

FOREST RESEARCH REPORT



Nova Scotia Department of Natural Resources
Forest Management Planning

Tolerant Hardwood Management Guide

by

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Introduction

Hardwoods are an important part of Nova Scotia's forest. Hardwood stands cover over 12% of the province's forested area and hardwood trees, in all stands, account for over 30% of the merchantable growing stock (Townsend, 2004). Tolerant hardwoods (yellow birch, sugar maple and white ash) account for 28% of the hardwood volume (39 million m³). Part of this tolerant hardwood volume (4 %) has high value for sawlogs and veneer (Keys et al., 2007). Although the portion of hardwoods suitable for high value products is low at present, with proper management it can be increased. To accomplish this, silviculture practices must be compatible with production of quality sawlogs on appropriate sites. Clear cutting high quality young growing stock and high-grading the best logs, leaving poor quality stems, reduces the future potential for growing quality timber. Future supply of these logs has been and continues to be compromised by these activities, endangering the viability of the hardwood sawlog industry in Nova Scotia. Immature hardwood trees with potential for increased growth and higher value must be tended to improve the outlook for sawlog supply.



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To increase the proportion of quality hardwood, progress needs to be made in (i) setting specific management goals to enhance quality hardwood growth, (ii) prescribing appropriate treatments after gathering required stand information, (iii) implementing these treatments effectively and in an economically feasible way and (iv) assessing the quality of treatments after completion. Items (ii) and (iv) are addressed in this document through decision keys, quality criteria and cruising methods to collect pre- and post-treatment data.

This guide was developed with reference to work in Ontario (OMNR, 1998), New England (Leak et al. 1987), results of Nova Scotia trials (McGrath, 2007) and operational use of preliminary versions.

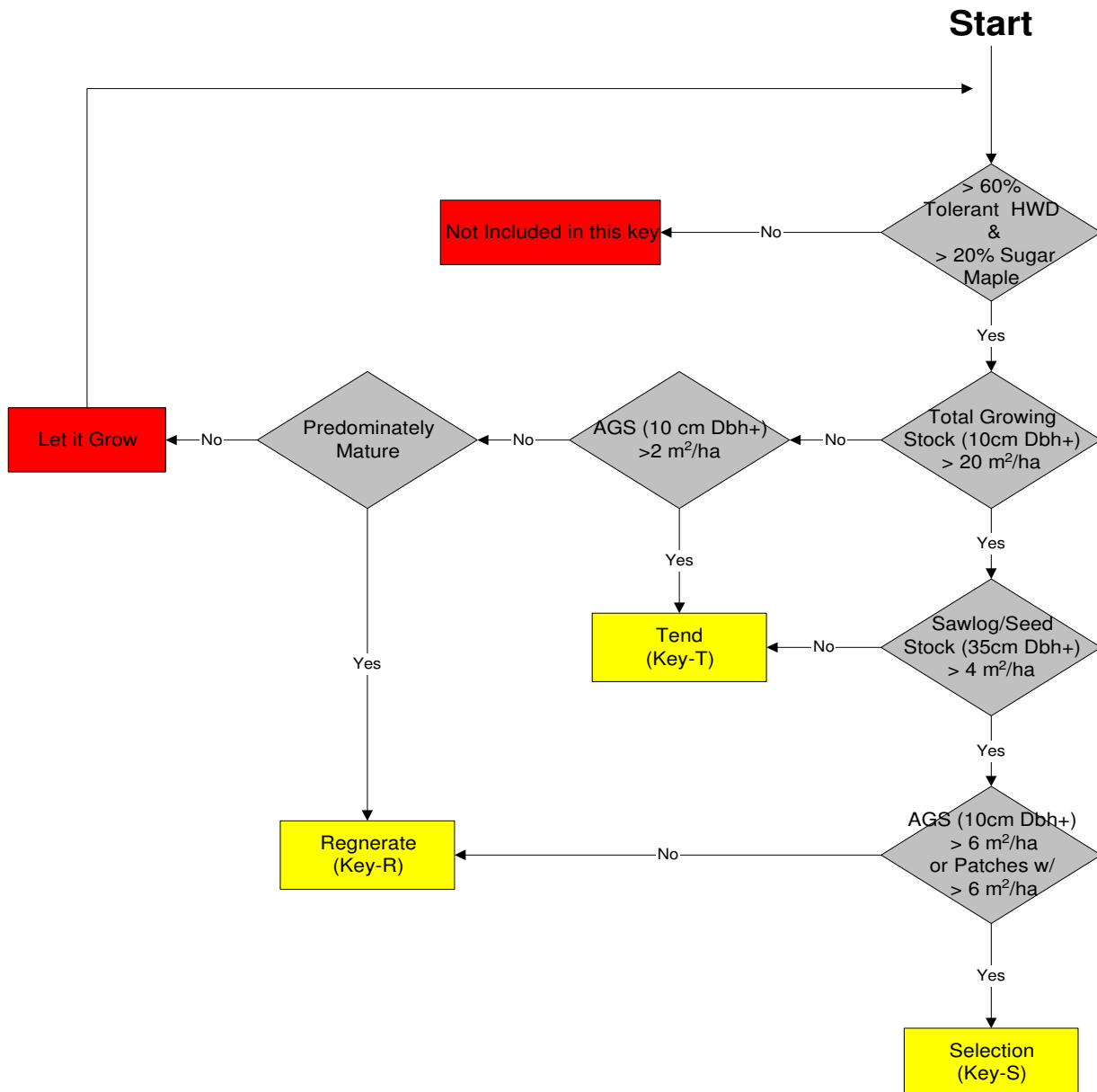
Use of the Keys

These keys were developed for predominately Tolerant Hardwood Stands located in Nova Scotia. Tolerant Hardwood in this case is defined as a stand that is dominated by sugar maple (*Acer saccharum* Marsh.) and yellow birch (*Butula alleghaniensi* Britton) with lesser amounts of other species. The most common associates are beech (*Fagus grandifolia* Ehrh.), white ash (*Fraxinus americana* L.), and red maple (*Acer rubrum* L.). The keys are applicable to the Sugar Maple - White Ash, Christmas fern (VT-21), Sugar Maple - Yellow Birch, Hay-scented fern (VT-22) and White Ash - Sugar Maple, Ostrich fern (VT-28) vegetation types throughout Nova Scotia (Keys et al, 2003). The keys assume that growth of high quality and valuable tolerant hardwood (sugar maple, yellow birch, white ash) is the management objective. As such, the production of larger trees with clean boles is necessary.

The Tolerant Hardwood Management Guide consists of 4 separate keys. Users start at the Main key (Key M) working their way through a series of questions concerning current stand conditions or management objectives to arrive at a recommended prescription. To reach a recommendation, the user may be referred to one of three sub-keys. The sub-keys include one for Selection (Sub-Key S), Tending (Sub-Key T), and Regeneration (Sub-Key R).

In the keys, any text outlined by a diamond and shaded in grey is a question that must be answered. Depending on the answer to these questions the designated path is followed until a rectangle is encountered. These rectangles refer either to a sub-key (shaded in yellow), a management prescription (shaded in green), or recommendation to wait and re-evaluate at a later time (shaded in red). If a sub-key is indicated, it is followed until arriving at a prescription.

Tolerant Hardwood Management Key Key M - Main



KEY - M - Main

Instructions and Definitions for:

Decision Diamonds

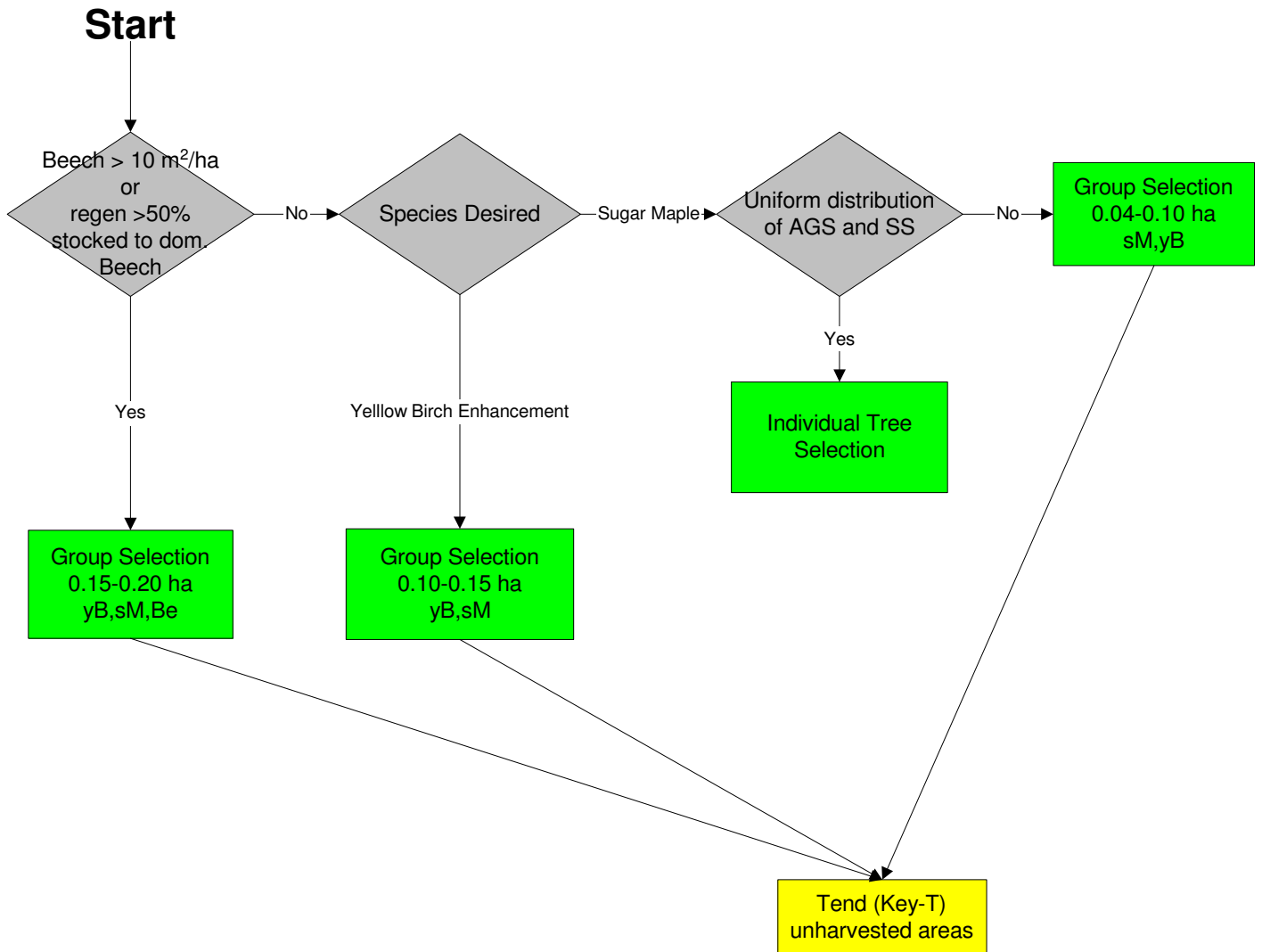
- **> 60% Tolerant Hardwood & > 20% Sugar Maple** – Is the stand made up of more than 60% tolerant hardwood species, including sugar maple, yellow birch and white ash and is more than 20% of the stand's basal area sugar maple?
- **Total Growing Stock (10cm Dbh+) > 20 m²/ha** – Is the total basal area of trees at least 10 cm (4 inches) in diameter at breast height greater than 20 m²/ha (85 ft²/acre)?
- **Predominately Mature** – Is the overstory predominately mature in terms of being able to produce adequate seed for regeneration and reaching best economic value (Mills and Lamson, 1999) ?
- **Sawlog/Seed Stock (35cm Dbh+) > 4m²/ha** – Is the stock of trees at least 35 cm (14 inches) in diameter at breast height and having sawlog quality greater than 4 m²/ha (17 ft²/acre)?
- **AGS – Acceptable Growing Stock** - Trees that are either undersized now but have the quality and vigour to potentially grow into sawlogs (better than pallet quality¹) or have sawlog quality and size now (better than pallet quality) and will not degrade into a lower quality sawlog or worse within 15 years.
- **AGS (10cm Dbh+) > 6 m²/ha** – Is the basal area of trees at least 10 cm (4 inches) in diameter at breast height and judged to be Acceptable Growing Stock greater than 6 m²/ha (25 ft²/acre)?
- **Patchy w/ AGS (10cm Dbh+) > 6 m²/ha** – Does the stand have patches of mature trees to be harvested intermixed with patches in different areas of smaller Acceptable Growing Stock worthy of tending? The amount of AGS at least 10 cm (4 inches) in diameter at breast height in the unharvested patches must amount to at least 6 m²/ha (25 ft²/acre).

Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate the stand with the key after suitable time has elapsed.

¹ Trees must be a G-3 or better according to Calvert and Petro (1993) or a Growing Stock Grade – 3 or better according to Boyce and Carpenter (1968)

Tolerant Hardwood Management Key Sub-Key S - Selection



SUB-KEY S - Selection

Instructions and Definitions for:

Decision Diamonds

- **Beech > 10m²/ha or regen > 50% stocked to dom. Beech** - Is beech growing stock greater than 10 m²/ha (44 ft²/acre) or dominant regeneration stocking to Beech greater than 50%?
- **Yellow Birch Enhancement** – Is the management objective to enhance yellow birch regeneration over sugar maple by producing suitable light conditions?
- **Uniform distribution of AGS and SS** – Is the Acceptable Growing Stock and the Sawlog /Seed Stock intermixed uniformly throughout the stand?

Management Prescriptions

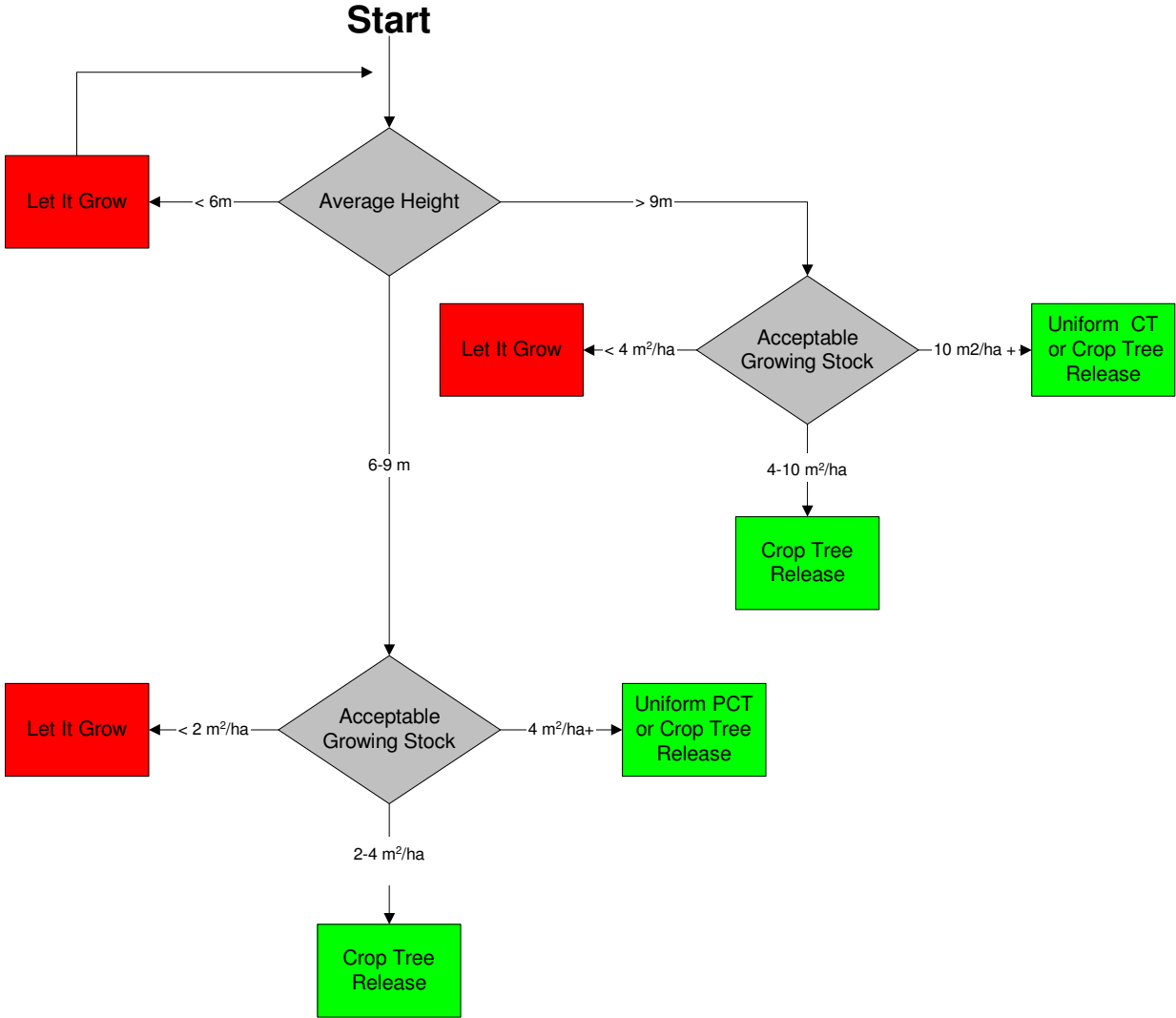
- **Individual Tree Selection** – Individual Tree Selection involves a thinning across all size classes throughout the stand to create a diameter class distribution suitable for sustaining a periodic harvest of suitable trees over relatively short harvesting cycles (10-20 years). The objective is to create conditions suitable for regeneration of preferred species at each entry while also improving the growing stock by releasing the highest quality immature trees. Tolerant species regeneration such as beech and sugar maple are favored. Where the proportion of beech is high it will dominate sugar maple under high shade conditions.
- **Group Selection** – Group Selection involves identifying areas within the stand that are suitable for harvesting or regeneration because they are predominately mature or contain non-commercial trees. These areas are to be cleared to create conditions suitable for preferred regeneration. Areas predominately consisting of AGS are to be left. They can be tended using either pre-commercial thinning, commercial thinning or crop tree release methods.
 - Where **Beech** is dominant the larger openings are prescribed (0.15 to 0.2 ha) . Yellow Birch, Sugar Maple and Beech will be favored in that order.
 - Where favoring **Yellow Birch** regeneration is desired and Beech is not dominant, 0.1 to 0.15 ha openings are prescribed. Mineral soil mixing with the forest floor is also desired. Yellow Birch and Sugar Maple will be favored in that order.
 - Where Beech is not dominant and **Sugar Maple** is desired the smaller opening size is prescribed (0.04-0.1 ha). Sugar Maple and Yellow Birch will be favored in that order.

Harvest Patch Dimensions.					
Area		Circular Radius		Square Length	
(ha)	(acre)	(m)	(ft)	(m)	(ft)
0.04	1/10	11	37	20	66
0.10	1/4	18	59	32	104
0.15	1/3	22	72	39	127
0.20	1/2	25	83	45	147

Post Treatment Criteria

- Acceptable Growing Stock (of trees > 10 cm Dbh) must be greater than 5 m²/ha following treatment
- 90% of residual stand basal area must not have damage to boles (trees with exposed cambium exceeding 100 cm² resulting from harvest) or crowns (greater than 1/3 of crown damaged by harvest activities).

Tolerant Hardwood Management Key Sub-Key T - Tend



SUB-KEY T - Tend

Instructions and Definitions for:

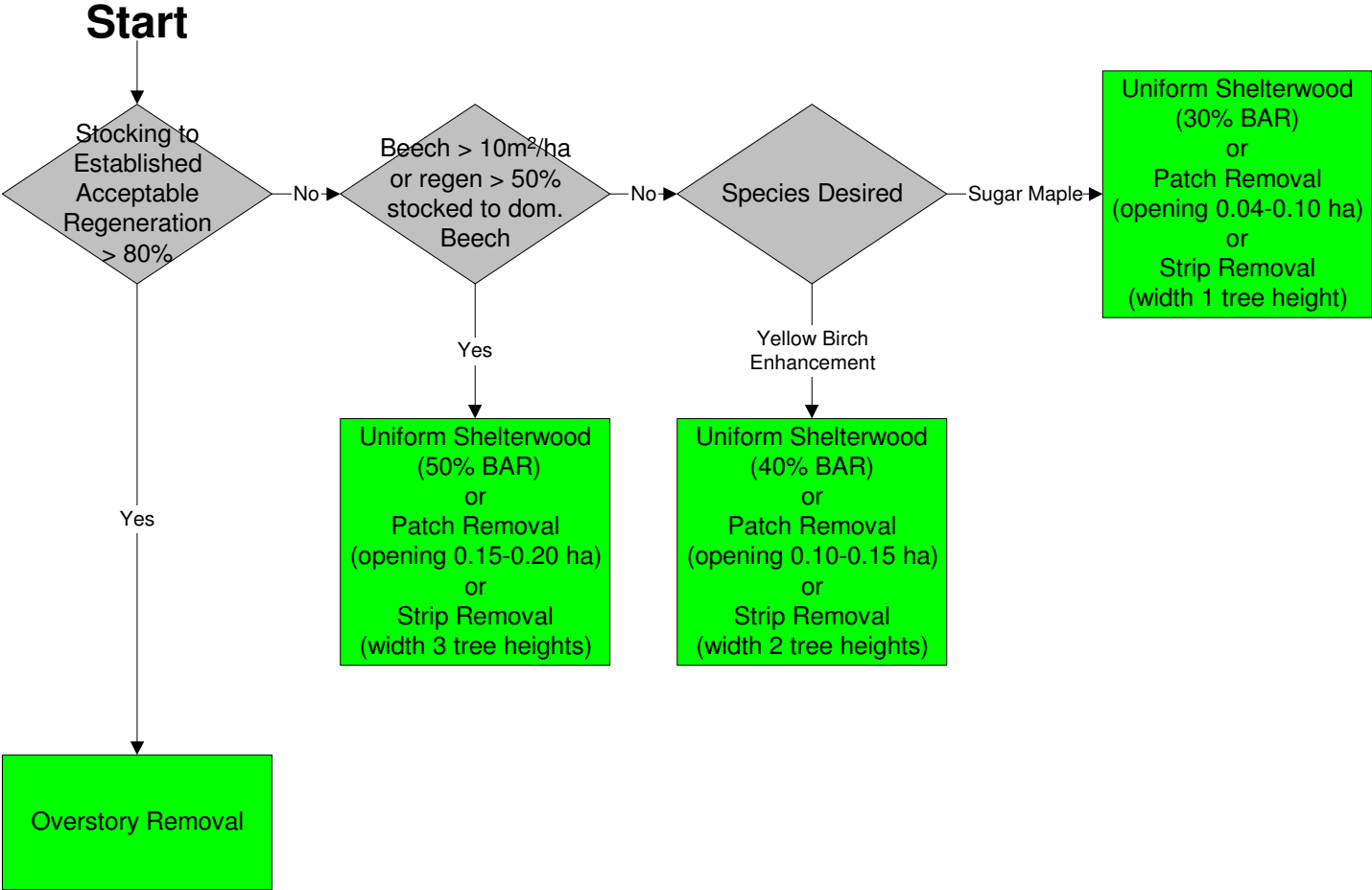
Decision Diamonds

- **Average Height** – What is the average height of the stand in metres?
- **Acceptable Growing Stock** – What is the basal area in m²/ha of **Acceptable Growing Stock** – AGS are trees that are either undersized that have the quality and vigour to potentially grow into sawlogs (better than pallet quality) or have sawlog quality and size now (better than pallet quality) and will not degrade into a lower quality sawlog or worse within 15 years.

Management Prescriptions

- **Crop Tree Release** – Where moderate levels of AGS exist, release trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous trees of good form and have high value potential. Trees must be self pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at most every 3m (10ft)) a uniform pre-commercial thinning is appropriate.
- **Commercial Thinning (CT)** – Where the stand contains predominately merchantable trees of AGS uniformly distributed throughout the stand a uniform commercial thinning is prescribed. The objective of this treatment is not to regenerate the stand. It is intended to increase the growth of the trees with the highest potential value.
- **Let it grow** – Where low levels of AGS exist, let the stand grow and re-evaluate with the key after suitable time has elapsed.

Tolerant Hardwood Management Key Sub Key R - Regenerate



SUB-KEY R - Regenerate

Instructions and definitions for:

Decision Diamonds

- **Stocking to Established Acceptable Regeneration > 80%** – Is the stocking to acceptable regeneration exceeding 0.3 m (1 ft) in height greater than 80% ?
- **Beech > 10m²/ha or regen > 50% stocked to dom. Beech** – Is beech growing stock greater than 10 m²/ha (44 ft²/acre) or dominant regeneration stocking to Beech greater than 50% ?
- **Species Desired** – What regeneration species do you wish to favor if Beech does not exceed > 10m²/ha or exceed a stocking to dominant regeneration of 50% ?
- **Yellow Birch Enhancement** – Is the management objective to enhance yellow birch regeneration over sugar maple by producing suitable light conditions?

Management Prescriptions

- **Overstory Removal** – Release regeneration by removing overstory. Use methods that protect advanced regeneration.
- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking.
 - Where **Beech** is dominant remove 50% of the basal area (BAR).
 - Where favoring **Yellow Birch** regeneration is desired (mineral soil mixing with the forest floor is also desired) and Beech is not dominant remove 40% of the basal area
 - Where Beech is not dominant and **Sugar Maple** is desired remove 30% of the basal area.
- **Systematic Patch Removal** – Small groups of trees are cut systematically throughout the stand without tending the unharvested areas, as there is not sufficient immature Acceptable Growing Stock. The main objective is to create the conditions to regenerate the desired species and to harvest the Sawlog Stock before it becomes overmature.
 - Where **Beech** is dominant the larger openings are prescribed (0.15 to 0.2 ha (1/3 – 1/2 acre). Yellow Birch, Sugar Maple and Beech will be favored in that order.
 - Where favoring **Yellow Birch** regeneration is desired and Beech is not dominant, 0.1 to 0.15 ha (1/4-1/3 acre) harvest groups are prescribed. Mineral soil mixing with the forest floor is also desired. Yellow Birch and Sugar Maple will be favored in that order.
 - Where Beech is not dominant and **Sugar Maple** is desired the smaller opening size is prescribed (0.04-0.1ha (1/10 – 1/4 acre)). Sugar Maple and Yellow Birch will be favored in that order.
- **Strip Removal** – Harvest strips to produce shade requirements necessary to regenerate desired species. Leave at least 2 strips unharvested between harvested strips.
 - Where **Beech** is dominant remove strips of 3 tree heights in width.
 - Where favoring **Yellow Birch** regeneration is desired (mineral soil mixing with the forest floor is also desired) and Beech is not dominant remove strips 2 tree heights in width.
 - Where Beech is not or will not be dominant and **Sugar Maple** is desired remove strips of 1 tree height in width.
- **Let it grow** – Let the stand grow and re-evaluate the stand with the key after suitable time has elapsed.

References

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- OMNR. 1998. A silvicultural guide for the tolerant hardwood forest in Ontario. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto. 500p.
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Pre-Treatment Information Requirements

To implement the tolerant hardwood management keys, information must be collected on the stands of interest. The required stand information includes:

- Species
- Size class
- Stem quality
- Patchiness of the stand
- Existing regeneration
- Exposure
- Blowdown
- FEC Vegetation Type
- FEC Soil Type
- Height

The user of the keys must also decide what their goals are in the stand:

- Regeneration Goals

Cruising Instructions

Take 1 prism point per hectare with a minimum of 5 prism points and a maximum of 50.

- Use a BAF 2 prism.
- Evenly distribute these points throughout the stand.
- If volume estimates are required take at least one height, from the tree of average basal area (average co-dominant tree), for each product class at each point and take diameters in 2 cm diameter classes.
- If treatment prescriptions only are required 5 cm diameter classes will suffice.
- The following information will be calculated from the pre-treatment assessment to use with management keys to determine a recommended prescription:
 - Total Basal Area
 - Basal Area of **Acceptable Growing Stock**
 - Basal Area of Sawlogs/Seed trees
 - Patchiness assessment
 - Regeneration stocking
 - Blowdown hazard
 - Average height of stand
 - Species composition
 - Beech Basal Area
 - Dominant Beech regeneration stocking

Pre Treatment Tree Assessment Tally Sheet Date: June 25, 2097 Prism Factor: 2 *******SAMPLE*******

Loc: Lynn Mtn Co: Cumberland BL: 1 ST: 1 # Plots: 12 Cruiser: TM Page: 1 of 1

Sp	SM						YB						BE						RS							
TC	UC	UP	UL	UH	AL	AH	UC	UP	UL	UH	AL	AH	UC	UP	UL	UH	AL	AH	UC	UP	UL	UH	AL	AH		
Dbh																										
5	5																									
10	2	2			1		1						2													
15	1	5			9			1																		
20		6			5	2					2															
25		6	1		4	10		2			3															
30		4	4		4	8					2													1		
35		1	1		4	2	1	1	2		1	2												1		1
40		4	2		3	4	1		1			1													1	
45		1	2	1	3						1	3														
50		1	9		1	2			1	1		2														
55		1	7	2	2	3			1		1														1	
60		2	1	1	1				2			1														
65		2	4	1	1																				1	
70			2	2																						
75		1	1	1																						

Pre-Treatment Site Assessment Tally Sheet. Loc: Lynn Mtn Co: Cumberland Stand: 1 ******SAMPLE*****

Plot	ST	VT	Sp	Dr	RD	BD	Patch	Regen	Comments
1	8	22	0	W	D	0	U	SM/D/30/0.3	
2						S	M	YB/D/40/1.0	
3						0	U	SM/D/20/0.2	
4						0	U	BE/D/60/1.5	
5						0	U	SM/D/50/0.6	
6						S	U	SM/D/10/0.1	
7						0	U	RS/D/30/0.3	
8						0	U	SM/D/30/0.4	
9						0	U	SM/D/50/0.3	
10						0	I	SM/C/30/0.3, YB/C/10/0.4	
11						0	U	SM/D/60/0.1	
12						0	M	SM/D/30/0.3	

Sample Cruise Summary & Prescription

Based on the sample cruise, the stand characteristics are as follows:

Tolerant Hardwood:	96%
Sugar Maple:	79%
Yellow Birch:	17%
Total Growing Stock:	32.8 m ² /ha
Sawlog Stock:	11.8 m ² /ha
Acceptable Growing Stock (10cm+)	15.5 m ² /ha
Uniform Distribution:	83%
Beech Component:	0.3 m ² /ha
	5%

Recommended Stand Prescription

Individual Tree Selection:

Q ratio (the Ratio of trees in each smaller diameter class) = 1.4

LDT (Largest Diameter Tree after harvest) = 55 cm

RBA (residual Basal Area) = 20 m²/ha

Cutting Ratio (for trees in the 15-55 Dbh classes) = 1:3

Pre-Treatment Tree Assessment Tally Sheet

Tree Codes (TC)

1st letter (U or A):

U - Unacceptable growing Stock (UGS) - will not make sawlog quality stem in the future or has sawlog quality stem now but will degrade in quality before the time of the next harvest. If the tree vigor is low due to reasons such as broken/dead tops, insect/disease damage, small crowns etc which make it a poor candidate to leave growing as a future crop tree it should be called an UGS.

A - Acceptable Growing Stock (AGS) - will make a sawlog quality stem in the future or is one now and will maintain or improve in quality by the time of the next harvest.

2nd letter (C, P, L or H):

C - Cull - Does not have potential for any merchantable products

P - Pulp - Potential for Pulp log at best

L - Low Grade Sawlog - Potential for low grade sawlog at best (must have better than pallette log potential) – G 3

H - High Grade Sawlog - Potential for high grade sawlog at best (high end sawlog or veneer log) – G2 or better

Examples

UC - Unacceptable growing stock without potential for any merchantable products

UP - Unacceptable growing stock, maximum potential product is pulp

UL - Unacceptable growing stock with low grade sawlog quality stem now but will degrade by the next harvest (15 years).

UH - Unacceptable growing stock with high grade sawlog quality stem now but will degrade by the next harvest (15 years).

AL - Acceptable growing stock with potential or existing low grade sawlog quality stem - will not degrade by the time of the next harvest (15 years)

AH - Acceptable growing stock with potential or existing high grade sawlog quality stem - will not degrade by the time of the next harvest (15 years)

Pre-Treatment Site Assessment Tally Sheet:

Codes

ST- FEC soil type

VT- FEC vegetation type

Sp-Sphagnum Moss: - **0** - none; **L** - 0-10%; **M** - 10-50%; **H** - >50%

Dr- Drainage: - **E** - excessive; **W** - well; **I**- Imperfect; **P** - Poor

RD- Rooting Depth - **S** - shallow < 30cm, **M** - moderate 30-60 cm, **D** - deep > 60cm

BD- Blowdown: - **S** - single tree; **P** - patch of trees

Patch: - is the area around the sample plot dominated by **M** - mature to over mature trees, **I** - Immature AGS , **R**- Advanced regeneration of preferred species, or a **U**- Uniform mix of all age classes

Regen-Regeneration: Species, Dominance (D= dominant; C - Co-dominant, S - suppressed), Cover (%), Average Height (m) eg:
rS/D/30/0.3 - red spruce dominant 30% cover, 30cm tall

Comments:

Post-Treatment Information Requirements – Selection

In order to meet quality specifications for Selection Harvests the following information must be collected:

- Basal area remaining after Harvest
- Basal area of trees damaged during harvest activities with exposed cambium exceeding 100 cm² in area or with damaged to more than 1/3 of their crowns
- Basal area of Acceptable Growing Stock after harvest.

Instructions

- Take 1 prism point per hectare with a minimum of 5 prism points and a maximum of 50.
- Use a BAF 2 prism.
- Evenly distribute these points throughout the stand.
- When tallying basal area, do so by UGS and AGS. If species specific information is necessary also tally by species
- AGS – Acceptable Growing Stock. Trees that have the potential for producing sawlog quality logs of better than palette quality and will not degrade by the time of the next harvest (15 years). These trees must not have been scarred by harvesting activities with scars of exposed wood exceeding 100 cm² in area or have greater than 1/3 of their crowns damaged by harvesting activities.
- UGS – Unacceptable Growing Stock. Trees that do not have the potential to produce a better than palette quality sawlog or one with a sawlog now but that will degrade by the time of the next harvest (15 years)
- HT = Average height in metres of the species tallied, only if required.
- HD = Trees with harvesting damage of exposed wood exceeding 100 cm² in area or crown damage exceeding 1/3 of the live crown
- Calculate the following: Basal area of acceptable growing stock in m²/ha, % of basal area that is damaged

