BCTS BC Timber Sales Skeena	**Operating Guidelines** **SINGLE ENTRY DISPERSED RETENTION SYTEM** **November 2011**

RATIONALE

Northwest BC mainly consists of temperate coastal forests with old growth structure and attributes. To ensure ecological diversity is maintained and timber can be harvested, retention silvicultural systems that retain crown cover can be used. Retention systems are also consistent with Ecosystem Based Management (EBM) practices and the management of a wide range of values important to the public such as; wildlife, riparian areas, fish habitat, and visual quality. The single entry dispersed retention silvicultural system (SEDRS) is one variant of the retention systems and will be the emphasis of this guidance document.

The purpose of this document is to provide guidance to consultants who perform layout and prepare site plans for partial cutting and to BCTS representatives who plan and implement FSP's, site plans and Timber Sale Licenses (TSL's). Helicopter harvesting is a common method used for retention systems however high lead and ground methods can also be used, depending on the site.

DEFINITIONS

Retention System:

A silvicultural system that is designed to:

(a) retain individual trees or groups of trees to maintain structural diversity over the area of the cut-block for at least one rotation, and

(b) leave more than half the total area of the cut-block within one tree height from the base of a tree or group of trees, whether or not the tree or group of trees is inside the cut-block. (MOFR 2003)

High Grading:

1. Removal of only the best trees from the stand often resulting in a residual stand of lower value. Essentially, this practice sacrifices future values that may flow from a stand for short term economic gain (Silviculture Systems Issues Working Group 2006).

2. A harvesting technique that removes only the biggest and most valuable trees from a stand and provides high returns at the expense of future growth potential. Poor quality, shade-loving trees tend to dominate in these continually high-graded sites (About Forestry 2010).

Single Entry Dispersed Retention System (SEDRS):

A partial cut harvest entry where retained overstorey stems contribute towards a stocking obligation. Future stand entries are not required to meet stand structural objectives. Stands will have a dispersed Residual Basal Area (RBA) ranging from 5 to 39m^2 per ha, (Silviculture Working Group 2009).

APPLICATION

The SEDRS stocking standard framework provides the linkage from stand level to forest level management. This type of standard is applicable where retention of dispersed stems is required to achieve FRPA management objectives (non- timber). The Forest Stewardship Plan (FSP) **must** specify the situations and circumstances where the stocking standard will be applied. Note: For interim entries into a stand (multiple entries may be made over the rotation period) other silvicultural systems such as single tree or group selection are used.

General Application of Dispersed Retention:

High Retention: ≥40m^2 - Intermediate Cut

- Non-timber objectives do not allow for a lot of flexibility in post harvest stand structure.
- Constraints may be: riparian management area, retention VQO, unstable terrain, wildlife habitat, and cultural heritage resource.
- Site has significant retention where current stocking is of good quality, form and vigour.
- Stand modifications may enhance the growth of established trees (e.g. commercial thinning from below).
- Areas with adjacency conditions such as green-up. Harvest some now then continue when adjacency condition is met.

Moderate Retention: ≥5 to 39m^2 - SEDRS

Non-timber objectives moderately constrain post harvest stand structure. Non-timber objectives include; partial retention VQO, wildlife considerations (example - ungulate winter range), overstorey species diversity, terrain concerns and other non-timber values.

- Timber quality moderately constrains the economics of harvesting.

Low Retention: < 5 m^2 - Clearcut

- The landscape is not constrained by non-timber objectives.
- Timber objectives allow for lower retention levels.

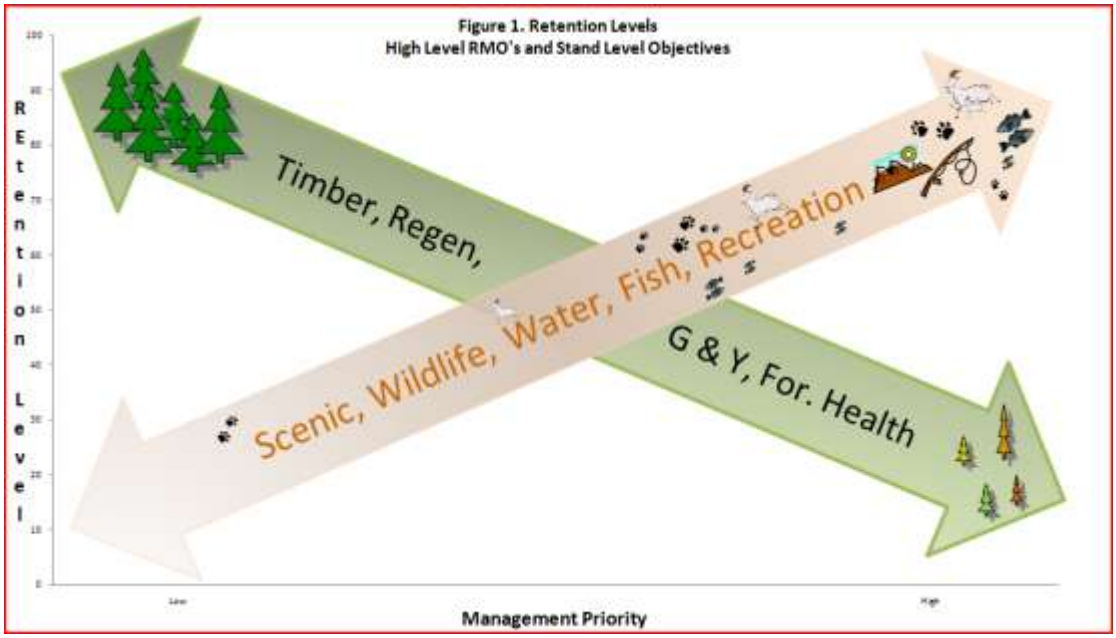
RETENTION

Retention Target

The target retention level depends on higher level resource management objectives, stand level objectives, and ecological site factors. Higher level objectives such as visual quality are broader and provide direction on how to establish retention levels. Stand level objectives are site specific such as timber quality. Ecological site factors may also influence the retention levels.

The following figure illustrates the level of retention with the resource management objectives/values (RMO's). RMO's can be for scenery, recreation, cultural heritage, wildlife, water, fish and other non-timber resource values. Timber/stand level objectives can be for overstorey and regeneration quality, growth and yield and forest health. Figure 1 illustrates that when the priority for non-timber objectives is high, the target level of retention may be high. When the timber values and objectives are high, then the target level of retention level may be low. The **site values and objectives are often conflicting therefore the retention level needs to reflect a reasonable balance where one objective is not jeopardized at the expense of another objective.** An example is if the visual quality objective requires partial retention then the retention level should be appropriate but not excessive as to cause an unnecessary negative impact to timber growth and yield.

Figure 1. Retention Level Matrix



Distribution of Retention Trees

Retention of trees can be dispersed or grouped depending on the landscape and stand level objectives being managed for. Group retention is often preferred as the integrity and structure of the forest is better maintained for habitat. Another advantage of group retention is growth and yield and timber supply impacts are less than dispersed. Forest health issues and blow-down are also minimized with grouping of trees. Groups should be 0.25ha or larger but 'clumps' < 0.25 ha may still be designed to meet objectives. Dispersed trees have an increased risk of blowing over; causing site disturbance and occupying planting space. Dispersed trees also increase the risk of disease to spread to the lower regeneration layers where hemlock dwarf mistletoe is a factor.

It is recognized that our harvesting practices should mimic natural disturbances. Natural disturbances may be caused from fire, wind, pests and disease and are variable in size and pattern. Retention can be dispersed throughout a cut-block (individual trees or small groups) or aggregated (larger groups) depending upon the objectives. Specific objectives for retention are to:

- Ensure forest structures are maintained for the diversity of second-growth stands,
- Provide timber to the market without high-grading or compromising forest health, vigour, genetics or timber quality, and
- Meet social expectations of stewardship, professionalism and visual aesthetics (Beese et al).

Placement of Retention (Zielke et al. 2008)

Look for "Biological Anchors" such as:

- **Biological hotspots**: Rare, threatened, or endangered ecosystems or ecosystems with unique concentrations of species or individuals, such as stream reaches where fish populations congregate, or estuaries.
- **Other special ecosystems**: Examples are riparian areas with diverse terrestrial vegetation, wetlands, dry rock outcrops or talus slopes, and deep ravines with unique microclimates. These can include areas that currently have no legislative protection for reserves (e.g., small ponds and wetland patches for amphibians).
- **Wildlife trees and snags**: Wind-firm, mature trees with large diameters should be favored as a retention component. Class 2 to 8 wildlife trees can be used to anchor groups of trees, when available and logistically possible (see further information on page 7).
- **Other desirable habitat structures**: This includes concentrations of broadleaf trees or other less common tree species, areas of specific attributes (e.g., large-limbed trees for nesting sites), or special features such as mineral licks.

Evaluating and Managing the Risks

The main risks for variable retention are increased risk of wind-throw, increased spread of hemlock dwarf mistletoe infection, shift towards more shade tolerant species, and the potential negative effect on growth and yield.

(a) Wind-throw Risk: (Zielke et al. 2008)

Wind hazard and risk assessments should be carried out to minimize the effects of wind-throw. Avoiding all wind-throw may not be possible. Consideration should be given to the amount and type of wind-throw that will likely occur in different situations.

Evaluating Wind-throw Risk:

- Most wind-throw occurs in the first 3 years after harvest.
- Wind-throw rates strongly increase for upper slopes and ridges (as well as valley bottoms oriented parallel to prevailing winds).
- Wind-throw increases with general stand height. Rates may increase fourfold as height goes from <17m to >40m. Tall, dense second-growth stands are particularly susceptible.

- Large, old veteran trees, with crowns exposed to prevailing winds (high percent live crown, but sparse) are usually wind firm.
- Larger patches of retention normally experience a lower proportion of wind-throw than smaller patches (but the total volume of wind-throw may be more). However, small clumps of several trees may be highly wind firm if the trees are well chosen.
- On stream buffers located perpendicular to prevailing winds, wind-throw may increase two to fourfold as buffer width drops from 25-30 m to 5-10 m.
- For retention perpendicular to prevailing winds on incised stream and gullies, it is best to establish edges 10-20m into the upland area from the gully break. Even setbacks of 4-5 m may provide reduced wind-throw entering into the stream.
- Wind-throw may drop by 30-60% as fetch distance perpendicular across openings between two edges drops from five tree heights (or more) to two tree heights or less.

Layout strategies to decrease wind-throw are:

- Uniform and smooth stand edges with no sharp corners,
- Utilize natural landscape boundaries to create wind firm edges (eg. Rock bluffs, bogs, non-merchantable timber),
- Feathering boundary edges, and
- Avoid areas with a history of chronic wind-throw.

Note: See BCTS Windthrow Manual web link in the Resource Information section (page 12).

(b) Dwarf Mistletoe Risk

Hemlock dwarf mistletoe (DMH) is a parasitic seed plant that is endemic and common to coastal western hemlock forests. Any infected tree left after harvesting poses a risk to regenerating stands, as seeds are dispersed from infected residuals to nearby trees. DMH can cause significant growth loss over time as well as increase the susceptibility of infected trees to other forest health agents. Mistletoe spread is most apparent within 15 m of an infected tree. Trees 2-3 m in height are most easily infected. Mistletoe survives only on live branches and spreads slowly in dense, even-aged stands. (Zielke et al. 2008) See the Hawksworth rating – *Appendix AA*. The results of opening up a stand and leaving DMH infected residuals are likely to seen in the future often past the free growing stage. A dispersed retention silvicultural system in hemlock dominated stands can create conditions that exacerbate the spread, intensity and overall effects of mistletoe therefore it is suggested to be prudent and remove as much of the mistletoe infected residual overstorey as possible.

(c) Growth and Yield Risk and Species Conversion

The BC Ministry of Forests and Range model TIPSY is calibrated to consider the associated yield losses after variable retention harvesting in its growth and yield projections. The following Table was generated using TIPSY for uniformly dispersed retention scenarios of: 0 m2/ha, 5 m2/ha, 20 m2/ha and 40 m2/ha. The retention was divided into two categories in the TIPSY runs, with the first category being more dispersed than aggregate which resulted in a greater volume loss. According to this model the effects of moderate retention on future regeneration volume are significant. Note: This volume excludes residuals.

Table 1. TIPSY Calculations - Regeneration Volume at Harvest
Rotation =126 years (max. Mai), Species = Hw55% Cw45%, SI = 24, Aggregate retention size = 0.3ha

10% aggregate retention & 90% dispersed				
	0m2/ha RBA	5m2/ha RBA	20m2/ha RBA	40m2/ha RBA
Net m3/ha	837	688	358	190
Volume Reduction		18%	133%	340%
Crown Closure		7%	31	61
90% aggregate retention & 10% dispersed				
	0m2/ha RBA	5m2/ha RBA	20m2/ha RBA	40m2/ha RBA
Net m3/ha	837	742	506	190
Volume Reduction		11%	65%	340%
Crown Closure		7%	28	55

Table 2. Height Growth Loss (%)

	50% Ret. Group	60% Ret. Group	70% Ret. Dispersed
Cw	25	62	—
Cw(vexar)	15	40	35
Ss	45	57	63
Hw	10	18	21

Results from Table 2 of Rennell Sound indicates that by increasing the retention levels there is a negative effect on the height growth.

For Table 2 the Cw was browsed therefore the growth losses are probably less than indicated.

Another consideration with higher retention levels is an increase in species conversion from Cw to Hw as hemlock is more shade tolerant. Crop tree height to diameter ratios will also increase due to the fact that the understory stems will have smaller diameters. Thinner stems lead to volume losses and are more prone to forest health factors. The volume losses in Table 1 may seem high but the information shows that higher retention levels negatively affect timber growth and yield.

LAYOUT AND HARVESTING CONSIDERATIONS

Main Factors

- Resource management objectives (visuals, terrain etc).
- Location of suitable timber for economical harvest,
- Biological anchors for retention, and
- Harvesting considerations and limitations.

Layout & Reconnaissance

Items to consider are:

1) Prior to layout the forest professional must obtain information on the resource management objectives and values for the area of interest.
2) Form ideas on retention levels based upon these objectives and discuss these with BCTS practices foresters (silviculture and timber).
3) Reconnaissance is then performed where one is focusing on the values and features that are to be managed in relation to potential timber. Timber species, quality and volume are key elements to make the harvest economical therefore higher percentages of target species are preferred.
4) A mix of target species is also preferred to avoid a potential species shift and the perception of high grading.
5) The condition of in-block trees is to be observed during reconnaissance to help determine the silvicultural system, retention /cut levels, and silviculture strategies that would best suit the stand.
6) Retention type and location of retention patches.
7) Harvesting factors – deflection, terrain, equipment, etcetera.

Field Information Collection (Timber-cruise phase)

A. Stand Table for Overstorey trees
Overstorey trees (≥ 12.5cm dbh) are to be counted by using a prism and trees assessed for quality. Data collected is species, diameter, and quality (assessed as "**Crop"**, **"Poor"** " or **"Snag"**) and tallied on a cruise card. The emphasis is to collect information to develop a diameter distribution by species and identify which trees are crop trees versus non crop trees. It is used to develop a Stand Table – Diameter Distribution as illustrated in *Appendix 2*.

B. Understorey Trees
Understory trees (< 12.5cm dbh) are to be counted and assessed as layer 2, 3, or 4 using a 5.64m or 3.99m plot radius. They are also to be tallied as crop trees or poor trees by species as in a normal silviculture survey. This information can be collected on a FS 658 card and it is be used to develop a Regeneration Summary as illustrated in *Appendix 3*.

Overstorey and understorey information is preferred to be collected during the cruise or it can be collected during the site plan. The minimum number of plots is 5 and is to be determined and included in the contract.

C. Silviculture

Quality

Appendix 1- Table A and B, Appendix AA and 1C are the evaluation criteria for crop trees. **The number and quality of trees from the stand table is critical for developing a silviculture strategy to ensure the site is improved and stocked following harvest.** *Appendix 1C* is to evaluate if Cw is merchantable.

Forest Health

Record forest health factors using criteria according to the Appendices above. Specific to hemlock, for hemlock dwarf mistletoe (DMH) use the Hawksworth rating in *Appendix AA.* Also record general forest health observations. Crop trees must show vigour, growth and or value that will contribute volume in the next cut.

Silviculture Strategies: (record notes on)

- distribution of different species, and
- potential retention.

Plantability: (record notes on)

- drainage, aspect, brush potential, forest health concerns, and depth to planting restrictive layer.

This information will then be reviewed by the silviculture practices forester and discussed with the prescribing forester. The emphasis here is to ensure all of this information is integrated into the prescription. Silviculture strategies are dependent on the quality of the existing trees. It is highly recommended that a joint field meeting be carried out during the reconnaissance and/or site plan phase.

SITE PLAN

Key Information (MOFL - FRPA s. 10; FPPR s. 34)

- ✓ higher level objectives and how they affect stand structural goals and retention (visual, terrain, EBM),
- ✓ silvicultural system and projected rotation including any planned future stand entries,
- ✓ silvicultural system should have a good rationale and supported by assessments and analyses,
- ✓ harvest method,
- ✓ quality and condition of existing stand, pre –harvest stand table information - composition of overstorey species by diameter class (*Appendix 2*),
- ✓ pre-harvest regeneration information *(Appendix 3),*
- ✓ post-harvest retention levels of all species,
- ✓ post-harvest retention of target species,
- ✓ post-harvest distribution of stems,
- ✓ leave tree characteristics and purpose,
- ✓ forest health of overstorey and understorey – current condition of stand and practices to improve the site, and
- ✓ stocking standards consistent with stand structural goals and silvicultural system.

Note: Retention levels must be measureable units such as basal area, sph or volume and are to have a target, minimum and maximum value.

Silviculture Strategies

- identify what needs to stay and what needs to be cut.
- natural regeneration, planting and/or a combination of regeneration methods. Be specific in what you are prescribing and where it applies.
- open up the stand for adequate sunlight for planted and natural trees to encourage conditions for growth (dispersed retention greater than 15-20m2 per ha will probably result in a substantial decrease in growth and yield due to shading).
- improve the stand value by cutting decadent stems that will not contribute to stocking.
- avoid species shifts by retaining a composition of all species.
- avoid species shifts and maintain or enhance future stand value by planting original species harvested and/or higher value species.

IMPLEMENTATION

It is critical to ensure consistency with higher level plans, TSR forest management assumptions, operational guideline documents, the FSP, the Site Plan and the TSL document (Harvest Plan). The direction and supervision of timber harvesting according to the ABCFP Foresters Act is considered the "practice of professional forestry". A registered professional is therefore expected to provide professional oversight of harvesting to ensure operations are carried out in a manner consistent with the Site Plan. Key components of the site plan are written into the TSL document/harvest plan. The TSL document should include specifications for the harvest crew to carry out site plan objectives which include the following:

Retention Levels – min & max	Yes
Species Composition – min cedar component – %, basal area or sph	Yes
Simple Diameter distribution cutting table (which trees to cut & leave)	Yes
Post Harvest target stand structure	Maybe
Forest Health Management Strategies (simplify from site plan)	Yes
Leave tree damage criteria	Maybe
Plantable Spots / ha	Yes

MAIN CONCEPTS of SINGLE ENTRY DISPERSED RETENTION SYSTEM

- Future stand entries are not required to meet stand structural objectives where the retention is long-term;
- Applicable where retention of dispersed stems is required to achieve FRPA management objectives (non- timber);
- Stands will have a dispersed residual basal area ranging from 5 to 39m2/ha;
- Overstorey trees may or may not contribute as crop trees. A crop tree is one that is expected to remain healthy and valuable until the next harvest entry. A non-crop tree is not expected to contribute to the next harvest entry;

- Crop trees are evaluated based upon their value (cedar has value if 2/3's of the tree is 50% merchantable); and
- Stocking is measured using a combination of overstorey trees ≥ 12.5cm dbh and understory trees less than 12.5cm dbh; this is called the Deviation from Potential[2] (DFP) stocking assessment method.

STRATIFICATION CRITERIA

i) Areas ≥ 1.0 ha. with < 5m2/ha of Retention: remove from the SU and treat with an even-aged stocking standard;

ii) Areas ≥ 0.25 ha uncut: remove from SU and map as a **Grouped Retention** SU, classify as **Group Reserve**, removed from NAR and report in RESULTS;

ii) Areas ≥ 1.0 ha: with full stocking of ecologically suitable species (RBA ≥40 m2/ha) with no openings > 0.1 ha in size are defined as an **Intermediate cut** (with no regeneration obligations) requiring a separate stocking standard.

Notes for Above Criteria:
Areas ≥ 1.0 ha, with full stocking of ecologically suitable species (RBA 5m2 to 39m2/ha) have the SEDR stocking standards applied.

Areas < 1.0 ha with <5m2/ha of Retention are to be amalgamated with the dispersed retention strata. If low retention patches > 0.25ha accumulate to 1.0ha or greater then these patches can be stratified as low retention strata.

Multiple areas of uncut group retention ≤0.25ha are to be blended in with an appropriate stratum (e.g. part of NAR). If these uncut areas accumulate to ≥1.0ha they are to be stratified as Grouped Retention.

REPORTING AND TRACKING RETENTION AREAS

Harvested area and post harvest forest cover must be reported to the government according to the FPPR sections 85 and 86. The reporting data base is RESULTS. Each Standard Unit with retention must describe the distribution as group or dispersed, the tree cover pattern and inventory/silviculture labels, stocking obligation, basal area and describe the objective for reserves (example BIO).[3]

REFERENCE and RESOURCE LIST

References

Ministry of Forests & Range. 2003. Forest Practices Code of BC Act; Operational and Site Planning Regulation, Part 1 Definitions.

[2] Deviation from Potential is the deviation from a fully stocked stand to a completely non-stocked stand. Full stocking occupancy is a DFP of one (1) and no stocking occupancy is a DFP of zero (0). See Single Entry Dispersed Retention Silvicultural System Stocking Standard – Discussion Paper 2009; and MOF, Silviculture Survey Procedures Manual April 1 2010

[3] See MOFL, Silviculture Survey Procedures Manual April 1 2010 pages 132-140 and 163.

Silvicultural Systems and Partial Cut Harvesting Issues in the Coast Forest Region 2006 Monitoring Results report.
http://www.for.gov.bc.ca/RCO/stewardship/CRIT/silviculture_working_group.htm

About Forestry website. 2010

Silviculture Working Group, Coast Region FRPA Implementation Team (CRIT). 2009. Single entry dispersed retention silvicultural system Stocking Standard – Discussion Paper.
http://www.for.gov.bc.ca/RCO/stewardship/CRIT/silviculture_working_group.htm

Beese, W.J.; Dunsworth, B.G.; Zielke, K.; and Bancroft, B.; Maintaining Attributes of Old Growth Forests in B.C. through Variable Retention.

Zielke, K.; Bancroft, B.; Swift, K.; and Turner, J. 2008. Variable Retention Decision Aid for Biodiversity and Habitat Retention. http://www.forrex.org/jem/ISS48/vol9_no2_art1.pdf

Ministry of Forests and Lands & NRO: Forest and Range Practices Act - section 10. Forest Planning and Practices Regulation - section 34.

Resource Information

Single Entry Dispersed Retention Stocking Standard Framework Implementation Guide. Silviculture Working Group, Coast Region FRPA Implementation Team, August 2011.
http://www.for.gov.bc.ca/RCO/stewardship/CRIT/silviculture_working_group.htm

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Variable Retention Implementation Monitoring on Weyerhauser's British Columbia Coastal Timberlands. Zielke, Beese and Bancroft. 2004.
http://www.forrex.org/events/mebc/PDF/Part3-11.pdf

Operating Guidelines: Guidelines for Helicopter Logging in Northwest BC. Skeena TSO, SFI certification document.
http://www.for.gov.bc.ca/ftp/TSK/external/!publish/EMS2/Supplements/OG_Helicopter_Logging.pdf

Variable Retention Training Posters. Weyerhaeuser. Zielke, 2003.
Sustainable Forest Management http://www.for.gov.bc.ca/bcts/areas/TSK/TSK_ems.htm

Silviculture Surveys Website:
http://www.for.gov.bc.ca/hfp/silviculture/Silviculture_Surveys.html

BCTS Windthrow Manual. A Compendium of Information and Tools for Understanding, Predicting and Managing Windthrow on the BC Coast. Zielke, K. et al 2010. http://www.for.gov.bc.ca/ftp/TSG/external/!publish/Windthrow%20Program%20Material/BCTS%20Windthrow%20Manual%20Apr%2030-10.pdf

Wildlife Trees websites:
http://www.for.gov.bc.ca/hfp/meta/publications.htm#005
http://www.for.gov.bc.ca/hre/deadwood/DTint.htm

FG DAMAGE CRITERIA FOR *SINGLE ENTRY DISPERSED RETENTION STOCKING STANDARD* (SEDRSS) MANAGED STANDS IN COASTAL B.C.

Note: this table overrides all other damage criteria for SEDRSS managed stands

APPENDIX 1 - TABLE A- Layer 1 - ≥ 12.5 cm DBH. (Reference; Single Entry Dispersed Retention Stocking Standard Framework Implementation Guide, 2011).

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:		Possible damage agents & codes	Comments
		Hw, Ba, Bg, Bl, Cy, Fdc, Ss, Pw, Pl	Cw		
Stem	**Wound**	• Wound girdles >**33%** stem circumference, or • One wound >**400 cm^2** on stem, or • Wound on major root within **1 m** of stem, or • Tree has **gouge** in stem.	• **No criteria**	fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TT.	A **wound** is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable.
Stem	**Decay**	• Any pathological indicator(s) are present. This may include **conk, blind conk, frost crack,** or **rotten branches.**		various decay fungi DD.	
Stem	**Bark Mining**	• Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark.	• **No criteria**	Douglas-fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	Note: pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and/or larval galleries). Stressed trees are susceptible to secondary bark and twig beetles.
Stem	**Deformation (including crook, fork and dead or broken top)**	• A **crook** displaces the portion of the stem above the defect by >50% from the line of growth formed by the stem below the point of defect in the bottom 2/3rds of the stem only. • A **fork** occurs above stump height in the bottom 2/3rds of the stem only.	• **No criteria**	frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	**Note**: Field guidance procedures for the estimation of merchantable Cw volume are identified in ***Appendix 1C.***

		• A **dead** or **broken top** extends more than 20% of the stem length or the live crown is removed.	• A **dead tree** with no live foliage • < 2/3rds of the stem unable to produce > 50% merchantable volume.		
Location of Damage	**Type of Damage**	**Tree being assessed is UNACCEPTABLE if:**		**Possible damage agents & codes**	**Comments**
		Hw, Ba, Bg, Bl, Cy, Fdc, Ss, Pw, Pl	**Cw**		
Stem	**Dwarf Mistletoe Infection**	• **Hawksworth rating >3**, or severe stem infections (major swelling or deformity) present.	• **No criteria**	hemlock dwarf mistletoe DMH	The Hawksworth rating system is described in the FPC *Dwarf Mistletoe Management Guidebook* (or refer to *Appendix AA* of this document) For SEDRSS, this rating system will only apply to the tree/plot assessment level, and not at the stand level.
Foliage	**Defoliation**	**For defoliating insects:** • > 80% of foliage has been removed, lost or damaged due to insect defoliation. **For foliar diseases:** • > 50% of foliage has been removed, lost or damaged	• **No criteria**	defoliators ID, foliage diseases DF	
Foliage	**Live Crown Vigour**	• **Stems < 17.5 cm dbh** - < 30% live crown due to poor vigour. • **Stems ≥ 17.5 cm dbh** - < 20% live crown due to poor vigour.	• A dead tree with no live foliage		Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height.

<table>
<tr><th rowspan="2">Location of Damage</th><th rowspan="2">Type of Damage</th><th colspan="2">Tree being assessed is UNACCEPTABLE if:</th><th rowspan="2">Possible damage agents & codes</th><th rowspan="2">Comments</th></tr>
<tr><th>Hw, Ba, Bg, Bl, Cy, Fdc, Ss, Pw, Pl</th><th>Cw</th></tr>
<tr><td rowspan="3">Roots</td><td rowspan="3">Root Disease</td><td>• Sign(s) or definitive combinations of symptoms of root disease are observed</td><td rowspan="2">• For Cw, there is no criterion for net down calculation - considered not susceptible or low susceptibility.</td><td>armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.</td><td>Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.</td></tr>
<tr><td>• Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer.</td><td>armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.</td><td>Example: How to apply net down for root disease.

If root disease-infected trees are found in the plot:

1. Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value;

2. Count the number of infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree);

3. Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not affect higher layers;

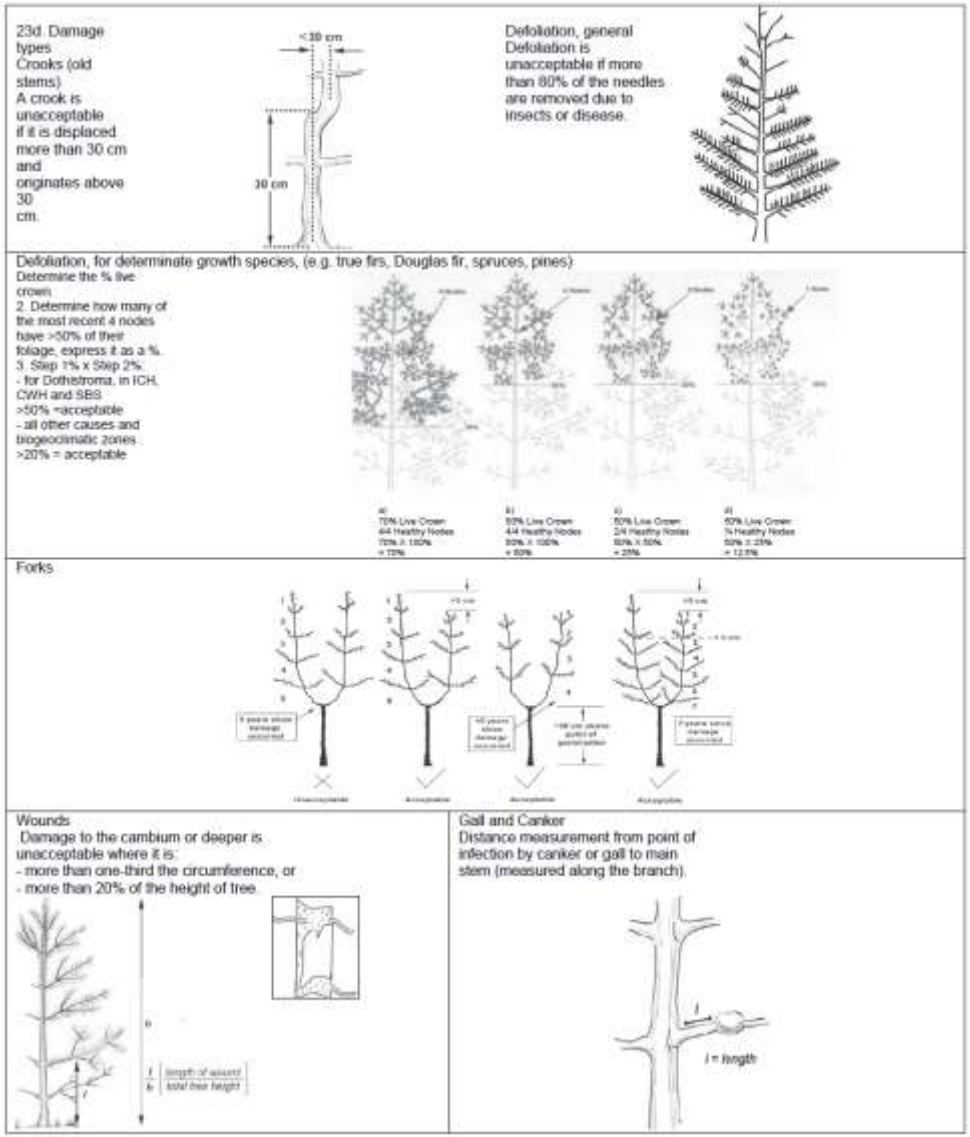
Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. 10 – 8 = 2). The result is the maximum number of free growing trees tallied for the plot.</td></tr>
<tr><td colspan="2">TABLE Y. Deductions from numbers of acceptable well-spaced uninfected stems for trees infected by root disease in layered stands.
<table>
<tr><th rowspan="2">Tree layer with infected tree(s) or stumps</th><th colspan="4">Multiplier used to determine number of acceptable trees to be deducted from:</th></tr>
<tr><th>Layer 1</th><th>Layer 2</th><th>Layer 3</th><th>Layer 4</th></tr>
<tr><td>Layer 1</td><td>Deduct BA of infected layer 1 from Crop BA</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Layer 2</td><td></td><td>2</td><td>2</td><td>3</td></tr>
<tr><td>Layer 3</td><td></td><td></td><td>2</td><td>2</td></tr>
<tr><td>Layer 4</td><td></td><td></td><td></td><td>2</td></tr>
</table></td></tr>
</table>

APPENDIX 1 - TABLE B- Layers 2, 3 & 4 - < 12.5 cm DBH. SEDRSS damage criteria (Layers 2, 3 & 4 must be outside of the dripline of layer 1 trees)

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Possible damage agents & codes	Comments
Stem	**Wound**	• Wound girdles **>25% stem circumference**, or • One wound **>10% the length of stem**	All	fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TT.	A **wound** is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable.
Stem	**Decay**	• Any pathological indicator(s) are present. This may include **conk, blind conk, frost crack,** or **rotten branches.**	All	various decay fungi DD.	
Stem	**Bark Mining**	• Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark.	All	Douglas-fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	Note: pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and/or larval galleries). Stressed trees are susceptible to secondary bark and twig beetles.
Stem	**Deformation (including crook, fork and dead or broken top)**	• The pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination	All	defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	
		• The tree leader has been killed three or more times in the last 5 years (weevil only)	Ss		This criterion applies only for terminal weevil damage.
		• The tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination. • The tree has a dead or broken top at a point that is > 3cm in diameter. • The tree has a flat top (umbrella like) form and no distinct leader.	All		Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. *See Appendix AA* on Damage Types.

Stem	**Lean and Sweep**	• The tree leans >30^0 from the vertical with or without growth correction.	All	Flooding NF, snow NY, slides NS, wind NW, mechanical TM	
Location of Damage	**Type of Damage**	**Tree being assessed is UNACCEPTABLE if:**	**Host Species**	**Possible damage agents & codes**	**Comments**
Stem	**Infection (includes cankers and galls)**	• Any infection occurs on the stem.	All	white pine blister rust DSB, atropellis canker DSA, Dwarf mistletoes (see below).	**Note**: Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	**Infection (cankers)**	• An infection occurs on a live branch less than 60 cm from the stem.	Pw, Pl, Py	white pine blister rust DSB, comandra blister rust DSC, stalactiform blister rust DSS.	
Branch	**Galls**	• A gall rust infection occurs on a live branch less than 5 cm from the stem.	Pl, Py	western gall rust DSG.	
Foliage	**Defoliation**	• >60% tree foliage has been removed by hemlock looper	Hw	Hemlock looper IDL	
		• > 80% of foliage has been removed, lost or damaged due to insect defoliation.	All other	defoliators ID	
		• > 50% of foliage has been removed, lost or damaged due to foliar disease.	All	foliage diseases DF	
Foliage	**Live Crown Vigour**	• <30% live crown present due to poor vigour.			Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height.
Stem or Branch	**Adelgid Gouting**	• Any adelgid **gouting** occurs on a stem or branch.	Ba, Bg, Bl	balsam woolly adelgid IAB.	**Gouting** is defined as excessive swelling on a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Stem or Branch	**Dwarf Mistletoe Infection**	• Any infection occurs on the stem or a live branch, or • A susceptible tree is located within 10 m of the bole of a higher layer tree that is infected with dwarf mistletoe.	Hw	hemlock dwarf mistletoe DMH	**Note:** To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms.

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Possible damage agents & codes	Comments
Roots	**Root Disease**	• Sign(s) or definitive combinations of symptoms of root disease are observed	All	armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.	**Signs** are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. **Symptoms** include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.
		• Infected conifer or stump found in plot. See **Table Y** for well-spaced tree net down calculation by layer.	All	armillaria root disease DRA.	**Example:** How to apply net down for root disease. If root disease-infected trees are found in the plot: 4. Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value; 5. Count the number of infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree); 6. Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not affect higher layers; Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. 10 – 8 = 2). The result is the maximum number of free growing trees tallied for the plot.
		• Infected conifer or stump found in plot. See **Table Y** for well-spaced tree net down calculation by layer.	Fd, Ba, Bg	laminated root rot DRL.	**Note:** Bl, Cw, Pl, Pw, and broadleaf species are considered **not susceptible** for survey purposes only
		• Infected conifer or stump found in plot. See **Table Y** for well-spaced tree net down calculation by layer.	Ba, Hw, Ss	annosus root rot DRN.	**Note:** Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, and broadleaf species are considered **not susceptible** for survey purposes only.



Appendix AA Damage Types

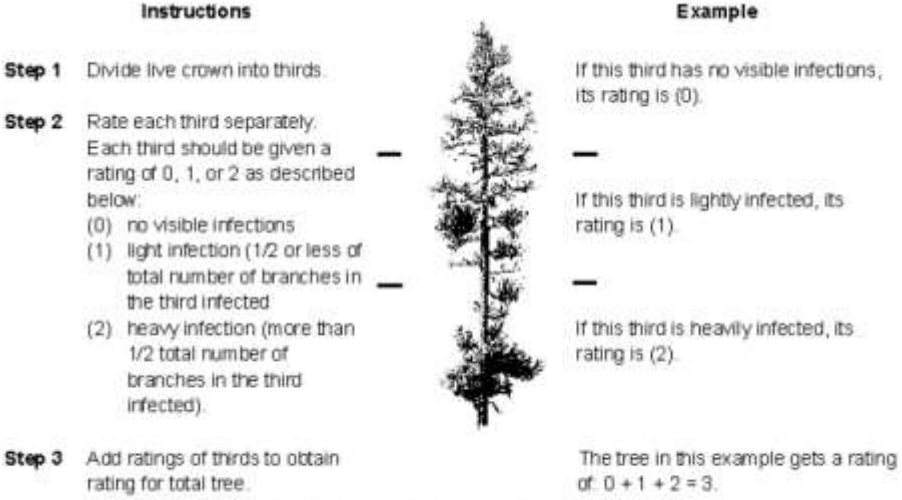


Figure 4. The Hawksworth six-class dwarf mistletoe rating system.

Appendix 1C: Field Guidance Procedures for the Estimation of Cw Merchantable Volume

1.0 Cw Stem Merchantability Criteria

Criteria Definition: A Cw tree being assessed is Unacceptable as a contributing Crop Tree if –

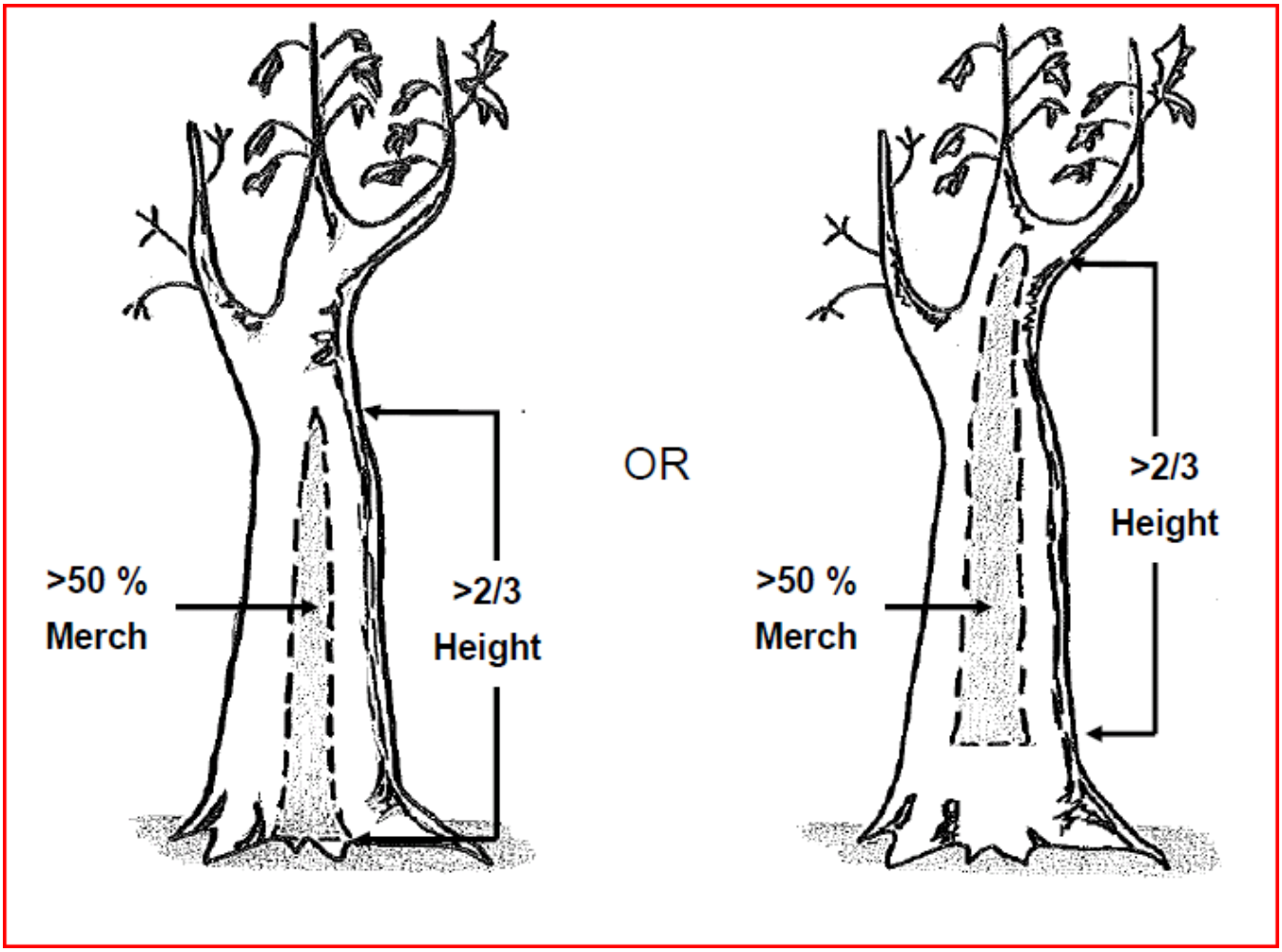
< 2/3rds of the stems height is unable to produce > 50% merchantable volume

Merchantable Volume Definition:

Either:

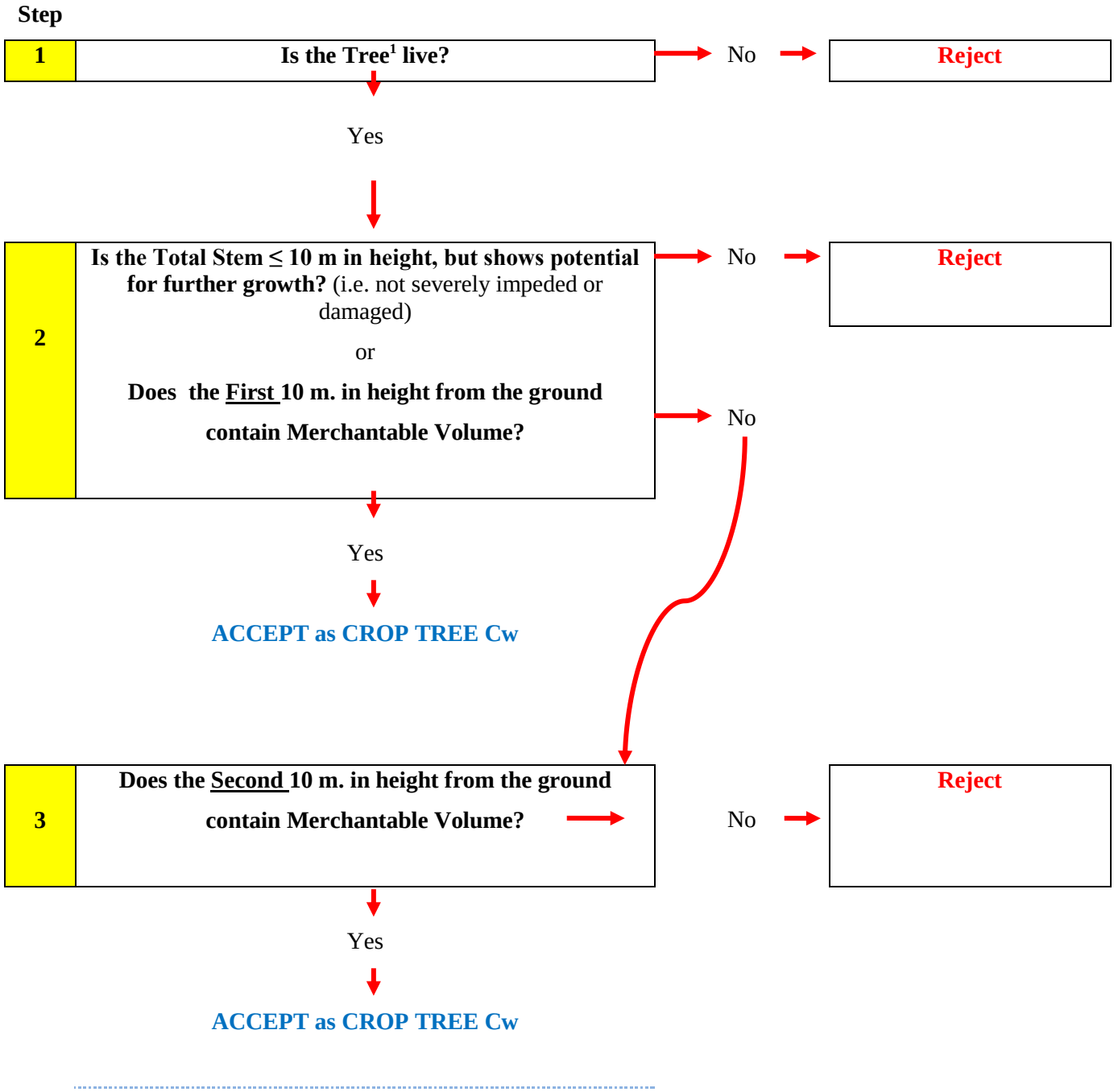
1. Utility Grade – At least a solid 8 inch shell – Shake and Shingle and /or
2. Higher Grade – Complete solid wood – Saw Logs

Figure 1: Visual Graphic examples of Cw Stem Merchantability Criteria



Examples: > 50 % merchantable volume from a portion of the tree that represents > 2/3 the height of the tree.

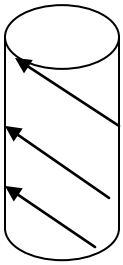
2.0 Suggested Assessment Key Steps



[1] Live tree means tree has at least 1 live branch with green foliage

3.0 Significant Visible Defect Indicators - Representing Unmerchantable Conditions

1. Significant Butt Rot as to produce a complete "see through gap" in the flared butt of a Cw – above the root collar.
2. Woodpecker Holes around the complete circumference of the first and second 10 m. length of the stem.
3. Excessive Grain Twist to the Left[2] for the entire first and second 10 m. length of the stem.



4. Large Branches ≥ the diameter of sound bole wood around the complete circumference of the first and second 10 m. length of the stem.
5. Excessive Sun Check on "grey ghost" upper segment of dead top on a Cw – for sun checks will penetrate twice the visible distance into sound wood to create unacceptable splitting.

[2] Twist to the left extends into the heartwood significantly degrading the log quality and value

4.0 Example Photos of Acceptable and Unacceptable Cw Trees

Acceptable Cw Trees

	Acceptable Butt Rot Note: Butt rot does not extend completely through the tree.
	Acceptable Forking and form Live tree with first 10 meters containing > 50 % merchantable volume

	Live tree First 10 meter log shows contains > 50 % merchantable volume

Unacceptable Cw trees

	Catface and live fork First and second 10 meters of stem contain < 50 % merchantable volume due to large catface.

Appendix 2: Stand Table. Overstorey, Layer 1, Diameter distribution for SU ___

Species	Form Class	Residual Diameter (cm) Distribution – BA (m2/ha)														
	dbh(cm)	15	20	25	30	35	40	45	50	60	70	80	90	100	>100	Total
Hw	Crop															
	Poor															
	Snag															
	Total (excluding snags)															
Cw	Crop															
	Poor															
	Snag															
	Total (excluding snags)															
Ss	Crop															
	Poor															
	Snag															
	Total(excluding snags)															
Yc	Crop															
	Poor															
	Snag															
	Total (excluding snags)															
Total basal area retained (excluding snags)																

Pre-harvest inventory label Layer 1
(Species % - Ht – basal area – SI)

Total Stems
Cw00Yc00Hw00Ba00 34 80m2 SI 26

Stems contributing to stocking: Layer 1
Cw00Yc00Hw00 36 m 50m2 SI 26

Appendix 3: Regeneration Summary for SU __

Species	Tree from class layer						Total trees	Well Spaced
	Crop (sph)			Poor (sph)			(sph)	(sph)
	2	3	4	2	3	4		
Totals								

Regeneration inventory label: Layers 2,3 and 4 combined
(Species % - Ht – sph area)

Hw00Cw00Ba00Ss00Yc00 0.0m 0000 sph

Regeneration silviculture label: Layers 2, 3 and 4 which contribute to stocking
Hw00Ss00Cw00 0.0 m 000 well spaced