BCTS Chinook Business Area

Forest Stewardship Plan

#644

Sea to Sky Natural Resource District

Supporting Information

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9.7 Hardwood Management in the Coast Forest Region, File: 00202-20/53908F, SWG Hardwood Management Strategy. Not dated.

1. Introduction

This document provides the statutory decision maker with the supporting information and documentation that BC Timber Sales (BCTS) used when developing the Results, Strategies, and Measures for the BCTS Sea to Sky Natural Resource District Forest Stewardship Plan (FSP).

In response to the Forest Practices Board (FPB) audit, BCTS has prepared this FSP to meet the legal requirements as outlined in the FPB report. BCTS has reviewed the District Manager's Letter of Expectation (LOE) (June 30, 2016), and the Chief Forester's Guidance on the Replacement of FSPs (March 2016). All the topics have been reviewed and considered for inclusion in the FSP.

It is important to recognize that many of the recommendations and issues addressed in this document are not legally binding. This supporting document will address many of those topics and indicate how they were considered during the development of the FSP, but that does not mean that all of the considered information is referenced in FSP.

1.1 Definitions:

"FPPR" means *Forest Planning and Practices Regulation*

"WLPPR" means Woodlot Licence Planning and Practices Regulation

"SMRZ" means Special Resource Management Zones

"MAC" means matrix activity center

2. Summary of Changes to the FSP

- Review of all results, strategies, and/or measures to ensure they are measurable and verifiable.
- Consideration and incorporation of issues noted in FPB audit, Chief Forester's Guidance and District Manager's Letter of Expectation.
- Incorporation of new legislation into results, strategies, and measures.
- Consideration of draft legislation.
- Increased detail in the First Nations information sharing process within the Cultural Heritage Resources Results and Strategy.
- Increased detail in the stakeholder information sharing process.

2.1 Response to District Manger's Letter of Expectation

The LOE notes that over the past decade there have been substantive changes with regard to the bio-physical landscape.

Over this time, BCTS has worked to stay abreast of these changes and to continuously improve business processes. This is evidenced by a more robust information sharing process with First Nations and stakeholders, incorporation of new legislation, consideration of draft guidance into forest development planning, and BCTS' ongoing commitment to safety.

Specifically, this is demonstrated by the following:

1. Safety Accord Forestry Enterprises (SAFE) Companies certification;
2. ISO 14001 certification;
3. Sustainable Forestry Initiative (SFI) certification;
4. regular internal and external audits;
5. development of BCTS Chinook Business Area Best Management Practices (BMPs)
    a. e.g. Wet Weather Shutdown Guidelines
    b. e.g. invasive plants measures;
6. robust information sharing process with First Nations and stakeholders;
7. new legislation is incorporated in the FSP;
8. draft legislation is considered as part of forest development planning;
9. timber sale licence documents include more specifications (e.g. Detailed road construction, steep slope information, etc.);
10. continuous improvement processes for operations; and
11. review of Forest Resource Evaluation Program (FREP) data

Legislation is constantly changing and BCTS reviews, considers, incorporates, and complies with legal directions.

2.2 Public Information Sharing

The FPB audit and the LOE indicate concern with the lack of public review afforded by the current system of FSPs and a need to ensure that the public is more engaged and able to review plans on a regular basis.

BCTS has a robust information sharing process with stakeholders. In our planning stages, BCTS prepares and sends out an operating plan (OP). This OP includes: block name, location, age, site description, constraints, area (ha), estimated volume, species composition, planned assessments, harvest method and any other relative comments. The intent is to provide as much information as possible.

BCTS considers the information brought forward during the OP referral stage and develops mitigation strategies, if required, prior to layout beginning. The engineered shapes are then re-shared with First Nations and stakeholders providing more detail, and another opportunity for feedback.

Examples of how BCTS has addressed concerns raised by stakeholders include:

1. required timing restrictions regarding harvest operations and hauling;
2. cut block boundary changes;
3. additional clauses within the timber sale licence to require
    a. Signage, trail closures, trail rehab, notification of stakeholders;
4. additional clauses within the road permit;
5. recommendations for additional clauses for the road use permit issued by district;
6. notification of stakeholders prior to harvest commencement;
7. invitation to attend pre-work with the licensee prior to harvest commencement; and
8. trails and features are often considered despite the fact that they are not legally established.

Throughout the information sharing process, BCTS focuses on relationship building. BCTS understands the importance of building and maintaining social licence with the public. BCTS has increased the frequency of information sharing, and protocols are in place to guide that process. We have also tried to educate stakeholders about our mandate and our process.

The range of stakeholders includes:

1. recreation groups;
2. regional district government;
3. municipal governments;
4. water licence holders;
5. tenure holders; and
6. private landowners other forest licensees.

2.3 Public Safety

BCTS works hard to maintain safety at all times in all our practices, our safety page can be located at: https://gww.for.gov.bc.ca/bcts/ba/safety/tch/.

As recreational use increases within the working forest, the public will find themselves in closer proximity to BCTS operations. The following list is a variety of methods BCTS routinely employs to improve safety for all parties:

1. Environmental field procedures:
    a. EMS program provides guidance on how to behave in operational conditions (e.g. Hazard assessment, hazard reporting, etc.);
2. Checklist reports and guidance:
    a. helps to ensure that all hazards and risks are identified and addressed, and
    b. formalizes documentation;
3. Timber sale licenses now include a highlights sheet:
    a. increases awareness of licensee responsibilities (e.g. signage, timing, etc.),
    b. highlights special circumstances (e.g. Trail closures, steep slopes, etc.), and
    c. reinforces requirements (e.g. Communication plan with stakeholders);
4. Licensee pre-works:
    a. These pre-works help highlight any safety concerns with regard to the activity and includes risk rating matrices and other measures to ensure that all parties are aware of the hazards that may be present,
    b. For licenses where conditions exist to protect/preserve site features, the affected stakeholder is invited to be in attendance at the pre-work to facilitate communication, and
    c. BCTS uses tools like timing restrictions, trail closures and signage to ensure that any public users are well informed of safety information.

3. Response to Chief Forester's Guidance Letter, March 2016

3.1 Fire Management Stocking Standards

Designing cutblocks with fire/fuel management as the main objective is currently out of scope for BCTS in the Sea to Sky Natural Resource District. Cutblocks and permits are designed with the goal of supplying fibre to the market so that the timber pricing mandate can be achieved.
Stocking standards for fire management would be used mainly in response to a legacy or unique situation, BCTS feels the best approach is to prescribe those on a case by case basis to ensure that the prescription takes into account all of the site specific factors. Modified and/or fire management stocking standards should be applied with the intent of improving stand sustainability, with an emphasis on stand density and forest health.

3.2 Non-Legal Guidance

BCTS considers draft guidance when planning operations and incorporates the recommendations where it is operationally practicable. Recommendations are viewed in the context of fibre supply, operational issues and environmental management.

3.3 Monitoring Trends – Forest Resource Evaluation Program (FREP)

The results and recommendations of the FREP reports are considered and incorporated when operationally practicable. In addition, BCTS staff attends various training opportunities, and continuous improvement (CI) principles are applied to forest operations. FREP reports and extension notes are reviewed from the FREP website. BCTS holds monthly meetings with contractors and staff, where CI principles are applied to review and integrate new information into ongoing work processes.

3.4 Draft Orders for Species at Risk

Any draft orders that are in place are considered in the context of fibre supply, operational issues and environmental management. BCTS has developed BMPs that include practices to manage for SAR, including seeking advice from a qualified professional when encountered. The presence of SAR is evaluated at all five phases of block development, to ensure all known species are addressed in plans.

4. BCTS Information Sharing Process

4.1 Who BCTS Engages

The primary criterion for engaging First Nations and public stakeholders is the geographic location of the planned activity. Using iMapBC as the primary mechanism to identify First Nation and stakeholders, BCTS shares information regarding the proposed forest development (e.g. timber harvest and road construction) with parties who have a vested interest in the land.

BCTS identifies First Nations and stakeholders, from the range listed below:

1. first nations;
2. BC government agencies;
3. municipalities and regional districts;
4. land and water tenure holders;
5. private land owners;
6. stakeholders and interest groups (e.g. recreation groups);
7. trap line holders; and
8. additional groups that self-identify

Given the number of years BCTS has been operating in the Sea to Sky Natural Resource District, there is a solid understanding of who the stakeholders are. That said BCTS continually scans the land base for new stakeholders to add to the referral list.

In addition to information sharing package mail-outs, BCTS makes all information sharing information available on the web. This provides the opportunity for stakeholders to self-identify and become involved in the process.

4.2 How BCTS Engages: Information Sharing Process

The process outlined in the next section of this document details BCTS' information sharing process for planning and operational activities.

The process is divided into two categories. The first is specific to First Nations information sharing, while the second is the protocol for stakeholders. While the processes vary slightly, the intention is the same – share information and seek feedback through a meaningful engagement process.

4.2.1 First Nations Information Sharing Process

The First Nations information sharing processes are outlined below:

1. OP:
    1. OPs are sent, at least once per year (or more often as new projects progress). These OPs contain proposed cut blocks and roads that have not yet been engineered in the field.
    2. Details such as, block name, location, landscape unit, stand age, estimated area, volume, planned assessments, species composition, harvest method, comments, maps, shape files, and road information are included when possible.
    3. BCTS follows the timeframes and consultation levels defined in First Nation Forestry Consultation and Revenue Sharing Agreements (FCRSAs). When requested BCTS tries to accommodate requests for timelines extensions.
    4. If more than three years has passed, a previously referred cutblock will be shared again with First Nations to ensure they have no new concerns.
2. Changes to the Proposed Development:
    1. When a cutblock undergoes significant changes such as the size (i.e. >25%), shape or location, BCTS will re-share with First Nations to ensure they have no new concerns.
3. No Reponses Received:
    1. If no responses are received, BCTS will send a follow up letter requesting input.
4. Responses Received:
    1. All comments and concerns are considered by BCTS. A meeting with a First Nation may be required to better understand concerns and how to effectively address them. First Nations' concerns may be incorporated into forest development planning in order to minimize or mitigate the impact of timber harvest activities on a First Nation's Aboriginal interest(s).
    2. If BCTS cannot address a First Nation's concern then a written response will be provided with a rationale.

5. Assessments:
    1. If the cutblock(s) require a visual impact assessment, a terrain stability assessment and/or a hydrological assessment, BCTS will ensure they are completed and provided to First Nations, if requested. A qualified professional will review the assessments and make recommendations that will be specified in a plan.
    2. Additional assessments may also be requested by a First Nation such as:
        i. Preliminary Field Reconnaissance
        ii. Archeological Impact Assessment
        iii. Traditional Use Study
        iv. Heritage Field Reconnaissance
        v. Botanical Resource Surveys
    3. Recommendations from these assessments are considered by BCTS, additional meetings with a First Nation may be required develop mitigation strategies, if required. BCTS will provide a written response indicating which recommendations can be implemented and a rationale if recommendations cannot be implemented.
6. Further Information Sharing at the Timber Sale Licence (TSL) stage.
    1. For First Nations that responded to the OP, BCTS will notify them of the TSL number, the associated cutblocks, and roads and the planned TSL advertisement date.
7. Notification
    1. The timber sale licence document lists the First Nations that must be notified. Licensees are required to provide a minimum of 2 weeks' notice, prior to harvest commencement.
8. Due Diligence Report (DDR)
    1. A DDR summarizing the information sharing process and any accommodations that were made is prepared and approved by the timber sales manager.

4.2.2 Stakeholders Information Sharing Process

This process is similar to the information sharing process used for First Nations with minor exceptions including consultation time frames and that BCTS does not complete assessments related to Aboriginal interests.

1. OP:
    a. OPs are sent, at least once per year (or more often as new projects progress). These OPs contain proposed cut blocks and roads that have not yet been engineered in the field. BCTS attempts to provide a package which accurately represents the planned activities.
    b. Details such as, block name, location, landscape unit, stand age, estimated area, volume, planned assessments, species composition, harvest method, comments, maps, shape files, and road information are included when possible.
    c. These plans are sent with a request for a response within a specified time frame. This varies with stakeholders, but it is never less than 30 days.
    d. If more than three years have passed, a previously referred cutblock will be shared again with stakeholders to ensure they have no new concerns.
2. Changes to the Proposed Development
    a. When a cutblock undergoes significant changes such as the size (i.e. >25%), shape or location, BCTS will re-share with stakeholders to ensure they have no new concerns.
3. No Reponses Received
    a. If no responses are received, BCTS will send a follow up letter requesting input.

4. Responses Received
    a. Comments and concerns are considered by BCTS. A meeting with the stakeholder may be required to better understand their concerns, and plans may change in order to minimize or mitigate the impact of timber harvest activities on the stakeholder value.
5. Assessments
    a. If the cutblock(s) require visual impact assessment, terrain stability assessment and or a hydrological assessment, BCTS will ensure they are completed. A qualified professional will review the assessments and make recommendations that will be specified in a plan.
6. Further Information Sharing at the TSL stage.
    a. For stakeholders that responded to the OP, BCTS will notify them of the TSL number, the associated cutblocks, and roads and the planned TSL advertisement date.
7. Notification
    a. The timber sale licence document lists the stakeholders that must be notified. Licensees are required to provide a minimum of 2 weeks' notice, prior to harvest commencement.
8. Due Diligence Report (DDR)
    a. A DDR summarizing the information sharing process and any accommodations that were made is prepared and approved by the timber sales manager.

5. Protection of Cutblocks and Roads

BCTS is not declaring any cutblocks at the time of submission of this FSP.

Road Permits and Timber Sales Licences in effect have been listed in the appendices (Table A3 and Table A4) of the FSP.

6. Results or Strategies

6.1 Soils

The objective set by government for soils in the FPPR is "without unduly reducing the supply of timber from British Columbia's forests, to conserve the productivity and the hydrologic function of soils". BCTS will default to the Soils Practice Requirements detailed in sections 35 and 36 of the FPPR.

Performance measures are in place on a block specific basis to help ensure that soils are protected. For example:

1. Site Plan and Harvest Plan documents align with sections 35 and 36 of the FPPR and are signed by a qualified professional.
2. Soil disturbance limits and permanent access structures (PAS) limits are calculated and specified in a plan.
3. Harvest operations are inspected to ensure the plan is followed and the soil resources are protected. Compliance and Enforcement Branch staff will be notified if limits are exceeded.
4. Detailed road construction and deactivation/rehabilitation require a sign off by a qualified professional to ensure the activity meets design/plan specifications, and soils are protected.
5. Bridge installations require a sign off by a qualified professional, to ensure construction meets design specifications, and soils are protected.

Best Management Practices (BMPs)

BCTS implements the following BMPs for soil conservation:

1. Machine Free Zones
2. Wet Weather Shutdown guidelines
3. Soil disturbance limits and PAS limits

6.2 Wildlife

The presence of SAR is evaluated at five different stages in block development, to ensure the latest information is used.

- Stage 1: Block Planning and Development
- Stage 2: Block/Engineering layout Pre-Work
- Stage 3: Field Work Quality Assurance
- Stage 4: Site Plan/ Road Site Quality Assurance
- Stage 5: TSL/Contract Package Preparation

BCTS commits to seeking advice from qualified professionals, as required, and will also provide updates the BC Conservation Data Center (CDC) with any relevant field information that pertains to SAR.

BCTS has also signed on to the "Memorandum of Understanding regarding Interim Management of Marbled Murrelet and Northern Goshawk Habitat". This is in place while the Province of British Columbia develops Implementation Plans for these species. This document is provided in the appendices.

6.2.1 Marbled Murrelet

The TSM will undertake to comply with the Order.

Order – Wildlife Habitat Areas 2-303 to 2-306, 2-308, 2-309 &2-316 (April 15, 2014)

6.2.2 Spotted Owl

Special Resource Management Zones (SRMZ) and Matrix Activity Centres (MAC) are applicable to the Sea to Sky Natural Resource District

The TSM will undertake to comply with the Order.

Order - Wildlife Habitat Areas (WHA) 2-517 to 2-525 (February 28, 2013)

6.2.3 Coastal Tailed Frog

The TSM will undertake to comply with the Order.

Order- Wildlife Habitat Areas 2-272 to 297, 2-381 to 2-386, 2-388, 2-390 to 2-406, 2-436 to 2-443 Grizzly Bear – Squamish Forest District (Aug 25, 2010)

(*Note: the Coastal Tailed Frog objective is entirely overlapped by the Grizzly Bear WHA and is included in the same order).

6.2.4 Grizzly Bear

The TSM will undertake to comply with the Order.

Order- Wildlife Habitat Areas 2-272 to 297, 2-381 to 2-386, 2-388, 2-390 to 2-406, 2-436 to 2-443 Grizzly Bear – Squamish Forest District, dated Aug 25, 2010

6.2.5 Northern Goshawk

No order is currently in place, BCTS has committed to seeking advice from a qualified professional when Northern Goshawk and/ or nesting site is encountered.

6.2.6 Pacific Water Shrew

No order is currently in place, BCTS has committed to seeking advice from a qualified professional when Pacific Water Shrew is encountered.

6.2.7 Ungulate Species, SAR, WHA, Section 7

The TSM will undertake to comply with the objectives established under sections 9(2) and 12(1) of the following Government Action Regulations (GAR) Orders:

#U2-002, Order dated October 6, 2003; Order- Mountain goat (*Oreamnos americanus*) Soo TSA;

#U-2-005, Order dated October 31, 2014; Order – Amendment to Ungulate Winter Range U-2-005 Black tailed Deer and Moose- Sea to Sky Forest District, Soo TSA

#U-2-007, Order dated July 5, 2007; Order – Ungulate Winter Range (mountain goat) #U-2-007, TFL38

#U-2-008, Order dated July 5, 2007; Order- Ungulate Winter Range (black-tailed deer &mule deer) #U-2-008

#U2-010, Order dated March 17, 2005, Order- Ungulate Winter Range #U-2-010 (Moose (Alces alces), within TFL38)

6.2.8 Species at Risk: Non-Legal if outside of a Section 7 Notice

BCTS has addressed SAR within the FSP document. Species that are not currently subject to a section 7 notice (e.g. SAR Notices FPPR section 7 and WLPPR section 9) have been addressed in the following ways:

- BCTS Chinook's SFI certification requires that BCTS Chinook manage for red listed species as defined by the provincial and federal governments, and, must also manage for species that are classified as critically imperilled or imperilled by Nature Serve.
- BCTS ensures that any forest resource development activities protect and manage for both the species and its critical habitat.
- BCTS Chinook ensures that any plant, animal, or ecological community that meets the SFI criteria is managed for on a block by block basis, and, that all staff, contractors, and licensees are made aware of the presence of any of these species that may exist in the areas of operation.
- If previously unidentified species are located that have not been managed for, that under our Environmental Management System, operations must cease until such time as a qualified professional has been consulted and a decision on how to proceed is made.

- BCTS also has a comprehensive Invasive Plant management program that ensures that invasive plant species are not spread by operations. Special attention is paid when there are invasive plant species that could negatively impact habitat of an endangered species in areas of proposed operations.
- All strategies applied in these cases will be documented and included in a plan.

6.3 Water

BCTS is adopting the default riparian classifications for streams, wetlands, lake and the restrictions in riparian management areas as outlined in the FPPR sections 47-51, 52(2) and 53 (for temperature sensitive streams).

Hydrologic reviews will consider the potential impacts of timber harvest activities on water quality, water quantity, timing of water flows, and to assess the risk to public health.

Inside community watersheds, the TSM will ensure that any forest activities undertaken are consistent with the recommendations of the qualified professional who prepares the plan. The qualified professional will use the Coastal Watershed Assessment Procedure (CWAP) guidebook as reference as well as Integrated Watershed Management Plans (IWMP) for the Stawamus/ Mashiter and Pemberton watersheds (as they apply) and will ensure this information is considered in any hydrologic review.

A copy of the professional report (hydrologic assessment) will be held by BCTS and will be made available for review to stakeholders and First Nations.

Performance Measure

- Site plans (SP) identify watercourses to the default riparian classifications and indicate any offsets and management/reserve zones,
- Watershed documents are referenced in the SPs where they apply,
- Water assessments are performed, results are assessed and any required mitigation is specified in a plan (SP document).

6.3.1 Retention Levels in Riparian Management Zones (RMZ)

One of the recommendations from FREP reports and the Multiple Resource Value Assessment Sea to Sky District (December 2013), is increased retention in the first 10m for S5 and S6 streams.

BCTS has reviewed reports, attended the recent “FREP/Industry Small Streams Workshop” (FLNRO) and taken part in the associated webinar (ABCFP). This information coupled with the understanding that in the Sea to Sky Natural Resource District, streams are abundant and display a wide range of variability with respect to riparian features (e.g. the role of trees: conserving water quality, habitat, biodiversity and stream bank integrity), BCTS does not have a blanket policy, but instead will manage RMZ retention levels on a site specific basis. Retention levels will be prescribed by a qualified professional through a riparian assessment. The assessment will consider all factors listed in Schedule 1(2) of the FPPR. Road and cutblock design will be consistent with the RMZ retention levels as recommended in the riparian assessment and those retention levels will be specified in a plan.

BCTS will continue to review FREP reports, and will consider recommendations during planning processes. The “FLMT Riparian Management Emphasis Field Guide (North Island – Central Coast Forest Management Leadership Team)” is a document that provides local level guidance for qualified professionals.

6.4 Fish

Consistency with the objectives for fish within riparian areas is achieved through results and strategies that are provided in section CHS214 of the FSP.

- Any streams with a gradient of less than 20% are considered fish bearing and treated as such, unless a known barrier exists or a fish inventory has indicated that fish are not present.
- Appropriate retention levels/ buffer are prescribed by a qualified professional as required and specified in a plan.
- Riparian classification is determined by section 47 of FPPR

6.5 Biodiversity

Consistency with the objectives for biodiversity is achieved through results and strategies that are provided in sections CHS215 to CHS219 of the FSP.

The following strategies are in place to help address biodiversity:

- Deciduous species have been added as an acceptable species in some stocking standards to allow for a deciduous component in regenerated stands. Deciduous species can improve nitrogen fixation, and provide increased habitat features for wildlife.
- Stocking standards were designed to include as many suitable species as possible to increase plantation diversity.
- It is noted that the deciduous component may not exceed 10% of the well spaced and/or free to grow of the stand, as measured by surveys and reportable data.

6.5.1 Non Spatial Old Growth Objectives within the Elaho and Upper Squamish FDUs.

The TSM will work with the holders of the TFL 38 licence, North West Squamish Forestry Limited Partnership (NWSF), to ensure the Old Growth Retention Targets for Non-spatial Landscape Units are met.

Currently, all BCTS blocks located within the Elaho and Upper Squamish FDUs are developed by the licence holders of TFL38, NWSF. Through a Cooperative Management Agreement (CMA) NWSF develops blocks, BCTS purchases this development (all assessments, layout and mapping) and then BCTS auctions the sale.

The CMA indicates that NWSF will carry out all strategic and operational planning, in keeping with government policy. BCTS reviews the development deliverables, to ensure consistency with the FSP, safety, and operability, and formats the information into a BCTS timber sale licence package. BCTS has confirmed with NWSF that blocks are in fact being developed in compliance with Old Growth Retention Targets for Non-spatial Landscape Units.

6.6 Cultural Heritage Resources

Consistency with the objectives for cultural heritage resources is achieved through results and strategies that are provided in sections CHS220 to CHS222 of the FSP.

Cultural Heritage Resources (CHR) Performance Measures:

- Annual (at minimum) information sharing with First Nations to determine if any CHR exist in proposed areas
- Complete assessments as requested (eg. AOA, AIA, etc.)
- Completed information sharing summary for each OP shared
- Completed assessments as agreed with identified by First Nations (eg.TUS, HFR,

Botanical Resources etc.)

- A clause has been included in the TSL that indicates "If previously unidentified features are located, that have not been managed for, under our Environmental Management System, operations must cease until such time as a decision on how to proceed is made by a qualified professional."
- The TSM will ensure that Due Diligence has been exercised

6.7 Recreation Resources

For recreation sites and trails that are legally established and/or authorized, as per sections 56 and 57 of FPRA or under GAR, BCTS will follow the same protocol used in our information sharing process with all stakeholders.

For recreation sites and trails that are not legally established and/or authorized BCTS will follow the same protocol with regard to information sharing and work with stakeholders to mitigate impact to the resource where practicable.

Performance Measures

- BCTS has successfully completed timber sale licences including measures for:
  - preservation of mountain bike trails and hiking trails (SORCA)
  - timing restrictions, advance notice, temporary trail closures, (SORCA)
  - Paragliders, and all other types of stakeholders have been identified and are working with us to protect, preserve and/or rehab existing features post-harvest.

6.8 Visual Quality

BCTS will complete VIAs in areas covered by an established VQO, as well as in other areas where visuals are a concern for stakeholders.

With our operating area being in such close proximity to Squamish, stakeholders often request a VIA to ensure that their concerns are being addressed. The Visual Landscape Design Training Manual is referenced when designing and completing the assessments.

BCTS will ensure that the plan for primary forest activities is consistent with the established VQO, and that it will be *Well met* or *Met* using the FREP evaluation process.

7. Additional Information

7.1 Climate Change

BCTS recognizes that climate change is an important issue, has reviewed existing guidance and will continue to review and implement new information/ guidance as it is made available. The following guidance has been considered under this FSP:

Seed Transfer Guidelines: BCTS will continue to implement Seed Transfer guidelines to move species in a more targeted fashion as a means to mitigate climate change and changes to species amplitude. BCTS is implementing hardwood management by adopting the deciduous management stocking standards.

Updated Reference Guide for FDP stocking standards (2017) Climate change: The guide was used to make modifications to certain zones/subzones and site series preferred/acceptable species. The rationale from the guide recommends species that may be considered preferred or acceptable, and also includes recommendations for changing to/from preferred and/or acceptable.

(Climate Based SeedTransfer) CBST Seedlot Selection Tool Version 1.0. This climate change adaptation tool is used to assist in the selection of species and seedlots for BCTS cut blocks. The tool highlights specific drainages or blocks that may have forest health concerns, which may make certain species unsuitable. It also allows the user to select a block location to determine whether or not a certain species (based on climate based seed transfer) would be suitable for a specific block. It may also indicate/recommend species that are not currently showing as preferred or acceptable for that block/drainage.

Natural regeneration. For blocks where there is an expectation of good natural regeneration, consideration will be given to planting an alternative climate adaptive species in order to test performance. That performance will be assessed in silviculture surveys and depending on results; these species may be incorporated as either preferred or acceptable through the FSP stocking standard amendment process. BCTS recognizes that this approach is not taking place on a broad ecosystem level, rather the changes are evaluated on a block specific level, to ensure all local factors are considered. Given the potential level of unpredictability related to species success, BCTS is confident that block specific is the appropriate level for these trials.

Western Larch (referenced in Appendix A). In the case of species that are not native to the Sea to Sky Forest District, like western larch, reforestation of those species is being limited to 20% or less of the reforested crop. Larch has been planted in parts of the district with good results and will continue to be included in species mixes where the climate change tools indicate that it is suitable.

White pine. For species such as white pine, where there is no disease resistant seed for the submaritime seed zone, BCTS uses the best maritime seed available in small percentages (e.g. <20% of the planted species) to start increasing stand biodiversity and will continue to monitor disease resistance over time to see whether or not that species has a chance of being a viable crop in future.

Monitoring will also continue for invasive plant spread as risk will continue to increase given their ecological amplitudes.

7.2 Forest Health

BCTS commits to reviewing strategies, and surveys to determine forest health trends in the area covered by this FSP. Using this information, qualified professionals will assess forest health, prescribe and document appropriate strategies, as required. The following list is an example of species/ diseases that would be considered when assessing forest health:

- Western Spruce Budworm
- Hemlock dwarf mistletoe (Arceuthobium spp.)
- Phellinus weirii
- Armillaria
- Spruce Bark Beetle
- Douglas fir beetle
- Spruce Weevil (* endemic levels still present in Sea to Sky, though Chilliwack is experiencing higher than endemic levels of this concern)
- Swiss needle cast

7.3 Fire/Fuel Management

There is information around fire and fuel management, but currently, there are no district policies in place. Qualified professionals take the information into account when they create site plans with the long term objective of timber production. Stocking standards specifically geared at fire/fuel management may be developed using documents like the "Fire Management Stocking Standards Guidance" (dated Feb 2016). As mentioned in section 3.1 of this document, BCTS has not included specific stocking standards for fire management, as those will be prescribed on a site specific basis.

Hazard abatement is included in our TSLs, and requires that a qualified professional sign off indicating the hazard has been abated. If there is a disagreement about the assessment we can bring the assessment forward to Wildfire Management Branch and they can assess, and have the ability issue an abatement order as required.

7.4 Measures to Prevent the Introduction and Spread of Invasive Plants

The requirement for Invasive Plant (IP) management comes from the FRPA and through 3rd party certification requirements of the SFI Standard.

Since the original inception of the invasive plant FSP measure, BCTS Chinook has gained significant insights into how best to control the introduction and spread of not only IPs listed under the *Invasive Species Regulation*, but all IPs. It is important from a legal perspective that those reading this 'Measure' understand that only plants listed under the *Invasive Species Regulation* are the responsibility of the forest sector to manage.

The new learnings lead to the development of the Chinook Business Areas Invasive Plant BMP. The backbone of the Chinook BMP and now the new IP 'Measure' is defined as, "the use of an appropriate seed mix to seed disturbed soils so that site occupancy is not available for invasive plants".

BCTS Chinook's SFI 3rd party certification also requires that signatories to its 'Standard' deal with IP so as to protect natural ecosystems. For example, Principle #2 "Forest Productivity and Health", states and a number of underlying Performance Measures and Indicators require signatories to "…protect forests from…invasive exotic plants…"

BCTS follows a process where seeding is tracked as a part of the timber sale licence, in the BCTS database, and inspections are carried out to ensure compliance.

Scheduled silviculture surveys are designed to capture the presence of invasive species, post harvest. Mitigation and treatments, if required, can be prescribed at that time.

8. Stocking Standards

8.1 How Climate Change, Fire Management and Forest Health have been addressed.

BCTS has reviewed climate change reports and guidance and have incorporated trial species into the stocking standards, increased the number of acceptable species to promote an increase in biodiversity and have allowed for a small component of deciduous in some standards.

Fire management stocking standards will be prescribed on a block/ site specific basis, as required, to ensure the best result.

An increased variety of species, including deciduous, are included as acceptable to help address species specific forest health concerns, and promote more diverse stands. It has been indicated that the deciduous component of a cutblock may not exceed 10% of the free growing or well spaced conifer component of the stand.

Deciduous stocking standards have been proposed in the FSP to provide flexibility to prescribing forester. Any decision to implement these standards must be supported by a rationale, which must clearly outline management objectives and discuss any implications to timber supply. The memo from the ADM and Chief Forester, titled "Incorporation of mixedwood and broadleaves into Forest Stewardship Plan stocking standards, SP amendments and TSR regeneration assumptions" (May 1, 2008) will be used to guide decisions. Deciduous sawlogs were recently (2017) harvested and marketed by a BCTS licencee.

1. Secondary objectives for Hardwood management are to:
    a. diversify timber yields to address changing market conditions,
    b. respond to climate change (science based reports and/or direction),
    c. maximize land base utilization,
    d. manage for root disease centers as a short rotation interim crop

2. When selecting a deciduous stocking standard, the primary objective must not be to:
    a. specifically manage biodiversity,
    b. promote nutrient cycling,
    c. provide a nurse crop to grow other species.

3. Site selection for the application of deciduous stocking standards will:
    a. target lower slopes and toe slopes, especially seepage zones (even on mid slopes),
    b. avoid shedding slopes (ie ridges and upper slopes) and areas where cold air ponds, which have the potential to damage deciduous crops,
    c. give preference to ground based harvesting sites,
    d. target north or east facing aspects and avoid hot, sunny south and south-west facing aspects especially on steep slopes,
    e. target 350-600m as a guide for upper elevations, with slope position and moisture flows remaining the most important factors,
    f. target fine textured soils, such as alluvial silts and fine sands. avoid coarser sands, coarse cobble soil types, and organic soils. The exception will be organic soils that are well decomposed (black) and have mineral soil mixed in.

4. Surveys/Assessments
    a. BCTS will prescribe a secondary coniferous stocking standards selected to implement, so that if for any reason the deciduous standard is deemed not suitable, an alternative has been identified.
    b. due to higher density requirements and product objectives, alder managed stands will have additional monitoring to ensure that the crop is performing as expected and that no intervention is required prior to the free growing assessment due to unpredictable ice storm damage, frost damage, drought, density issues or other factors.
    c. BCTS will monitor stands on a biannual basis, in addition to a survival assessment (yr 1) and a regen assessment (yr 2), until they have been declared free to grow.
    d. survey assessments will be reported to RESULTS with any necessary support documentation.

5. Unless otherwise stated in regulation or an approved FSP stocking standard, an acceptable broadleaf crop tree must:
    a. not have tree pith that is laterally displaced more than 30 cm from the location of the root-crown pith,
    b. not originate from a cut stump,
    c. have one dominant live leader,
    d. not have a wound that is greater than 10% of the stem circumference nor is greater than 10% of the total length of the stem,

e. not have any fungal infections or insect infestations affecting tissues below the bark surface, visible without destructive sampling,
f. not be browsed so as to limit its ability to become a crop tree.

6. Pre-harvest site conditions will use the following criteria for prescribing Red alder natural regeneration.
    a. Regeneration densities of more than 1000sph in establishing (2-4 year old) blocks.
    b. Pre- FG densities with a minimum of 600 sph in blocks 5-8 years old, with the majority plots indicating ~1000sph.

Single Entry Dispersed Retention Stocking Standards (SEDRSS) have replaced the multi-story stocking standards. BCTS does not currently have plans to utilize this harvest method. However, if a specific situation calls for the development of a SEDRSS , the Single Entry Dispersed Retention Stocking Standard Framework Implementation Guide (Coastal)from the Silviculture Working Group, Coast Region, FRPA Implementation Team, Version 2.0 (Feb. 14, 2014), will be used to guide decisions, pre-harvest and appropriate stocking standards can be designed and submitted for approval.

8.2 Rules for modifying Stocking Standards

The following list of rules will be used by qualified professionals when prescribing a stocking standard for a block. They indicate the process and criteria for modifications to an approved standard, and also require that these modifications be supported by a rationale, documented and incorporated into a plan.

It is important to note that these rules are to be applied with thorough consideration of the site, the site characteristics and timber production/supply. These tools provide flexibility for the qualified professional to prescribe a site/condition specific plan. These site specific plans can be used to increase biodiversity, manage forest health concerns, and provide opportunity for species trials as well as other innovations.

Rule 1. Site Series Mosaics/Complexes

Where more than one site series is located within a logical standards unit area, the dominant site series standard will apply (minimum size of 1 hectare).

For specific areas of the mosaic or complex, the standard can be modified to include additional species selected from subdominant site series standard. These additional components to the standard will be supported by a rationale, documented and incorporated into a plan.

Rule 2. Transitional Sites

On transitional sites occurring between two BEC units, the dominant BEC unit standard will apply. This standard can be modified with the inclusion of components of the standard associated with the sub-dominant BEC unit.

These additional components to the standard will be supported by a rationale, documented and incorporated into a plan.

Rule 3. Minimum Inter Tree Distance (MITD)

The general MITD of 2.0 metres can be reduced down to 1.5 metres where productive and/or plantable spots are limited by pre-harvest site characteristics. These are limited to colluvial sites, sites with an overstory canopy, and wet sites. Justification for a reduced MITD will be supported by a rationale, documented and incorporated into a plan.

The allowed reduction of inter tree spacing ensures that enough crop trees are planted to ensure timber supply and the best microsites are selected, giving seedlings the best chance to establish and survive. Reduced inter tree spacing is a widely used and accepted method and is included in previously approved stocking standards approved under FSP #179.

Rule 4. The crop tree height to brush ratio in a fireweed complex can be lowered to 100% for all species. Justification for a reduced ratio will be supported by a rationale, documented and incorporated into a plan.

Rule 5. Leave Trees

The minimum characteristics, in order for leave trees to contribute toward the free growing stand, are they must be of good form, health and vigour and otherwise meet the stocking standards for that site.

In situations where leave trees will not contribute to the free growing stand, the leave trees within the harvest area must have characteristics appropriate to meet forest management objectives developed for the site.

The forest management objectives must be supported by a rationale, documented and incorporated into a plan.

Rule 6. Western Larch Range Expansion LR2

Western Larch can be considered an acceptable species in the D'Arcy area of the Sea to Sky Natural Resource District. Densities are to be limited to 200 stems per hectare or less on the mid to lower South facing slopes away from major waterbodies in the LW1 Seed Planning Zone (as per attached map and announcement in FSP appendix 1)

Definitions:

Fd = douglas fir	Dr= red alder
Pl = lodgepole pine	Ep = birch
	Mb = bigleaf maple

APPENDICES

Appendix 9.1

Sustainable Forest Management:

https://www.for.gov.bc.ca/ftp/HBT/external/!publish/Web/EMS2/BCTS-Provincial-SFM-Plan.pdf

Chinook Invasive Plant BMP

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BCTS Chinook Invasive Plant Best Management Practice (BMP)

Update(s): BMP revised May 6, 2011 to reflect ministry name change and a rewording of sections to enhance clarity of understanding.

Operating areas covered by the Chinook Invasive Plant BMP

1. BCTS Operations in the Chilliwack, Squamish, and Haida Gwaii Forest Districts
2. BCTS Operations in TFL's within the 3 districts noted above
3. Any other land tenure in which BCTS operates as a forest land management partner with 3rd party entities; e.g., community forests

Reference sources for BMP development

This BMP reflects the best science and information to date related to controlling the spread and/or introduction of invasive plants. Knowledge used to guide the development of this BMP is based upon information obtained from the Invasive Plant Council of BC (IPCBC) and from the Ministry of Forests, Lands and Natural Resource Operation's Invasive Plant program (MFLNRO).

Legislative and policy requirements concerning Invasive Plants

BCTS Chinook's requirement to manage for invasive plants is driven by two impetuses:

1. Forest and Ranges Practices Act and related Invasive Plant Regulation
2. 3rd party certifications via the Sustainable Forestry Initiative and the Forest Stewardship Council

Primary Objective of Invasive Plant BMP

1. To stop the spread and introduction of Invasive Plants to meet our legal and 3rd party certification obligations
2. To educate the staff and Licensees, Permittees, and Contractor about how to stop the introduction and/or spread of invasive plants

Limitations to the control of the introduction and/or spread of Invasive Plants

Due to the extent of existing populations of invasive plants within BCTS' operating areas it is not possible or prudent to attempt to manage for the introduction and spread of all invasive plants on a species by species basis. Though the guidance of expert advice available on the IPCBC web site and through consultation with invasive plant experts in MFLNRO, BCTS Chinook is taking a 2 pronged approach:

1. That the control of the introduction and spread of invasive pants is best managed though the occupation of newly disturbed soils; i.e., potential seed beds, that could be used by invasive plants to become established or used to spread, with agronomical suitable grass seed '*sodgrass*' mixture(s)

2. That as experience with invasive plants and their autecology continues to increase, that grass seeding efforts will focus solely on protecting Sensitive Sites[1]. These Sensitive Sites equate to:
    - Riparian areas, lake, wetlands, bogs
    - Wildlife habitat areas (WHAs)
    - Endangered ecosystems; e.g., Garry oak complexes
    - Ungulate winter ranges
    - Areas of FN spiritual use/plant collection
    - Culturally significant areas; parks and ecological reserves
    - Other areas as defined by 'experts' and/or stakeholders

[1]Sensitive Sites equates to sites classified as '*Extremely High Risk to invasive plants*' in the Chinook Chilliwack FSP

Foundation of the Chinook BA's Invasive Plant BMP

Noting the extensive range and diversity of invasive plants in Chinook's operating areas the Chinook BA is focusing on eliminating the potential for IP spread via grass seeding disturbed soils to manage the introduction and/or spread of invasive plants. Legally the Chinook BA is only required to manage for invasive plants as identified in the Forest and Range Practices Act (FRPA) Invasive Plant Regulation but, through the removal of potential seed bed via grass seeding it is felt that this method will limit the introduction and/or spread all invasive plants that could threaten Sensitive Sites.

It is also understood that very few invasive plants can thrive under a closed canopy situation where light is limited therefore there is no need to grass seed any portions of a forest operations that will see a closed canopy established either naturally or artificially post disturbance unless there is an adjacent IP that can thrive in closed canopy conditions.

Where to grass seed

Grass seeding should occur under the following conditions:

1. Invasive plants are within the vicinity of proposed operations and when these operations will **create new disturbed soil**. The target areas for grass seeding in this case relates to new construction activities:
    a. building new roads into the forested land.
    b. Building new structures; bridges, etc.,
2. When invasive plants are present and, based upon their autecology, they pose a risk to a sensitive site. In this situation road activities; construction or maintenance, will create seed bed(s) that can act as a vector for the spread of invasive plants by:
    a. Creating a new seed bed (disturbed soil) that can act as a vector for the spread of invasive plants along the newly disturbed soil, or
    b. Moving reproductive material from an existing location to a new location **that will pose a risk to a Sensitive Site**.
3. When undertaking activities immediately adjacent to any Sensitive Site

Where grass seeding is not required

BCTS and/or its Licensees, Permittees and Contractors do not have to grass seed when operational activities are occurring an area where invasive plants are well established and activities will not spread invasive plants into new areas.;

Example grass seeding scenarios

1. A TSL Holder **is building a new road** into a proposed block location off of an existing mainline with established invasive plants along the mainline network and his tenure requires that he maintain the existing road:
    a. The Licensee **must grass seed** where the new construction has occurred
    b. The Licensee **does not have to grass seed** along the mainline if none of the existing invasive plants pose a risk to a Sensitive Site based upon their autecology. In this case, even though grading, etc can create new disturbed soil (seed beds) because the invasive plants have already been established along the mainline in essence the activities are not introducing or spreading the invasive plants, rather, there may simple be a redistribution of existing IPs along an already infested corridor.
2. A TSL Holder is using an existing mainline to access his timber. Under his permit/road tenure he is required to maintain the road including grading, culvert maintenance, etc, **but there will be no new construction activities**. There are established invasive plants along the mainline but none that pose a risk to a Sensitive Site based upon their autecology. In this case, even though grading, etc can create new disturbed soil (seed beds) because the invasive plants have already been established along the mainline in essence the activities are not introducing or spreading the invasive plants rather, there may simple be a redistribution of existing IPs along an already infested corridor.
3. A Contractor is replacing a bridge along a mainline and the mainline has established invasive plants along it. One of the invasive plants that has already become established along a portion of the mainline **poses a threat to riparian habitat** based upon its autecology. The contractor **must grass seed the new disturbed soil related to the bridge replacement project**. The reason for the need to grass seed is because the bridge construction activities are creating new disturbed soil immediately adjacent to a Sensitive Site. The prudent step is to grass seed the construction site to ensure that the problematic invasive plant will not be given an opportunity to move down the road through the new bridge related construction and enter into the riparian habitat.

Future direction of grass seeding

As individuals responsible for developing operational plans become more comfortable with the identification and related autecology of invasive plants, and with the identification of Sensitive Sites, grass seeding will only be required when there is the possibility that an activity will create a situation where invasive plants can spread into the Sensitive Site. Until such time, grass seeding will be required to be done as per the direction and clarifications above.

This BMP will be updated to reflect this future direction at such time as it is felt that the understanding of plant identification and autecology, and Sensitive Site identification, are sufficient to ensure that there is a minimal risk to the Sensitive Sites.

Timing of grass seed application

- Grass seeding should occur at a time that is conducive to grass seed establishment. The spring and fall seasons are the best times when there is the least likely risk of moisture deficit but spring seeding is preferred
    - Grass seeding should occur prior to seed development by invasive plants in the vicinity of operations

General rules concerning the type of grass seed mix to use

- Minimum grass seed standard in the Chinook BA is a seed that will meet or exceed '*Canada Common Number 1 Forage*' mixture specifications as defined by the Canada Seeds Acts; sodgrass mixtures are mandatory in the Chinook BA
    - When ordering seed be sure to specify if you are seeking a coastal seed mix or an interior seed mix
        - Example interior operating areas include:
            - Squamish Forest District: Pemberton and points north and east
            - Chilliwack Forest District: Spuzzum and points north and east
- use *sodgrasses* for erosion control, restoration works, or to occupy disturbed soils (seed beds) within close proximity to established invasive plant populations.
- for erosion control & restoration planned in areas free of invasive plants then agronomic *bunchgrasses* allow for native vegetation to in-fill (between the bunches).
- The section below "Appropriate Seed Mix" lists the latest recommendation for seed mixes based upon biogeoclimatic zones (BEC). These mixtures can be more expensive and harder to come by but will provide an overall better ecological result and should be used where practicable.
- Below is also a listing of banned seed **that must be adhered to** due to their invasive qualities or other environmental risks they pose.
- Suggested seeding rate: 50 kg/ha
- Suggested fertilization rates: 250 kg/ha

Licensees Permittees and Contractors obligations

1. Always grass seed as per examples above if creating disturbed soil unless otherwise directed in Site Plans or by ministry staff
2. Ensure that you are fully appraised of invasive plants within your proposed area of operations by your ministry representative during pre-works
3. Ensure that you are fully appraised of your grass seeding requirements by your ministry representative during pre-works

4. Follow the scenarios above to understand where grass seeding should occur if not discussed at your pre-work(s) and/or documented with Site Plans; harvesting and/or road construction, prepared for your activity.
5. Ensure that your staff are fully aware of problematic invasive plants and any grass seeding requirements
6. Review T.I.P.S. on the Invasive Plant Council of BC web site prior to undertaking any operations.
    a. http://www.invasiveplantcouncilbc.ca/publications/TIPS/Forestry_Oper_TIPS.pdf

General Steps for Managing Invasive Plants

1. For a specific area, prior to development activities occurring, use the IAPP map display program to note the last known location for IPs.

2. Survey the area to determine if the IPs have spread further and/or if there are additional species that have not been identified that extend beyond the last known location of IP occurrence. If the IP has spread or if there are new IPs beyond this 'known' location, record their location, population size, etc and then report back to the IAPP application (the 22 priority plants listed on the carabineers are the ones that must be reported to the IAPP database using the "Report-A-Weed" tool). This sets the baseline for BCTS to ensure that plants do not spread further. This is also sets the point beyond which our legal obligations commence.

3. For the IPs that are found consider their form of spread; see Appendix C, which provides the mechanism of spread by plant, as well as, a link to learn more about the plant's autecology. Once you understand the form of spread then consider, if possible, aligning operations to occur in a time or way that is less likely to spread the plant.

Consider the plant survival triangle; form of spread, suitable seed bed, nutrients and light. Target activities that will eliminate one or more sides of the triangle and the plant will not spread; e.g. eliminate seed bed(s) by grass seeding and monitoring, or, out competing the IP plant for water and nutrients by using suitable sodgrass seed mix(s).

4. Where grass seeding has taken place ensure that there is a suitable monitoring strategy/plan in place for the next growing season(s) to ensure that the grass seed has established.

5. For more detailed information concerning Invasive Plant management review the Chinook Invasive Plant Process map and related SOP

- Internal staff: https://www.for.gov.bc.ca/bcts/areas/TCH/TCH_ems-internal.htm
- External contractors and LPC's: http://www.for.gov.bc.ca/ftp/TCH/external/!publish/EMS2/Supplements/

Chinook BA IP BMP effectiveness monitoring

Roads: Integral to the road maintenance activities is the requirement to monitor to ensure that any grass-seeding that has occurred has been successful. Where grass seeding has failed additional grass seeding will take place. Any additional spread of IP's will be noted and reported through the "Report-A-Weed" tool on the IAPP web site. The requirement to monitor grass seeding or follow-up treatments is scheduled in Cengea.

Silviculture:

Silviculture activities play a limited role in stopping the spread of IPs. The primary objective is to ensure that plantations reach "free-growing" status within legislated timelines and as the plantation grows IPs are outcompeted for sunlight and nutrients and their spread is halted. During surveys any new locations of IPs are recorded and reported through the "Report-A Weed" tool of the IAPP web site.

Where to go for additional information

1. The Invasive Plant Council of BC has great resources on their web site and it should be referred to on an ongoing basis. Below is a link to the Invasive Plant Council of BC T.I.P.S. (Targeted Invasive Plant Solutions) for Invasive plants and forestry operations. You may want to give this link to contractors during pre-works.
   http://www.invasiveplantcouncilbc.ca/publications/TIPS/Forestry_Oper_TIPS.pdf

2. The *Global Invasive Species* database is a new database that was created with the aim of increasing awareness about invasive alien species and to facilitate effective prevention and management activities. It is managed by the Invasive Species Specialist Group of the Species Survival Commission of the IUCN – World Conservation Union.
   http://www.issg.org/database/welcome/

Appendix A: Appropriate Seed Mixes by BEC

BEC Zone	Recommended Native Seed Mixture Constituents	Recommended Agronomic Seed Mixture Constituents
IDFww	➢ **Junegrass**[B] ***Koelaria macrantha*** ➢ **Rocky Mountain fescue**[B] ***Festuca saximontana*** ➢ **Idaho fescue**[B] ***Festuca idahoensis ssp. idahoensis***	➢ **Annual rye**[B] ***Lolium multiflorum*** ➢ **Perennial rye**[B] ***Lolium perenne*** ➢ **Hard fescue**[B] ***Festuca trachyphylla*** ➢ Red fescue[S] *Festuca rubra*
CDFmm *(Garry Oak Ecosystems only)*	➢ **Roemer's fescue**[B] ***Festuca idahoensis ssp. roemeri*** ➢ **California oatgrass**[B] ***Danthonia californica*** ➢ **California brome**[B] ***Bromus carinatus*** ➢ **Blue wildrye**[B] ***Elymus glaucus*** - No legumes to be included	N/A
CDFmm *(excluding Garry Oak Ecosystems)*	➢ **California brome**[B] ***Bromus carinatus*** ➢ **Blue wildrye**[B] ***Elymus glaucus*** ➢ **Native red fescue**[S] ***Festuca rubra ssp. arenicola*** ➢ Canada bluegrass[S] *Poa compressa* ➢ Spike bentgrass[S] *Agrostis exarata* ➢ Hair bentgrass[B] *Agrostis scabra* ➢ Slimstem reedgrass[B] *Calamagrostis stricta* ➢ Tufted hairgrass[B] *Deschampsia cespitosa* ➢ Slender hairgrass[B] *Deschampsia elongate*	➢ **Red fescue**[S] ***Festuca rubra*** ➢ **Red top**[S] ***Agrostis gigantea*** ➢ **Perennial rye**[B] ***Lolium perenne*** ➢ **Annual rye**[B] ***Lolium multiflorum*** ➢ Alsike clover[L] *Trifolium hybridum* ➢ Red clover[L] *Trifolium pratense* ➢ White clover[L] *Trifolium repens*
CWH "dry" (subzones: xm, ds, dm, ms, mm, ws)	➢ Same as immediately above, except: **1.** Replace **California brome** ***Bromus carinatus***[B] with **Alaska brome**[B] ***Bromus sitchensis*** 2. On wet sites, **Alaska brome**[B] ***Bromus sitchensis*** is reduced to 25% by weight and Tufted hairgrass[B] *Deschampsia cespitosa* is increased to 10% by weight.	➢ **Red fescue**[S] ***Festuca rubra*** ➢ **Red top**[S] ***Agrostis gigantea*** ➢ **Perennial rye**[B] ***Lolium perenne*** ➢ **Annual rye**[B] ***Lolium multiflorum*** ➢ Alsike clover[L] *Trifolium hybridum* ➢ Red clover[L] *Trifolium pratense* ➢ White clover[L] *Trifolium repens*
CWH "wet" (subzones: wm, vm, wh, vh)	➢ Same as immediately above, except: 1. Replace **Native red fescue** ***Festuca rubra***[S] ***ssp. arenicola*** (e.g. 20%) with **Native red fescue** ***Festuca rubra***[S] ***ssp. pruinosa*** (e.g. 20%)	➢ **Red fescue**[S] ***Festuca rubra*** ➢ **Red top**[S] ***Agrostis gigantea*** ➢ Alsike clover[L] *Trifolium hybridum* ➢ Red clover[L] *Trifolium pratense* ➢ White clover[L] *Trifolium repens*
MH (subzones: mm, wh)	➢ **Native red fescue**[S] ***Festuca rubra ssp. pruinosa*** ➢ **Alaska brome**[B] ***Bromus sitchensis*** ➢ **Blue wildrye**[B] ***Elymus glaucus*** ➢ **Tufted hairgrass**[B] ***Deschampsia cespitosa***	➢ **Red fescue**[S] ***Festuca rubra*** ➢ **Red top**[S] ***Agrostis gigantea*** ➢ Alsike clover[L] *Trifolium hybridum* ➢ Red clover[L] *Trifolium pratense* ➢ White clover[L] *Trifolium repens*

[S] = sodgrass [B] = bunchgrass [L] = Legume

Appendix B: Grass seed species that should not be included in seed mixtures

☐ Alfalfa *(Medicago sativa)* ☐ Annual bluegrass (*Poa annua)* ☐ Barnyardgrass (*Echinochloa crusgalli)* ☐ Bermuda grass *(Cynodon dactylon)* ☐ Birdsfoot trefoil (*Lotus corniculatus)* ☐ California poppy (*Eschscholzia californica*) ☐ Cheatgrass or Downy brome (*Bromus tectorum*) ☐ Colonial bentgrass or Brown top *(Agrostis capillaris)* ☐ Couchgrass *(Elymus repens)* ☐ Creeping bentgrass *(Agrostis stolonifera)* ☐ Crested wheatgrass *(Agropyron cristatum)* ☐ Dames rocket *(Hesperis matronalis)* ☐ Dandelion *(Taraxacum officinale)* ☐ Fall rye *(Secale cereale)* ☐ False brome *(Brachypodium sylvaticum)* ☐ Flat pea *(Lathyrus sylvestris)* ☐ Foxglove (*Digitalis purpurea)* ☐ Foxtail barley *(Hordium jubatum)* ☐ Golden clover *(Trifolium aureum)* ☐ Green bristle grass *(Setaria viridis)* ☐ Green foxtail (*Setaria viridis*) ☐ Hairy vetch *(Vicia villosa)* ☐ Hedgehog dogtail (*Cynosurus echinatus)* ☐ Johnsongrass *(Sorghum halpense)*	• Jointed goatgrass *(Aegilops cylindrical)* • Kentucky bluegrass *(Poa pratensis)* • Lovegrass (*Eragrostis minor)* • Meadow foxtail *(Alopecurus pratensis)* • Perennial peavine *(Lathyrus latifolius)* • Purple nutsedge *(Cyperus rotundus)* • Quack grass (*Elymus repens)* • Queen Annes Lace *(Daucus carota)* • Reed canary grass (*Phalaris arundinacea*) • Scentless chamomile (*Matricaria maritima*) • Shasta daisy *(Leucanthemum x superbum)* • Silver hairgrass (*Aira caryophyllea)* • Smooth brome (*Bromus inermis*) • Soft brome (*Bromus hordeaceus)* • Subterraneum Clover *(Trifolium subterraneum)* • Sweet vernalgrass (*Anthoxanthum odoratum)* • Timothy (*Phleum pratense)* • Velvetgrass (*Holcus latatus*) • White sweetclover (*Melilotus alba)* • Wild oats (*Avena fatua*) • Wild proso millet (*Panicum miliaceum*) • Yellow hairgrass *(Aira praecox)* • Yellow nutsedge *(Cyperus esculentus)* • Yellow sweetclover *(M elilotus officinalis)*

**species listed above are either invasive, too persistent, attract wildlife (forage), a wildfire hazard or have been proven to provide minimal cover*

Appendix C: Road and road management activities

The spread of invasive plants and noxious weeds is a significant issue in projects that involve soil disturbance. Earth moving activities contribute to the spread of weeds through movement of seeds and propagules contained in transitory soils. Prevention is the least expensive and most effective way to halt the spread of such plants. The three pillars of prevention for earth moving projects include:

1. Education of workers about the importance of managing weeds on an ongoing basis.

- Properly identify priority plants - training, brochures etc.
- Ensure that they know where the high risk sites are (i.e. sites that that you aim to protect)
- Ensure that they understand that storage areas, equipment yards and gravel pits are staging areas for IPs
- Actively use IAPP Application to record and monitor priority plants - it can be as simple as entering the species code, the area of the infestation (ha), location (UTM easting/northing and zone), density and distribution codes.
- Encourage staff to forward their ideas about measures that can be incorporated into future projects and strategic plans that prevent seeds or propagules from spreading and establishing new or bigger populations.

2. Prevention practices - minimizing the spread by controlling seed and/or plant part dispersal vectors:

- Where possible, avoid moving weed-infested gravel, rock and other fill materials to relatively weed free locations.
- Inspect and clean equipment of plant seed or propagules from clothing and/or equipment by dislodging and containing associated water, mud and dirt at designated cleaning stations or in the field (e.g. excavator operators can get most of the dirt from undercarriages, if they have been working among infestations, by spinning the machine 90 degrees, dropping a blade to elevate one track. He can then spin his track to remove the bulk of the material and use a narrow trenching shovel to remove the remainder. Repeat the process for the other track. Localize accumulations for ease of future treatment.)
- Keep roadside infestations away from road surfaces so that seeds and plant parts are not inadvertently transported by vehicles and equipment.
- Maintain soil, subgrade or surfacing material that is being moved during road construction as free of weeds as possible.
- Promptly re-vegetate disturbed areas adjacent to, or known to be at risk from priority IP establishment using an appropriate combination of scarification, grass seeding (native seed or a coastal agronomic seed that is a grade of Common #1 Forage Mixture or better), fertilizer, and/or mulch.

Appendix D

Chinook 22 priority plants for reporting to IAPP database are indicated with highlighted text; e.g., Common tansy

Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Anchusa	*Anchusa officinalis*	seed	dry open areas incl. fields and range areas	pull before seed set; competitive perennial seed	http://www.agf.gov.bc.ca/cropprot/weedguid/bugloss.htm
Baby's breath	*Gypsophila paniculata*	seed	dry open areas incl. fields and range areas	pull before seed set; competitive perennial seed	http://www.agf.gov.bc.ca/cropprot/weedguid/babysbreath2.htm
Black knapweed	*Centaurea nigra*	Primary - seeds; occasionally from root shoots	wide array of disturbed sites including riparian areas, range/pastures and cut blocks	small pops - pull/ large pops - mow and herbicide emerging seedlings; competitive perennial seed	http://www.weedsbc.ca/demo/pdf/black_knapweed.pdf
Blueweed	*Echium vulgare*	seeds	pastures/rangelands	small pops - pull/ large pops - herbicide; competitive perennial seed	http://www.weedsbc.ca/pdf/blueweed.pdf
Brown knapweed	*Centaurea jacea*	seeds and woody root crown	range and open areas incl open forests	small pops - pull/ large pops - herbicide; competitive perennial seed	http://www.nwcb.wa.gov/weed_info/Written_findings/Centaurea_jacea.html
Bull thistle	*Cirsium vulgare*	seeds	open disturbed areas	cutting and mowing prior to 'bolting'/competitive perennial seed.	http://www.weedsbc.ca/weed_desc/bull_thistle.html#
Canada thistle	*Cirsium arvense*	seeds/roots	open disturbed areas and riparian areas	herbicide, competitive perennial seed	http://www.weedsbc.ca/weed_desc/canada.html

Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Common burdock	*Arctium minus*	seeds	disturbed areas incl roadsides and riparian areas also range	mow after 'bolting' but prior to seed set. Eliminate seed bed. Can use herbicide.	http://www.weedsbc.ca/pdf/common_burdock.pdf
Common tansy	*Tanacetum vulgare*	seed/root	disturbed areas incl roadsides and riparian areas also range	Cutting and mowing in conjunction with other techniques as also spreads by roots	http://www.weedsbc.ca/pdf/common_tansy.pdf
Dalmatian toadflax	*Linaria dalmatica*	seed/root	disturbed areas incl roadsides and range/pasture	small pop - hand pull before seed set. Use competitive perennial seeding	http://www.weedsbc.ca/pdf/dalmation_toadflax.pdf
Diffuse knapweed	*Centaurea diffusa*	seed	disturbed areas incl roadsides and range/pasture	hand pulling/herbicides	http://www.weedsbc.ca/pdf/diffuse_knapweed.pdf
Field scabious	*Knautia arvensis*	seed	ditch lines and disturbed areas impacting range/pasture	small pop - hand pull before seed set. Larger pop - cut/mow before seed set	http://www.weedsbc.ca/pdf/field_scabious.pdf
Giant knotweed	*Polygonum sachalinense*	rhizomes and root fragments/seed	riparian areas and road sides, R/W	do not create opportunity to spread.	http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Knotweed-Control.pdf
Gorse	*Ulex europaeus*	seed	disturbed areas incl. roadsides and plantations	burning/mowing then herbicide	http://www.weedsbc.ca/pdf/gorse.pdf
Hoary alyssum	*Berteroa incana*		disturbed sites impacts range pasture	hand pull before seed set. Herbicide	http://www.weedsbc.ca/pdf/hoary_alyssum.pdf
Hoary cress	*Cardaria draba*	seed/root	disturbed sites incl. roadsides also pasture/range	herbicide/competitive perennial seed seeding	http://www.weedsbc.ca/pdf/hoary_cress.pdf

Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Hound's-tongue	*Cynoglossum officinale*	seed	disturbed soils especially pastures, cut blocks; prefers alkaline soils	hand pull small pops; mow before bolts, herbicide	http://www.weedsbc.ca/pdf/hounds_tongue.pdf
Japanese knotweed	*Polygonum cuspidatum*	Primarily reproduction is vegetative through long creeping rhizomes or by root fragments,	wetland/riparian and wet moist low lying areas	herbicide	http://www.agf.gov.bc.ca/cropprot/weedguid/jknotweed2.htm
Leafy spurge	*Euphorbia esula*	seed but primarily roots	rangeland	herbicide/ competitive perennial seeding	http://www.weedsbc.ca/pdf/leafy_spurge.pdf
Marsh (plume) thistle	*Cirsium palustre*	seed	pasturelands, plantations/moist to wet areas, riparian areas	hand pull small pops; mow before flowering/competitive perennial seeding	http://www.weedsbc.ca/weed_desc/marsh.html
Meadow hawkweed	*Hieracium pilosella*	seed, stolons, rhizomes	riparian areas, pastures, plantations	herbicides, grazing, competitive perennial seeding	http://mtwow.org/meadow-hawkweed-complex.html
Meadow knapweed	*Centaurea pratensis*	seed	rangeland/pastures	hand pull small pops; mow then herbicide new growth	http://www.weedsbc.ca/weed_desc/meadow.html
Nodding thistle	*Carduus nutans*	seed	rangeland/pastures/plantations	herbicide/ hand pull small pops.	http://www.weedsbc.ca/pdf/nodding_thistle.pdf
Orange hawkweed	*Hieracium aurantiacum*	vegetatively via stolons	pastures/rangelands	herbicide/competitive perennial seed, minimize disturbed soil.	http://www.weedsbc.ca/pdf/orange_hawkweed.pdf

Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Oxeye daisy	*Chrysanthemum leucanthemem*	seeds and vegetatively via roots	pastures/rangelands	herbicide/fertilizer/competitive perennial seed	http://www.weedsbc.ca/pdf/oxeye_daisy.pdf
Perennial pepperweed	*Lepidium latifolium*	seeds and vegetatively via roots	riparian areas, marshy floodplains, seasonally wet areas; pastures/meadows	mowing/burning/hand pull before seed set.	http://www.weedsbc.ca/pdf/perennial_pepperweed.pdf
Plumeless thistle	*Carduus acanthoides*	seed	pastures	herbicide; mow to eliminate seed production	http://www.weedsbc.ca/pdf/plumeless_thistle.pdf
Puncture vine	*Tribulus terrestris*	seed (burrs)	pasture/recreation areas	herbicide/competitive perennial seed	http://www.weedsbc.ca/pdf/puncturevine.pdf
Purple loosestrife	*Lythrum salicaria*	seeds, vegetatively by roots; also root and stem fragments	riparian areas, wetlands, streams, ponds	hand pull small pops but must get all of root/herbicide	http://www.weedsbc.ca/pdf/purple_loosestrife.pdf
Rush skeletonweed	*Chondrilla juncea*	seeds, vegetatively by roots	pastures, rangeland, meadows	hand pulling, cutting to prevent seed-set and herbicides	http://www.weedsbc.ca/pdf/rush_skeletonweed.pdf
Russian knapweed	*Acroptilon repens*	primarily vegetatively; possibly by seed	pastures, rangeland, meadows, plantations	mowing/cutting and herbicide	http://www.weedsbc.ca/pdf/russian_knapweed.pdf
Scentless chamomile	*Matricaria maritima*	seed	range, pastures; riparian and wetland areas and areas subject to seasonal flooding	hand pulling; early and frequent mowing; herbicide, competitive perennial seed.	http://www.weedsbc.ca/pdf/scentless_chamomile.pdf

Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Scotch broom	*Cytisus scoparius*	seed	plantations, pastures. range	hand pull but must get all of stump and roots/ mow while flowering; minimize disturbed soils; competitive perennial seed	http://www.evergreen.ca/en/cg/pdf/invasive/scotchbroom_factSheet.pdf
Scotch thistle	*Onopordum acanthium*	seed	range/pastures/crop land	herbicide before bolting or in fall on rosettes	http://www.weedsbc.ca/pdf/scotch_thistle.pdf
Spotted knapweed	*Centaurea biebersteinii*	seed	range/pastures	hand pull small pops but get all of root; herbicide; competitive perennial seed	http://www.weedsbc.ca/pdf/spotted_knapweed.pdf
St. John's wort	*Hypericum perforatum*	seed and via vegetatively from roots	range, pastures and meadows.	herbicide; seed with perennial grasses and forbs	http://www.weedsbc.ca/pdf/st_johns_wort.pdf
Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Sulphur cinquefoil	*Potentilla recta*	seed and via vegetatively from roots	range, pasture, grassland	herbicide; seed with perennial grasses and forbs; also cultivation	http://www.weedsbc.ca/pdf/sulphur_cinquefoil.pdf
Tansy ragwort	*Senecio jacobaea*	seed	pasture, hayfields, clear cuts	mowing, herbicides and competitive perennial seed	http://www.weedsbc.ca/pdf/tansy_ragwort.pdf
Teasel	*Dipsacus fullonum*	seed	disturbed sites	cutting/digging/burning; herbicide	http://dnr.wi.gov/invasives/fact/teasel_com.htm

Invasive Plant Species	***Scientific name***	**Spread mechanism**	**Habitat at Risk**	**Control: (Seed disturbed areas at all times excluding plantations.)**	**Web Link**
Yellow iris	*Iris pseudacorus*	underground rhizomes; seed	streams, wetlands, riparian areas, wet ditches	v. difficult due to location and source of spread. Multiple weedings over number of seasons required.	http://www.evergreen.ca/en/cg/pdf/invasive/yellow%20flag_factSheet.pdf
Yellow starthistle	*Centaurea solstitialis*	seed	rangeland, pastures	mowing, burning, herbicides	http://tncweeds.ucdavis.edu/esadocs/documnts/centsol.pdf
Yellow toadflax	*Linaria vulgaris*	seeds and vegetatively from roots	rangeland, pastures, plantations	competitive perennial seed, mowing, herbicide	http://www.weedsbc.ca/pdf/yellow_toadflax.pdf

Note: Where seed is the mode or spread then control measures should focus on activities that eliminate seed production, eliminate a seed bed, and/or create competition

Vegetative reproduction: a type of reproduction that occurs when a "parent" plant grows new plants from its roots, stems, or leaves

Species At Risk Management Process Standard Operating Procedure

February 24, 2011

PURPOSE

To define the various steps that are required to occur at different operational stages and identify the individuals who are responsible to undertake these steps to effectively manage and protect Species At Risk (SAR).

SCOPE

This Standard Operating Procedure (SOP) covers all aspects of forestry planning and block/road development, the signing and sealing of the applicable Site Plan, and implementation. It includes relevant business area staff, licensees, and contractors working for BCTS.

Important Information Sites

Conservation Data Centre: This site's Internet Mapping Service (IMap) will be utilized to identify known occurrences of Species At Risk: http://www.env.gov.bc.ca/cdc/access.html

BC Species and Ecosystems Explorer: Species and Ecosystems Search: utilize this site to confirm various Species At Risk and to access reports concerning specific species at risk. This site can also be used to see mapped locations of a specific species: http://www.env.gov.bc.ca/atrisk/toolintro.html

UBC Herbarium: This site contains a database that details the location of known SAR. It only provides written descriptions of locations and latitude and longitudinal information: http://www.beatymuseum.ubc.ca/herbarium/index.html

Recent Changes (Feb. 24, 2011): This SAR SOP has been updated to include reference to using the UBC Herbarium layer in Cengea Resources rather than having to go to the Herbarium website as an additional source for locating known information of rare and endangered plants. References to District SAR listings have been removed.

Note: this SOP is linked to the SAR Process Design Map.

PROCEDURE	RESPONSIBILITY
Stage 1: Block Planning SAR Management	
• Ensure blocks have passed initial economic viability test; i.e. ensure it meets *PP Done* test.	*Planning Forester* *Practices Forester*
• Confirm location of potential cut block and associated road networks	*Practices Forester*
• Check CDC website utilizing *IMap* function to determine if any SAR have been mapped within area of proposed activity o Record any findings of relevant SAR ▪ If necessary complete and submit CDC *Custom Data Request*	*Practices Forester*
• Check UBC Herbarium map layer in Resources to determine if any SAR have been mapped within area of proposed activity. o Record any findings of relevant SAR ▪ If necessary complete contact expert in plant ID	*Practices Forester*

Species At Risk Management Process
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PROCEDURE	RESPONSIBILITY
• Determine management options for each SAR discovered on CDC IMap website or on UBC Herbarium map layer: o Discuss with Planning Officer/Forester, Area Forester/Woodlands Supervisor and/or Woodlands Manager to see if there are any previous commitments related to species management; e.g., Phantom orchid, tailed frog, etc., or recommendations provided by Qualified Professional o If no management recommendations available consult with Qualified Professional ▪ discuss Qualified Professional's recommendations with Area Forester/Woodlands Supervisor and Woodlands Manager	*Practices Forester* *Multiphase Forester* *Planning Forester* *Qualified Professional*
• Review BA SAR plant, animal, and ecological community listing to determine potential SAR species in area of proposed activity. o Make list of potential SAR species that could be encountered ▪ If uncertain about potential of SAR in area of proposed activity have the area field reviewed by a Qualified Professional.	*Practices Forester* *Multiphase Forester* *Qualified Professional*
• Review Chinook plans and policies to determine if there are any pre-existing SFI/EMS SAR commitments in relation to SAR management; e.g., percent Deer Winter Range available for harvest.	*Practices Forester* *Multiphase Forester*
• Update and/or review SAR tracking form and attach to SAR Block Activity in Cengea Resources with other relevant documents and comments	*Practices Forester* *Multiphase Forester*
• Determine if block planning should proceed based upon management recommendations	*Practices Forester* *Multiphase Forester* *Planning Officer*
• During field review collect basic coarse ecological information necessary to assist with use of MOE Species Explorer/TCH SAR database o BEC, subzone, variant o Primary forest cover/landscape attributes • If uncertain about potential SAR prior to field visit engage Qualified Professional during field visit • Detail any SAR located in field and discuss management options with Area Forester/Woodlands Supervisor, Woodlands Manager and/or a Qualified Professional • Determine if proposed activity should occur based upon SAR recommendations	*Practices Forester* *Multiphase Forester* *Qualified Professional*
Stage 2: Block/Engineering Layout Pre-work (Multiphase)	
• Confirm location of proposed block or road	*Practices Forester* *Multiphase Forester* *Operations*

PROCEDURE	RESPONSIBILITY
• Summarize findings from block planning stage if applicable for handover to multiphase staff/contractor(s)	*Operations Technician*
• Prior to pre-work meeting, check CDC website utilizing *IMap* function to determine if any new SAR have been mapped within area of proposed activity prior to pre-work meeting o Record any findings of relevant SAR • If necessary complete and submit CDC *Custom Data Request*	*Multiphase Forester* *Operations Technician*
• Check UBC Herbarium map layer in Resources to determine if any SAR have been mapped within area of proposed activity. o Record any findings of relevant SAR ▪ If necessary complete contact expert in plant ID	*Multiphase Forester* *Operations Technician*
• Update SAR tracking form and attach to SAR Block Activity in Cengea Resources with other relevant documents and comments	*Operations Technician* *Multiphase Forester*
• Provide SAR summary to contractor with any SAR management recommendations including those from Qualified Professionals where available	*Operations Technician*
• Discuss how contractors SAR field investigations should be documented o In site plan under relevant R/S o As supporting document to Site Plan o In the SP declaration letter o Private filing with documentation available upon request	*Practices Forester*
• Review capabilities of CDC and MOE "Species Explorer" websites, and UBC Herbarium map layer with contractor; reports, maps, reference material, etc.	*Operations Technician*
• Operations Tech to communicate with multiphase contractor during monthly progress meetings Re: any new SAR found	*Operations Technician*
Stage 3: Field Work Quality Assurance (Inspection)	
• Select blocks for review based on EMS and SAR risks	*Practices Forester*
• Review pre-work (Multiphase) notes and material, including SAR management strategies	*Operations Technician* *Practices Forester*
• Check CDC website utilizing *IMap* function to determine if any new SAR have been mapped within area of proposed activity prior to pre-work meeting o Record any findings of relevant SAR • If necessary complete and submit CDC *Custom Data Request*	*Operations Technician* *Practices Forester*
• Check UBC Herbarium map layer in Resources to determine if any SAR have been mapped within area of proposed activity. o Record any findings of relevant SAR ▪ If necessary complete contact expert in plant ID	*Operations Technician* *Practices Forester*

PROCEDURE	RESPONSIBILITY
• Check field ecological classification for accuracy to aid in proper identification of potential SAR species/communities	*Operations Technician* *Practices Forester*
• Where uncertain about potential for SAR in proposed area of activity engage Qualified Professional to jointly conduct field review.	*Operations Technician* *Practices Forester* *Qualified Professional*
• Ensure previously identified SAR are adequately managed • Record any new SAR found in field and discuss management recommendations with multiphase Forester/Practices Forester • If uncertain about management recommendations seek input from Qualified Professional	*Operations Technician* *Practices Forester* *Qualified Professional*
• Update SAR tracking form and attach to SAR Block Activity in Cengea Resources with other relevant documents and comments	*Operations Technician* *Practices Forester* *Multiphase Forester*
Stage 4: Site Plan/Road Site Plan Quality Assurance	

• Site Plan prepared by multiphase or in-house
• Site Plans peer reviewed:
  • Review CDC website and UBC Herbarium map layer to check for any new SAR occurrences
  o If new SAR found determine management requirements with QP input as deemed necessary
  o Refine SP/field work to incorporate new SAR finding(s) if block still economically viable
  • BA staff should review Site Plan to ensure SAR has been considered and management options are suitable for species habitat needs.
  • Review SAR management options detailed in SP to ensure consistency with previous BA commitments
  • Review any submissions by qualified professional(s) to ensure that they have been properly incorporated into the Site Plan and block/road engineering
  • Seek corrections if inconsistencies or errors/omissions discovered
  • Confirm documentation is present, if required, in relation to SAR and associated reports and recommendations.
	Practices Forester
	Multiphase Forester

• Update SAR tracking form and attach to SAR Block Activity in Cengea Resources with other relevant documents and comments	*Practices Forester* *Multiphase Forester*

• Annual, detailed BA risk-based review of Site Plan population
  • Focus on any high risk EMS/SAR areas that may have been previously identified by BA Planning section
  • Confirm documentation is present, if required, in relation to SAR and associated reports and recommendations.
	Practices Forester
	Operations Technician

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PROCEDURE	RESPONSIBILITY
Stage 5: TSL/Contract Package Preparation	

• During preparation of TSL package, review CDC website and UBC Herbarium map layer in Resources to determine if any new SAR occurrences have been mapped in proposed area of activity
  • If new SAR found determine management requirements with QP input as deemed necessary
  • Refine SP, etc to incorporate new SAR finding(s) if block still economically viable
	Operations Technician
	Multiphase Forester

• Update SAR tracking form and attach to SAR Block Activity in Cengea Resources with other relevant documents and comments	*Operations Technician* *Multiphase Forester*
• Review any SAR specific details that must be addressed in TSL or contract documents to ensure they are adequately incorporated into plan	*Operations Technician* *Multiphase Forester*
Stage 6: TSL/Contract Pre-work	
• Review any SAR specific details in Site Plan with Licensee including discussions around how SAR management options were integrated into the block/road engineering and related Site Plans	*Forest Technician* *Operations Technician*

• Provide summary of species characteristics to TSL Licensee to enable additional identification of new occurrences in the field
  o SAR name; Latin, common
  o Pictures
  o Reports
	Forest Technician

Stage 7: Conformance Quality Assurance (Inspection)	
• Review relevant plans and SAR descriptions/information to familiarize self with potential species	*Forest Technician*
• Review relevant plans to ensure thorough understanding of how SAR species habitat needs were to be addressed in the field.	*Forest Technician*
• Check operations to ensure consistency with legal plans.	*Forest Technician*
• Where deviations from the plan have occurred that impact SAR follow standard conformance process. o Ensure appropriate agencies have been notified.	*Forest Technician*
• Ensure non-conformances and/or potential non-compliances have been entered into the EMS Issue Tracking System and Action Plan has been developed.	*Forest Technician*
• Return to field for follow-up inspection(s) to ensure any Action Plans/mitigation strategies have been implemented	*Forest Technician*

Wet Weather Safety Shutdown Guidelines (WWSSG) (Rainfall &Snowmelt)

CHINOOK BUSINESS AREA

Important : These shutdown guidelines **are focused on safety;** but may also contribute, in part, to maintaining water quality as these guidelines can reduce the likelihood of worker caused landslide initiation during operations. In most cases operations may have ceased prior to reaching these shutdown guideline limits due to the requirements of other operational controls.

The primary control mechanism to protect water quality is through the operational controls of the EMS. The EMS plays a significant role in water quality as it requires the licensees and contractors to manage erosion and sediment delivery into water bodies appropriately and as required; if the operational controls cannot adequately maintain water quality, operations would be required to cease.

The Chinook BA has been divided into 3 broad precipitation zones each with its maximum water inputs (operational limits) for fixed time periods; "Shift end", 24, 48, and 72 hours. The Chinook BA Staff will indicate which zone you are operating in and the applicable shutdown limits.

The licensee or contractor may use their operational procedures in conjunction with the Chinook BA precipitation zone maps which sets the operational limits for the zone they are working in. If the licensee or contractor does not have their own WWSSG they may consider using the guidelines developed for the Chinook BA. The Business Area Staff representative can review the Chinook BA guidelines with the licensee or contractor at their request.

Excavation Caveat

WorksafeBC Section 20.78 (Excavations) requires written instructions by a qualified professional that specifies the influence of changing weather conditions on the stability of the excavation. This procedure does not waive or take precedence over the requirements of WorksafeBC Section 20.78

A. Environmental signs that require immediate work shutdown and evacuation of the worksite

A. Shutdown when these conditions exist.
   a. Sudden muddy water in creek (especially in gullies)
   b. Sudden lack of flow in streams during wet weather
   c. Cracks appearing in the soil
   d. Small (anything ≥1m x 1m) sloughs of soil occurring
   e. Anchor stumps pulling out in wet soil
   f. Landslides occurring in the general area, or sounds of landslides occurring
   g. Sloughs in road cuts, especially during road construction or deactivation.

B. Operational Conditions where Wet Weather Shutdown Guidelines Should Be Utilized

   a. Worksite on or below landslide–prone terrain
      i. Definition of "landslide-prone terrain": Areas mapped **U** or **P** on reconnaissance terrain mapping, or mapped Class **V**, Class **IV**, or Class **III** on detailed terrain mapping, or, if no terrain mapping available, any area with slopes **>60%** (**>50%** in Haida Gwaii District), or areas that show signs of instability, or any areas that are defined as having a high or moderate failure potential in Tables A1 or A2 of the Gully Assessment Procedure Guidebook (GAP).

ii. Definition of areas "below landslide-prone terrain": Areas with smooth open slopes or flat ground (no gullies, incised streams, or draws) are considered to be below landslide-prone terrain unless there is **>300 m** of terrain with a slope gradient **<30%** between the landslide prone terrain and the work site or travel route. Any confined area in a gully, or incised stream or draw area, or alluvial fan below a gully, is below landslide prone terrain if there is any upslope landslide prone terrain.

b. Use the "Unstable upslope road conditions" operational limits in Table 1 if there is a road(s) upslope of worksite that is on, or above, landslide-prone terrain and the road(s) has any of the following conditions.
   i. Uncontrolled drainage
   ii. Blocked culverts
   iii. Tension cracks
   iv. Other signs of instability

c. **Note:** Under sunny conditions resulting in snow melt if there is snow on or upslope of work site and road networks exist upslope that have not been assessed for factors listed in Sec. B subsection b. above, do not work unless measurements of snowmelt, and subsequent conversion to water equivalents (mm), are taken and compared to Table C below.

C. **Chinook Precipitation Zones:** *Operational Limits*

Table #1: Operational Limits for this worksite are shaded in gray:

(Ops Tech to highlight the appropriate precipitation zone and operational limits for the specific worksite i.e. licence or contract)

Zone	Shift end	24 hour	48 hour	72 hour
Very Wet Zone	50mm	100mm	150mm	200mm
Wet Zone	45mm	80mm	130mm	170mm
Drier Zone	30mm	50mm	80mm	110mm
Unstable upslope road conditions	10mm	20mm	30mm	40mm

D. Recommencement of Operations

If any of the water input operational limits for the work site are exceeded via addition of precipitation as measured in a rain gauge added to input levels from snowmelt for tables #2 and/or #3 or #4 (where applicable) then shut down operations as soon as possible

Shutdown for a minimum of one day, and stay shutdown if water inputs continue to exceed any of the operational limits. Maintaining a base station for measuring rainfall and snow melt, and using weather forecasts will help avoid travelling to the work site during shutdown conditions. Restart operations when all of the water inputs are below the operations limits

Wet Weather Safety Shutdown Guidelines (WWSSG) (Rainfall &Snowmelt)

CHINOOK BUSINESS AREA

Snow Melt Soil Moisture Input

Snow melt is an important factor in determining the total soil moisture input. The following tables provide guidance as to the amount of snow melt **that must be added** to the precipitation recorded in a rain gauge at the worksite in applicable situations. Snow melt must be considered at or above the worksite; i.e., where the melt event is occurring.

Table #2: 24 Hour Snowmelt additions during rain-on-snow events

Average Temperature[1]	Open Area			Forested Area		
	WIND[2]			WIND[2]		
	Low	***Moderate***	***High***	***Low***	***Moderate***	***High***
0.5-2.0˚C	3mm	10mm	25mm	1mm	5mm	11mm
2.1 – 5.0˚C	15mm	35mm	75mm	5mm	10mm	25mm
5.1-10.0˚C	25mm	70mm	120mm	10mm	28mm	40mm
10.1-15˚C	35mm	95mm	160mm	15mm	40mm	60mm

Table #3: Hourly snow melt during rain-on-snow events[3]

Average Temperature[1]	Open Area			Forested Area		
	WIND[2]			WIND[2]		
	Low	***Moderate***	***High***	***Low***	***Moderate***	***High***
0.5-2.0˚C	0.15mm	0.45mm	1.05mm	0.04mm	0.2mm	0.5mm
2.1 – 5.0˚C	0.65mm	1.5mm	3.15mm	0.2mm	0.4mm	1.2mm
5.1-10.0˚C	1.05mm	3.0mm	5.0mm	0.4mm	1.2mm	1.7mm
10.1-15˚C	1.5mm	4.0mm	6.7mm	0.65mm	1.7mm	2.50mm

Table #4: Snow melt during sunny conditions

Average Temperature[1]	24 hr Melt		Hourly Melt[3]	
	Open	**Forested**	**Open**	**Forested**
0.5-2.0˚C	8mm	2mm	0.3mm	0.1mm
2.1 – 5.0˚C	24mm	4mm	1.0mm	0.17mm
5.1-10.0˚C	43mm	17mm	1.8mm	0.7mm
10.1-15˚C	53mm	21mm	2.2mm	0.9mm
>15˚C	65mm	25mm	2.7mm	1.1mm

[1] **Average Temperature** is calculated by adding the maximum and minimum temperature for the time period and dividing by 2.
OPTIONAL: Temperature decreases at ***0.5^{0}C*** for every *100m* increase in elevation for **rain-on-snow** and ***1.0^{o}C*** for **sunny conditions**.

[2] ***Low*** (<10 km/hr): Leaves and small twigs in constant motion speed; wind extends light flag
Moderate (10-20km/hr, gusts >30km/hr)**:** Small trees sway, maps/paper difficult to hold still.
High (>20km/hr, gusts >40km/hr)**:** Whole trees in motion, clouds moving rapidly, rain blowing sideways.

[3] Using hourly melt rates to calculate 24 hr melt rates will not equal values in Table 2 and Table 4 because numbers were rounded for ease of calculation.

IF WIND SPEED INDICATORS OVER UNSTABLE TERRAIN CANNOT BE SEEN, ASSUME WIND SPEED IS *HIGH*. WINDSPEED *ALWAYS* INCREASES WITH ELEVATION (MOUNTAIN TOP WINDS ARE HIGHER THAN VALLEY BOTTOM). IT IS RECOMMENDED THAT IF UNCERTAIN ABOUT ANY PARAMETER USE THE MOST CONSERVATIVE VALUES TO ENSURE WORKER SAFETY

.

Wet Weather Safety Shutdown Guidelines (WWSSG) (Rainfall &Snowmelt)

CHINOOK BUSINESS AREA

Sample WWSSG Data Sheet

Location:_____Precipitation Zone:_____

Water Input Operational Limits:

Shift end:_____ 24-hr_____ 48-hr_____ 72-hr:_____

A	B	C	D		E			F	G	H	I	J	K
					Temperature (°C)								
Date	Time	Rainfall (mm)	Open or Forest ? (**O** or **F**)	Wind Speed Class (**L, M, H**)	Min	Max	Ave	Snow melt in (mm)	Water Input mm (Col C+D)	Shift end (mm)	24 hr total (mm)	48 hr (mm)	72 hr (mm)

MEMORANDUM OF UNDERSTANDING
REGARDING INTERIM MANAGEMENT OF
MARBLED MURRELET AND NORTHERN GOSHAWK HABITAT

BETWEEN:

The Province of British Columbia, represented by

The Ministry of
Forests, Lands and Natural Resource Operations

AND:

Coast Forest Products Association

(Collectively referred to as the "Parties")

Preamble:

The Province of British Columbia is in the process of developing Implementation Plans for Marbled Murrelet and Northern goshawk *(laingi* subspecies). The Implementation Plans and associated actions are intended to set provincial recovery objectives which will enable the Province to demonstrate continued progress related to the management of these species.

For Marbled Murrelet and Northern goshawk *laingi,* critical habitat has been identified (or is pending identification) under the federal *Species at Risk Act* (SARA). The Province intends to demonstrate that existing protections and the designation of new protections will "effectively protect" critical habitat on Crown lands where it aligns with provincial recovery objectives. This MOU is required to ensure management options are maintained while Implementation Plans are being developed.

Inventory efforts and research are continuing to improve knowledge on the species' occurrences, to identify key habitats, and to support additional management actions.

The intent of this Memorandum of Understanding (MOU) is to:

- Ensure that the expectations of the Parties to this MOU regarding the principles, processes and actions to be completed under the MOU are understood and accepted.
- Ensure draft Wildlife Habitat Area (WHA) management options are available to support viable Implementation Plans for the Marbled Murrelet and Northern Goshawk *laingi* subspecies.
- Support a coordinated approach in the assessment and identification of WHA options that may progress to a statutory decision.

This MOU is not intended to:

- Create legally binding obligations, nor does it describe or reference all matters for which agreement must be reached in order for an activity to proceed.

- Disadvantage any party that chooses not be a signatory to this agreement.
- Reduce or alter the accountability for decision-making where government has full and exclusive responsibility to act under authority of statute or regulation, or fetter the discretion of any decision-maker.
- Apply to cutblocks and roads in approved cutting authority areas, approved road permits and issued Timber Sale Licenses or Declared blocks. (Minor boundary amendments can be made if agreed to by both parties).
- Apply to cutblocks and roads that have a significant investment in planning and layout (unless the parties agree to defer activity in these areas).
- Cover foraging habitat management provisions for Northern Goshawk.

The Parties to this MOU will:

- Support proposed WHAs proceeding to statutory decision-makers for determination where meaningful engagement[1] has occurred and there is mutual agreement by the Parties.
- Defer harvesting of areas confirmed through mutual agreement to be required to support provincial Implementation Plan objectives.
- Maintain areas on a distinct map layer and supporting spreadsheet that may be amended as new information becomes available.
- Commit to information-sharing related to operational management of known and newly-discovered Northern Goshawk nest sites.
- Undertake activities that are consistent with and support the provincial recovery objectives for Marbled Murrelet and Northern Goshawk *laingi* to the extent practicable.
- Use the best available information to guide operational decisions.
- Seek to ensure that areas being considered for potential WHAs are assessed and configured in a manner that maximizes the use of co-location, constrained and/or un-harvestable areas where possible.
- Seek to ensure that areas being proposed for WHA designation are consistent with and support provincial recovery objectives where possible.
- Enable minor boundary adjustments to habitat areas for operational reasons where there is mutual agreement by the Parties.
- Develop criteria/protocols for operational management considerations for newly discovered nests.
- Participate in regular reviews of new information as inventory and monitoring efforts continue, to determine if additional areas can/ should be included in this MOU.
- Look for new and innovative approaches to effectively manage species habitat requirements.

[1] Engagement is represented by meaningful attempts to seek and incorporate, where practicable, input from potentially affected parties to minimize impacts to Forest Act agreement holders and BCTS.

Monitoring and Inventory

The Parties will work together to develop monitoring and inventory projects that will:

- Continue to build an understanding of the distribution and habitat use by Marbled Murrelet and Northern Goshawk *laingi;*
- Develop and enhance monitoring protocols to enable Forest Act agreement holders and BC Timber Sales to monitor the use of known nest sites by Northern Goshawk *laingi;*
- Inform development of criteria/ operational protocols for managing new breeding areas discovered during block planning or harvesting;
- Refine information-sharing mechanisms to ensure the most up to date inventory data is available for planning and analysis;
- Provide an opportunity to modify or adapt the Implementation Plan to reflect new information;
- Review the effectiveness of existing protection measures to ensure that they are consistent with and support the provincial Implementation Plan recovery objectives for Marbled Murrelet and Northern Goshawk *laingi;*
- Support completion of Implementation Plans for Marbled Murrelet and Northern Goshawk *laingi.*

Communications

Subject to all applicable laws, the Parties will share information regarding the location of nests sites, suitable habitat, and proposed development activities that may affect nest sites or nesting habitat, and information related to areas identified as priorities for field inventory and assessment.

The Parties will support this MOU in communications materials relevant to this agreement for their respective constituents.

Dispute Resolution

The Parties agree to resolve disputes related to this agreement through the Manager responsible for species at risk recovery and a representative of the signatories to this agreement. Only where disputes cannot be resolved at this stage will resolution be pursued and resolved by the signatories of this agreement.

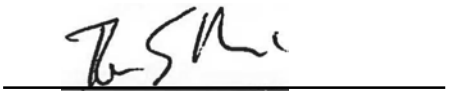
Term

The term of this MOU begins from the date of signature until hnplementation Plans for these species are approved with relevant conservation and management measures in place.

This MOU may be revised from time to time upon the agreement of the undersigned.

This MOU may be cancelled at any time upon the agreement of the undersigned.

Signatories:



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BRITISH COLUMBIA
The Best Place on Earth

Ministry of Forests and Range

Executive

MEMORANDUM

File: 195-40

MAY 0 1 2008

To: Regional Executive Directors
District Managers

From: Tim Sheldan
Assistant Deputy Minister
Operations Division

Jim Snetsinger, R.P.F.
Chief Forester

Re: Incorporation of mixedwood and broadleaves into Forest Stewardship Plan stocking standards, SP amendments and TSR regeneration assumptions

Interest in the role and use of broadleaf species in the future timber supply and in satisfying silvicultural obligations throughout the province has been increasing. The intent of this memo is to update the previous Chief Forester (CF) memo on *Silviculture Prescription Submissions that Include Broadleaf Species* (August 22, 2000) and provide guidance on the conditions that Delegated Decision Makers (DDM) may consider prior to making a determination that provides for an increase in the use of hardwoods to satisfy silvicultural obligations.

The incorporation or existence of broadleaf species in a stand may be desirable for a number of reasons, including broadleaf timber production, biodiversity, increased resiliency to climate change, wildlife habitat, nurse crops for conifers, reducing the risk of fire and forest health problems, and potentially increasing yield. Some of these benefits are currently promoted, in part, by the practices of retaining low levels of mature hardwoods after harvest, the tolerance of low levels of hardwoods at free-growing as per Appendix 9 of the *Establishment to Free Growing Guidebook* (May 2000), and the management of mixedwood stands in certain management units (e.g., NE British Columbia).

Any change in management direction from conifer to mixedwood or broadleaf production should be preceded by careful analysis and setting of clear objectives before a stand is harvested. Successful broadleaf or mixedwood management is an active process and cannot usually be achieved through default of failed coniferous management.

As part of the ministers consideration of stocking standards identified under *Forest Planning and Practices Regulation* (FPPR) sections 26(3) and (4) stocking standards need to:

(1) demonstrate that the area will be stocked with ecologically suitable species that address the immediate and long term forest health issues;

(2) maintain or enhance an economically valuable supply of commercial timber; and

(3) be consistent with the timber supply analysis and forest management assumptions that apply to the area.

Broadleaf species in the tree species selection guidelines

The species selection guidelines of the current *Reference Guide to Forest Development Plan Stocking Standards* outline those ecosystems where the management of hardwoods may be ecologically appropriate. The footnotes in that guide differentiate as to whether or not a broadleaf species is a feasible regeneration option.

Broadleaves to fulfil silviculture obligations in Forest Stewardship Plan (FSP) stocking standards

Stocking standards specified within a FSP are expected to be consistent with the Timber Supply Review (TSR) and the forest management assumptions for the plan area. Broadleaf or mixedwood stocking standards specified in an FSP in a timber supply management unit (i.e., Timber Supply Area (TSA), Tree Farm Licence (TFL), or Woodlot Licence (WL)) with a TSR that does not assume any broadleaf management may be considered as not being consistent with that TSR. However, that does not mean that broadleaf or mixedwood management standards are inappropriate if they fit with changing management objectives within the management unit.

Where proposed stocking standards are not consistent with TSR and forest management assumptions, FPPR section 26(5) provides the minister or DDM the authority to approve those standards when they do not conform to FPPR sections 26(3) and 26(4). In the case of the incorporation of broadleaves consideration should be given whether it is the intention to **actively manage** for mixedwood or broadleaf stands (e.g., consideration is given to the processes of stand and product development) having reasonable regard to the future timber supply of the encompassing management unit. In these situations the DDM may request additional information to allow the estimation of the potential impacts on timber yield. Also in light of adaptive management it may be appropriate to initially establish limited scope and scale operational trials.

When a broadleaf species is proposed to fulfil silviculture obligations, consideration should be given to the species productivity, reliability and feasibility as a regeneration option for the production of commercially valuable timber along with the species ecological suitability. Also, consideration should be given as to whether the broadleaf species in fulfilling the silviculture obligation satisfies any one of these conditions:

1. Broadleaves are deemed suitable as a new forest crop as either pure or mixedwood stands on the basis of:

    a. Broadleaf species are currently or will be included in the estimation of volume contributing to a management unit's timber supply. For example, management units in the northeast with broadleaf regeneration assumptions and/or an allowable annual cut, or;

    b. Broadleaf species are currently included as part of an over-arching Land Use Objective for that area.

2. Their use is consistent with a science based strategy (e.g., TSA silviculture strategy or TFL Management plan) that provides stated management objectives for broadleaves. These science-based strategies should incorporate careful analysis of growth and yield implications and set out viable silviculture regimes that will achieve the management objectives.

3. Broadleaves are to be used to reduce catastrophic fire risk in Wildland Urban Interfaces under the guidance of a Community Wildfire Protection Plan, or;

4. Broadleaves are to be used as a short-rotation interim crop to manage for root rot centres. While research does suggest that, in certain pathosystems, broadleaves can be successfully used to address root diseases, it is critical that prior to undertaking this approach, sufficient analysis of the disease, broadleaf, and conifer interactions be conducted. Therefore, this practice should only be considered as an operational trial and is not recommended for widespread use at this time until more definitive recommendations are produced.

Damage criteria for broadleaf species are not provided in Appendix 5 (Free Growing Damage Criteria for British Columbia) of the *Establishment to Free Growing Guidebook* (May 2000). The different growth habits and pests of broadleaves require a separate set of criteria that are currently being developed. In the interim, damage criteria may need to be established in a district standard operating procedure or similar where broadleaves are proposed in the stocking standards to fulfil silviculture obligations. Regional and branch forest health staff or other forest health experts should be consulted when developing local broadleaf damage criteria.

Where broadleaves are not intended to be part of the future commercial harvest it is anticipated that objectives such as nurse crop, nutrient cycling, general biodiversity, visuals, or other non-timber values will be achieved through free growing criteria that allow for a broadleaf component within the stand, but at a stocking level that will have minimal impact on the growth rate of the commercial timber producing portion of the stand. Examples of such criteria are outlined in Appendix 9 of the *Establishment to Free Growing Guidebook* (May, 2000).

Incorporation of broadleaves into existing approved Site Plans or Silviculture Prescriptions

The regeneration of broadleaves in either pure or mixedwood stands requires active well thought-out strategies and actions. Amending broadleaves into existing under-achieved conifer stocking standards may be a reasonable option when considered as part of a larger broadleaf/mixedwood strategy for that management unit, as part of one of the conditions listed above for FSPs, or when no other practicable options exist.

Broadleaf species and timber supply review regeneration assumptions

Based on past practices, the current TSR assumption in the majority TSAs and TFLs, is that disturbed areas will regenerate to pure conifer. Where management of broadleaf species is being introduced, the growth and yield projections for future timber supply analysis should reflect this shift. Where FSPs, Forest Development Plan stocking standards, or SPs have been approved that include broadleaves to fulfil silviculture obligations, the species assumptions

for regeneration should be reviewed and modified as required in the next round of TSR if the total area to which this strategy applies, and is carried out, is significant.

We believe that the complex mix of forest resource management issues in British Columbia requires a diversity of stand and forest conditions across the province. The acceptance and tolerance of broadleaves are an important contribution to this objective. Appropriate decisions with respect to broadleaf management require a clear statement of objectives at the TSA or TFL level. To this end, we encourage joint dialogue between industry and government that will lead to appropriate management unit timber supply objectives and the silviculture regimes required to achieve them.

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Hardwood Management in the Coast Forest Region

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Introduction

In October of 2007 the Minister of Forests introduced the Coast Forest Action Plan. This plan presents a vision for a competitive and sustainable coastal forest sector. One of the components of the Coast Forest Action Plan is to *"Encourage the utilization and management of Deciduous species"*. Deciduous or hardwood management has been successfully implemented, to a limited, extent over the past decade within the Coast Forest Region. During this period Red Alder (*Alnus Rubra*, *Bong*) has proven to be a valuable commercial species. The value of Red Alder sawlogs have appreciated more rapidly than any other coastal species. This increased value has been recognized by the coastal silviculture community which has debated the merits of Red Alder as a preferred crop species.

As broad scale hardwood management is fairly new to coastal British Columbia (BC), it is essential that a strategy based on the best science available, but flexible enough to adapt to new information arising from the application of this science be pursued. This strategy is intended to strike this balance.

The support and expansion of hardwood management will:

- Diversify the coastal fibre supply to accommodate demands for non conifer timber products.
- Enable a wide range of timber products to become available to aid in stabilizing the flow of timber from the forest land base.
- Ensure a diverse supply of timber is available in the medium and long term.

Hardwood Management Strategy Objectives

This strategy will:

- Present a strategy consistent with the Coast Forest Action Plan as presented by the Minister.
- Provide context for the review of hardwood management strategies at Timber Supply, Landscape Unit Plan, and Forest Stewardship Plan levels.
- Develop broad scale principles to guide professionals and decision makers in the preparation and review of hardwood management strategies and regimes by:
    - Focusing management on the production of sawlogs,
    - Developing ecological evaluation filters to focus efforts on the most appropriate growing sites, and identifying the most suitable geographic areas.
- Identify Red Alder, Big Leaf Maple, and Birch as the most suitable coastal hardwood species for sawlog management.

Regional Committee

Due to the complexity created by the broad administrative area of the Coast Forest Region, and the limited experience in applying scientifically-based hardwood management regimes, it is essential that implementation be consistent and co-ordinated. To this end a regional committee will be formed to guide the implementation of the Hardwood Management Strategy.

This committee will be a working group composed of forest professionals representing the coastal forest industry and the Ministry of Forests and Range, as well as hardwood management experts. This group will develop standards of performance, guide and monitor implementation and provide limited mentoring services to ensure the success and growth of the program.

Standards of performance will be primarily broad-based, focused on the flow and production of timber. A monitoring program will track performance against these standards and provide feedback regarding the appropriateness of the standards to coastal BC ecosystems. Mentoring and training programs will be designed to close any gaps that exist between standards and actual performance, and provide a forum for feedback and exchange of ideas and success stories.

A regional hardwood management committee will be integral to the successful implementation of a hardwood strategy on the BC coast.

Implementation

This strategy is intended for implementation in the Coast Forest Region at the Tree Farm Licence (TFL) and Timber Supply Area (TSA) level. Formal targets may be established through the Timber Supply Review process for each management unit. These targets will be developed to ensure opportunities are distributed and capitalized. An important component of this strategy will be the ability to measure how management activities affect the amount, type and spatial distribution of hardwood stands across the coastal land base.

In the interim it is suggested that the Coast Forest Region adopt a target, to actively manage for and grow, up to 1200 ha per year of hardwood species for sawlog production. This interim target is based on the desire to grow a standing hardwood timber inventory to support approximately 300,000 m^3 of annual timber harvest. Based on where the current hardwood volume is located and the most productive ecological subzones for growing these hardwoods (primarily Red Alder), it is suggested that the targeted area be distributed within management units[1] across the following coastal forest districts:

- Sunshine Coast District (DSC) – 250 ha per year[2]
- Chilliwack District (DCK) – 250 ha per year
- Campbell River District (DCR) – 200 ha per year
- North Island –Central Coast District[3] (DPM) – 200 ha per year
- South Island District (DSI) – 100 ha per year
- Other Districts[4] – 200 ha per year

[1] Includes TFL and TSA
[2] Average number of ha per year over a 5 year period as determined by date of harvest
[3] Includes both Kingcome and Mid Coast TSAs
[4] The total 200 ha per year allocated between the North Coast District (DNC), Queen Charlotte Island District (DQC), and the Squamish District (DSQ).

Within the above districts license holders, will need to agree and commit to the portion of the target area each licensee will manage towards. Monitoring performance towards achievement of these targets would be completed using the Reporting Silviculture Updates and Land Status Tracking System (RESULTS) forest cover and stocking status data submitted by licensees.

Geographic Considerations

Successful implementation of this strategy will be dependant on planning future timber flow patterns. The harvest opportunity of a hardwood stand falls within a narrower time spectrum than a conifer stand. Therefore, a strategic perspective that incorporates stand location and planned timber flow should be considered as part of the hardwood management strategy. Stand locations should be chosen to optimize planned timber flow and to create logical future harvest units. Large units located in areas where adjacent conifer stands will be harvested at similar timing to the hardwood stand will aid in off setting fixed development costs.

A conservative consideration of future operating costs should direct stand locations to areas that have ready access to road infrastructures and gentle terrain. Helicopter access and or steep terrain should be avoided due to increased costs and complexity relating to future harvests.

Timber Supply

This strategy is directed at the supply of timber. The diversification of the regional timber supply will assist in achieving the objectives of the coast recovery plan. Adjustments to the timber supply models will be required at a future date as the strategy progresses. A review of the current standing hardwood timber inventory and potential land base has been completed as a separate component of the Coast Forest Action plan.

Legislation

Forest and Range Practices Act

Landscape level forest development and planning activities are implemented and administered through Forest Stewardship Plans (FSP). The linkage between forest practices and the timber supply process occurs via stocking standards. These stocking standards form the basis for future timber supply. Hardwood or mixed wood management regimes may not be consistent with current timber supply or forest management assumptions. The *Forest and Range Practices Act, Forest Planning and Practices Regulation (FPPR) section 26 (5)* provides the mechanism for approval of stocking standards in a Forest Stewardship Plan that are not consistent with current timber supply assumptions. The review test for section 26(5) requires the Delegated Decision Maker (DDM) to be satisfied that the regeneration date and stocking standards are reasonable, having regard for future timber supply. A commitment to a hardwood management strategy will provide the information necessary to support this decision. In addition to the tests set out in section 26 a Forest Stewardship plan may need amending to identify **Timber** strategies for the management of hardwood or mixed wood stands.

Management Principles

These principles are presented to ensure consistency within the region regarding hardwood management and hardwood stocking standards.

A Hardwood management strategy should be considered to:

1) Produce products to support timber supply (sawlogs),
2) Address timber supply short falls in the medium and long term scenarios',
3) Diversify timber yields to address changing market conditions,
4) Maximize land-base utilization,
5) Manage for root disease centers as a short- rotation interim crop,

A hardwood management strategy is not intended to:

1) Specifically manage biodiversity,
2) Promote nutrient recycling,
3) Provide for a nurse crop to grow other species.

Strategy Options

The successful management of hardwoods requires a combination of well-defined objectives at the landscape level and flexible planning at the stand level. A variety of management strategies may be applied concurrently across the landscape to achieve timber flow objectives. The range of strategies may include high investment intensive management regimes, low investment extensive regimes or mixedwood regimes.

Intensive Management Strategy

Under an intensive management regime, with artificial regeneration, the target rotation length, to produce a saw log within minimum size characteristics[5], is 25 to 35 years. Under this regime there is no anticipated reduction to Allowable Annual Cut (AAC) as growth rates for Red Alder, exceed all conifers for the first 25 years. It is suggested that an intensive regime be used to fulfill medium timber supply gaps and be focused on areas close to developed communities on sites with low development cost and high productivity potentials.

To achieve these target rotation harvests the regime must focus on;

- High initial establishment density
- Rapid early growth rates
- Live crown management
- Active control of stocking density

For hardwood species, such as Red Alder, it is very important to quickly capture the site and take full advantage of the rapid juvenile growth. This is best accomplished by high initial stocking levels and uniform crop tree distribution.

Red Alder saw logs increase in value with diameter and proportion of clear wood with the highest values in appearance grades. Large branches are attributed to causing the greatest reduction in value of log grades. Branching can be reduced through manipulation

[5] Alder sawlog typically 13 meters in length with 20 cm top diameter

of stocking density and live crown length. For short rotations this involves a balance between capturing and maintaining juvenile growth and advancing the height to live crown ratio to produce a stem bole with fewer and small knots. Timing for stocking control (juvenile spacing), under an intensive regime, should be based on stand height and height to live crown ratio rather than age. The suggested height for when juvenile spacing should occur is 10 meters with a height to live crown ratio of 50 %. Reducing stand density too quickly or carrying out stand treatments too late, can lead to snow and/or wind damage. The correct combination of high initial stand density and stocking control produces the required clear wood for higher value products.

Throughout the Pacific Northwest, many trials have been established to gain an understanding of the importance of density management and the log value benefits of intensive management regimes. Operational plantations are also providing very useful information regarding stand treatments to achieve the highest log values from Red Alder.

Silviculture Costs

Our current knowledge suggests that Red Alder can be left to grow without intervention and will provide sawlogs on longer rotations, or through early manipulation it can produce sawlogs much sooner, probably in the 20-30 year range. This implies that rotation lengths and harvest timing are management decisions which can be manipulated to meet Timber Supply timing needs.

Licensees harvesting timber from crown lands in BC are responsible for basic silviculture costs[6]. In even aged stands being managed for conifer production the license holder is not responsible to pay for incremental treatments, as these treatments are considered part of an intensive silviculture regime. It is therefore suggested that licensees should not be responsible to pay for stocking control treatments related to intensive management of hardwoods as these treatments are conducted to adjust the timing of timber availability.

It is recommended that funding for stocking control treatments associated with an intensive management regime be funded through allocations of the Forest Investment Account.

Example regime: Intensive management, moderate to high density

Site Preparation	Stocking density	Stocking control	Final Harvest (technical rotation)
Optional - Herbicide - Mechanical	Plant 1400-1600 sph Optional -Fertilize at time of planting with Phosphate	-Stand height 10m -50% live crown ratio - Post spacing density 600[7]-1000 sph	30 cm diameter target Age 25-35 years Target volume 300 m^3 per ha

[6] Costs associated with establishment of a free growing stand.
[7] Low density may not be appropriate where initial density greater than 1500 sph and/or there is risk of snow or wind damage

Extensive Management Strategy

Under an extensive management regime, with artificial regeneration, the target rotation length, to produce a saw log within minimum size characteristics[8], is 30-50 years. Under this regime there is an anticipated reduction to Allowable Annual Cut (AAC) when compared to conifer management as the mean annual increment for conifers exceeds that of hardwoods after approximately age 25. It is suggested that an extensive regime be used to fill medium and longer term timber supply gaps and be applied in locations further away from development centers or areas with more difficult access.

To grow the desired sawlog product, achievement of rapid crown closure and suppression of lower branches is very important. This requires an appropriate level of stocking and uniform crop tree distribution. Too high an initial density will result in stands with clear boles but lack sufficient diameter to meet sawlog standard within the target rotation length. Too low an initial density will result in crop trees with excessive branching and may result in insufficient clear wood to meet the desired product objective at rotation.

Example Regime: Extensive management at moderate density

Site Preparation	Stocking density	Final Harvest (technical rotation)	Comments
Optional - Herbicide - Mechanical	Plant 1000-1200 sph Optional -Fertilize at time of planting with Phosphate	30 cm diameter target Age 30-50 years Target volume 300 m^3 per ha	-Natural ingress not well understood -prompt planting recommended.

Mixedwood Management Strategy

Under a mixedwood management regime, with either natural or artificial regeneration, the target rotation age to produce a hardwood and a conifer sawlog with minimum size characteristics is 50-70 years.

Under this regime there is an anticipated reduction to Allowable Annual Cut (AAC) when compared to conifer management. This regime is complex to model; the magnitude of the reduction is anticipated to be similar to the extensive management regime.

The regime is sub-divided into forest types or land classes based on the leading species component.

- Conifer leading (C): >80% basal areas is conifer
- Conifer leading mixedwood (CD): > 50% but < 80% basal area is conifer
- Deciduous leading mixedwood (DC): > 50% but < 80% basal area is deciduous hardwoods
- Deciduous leading (D): > 80% B=basal area is deciduous broadleaf

The mixed designations, CD and DC, are recognized to have differentiations based on structural attributes. These classes can be broken into:

[8] Alder sawlog typically 13 meters in length with 20 cm top diameter

- Stratified mixtures: where one component (usually deciduous) makes up the overstory and the other is in the understory
- Intimate mixtures: where both components share dominance on the site and each are within the overstory.
- Mosaic mixtures: where each component is a distinct separate patch.

A mixedwood strategy should outline:

- The objectives for mixedwood management (e.g. products, yield, stand and landscape diversity, etc.)
- The method for classifying and tracking the forest types or land classes (CD, DC)
- The ecosystems where mixedwood management will achieve the desired rotation lengths and product values ((BEC zone/subzone site series)
- The types of mixedwood strategies being pursued
- The stocking standards and free growing criteria associated with each type.

Types of mixedwood strategies

The potential mixedwood strategies are

- Macro patch mixedwood (large distinct and discreet patches of pure hardwood and pure conifer – e.g. one block hardwood – one conifer, or one half a block as hardwood the other 1/2 conifer)
- Meso patch mixedwood (medium sized distinct and discreet patches of pure hardwood and pure conifer – e.g. a stratum divided into one portion hardwood and the rest conifer)
- Micro patch mixedwood (small distinct and discreet patches >1/2ha - of pure conifer and hardwood intermixed through out the stratum)
- Intimate mixedwood (intermixing of both conifer and hardwood throughout with the intention of producing a crop of both at the same time in the future)
- Successional mixedwood (intermixing of both conifer and hardwoods but stratifying based on canopy level with the intent of sequentially harvesting one then the other)

At this point the main focus of the Coastal Mixedwood Strategy is on management of Red Alder with conifers on similar rotations. The only feasible mixedwood strategies for this focus, given the growth requirements, are the **patch mixedwood strategies** (macro, meso, and micro).

Example regime: Patch mixedwood management

Strategy Option	Site Preparation	Stocking density	Final Harvest (technical rotation)	Comments
Patch mixedwood (macro, meso, micro)	Optional - mechanical	1000 -1200sph of conifer Natural regeneration of hardwoods (Alder)	Target Hardwood diameter 30 cm Rotation 50-70 years Target hardwood volume 300 m^3 per ha	-Natural regeneration of hardwoods may be managed for if various criteria are met; (appropriate density and tree distribution, > minimum patch, appropriate ecosystem)

Stocking standards and free growing criteria

Every mixedwood structural class will have associated with it unique stocking standards and free growing criteria. A definition of what constitutes a free growing tree in each of these structural classes is required to ensure that the desired future conditions are achieved. For example, a free growing Fdc in a large patch mixedwood will look considerably different than a free growing (or well growing) Fdc in an intimate mixture. In a patch mixedwood scenario the free growing criteria should describe the attributes of the target tree that indicate that it is currently growing, and is anticipated to continue to grow, at a rate that is consistent with achieving the targeted future land classification and yield targets.

Within each broad land class designation there is a range of potential combinations of broadleaf and coniferous species. The management strategy chosen and the resulting species mixtures will have different future yields. If a landscape level approach is taken in the management of the mixedwood stands, yield targets for each component (broadleaf and coniferous) should be determined and managed towards.

One approach is to determine the potential yield from each land class category and set a category target within the landscape. Managed stand yield achievements are then coalesced for each land class and compared to the yield target for that designation within the landscape being assessed. If the realized yield projection varies significantly from the target potential yield then adjustments should be considered.

Target rotations and mixedwood strategies

A critical component of mixedwood management is making allowance for the rotation length target for each stand and each component of the stand. Depending on how rotation length is to be defined (e.g. economic, max Mean Annual Increment (MAI), target diameter, etc.) broadleaf and coniferous species can have different rotation lengths. As such, prescribing the desired rotation length for the stand, or the components of that stand, can influence the choice of stocking standards and configuration of the mixedwood strategy undertaken. If a significant difference in rotation length for the desired components of the mixedwood is anticipated, or deliberately targeted, it may result,

depending on strategy chosen, in different stocking standards and free growing criteria. It may also limit the configuration of the mixedwood (i.e. the pattern and size of patches) on the unit being managed. The main reason for this consideration of mixedwood configuration and standards in relation to rotation length is to be able to effectively and efficiently access each component at the anticipated harvest time and not foreclose on future harvest options on the site.

Patch mixedwood stocking standards (Macro, Meso, and Micro patches)

Stocking standards for the patch mixedwood strategy should consider developing complementary standards that will be applied depending on the land class that the survey plot falls within. In areas designated as CD or DC, survey plots that fall within conifer dominated portions of the opening will have a coniferous stocking standard applied and survey plots that fall within broadleaf dominated portions will have the broadleaf stocking standard applied.

In order to focus on the management of target species within each of these patches, the use of coniferous species as acceptable in broadleaf standards or broadleaf species as acceptable in coniferous standards should be avoided. It is assumed that in these situations where lone individuals or groups of individuals of the non-target species occur within a patch that the tolerance allowances outlined in the Free Growing criteria will compensate for their presence. Inclusion of the non-target species in the stocking standards may cloud the actual achievement of the land class designation on the unit as a whole.

In all patch mixedwood cases, the complementary conifer stocking standard should reflect those developed for the applicable site series the unit falls within for even aged conifer reforestation. A stocking standard combining both the deciduous and coniferous portion could be presented. Appendix 3 contains example stocking standards.

Free Growing Criteria

All coniferous free growing criteria will be as per appendix 9 Free from brush – free growing criteria in the *Establishment to Free Growing Guidebook* version 2.3 (May 2000 – revised October, 2007) for the Coast Region unless otherwise specified in an approved SP, FDP or FSP.

Broadleaf free growing criteria should include the appropriate height-above- brush ratio for the ecosystem being managed and include considerations for the relationship between the target tree and surrounding vegetation.

Free Growing Damage Criteria

All coniferous free growing criteria will be as per appendix 9 Free from brush – free growing criteria in the *Establishment to Free Growing Guidebook* version 2.3 (May 2000 – revised October, 2007) unless otherwise specified in an approved SP, FSP, or FDP.

Unless otherwise stated in regulation or an approved FSP stocking standard, an acceptable broadleaf crop tree must:

- Not have a tree pith that is laterally displaced more than 30 cm from the location of the root-crown pith.
- Not originate from a cut stump[9].
- Have one dominant live leader[10].
- Not have a wound that is greater than 10% of the stem circumference nor is greater than 10% of the total length of the stem.[11].
- Not have any fungal infections or insect infestations affecting tissues below the bark surface, visible without destructive sampling[12].
- Not be browsed so as to limit its ability to become a crop tree.

Free growing Survey System

Pre-stratify the block into appropriate polygons assigning land class designations of C, D, CD, or DC.

In each unit identified as being managed for patch mixedwood strategies establish a grid of plots based on 1 plot per ha to a minimum of 5 plots per polygon. At each plot identify the leading land class designation, and then utilize the applicable broadleaf or coniferous stocking standard for that unit.

Tally the number of plots falling into each land class category and determine the percentage of the plots as either D or C. Determine the overall mixedwood land class designation based on the proportion of the area comprised of both D and C classes. For example, if 60% of the plots are classified as C and 40% of the plots are classified as D the land class for the polygon will be CD.

All C and D plots will be tallied separately to determine overall achievement of stocking and reporting of inventory labels for each land class within the mixedwood identified polygon.

Minimum patch size

The establishment of a minimum patch size is essential to ensure that each species being managed for within the mixedwood achieves the desired volume and product value targets. Patch size should be large enough to ensure adequate growth rates and the development of acceptable tree form, so that desired rotation lengths are achieved and so that product value is maximized for each species.

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[9] Stems originating from the sides or cut surface of stumps are very susceptible to breakage at the coppice point, exception may be Big leaf maple

[10] The objective is that the tree has a single stem that will develop into a healthy crop tree. Accordingly, a healthy, free growing broadleaf tree must have an identifiable live leader. It is not important if a portion, but not all, of the leader is browsed or killed for example by venturia blight.

[11] A wound is defined as an injury in which the cambium is dead or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood. Healed-over wounds (= scars) are acceptable. Fire or sunscald damage can also cause wounds.

[12] Visible stem infections include cyptospora canker or sooty-bark canker, and visible insect infestations, such as poplar borer. The significance of some diseases, such as armillaria root disease, to broadleaves is unknown or uncertain, and several cannot be feasibly identified by visual features during free growing surveys.

Regarding coastal Red Alder /conifer mixed woods, in order to achieve optimal growth rates it is recommended that patches not be smaller than ½ ha. Any patch smaller than these sizes should not be tallied as achieving the targeted land class.

Recommendations

1. It is recommended that a regional Hardwood Management Strategy be adopted for the Coast Forest Region to compliment the Coast Forest Action Plan.
2. It is recommended that the CRIT Silviculture Working Group with the assistance of the MFR and licensee experts in hardwood management involved in drafting this strategy guide and monitor the successful implementation of the hardwood management strategy.
3. It is recommended that the strategy be implemented to an interim target level of 1200 hectares distributed across the region.
4. It is recommended that funding for intensive treatments be pursued through the Forest Investment Account.

Appendix 1

TIPSY *analysis comparing extensive and intensive Red Alder regimes against Douglas-fir.*

The following curves and data sets are for example purposes. These two sets of analysis present different ways of developing a hardwood management strategy. The outcomes are consistent with best known information for the management of hardwoods.

TIPSY Simulations

Regimes:

FDC (FD):

- Plant Fdc 1200 stems/ha
- Site Index 36
- Regeneration delay 2 years
- OAF 1 = 0.85
- OAF 2 = 0.95

DR intensive 1600:

- Plant Dr 1600 stems/ha
- Site Index 32
- Regeneration delay 2 years
- Pre-commercial thin to 700 stems/ha
- OAF 1 = 0.85
- OAF 2 = 0.95

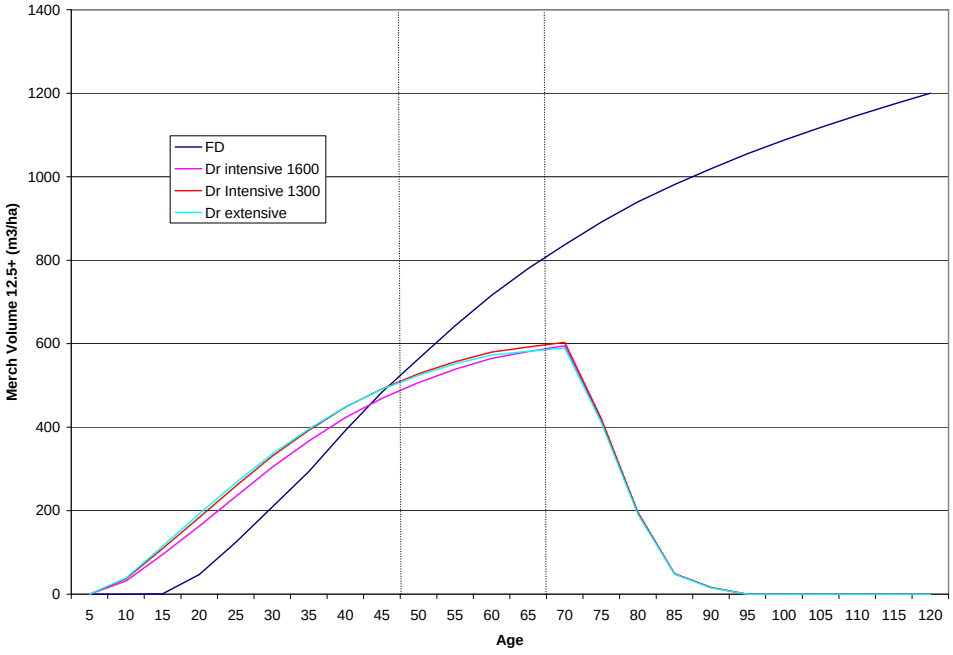
DR Intensive 1300:

- Plant Dr 1300 stems/ha
- Site Index 32
- Regeneration delay 2 years
- Pre-commercial thin to 900 stems/ha
- OAF 1 = 0.85
- OAF 2 = 0.95

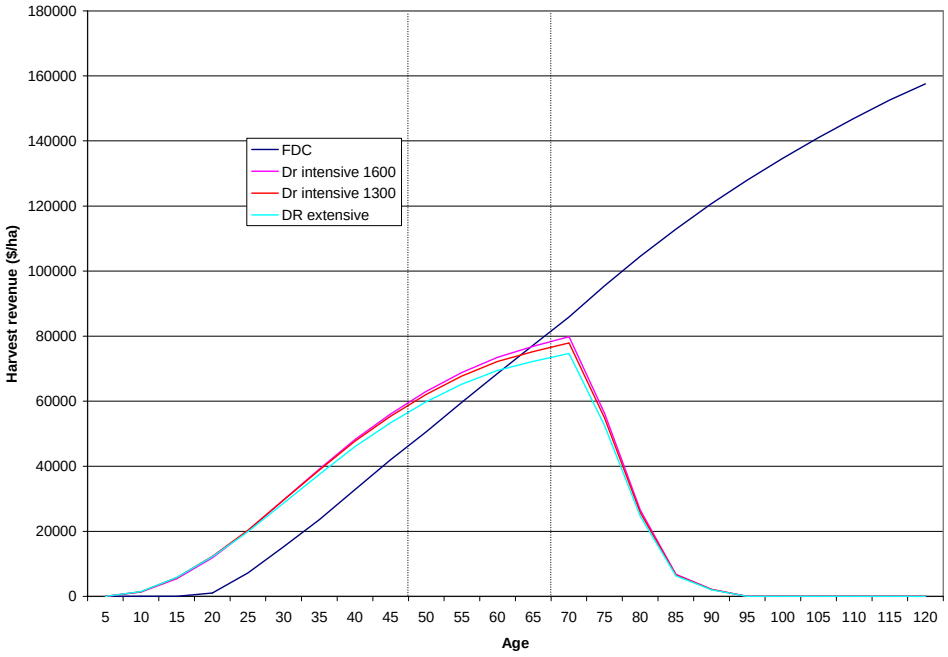
DR Extensive:

- Plant Dr 1100 stems/ha
- Site Index 32
- Regeneration delay 2 years
- OAF 1 = 0.85
- OAF 2 = 0.95

Within the target rotation period for the mixedwood and broadleaf managed land base in this example the Fdc merchantable volume exceeds that of all the Dr regimes.

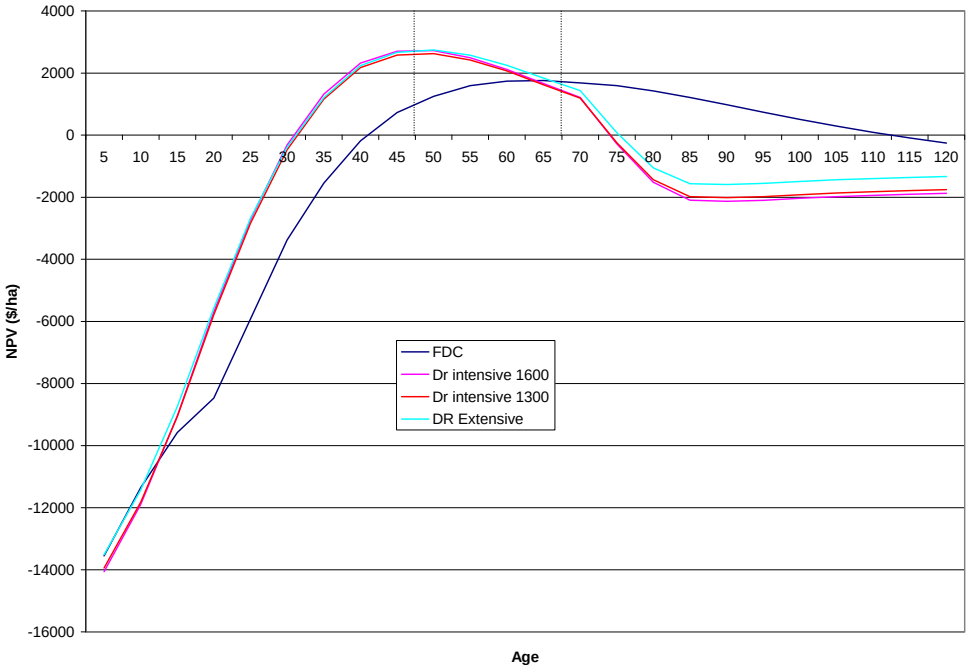


However, when looking at the potential harvest revenue from the different regimes

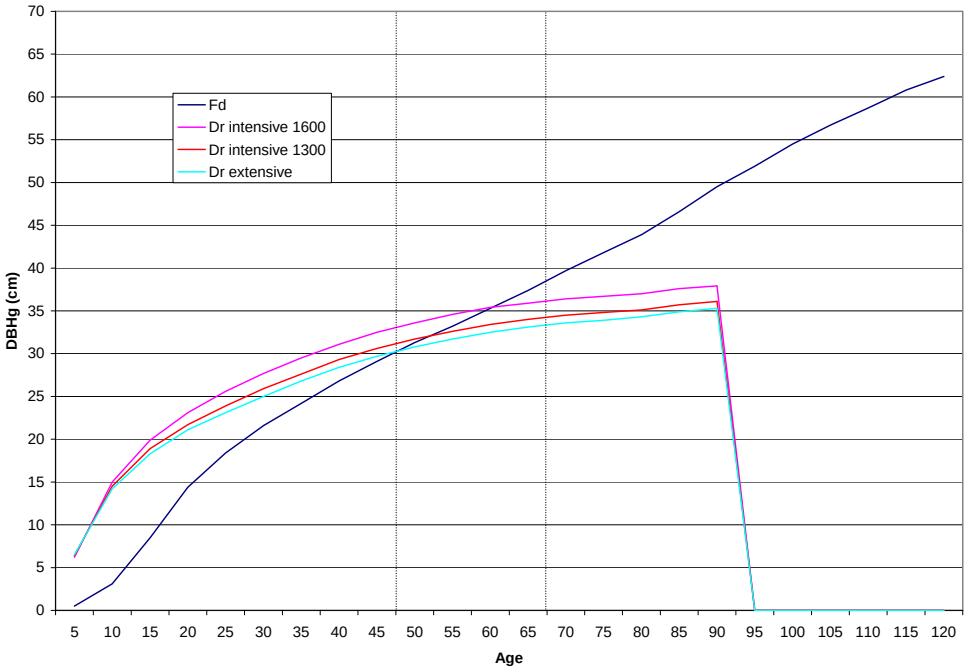


we see that the intensive regimes have greater harvest revenue for a large part of the target rotation periods. With the extensive Dr regime according to this TIPSY simulation it will have a greater harvest revenue that the Fdc regime during the earlier dates of the target rotation periods

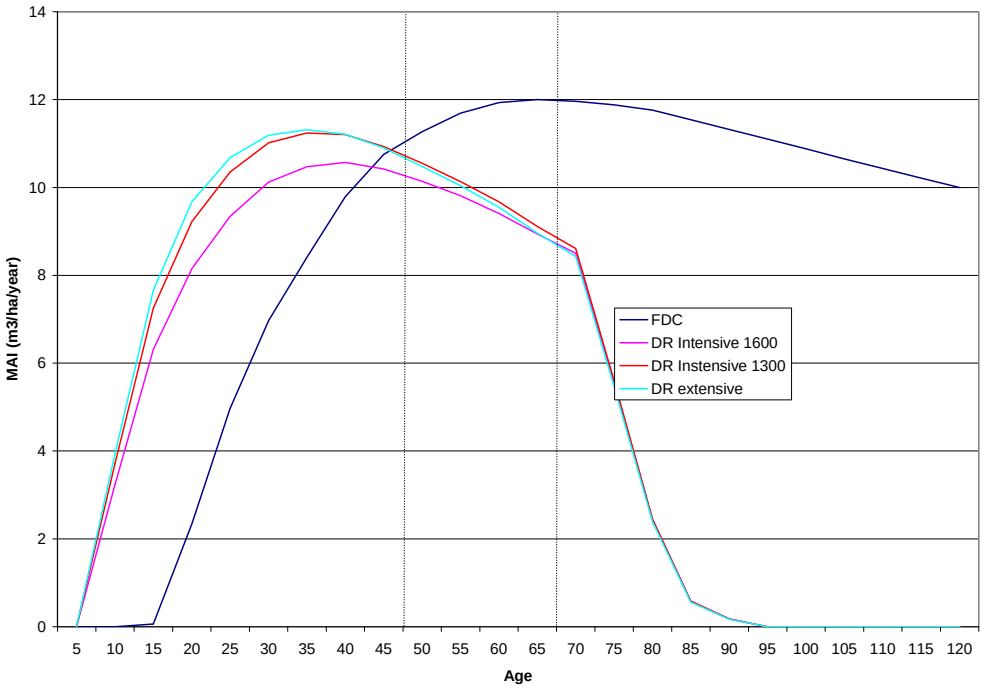
When we examine the net present value (NPV) resulting from the cost of treatment and revenue received we see that all the Dr regimes have a greater NPV than Fdc for all but the latest dates within the target rotation period.



Other methods of defining rotation age are target diameter and Maximum MAI. In the case of target diameter:



These simulations show that Dr achieves its usual target diameter of 30 cm at the earliest point in the target rotation window under all regimes while Fdc reached the usual target diameter of 35 cm by the mid-point of the target rotation window.
Regarding Maximum MAI as a basis for rotation age the TIPSY simulations show



the later periods of the target rotation window contain the maximum MAI point (65 years) for Fdc and that during the early periods of this window MAI are at 94% of the maximum. The target rotation period, however, misses the maximum MAI point for DR, however, when looking at the maximum MAI period in conjunction with the revenue and NPV these TIPSY simulations indicate that Max MAI based rotations for DR may not be a profitable management strategy.

TASS runs produced for Weyerhaeuser's Alder Management Strategy in 2003.

The following TASS runs were produced by MoF Growth and Yield staff in Victoria to help with setting up management regimes for Weyerhaeuser's proposed alder management strategy in 2003. The scenarios explored covered lower planting densities without spacing and two different planting densities with spacing at approximately 10m in height. These model predictions roughly equate to the concepts of extensive and intensive regimes and indicate rotation lengths of 35-45 years the extensive regime and 25-35 years for the intensive regimes.
Field data from stands that had stocking control further support the validity of the tables for planning purposes.

Common Header for each following dataset:
Merchantable volume is calculated using minimum DBH: 12.50 cm, top DIB: 10.0 cm, stump height: 0.3 m .
Total and merchantable volumes are expressed in units of cubic m .
Heights are in m , diameters are in cm. Basal and crown areas are in square m .
Gross production figures include mortality and thinnings.
Top height: average height of 100 trees/ha of largest diameter.
Predominant height: average height of 100 tallest trees/ha .
Plot size: 99.00 m x 99.00 m = 0.9801 ha ; grid size:0.1000 m ;
OAFs 1&2: 1.000 1.000 (Operational Adjustment Factors)

Plot Description: site index: 34, plant @ 1100/ha

AGE (yr)	SITE HT	TREES	CC %	VOLUME TOTAL	VOLUME MERCH	MAI TOTAL	MAI MERCH	BA OB	HEIGHT TOP	HEIGHT PREDOM	CA	CW	CL	CL%	DBH-OB ARITH	DBH-OB QUAD	HEIGHT TOTAL	HEIGHT MERCH	VOLUME TOTAL	VOLUME MERCH	FOLIAR VOLUME	BA OB	VOLUME TOTAL	VOLUME MERCH
2	1.8	1111	100	7	0	3.47	0.00	2.6	5.6	5.9	9.0	3.4	4.2	85	5.4	5.5	4.9	0.0	0.006	0.000	58.433	0.002	7	0
4	4.6	1111	100	28	0	7.10	0.04	7.7	8.5	8.8	9.0	3.4	6.6	89	9.3	9.4	7.4	0.0	0.026	0.000	124.873	0.007	28	0
6	7.6	1103	100	62	24	10.37	4.01	13.1	11.3	11.6	9.0	3.3	6.9	70	12.2	12.3	9.8	2.0	0.056	0.022	134.801	0.012	62	24
8	10.5	1083	100	101	69	12.61	8.68	17.9	13.8	14.2	9.2	3.4	6.8	56	14.4	14.5	12.0	5.1	0.093	0.064	128.615	0.016	102	69
10	13.1	1069	100	141	111	14.09	11.10	21.9	16.0	16.5	9.3	3.4	6.5	46	16.0	16.1	13.9	7.1	0.132	0.104	118.835	0.020	142	111
12	15.4	1062	100	180	150	15.04	12.50	25.4	18.0	18.6	9.4	3.4	6.3	39	17.2	17.4	15.7	8.7	0.170	0.141	107.830	0.024	183	150
14	17.5	1055	100	219	187	15.61	13.36	28.3	19.9	20.4	9.5	3.4	6.0	34	18.3	18.5	17.3	10.1	0.207	0.177	97.258	0.027	221	188
16	19.4	1045	100	256	224	16.02	13.97	30.9	21.6	22.1	9.5	3.4	5.8	30	19.2	19.4	18.7	11.3	0.245	0.214	87.842	0.030	260	225
18	21.1	1024	100	294	261	16.36	14.51	33.3	23.1	23.5	9.7	3.4	5.6	28	20.1	20.3	20.0	12.5	0.287	0.255	80.034	0.032	301	264
20	22.6	993	100	333	300	16.65	15.00	35.3	24.4	24.9	10.0	3.5	5.6	26	21.0	21.3	21.2	13.8	0.335	0.302	73.908	0.036	344	307
22	23.9	959	100	373	340	16.93	15.45	37.3	25.6	26.0	10.3	3.5	5.5	24	21.9	22.2	22.3	15.1	0.388	0.355	68.627	0.039	389	351
24	25.1	913	99	410	379	17.08	15.79	38.8	26.7	27.1	10.8	3.6	5.6	23	22.9	23.3	23.3	16.5	0.449	0.415	64.855	0.043	435	396
26	26.2	874	99	446	417	17.17	16.02	40.3	27.7	28.1	11.2	3.7	5.6	23	23.8	24.2	24.3	17.7	0.511	0.476	61.138	0.046	480	441
28	27.2	823	98	477	449	17.03	16.03	41.1	28.5	29.0	11.8	3.8	5.8	22	24.8	25.2	25.2	19.0	0.579	0.545	58.481	0.050	524	485
30	28.1	780	98	505	478	16.82	15.94	41.9	29.3	29.8	12.4	3.9	5.9	22	25.8	26.2	26.1	20.1	0.647	0.613	56.043	0.054	565	526
32	28.9	747	97	532	507	16.63	15.85	42.7	30.1	30.5	12.9	4.0	6.1	22	26.6	27.0	26.8	21.1	0.713	0.679	53.304	0.057	604	565
34	29.6	709	97	553	529	16.26	15.56	43.1	30.7	31.2	13.5	4.1	6.3	22	27.4	27.8	27.5	22.0	0.780	0.746	51.216	0.061	641	601
36	30.3	685	96	575	552	15.99	15.34	43.7	31.3	31.8	14.0	4.2	6.5	23	28.1	28.5	28.1	22.7	0.841	0.806	48.700	0.064	674	635
38	30.9	672	97	601	578	15.82	15.21	44.7	31.8	32.3	14.3	4.2	6.5	22	28.7	29.1	28.7	23.3	0.894	0.860	45.790	0.066	706	666
40	31.5	656	97	622	599	15.55	14.98	45.3	32.3	32.9	14.6	4.2	6.7	22	29.3	29.7	29.2	23.8	0.948	0.913	43.234	0.069	735	695
42	**32.0**	**645**	**97**	**643**	**620**	**15.31**	**14.77**	**46.1**	**32.8**	**33.3**	**14.9**	**4.3**	**6.7**	**22**	**29.8**	**30.2**	**29.7**	**24.3**	**0.997**	**0.962**	**40.738**	**0.071**	**762**	**722**
44	32.5	634	97	662	639	15.04	14.52	46.7	33.3	33.8	15.2	4.3	6.8	22	30.2	30.6	30.1	24.8	1.044	1.008	38.475	0.074	788	747
46	33.0	615	96	672	650	14.61	14.12	46.7	33.7	34.2	15.5	4.4	7.0	22	30.7	31.1	30.5	25.2	1.092	1.056	36.591	0.076	811	770
48	33.4	600	96	684	661	14.24	13.78	46.9	34.1	34.6	15.9	4.4	7.1	23	31.2	31.5	30.9	25.6	1.140	1.103	34.907	0.078	833	791
50	33.8	588	96	695	673	13.90	13.46	47.1	34.4	35.0	16.2	4.5	7.3	23	31.6	31.9	31.3	25.9	1.183	1.145	33.222	0.080	853	811
52	34.2	572	95	702	680	13.50	13.08	47.0	34.7	35.3	16.5	4.5	7.4	23	31.9	32.3	31.7	26.3	1.226	1.188	31.698	0.082	871	830
54	34.5	560	95	710	688	13.14	12.74	47.1	35.0	35.6	16.8	4.6	7.6	23	32.3	32.7	32.0	26.6	1.267	1.228	30.235	0.084	889	847
56	34.8	545	94	711	690	12.70	12.32	46.7	35.3	35.9	17.2	4.6	7.8	24	32.7	33.1	32.3	26.8	1.306	1.266	29.020	0.086	905	863
58	35.1	536	94	719	697	12.39	12.02	46.8	35.6	36.2	17.4	4.7	7.9	24	33.0	33.4	32.6	27.1	1.341	1.302	27.690	0.087	919	877
60	35.4	532	94	729	707	12.14	11.79	47.1	35.9	36.5	17.6	4.7	8.0	24	33.2	33.6	32.9	27.3	1.371	1.331	26.350	0.089	933	891
62	35.7	531	94	741	720	11.96	11.61	47.6	36.1	36.7	17.7	4.7	8.1	24	33.4	33.8	33.1	27.5	1.397	1.357	24.971	0.090	946	904
64	35.9	529	94	752	730	11.74	11.41	48.0	36.3	36.9	17.9	4.7	8.1	24	33.6	34.0	33.3	27.7	1.422	1.381	23.708	0.091	959	916
66	36.2	526	95	761	739	11.53	11.20	48.4	36.5	37.2	18.0	4.7	8.2	24	33.8	34.2	33.5	27.9	1.446	1.404	22.524	0.092	970	927
68	36.4	522	95	768	746	11.30	10.98	48.5	36.7	37.4	18.1	4.7	8.2	24	34.0	34.4	33.8	28.1	1.470	1.429	21.462	0.093	981	938
70	36.6	511	95	764	743	10.92	10.61	48.0	36.9	37.6	18.2	4.8	8.3	24	34.2	34.6	34.0	28.2	1.495	1.453	20.505	0.094	995	951

Plot Description: site index 34, plant@ 1400/ha, pct 700 at age 13

========= STAND STATISTICS (per ha) ==========												TREE STATISTICS (avg. tree)								== GROSS ==		
AGE	SITE	TREES	CC	VOLUME		MAI		BA	HEIGHT		CA	CW	CL	CL%	DBH-OB		HEIGHT		VOLUME		FOLIAR	BA	VOLUME	
(yr)	HT		%	TOTAL	MERCH	TOTAL	MERCH	OB	TOP	PREDOM					ARITH	QUAD	TOTAL	MERCH	TOTAL	MERCH	VOLUME	OB	TOTAL	MERCH
2	1.8	1403	100	8	0	4.14	0.00	3.1	5.7	5.9	7.1	3.0	3.6	72	5.2	5.3	4.9	0.0	0.006	0.000	49.174	0.002	8	0
4	4.6	1403	100	33	0	8.35	0.03	8.6	8.6	8.9	7.1	3.0	6.0	81	8.8	8.8	7.4	0.0	0.024	0.000	102.787	0.006	33	0
6	7.6	1392	100	72	18	11.93	3.08	14.5	11.4	11.7	7.2	3.0	6.2	63	11.4	11.5	9.8	1.2	0.051	0.013	107.877	0.010	72	18
8	10.5	1368	100	114	67	14.31	8.43	19.5	13.9	14.3	7.3	3.0	6.1	50	13.3	13.5	12.0	4.0	0.084	0.049	102.855	0.014	115	67
10	13.1	1342	100	158	114	15.81	11.36	23.7	16.2	16.7	7.4	3.0	5.8	41	14.8	15.0	13.9	6.1	0.118	0.085	95.623	0.018	160	114
12	15.4	1322	100	201	158	16.74	13.15	27.3	18.3	18.8	7.6	3.0	5.6	35	16.0	16.2	15.7	7.9	0.152	0.119	87.549	0.021	203	158
13	16.5	700	68	142	122	10.94	9.36	18.0	19.2	19.7	9.7	3.4	6.4	36	17.9	18.1	17.2	10.1	0.203	0.174	109.877	0.026	225	179
14	17.5	700	83	158	137	11.28	9.80	19.2	20.1	20.6	11.9	3.8	7.1	39	18.5	18.7	18.0	10.9	0.226	0.196	125.875	0.027	240	194
16	19.4	700	91	192	171	11.99	10.67	21.7	21.8	22.3	12.9	4.0	7.4	37	19.6	19.9	19.5	12.3	0.274	0.244	122.570	0.031	274	228
18	21.1	696	94	229	208	12.73	11.54	24.2	23.3	23.7	13.6	4.1	7.5	35	20.7	21.0	20.8	13.8	0.329	0.299	114.828	0.035	312	265
20	22.6	692	97	270	248	13.48	12.39	26.7	24.6	25.1	13.9	4.1	7.5	34	21.8	22.2	22.0	15.1	0.390	0.358	105.740	0.039	353	306
22	23.9	685	98	312	290	14.18	13.18	29.2	25.8	26.3	14.2	4.2	7.5	32	22.9	23.3	23.0	16.4	0.455	0.423	96.965	0.043	396	348
24	25.1	674	98	354	332	14.74	13.83	31.5	26.8	27.3	14.5	4.2	7.5	31	24.0	24.4	24.0	17.6	0.525	0.492	89.357	0.047	440	392
26	26.2	667	99	396	374	15.22	14.37	33.7	27.8	28.3	14.8	4.2	7.5	29	24.9	25.4	24.9	18.7	0.593	0.560	82.009	0.051	484	435
28	27.2	655	99	435	413	15.52	14.75	35.6	28.7	29.2	15.0	4.3	7.5	28	25.9	26.3	25.8	19.8	0.664	0.631	75.724	0.054	526	477
30	28.1	642	99	471	450	15.71	14.99	37.4	29.5	30.0	15.3	4.3	7.5	28	26.8	27.2	26.5	20.7	0.733	0.700	70.235	0.058	566	517
32	28.9	629	99	504	483	15.75	15.08	38.8	30.2	30.8	15.6	4.4	7.6	27	27.6	28.0	27.3	21.5	0.801	0.767	65.317	0.062	604	554
34	29.6	612	98	532	511	15.65	15.03	39.9	30.9	31.4	15.9	4.4	7.7	27	28.4	28.8	27.9	22.3	0.870	0.835	61.222	0.065	639	589
36	30.3	598	98	559	538	15.53	14.94	41.0	31.4	32.0	16.3	4.5	7.8	27	29.1	29.5	28.5	22.9	0.934	0.899	57.516	0.069	672	622
38	30.9	591	98	586	565	15.42	14.86	42.2	32.0	32.6	16.5	4.5	7.9	27	29.7	30.1	29.1	23.5	0.991	0.955	53.686	0.071	703	653
40	**31.5**	**581**	**98**	**609**	**588**	**15.24**	**14.71**	**43.1**	**32.5**	**33.1**	**16.8**	**4.6**	**8.0**	**26**	**30.3**	**30.7**	**29.6**	**24.0**	**1.049**	**1.013**	**50.346**	**0.074**	**732**	**681**
42	32.0	573	98	632	610	15.04	14.53	43.9	32.9	33.6	17.0	4.6	8.1	26	30.8	31.3	30.1	24.5	1.103	1.066	47.226	0.077	758	707
44	32.5	564	98	651	630	14.79	14.31	44.7	33.4	34.1	17.3	4.6	8.1	26	31.3	31.8	30.5	25.0	1.155	1.117	44.404	0.079	783	732
46	33.0	554	98	668	647	14.53	14.07	45.3	33.8	34.5	17.6	4.7	8.3	26	31.8	32.2	30.9	25.4	1.206	1.167	41.948	0.082	806	754
48	33.4	544	98	683	662	14.22	13.78	45.7	34.2	34.9	17.8	4.7	8.4	26	32.3	32.7	31.3	25.8	1.255	1.216	39.703	0.084	827	775
50	33.8	535	97	696	675	13.93	13.50	46.1	34.5	35.3	18.1	4.7	8.5	26	32.7	33.1	31.7	26.1	1.302	1.262	37.637	0.086	847	795
52	34.2	530	97	711	690	13.67	13.26	46.6	34.9	35.6	18.3	4.8	8.6	26	33.1	33.5	32.1	26.4	1.342	1.302	35.536	0.088	866	813
54	34.5	521	97	720	699	13.34	12.95	46.8	35.2	35.9	18.5	4.8	8.7	26	33.4	33.8	32.4	26.7	1.384	1.343	33.669	0.090	883	830
56	34.8	517	97	734	712	13.10	12.72	47.3	35.5	36.2	18.7	4.8	8.8	26	33.7	34.1	32.7	27.0	1.418	1.377	31.843	0.091	899	846
58	35.1	511	97	744	722	12.82	12.45	47.6	35.7	36.5	18.9	4.8	8.9	27	34.0	34.4	33.0	27.2	1.454	1.413	30.229	0.093	914	861
60	35.4	509	97	756	734	12.60	12.24	48.1	36.0	36.8	19.0	4.9	8.9	26	34.3	34.7	33.2	27.5	1.484	1.442	28.626	0.094	928	875
62	35.7	508	97	768	747	12.39	12.04	48.6	36.3	37.0	19.0	4.9	9.0	26	34.5	34.9	33.5	27.7	1.511	1.469	27.057	0.096	941	888
64	35.9	504	97	776	755	12.13	11.79	48.8	36.5	37.3	19.2	4.9	9.0	26	34.7	35.1	33.7	27.9	1.539	1.497	25.698	0.097	953	900
66	36.2	504	97	788	766	11.94	11.61	49.3	36.7	37.5	19.2	4.9	9.0	26	34.9	35.3	33.9	28.0	1.563	1.519	24.332	0.098	965	911
68	36.4	501	97	796	774	11.71	11.39	49.5	36.9	37.7	19.3	4.9	9.1	26	35.1	35.5	34.1	28.2	1.589	1.546	23.149	0.099	976	922
70	36.6	491	97	793	771	11.32	11.02	49.1	37.1	37.9	19.4	4.9	9.1	26	35.3	35.7	34.3	28.4	1.615	1.571	22.043	0.100	989	934

Plot Description: site index 38, plant@ 1100/ha

AGE	SITE	TREES	CC	VOLUME		MAI		BA	HEIGHT			CA	CW	CL	CL%	DBH-OB	HEIGHT	VOLUME		FOLIAR	BA	VOLUME	
(yr)	HT		%	TOTAL	MERCH	TOTAL	MERCH	OB	TOP	PREDOM						ARITH	QUAD	TOTAL	MERCH	TOTAL	MERCH	VOLUME	OB	TOTAL	MERCH
2	1.8	1111	100	8	0	4.17	0.00	2.9	6.2	6.4	9.0	3.4	4.4	81	5.8	5.8	5.4	0.0	0.007	0.000	66.952	0.003	8	0
4	5.0	1111	100	35	1	8.64	0.16	8.4	9.4	9.7	9.0	3.3	7.1	86	9.8	9.8	8.2	0.1	0.031	0.001	141.806	0.008	35	1
6	8.4	1106	100	76	36	12.65	6.05	14.4	12.5	12.9	9.0	3.3	7.4	67	12.7	12.9	10.8	2.9	0.069	0.033	151.532	0.013	76	36
8	11.6	1091	100	123	91	15.42	11.37	19.5	15.3	15.8	9.1	3.3	7.2	53	14.9	15.1	13.3	6.2	0.113	0.083	143.926	0.018	124	91
10	14.5	1083	100	173	141	17.26	14.11	24.0	17.8	18.4	9.2	3.3	6.9	44	16.6	16.8	15.5	8.4	0.159	0.130	132.294	0.022	174	141
12	17.2	1075	100	222	189	18.49	15.76	27.8	20.2	20.7	9.3	3.3	6.6	37	17.9	18.1	17.4	10.1	0.206	0.176	119.948	0.026	223	189
14	19.5	1060	100	273	239	19.50	17.10	31.2	22.3	22.8	9.4	3.4	6.3	32	19.1	19.4	19.2	11.8	0.258	0.226	108.857	0.029	276	240
16	21.6	1016	100	327	293	20.42	18.34	34.2	24.2	24.6	9.8	3.4	6.2	29	20.4	20.7	20.9	13.6	0.321	0.289	101.153	0.034	335	298
18	23.5	972	100	386	353	21.43	19.62	37.3	25.9	26.3	10.2	3.5	6.1	27	21.7	22.1	22.4	15.4	0.397	0.363	94.486	0.038	401	363
20	25.2	913	99	444	413	22.19	20.65	39.8	27.4	27.7	10.8	3.6	6.1	25	23.1	23.5	23.9	17.3	0.486	0.452	90.010	0.044	470	432
22	26.7	840	99	495	467	22.48	21.21	41.5	28.7	29.1	11.6	3.8	6.3	24	24.7	25.1	25.3	19.2	0.589	0.556	87.352	0.049	540	501
24	28.0	778	98	542	516	22.57	21.50	42.9	29.8	30.3	12.4	3.9	6.5	24	26.1	26.5	26.5	20.9	0.696	0.663	84.505	0.055	606	567
26	29.2	715	97	579	555	22.27	21.35	43.7	30.9	31.4	13.3	4.0	6.8	24	27.5	27.9	27.6	22.3	0.810	0.776	82.389	0.061	669	630
28	30.3	689	97	625	601	22.31	21.48	45.4	31.8	32.3	13.9	4.1	7.0	24	28.5	29.0	28.6	23.4	0.907	0.873	78.319	0.066	728	688
30	31.3	663	97	666	643	22.20	21.44	46.8	32.7	33.2	14.5	4.2	7.1	24	29.6	30.0	29.5	24.4	1.004	0.970	73.975	0.071	782	742
32	**32.3**	**634**	**97**	**696**	**674**	**21.76**	**21.06**	**47.6**	**33.5**	**34.1**	**15.0**	**4.3**	**7.3**	**24**	**30.5**	**30.9**	**30.3**	**25.2**	**1.099**	**1.063**	**70.327**	**0.075**	**832**	**791**
34	33.1	606	96	723	701	21.28	20.62	48.2	34.2	34.8	15.6	4.4	7.6	24	31.4	31.8	31.1	25.9	1.194	1.157	67.053	0.079	877	836
36	33.9	586	96	749	727	20.82	20.20	48.8	34.9	35.5	16.2	4.5	7.8	24	32.2	32.6	31.8	26.6	1.280	1.242	63.770	0.083	919	877
38	34.6	555	95	758	737	19.96	19.39	48.4	35.5	36.1	16.8	4.6	8.1	25	32.9	33.3	32.5	27.2	1.366	1.327	61.149	0.087	957	914
40	35.2	542	94	782	760	19.54	19.00	49.1	36.1	36.7	17.3	4.6	8.3	25	33.6	34.0	33.1	27.7	1.443	1.403	58.068	0.091	991	948
42	35.8	536	95	807	786	19.23	18.70	50.0	36.6	37.3	17.6	4.7	8.4	25	34.1	34.5	33.6	28.2	1.507	1.467	54.570	0.093	1022	979
44	36.3	533	95	834	812	18.95	18.45	51.0	37.1	37.8	17.8	4.7	8.5	25	34.5	34.9	34.1	28.6	1.566	1.524	51.201	0.096	1051	1008
46	36.9	529	95	857	835	18.64	18.15	51.8	37.6	38.2	18.0	4.7	8.6	24	34.9	35.3	34.5	29.0	1.622	1.580	48.076	0.098	1078	1035
48	37.3	525	96	878	856	18.30	17.83	52.5	38.0	38.7	18.2	4.7	8.6	24	35.3	35.7	34.9	29.3	1.672	1.629	45.146	0.100	1103	1059
50	37.8	522	96	898	875	17.96	17.50	53.2	38.4	39.1	18.3	4.8	8.7	24	35.6	36.0	35.3	29.7	1.719	1.675	42.433	0.102	1127	1082
52	38.2	521	96	918	895	17.66	17.22	54.0	38.7	39.5	18.4	4.8	8.7	24	35.9	36.3	35.6	30.0	1.762	1.717	39.885	0.103	1149	1104
54	38.6	519	96	936	912	17.33	16.90	54.6	39.1	39.8	18.5	4.8	8.8	24	36.1	36.6	36.0	30.2	1.802	1.757	37.553	0.105	1169	1124
56	38.9	518	96	953	930	17.03	16.61	55.2	39.4	40.2	18.6	4.8	8.8	24	36.4	36.8	36.3	30.5	1.840	1.794	35.380	0.106	1188	1142
58	39.3	517	97	970	946	16.73	16.32	55.8	39.7	40.5	18.7	4.8	8.8	24	36.6	37.1	36.6	30.7	1.875	1.830	33.374	0.108	1205	1160
60	39.6	516	97	986	962	16.43	16.03	56.3	40.0	40.8	18.8	4.8	8.9	24	36.8	37.3	36.8	31.0	1.909	1.863	31.516	0.109	1222	1176
62	39.9	515	97	1000	976	16.13	15.74	56.8	40.3	41.0	18.8	4.8	8.9	24	37.1	37.5	37.1	31.2	1.941	1.894	29.806	0.110	1238	1192
64	40.2	513	97	1012	988	15.82	15.44	57.2	40.5	41.3	18.9	4.8	8.9	23	37.3	37.7	37.3	31.4	1.973	1.925	28.245	0.112	1252	1206
66	40.4	513	97	1026	1002	15.55	15.18	57.7	40.8	41.6	19.0	4.8	8.9	23	37.4	37.8	37.6	31.6	1.999	1.952	26.745	0.113	1266	1220
68	40.7	512	97	1038	1013	15.26	14.90	58.1	41.0	41.8	19.0	4.9	8.9	23	37.6	38.0	37.8	31.8	2.026	1.978	25.363	0.113	1279	1233
70	40.9	493	97	1016	992	14.51	14.17	56.6	41.2	42.0	19.2	4.9	9.0	23	37.8	38.2	38.0	32.0	2.061	2.013	24.252	0.115	1296	1249

Plot Description: site index 38, plant@ 1600/ha, pct 700 at age 10

========= STAND STATISTICS (per ha) ==========														TREE STATISTICS (avg. tree) ==========						== GROSS ==		
AGE	SITE	TREES	CC	VOLUME		MAI		BA	HEIGHT		CA	CW	CL	CL%	DBH-OB		HEIGHT		VOLUME		FOLIAR	BA	VOLUME	
(yr)	HT		%	TOTAL	MERCH	TOTAL	MERCH	OB	TOP	PREDOM					ARITH	QUAD	TOTAL	MERCH	TOTAL	MERCH	VOLUME	OB	TOTAL	MERCH
2	1.8	1600	100	11	0	5.39	0.00	3.6	6.3	6.5	6.3	2.8	3.4	63	5.3	5.3	5.4	0.0	0.007	0.000	49.622	0.002	11	0
4	5.0	1600	100	44	0	10.91	0.10	9.8	9.5	9.9	6.2	2.8	6.2	75	8.7	8.8	8.2	0.0	0.027	0.000	103.127	0.006	44	0
6	8.4	1592	100	93	29	15.43	4.83	16.4	12.7	13.1	6.3	2.7	6.3	58	11.2	11.4	10.8	1.6	0.058	0.018	106.722	0.010	93	29
8	11.6	1553	100	147	88	18.39	11.02	22.0	15.5	16.0	6.4	2.8	6.2	46	13.2	13.4	13.3	4.5	0.095	0.057	102.527	0.014	148	88
10	14.5	1500	100	202	148	20.17	14.77	26.5	18.1	18.7	6.6	2.8	5.9	38	14.7	15.0	15.6	6.9	0.134	0.098	96.684	0.018	204	148
10	14.5	700	61	115	93	11.51	9.32	14.7	18.1	18.6	8.7	3.2	6.8	42	16.2	16.4	16.2	8.7	0.164	0.133	130.484	0.021	204	148
12	17.2	697	88	156	135	13.00	11.27	17.9	20.4	21.0	12.6	3.9	8.2	44	17.9	18.1	18.3	11.1	0.224	0.194	168.643	0.026	245	190
14	19.5	696	95	204	183	14.55	13.06	21.3	22.6	23.0	13.6	4.1	8.4	41	19.4	19.7	20.1	13.0	0.293	0.263	162.444	0.031	293	237
16	21.6	691	97	260	239	16.24	14.91	24.9	24.6	24.9	14.1	4.1	8.4	38	21.1	21.4	21.7	14.9	0.376	0.345	150.063	0.036	350	293
18	23.5	684	98	322	301	17.90	16.71	28.6	26.2	26.6	14.4	4.2	8.3	35	22.6	23.1	23.2	16.7	0.471	0.440	137.119	0.042	413	356
20	25.2	670	99	386	365	19.30	18.23	32.1	27.7	28.1	14.7	4.2	8.2	33	24.2	24.7	24.6	18.4	0.576	0.544	125.918	0.048	479	422
22	26.7	659	99	450	428	20.46	19.48	35.4	29.1	29.4	15.0	4.3	8.2	31	25.6	26.1	25.8	19.9	0.683	0.650	115.391	0.054	546	488
24	28.0	637	99	508	487	21.19	20.30	38.1	30.3	30.6	15.5	4.4	8.2	30	27.1	27.6	27.0	21.4	0.798	0.765	107.364	0.060	611	552
26	29.2	617	99	561	540	21.59	20.78	40.4	31.3	31.7	15.9	4.4	8.3	29	28.4	28.9	28.1	22.6	0.910	0.876	99.956	0.066	672	613
28	30.3	602	99	612	590	21.85	21.09	42.6	32.3	32.7	16.3	4.5	8.4	28	29.5	30.0	29.0	23.6	1.016	0.981	92.940	0.071	729	670
30	**31.3**	**581**	**98**	**653**	**632**	**21.77**	**21.06**	**44.2**	**33.2**	**33.7**	**16.8**	**4.6**	**8.6**	**28**	**30.6**	**31.1**	**29.9**	**24.5**	**1.124**	**1.088**	**87.350**	**0.076**	**782**	**722**
32	32.3	566	98	694	673	21.69	21.03	45.8	34.0	34.5	17.2	4.6	8.7	28	31.6	32.1	30.8	25.4	1.226	1.189	81.772	0.081	831	770
34	33.1	547	98	727	705	21.37	20.74	46.9	34.7	35.2	17.7	4.7	8.9	28	32.6	33.0	31.6	26.1	1.328	1.289	77.128	0.086	876	815
36	33.9	531	97	758	737	21.05	20.46	47.9	35.4	35.9	18.2	4.8	9.1	28	33.5	33.9	32.3	26.9	1.427	1.387	72.717	0.090	917	855
38	34.6	521	97	787	765	20.71	20.14	48.9	36.0	36.6	18.6	4.8	9.2	28	34.1	34.6	33.0	27.4	1.510	1.469	68.307	0.094	954	892
40	35.2	510	96	810	789	20.26	19.72	49.7	36.6	37.2	18.9	4.8	9.4	28	34.8	35.2	33.5	28.0	1.589	1.547	64.195	0.097	989	926
42	35.8	505	97	837	815	19.93	19.41	50.6	37.1	37.7	19.1	4.9	9.5	27	35.3	35.7	34.1	28.4	1.658	1.615	60.019	0.100	1020	957
44	36.3	500	97	861	839	19.57	19.07	51.5	37.6	38.2	19.3	4.9	9.5	27	35.8	36.2	34.6	28.9	1.722	1.678	56.216	0.103	1050	986
46	36.9	498	97	886	864	19.26	18.77	52.4	38.1	38.7	19.4	4.9	9.6	27	36.2	36.6	35.0	29.2	1.779	1.734	52.540	0.105	1077	1013
48	37.3	494	97	907	885	18.90	18.43	53.2	38.5	39.1	19.6	4.9	9.6	27	36.6	37.0	35.4	29.6	1.836	1.791	49.333	0.108	1102	1038
50	37.8	493	97	929	906	18.58	18.13	54.0	38.9	39.6	19.7	4.9	9.6	27	36.9	37.3	35.8	29.9	1.885	1.838	46.226	0.110	1125	1061
52	38.2	490	97	948	925	18.24	17.79	54.7	39.3	39.9	19.8	5.0	9.7	26	37.3	37.7	36.2	30.3	1.935	1.888	43.466	0.112	1147	1082
54	38.6	490	97	969	945	17.94	17.51	55.4	39.7	40.3	19.9	5.0	9.7	26	37.5	37.9	36.5	30.6	1.977	1.929	40.795	0.113	1167	1102
56	38.9	490	97	987	964	17.63	17.21	56.1	40.0	40.6	19.9	5.0	9.7	26	37.8	38.2	36.8	30.8	2.015	1.967	38.324	0.115	1186	1121
58	39.3	490	98	1005	981	17.33	16.92	56.8	40.3	41.0	19.9	5.0	9.7	26	38.0	38.4	37.1	31.1	2.051	2.003	36.056	0.116	1204	1138
60	39.6	490	98	1022	998	17.03	16.63	57.4	40.5	41.3	20.0	5.0	9.7	26	38.2	38.6	37.4	31.3	2.085	2.036	33.969	0.117	1220	1155
62	39.9	490	98	1037	1013	16.73	16.34	58.0	40.8	41.5	20.0	5.0	9.7	25	38.4	38.8	37.6	31.5	2.117	2.068	32.043	0.118	1236	1170
64	40.2	490	98	1052	1028	16.44	16.06	58.5	41.1	41.8	20.0	5.0	9.7	25	38.6	39.0	37.9	31.7	2.147	2.097	30.265	0.119	1251	1185
66	40.4	490	98	1066	1041	16.15	15.78	59.0	41.3	42.1	20.0	5.0	9.7	25	38.7	39.2	38.1	31.9	2.175	2.125	28.623	0.120	1264	1198
68	40.7	489	98	1077	1053	15.84	15.48	59.4	41.5	42.3	20.1	5.0	9.7	25	38.9	39.3	38.3	32.1	2.203	2.153	27.143	0.121	1277	1211
70	40.9	481	98	1072	1047	15.31	14.96	58.9	41.8	42.5	20.1	5.0	9.7	25	39.0	39.5	38.5	32.3	2.228	2.178	25.758	0.122	1295	1227

Appendix 2

Productivity of hardwood species based on ecological conditions

Medium and good productivity site series for Red Alder, Maple and Birch management

Species	BGZ	Site series													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
alder	CDFmm					6/C	6/D-E	*all*	*all*				all	all	
alder	CWHdm CWHxm	4/C				4/D-E	5-6/C	all	*all*	*all*				all	all
alder	CWHds1 CWHds2	4/C				4/D-E	5-6/C	all	*all*	*all*					
alder	CWHms2	4/C			4/D-E	5-6/C	all	all	all						
alder	CWHmm1	3-4/C				all	5-6/C	all	*all*	*all*					
alder	CWHvm1	3-4/C				all	5-6/C	all	*all*	*all*	*all*				
alder	CWHvh1 CWHvh2	*4-5/C*		*2/C*	3/C	all	all	*all*	*all*						
alder	CWHwh1	3-4/C			5-6/C	all	all	*all*	*all*						
maple	CDFmm				all		all	*all*	*all*				all	all	
maple	CWHxm CWHdm				all	all		all	*all*	*all*				all	all
maple	CWHds1 CWHds2				all	all		all	*all*	*all*					
maple	CWHmm1				all	all		all	*all*	*all*					
maple	CWHvm1				all	all		all	all	*all*	*all*				
maple	IDFww				all	all	all		*[13]	*					
birch	CWHxm CWHdm	3-4/C				all	5-6/C	*all*	*all*	*all*				all	all
birch	CWHds1 CWHds2	3-4/C				all	5-6/C	*all*	*all*	*all*					
birch	IDFww	3-4/C			all	all	all								

Comments

Underlined = fluctuating water table sites, Italics = flood plain site series, Red = additions to EN16 (alder only), All = all edatopes are covered in the site series, otherwise only part of the site series (eg 4/c)

Shaded = best productivity sites, Unshaded = medium productivity sites

For species restrictions refer to: B.C. Ministry of Forests. 2000. Establishment to free growing guidebook. Vancouver Forest Region. Rev. ed., Version 2.2. For. Prac Br., B.C. Min. For. Victoria B.C. Forest Practices Code of British Columbia Guidebook.

[13] * + flood plain sites not recognized in red book

Appendix 3

Example stocking standards

Intensive/extensive stocking standard for Red Alder hardwood management

Ecology	Species[14]		Target	MSS_p	MSS	MITD	Regen date	Free Growing
	Preferred	Accept						
CWHdm SS 07	Dr 4.0	Mb 4.0 EP 4.0	1200	500	700	2.0	3	20

Mixedwood management stocking standard

Example: **patch mixedwood** stocking standard, deciduous portion only (CWH mm1 – 05)

Preferred	Accept	Stocking density (stems per ha)		Mitd	Regen delay	Free growing (years)		% Ht above brush	Min. Ht.
Species	Species	Preferred	p&a	(m)	(Years)	Early	Late		(m)
Dr		1200	700	2.0	3	5	20	150	4.0

Example: **patch mixedwood** combined deciduous and conifer stocking standard (CWH mm1 – 05)

Class	Preferred	Accept	Stocking density (stems per ha)			Mitd	Regen delay	Free growing (years)		% Ht above brush	Min. Ht.
	Species	Species	Preferred	p&a	Min p	(m)	(Years)	Early	Late		(m)
D	Dr		1200	700		2.0	3	8	20	150	Dr4.0
C	Fd Cw	Pw[31]	900	500	400	2.0	3	8	20	150	Fd3.0 Cw1.5 Pw2.5

[14] Includes minimum height at free growing in meters

Appendix 4

Reference material for hardwood management

Red Alder

Red Alder Managers' Handbook for British Columbia. 1996. Peterson,E. Ahrens,G. Peterson,N. FRDA Report 240. BC Ministry of Forests, Victoria.

The Biology and Management of red alder. 1994.Hibbs,D.Tarrant,R. DeBell,D. editors. Oregon State University press, Corvallis, Oregon.

Red Alder: A State of Knowledge. 2006. Deal,R. Harrington,C. Technical Editors. US Department of Agriculture, Pacific Northwest Research Station, Portland, Or

Red alder management trials in the Vancouver Forest Region. 2002. Courtin, P. Brown, K. Harper, G. Forest Research Extension Note EN-016. BC Ministry of Forests, Vancouver Forest Region, Nanaimo, BC.

The use of red alder to enhance Sitka spruce growth in the Queen Charlotte Islands. 2001. Courtin, P. Brown, K. Forest Research Extension Note EN-008. . BC Ministry of Forests, Vancouver Forest Region, Nanaimo, BC.

The effects of red alder on stand dynamics and Nitrogen availability. 2005. Thomas, K. Note EN-076 BC Ministry of Forests, Research Branch, Victoria, BC.

Red alder: Guidelines for successful regeneration. 1992. Ahrens, G. Dobkowski, A. Hibbs, D. Special Publication 24 College of Forestry Oregon State University

Density management guide for red alder. 1993. Puettman, K. DeBell, D. Hibbs, D. Research Contribution 2 College of Forestry Oregon State University

The Hardwood Silviculture Coop has a useful web site at :
http://www.cof.orst.edu/coops/hsc/
The annual reports with research information on red alder is at :
http://www.cof.orst.edu/coops/hsc/report/index.htm

Bigleaf Maple

Bigleaf maple managers' handbook for British Columbia. 1999. Peterson, E. Peterson, N. Comeau, P. Thomas, K. BC Ministry of Forests, Victoria, BC.

The ecology and silviculture of bigleaf maple. 1999. Thomas, K. Extension Note EN-033 BC Ministry of Forests, Research Branch, Victoria, BC.

Birch

Paper birch managers handbook for British Columbia. 1997. Peterson, E. Peterson, N. Simard, S. Wang, J. FRDA publication, BC Ministry of Forests, Victoria.