forest landbase or alternatively an explicit overview of the practice as part of the timber supply review (TSR) process where there is a significant³ level of demonstrated performance. Consideration of this practice as part of the regular allowable cut determination will allow for an evaluation of how much opportunity harvest volume or area that may be cut in the short term versus the amount to be maintained for future generations. Low levels of *opportunity harvesting* (limited performance) may not be suitable for consideration as part of the TSR process unless otherwise directed by the Chief Forester.

³ The amount would vary by management unit, but as a general rule of thumb any modelling in timber supply where the outcome is > 1 % of the AAC is deemed significant.

The potential level of *opportunity harvesting* may in fact be greater or less than the situation or circumstances initially identified during the Tofino workshop. For areas where *opportunity harvesting* is considered, the key is to ensure that *opportunity harvesting* is generally a *final consideration*⁴ by professionals for deriving some timber values, it may also be the only option for timber harvest given the limitations of the site. While the Tofino workshop participants identified various situations and circumstances where *opportunity harvesting* might be appropriate, they were considered as a starting point for local discussions only and as preliminary guidance to forest professionals considering where and when the practice may be potentially applied. These situations and circumstances have not been referenced in this options paper as it has been recognized that the potential site limitations vary greatly among management units within the CFR.

The final report from the Tofino workshop identified key timber supply considerations which are reiterated below:

1. A proportion of *opportunity harvesting* volume over a defined time period may be considered with maximum targets to guide planning for licence holders.
2. Potential area or volume for *opportunity harvesting* should be determined by the Province through a strategic process and reviewed periodically consistent with TSR.
3. The harvest level may be specific to the management unit with respect to the potential volume that may be available.
4. As *opportunity harvesting* areas, by definition are currently excluded from the timber harvesting landbase, the risk to long-term timber supply, other resource values and ecological services should be minimal. Note, in some cases areas identified for *opportunity harvesting* have had timber supply net downs based on their environmental sensitivity and have been accounted for in TSR Analysis. This may provide options to monitor and improve upon these assumptions and adjust accordingly.
5. The amount of area, distribution and location of *Opportunity harvesting* needs to be tracked within the RESULTS data base.

A fundamental benefit of including *opportunity harvesting* on Crown lands within the TSR process is that the public review and comment will ensure transparency in Provincial decision making. It would also allow the Chief Forester to consider the flow of timber and ecosystem services provided on these sites over time for future generations.

⁴ Final consideration means all silvicultural system options have been explored and not considered appropriate.

Economic and Social Benefits

The Ministry of Forests and Range, "Coastal Forest Action Plan" (CFAP 2007) noted "*Since the early 1990s, the timber harvesting land base on the Coast has been reduced significantly. Of the 15.8 million hectares that make up the Coast Forest Region, about 2.5 million hectares make up the Crown timber harvesting land base, while 3.14 million hectares are in parks and other areas excluded from harvesting. The land available for harvesting continues to shrink as new parks, recreation and wildlife habitat areas are established and urban development increases. As well ecosystem-based management objectives in the central and north coast land use planning areas further reduce available areas for timber harvesting.*"

The CFAP also stated "*Government's vision is for a competitive coastal forest sector that contributes to prosperous communities, First Nations, stable employment and government revenue.*" Each cubic meter harvested on the coast will generate \$355 in economic benefit. ("It's just a hectare presentation", Coast Forest Products Association, 2007).

Operating costs for the forest industry in the CFR have been rising despite considerable efforts on the part of government and industry to reverse the trend. The forest industry believes that by improving its ability to amortize fixed costs by spreading these expenditures over a larger volume/operating area will improve its competitiveness. The possibility of implementing *opportunity harvesting* may provide tenure holders the much needed economic incentive to operate over larger geographic areas of a management unit. *Opportunity harvesting* may have the potential benefit of providing additional volume to make conventional or helicopter cutting authorities more economically feasible

Potential Benefits

- Potential short-term increase in commercial activity for direct and indirect employment within industry, local communities and the province.
- Potential greater short term fibre flow to maintain and diversify the processing facilities that remain on the coast.
- Improved operating margins through amortization of fixed costs over greater volume due to the increased volume resulting from *opportunity harvesting* on a particular cutting authority.
- Increased corporate stability.
- Increased short term employment options for local communities and First Nations to be involved in various scales of forestry.
- Potential short term additional social well being (enhanced community stability) to be generated for the Province through increased harvest performance during times when economic conditions are not allowing harvesting of the full AAC allocated to each management unit.

Economic, Social and Environmental risk

Opportunity harvesting may have implications for environmental, economic, and social values, the degree of which will depend on the scope, scale, and spatial location of application. Risk assessment and management will be an important consideration when evaluating the potential for *opportunity harvesting*. Risks may include, but are not limited to, the following:

Risks to Biodiversity and Wildlife Habitat⁵

- Provincial forest policy and its associated planning initiatives have assumed that biodiversity and wildlife habitat values are partially captured within areas considered to be non contributing for TSR (e.g. constrained, inoperable, un-merchantable and various types of stand and landscape reserves), and rely on these non contributing areas and their associated attributes, as a coarse filter management element, to meet these objectives. At this point there is insufficient scientific guidance to define the quantity (i.e., stems per hectare, volume, or basal area) and quality (i.e., tree species, gene resources, structural characteristics, tree age, or state of decay) of trees that can be removed from a stand without affecting its intactness.
- *Opportunity harvesting* that removes specific types of trees (e.g. large cedar, Douglas fir or spruce) from non-contributing or otherwise constrained stands will modify the stands structurally, compositionally and functionally, the impact of which is not well understood.
- In areas where old growth is limited, *opportunity harvesting* could render a non contributing stand unsuitable for old growth or wildlife and biodiversity management. This may have implications in areas where non spatial old growth orders are in place and may affect the placement of new Old Growth Management Areas (OGMA) or wildlife habitat areas (WHA) due to the potential reduction in old growth or wildlife stand structural attributes in stands subject to *opportunity harvesting*. Special attention may be required to complete planning for these values in landscapes where the risk is high, due to past harvest development. This may need to occur before *opportunity harvest* is contemplated.
- There may be higher risks to biodiversity and wildlife habitat when considering *opportunity harvesting* on areas not subject to ecosystem based management (EBM). With the introduction of EBM on the Central and North Coast and the higher level orders associated with them (South Central Coast Order and the North and Central Coast Order), the level of habitat and biodiversity protection for that area has increased considerably. Of the 6.4 million hectares in the higher level plan area, the conservancies have introduced an additional 2 million hectares of protected areas. Within the cumulative risk management framework of EBM (CIT 2004), this additional strategic protection may provide flexibility in the application of *opportunity harvesting* at finer operational scales while still managing overall to low risk for non-timber resources.

⁵ These associated risks were provided by Provincial wildlife and biodiversity specialists. Details are presented in a submission prepared for the SWG (see Todd 2009).

Risk to Resources Features

- An increased ability for licensees to access traditionally non-contributing areas for harvesting may place resource values and biophysical attributes under FRPA at potential risk. The risk will be commensurate with the nature of the feature, the scale and spatial location of *opportunity harvesting* relative to the feature.

Risk of Controversy

- Environmental Non Governmental Organizations (ENGO) opposition may become an issue due to biodiversity threats and questions about the sustainability of the practice. This topic can easily confuse the public through contrasting viewpoints presented by media coverage.
- There is risk of international attention raised for MFR executive and the Chief Forester if the scope and scale is not delimited.

Risk to Timber Supply

- Risk of inappropriately prescribing *opportunity harvesting* in situations where the application of a silvicultural systems or other partial cut harvest entry (e.g., commercial thinning or high retention holdover cut) is legitimate given the nature of the site limiting factor(s). The level of guidance and policy required to support broad application of *opportunity harvesting* is not available at this time. This creates a risk of losing the intended context of the practice over a short timeframe, resulting in converting timber harvest land-base (THLB) areas into problem forest types or non contributing land base for the foreseeable future. Conversely the risk exists of THLB avoidance by concentrating harvesting activities on areas outside the THLB with site limiting factors to harvest high value timber with little or no planning and reforestation costs.
- In absence of a strategic approach, the risk of *opportunity harvesting* being applied to some currently economically inoperable areas within long term THLB is provided by the uncertainty of future markets. Removal of valuable stems today through a onetime harvest entry may deplete the long-term economic carrying capacity of the stand. Any future options for these stands to contribute to long term timber supply could be diminished (e.g., low sites).

Options

Given that the FPB recommended that the MFR consider developing a policy around *opportunity harvesting* the following three options with respect to scope of application are presented:

1. No Opportunity Harvesting⁶

⁶ Under this option no additional opportunity harvesting would be considered recognising that some limited amount of the practice has currently been approved or implemented under existing FSPs.

Risk to Resource Values

- This is the lowest risk option as it adds no incremental pressures or risks to resource values and biophysical features beyond those currently accounted for in present forest management policy, plans, and practices.

Risk to Timber Supply

- Certain cutting authorities may not be viable and therefore some harvest volume may be foregone contributing to an undercut within coastal management units.

Benefits for the Coastal Forest Industry and Crown

- No potential benefit to the commercial forest operations and elimination of a potential to amortise fixed costs and generate revenue in the short term. No additional benefits to the Crown related to the forest sector performance.
- Avoidance of controversy
- Current coarse filter biodiversity assumptions would be maintained with no incremental risk to maintenance of environment goods and services

2. Interim Measure of ≤ 5% of a licence holders AAC

In this option, *Opportunity harvesting* would be dependent on a volume limit of ≤ 5% of a licence holder's AAC managed under the professional reliance model. This level of *opportunity harvesting* allows for some social and economic benefits while somewhat limiting the level of environmental risk. A significant consideration is that, while a cut level less than 5% may appear minor, the low level of harvest per hectare envisioned by this practice may affect many hectares.

On site field assessments to determine stand suitability and management approach would be completed by forest and other resource professionals. The prescription development and implementation of *opportunity harvesting* must be professionally defensible and subject to monitoring reviews. Any harvesting limitations or measures would be integrated into harvesting plans.

This option may meet some of the forest industry needs in the short term while providing the MFR time to consider developing a more strategic overview assessment or policy for *opportunity harvesting*. To this end it also creates operational examples for monitoring and a sample population to draw upon for developing further strategic context.

Risks to Resource Values

- Under this option risks to other resource values are assessed in the short term on a site by site basis by resource professionals until a strategic overview assessment is undertaken by the Province. This increases risk relative to option 1 and limits the risk relative to option 3.

Risk to Timber Supply

- The socio-economic risks outlined in option 1 are reduced.

Benefits for the Coastal Forest Industry and Crown

- Potential for some economic benefits outlined above to be achieved.
- Improved access to valuable timber from areas currently considered inoperable due to site limitations which supplements harvesting from normally managed stands, providing the potential to amortize fixed costs over a higher harvest volume.
- There is potential for increasing stumpage revenue to the Crown from higher harvest levels.
- Allows industry and the MFR to monitor the performance level of *opportunity harvesting* as operational uncertainties exist as to how much can be realized.

Risk to Crown

- Generation of controversy.

3. Opportunity Harvesting by Definition Only with no Scope Limitation

Risks to Resource Values

- This is the highest risk option.
- All previous identified risks are a concern in the absence of a strategic overview assessment to guide the practice across the landscape.

Risk to Timber Supply

- Highest risk of prescribing *opportunity harvesting* outside of the intended context.

Benefits for the Coastal Forest Industry and Crown

- The economic benefits outlined above are more likely to be achieved.
- Unlimited access to valuable timber from areas currently considered inoperable due to site limitations which supplements harvesting from normally managed stands, providing the potential to amortize fixed costs over a higher harvest volume.
- There is potential to maintain or increasing stumpage revenue to the Crown from full AAC harvest levels within a management unit.

Risk to Crown

- Generation of higher level of controversy, likely dependant on the scale and location of the practice, relative to the risk factors identified above.

Next Steps

The next steps in forest policy development have not been provided for the MFR or other agencies as it is unclear if it is warranted at this time. It is critical that this step occur if the practice continues to broaden under FRPA through FSP approvals and a commensurate level of *opportunity harvesting* is occurring.

Forest policies for field guidance and implementation as well as a strategic stewardship overview for planning and a monitoring and evaluation strategy are likely key elements for a structured approach to *opportunity harvesting*.

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Appendix A:
Web Link and Executive Summary for
*High Retention Harvesting in Coastal BC:
Results of a Workshop
October 3-4, Tofino BC.*

Executive Summary

A meeting of forest professionals convened in Tofino British Columbia on October 3rd and 4th 2007 to discuss high retention harvesting and associated silvicultural systems on the Coast of British Columbia. The intent of the workshop was to identify issues and begin to resolve questions and concerns.

Pre-harvest stand types of concern are dominated by mostly marginally economic old growth hemlock with lower levels of red-cedar and spruce. These stands are mostly found on the Mid and North Coast, although similar situations may occur further south with Douglas-fir. Harvesting is primarily with helicopter to preferentially remove high value species in an effort to cover high logging costs. With mostly hemlock in the post harvest stand, the shaded growing environment together with a reliance on natural regeneration will result in colonization of lower value hemlock, growing slowly due to limited light and mistletoe.

Presently, the silvicultural systems nomenclature used in BC is relatively limited in its ability to describe cut blocks where relatively high levels of dispersed retention are being left, primarily for non-timber values. First, the existing nomenclature does not accurately characterize the levels of retention such that cut blocks which use a high dispersed retention approach can be identified. As well, foresters are compelled to describe a silvicultural system or harvest entry in a prescription, are unable to correctly reflect the full rotational management regime intended, or not intended.

The primary situation of concern is harvesting that leaves behind a large amount of low value dispersed old growth over-story trees such that future harvesting opportunities are highly unlikely within a reasonable management rotation. For the purpose of this report only, this situation will be referred to as a "High Retention Opportunity Cut".

It has been identified that in limited circumstances opportunity cuts may be desirable to meet local short term economic and social objectives, where they do not negatively impact other resource values.

Without government direction on when and where such harvesting is acceptable, some professionals do not feel comfortable to prescribe harvesting without obvious future options. Recognizing the non-sustainable nature of high retention opportunity cuts, there was considerable reluctance by the professionals at the workshop to allow such harvesting without clear guidance for the scale and scope of its use.

For meaningful stewardship clear direction on the area available for *opportunity cuts* and other high retention harvesting is needed. If BC is going to allow any use of these harvesting practices, professionals must be able to clearly define them as a one-time harvest entry with no silvicultural system to better determine impacts on timber supply and facilitate planning for sustainability.

Because of the clear need for standards that are suited to the situations identified here additional work is needed. An additional workshop and related projects were envisioned. A summary document of all the resulting work on stocking standards, strategic planning and timber supply for dispersed retention harvest units should be designed to inform those people involved in development or approval of plans under FRPA.

For the full report: <http://www.for.gov.bc.ca/RCO/stewardship/CRIT/docs/111453%20-%20Tofino%20Summary.pdf>

Appendix B:

Author Acknowledgements

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