Forest Management Plan

Fitzgerald woodlot

By Minga O'Brien, MSc, BSc, Forest technician

March, 2011

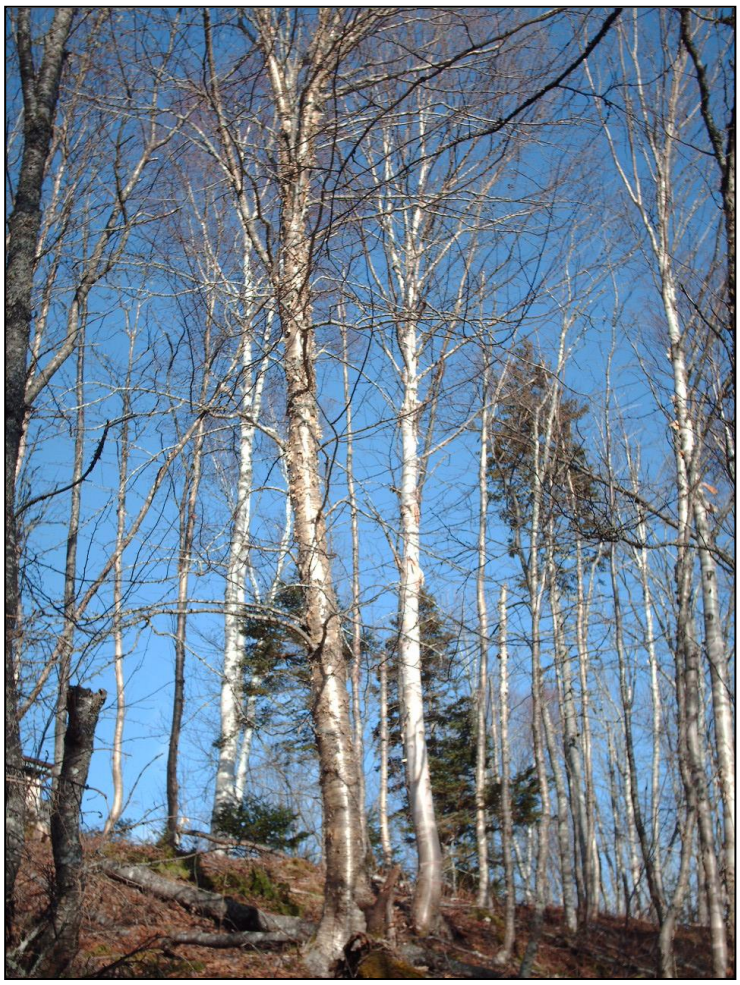

Table of Contents

List of figures and tables

Purpose of this plan

This plan is to help guide the responsible stewardship of healthy natural forests within the Acadian Forest Region. Forests are a natural, renewable resource and as such, interventions must aim to maintain and/or restore Acadian Forest characteristics. Forest management should follow an ecosystem-based approach, employing sound and responsible methods that consider the future. This approach can help ensure existing forest values and associated benefits are maintained for future generations.

The purpose of this plan is to:

1. Promote awareness of how all components of the forest are interconnected and dependent on one another.
2. Promote awareness of the many values that exist within the forest, besides timber production, and how many forest values can be maintained over time with proper pre-intervention planning.
3. Provide recommendations based on the landowner's goals and objectives.
4. Encourage documentation and record keeping for all forest activities including periodic monitoring and re-assessments of areas after interventions have been completed to determine if results are as expected and if methods or scheduling should be altered or changed.
5. Develop the woodlot into a multi-generational project and learning experience that will expand knowledge and improve future activities.

Landowner's management philosophy

The landowner's management philosophy is to maintain and/or restore a diverse, uneven-aged forest, enjoy the natural splendour of St Ann's Bay, and minimize their footprint on the land.

All activities conducted in the forest shall be of low impact by following sound and responsible practices to maintain health of soil, water and wildlife habitat. Restoration activities should minimize ground disturbance and protect environmentally sensitive areas. This will maintain overall forest ecosystem health and long term productivity, and allow future generations to enjoy and benefit from the forest.

Landowner's objectives

The landowner's objectives are the underlying basis of the planning process. They aid in the development and direction of management prescriptions. The Fitzgerald family's management objectives are as follows:

- Conservation first. The family is not interested in a commercial forestry operation.
- Minimize fire hazard caused by the abundance of dead and dying spruce trees.
- Maintain wildlife and wildlife habitat, with special attention to uncommon species and key habitat features, such as vernal pools, supercanopy trees, large diameter trees, cavity and mast trees, and stick nests.

- Protect water quality, and minimize impacts on peak flows and summer low flows in watercourses and seepages.
- Utilize some wood material for firewood, prioritizing slow-growing, low vigour, dying and recently dead softwood trees for removal.
- Maintain a healthy ecosystem with a wide variety of native species, favouring those that are long-lived and representative of the original Acadian forest.

General description

Ownership

This property is owned by William and Mary Fitzgerald of St Anthony, Newfoundland. They plan to retire in the near future and live on this property.

Woodlot location & area

The woodlot is located on St. Ann's Bay, Victoria County, Cape Breton. It is 17.5 kilometers northeast of Baddeck, Nova Scotia.

The woodlot is 26.3 hectares in size, and is a contiguous parcel of land (PID #85107019) bounded by the Cabot Trail to the west and St Ann's Bay to the east (Figure 1), and was acquired in 1995.

There are 7 distinct forest stands on the property, as well as freshwater and brackish ponds, several wetlands, sinkholes, and a house and barn (Figure 1, Appendix A). The geographic coordinates for the southwest corner of this property are 20T 684,132 metres East; 5,121,391 metres north; WGS 84.

Landuse and history

Much of this parcel was cleared and used as pasture, then grew back in white spruce and balsam fir with shade intolerant hardwoods (red maple, white birch, poplar) scattered throughout. The white spruce is now dead or in decline. Small stands of balsam fir were killed by the spruce budworm in the early 1980s, with some dead fir trees still standing among a new age class of balsam fir. This newer age class is already in decline.

Ecological land classification

This property is in the Acadian Forest Region, with elements of the northern hardwood forests to the south and the mostly conifer-dominated boreal forests to the north. Acadian Forests have a diverse range of both softwood and hardwood tree species, though their most distinguishing feature is an abundance of red spruce. The Acadian Forest Region includes all of Nova Scotia, Prince Edward Island, New Brunswick and a portion of the New England States.

The woodlot lies within the Cape Breton Hills Ecodistrict (Appendix B). Most elevations in this Ecodistrict are 150 - 300 m above sea level. The ecodistrict is influenced by the strong, cold winds off the Gulf of St. Lawrence. Temperatures are slow to warm up in the spring resulting in a short growing season. The area receives between 1400 - 1550 mm of precipitation annually.

The higher steep-sloped hills are underlain with older resistant rocks and are covered with well-drained, moderately coarse-textured tills. In general, the lower more gradually sloping hills are underlain by coarse carboniferous sediments. The soils tend to be imperfectly drained, fine textured tills. Seepage sites are common on the slopes providing some of the richer sites for tree and plant growth. Areas of karst topography (an irregular landscape derived from soluble bedrock such as gypsum) are found throughout the district at lower elevations.

This ecodistrict is predominantly a tolerant hardwood forest with scattered spruce and fir. In coastal areas, white spruce is more frequent. Eastern hemlock, white pine and scattered red spruce are found in ravines with well drained, medium textured soils. On top of the larger hill complexes, level to hummocky topography underlain with imperfectly drained soils yield stands of black spruce and balsam fir. Yellow birch, sugar maple and red maple grow on the better drained soils. Much of the early land grants on the upland sites were cleared for farming, but once abandoned in the early to mid 1900s, the fields and pastures reverted to pure stands of white spruce.

Terrain & Soil

The western portion of this property, along the Cabot Trail, reaches 35-m above-sea-level. The eastern portion is along St Ann's Bay. The terrain is highly uneven due to the underlying gypsum. The contours on the provincial property map are inaccurate, and do not reflect the north-south ridges, sinkholes and other variable terrain.

The soils on this property are part of the Westbrook soil series. The underlying parent material is a reddish-brown, gravelly sandy loam glacial till derived from the underlying conglomerate (which varies in texture from fine gravelly material to coarse cobbly or stone fragments). Soils have good drainage, and the majority (92%) are on slopes greater than 8%.

Land classification, forest cover types & dominant species

Mixedwoods (a mix of hardwoods and softwoods) are the primary forest cover type on this woodlot, comprising 79% of total area (Table 1). Hardwoods comprise 10%, and wetlands, ponds and barachois comprise 11% of the property.

Table 1. Land classification for Fitzgerald woodlot.

Forest cover type / land use	Acres	Hectares	% of total
Softwood	0.00	0.00	0%
Mixedwood	51.10	20.69	79%
Hardwood	6.54	2.65	10%
Ponds and barachois	7.06	2.86	11%
Residence	0.25	0.10	0%
Total	64.95	26.29	100%

Natural succession & disturbance patterns

Natural succession is a fundamental concept in ecology that refers to more or less predictable and orderly changes, over time, in the composition or structure of an ecological community. In forest ecosystems, succession is typically initiated by some form of disturbance (e.g. logging, severe windthrow, fire) of an existing community.

The trajectory of ecological change can be influenced by site conditions (e.g., geology/soil, landforms, topography, drainage, and surface materials), interactions of the species present, and other factors such as availability of seed trees, or weather conditions at the time of disturbance.

In general, early successional forests will be dominated by fast-growing, light-loving (i.e. shade-intolerant), well-dispersed 'pioneer' species. In Victoria County, trees such as grey and white birch, poplar species, balsam fir, red maple, white spruce and pin cherry are particularly well-adapted to exploit large-sized gaps in forest canopies.

As succession proceeds, these pioneer species will tend to be replaced by more long-lived, slower-growing, shade-tolerant species like yellow birch, sugar maple, red spruce and hemlock (Table 2). Late-successional species require some level of shade, moisture, and soil fertility to germinate and establish.

Table 2. Shade tolerance ranking of common eastern Canadian tree species (Harrison, 2006).

Very Intolerant	**Intolerant**	← →	**Intermediate**	← →	**Tolerant**	← →	**Very Tolerant**
Larch	Red pine	White ash	White pine	Red maple	Black spruce	Red spruce	Balsam fir
Poplar	White birch		Yellow birch	Norway spruce	Cedar		Eastern hemlock
Grey birch	Jack pine		Red oak				Sugar maple
Pin cherry			White spruce				Beech
Willow							

The shade-tolerant, long-lived tree species of the Cape Breton Hills Ecodistrict vary significantly with drainage. Yellow birch will grow in association with red spruce on well-drained hummocks, mixed with an occasional occurrence of beech, sugar maple and hemlock. Red spruce with scattered white pine and hemlock may occur on the better drained sites. On sites where soils are derived from glacial outwash till, white pine will occupy the coarser soils. Forests of black spruce and scattered white pine are found on the imperfectly drained soils.

As forests and soils develop over time, organic matter is generated by living organisms and decomposed and cycled through the soils, increasing fertility and moisture retention. Downed woody debris created by fallen trees and limbs decomposing on the forest floor

contributes to both nutrient cycling and increased soil moisture providing conditions conducive for many species to germinate and establish.

Most of Nova Scotia's pre-colonial forests consisted of longer-lived species that survive well in partially shaded conditions, such as sugar maple, yellow birch, American beech, white pine, red spruce, and eastern hemlock. Large ancient trees were a major component of the forests. As old trees died and fell over, gaps created in the canopy allowed sunlight to reach the forest floor, enabling the germination of seeds and growth of saplings. The continual formation of gaps was the most common means of forest renewal. Nova Scotia's forests had a multilayered appearance, with a variety of live, dying, and dead trees, and accumulations of dead wood on the ground.

These forests were not just trees, though. They included all the animals, plants, mosses, lichens and myriad other organisms that depended on the live and dead trees for food, reproduction, and cover. The diversity of organisms contributed to a healthy forest both resistant and resilient to outside influences, such as storms, insect attacks and drought.

Like this woodlot, most of Nova Scotia's forests are now in early stages of succession (less than 60 years old), growing back from previous cuts or from land cleared for agriculture, and may contain only a few remnant long-lived trees. Our forests are generally young, and lack many of the features of the original Acadian forests. Furthermore, species like beech and elm have been severely affected by introduced diseases, and make up a much smaller portion of today's forests.

From the perspective of forest restoration – whereby land managers are attempting to speed up the restoration of late successional tree species - early successional, pioneer species can serve as a nurse crop for longer-lived, late successional trees (if present as seeds or seedlings) to germinate, establish and grow. Once the pioneer trees fall to the forest floor, climax species are released, becoming the dominant species in the stand.

Harvest activities should mimic our natural disturbance patterns both in scale and frequency. Common natural disturbances in the province include weather related events and to some extent insect infestations. Insect infestations tend to be patchy in their impacts, and their severity and frequency are often influenced and exacerbated by land use practices like farming that result in an abundance of even-aged balsam fir or old field white spruce.

Strong winds, heavy snow and ice can have moderate to severe impacts on Nova Scotia's forests. They may cause large and often shallow-rooted trees and snags to fall and cause damage and/or breakage to other trees. Commonly, small-scale weather events create gaps in the forest canopy. Sunlight reaches the forest floor, enabling the regeneration of tree seedlings. This 'gap' formation is the major type of regeneration in the forests of Nova Scotia. Over time, a multilayered forest develops, with a variety of live, dying, and dead trees, and accumulations of dead wood on the ground.

Occasionally – though infrequently – Nova Scotia is hit by hurricane-force winds. Hurricanes are not unusual, though most hurricanes are relatively weak by the time they reach the east coast of Canada. Notable exceptions include Hurricane Edna in 1954 (a

category 3 hurricane), and Hurricane Juan in 2003 (a category 1-2 hurricane). Weaker than Edna, Juan passed over central Nova Scotia on September 28th 2003.

The impacts of hurricanes are typically uneven and patchy in distribution. Hurricane Juan resulted in moderate to severe blowdown (30-100% stems downed) on 23,000 ha (5% of the hurricane's swath). While considerable, this is relatively small in comparison to the area clearcut (with >90% of the stems downed) every year in the province (41,000 ha).

Maintaining multiple age classes and tree species diversity is the best insurance against the potential impacts of large-scale natural and anthropogenic disturbances.

Protected species

The Nova Scotia Endangered Species Act protects species categorized as either endangered, threatened, vulnerable or extirpated (no longer exists in the region). More information regarding the Nova Scotia Endangered Species Act and an updated listing can be found using the website: www.gov.ns.ca/natr/wildlife/biodiversity/species-list.asp.

During the forest inventory assessment none of these species were observed. However, from this list the species most likely to stopover during migration, potentially live, or that once lived in this area include the Red Knot, Boreal Felt Lichen, Harlequin Duck, Bicknell's Thrush, Eastern Moose, Chimney Swift, Canada Lynx, Common Nighthawk, Wood Turtle and American Marten. Appendix C has pictures and brief descriptions of each of these species.

Many other species are considered to be in decline, but are not listed under an Act. Their status can be queried using the website: www.gov.ns.ca/natr/wildlife/genstatus/ranks.asp. Rare species that may currently or have previously occurred in the St Ann's Bay area include:

- Showy Lady Slipper (which is "red listed" under NSDNR's general status ranking system and thus known or thought to be at risk); and
- Monarch Butterfly, Fisher, Southern Flying Squirrel, Yellow Lady Slipper, Giant Rattlesnake Plantain and Black Ash (which are "yellow listed" and thus recognized as being sensitive to human activities).

To find out more information regarding identifying species at risk and their associated habitats the newly available booklet "Species at Risk in Nova Scotia – Identification and Information Guide" can be viewed or downloaded online from the website: www.speciesatrisk.ca/SARGuide/ or by contacting a wildlife biologist specializing in stewardship of species at risk – Terry Power, powertd@gov.ns.ca (regional biologist) or Mark Elderkin, elderkmf@gov.ns.ca (species at risk biologist) with Nova Scotia's Department of Natural Resources.

It is each forest owner's responsibility as a steward of the land to adopt a precautionary approach to protect life and habitat if any of the afore-mentioned species do exist or have the potential to exist on your property. To that end, measures should be adopted to:

- Maintain or recruit large-sized snags for nesting and roosting Chimney Swifts and Southern Flying Squirrels. Recruitment can be achieved through girdling, intentional scarring and tree topping.
- Moose, American Marten and Fisher are negatively affected by forest fragmentation and conversion of older forests to young forests. Thus, woodlot owners should minimize forest fragmentation created by roads and large openings, and maintain or manage towards closed canopy, uneven-aged forests where possible.
- Minimize disturbance to wetlands, forest swamps, streams, seeps and sinkholes to protect habitat of flycatchers, ducks, amphibians, reptiles and fish. Any cutting within 20-meters of such areas should take place on relatively level ground, when soils are frozen or dry, with canopy closure staying at or above 70%.
- Protect water quality by minimizing soil disturbance and removal of forest cover. It is important to halt operations when soils are saturated and easily disturbed.
- Minimize disturbance during breeding season. The months of May to July are critical for breeding and raising young, especially for amphibians, reptiles, birds and mammals.

Access

This property is accessible from the Cabot Trail, and from an old road and driveways into this and adjacent properties (Figure 3, Appendix A). The old road could be cleared and used again for a walking trail or for usage with small equipment to extract firewood or carry seedlings.

The landowners could create a network of walking/skiing trails throughout the property, designed to optimize views and experience the wide diversity of stands and special features of this property.

Relationship to surrounding lands

All properties surrounding this woodlot are privately owned. This is a rural landscape made up of woodlots, ocean frontage, and a scattering of homes and cottages. Fitzgerald's neighbours are as follows (Figure 4):

PID 85026318 – (Janet Lee Miller to the south)

PID 85107001 – (Murdoch Morrison to the north)

PID 85026292 – (Murdoch Morrison to the west)

PID 85105732 – (Sheila and Leonard Lynk - small trailer lot to the west)

Boundary lines

Survey markers were found in NE, NW and SW corners, and a survey line along a portion of the north boundary. Otherwise no clear property lines were located. Partly-uncovered barbed wire fencing was found in proximity to the northern boundary.

Strengths & weaknesses of the Fitzgerald woodlot

The strengths of this operation are:

1. Woodlot is relatively accessible, with road frontage to the west on a paved road and along driveways.
2. Firewood is plentiful.
3. Yellow birch, sugar maple, white pine, red spruce and hemlock are scattered throughout the woodlot, providing seed sources of shade-tolerant tree species.
4. Residence located on woodlot, allowing ready supervision of property. As well, the neighbour, Murdoch Morrison, is present year-round.

Weaknesses that may create challenges for the landowner to achieve management objectives:

1. Within the last 10 years, many pasture spruce and balsam fir have and continue to die. In places there are many downed trees. Until regeneration overtops downed trees, there is a moderate fire hazard associated with the accumulation of dead trees.
2. The many ponds, hills, sinkholes and marshy areas on this property pose access problems to much of the woodlot. On the bright side, they are natural fire breaks.

Forest inventory results and stand descriptions

The forest inventory summary (Table 3) outlines the stand units, associated area, and pertinent characteristics such as dominant height, dominant age, average merchantable basal area, forest cover type, species composition, and merchantable wood volumes per acre.

Table 3. Forest inventory summary for Fitzgerald woodlot.

Stand #	Area (ac)	Area (ha)	Range in Dominant Height (m)	Range in Dominant Age (yrs)	Average Basal Area (m2/ha)	Forest Cover Type	Species Present*	Merchantable Volumes			
								Cords/acre**			Fbm/ acre***
								SWD	HWD pulp	HWD logs	SWD
1	10.2	4.11	16	65	17	MXD	wS, rM, wB, bF	7.0	5.7	0.7	1,074
2	21.2	8.60	10-20	>100	22	MXD	wB, bF, rM, wS, yB, eH, wP	8.1	8.7	0.7	871
3	8.3	3.36	10-14	35	22	MXD	bF, rM, wB, wS	17.5	4.3	0.0	0
4	4.6	1.86	15	65	20	MXD	wS, bF, wB, rM, yB	9.0	5.4	0.0	1,880
5	6.3	2.55	18	>100	24	HWD	yB, rM, sM, Beech	0.0	14.6	5.2	0
6	6.8	2.75	14	65	14	MXD	wS, bF, wB	6.2	2.9	0.0	1,433
7	0.2	0.10	8	30	4	HWD	wB, yB, rM				
Total	57.64	23.34									

* Refer to Appendix D for tree species codes

** Cords per acre includes all pulpwood & studwood products for softwood; & includes hardwood pulpwood and logs

*** Fbm is board feet measure; includes softwood log products only.

Stand 1 extends to the shore of St. Ann's Bay. It is dominated by 'pasture' spruce (white spruce that has grown up in an old field) that is currently dead or dying. Red maple and white birch are scattered throughout. A walking trail to the beach bisects this stand. The path is cleared periodically of fallen spruce by a local cutting crew, who have made tidy stacks of firewood-sized logs. The sheltered side of this stand, away from the ocean, has some remnant hemlock, sugar maple and yellow birch.

Stand 2 is the largest stand on this property. The terrain is highly variable, with north-south ridges, freshwater and brackish ponds, and numerous small and large sinkholes (due to the underlying gypsum, a type of mineral that dissolves in water). East-facing slopes, exposed to the strong winds off St. Ann's Bay, are dominated by poor vigour red maple, white birch and balsam fir. Ridge tops are very exposed, with many dead trees. There is a fair amount of old field white spruce, with sheltered areas harbouring some hemlock, white pine, red spruce, sugar maple, yellow birch and beech. A scenic trail could be built through this stand, meandering along ridges, hemlock groves, and ponds.

Stand 3 also borders the ocean. It is younger in age than stand 1, with variable stocking (areas where stems are sparse, and other areas where they are very dense). It appears to have been cleared for pasture, grown back, and later cut again, and is now caught in a short-rotation balsam fir/spruce budworm cycle. Considerable effort will be required to restore this stand. One white pine tree was found on the sheltered side.

Stand 4 is somewhat similar in composition to stand 1. It is dominated by white spruce, many of which are dead and dying, as well as balsam fir and poor vigour white birch. This stand borders the Cabot Trail, and is relatively level as well as sheltered from the ocean.

An old road, still visible in places, borders the eastern edge of the lower part of stand 4. The view from this road, into the hardwood-dominated ravine to the east (stand 5), is quite dramatic. It would be worth including the old road in a scenic/recreational trail network.

Stand 5 has sugar and red maple, yellow birch, beech, and an occasional hemlock. Beech are reproducing vegetatively (root sprouting) as they are no longer producing viable seeds (due to an introduced disease). There are also some scattered, but dead, red spruce in this stand. The stand is on well-drained slopes, a good distance from the ocean, and sheltered from strong winds.

Stand 6 surrounds the house lot. It is fragmented by driveways, clearings, thinning, and drinking water infrastructure. The woods are dominated by a degraded forest of white spruce, fir, white birch and red maple. To break up the age classes and re-introduce long-lived tree species, small patch cuts and fill planting is highly encouraged. Also, gardening with exotic ornamental plants could easily become escapees into this stand, so caution is recommended.

Stand 7 is a tiny stand of young hardwoods (white and yellow birch and red maple), sitting on a flat, poorly drained hilltop.

Area distribution of age classes & previous intervention activities

Mixedwood forests comprise 20.8 ha of this property and hardwood forests 2.6 ha (Table 4). About 48% of this woodlot is uneven-aged as a result of varied land use practices and differing exposures to the ocean. The owners are encouraged to move the remainder of the woodlot towards an uneven-aged condition. This will help diversify and restore the forest, thereby reducing the impacts of future storms and insect outbreaks, and improving overall habitat diversity.

Table 4. Area distribution of age classes for Fitzgerald woodlot.

		Forest Cover Type by Hectares			
Age Class	Tree Age	Softwood Hectares	Mixedwood Hectares	Hardwood Hectares	Total Hectares
I	1--20				0.00
II	21--40		3.40		3.40
III	41--60		2.80		2.80
IV	61--80		6.00		6.00
V	81--100				0.00
VI	101--119				0.00
VII	UE*		8.60	2.60	11.20
Total		0.00	20.80	2.60	23.40
Percentage		0%	89%	11%	100%

Wood product volumes

In total, there are approximately 95 cords of softwood sawlogs that, combined with the softwood cordwood (pulp & studwood) of 466 cords, provides a total softwood volume of 561 cords (Tables 5, 6 & 7). In hardwoods, there are approximately 57 cords of sawlogs, and 418 cords of firewood grade logs. The overall total of both softwoods and hardwoods in the woodlot is 1,037 cords. Over the 58 acres of forestland classed as productive/operable, this total wood volume relates to an average of 18 cords per acre.

Table 5. Total merchantable wood volume summary, by species and product.

Species / Product	Total Volume	Units
sP/bF Pulpwood	201	cords
sP Studwood	265	cords
sP Sawlogs	37,263	FBM
Intol Hwd Pulpwood	271	cords
Intol Hwd Potential logs	58	cords
Intol Hwd logs	16	cords
Tol Hwd Pulpwood	49	cords
Tol Hwd Potential logs	41	cords
Tol Hwd AGS logs	42	cords
Summary		
Total Hwd Cords - pulp	418.14	cords
Total Hwd Cords - logs	57.18	cords
Total Swd Cords	466.25	cords
Total Swd Fbm	37,263	FBM

* See Appendix D for tree species codes

Table 6. Total merchantable softwood volumes by species and product for each stand unit.

	Softwoods		
Stand #	Spr/bF Pulp cords	Spr Stud cords	Spr Logs FBM
1	48.38	22.33	10,912
2	77.87	85.66	7,611
3	5.13	141.62	0
4	26.67	15.48	8,828
5	0.00	0.00	0
6	43.10	0.00	9,912
Totals:	201.16	265.10	37,263

Table 7. Total merchantable hardwood volumes by species and product for each stand unit.

	Hardwoods					
Stand #	Intol. Hwd Pulp cords	Intol. Hwd Pot. Logs cords	Intol. Hwd Logs cords	Tol. Hwd Pulpwood cords	Tol. Hwd Pot. Logs cords	Tol. Hwd AGS Logs cords
1	58.06	0.00	7.60	0.00	0.00	0.00
2	121.48	45.56	7.95	7.95	10.12	7.95
3	36.02	0.00	0.00	0.00	0.00	0.00
4	23.48	0.00	0.00	1.68	0.00	0.00
5	12.24	12.24	0.00	38.91	30.61	33.67
6	19.78	0.00	0.00	0.00	0.00	0.00
Totals:	271.06	57.80	15.56	48.55	40.73	41.62

Annual growth & reasonable harvest level

Annual growth refers to yearly volume growth increments of tree species as a function of land capability, which is based on site and soil conditions, topographical and climatic factors. The annual growth rate of softwoods and hardwoods provide a basis to establish a reasonable harvest level that will serve as a guide when planning and implementing forest management activities. We must harvest less than what the forest is growing in order to sustain all of nature's functions and processes, particularly the role of standing deadwood and coarse woody debris. This will ensure a long-term balance of all forest values.

The determination of annual growth to establish a reasonable harvest level of both softwoods and hardwoods is based on the measured land capability of the woodlot. The harvest level for softwoods is 13 cords/year, and for hardwoods, 11 cords/year (Table 8).

Table 8. Annual growth rates for softwoods and hardwoods, Fitzgerald woodlot.

Stand unit	Acres (ac)	Hectares (Ha)	LC SWD (m3/ha/ year)	LC HWD (m3/ha/ year)	Total Growth* SWD (m3/year)	Total Growth* HWD (m3/year)	Annual Growth** SWD (m3/year)	Annual Growth** HWD (m3/year)	Portion of stand >30 years old	AAC for merchant-able SWD stands	AAC for merchant-able HWD stands	Total Annual Growth Swd + Hwd (m3/yr)
1	10.16	4.11	4.0	2.0	8.23	8.23	8.23	8.23	0.5	4.11	4.11	8.23
2	21.24	8.60	4.0	2.0	14.89	9.75	14.89	9.75	0.65	9.68	6.34	16.02
3	8.31	3.36	4.0	1.5	9.79	1.21	9.79	1.21	0.8	7.83	0.97	8.80
4	4.59	1.86	4.0	1.5	3.72	2.79	3.72	2.79	0.7	2.60	1.95	4.55
5	6.30	2.55		2.5		6.38		5.10	1	0.00	5.10	5.10
6	6.80	2.75	4.0	2.0	7.87	5.51	7.87	5.51	0.5	3.93	2.75	6.69
7	0.24	0.10		2.0		0.19		0.19	0.5	0.00	0.10	0.10
Totals	57.64	23.34		m3/year =	44.48	34.06	44.48	32.78		28.15	21.33	49.48
				cds/year =		Potential harvest:	20.14	16.54	Actual harvest:	12.75	10.76	23.5

* may incorporate a reduction for natural mortality, cycling, etc.

For several stands, a small reduction in annual harvest levels has been incorporated to allow for the ongoing recruitment of deadwood. Dead and dying wood provide critical habitat for many species. If fallen timber and slightly decayed trees are removed, the whole system is impoverished. In addition, dead organic matter (in the form of trunks, limbs and branches) contains large amounts of nutrients and carbon, which are slowly released during decomposition. In this way, dead wood acts as a fertilizer, and plays an important role in maintaining productivity. For this woodlot, there is an abundance of dead and dying trees, so the usual 30% reduction in harvest levels for the recruitment of deadwood has not been uniformly applied.

Overall, the annual allowable cut for this woodlot is very low. This is due, in large part, to the age of the old field white spruce stands. They are in rapid decline, with many dead and dying trees. Fill planting, patch cutting and crop tree release will encourage a transition from degraded, single-species and single-aged stands to a more diverse, long-lived forest.

Calculated harvest levels serve as a guide for planning and implementation of harvest activities, and as a measure against actual harvest levels to ensure over-cutting does not occur over a specified time frame. Harvest volumes do not have to be cut each and every year as long as an average harvest is maintained over a specified period.

Woodlot recommendations

Priority of stands for treatment

Stands that are high priority for treatment:

- have trees with thinning crowns, lack of vigour, natural stem exclusion, and/or trees that exhibit insect or disease infestations,

- have a high proportion of trees of one species in one age class, that are in rapid decline, resulting in a narrow window of opportunity to fill plant and/or harvest
- have not received treatment activity for some time.

Stands that are moderate priority for treatment:

- trees are growing reasonably well but require treatment to space crowns of *crop trees* to encourage growth in quality and volume (Appendix F describes *crop trees*).

Stands that are low priority for treatment:

- consist of less desirable tree species,
- exhibit poor growth due to low productivity of the site (i.e., a swamp or bog),
- are susceptible to environmental degradation,
- are younger, or need more time,
- are highly degraded,
- best suited for wildlife purposes,
- inaccessible, or
- costs of establishing access or conducting activity are too high to justify the treatment.

Stands 1, 2, 3, 4 and 6 are classed as high priority for treatment (Table 9). Stands 1 and 3 are dominated by white spruce, some of which are still alive. The recommended treatment is to break up the uniformity of the stands with small patch cuts (if needed, however gaps from dying trees already exist), planting gaps with hemlock, white pine, red spruce, sugar maple and yellow birch.

Table 9. Summary of stands of high, moderate, and low priority, Fitzgerald woodlot.

Stand #	Hectares	Level of Priority (ha)		
		High	Moderate	Low
1	4.11	4.11		
2	8.60	8.60		
3	3.36	3.36		
4	1.86	1.86		
5	2.55		2.55	
6	2.75	2.75		
7	0.10			0.10
Total	23.34	20.69	2.55	0.10
% of total:		89%	11%	0%

Stand 2 has also been assessed as high priority. It is a diverse stand with great potential for restoration and enjoyment. It also has many dying/dead white spruce and balsam fir. Basal area is 22 m^2/ha, and will continue to decline as more trees die. To receive category 7 silviculture funding (if this is of interest), basal area must be no less than 16 m^2/ha post-harvest for selection management in softwoods (see Appendix G). If treated in the near future, stand 2 will be eligible for silviculture funding for selection management. This treatment should aim to encourage vigorous, well-formed, long-lived tree species.

Stands 5 has been assessed as moderate priority. It is an uneven-aged, tolerant hardwood stand with long-lived tree species that could be managed for quality hardwoods. However this is not likely in line with the landowner's objectives.

Stand 7, currently low priority, is a young hardwood stand which could be eligible for a crop tree release treatment within the next few years.

Stand intervention recommendations

Table 10 and Figures 2 and 3 summarise silviculture recommendations for the Fitzgerald woodlot, as well as water considerations, in terms of areas/features that require caution and care. As well, if the landowner wishes to obtain silviculture funding to help offset the costs of improvement work, the technical criteria to meet funding requirements are outlined in Appendix G.

Recommendations outlined in Table 10 serve as a guide to help achieve woodlot management goals and objectives. Efforts should be focussed on stands classed as high and moderate priority. Where patch cutting or thinning is recommended, gap size should be small, creating openings no wider than the height of the canopy. Depending on the owner's wishes, trees that are cut can either be left in place as a soil fertilizer, or removed. Removal will require a network of access trails.

Planning of access trails should take into account environmentally sensitive areas, ground conditions, and wildlife usage. Monitoring of possible damage and treatment response are important. Openings may be too small, promoting insufficient or undesired regeneration and poor crop tree release. Such observations and note taking will aid in future management and harvest decisions.

Cutting and fill planting should be completed during the appropriate time of year with low impact equipment. A minimum buffer width of 20 meters on either side of streams greater than 50 cm in channel width is required by the provincial Wildlife Habitat and Watercourses Protection Regulations. A 5 meter machine exclusion zone is required from the edge of the channel. Harvesting is permitted within this buffer zone as long as a minimum basal area of 20 m^2/ha is maintained.

Table 10. Silviculture & access recommendations, water considerations and potential funding, Fitzgerald woodlot.

Stand #	Area (ha)	Recommended activities	Water considerations	Establish / upgrade access	Silviculture funding (as of 2011)
1	4.11	This stand was cleared (likely in the 1800s), used as a field, and when abandoned, grew back in white spruce. The short-lived white spruces are now succumbing to the spruce bark beetle. There are a few remnant sugar maple, yellow birch and hemlock on the sheltered side of the stand, away from the ocean. As well, red maple is scattered throughout the stand. To reduce fire risk, regeneration needs to be encouraged. Consider planting gaps with hemlock, yellow birch, sugar maple, white ash, red spruce, white pine and red oak to encourage restoration and increase species diversity.	This stand is largely surrounded by wet areas - the ocean, a pond, and a marshy area. Nevertheless it is readily accessed on foot, enabling tree planting and clearing of downed trees across the walking trail to the beach. Soils are moderately well-drained.	Can be readily accessed on foot or with small equipment (e.g. ATV) to remove firewood.	Fill planting
2	8.60	This stand had a varied cutting history. Some areas are dominated by dying pasture spruce. Other areas were affected by the spruce budworm epidemic in the early 1980s, which targeted balsam fir. Exposed east facing slopes and ridge tops are dominated by balsam fir, red maple and white birch, while sheltered west facing slopes have some hemlock, yellow birch, white pine, and red spruce. To break balsam fir cycle, need to encourage non-balsam fir regeneration by giving the crowns of preferred crop trees species space to grow. May want to plant gaps in areas with declining fir and white spruce with hemlock, yellow birch, sugar maple, white ash, red spruce, white pine and red oak.	North-south ridges are interspersed with ponds, swampy areas and sinkholes. Slopes are well-drained.	Best access is from the neighbour's driveway to the south. Placement of trails should be along ridges.	Selection management and fill planting
3	3.36	Declining pasture spruce and balsam fir. To restore site, and break balsam fir cycle, need to plant gaps with hemlock, yellow birch, sugar maple, white ash, red spruce, white pine and red oak. May also want to cut patches in dense areas to create gaps and allow light to reach forest floor.	Both parts of stand surrounded by ocean, ponds and swampy areas. Imperfect- to moderately well drained.	Best to enter on foot or with small equipment (e.g ATV).	Selection management and fill planting
4	1.86	Declining pasture spruce, balsam fir and white birch. To restore site and reintroduce long-lived tree species, need to break balsam fir cycle. To do this, consider cutting small patches and planting gaps with hemlock, yellow birch, sugar maple, white ash, red spruce, white pine and red oak.	Imperfect- to moderately well drained.	Readily accessed from paved road.	Fill planting

Refer to Appendix E for definitions of forestry terms, and Appendix G for silviculture standards and funding.

Stand #	Area (ha)	Recommended activities	Water considerations	Establish / upgrade access	Silviculture funding (as of 2010)
5	2.55	Tolerant hardwood forest with some red spruce and hemlock - best vestige of original forest left on property. Sugar and red maple, yellow birch and beech dominate, with a few large hemlock and red spruce. Option 1: leave alone - seed sources of long-lived Acadian forest species already dominate. Option 2: carry out light treemarking, removing about one quarter of the basal area. Select for healthy crop trees, and either remove cut trees for firewood or leave in situ. At a minimum, make a walking trail along the top of the ridge overlooking this beautiful stand.	Well-drained along the slopes. Stream, ponds and sinkholes at base of slope.	Old road off existing paved road provides excellent access to this stand. Needs to be cleared of downed trees.	Selection management
6	2.75	This stand surrounds the house. It has been partly cleared for the house, the driveway and the barn. Previously old field. Consider thinning dense areas of white spruce and fir, and fill planting these and other gaps with hemlock, yellow birch, sugar maple, white ash, red spruce, white pine and red oak to encourage restoration of long-lived Acadian forest species and to increase species diversity.	Moderately well-drained. Small stream along south end of stand, and small wet area near barn.	Readily accessed from driveway.	Fill planting
7	0.10	Small stand close to house lot and stream. Balsam fir died during spruce budworm epidemic in the early 1980s, and area came back in white and yellow birch and red maple. Either leave as is or lightly thin to encourage healthy straight stems.	Poor drained.	Best to access on foot.	

Refer to Appendix E - for definitions of forestry terms

Fill planting recommendations

Every stand was assessed for regeneration. The stands that were once farmed are regenerating primarily in balsam fir, and the density of seedlings ranges from low to moderately high. Fill planting gaps with hemlock, white pine, red spruce, sugar maple, and yellow birch – all of which were found on this property – is highly recommended. White pine and yellow birch regeneration are most successful if the ground is slightly scarified to expose mineral soil. White ash and red oak could also be planted. Acorns are an important food source for many wildlife species. Deer browse preferentially on hemlock seedlings and hardwoods, though they are less likely to traverse areas with many downed trees.

Boundary line recommendations

Boundary lines should be reflagged or better, reblazed. This will ensure lines remain easy to identify and follow, preventing trespass. If blazes are found, be sure to create new blazes above or below existing blazes since original evidence must not be tampered with.

Five year intervention timeline of activities

Table 11 will help guide activities by stand and by order of priority. Plans can be revised as you see fit.

Table 11. Five year timeline of activities, Fitzgerald woodlot.

Year	Stand #	Recommended Activity
2011	1,3,4,6	Fill plant existing gaps. Strip, thin or patch cut in stands 3&4, and plant gaps.
2012	2	Release existing crop trees to encourage growth and regeneration. Fill plant gaps.

Monitoring & record keeping

Monitoring, maintaining and compiling records of activities by operating year is a crucial part of management planning and the overall learning process. These records will help improve future management decisions.

You are also encouraged to record natural history observations, like sightings of particular bird nests, or beaver activity. This will increase your familiarity with your woodlot.

Concluding comments

This management plan will allow you to become more familiar with your woodlot and serves as a guide as to what to do and where to prioritize your activities. It should also provide direction for things to think about and take note of prior to, during and after harvest/silviculture activities that will help you achieve your goals and objectives for the short and long term.

If you have any questions at any time while reviewing this document, when you are considering implementing activities, and/or during implementation stages, please let me know.

Sincerely,

Minga O'Brien, BSc, MSc, For.Tech.

Appendix A. Maps

Appendix B. Cape Breton Hills Ecodistrict

Most elevations in the Cape Breton Hills Ecodistrict fall between 150 - 300 m above sea level. This includes the more recognizable hills of Kelly's Mountain, Cape Mabou, Cregnish Hills, North Mountain, Boisdale Hills, Sporting Mountain, East Bay Hills, Whycocomagh and Lewis Mountain. Also falling into this district are several lower elevation hills, including Mount Young, Washabuck/Cains Mountains, Southwest Mabou Ridge, Beinn Bhreagh and Rear Forks Baddeck. The ecodistrict is influenced by the strong, cold winds of the Gulf of St. Lawrence. Temperatures are slow to warm in the spring resulting in a short growing season. The area receives between 1400 - 1550 mm of precipitation annually. The total area is 2542 km2 or 26% of the Nova Scotia Uplands Ecoregion.

The higher steep-sloped hills are underlain with older resistant rocks and are covered with well drained, moderately coarse textured tills. In general, the lower more gradually sloping hills are underlain by coarse carboniferous sediments. The soils tend to be imperfectly drained, fine textured tills. Seepage sites are common on the slopes providing some of the richer sites for tree and plant growth. Areas of karst topography are found throughout the district at lower elevations, most notably on the Iona peninsula and at Marble Mountain and near Mabou, Port Hood/Judique and Inverness. Freshwater accounts for 0.4% or 1,032 hectares of the ecodistrict.

This ecodistrict is predominately a tolerant hardwood forest with scattered spruce and fir. In coastal areas, white spruce is more frequent. On ravines with well drained, medium textured soils eastern hemlock, white pine and scattered red spruce are found. On top of the larger hill complexes, level to hummocky topography underlain with imperfectly drained soils yield stands of black spruce and balsam fir. Yellow birch , sugar maple and red maple grow on the better drained soils. Much of the early land grants on the upland sites were cleared for farming, but once abandoned in the early to mid 1900s the fields and pastures reverted to pure stands of white spruce.

Appendix C. NS Endangered Species Act: legally listed species as of 2007

The following species at risk are legally protected under the *NS Endangered Species Act*. This is a subset of the full list. Only those species with a remote chance of being found on this woodlot are in this list.

Included for each species is the year it was listed under the Act, the status category, and a brief explanation of why it was listed. Please note that species are assessed each year and therefore the list of species at risk protected under the act is updated annually. Refer to http://www.gov.ns.ca/natr/wildlife/biodiversity/species-list.asp for additional information.

Status Category	Definition
Endangered	a species facing imminent extirpation or extinction
Threatened	a species likely to become endangered if limiting factors are not reversed
Vulnerable	a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
Extirpated	a species that no longer exists in the wild in the Province but exists in the wild outside the Province
Extinct	a species that no longer exists

ENDANGERED

Red Knot (*Calidris canutus rufa subspecies*) - **Endangered** (2007)

This medium sized shorebird subspecies breeds in arctic Canada and migrates thousands of kilometres between the breeding grounds and wintering areas in south America. This subspecies of Red Knot has shown a 70 percent decline in population size over the past 15 years. In Nova Scotia, Red Knot stopover to feed during their migration south in late summer. Counts and surveys in the province also show a decline. The primary cause of the decline is considered to be the depletion of horsed shoe crabs. These crab eggs are a critical food source during the spring migration north.

Chimney Swift (*Chaetura pelagica*) - **Endangered** (2007)

The Canadian population of Chimney swift has declined by almost 30 percent in the past 13 years and geographic area these birds occupy has declined about one third over the same period. In Nova Scotia,the number and the sites where chimney swifts are found has also declined. Many aerial insect eating bird species have declined throughout the Americas in the past 30 years. The cause of the declines is not clear but likely involves changes in insect populations due to habitat changes and pesticide use. A decline in chimneys and large hollow tress that are used for nesting and roosting is also a factor. Large kills resulting from hurricanes crossing migration paths has recently been a serious concern.

Moose (Mainland Population) (*Alces alces americana*) - **Endangered** (2003)

The native population of moose in Nova Scotia is limited to approximately 1000 individuals in isolated sub-populations across the mainland. The population has declined by at least 20% over the past 30 years with much greater reductions in distribution and population size over more than 200 years, despite emxtensive hunting closures since the 1930's. The decline is not well understood but involves a complex of threats including: over harvesting, illegal hunting, climate change, parasitic brainworm, increased road access to moose habitat, spread of white-tailed deer, very high levels of cadmium, deficiencies in cobalt and possibly an unknown viral disease.

Moose on Cape Breton Island are not risk as they are abundant and the result of a re-introduction of moose from Alberta in the 1940's.

Canada Lynx (*Lynx canadensis*) - **Endangered** (2002)

Lynx formally occurred in areas of suitable habitat across mainland Nova Scotia and Cape Breton Island. The current population is very small and restricted to two areas in the highlands of Cape Breton Island. Historic and current threats to Lynx include: harvesting, competition from bobcats and coyotes, habitat loss, disease and climate change.

American Marten (Cape Breton Population) (*Martes americana*) - **Endangered** (2001)

The Cape Breton population of Marten is likely less than 50 animals. At present there is no evidence of breeding and there has been extensive loss and degradation of suitable habitat. Marten were trapped extensively throughout Nova Scotia since the 1700's until the season was closed in the early 1900's due to low numbers. The species was thought to have been extirpated from the mainland and several re-introductions have been attempted. There have been some very recent records of Marten in southwest Nova Scotia. However, the status of the Marten on the mainland is considered "data deficient." More research is required.

Boreal Felt Lichen (Erioderma pedicullatum - Endangered (2003)

This small, inconspicuous lichen has experienced a dramatic decline of over 90% in occurrences and individuals over the last two decades. Boreal Felt Lichen is now known in Nova Scotia from only one site that includes three individuals all within an area of only a few hundred square meters. The primary threats to Boreal Felt Lichen are atmospheric pollutants and acid precipitation which can cause the death of individuals and disrupt reproduction. The lichen can also be threatened by forestry and other land use practices if they disrupt the moist microclimate that is essential for the species.

Harlequin Duck(*Historonicus historonicus*) - **Endangered** (2000)

Less than 250 Harlequin Ducks winter on the coast of Nova Scotia. The eastern sub-species, which occurs here, has declined. Little is known about it other than that it breeds along rivers in Labrador and Newfoundland. This species is at risk because of its small population size and other factors including illegal hunting and oil spills.

THREATENED

Common Nighthawk (*Chordeiles minor)* - **Threatened** (2007)

In Canada, this species has shown both long and short-term declines in population. Over the last nine years, a 49 percent decline was observed in survey. Declines have also been observed in Nova Scotia. Reduction in insect food resources has apparently contributed to the decline of this species as with other aerial insectivore. Reduction in habitat availability caused by fire suppression, intensive agriculture and declines in gravel rooftops in urban areas, may also be factors in some regions.

VULNERABLE

Eastern White Cedar (*Thuja occidentalis*) - **Vulnerable** (2006)

Cedar is an uncommon tree in Nova Scotia and currently only 32 stands in five counties have been identified. The population is fragmented and comprised of mostly small stands that appear genetically separate from each. Most populations are different from populations in NB and PEI. Almost all of the cedar are located on private land and only one stand is formally protected. In the recent past stands have been lost to forest harvesting and highway construction. Ornamental cedars of the same species have been planted around homes and in gardens; these trees are not considered part of the native population and are not covered by the listing under the Act.

Prototype Quillwort(*Isoetes prototypes*) - **Vulnerable** (2006)

A regional endemic with almost all of its global population in Canada . The species is an aquatic perennial with very specific habitat requirements limiting its occurrence in Canada to about 12 small unconnected lakes, 9 of which are in Nova Scotia. The species is found in nutrient-poor, cold, spring-fed lakes. Although several sites have been shown to contain large numbers of plants, one half of the documented sites contain small populations. A wide range of potential limiting factors could impact the species, including changes in water quality, boating and shoreline development.

Wood Turtle (*Clemmys insculpta*) - **Vulnerable** (2000)

There may be 2,500 Wood Turtles widely dispersed across river habitats in Nova Scotia, but information suggests that this species is declining. Like other turtles, this species is of concern because even low mortality rates of adults can have serious population impacts. Threats to wood turtles in Nova Scotia include alteration and destruction of river and stream habitats and translocations of turtles by people. (click image for larger pictures)

Bicknell's Thrush (*Catharus bicknelli*) - **Vulnerable** (2002)

Bicknell's Thrush is of concern because of habitat change, low numbers, patchy distribution, and low reproductive potential. However, little is known about this secretive species. It breeds in Quebec, New Brunswick, Nova Scotia and the northeastern United States. In Nova Scotia, it is currently restricted largely to Cape Breton Island, although historically it was found on a few offshore islands in the southwest part of the province. Habitat has been altered in Nova Scotia over the last century by infestations of spruce budworm and forest management practices.

Appendix D. Tree Species Codes

All Spruce = sP
Balsam Fir = bF
Beech = Be
Black Spruce = bS
Eastern Hemlock = eH
Grey Birch = gB
Largetooth Aspen = ltA
Norway Spruce = nS
Pin Cherry = pC
Poplar = pO
Red Maple = rM
Red Oak = rO
Red Pine = rP
Red Spruce = rS
Sugar Maple = sM
Tamarack Larch = tL
Trembling Aspen = tA
White Ash = wA
White Birch = wB
White Pine = wP
White Spruce = wS
Yellow Birch = yB

Appendix E. Definitions

The following is a list of definitions of forestry terms used in this forest management plan. For assistance with terms not covered in these few pages, see: http://forestry.about.com/library/glossary/blforgla.htm

Commercial thinning

Partial harvest of trees of similar age selected on an individual basis.

Objective = Promote growth and volume yield of high quality trees of similar age.

- Selection of trees to harvest similar to individual tree selection.
- Reduces competition and provides growing space for residual trees.
- Can be done in 1 or more entries.

Crop tree (also see Appendix E)

Any tree forming or selected to form a component of the final crop. Crop trees are selected based on potential for growth and physical characteristics such as quality, straightness, lack of limbs, scars, and species marketability.

Crop tree management

Involves managing for crop trees on an individual basis.

Objective = To ensure growth and quality development of crop trees are not being hindered to obtain high quality / high value product.

Continuous tending of crop trees utilizing individual tree selection, crop tree release and pruning methods.

Crop tree pruning

Involves the pruning of dead and live branches of chosen crop trees.

Objective = Promote growth of clear, white, high quality wood to add value and provide opportunities to fill niche, specialty markets (i.e., furniture making, tone wood, etc).

- Pruned height should be a minimum of 5 meters (16 feet) to produce clear (branchless) butt logs thus possibly veneer products for the future.
- Not recommended until total tree height is at least 8 meters (26 feet)
- Prune cut must be made flush with the branch collar for proper healing. Do not cause ripping or tearing of the bark, prevent cutting the tree bole, and prevent cutting into the branch collar. This will create entry points for fungal spores that cause rot. If the branch collar is damaged the tree will not be able to compartmentalize rot thus permitting the rot to spread through much of the tree severely degrading quality and end value.

Crop tree release

Similar to an individual tree selection, differs in that crop tree release only focuses on harvest of trees interfering with growth of the crop trees' crown.

Objective = Promote crown growth and quality development of chosen crop trees, can be an array of different ages.

- Removal of competing trees on one or more sides of a crop tree to provide additional growing space for the crown (foliage) to expand and increase growth; also referred to as crown thinning.

Not recommended until tree diameter reaches at least 5 inches and for older classes where response may be minimal to none.

Diameter at Breast Height (DBH) - Tree DBH is outside bark diameter at breast height. Breast height is defined as 4.5 feet (1.37m) above the forest floor on the uphill side of the tree. For the purposes of determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Foot Board Measure (FBM) - one square foot of lumber one inch thick.

Forest stand unit- considered a community of trees and other vegetation possessing similarities in species composition, age, arrangement, or condition that is distinguishable from adjacent communities, thus forming a management entity or unit (Natural Resources Canada, 1995).

Forest cover type – the mix of softwood and hardwood species within a particular forest stand or productivity unit within the landscape. To be classed as a mixedwood cover type, composition of both hardwoods and softwoods must exceed 25 % within a particular forest stand. Species composition must contain at least 75 % of softwood or hardwood species to be classed solely as a softwood or a hardwood stand respectively.

Group selection

Periodic partial harvest of groups of trees (patch cuts).

Objective = Promote natural regeneration of desired species to develop or maintain an all aged stand with even-aged patches.

Patch cuts can vary in size and shape. Their locations within a stand depend on specific site (i.e., slope aspect, elevation) and soil conditions (i.e., drainage, soil depth, rockiness) and where they are needed most in order to:

- salvage commercial volume before lost to mortality (i.e., patch of dying Balsam Fir &/or White Spruce),
- encourage tree species to regenerate. The size, shape and location (orientation) of patch cuts varies with the tree species (silvics) being promoted, particularly regarding shade tolerance. Species such as White Pine, White Ash, Yellow Birch and Red Oak have an intermediate tolerance to shade, in other words they need a

fair amount of light to regenerate and establish (as compared to Sugar Maple and Hemlock that are very shade tolerant and need moisture to germinate, however when germinated require partial sunlight / heat to establish).
- release an existing patch of regeneration or intermediate stems that are under canopy.

Living and non-living trees can remain within the patch cut to provide for partial shade conditions, seed source, and / or wildlife habitat purposes. Maintaining some degree of partial shade within patch cuts will limit invasion and competition for growth by pioneer tree (i.e., Aspen, Pin Cherry, Grey Birch) and vegetation species (i.e., Sheep laurel, ericaceous vegetation) to increase success rates of various tree species to germinate and establish.

Individual tree selection

Periodic partial harvest of trees selected on an individual basis.

Objective = Promote crown growth and quality development of chosen crop trees of all ages on a periodic basis of the stand over time.

Selection of trees to harvest must focus on:

- trees that may die or deteriorate considerably before the next harvest
- trees of lesser quality due to damage, structural defects, decay development
- suppressed trees that are likely not to release and improve timber value
- trees that are interfering with crown development of healthy, more desirable,
- better quality trees (referred to as crop trees) that are growing within the upper tree canopy and those growing under canopy.

Plantation establishment

Establishment of artificial regeneration of inadequately stocked harvested areas.

Objective = Ensure full stocking levels of desired regeneration within a recently harvested area.

- Can involve planting an entire site or partial planting (fill planting) to bring up stocking levels to adequate level and / or increase species diversity by planting a mixture of species.
- Some harvested sites may require site preparation for an entire planting job to break up duff layer and scatter brush more uniformly throughout the site to ensure suitable microsites for seedlings are provided.
- Usually followed by a plantation weeding if necessary to control competition and release planted trees.

Pre commercial thinning in natural stands

Spacing of naturally regenerated young trees ranging in height from 2 meters (6 feet) to 7 meters (23 feet) for softwoods and up to 9 meters (30 feet) for hardwoods to create growing space for the vigorous, good quality and form stems (referred to as crop trees).

Objective = Reduce stems per hectare to the 1500 – 3500 range to increase growth, health, and quality development of chosen crop trees.

- Permits stand to become more windfirm and vigorous.
- Usually followed by a commercial thinning treatment at 40 years of age, or crop tree release (crown thinning).

Pre commercial thinning in plantations (plantation weeding)

Weeding undesirable naturals that have filled in amongst planted stock to restore plantation to a free to grow state.

Objective = Release planted trees (or natural trees that consist of better quality) to the 1500 – 3500 range to increase growth, health and quality development of planted trees (crop trees).

- Permits stand to become more windfirm and vigorous.
- At time of weeding, if desire to add diversity to the stand consider leaving some hardwoods that are not or will not interfere with development of crop trees for some time.
- Usually followed by a commercial thinning treatment at 40 years of age, or crop tree release (crown thinning).

Seed tree cut

Harvest of all trees in an area except for a small number of desired seed bearing trees that are left singly or in groups.

Objective= Provide a method to naturally regenerate a forest stand with desired species.

Most common for white pine stands.

Selection harvest – partial harvest by either or in combination methods of individual tree

selection, group selection and crop tree release.

Shelterwood

Harvest of mature trees of similar age in two or more cuts for the purpose of obtaining natural regeneration under the shelter of the residual stand.

Objective = Promote desired natural regeneration, usually the intermediate and shade tolerant species.

Crown closure must be adjusted to satisfy light, moisture, and temperature requirements to ensure establishment and growth of desired regeneration.

Silviculture – the science and art of regenerating and tending forest stand units. The practice of silviculture requires an understanding of tree silvics (what a tree needs to grow, favorable conditions) and ecological processes.

The science is knowledge of growth rates, associated yields and land capabilities to manipulate and increase tree growth, & quality development to obtain desired product size sooner.

The art is knowing when a forest stand is ready for treatment (such as thinning) and utilizing appropriate methods and techniques to obtain desired results. The art of growing trees is measured by the success of the treatment.

Appendix F. Crop trees

What is a crop tree?
Crop trees are the best, most vigorous and high value trees on a site. They are assessed on straightness, vigour, potential for growth, lack of limbs, and lack of scars or other defects. Crop trees are selected for keeping in the stand, as seed producers, and to harvest when they are larger.

How to identify crop trees?
When you are looking for crop trees you want to ensure the trees you choose will in fact increase in size and improve in value. Thus crop trees must be healthy and vigorous. A vigorous tree has no serious infections, diseases or injury; a symmetrical, dense crown, with numerous fine branchlets and twigs; dominant or codominant crown position, with at least half the crown exposed to direct sunlight; responds well to release; and has firm bark with thin furrows.

Crop trees should have 1/3 crown to stem ratio to ensure they will respond well to increased sunlight and quickly increase in diameter growth to strengthen the stem. This ratio refers to the amount of foliage versus total tree height. If a tree has ¼ crown to stem ratio its ability to take advantage of canopy openings becomes questionable.

Bark can be a very helpful indicator of vigour. The more smooth the bark the more vigorous the tree. Low vigour stems may have dark-coloured, deeply-furrowed bark, even when young. Vigorous yellow birch will have shiny gold-coloured bark that peels in thin strips. Also, the bark of vigorous trees is less flaky and loose.

Sometimes a tree may meet most of the above criteria for vigour, but has a large and recent scar at its base from mechanical damage, or has a V-shaped fork at the base of its crown. Thus it is also important to determine current and potential risks when selecting crop trees. Low risk crop trees will have no canker or root infections, borer wounds, crown dieback, severe leaning, forks, sapsucker feeding holes, or crown damage. They will be at low risk of windthrow, splitting, and limb breakage, and are minimally exposed to threats (leaning trees, wind, drought).

Crop trees species that are eligible for funding for quality improvement treatments under the Forest Sustainability Regulations include sugar maple, yellow birch, white ash, red oak, eastern white pine, red pine, white birch, red spruce, red maple and eastern hemlock.

For more information on selecting good crop trees, see chapter 3 in the Ontario Tree Marking Guide:
http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@forests/documents/document/mnr_e000526.pdf

Appendix G. Technical standards, Forest Sustainability Regulations.

Schedule 1 - Technical Standards - Forest Sustainability Regulations
(Website: www.gov.ns.ca/natr/forestry/strategy/sustainabilityregs.htm)

General requirements for all silviculture categories

1 No site where silviculture has been conducted can be submitted under more than one silviculture category in any given year, except for the following silviculture category combinations:

(a) 1 and 3;
(b) 2 and 3;
(c) 6 and 7(b);
(d) 7(a) and (b);
(e) (e) or 7(b) and (c),

which can be submitted for the same year.

2 Only silviculture undertaken subsequent to January 1, 1998, is eligible.

3 No site where silviculture has been conducted and the credit has been claimed can be reclaimed in the same silviculture category during the life of the forest stand on that same site, except for categories 7(a) and (c) where minimum reclaim periods apply.

4 For a silviculture program to be considered as a softwood or hardwood program, the following conditions apply:

Hardwood silviculture program

- sites must contain 25% or greater hardwood commercial species of trees on each site
- limited to Silviculture Categories 1, 5, 6, and 7

Softwood silviculture program

- all softwood silviculture program sites must contain 25% or greater softwood commercial species of trees on each site
- all silviculture categories apply to the softwood silviculture program.

Technical Standard for Completed Silviculture

Silviculture Category 1: Natural Regeneration Establishment

(a) Regeneration and fill plant less than 300/ha

Minimum	Maximum	Limitations
• the site must contain at least 1500 commercial crop trees per hectare • the minimum acceptable stocking level of commercial crop trees on the site is equivalent to 80% at 2.4 x 2.4 m spacing • the height of commercial crop trees must be 10 cm or greater	• the average height of commercial softwood species for the site must be 2 m or less • the average height of commercial hardwood species for the site must be 6 m or less	• commercial crop tree species must be listed by percent for each site • average height in metres of the listed commercial crop tree species must be submitted for each site

(b) Regeneration and fill plant 300/ha or greater

Minimum	Maximum	Limitations
• the site must contain at least 1500 commercial crop trees per hectare • the minimum acceptable stocking level of commercial crop trees on the site is equivalent to 80% at 2.4 x 2.4 m spacing • the height of commercial crop trees must be 10 cm or greater • the site must contain at least 300 living planted trees per ha		• commercial crop tree species must be listed by percent for each site • average height in metres for up to 2 height classes of the listed commercial crop tree species must be submitted for each site

Silviculture Category 2: Plantation

(a) Plantation Establishment

Minimum	Maximum	Limitations
• the site must contain at least 1500 living planted/natural softwood commercial crop trees per hectare • the minimum acceptable stocking level of commercial softwood crop trees on the site is equivalent to 85% at 2.4 x 2.4 m spacing • the site must contain at least 900 living planted trees per hectare	• the maximum acceptable stocking level of naturally regenerated commercial softwood crop trees on the site is equivalent to 50% at 2.4 x 2.4 m spacing	• commercial softwood crop tree species must be listed by percent for each site • a plantation establishment site may be submitted for a silviculture credit in the year in which it was planted • this category can only be claimed for softwood species

(b) Intensive Plantation

Minimum	Maximum	Limitations
• the site must contain at least 2000 living planted/natural softwood commercial crop trees per hectare • the minimum acceptable stocking level of commercial softwood crop trees on the site is equivalent to 90% at 2.1 x 2.1 m spacing • the average height of the softwood crop trees must be at least 1.2 m • the site must contain at least 1500 softwood crop trees per hectare that are released on the site	• the maximum acceptable stocking level of naturally regenerated commercial softwood crop trees on the site is equivalent to 50% at 2.4 x 2.4 m spacing	• commercial softwood crop tree species must be listed by percent for each site • this category can only be claimed for softwood species • successful claim for category 2 or 2(a) required

Silviculture Category 3: Early Competition Control

Minimum	Maximum	Limitations
• the site must contain at least 1500 living planted/natural commercial softwood and/or hardwood crop trees per hectare that are released on the site • the minimum acceptable stocking level of commercial crop trees on the site must be equivalent to 80% for natural stands and 85% for plantations, at 2.4 x 2.4 m spacing • plantation sites must contain a minimum of 900 planted trees per hectare that are released on each site		• commercial softwood and/or hardwood crop tree species must be listed by percent for each site • this category applies to both natural stands and plantations • evidence of manual or chemical treatment is required • average height in metres of the listed commercial crop tree species must be submitted for each site

Silviculture Category 4: Density Control and Release in Plantations

Minimum	Maximum	Limitations
• the average height of softwood crop trees on the site must be at least 2 m • the number of commercial softwood crop trees on the site must be at least 1500/ha • the minimum acceptable stocking level for commercial softwood crop trees is equivalent to 85% at 2.4 x 2.4 m spacing	• the average height of trees on the site must not be greater than 6 m • the number of commercial softwood crop trees on the site must not be more than 3500/ha	• commercial softwood crop tree species must be listed by percent for each site • this category can be claimed for a silviculture credit for softwood plantations only • average height in metres of the listed commercial crop tree species must be submitted for each site

Silviculture Category 5: Density Control and Release in Natural Stands

Minimum	Maximum	Limitations
• the average height of commercial softwood crop trees on the site must be at least 2 m • the average height of commercial hardwood crop trees on the site must be at least 6 m • the number of commercial crop trees on the site must be at least 1500/ha • the acceptable minimum level of stocking of commercial crop trees on the site must be equivalent to 80% at 2.4 x 2.4 m spacing	• the average height of commercial softwood crop trees on the site must be no greater than 7 m • the average height of commercial hardwood crop trees on the site must be no greater than 9 m • the number of commercial crop trees on the site must not be more than 3500/ha	• commercial crop tree species must be listed by percent for each site • this category can be claimed for a silviculture credit for naturally established stands only, not previously claimed plantation sites • average height in metres of the listed commercial crop tree species must be submitted for each site

Silviculture Category 6: Commercial Thinning

Minimum	Maximum	Limitations
• the post-treatment residual basal area must be at least 16 m^2/ha	• the post-treatment residual basal area for softwood silviculture sites must not be larger than 30 m^2/ha • the post-treatment residual basal area for hardwood silviculture sites must not be larger than 24 m^2/ha	• commercial crop tree species must be listed by percent for each site • the basal area of remaining commercial crop trees must be made up of no more than 50% of balsam fir, and no more than 25% of poplar and red maple combined • average height in metres of the listed commercial crop tree species must be submitted for each site

Silviculture Category 7: Forest Quality Improvement

(a) Crop tree release

Minimum	Maximum	Limitations
• the number of commercial crop trees released must be at least 100 • the average diameter measured at 1.3 m from ground of released commercial crop trees must be at least 15 cm with no crop tree smaller than 10 cm in diameter • the total post-treatment residual basal area must be at least 15 m^2/ha	• the number of commercial crop trees released must not be more than 125/ha	• commercial crop tree species must be listed by percent for each site • acceptable commercial crop tree species include sugar maple, yellow birch, white ash, red oak, eastern white pine, red pine, white birch, red spruce, red maple and eastern hemlock • crop tree crowns must be released on at least 3 sides • a silviculture credit cannot be claimed for the same site more than once in a 10-year period • released crop trees must be marked for identification on each site • average height in metres of the listed commercial crop tree species must be submitted for each site

(b) Crop tree pruning

Minimum	Maximum	Limitations
• the number of commercial crop trees pruned must be at least		• commercial crop tree species must be listed by percent for

125/ha • the pruned height of a crop tree must be at least 5 m • the average height of commercial crop trees must be at least 8 m		each site • acceptable commercial crop tree species include sugar maple, yellow birch, white ash, red oak, eastern white pine, red pine, white birch and red maple • average height in metres of the listed commercial crop tree species must be submitted for each site

(c) Selection management for tolerant softwood, mixed wood or hardwood stands

Minimum	Maximum	Limitations
Total post-treatment basal area: • must be at least 16 m^2/ha • must contain at least 5 m^2/ha basal area of the following tolerant species: red spruce, white pine, eastern hemlock, eastern cedar, balsam fir, sugar maple, yellow birch, beech, red oak, white ash **Number of height classes post-treatment:** • there must be 3 height classes or more on the site with a minimum difference of 3 m in average height between height classes, and one height class must have an average height of greater than 10 m **Stocking of crop trees:**	**Total post-treatment basal area**: • must be smaller than 30 m^2 /ha	• commercial crop tree species must be listed by percent for each site • a silviculture credit cannot be claimed on the same site more than once in a 10-year period • average height in metres of the listed commercial crop tree species in the upper canopy must be submitted for each site

- the minimum acceptable stocking level for commercial crop trees is 80% at 2.4 x 2.4 m or equivalent spacing for each site

---

Spacing of crop trees:

- the minimum acceptable spacing for softwood species with a height of 3 m to 7 m is 1.5 m
- the minimum acceptable spacing for hardwood species with a height of 6 m to 9 m is 1.5 m

Schedule 1 replaced: O.I.C. 2007-299, N.S. Reg. 284/2007.