# Hardwood Management in the Coast Forest Region

## Acknowledgements

This discussion paper is a collaborative work prepared by members of the Silviculture Working Group (SWG), and coastal Hardwood Management Specialist.

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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<br>- Herbicide<br>- Mechanical | Plant 1400-1600 sph<br><br>Optional<br>-Fertilize at time of planting with Phosphate | -Stand height 10m<br>-50% live crown ratio<br>- Post spacing density 600[7]-1000 sph | 30 cm diameter target<br>Age 25-35 years<br>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<br>- Herbicide<br>- Mechanical | Plant 1000-1200 sph<br><br>Optional<br>-Fertilize at time of planting with Phosphate | 30 cm diameter target<br>Age 30-50 years<br>Target volume 300 $m^3$ per ha | -Natural ingress not well understood<br>-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<br>- mechanical | 1000 -1200sph of conifer<br><br>Natural regeneration of hardwoods (Alder) | Target Hardwood diameter 30 cm<br><br>Rotation 50-70 years<br><br>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

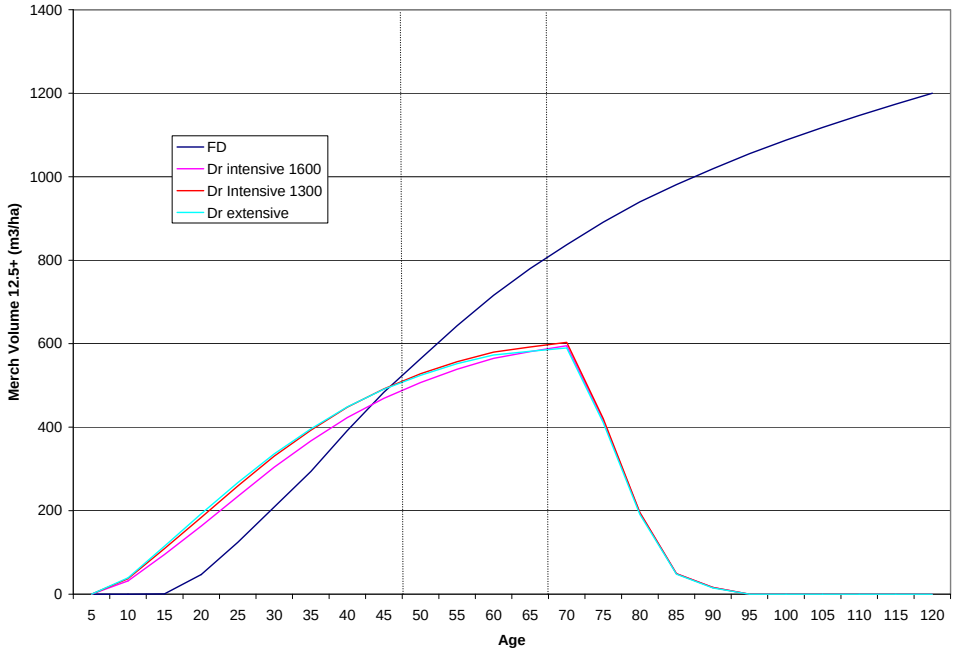
**DR Intensive 1300:**

- 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

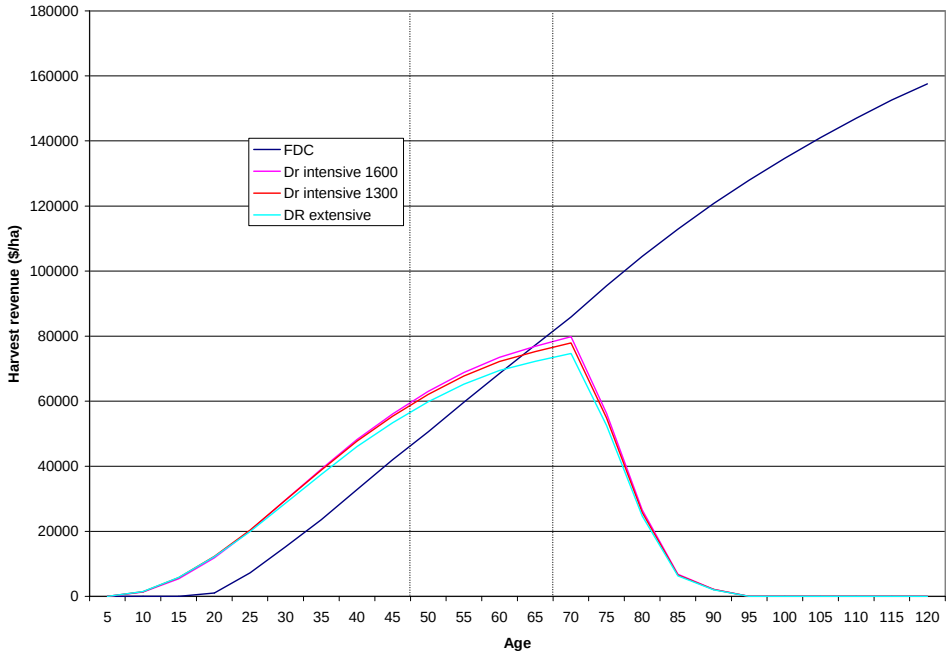
**DR Extensive:**

- 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.

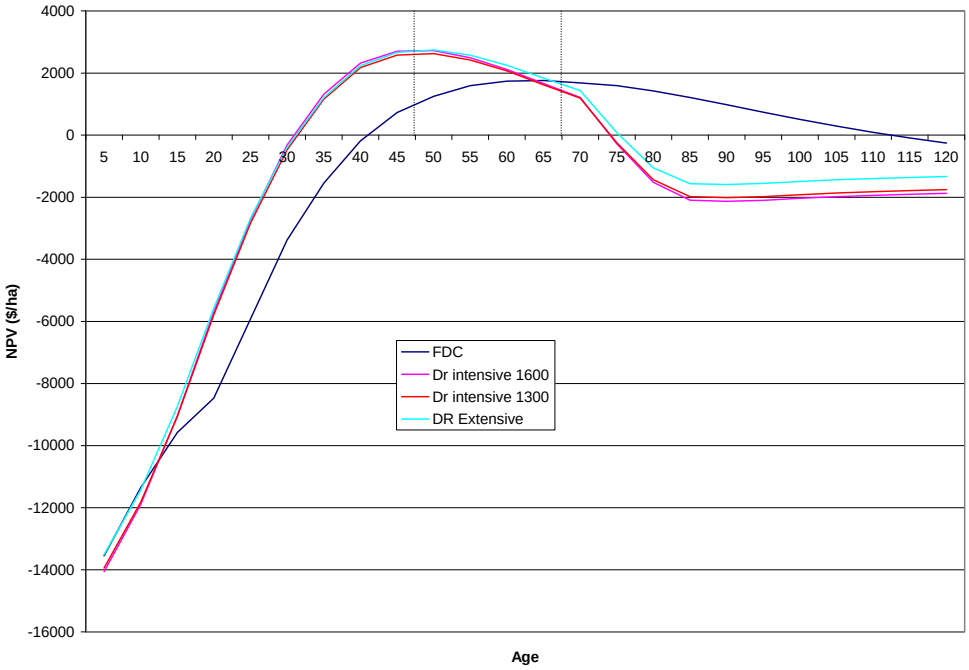



However, when looking at the potential harvest revenue from the different regimes

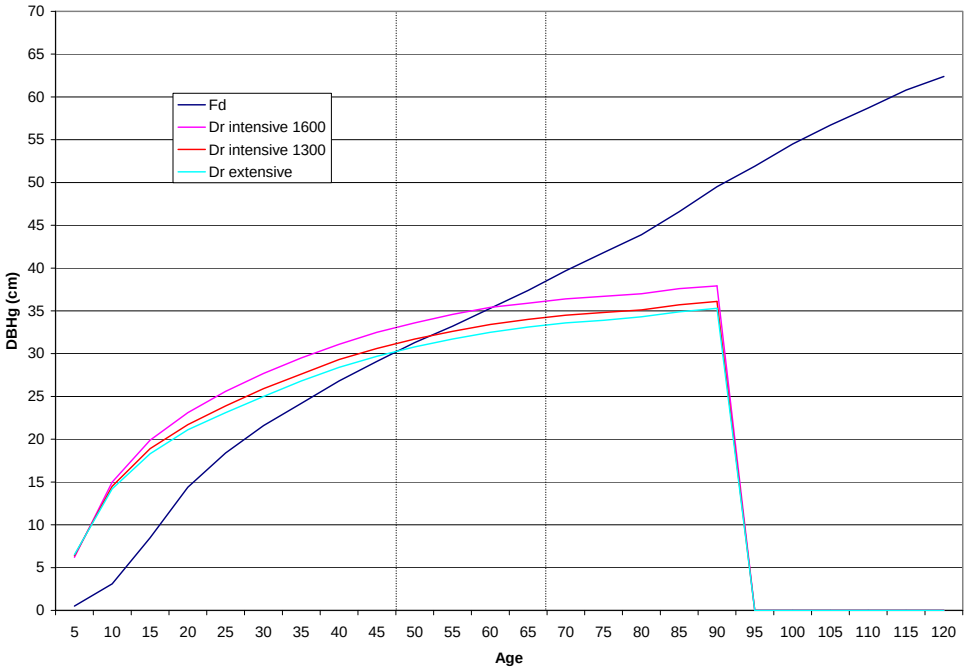



we see that the intensive regimes have greater harvest revenue for a large part of the target rotation periods. With the extensive Dr regime according to this TIPSY simulation it will have a greater harvest revenue that the Fdc regime during the earlier dates of the target rotation periods

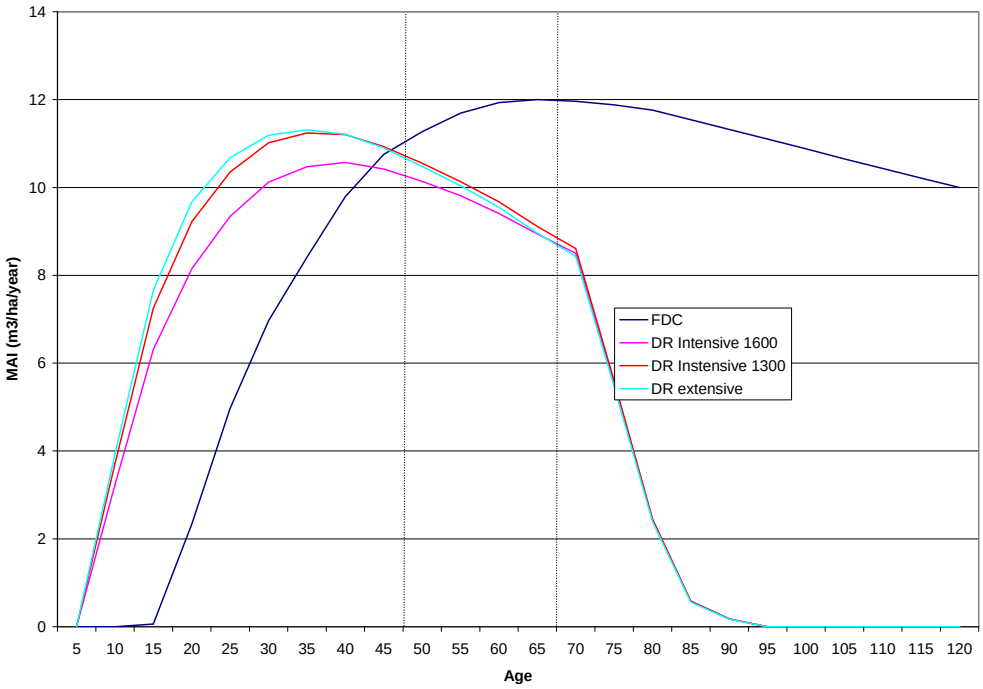
When we examine the net present value (NPV) resulting from the cost of treatment and revenue received we see that all the Dr regimes have a greater NPV than Fdc for all but the latest dates within the target rotation period.




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 | GROSS VOLUME TOTAL | GROSS 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**

| 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 | 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 (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 | 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**

| 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 | 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.