The CCISS tool in the creation of climate change informed stocking standards.

Adapted from the "Establishment to Free Growing Guidebooks"

Abbreviations: BEC :Biogeoclimatic Ecosystem Classification; BGC: Biogeoclimatic; CCISS: Climate Change Informed Species Selection; **GCM**: Global Circulation Models; ; **POI**: Point-of-interest ***PRISM:*** Parameter-elevation Relationships on Independent Slopes Model; **rF**: randomForest

The CCISS tool reassesses the suitability ranks of species at a site series level under multiple plausible modelled future climates. Understanding climate- and site-level species suitability is one of the foundational pieces of information that a forester requires for the creation of successful silvicultural prescriptions over a rotation. The CCISS tool looks at near- and mid-term projected changes to BGC climates and the implications to species suitability. The tool then aligns the projected future suitability rank of species at a POI with the suitability in the default stocking standards outlined in the Chief Forester's Reference Guide to highlight where there are predicted climate change induced shifts in species suitability. This information can be used to inform planting/ silvicultural prescription outlined in climate change informed stocking standard. The CCISS tool is spatial explicit to account for the gradient of climate change that will different regions and elevations of a BGC.

Setting management objectives

A forest development plan must have a set of goals or objectives to be achieved in order for the plan to be called successful. One of the most important decisions made in any reforestation program is how to meet stand objectives over time. This requires a clear understanding of how the stand fits within a management unit and within landscape priorities and how best to meet those priorities. Once a vision of the desired stand has been identified, a set of steps can be formulated to achieve it. Species selection and the choice of stocking level, combined with prompt and effective establishment, are crucial elements in creating a desired stand. In British Columbia, most forest sites can support a variety of tree species, allowing the silviculturist a range of species from which to choose. WITH A FUTURE CHANGING CLIMATE, CONSIDERATION SHOULD BE GIVEN TO ACCOUNT FOR PROBABLE CHANGES IN THE SITE LEVEL SUITABILITY OF SPECIES WITHIN THE FOREST DEVELOPMENT PLAN. THE CCISS MODELLING MAY SHOW CHANGES TO SPECIES SUITABILITY IN FUTURE TIME PERIODS IN SOME AREAS.

- WHERE CCISS SHOWS DECLINING SUITABILITY OF A SPECIES, THE MAY INDICATE THAT SPECIES SELECTIONS BASED ON CURRENT GUIDELINES MAY BE AT INCREASED RISK OF FAILURE DURING ESTABLISHMENT OR SUBSEQUENT STAND DEVELOPMENT AND SHOULD BE PLANTED WITH INCREASED CAUTION
- CURRENTLY SUITABLE SPECIES WITH IMPROVING SUITABILITY IN THE CCISS MAY REPRESENT NEW SILVICULTURAL OPPORTUNITIES THAT SHOULD BE CONSIDERED.
- SPECIES PREDICTED TO BECOME SUITABLE IN THE ESTABLISHMENT PERIOD THAT ARE CURRENTLY NOT LISTED IN THE REFERENCE GUIDE SHOULD BE CONSIDERED FOR PLANTING ON A TRIAL BASIS, OR ON AN

OPERATIONAL BASIS WHERE EVIDENCE FROM OFF-SITE SPECIES TRIALS OR OTHER INFORMATION DEMONSTRATES SUCCESSFUL ESTABLISHMENT.

The number of trees to be carried on the site at various benchmark times throughout the rotation will determine the size and value of the goods produced from the trees being grown. The *Establishment to Free Growing Guidebooks* focus on the required results at the time of the free growing assessment. It considers the need for flexibility in the prescription and considers integrated resource values that will be generated throughout the rotation.

In selecting the tree species and stocking requirements for each new stand, there are five elements to success:

- identifying desired stand goals throughout the rotation (e.g., stand structure; intermediate product removal)
- identifying ecological site attributes
- knowing and using the inherent silvical characteristics of all species suited to the site
- ASSESSING POSSIBLE CLIMATE CHANGE EFFECTS ON SPECIES SUITABILITY
- carefully matching these elements to produce a prescription that meets management objectives.

In British Columbia, forest land is managed for timber, range, recreation, water, fisheries, wildlife, and other purposes. The desired stand structure and tree species composition may not be the same for each of these management strategies, and may have to be adjusted, depending on various management needs.

THE SPECIES SUITABILITY RATINGS USED IN THE CCISS TOOL 2.0 ARE BASED ON THE CHIEF FORESTERS REFERENCE GUIDE. THESE STANDARDS ARE FOCUSSED ON CONIFER SPECIES SELECTION AND DEVELOPED FOR THE PRIMARY MANAGEMENT OBJECTIVE OF SAW LOG PRODUCTION UNDER AN EVEN-AGED SYSTEM. DEFAULT GUIDELINES FOR BROAD-LEAVED TREES AND MIXED-WOOD STANDS HAVE NOT BEEN DEVELOPED FOR VARIOUS PRODUCT OBJECTIVES, INCLUDING SAW LOG, PLYWOOD, PULP, AND ORIENTED STRAND BOARD PRODUCTION.

THE DEFAULT STANDARDS OUTLINED IN THE CHIEF FORESTERS REFERENCE GUIDE (CFRG) ASSUME THE FOLLOWING OBJECTIVES AND CONSIDERATIONS*:*

- *sawlogs as the primary product objective*
- *trade-off between piece size, value, and maximum volume production*
- *safe pathological rotation age, considering projected pest risks (e.g., Pl 80 years)*
- *recognition of higher planting costs associated with higher target stocking and increased harvesting and milling costs associated with smaller piece sizes*
- *minimized need for repeated stand entries*
- *ability of coastal species to attain full site occupancy at lower densities*
- FUTURE CLIMATE IS CONSISTENT WITH HISTORIC CLIMATE

Management units with differing approved timber product or other objectives (e.g., IRM or biodiversity) may have different stocking standards.

Where forest plans specify a particular product objective, integrated resource management goal, or different regeneration assumptions, modification of these guidelines may be required. Conflicts with higher level plans must be resolved at the higher planning level.

Selecting appropriate species

In British Columbia, most forest sites can support a variety of tree species, allowing the silviculturist a range of species from which to choose.

Ecological basis for species selection

The characteristics of tree species, forest sites, and managed forest ecosystems were important considerations in the development of the guidelines. (See the Ecological and Silvic Tables of Klinka et al. 2000) for a synopsis of selected silvical characteristics of major commercial tree species.)

An ecological and ecosystem-specific approach to the selection of tree species and stocking has been adopted. This was necessary because each tree species has adapted to a specific range of environmental conditions, and its growth and behaviour depend on the ecosystem in which it grows. In an unfavourable environment, that species growth potential will not be realized, and its susceptibility to damaging agents will increase. The suitability of species assigned at a site-level. Correlated site series (sites with similar ecological capabilities) provide the ecological framework for this guide. The relationship between site series and species selection is indicated in the CFRG and the CCISS tool. Conifer species are assigned one of 4 suitability ratings.

Primary species

Primary tree species are ecologically acceptable and have a high rating for silvicultural feasibility, reliability, and productivity under the average conditions for a site series. Primary species can be managed as a major component in a stand if any restrictions have been adequately addressed.

Note: Primary species are not by default the preferred species. Species from any of the three categories can be chosen as preferred, if the species meets the identified management objectives and if restrictions can be dealt with through treatments.

Secondary species

Secondary species are ecologically acceptable, but rank lower than primary species for one or more of silvicultural feasibility, reliability, or productivity. Depending on the nature and extent of these limitations, secondary species can be managed as either a major or a minor component in a stand.

Tertiary species

Tertiary species are ecologically acceptable, but rank lower than primary or secondary species for one or more of silvicultural feasibility, reliability, or productivity. Depending on the nature of their limitations, on local conditions, and on management objectives, tertiary species are normally suitable only as a minor component within a stand but may be. For example, tertiary species can be used as a minor component of all stands within an area.

Broadleaf species

Broadleaf species are included as a separate column in the tree species selection and stocking tables due to the unique management considerations associated with broadleaves. This category includes the broadleaf species known to reach tree size within a site series. The footnotes for

broadleaves in the stocking tables differentiate when a species is a productive, reliable, and feasible regeneration option **('A' OR '900')** versus when it is limited in one or more of these considerations **('B' OR '901).**

THE FOOTNOTES HAVE BEEN CONVERTED TO SUITABILITY RANKINGS IN THE CCISS TOOL WITH AN 'A' FOOTNOTE TREATED AS A SECONDARY SUITABILITY AND A 'B' TREATED AS A TERTIARY SPECIES.

Broadleaf species should be used to fulfill silviculture obligations (i.e., preferred or acceptable well-spaced trees) only if they are:

- consistent with TFL or TSA management plans and are deemed acceptable as a new forest crop. The plans should identify those site series appropriate for broadleaf management
- a short-rotation interim crop to manage for root rot centres.

The establishment or retention of broadleaf trees within a stand may be desirable to provide a nurse crop, promote nutrient cycling, or to meet other resource objectives such as biodiversity or wildlife habitat. In recognition of this, the free growing guidelines allow for a broadleaf component, but to a stocking level where the impact on conifer crop tree growth is acceptable. Where regeneration of broadleaf trees is a product objective, use the broadleaf stocking standards for the coast and interior (after the tree species selection and stocking tables) or the boreal broadleaf stocking guidelines as a guide. Changes to these standards are expected where product objectives vary and where the site characteristics cannot support the stems/ha listed in the guide. Maximum density provisions do not apply to areas managed as broadleaf stands or to the broadleaf component in conifer or mixedwood stands. For additional information, refer to the following publications: *Paper Birch Manager's Handbook for British Columbia, FRDA Report 240; Red Alder Manager's Handbook for British Columbia, FRDA Report 250; Black Cottonwood and Balsam Poplar Manager's Handbook for British Columbia, FRDA Report 230.*

Species restrictions

Restricted species are ecologically acceptable but raise productivity, reliability,or silvicultural feasibility concerns that need to be addressed. Restricted species may be in primary, secondary, or tertiary categories. Restrictions are denoted by the footnotes in the stocking tables as seen in Figure 1 (see Appendix 7 for interpretations of all restrictions and cautionary notes). Careful attention must be given to the footnotes when selecting species for preferred or acceptable status. Some restrictions can be accommodated through management activities, allowing particular species to be considered for use as preferred or acceptable. Restrictions and cautionary notes fall into several categories and are explained in more detail in Appendix 7.

OFF-SITE SPECIES/Exotic species

Exotic species are those species that are introduced, accidentally or intentionally, to a region beyond their natural range. The use of exotic species as part of a reforestation strategy must be consistent with the desired timber and non-timber objectives of the site. When contemplating the use of an exotic species, consider the silvics of the species and how it will interact with the characteristics of the intended site series. Exceeding the transfer limits for that species may decrease its productivity or increase its susceptibility to damaging agents. Problems that may arise when species are transferred beyond their ecological tolerance include poor survival or outright mortality, reduced growth, poor stem form, and undesirable wood properties. Exotic species can be used for small operational trials if they are approved in a silviculture prescription.

It is recommended that provenance information of the exotic seed source (elevation, latitude, longitude) be submitted with the silviculture prescription. Extended free growing time frames are also recommended to manage the risk associated with the uncertainty of long-term performance of exotic species.

Operational trials should include tagging of sample trees and a commitment to a schedule of assessments. Incorporation of comments on the performance of exotics should be included in the free growing report. Seed of exotic species intended for use on Crown land must be registered. In order to be registered, the seed must meet the Ministry of Forests *Technical Standards for Registration.* More information on the use of some exotic species can be found in the *Seed and Vegetative Material Guidebook.*

Mixed species

When proposing the species composition for the silviculture prescription, select a mix of species that is ecologically suited to the area if a mix of species was present on the area before the timber was harvested, unless otherwise specified in a higher level plan. Reasons for promoting a species mix include maintenance of historical species profiles in the landscape, improving stand resilience to damaging agents (e.g., red alder in root rot infected areas), increased future stand value, enhancing biodiversity, biological and ecological benefits, and even cultural considerations (e.g., western redcedar on the Queen Charlotte Islands). Under appropriate conditions, these objectives can be achieved by establishing mixed-species stands. The choice between establishing a single species or a mixture of species depends on the management objectives, site characteristics, and species compatibility. Factors affecting species compatibility include:

- the rate and level of natural ingress of all species on the specific site
- the relative growth rates of all species on the specific site
- the relative protection requirements and shade tolerance of the species
- the spatial requirements and branching habit of the crowns for the species
- the nutritional effects of the species or combination of species on the soil and each other
- the pathological and biological (morphological) rotation age of each species
- the forest health concerns (contact the local forest health specialists and refer to the various forest health guidebooks).

The integration of these factors determines how a species will perform in pure or mixed-species stands. Irrespective of tree species, a forest stand can be visualized as one of three general structure types:

- even-aged, non-stratified canopy stand structures
- even-aged, stratified canopy stand structures
- uneven-aged, multi-storey stand structures.

A description of these stand structures is included in Appendix 8. When required to prescribe a mix of species to meet the stocking requirements of the silviculture prescription, it is recommended that generally no more than 80% of the managed stocking be comprised of a single species established either through planting, seeding, or natural reforestation. The determination of an appropriate species mix, however, will be unique to each site and should

include consideration, at the landscape level, of what percentage of cutblocks should have a species mix, and the species distribution within each cutblock. Maximizing diversity on every site may result in stands that are difficult to manage. Therefore, planning for biological diversity is often best done at the landscape level. The desired tree species and stand structure for a specific site should reflect these landscape level objectives. Several methods may be adopted in order to address landscape level objectives on a site-specific basis. Selecting a single species only for the minimum stocking standard preferred (MSSp) or selecting a minimum stocking standard for a species are both legitimate strategies in the right context. For example, due to heavy deer browse, western redcedar regeneration is a concern on the Queen Charlotte Islands. The high level of browse has led to a serious reduction of redcedar regeneration. On sites where a species mix is required and redcedar was a component of the pre-harvest stand, establishment of a minimum amount of redcedar as part of the reforestation of these sites is generally required.

Forest health

When making the species selection decision, consider forest health concerns for your specific species and site combination. Consult with local forest health specialists for more information.

Soil fertility

When selecting a tree species, consider the effect that tree species, or a combination of tree species, will have on soil fertility. For example, on nutrient-poor sites, successive rotations of western hemlock or white spruce monoculture may result in a decline in productivity by increasing soil acidity. The relative availability of many plant nutrients is reduced by increasing soil acidity. On such sites, the addition of tree species with base-rich litter, such as western redcedar, trembling aspen, or red alder may ameliorate these conditions and improve soil fertility.

Species conversion

Species conversions, where appropriate, can be an effective means of increasing yield and reducing future site-specific hazards (e.g., from diseases, insects, or frosts). However, species conversions should be undertaken only after carefully weighing the relative risks and benefits of the intended plan relative to the silvics of the tree species, the ecology of the site, and biodiversity.

Mixedwood management

Mixedwood management involves managing both broadleaf and coniferous species on the same site. Mixedwood management produces a viable crop of both broadleaf and coniferous trees. Managing broadleaf species may be desirable for a number of reasons, including biodiversity, wildlife habitat, nurse crops for conifers, reducing the risk of forest health problems, and potentially increasing yield. In mixedwood management, broadleaf species often establish at high initial densities and overtop the coniferous component for several decades. For this reason, coniferous species selection in mixedwood stands is often determined by shade tolerance. This may lead to selection of more shade-tolerant secondary and tertiary species as the preferred/acceptable species. Also, the standard definition of free growing may require modification when assessing conifers overtopped by the broadleaf component.

Preferred and acceptable species

The selection of preferred and acceptable species must be consistent with higher level plans or the forest development plan for the area under the prescription. Preferred and acceptable species are defined below.

Preferred species

Preferred species are ecologically suited to the site. Management activities are primarily aimed at establishing these species. The characteristics of these species are consistent with the desired timber and non-timber objectives for the site.

Acceptable species

Acceptable species are ecologically suited to the site, but management activities are not aimed at establishing them. The reasons for including a species labelled only as acceptable may be a higher-than-acceptable site limitation, such as pest risk, or a lower productivity than the preferred species. Special restrictions or limitations may apply to the use of these species.

Selecting preferred and acceptable species from primary, secondary, and tertiary species

Preferred and acceptable species are generally selected from the list of primary, secondary, and tertiary species provided in the tree species selection and stocking tables. Primary, secondary, and tertiary species were determined on the basis of a species' productivity, reliability, and silvicultural feasibility based on current knowledge of the productive capability of each site series, the silvics of the tree species, and the growth and development of existing second growth forests.

For more detailed background information and examples for determining primary, secondary, and tertiary species, see Appendices 3 and 4. Figure 1 illustrates a systematic process by which preferred and acceptable tree species can be selected. This process should be undertaken before harvest and be reviewed after harvest. In determining the appropriate preferred and acceptable species, the prescriber is to review the recommended species options for the site. Consider:

- the desired stand structure
- the non-timber objectives for the area
- the desired reproduction method
- the potential for natural regeneration
- the role of advance regeneration
- the hazards, such as pests, likely to affect the stand throughout the rotation (e.g., in areas with a high risk of leader weevil infestation, spruce should be limited to mixed-species stands) (see Appendix 5; refer to the forest health guidebooks for additional information).
- the feasibility of the treatments required to establish the stand under existing management constraints
- the effect of the species or combination of species on the site
- the maintenance of biological diversity.

In general, preferred and acceptable species are selected from the primary and secondary species lists. In some cases, tertiary species also could be preferred or acceptable. In choosing preferred and acceptable species, the prescriber should review the species choices and the species restrictions.

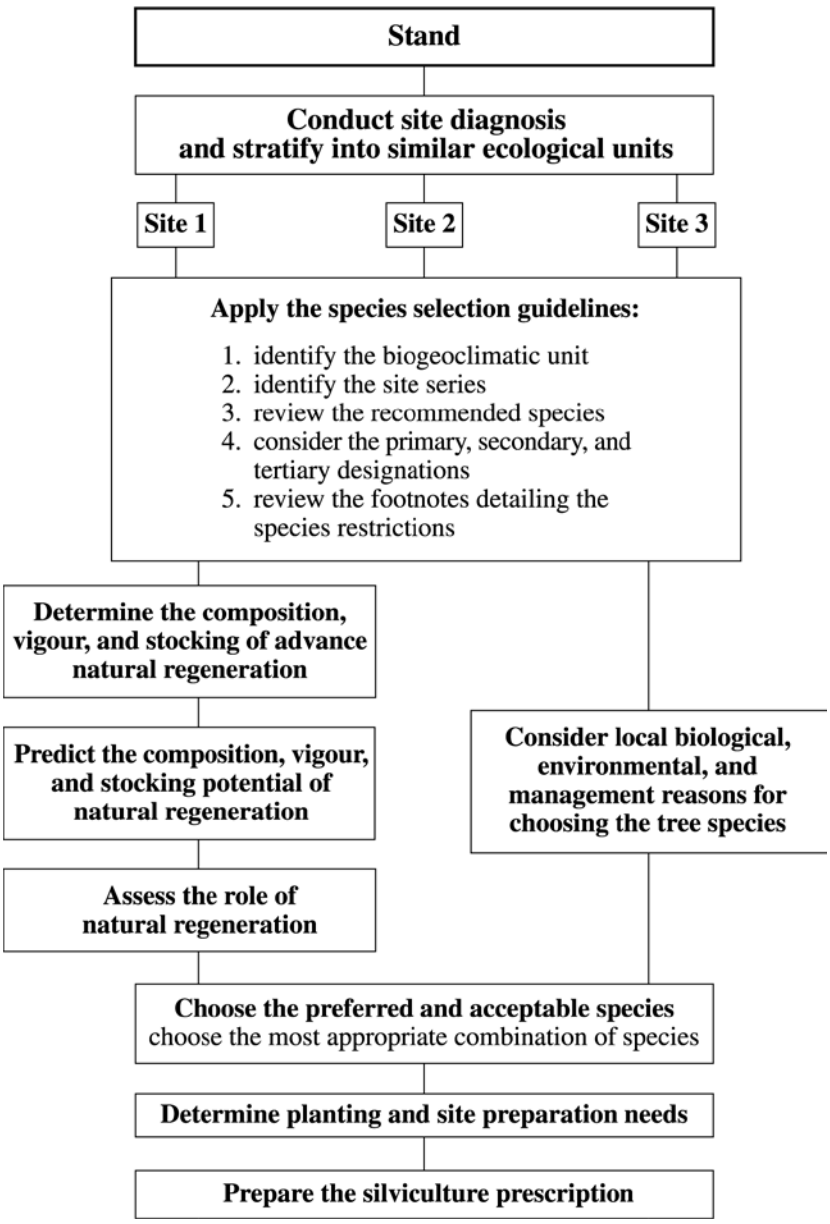
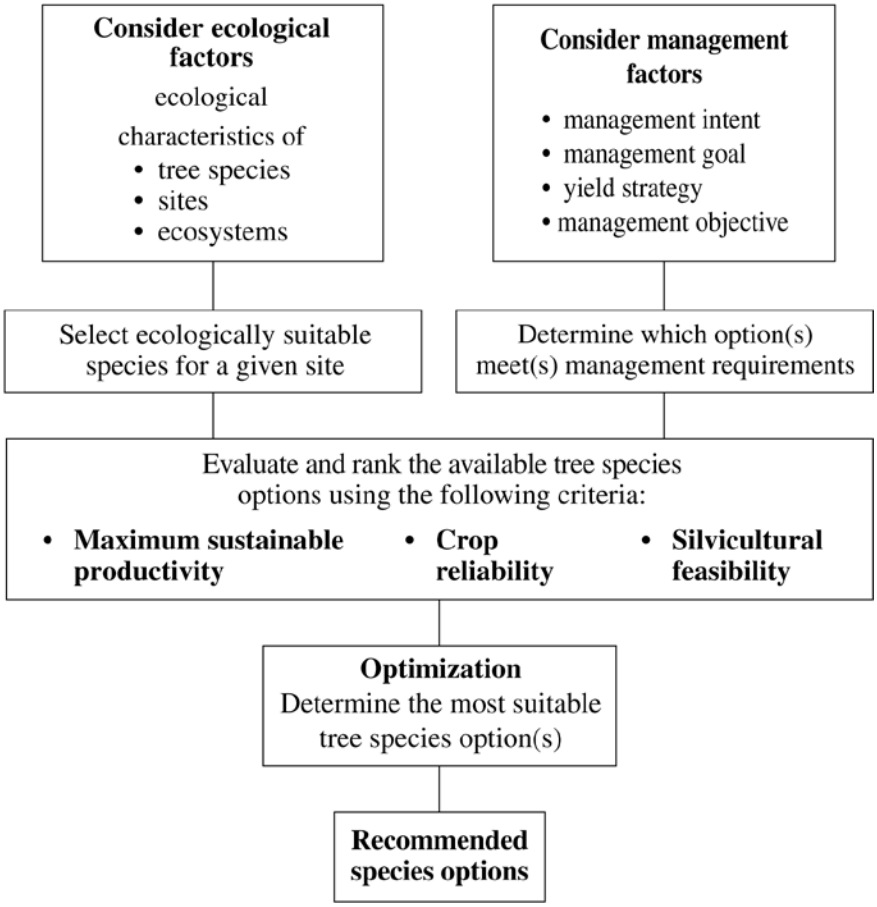


Figure 1. Decision making for the site selection of species to regenerate forest sites on a site and situation-specific basis (modified from Klinka *et al.* 1984).

Conceptual approach to tree species selection

The procedures used for tree species selection in these guidelines are based on work by K. Klinka and M.C. Feller (1984) for forest sites in southwestern British Columbia. These guidelines have been developed with consideration of both ecological and management factors. The evaluation criteria of maximum sustainable productivity, crop reliability, and silvicultural feasibility were stressed throughout the development process. The choice of stocking standards was tied to management objectives.



Species evaluation by site series

A list of ecologically acceptable species was prepared for each site series. Three criteria were then used to determine the most suitable species choices for sawlog production (the assumed management goal):

- maximum sustainable productivity
- crop reliability
- silvicultural feasibility.

Maximum sustainable productivity

To satisfy the maximum sustainable productivity criterion, the relative productivity for each tree species, or combination of tree species, was evaluated to determine which were best suited to each ecosystem unit.

Crop reliability

To satisfy the crop reliability criterion, the relative susceptibility to natural hazards was evaluated for each tree species, to determine which species provide the most reliable choices for a future crop on a given site series. Established stands should be both resilient and resistant to all anticipated hazards, so that they will survive until harvest.

Silvicultural feasibility

To satisfy the criterion of silvicultural feasibility, ecologically viable tree species were evaluated, based on accumulated silvicultural experience, to determine whether they were able to produce sawlogs in a cost-effective manner on each site series within an acceptable rotation length.

Examples of species selection and stocking standards

Example 1. Determining preferred and acceptable species by management objectives

A block is located in a site series for which the guidelines indicate Pl and Sx as primary species and Bl as a secondary species. The guidelines indicate that the free growing target stocking standard is 1200 well-spaced trees/ha and the minimum stocking standard is 700 well-spaced trees/ha. Reviews of the management unit plan and landscape priorities have identified that the production of Sx sawlogs, in an 80 year rotation, is the main objective for this portion of the landscape. The prescriber has also determined that, for this site, Sx has the best mix of maximum sustainable productivity, crop reliability, and silvicultural feasibility when compared with other species.

Once spruce sawlogs have been identified as the management objective, Sx is listed as the referred species in the silviculture prescription. Management activities will be aimed at actively managing for Sx through site preparation, planting, and brush control. Since Pl and Bl will not be planted or actively managed for, they will be identified only as acceptable species in the silviculture prescription. Pl and Bl will be considered acceptable for contributing to tree species diversity and additional stocking to the site.

Management activities will be aimed at meeting the target stocking at free growing.

At the regeneration delay date, a minimum of 700 well-spaced preferred and acceptable trees/ha and a minimum of 600 well-spaced Sx/ha must be on-site (see Table 1, page 17) in order to classify the site as satisfactorily restocked.

Within the free growing assessment period, to be classified as free growing, a minimum of 600 free growing Sx/ha must be on-site (see Table 1). In addition, there must be at least 700 free growing preferred and acceptable trees/ha on-site. If there are fewer than 600 free growing Sx/ha, or fewer than 700 total free growing trees/ha, the area is considered not free growing.

The standards are intended to ensure that sufficient numbers of the preferred tree species are established and free growing in order to produce the desired future forest conditions.

Example 2. Tertiary species as preferred

In this example, site classification shows the block to be on a southwest slope in the lower elevation of the ICH. Armillaria root rot is considered a serious threat to future productivity on the block. The original stand was composed of 30% Cw, 40% Hw, and 30% Fd.

Fd and Lw are classed as primary species, Pl and Sx as secondary species, and Bl, Cw, Hw, Pw, and Py as tertiary species. The cautionary and restrictive codes indicate that there is a high risk of blister rust for Pw; that Py be restricted to southerly aspects, at lower elevations, and be used on a trial basis only (as it is out of its natural range); and that Sx be restricted to north aspects and upper elevations. The target and minimum stocking standards provided in the guidelines are 1200 and 700 stems/ha, respectively.

The objective for the stand is to produce sawlog-quality timber over an 80- year rotation, while retaining species diversity. To reduce the incidence of root rot, the block is prescribed to be stumped after harvest. To ensure the maximum productivity on the site and to reduce the chance

of future armillaria root rot infection, a mix of species is prescribed for the new stand. Crown closure is estimated to occur in 30 years. No snags are to be left in this block, but adjacent riparian areas will be left unharvested to provide perching habitat.
The preferred species chosen in the silviculture prescription to create the target stand are Lw, Fd, Pw, and Py, even though Pw and Py are classed as tertiary species. Lw, Fd, and Py will be planted. Because Py is potentially a productive and reliable species on this site, a monitoring program will be established to assess performance. Pw is expected to fill in naturally. Blister rust is not presently a problem in the stand, however, pruning of Pw is prescribed to mitigate possible infection.
Acceptable species in the silviculture prescription are Bl, Cw, and Hw (all classed as tertiary). These species are thought useful in providing varied habitat and structural diversity. Bl, Cw, and Hw will occur naturally, and no management is required for their establishment. Pl and Sx are not listed in the silviculture prescription as either preferred or acceptable, because there is no Pl seed source on site and Sx is not adapted to this aspect or elevation.
The area will be planted at 1000 stems/ha, with an expected infill of 200 well-spaced stems from the preferred and acceptable species, to provide 1200 stems/ha at free growing.

Example 3. Deviation from the established stocking standards is recommended for maintenance of grizzly bear habitat

After a field check with Ministry of Environment staff, the block was identified as providing critical grizzly bear habitat. The block is near a local skunk cabbage swamp that has bear-marked trees in it. Harvesting in the valley is near the end of the first pass, where large areas of this site series have been clearcut and regenerated successfully to target stocking levels of Ss. There is a concern that forage availability is becoming constrained due to the ensuing canopy closure in these adjacent areas. The species guidelines suggest Ba, Cw, and Ss as the primary species. Hw on deep duff is suggested as a secondary species, and Yc is suggested as a tertiary species. The target and minimum stocking standards are suggested as 900 and 500 well-spaced stems/ha, respectively, with a regeneration delay of three years. Both Ss and Ba are listed as preferred species while Cw, Hw, and Yc are listed as acceptable species in the silviculture prescription. The target stocking is 600 well-spaced stems/ha, with a minimum of 400 well-spaced stems/ha. This is below the 900/500 suggested in these guidelines, but fits within the *Guidelines for integrating grizzly bear habitat and silviculture in the coastal western hemlock biogeoclimatic zone.*
The prescription calls for planting equal numbers of Ss and Ba in clumps of seven trees. Ss is to be planted on the outside of the clumps with Ba in the centres. The minimum inter-tree distance is 1 m. The clumps will be approximately 10 m apart, providing 100 clusters per hectare. Due to brush encroachment and lack of adjacent seed sources, natural regeneration is not expected to influence stocking on this block. The reduced targets and minimums as well as the clumpy distribution are suggested to allow greater space for colonization and maintenance of key forage species for grizzly bears. The target stand at rotation will provide approximately 450 stems at 80 years with partial canopy closure. To ensure that the conifers reach free growing, two brushing treatments are scheduled, two and five years after planting. Either backpack spot treatment or manual brushsaw vegetation control methods are suggested. Competing species include red elderberry, salmonberry, and red-osier dogwood. Either treatment should treat only a cylinder around each tree. Control of brush outside the zone of influence is not prescribed. It is intended that crop-tree centred brushing and clustered conifer spacing will provide adequate space for

shrub regrowth, and will provide conditions suitable for adequate berry production through the young sapling and pole stages (5–30 cm dbh).