Ontario

Forest Management Guide for Natural Disturbance Pattern Emulation

TECHNICAL SERIES

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SUMMARY

Forest Management Guide for Natural Disturbance Pattern Emulation

The following summary is provided for convenience only. Please refer to the full text of this document for details and explanation of the guide's standards and guidelines.

Landscape Harvest Patterns

- create a more natural landscape pattern (**standard**)

Percent of planned clearcuts that must be less than 260 ha

- 80% (Boreal) or 90% Great Lakes-St. Lawrence (GLSL) by frequency i.e. number of clearcuts (**standard**)
- conditions where the creation of clearcuts > 260 ha can occur (**guideline**)
- rationale for all clearcuts > 260 ha documented in FMP (**standard**)

Separation for planned clearcuts

Temporal – 3 metre Free to Grow green-up or 20 years, whichever occurs first (**standard**)

Spatial – 200 metres for clearcuts up to 260 ha; an additional 50 m for every 100 ha increase in clearcut size if temporal separation not achieved (**guideline**)

Natural forest disturbance template and forest composition and age class structure (mix of standards and guidelines)

- apply ecoregional based direction when available
- interim direction – develop locally (planning team, LCC, public) in consultation with Region

Structural Legacy: Residual Stand Structure

Insular residual patch retention

- range of 2 to 8% of planned disturbance area based on forest cover type (**guideline**)
- minimum patch size – .25 hectare
- well distributed within cutover subject to how fire would naturally distribute (**standard**)
- not available for subsequent harvest (**standard**)

Peninsular residual patch retention

- range of 8 to 28% of planned disturbance area based on forest cover type (**guideline**)
- well distributed around edge of cutover subject to how fire would naturally distribute (**standard**)
- 50% of peninsular residual patch area is available for subsequent harvest after 3 metre Free to Grow green-up (**standard**)
- alternatively, a one pass harvest may include the removal of 50% of the volume in 50% of the exterior edge of the peninsular area leaving the core area unharvested (**standard**)

Individual residual live trees and snags

- retain species based on fire tolerance, silvicultural requirements and wildlife habitat value (**guideline**)
- retain 25 well spaced trees/ha (minimum average) at least 6 large diameter, live, existing (or potential) high quality cavity trees (**standard**)
- range of tree species, diameters and condition (snags to healthy trees) to be left based on species (**guideline**)
- create snags during mechanical harvesting (**guideline**)

Downed Woody Debris

- provide coarse downed woody debris through: using cut to length or tree length harvest systems; individual tree and snag retention; leaving unmerchantable logs on site; redistribution of roadside slash/chipping waste and avoid windrowing of coarse wood debris during mechanical site preparation (**guideline**)
- provide fine woody debris on shallow or very shallow or very coarse textured soils through: avoiding full-tree harvesting on these sites and redistribution of logging slash after roadside delimbing or chipping (**guideline**)
- burn roadside slash where it cannot be redistributed (**guideline**)

Silvicultural Considerations

- use prescribed burning as frequently as possible as a silvicultural treatment (**guideline**)
- maintain a natural proportion of uneven-aged forest within the bounds of natural variation (**guideline**)

- retain old growth and natural age class structures (**guideline**)
- use partial harvest methods (e.g. harvest with understory protection) (**guideline**)
- use natural/assisted natural regeneration as the preferred method of regeneration

Disturbances in Areas of Concern

- apply species specific guidelines to protect values

Fire Salvage

- avoid salvage harvest in some areas (**guideline**)
- where fire salvage harvest operations are considered, the minimum residual standards (internal/peninsular areas and individual trees) in this guideline will apply (**standard**)
- minimize unburned area included in a salvage proposal (**guideline**)

Application of This Guide

This guide is applicable to all areas managed under the clearcut silvicultural system within the Boreal Forest (Hill's Site Regions 3S, 4S, 3W, 3E and portions of 4E) and the Great Lakes-St. Lawrence Forest (Hill's Site Regions 5S, 5E, 4W and portions of 4E) as defined by Rowe (1972). This guide, or portions of it, is also applicable to areas managed under the shelterwood silvicultural system.

The guide is not intended to be used as a mandatory requirement for private lands or for Crown lands which are not part of the landbase available for forest management (e.g. parks).

Stand level standards and guidelines will begin to be applied with forest management plans scheduled for approval in 2003 with full application of the guide beginning with plans scheduled for approval in 2004.

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ACKNOWLEDGEMENTS

The Forest Management Branch of the Ministry of Natural Resources (MNR) would like to thank the individuals who made up the writing team for this guide. These individuals gave of their personal time and took time away from their primary duties to provide MNR with their professional advice on the best balance for the ecological, social and economic values and issues discussed in the *Forest Management Guide for Natural Disturbance Pattern Emulation*. Much advice, often conflicting, was given and discussed at workshops and writing team meetings. The Ministry believes the guidance in this document reflects a responsible balance amongst these conflicting views.

The Ministry gratefully acknowledges the contributions of the writing team: Joe Churcher (Forest Policy Section, MNR), John McNicol (Forest Policy Section, MNR), Brian Nicks (Manager of Science & Technology – Ontario, Domtar Inc.), Richard Raper (Forest Management Planning Section, MNR), Neil Stocker (Forest Health and Silviculture Section, MNR) and Dr. Kandyd Szuba (Adjunct Professor of Biology & Environmental Science, Nipissing University). Jim Baker (Applied Research and Development Section, MNR) provided written material for the sections on fire dynamics. Linda Forsyth did the original analysis, compilation and report summarizing Ontario's 1920-50 fire history. Karen Laws (Land Use Coordination Section, MNR) developed the glossary. Joseph D'Agostino of Visto Art and Design provided graphic illustrations. Fran Paterson and Cathy Hamor (Forest Policy Section, MNR) produced drafts and the final document with good humor despite unreasonable deadlines.

The writing team expresses sincere appreciation to the public and to the staff of MNR for the comments that were submitted as a result of two workshops, meetings with the writing team, informal communications and the Environmental Bill of Rights (EBR) registry postings. Special thanks are extended to the staff of Domtar, the Forest Landscape Ecology Program (OFRI), MNR Science & Technology and the Provincial Forest Technical Committee.

PREFACE

As a result of the *Class Environmental Assessment by the Ministry of Natural Resources for Timber Management on Crown Lands in Ontario* (1994), one of the Environmental Assessment (EA) Board's terms and conditions (T&C) of approval mandated the creation of a guideline which, in part, is "*to provide direction in relation to harvest layout, configuration and clearcut sizes [T&C No. 94 (b)].*"

The Board also stated in their rationale for Decision:

> *"We conclude that clearcuts should be made in a range of sizes to emulate natural disturbances, and that - although extremely large clearcuts would likely be rare for practical reasons - limiting clearcuts strictly to small sizes would make it impossible to regenerate the boreal forest to its natural pattern of large even-age stands.*
>
> *We accept that some large clearcuts are required and we rely on the judgement of foresters to make exceptions above the 260-hectare limit for biological and silvicultural reasons such as salvage operations, overmature stands and wildlife habitat requirements. The rationale for exceeding 260 hectares must be reported in the Plan. It is also important that 260 hectares not become the standard size clearcut, resulting in only a few clearcuts being larger or smaller. The evidence is clear to us in supporting a range of various sizes."*

T & C No. 27 was imposed by the EA Board which states, in part, that,

> *"MNR shall implement a restriction on clearcut harvesting requiring a range of sizes of clearcuts not to exceed 260 ha."* However, the Board goes on to say in T & C No. 27 (b) that *"Where for sound biological or silvicultural reasons individual or contiguous clearcuts exceed 260 hectares, they shall be recorded in the Plan as an exception to this condition, with reasons provided"*.

The Board also states:

> *"MNR shall also develop standards for configuration and contiguity of clearcuts which will ensure that the purpose of this restriction is not frustrated..."*

The *Forest Management Guide for Natural Disturbance Pattern Emulation* is developed to address those requirements of T&C No. 94b with respect to providing direction in relation to harvest layout, configuration and clearcut sizes and T&C No. 27 of the Environmental Assessment Board's approval of the *Class Environmental Assessment by the Ministry of Natural Resources for Timber Management on Crown Lands in Ontario*.

Concurrent with the release of the *Environmental Assessment Board's Decision on the Class Environmental Assessment by the MNR for Timber Management on Crown Lands in Ontario* was the release of MNR's Policy Framework for Sustainable Forests. One of its Principles for Sustaining Forests states that "*Forest practices including all methods of harvesting must emulate, within the bounds of silvicultural requirements, natural disturbances and landscape patterns*."

The Crown Timber Act, which had been governing timber management since 1952 was replaced with the Crown Forest Sustainability Act (CFSA) in 1995. One of the guiding principles of the new Act is Section 1(3) 2 which states,

> *"The long term health and vigour of Crown forest should be provided for by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns while minimizing adverse effects on plant life, animal life, water, soil, air and social and economic values, including recreational values and heritage values."*

The *Forest Management Guide for Natural Disturbance Pattern Emulation* (hereafter the *Natural Disturbance Pattern Guide)* provides guidance on clearcut size and how cuts should be distributed to assist forest managers in simulating more natural disturbance patterns at the landscape level. This guide also addresses how managers can better simulate aspects of wildfire results and structural attributes during forest management activities at the forest stand level.

This version of the guide deals solely with simulating the pattern of fire disturbances, within societal, silvicultural and economic limitations, both at the landscape and the stand levels. Future versions of this guide may deal with other forms of natural disturbance as data availability and evolving science may allow.

The Purpose, Objective and Limitations of this Guide

The purpose of this guide is to provide direction for forest management practitioners in the development and implementation of forest management plans such that managed forest landscapes will resemble more closely the landscapes recently created naturally by fire (0 – 20 years old) with respect to the location and size of disturbances, residual stand structure, species composition of the forest and its age class distribution. The objective of this direction is to provide a coarse ecological filter (see following discussions) that will help to conserve biological diversity. Application of this guide over time will create a landscape that appears more natural than the one that has developed with the application of many of the species-specific wildlife habitat guidelines.

Application of the guide however will not mimic the results produced by fire. This is because harvesting is a mechanical process while fire is a chemical one. Further, harvesting patterns are subject to societal, silvicultural and economic limitations, unlike those created by fire.

In the sections titled "Landscape Harvest Patterns" and "Structural Legacy: Residual Stand Structure", direction is provided on how planning teams can meet the intended purpose of this guide. Following each piece of direction, the words "standard" or "guideline" appear in brackets. A "standard" indicates that the direction is a mandatory requirement that must be met and there is little room for interpretation. The term "guideline" is used to indicate that the forest manager must consider the requirement but has flexibility to interpret and adapt the requirement to meet the specific needs of the local management unit.

Table 1: Differences and similarities between wildfire and forest harvesting

Disturbance Feature	Fire	Forest Harvesting
Process	Chemical	Mechanical
Rapid Nutrient Recycling	Yes	No (except for prescribed burns)
Pathogen Control	Yes	Limited
Size Control	No	Yes
Favours Fire Dependant Species	Yes	No
Produces Islands and Peninsulas of Residual	Yes	Yes (under this guide)
Facilitates Forest Renewal	Yes	Yes
Protects Areas of Wildlife Habitat	No	Yes
Soil Compaction	No	Yes
Fine Organic Material in Soil	Reduces	Increases

MNR'S STRATEGIC DIRECTIONS AND STATEMENT OF ENVIRONMENTAL VALUES

The Ministry of Natural Resources (MNR) is responsible for managing Ontario's natural resources in accordance with the statues it administers. As the province's lead conservation agency, MNR is the steward of provincial parks, natural heritage areas, forests, fisheries, wildlife, mineral aggregates, fuel minerals and Crown lands and waters that make up 87 per cent of Ontario.

In 1991, the Ministry of Natural Resources released a document entitled *MNR: Direction '90s* which outlined the Ministry's goal and objectives. They are based on the concept of sustainable development, as expressed by the World Commission on Environment and Development. This document was updated in 1994 with a new publication, *Direction '90s … Moving Ahead 1995*, and again in 2000 with *Beyond 2000.* Within MNR, policy and program development take their lead from *Direction '90s*, *Direction '90s … Moving Ahead 1995* and *Beyond 2000.* Those strategic directions are also considered in Ministry land use and resource management planning.

In 1994, the MNR finalized its Statement of Environmental Values (SEV) under the Environmental Bill of Rights (EBR). The Ministry's SEV describes how the purposes of the EBR are to be considered whenever decisions that might significantly affect the environment are made in the Ministry. The SEV is based on the goals and objectives of the MNR as described in *Direction '90s* and *Direction '90s … Moving Ahead 1995*, since the strategic direction provided in these documents reflects the purpose of the EBR.

During the development of the *Forest Management Guide for Natural Disturbance Pattern Emulation*, the Ministry has considered *Direction '90s*, *Direction '90s … Moving Ahead 1995*, *Beyond 2000* and its Statement of Environmental Values. This guide is intended to reflect the directions set out in those documents and to further the objectives of managing our resources on a sustainable basis.

INTRODUCTION TO THIS GUIDE'S APPROACH

The purpose of wildlife habitat management guidelines has been to influence forest management activities in a way that creates forest conditions favorable to particular species. During the 1980's, this concern was primarily directed at featured species that included species listed by the OMNR as endangered, threatened, or vulnerable, as well as other species that were highly valued such as moose and white-tailed deer. This list of featured species was expanded to include American marten and pileated woodpeckers in 1996 as a result of the Timber Class EA decision.

Over this 20-year period, there has been an evolving approach to habitat management based on lessons learned in Ontario and elsewhere in North America. One of the primary lessons is that a broader, less species-specific approach to managing forest habitats is necessary. Imposing habitat management guidelines only in cases where there is concern for a particular species can amount to too little, too late as is evidenced by the lists of endangered species in many jurisdictions across North America. This evolving approach involves the use of coarse and fine filters.

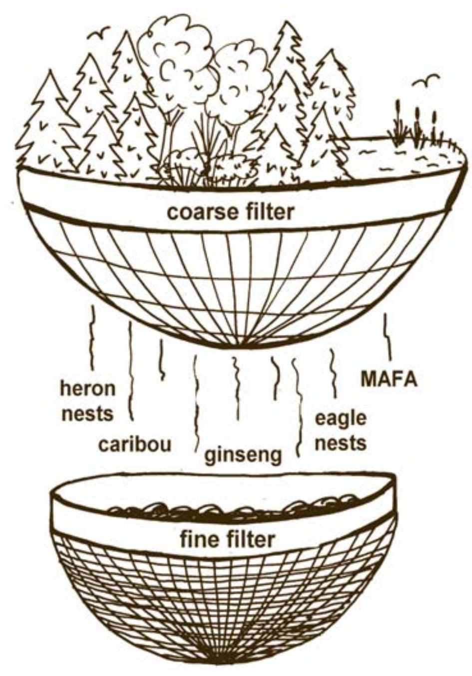
The Coarse and Fine Filter Approach to Biodiversity Conservation

There are hundreds of species of vertebrates in the boreal and Great-Lakes St. Lawrence (GLSL) forest regions of Ontario (see D'Eon and Watt 1994, Bellhouse and Naylor 1997) and invertebrate species are likely to number in the tens of thousands. Thus, a species-by-species approach to the provision of wildlife habitat and the conservation of biodiversity is impossible in the context of forest management. However, this might be achieved through the hierarchical application of guidelines that are judiciously selected to act as coarse and fine filters.

The concept of coarse and fine filters was popularized by Hunter (1990) and is illustrated in Figure 1. In essence, the coarse filter captures the requirements of a broad array of species by maintaining a broad array of forest conditions. The fine filter (or a series of fine filters) ensures that no species falls through the cracks because of particular, specialized requirements. For example, although sufficient foraging habitat might be provided for moose across the landscape, specific moose aquatic feeding areas (MAFA's) could require the application of fine filter guidelines that specify how they should be protected.

The biodiversity guidelines for the Fundy Model Forest (Woodley and Forbes 1997) interpret the coarse filter to apply only at the landscape scale. However, as noted in the silviculture guides for the GLSL forest region, an efficient coarse filter can operate at a variety of spatial scales, ranging from logs to landscapes (i.e., Naylor 1998a, b). For example, a coarse filter could provide for all the requirements of terrestrial salamanders by ensuring that coarse woody debris is present in regenerating cutovers, and residual trees are retained to supply coarse woody debris over a longer term.

Figure 1: Conceptual model of the relationship between coarse and fine filters in habitat management. A coarse filter operates at a variety of spatial scales to: provide habitat for a very broad range of wildlife, to support interactions among species, and to facilitate ecosystem processes. A fine filter may be required for species whose needs are not captured by the coarse filter. Biodiversity is most likely to be conserved by hierarchical application of both filters on the landscape.



The *Natural Disturbance Pattern Guide* will act as a coarse filter by striving to produce, as closely as possible, the habitat conditions at the stand and landscape levels that are required by wildlife species using all successional stages of the forest. The assumption underpinning this approach is that wildlife have adapted over the millennia to forest conditions (i.e. forest type, age, amount and distribution) resulting from unsuppressed wildfire and if management actions result in similar forest conditions it is more likely that biodiversity will be maintained. The main parameters of the coarse filter are illustrated in Figure 2.

An effective coarse filter may reduce the array of fine filter guidelines that are required to achieve specific objectives during forest management, such as the conservation of biodiversity. However, the effectiveness of the *Natural Disturbance Pattern Guide* as a coarse filter has not been tested. Formal, rigorous monitoring of this guide through an adaptive management process (see Baker 2000) to assess its effects on habitat for featured species is required before the established fine filter guidelines outlined in the Forest Operations and Silviculture Manual are relaxed. (see the section **Monitoring for the Natural Disturbance Pattern Guide**)

Established fine filter guidelines or models can be used to fine-tune certain aspects of the coarse filter. For example, the spatial habitat supply analysis tools in the moose module of OWHAM (Ontario Wildlife Habitat Analysis Models) could assist in determining the optimal placement of residual patches within a larger disturbance.

Figure 2: Examples of considerations for applying the Natural Disturbance Pattern Guide as a coarse filter in forest management. Attributes of the fine filter are shown to complete the description of the coarse/fine filter approach.

The Coarse Filter

Forest composition

- maintenance of habitat

Age Class Structure

- movement toward natural
- maintenance of older ages

Forest Patches

- shape
- range of sizes
- amount and size of mature habitat patches
- placement (natural landscape texture)
- fire salvage
- prescribed burns

Residual patches

- peninsular
- insular
- riparian buffers

Residual trees

- live cavity trees
- snags
- downed coarse and fine woody debris

The Fine Filter

Vulnerable, Threatened & Endangered species

- patch size for caribou
- site-specific habitat protection (e.g.. bald eagle, red-shouldered hawk, ginseng and other plants)
- peregrine falcon nest site management plan
- landscape-level habitat supply (e.g., red-shouldered hawk)

Featured Species

- landscape-level habitat supply (e.g., marten, moose, pileated woodpecker)
- deer yard management plans
- site-specific habitat protection (e.g., moose aquatic feeding areas, mineral licks, osprey nests, heronries, goshawk nests, fish spawning areas)

LANDSCAPE HARVEST PATTERNS

Patch Distribution – Clearcuts and Shelterwoods

The direction in the *Natural Disturbance Pattern Guide* at the landscape scale is to move towards a more natural landscape pattern (**standard**). Landscape pattern is a function of the distribution and size of forest stands or groups of stands (i.e. "patches"), their composition and age. Where only natural disturbance events such as fire are at work, there tends to be a wide range of forest patch sizes. Managed landscapes tend to have a much narrower range of patch sizes. Showing movement towards a more natural frequency distribution of disturbance sizes (i.e. clearcut and fire "patches" combined) is a requirement in forest management planning (see Page A-63, Forest Management Planning Manual FMPM). It is important to understand that in meeting this requirement, planning teams will allocate the harvest in such a way as to complement, not supplant, the historical natural fire size frequency distribution. For example, if a particular region has had a number of recent large fires, large clearcuts normally would not be planned.

Clearcuts

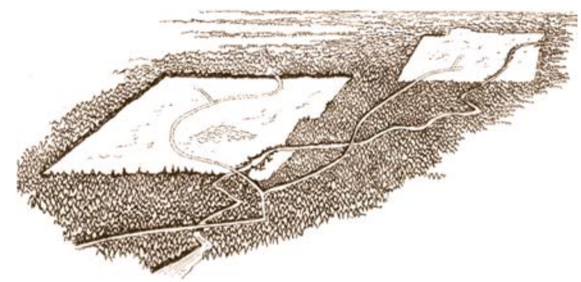
A "clearcut" is often envisaged by the public as unnaturally shaped square or rectangular areas where all trees have been removed. The approach to clearcutting has been changing (see Figure 3). This guide promotes a more environmentally friendly approach requiring that a "clearcut" follows natural landscape contours and forest stand boundaries as well as retains individual trees and patches of trees throughout the cut area and along the periphery. When viewed from an aircraft or on the ground, these changes will result in much more natural looking and visually pleasing forest landscapes where "clearcutting" has been practised. Accordingly, for the purposes of this guide, a "clearcut" is the harvesting of most of a forest stand or group of stands while retaining 10% - 36% of the original stand or stands in residual patches and an additional minimum average of 25 individual trees or snags per hectare (ha).

Clearcuts are normally completed within a year. The five year operational area is an aggegration of all of the harvested areas, regardless of the silvicultural system used, that are proposed for harvesting over a five year operating plan. A range of clearcut sizes (many small, some medium sized, a few large) should be created to ensure the size class distribution of clearcuts follows the same tendencies as fire disturbance size frequencies.

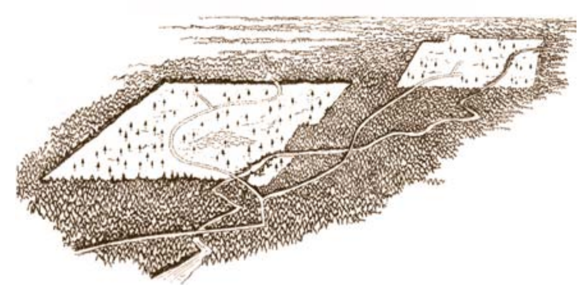
Accordingly, eighty percent (80% - Boreal forest) or ninety percent (90% - Great Lakes-St. Lawrence) of planned new clearcuts determined by frequency, beginning with plans to be approved in 2004, should be less than 260 ha in size (**standard**). MNR believes this is consistent with the EA Board's direction that clearcuts should not routinely exceed 260 ha.

Figure 3: Evolving approach to clearcuts under the guide

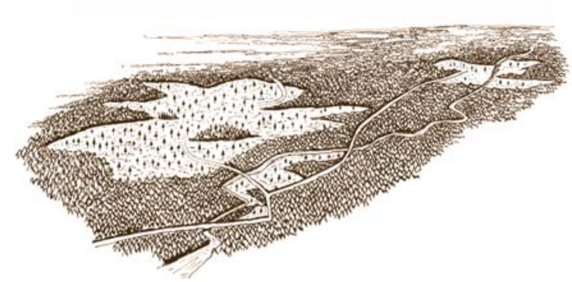
"Cut clear" Clearcut



Clearcut with Residuals



Clearcut Emulating Natural Disturbance Pattern



The creation of clearcuts greater than 260 ha in size can occur where it is consistent with the Forest Management Planning Manual requirement for moving towards a more natural frequency/disturbance size class and where one or more of the following conditions are encountered (**guideline**):

- the clearcut(s) is an attempt to "defragment" a previous group of smaller cuts;
- the clearcut(s) is integrated as part of an overall strategy to provide wildlife habitat; and
- public concerns and concerns regarding impacts to other forest users have been addressed to the best of the planning team's ability.

Although less than 80% - 90% of fires are smaller than 260 ha (and therefore more than 10% - 20% are larger than 260 ha), this direction recognizes the public sensitivity concerning large clearcuts.

In accordance with the Forest Management Planning Manual, a local citizen's committee, composed of representatives of stakeholder groups and other organizations, must be established to provide advice and input during the development of a forest management plan. The planning process also provides considerable opportunity for the public to provide input as options are developed and decisions are made.

"Block" clearcut

The advice and recommendations of the local citizens committee to the planning team and input through the public consultation process on any proposed large clearcuts will also ensure public sentiments on this issue are heard. The planning team is required to consider this input when deciding the range of clearcut sizes to be included in the forest management plan.

Clearcuts with more natural edges

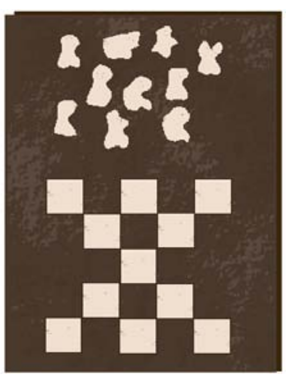
Constraints on clearcuts:

- For all clearcuts greater than 260 ha, the rationale must be documented in the forest management plan in accordance with the requirements of the Forest Management Planning Manual **(standard)**.
- New clearcuts must be separated in time from older clearcuts either long enough to allow vegetation in the old clearcut to reach 3 m in height or 20 years, whichever occurs first (**standard**).
- If the temporal separation cannot be met, spatial separation of the clearcuts on a sliding scale dependant on size of the clearcut is required (**guideline**) (see Table 2).

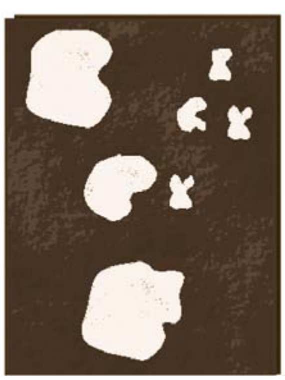
The 3 m height restriction between cuts defines the break between the presapling and sapling development stages used in the new wildlife habitat suitability models. Imbeau et al. (1999) found that forest bird assemblages were re-established on cuts in Quebec once the cuts reached the sapling stage.

The threshold of 3 m separates significantly different wildlife communities which use these different development stages (unpublished data, Brian Naylor, OMNR, Southcentral Science and Technology, North Bay).

Old style cuts evenly distributed



Variable sizes with variable spacing



Shelterwood

The application of the shelterwood silvicultural system results in the harvest of most mature trees in a series of 2 to 4 harvest cuts. For the most part, the results of these partial harvests is the retention of significant forest cover or, immediately after the final harvest, a well established young forest. For this reason, harvesting conducted under the shelterwood silvicultural system is not normally subject to the full requirements of this guide.

There are, however, some aspects of this guide that must be applied in the context of the application of the shelterwood silvicultural system and even some circumstances where shelterwood harvests should be considered in the context of the full requirements of the guide. These requirements are outlined in the following paragraphs.

At the time of the final harvest of the shelterwood silvicultural system, stand level residual requirements of this guide apply. This includes the retention of internal and peninsular patches, individual living trees, snags and downed woody debris. This will ensure the retention of a structural/biological legacy similar to that provided after the application of the clearcut silvicultural system.

In addition, where the final harvest cut will result in a young forest that is less than the required height for an Acceptable Break (see Table 2), the landscape level requirements of this guide will apply. This includes the application of spacing rules as if these harvests were conducted under the clearcut silvicultural system. In essence, the full requirements of this guide will apply where the application of the shelterwood silvicultural system has a result which closely resembles the application of the clearcut silvicultural system.

Table 2: Planned clearcuts in Ontario: their size frequency, temporal and spatial separation requirements (see Appendix 1)

Clearcut Parameter[1]	Parameter Requirement/Description[1]
Size Frequency	80% < 260 ha (Boreal Forest) 90% < 260 ha (Great Lakes-St. Lawrence Forest)
Timeframe for Creation	≤ 5 years (i.e. detailed planning term; does not apply to shelterwood)
Separation Distances (edge to edge) Between and Amongst Different Sized Clearcuts *NB. Separation distances are averages amongst similar sized clearcuts. Spacing of proposed cuts will be considered and assessed during the spatial allocation of the allowable harvest area during planning.*	If 3 m* regeneration in adjacent clearcut is not reached and the clearcut is less than 20 years old, 10 - 260 ha clearcuts should be separated an average 200 m (minimum 100 m); for every 100 ha increase in the size of clearcuts separate by an additional 50 m from clearcuts of similar size. Separate dissimilar sized clearcuts by the distance indicated by the smaller clearcut.
Time Before Harvest of Adjacent Areas Can Occur	20 years or 3 m* regeneration in earlier cut, whichever occurs first
Characteristics of Forest Separating Two Clearcuts or Shelterwood cuts	Within the separation break, at least 200 m will include forest ≥ 3 m* in height and .3 stocking. For larger separation distances between clearcuts (i.e. 600 m or more) at least 70% of the intervening terrestrial landbase is required to be in forest ≥ 6 m* in height and .3 stocking.

* Assumes regeneration standard is met and free to grow

[1] These parameters and requirements apply equally to two clearcuts as well as a clearcut and a natural disturbance.

Landscape Level Direction

Forest managers require an estimate of what a natural disturbance frequency by size class might have been for their forest to meet a planning requirement for the assessment of sustainability (Figure A-2, page A-63; FMPM).

The period 1921 to 1950 provides the best available data to represent the "natural" disturbance regime in Ontario. It is important to find the earliest and longest time period that can portray a more natural disturbance regime and for which data is available. The *Donnelly and Harrington Fire History Maps of Ontario* (1978) provide the earliest available fire data for the province of Ontario. Although coordinated fire suppression activities began in Ontario sometime in the late 1910s (personal communication, Paul Ward, Aviation and Forest Fire Management, MNR) these suppression activities were relatively ineffectual compared to post-1950 when technological advances after World War II made fire suppression much more effective. Data for size classes less than 200 ha, not compiled in the 1920-50 Donnelly and Harrington data base, are available from the Provincial fire data base for the period 1976-1995.

A good source for information on spatial wildfire history at the scale of the site region or forest management unit is the CD-ROM disc *Ontario's Forest Fire History: An Interactive Digital Atlas* compiled by the Forest Landscape Ecology Program, Ontario Forest Research Institute, Ministry of Natural Resources, Sault Ste Marie, Ontario. Copies of the CD can be ordered by contacting the Ministry of Natural Resources, Natural Resources Information Centre at (phone) 1-800-667-1940 or (fax) 705-755-1677.

It is recognized that although the Donnelly and Harrington data are the earliest provincial data available, data for an earlier time period, if available, could show different fire frequencies and extent. If planning teams have access to such data, at an ecologically relevant scale which includes the forest management unit, they are encouraged to seek Regional endorsement for its use in establishing a possible natural disturbance frequency by size class for planning purposes which will address ecological, social and economic values.

Implementation Direction

- Re-examine the natural forest disturbance template, used in the previous forest management plan (FMP), to determine if the proposed harvest allocation is moving towards the emulation of a natural disturbance pattern ("Frequency distribution of clearcut and wildfire sizes" Figure A-2, page A-63 FMPM).

The planning team may use or modify the local natural disturbance template used in the previous plan subject to endorsement by the MNR Regional Director. Discussions with Regional planning staff should occur early in the FMP development process. Regional staff must be satisfied that the template proposed is based on a "natural" disturbance database i.e. before effective fire suppression.

Implementation through the Forest Management Plan

How Do Other Guidelines "Fit" with the Natural Disturbance Pattern Guide?

- The planning team will first try to move toward a more natural disturbance pattern in the allocation of the available harvest area (AHA). This will represent partial application of the coarse ecological filter.
- Having achieved this to the best of their ability, the resulting disturbance pattern should be analyzed for habitat suitability of the species of concern selected by the planning team. Habitat assessment for each species would always begin with species having large home range requirements like caribou or marten. Adjustments could be made to the forest disturbance patch distribution to satisfy habitat concerns for that species. The resultant landscape would then be assessed for the next most spatially demanding species (e.g. marten or moose), adjustments made to the allocation, etc.

Should the disturbance pattern need adjustment to meet the needs of selected species, adjustment should always be attempted within the general guidance of moving towards a more natural disturbance pattern first and only deviate from it if absolutely necessary to prevent significant habitat losses.

Forest Composition

Fire, or the absence of it, can dramatically affect forest composition, which includes the relative proportion of tree species or stand types and their respective age classes (e.g., see Carleton and MacLellan 1994, Cumming et al. 2000).

Forest composition objectives, set for individual forest management units (FMU), must be moving towards the estimated natural forest condition (**standard**), while considering natural variation (see discussion of **Benchmarks** and **Bounds of Natural Variation**).

Age Class Structure

Age class structure for selected stand types must fall within or be moving toward the estimated range of the natural forest condition. Ideally, each selected stand type will be moving toward the estimated natural forest condition. The preferred management alternative will create the desired age class structure within acceptable bounds and within an acceptable time period. Acceptable bounds will reflect the following (**guideline**):

- the variability and uncertainty associated with natural forest disturbance and succession;
- the social and economic constraints in meeting impractical proportions of young age class distributions, which may be expected (e.g. as suggested in Van Wagner's curve); and
- the relative rarity of older age classes on many FMU forests and their resultant high ecological value for some wildlife species as well as their social value.

The objective of moving towards or remaining within the estimated bounds of natural variation for age class structure will be met through forest management planning for each FMU as is currently directed in the Forest Management Planning Manual (**standard**).

Benchmarks

A benchmark natural forest condition must be established for each FMU (**standard**), usually in consideration of a larger ecoregional context. This benchmark should be determined using the best quantitative and qualitative information available. Specifically, it should be derived from one or more of the following sources, in the following order of preference (**guideline**):

- good historical data from the FMU, preferably before effective fire management or large scale forest harvesting activities;
- a benchmark forest condition taken from an appropriate, local protected area that is > 50,000 ha in size. Only include those protected areas that have been subjected to wildfire, recognizing that varying degrees of fire suppression exist everywhere in the Province;
- modeled age class and forest cover as derived from a simulated fire regime upon the current forest condition, or a current forest condition modified to account for known historical conditions; and
- current forest condition.

The benchmark forest can be used as the starting point to estimate the bounds of natural variation by modeling.

Bounds of Natural Variation

Natural variation for major forest parameters (e.g. forest composition, age class distribution or landscape pattern) will be estimated using methods like long-term simulations (e.g. Strategic Forest Management Model; OnFire II). Acceptable bounds are those that best reflect the uncertainty around the estimated natural forest condition, tempered by exceptional ecological, social and cultural constraints (**standard**). The acceptable bounds are determined in the forest management planning process considering the ecoregional context.

The selected management alternative will create the desired forest condition within acceptable bounds and within an acceptable time period (**standard**). When selecting management alternatives, managers are required to do the following (**standard**):

- move towards the acceptable bounds of natural variation if current parameter values are outside the bounds and demonstrate that forest parameters will be within the acceptable bounds of natural variation within an acceptable time period;
- remain within the acceptable bounds of natural variation if forest parameter values are currently within the bounds.

STRUCTURAL LEGACY: Residual Stand Structure

Fire affects forest structure at the scale of the forest stand or stands as well as the landscape scale. Wildlife species have evolved with the structure of individual residual trees (dead and alive) and groups or patches of living trees that are often left after a fire occurrence (e.g., black-backed woodpeckers, kestrels, bluebirds, flickers and other cavity-nesting birds; see Murphy & Lenhausen 1998, Spytz 1993). Residual patches may act as wildlife corridors or as sanctuaries that permit fuller use of the disturbed area and more rapid recolonization of its interior by species characteristic of later successional stages. In addition, the residual patches, individual residual trees and coarse woody debris positively affect mico-site conditions to help establish the new vegetative community on cutovers.

Forest management activities should be modified, to more closely reflect the structural/biological legacy that occurs post-fire. The guide focuses on this structure taking several forms:

- standing snags;
- standing individual live trees;
- downed woody debris;
- internal and peninsular residual; and
- advanced regeneration and uneven-aged stand structure where appropriate.

The ecological value of this structure is maximized if it is left on site to age and decay. A significant portion of the residual should not be subject to future harvest. Where future harvest does occur, it should happen after the regenerating forest has reached the 3 m height.

Lessons from Fire History

In establishing the location, size and frequency of residual patches, the *Forest Management Guidelines for the Emulation of Fire Disturbance Patterns – Analysis Results* (OMNR 1997) provide useful guidance from Ontario's fire history. Forty-two fires (1920-1960) ranging in size from 54 ha to 52,772 (median size 1,327 ha) were analyzed using old aerial photography (1:15,840).

For example, the second and third quartiles of 42 historic wildfires (roughly 1 standard deviation about the mean):

Old style clearcut with little residual material

New clearcut with residual standing trees and woody debris

- had internal residual patches ranging from 0.4 to 1.0 ha in size;
- had peninsular patches ranging from 0.7 to 5 ha in size;
- contained from 6 to 15 internal patches of < 0.25 ha per 100 hectares of burn area;
- contained from 3 to 6 internal patches of > 0.25 ha per 100 hectares of burn area;
- contained from 5 to 14 peninsular patches of > 0.25 ha per 100 hectares of burn area; and
- had a mean patch area (both types) of from 1.4 ha to 3.4 ha.

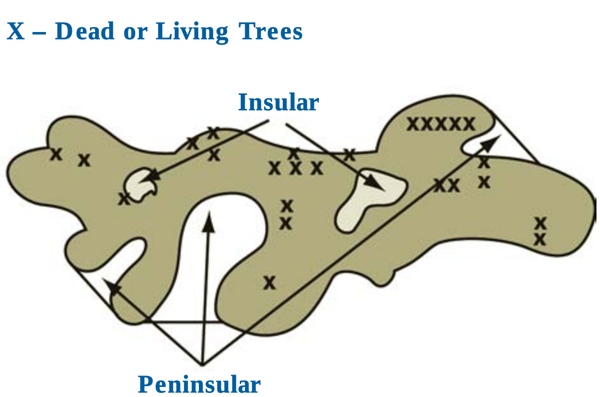
Forest managers should make best efforts to respect the foregoing ranges in locating residual patches.

Determination of Residual Area

For all 42 burns studied across Northern Ontario (OMNR 1997a), the percent residual area varied between 10% and 50% and averaged 24% (i.e. 5% internal and 19% peninsular) overall. On a prorated basis, this would suggest a range of 2% to 10% for internal patches and 8% to 40% for peninsular. Management operations should reflect these ranges, according to the forest cover types present that have varying fire susceptibility and must therefore be considered in establishing retention levels. Planning teams are to consult Figure 6 and Table 3 as a guideline to estimating the appropriate level of overall retention in a multi-stand clearcut, on a forest type-weighted average basis. For example, upland conifer blocks would have comparatively low overall retention (10% initially) compared to upland hardwood blocks (36% initially). Mixtures would have intermediate retention, as based on area weighting by forest type. Clearcutting up to 50% of peninsular areas, either using small openings on the first pass (see Figure 5), or conventionally on a second pass, would reduce these percentages.

Residual patches, individual trees and snags (Figure 4) must be distributed in cutover areas so there are at least individual trees retained on each hectare of the cut. Internal and peninsular patches should not all be aggregated into one large leave patch where fire would likely have created more diverse arrangements, as a function of species flammability, soil moisture regime, slope position and aspect (**standard**).

Figure 4: Different types of residual left after a wildfire event



Insular and Peninsular Residual Patch Retention

General Approach

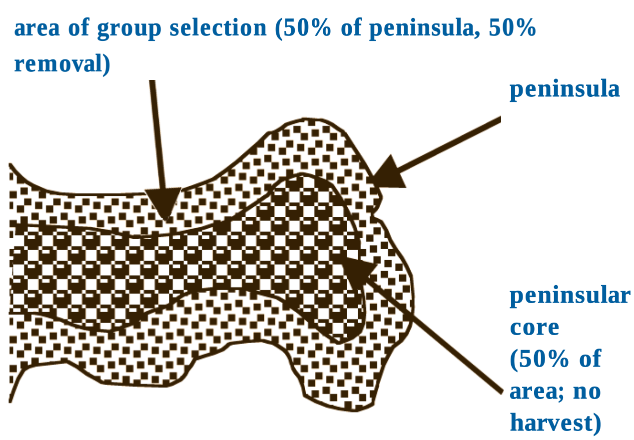
Living internal patches, consisting of distinct "islands" greater than 0.25 ha, will be retained on clearcut areas to provide vertical forest structure, relic patches of old growth, wildlife habitat and future sources of downed woody debris. For similar reasons, portions of live peninsular patches which are connected to the harvest block perimeter will also be retained.

All internal patches and 50 – 75% of peninsular patches (or area within peninsular patches) will be left to provide biological structure to the site (**standard**). Eligible portions of peninsular residual may not be subsequently harvested until regenerating trees have reached a height of 3 m (**standard**). Where a return harvest is deemed by the licensee to be infeasible for economic or social reasons, 25% of the area in the peninsulas (50% of the peripheral 50% of the peninsula) may be cut through the creation of small openings at the time of the original harvest. With the shelterwood system, internal and peninsular residual areas can be identified after the seeding cut. As with wildfire, the openings should occur on the exterior edge of the peninsula, leaving the core of the peninsula unharvested (**standard**) (Figure 5).

Species Composition

In determining specific tree species to favour within insular and peninsular patches, the analysis results provide guidance. Cover types within residual areas of all boreal

Figure 5: Harvesting technique within peninsular residual patches in the first pass



burns studied consisted most often of mixedwoods, followed by lowland conifers, then by upland conifers (Figure 6). These numbers reflect the comparative fire resistance of mixedwood, hardwood and any forest growing in lowland sites and should be used to set priorities for species retention within patches. Table 3 also provides guidance on the basis of expert opinion. Valid local fire data, acceptable to planning teams and the Regional Director, may supplant these estimates.

Size Distribution

In the analysis results, roughly 20% of average residual area (both types) was in patches less than 5 ha, with 35% in patches from 5.1 to 50 hectares and 45% in patches greater than 50 hectares. With flexibility of ± 50% in individual clearcuts, forest managers should strive to emulate this size distribution when planning harvest allocations (peninsular residual) and on an overall Annual Work Schedule basis for internal residual.

Placement and Planning

Residual patches should be located consistent with local fire history and observations. Preference should be given to low wet ground, hardwood clumps, backs of hills and the lee (normally eastern) shores of larger lakes and rivers. Areas of Concern (AOCs) and reserves identified to protect other values should be capitalized upon to the extent they are suitable, in order to limit timber withdrawals. Similarly, a peninsula of unmerchantable and/or unmarketable trees which extends into a block of allocated stands can achieve the same ecological effect as one composed of merchantable and marketable trees (see **Appendix 1 – Practical Aspects of Defining (Mapping) Forest Disturbances and Clearcuts** for additional details).

Planners should remember that an important objective in determining the location of residual patches and in determining cut boundaries is to respect natural borders and boundaries as much as possible. Accordingly, the best time for the initial determination of peninsular residual patches is during the spatial allocation of the available harvest area (AHA). It is at this time that natural stand boundaries, natural landforms and features, areas of unmarketable or unmerchantable forest and existing AOC prescriptions can be considered in the development of peninsular residual patches. Some potential internal residual patches (e.g. trees surrounding a small pond within the proposed cut) may be obvious and determined during the

Figure 6: The Fire Residual Continuum (Insular and Peninsular Combined). Tree associations least likely (low %) and most likely (high %) to be left as living residual after a fire event.

10% ↓	Upland Conifers (Pj, Sp, Bf)
	GL-SL Pines (Pw, Pr)
	GL-SL Mixedwood
	Conifer Lowlands (Sb, Ce, La)
	Boreal Mixedwoods
	Intolerant Hardwoods (Po, Bw)
36%	Tolerant Hardwoods (Mh,Be,Oak)

planning phase as well. Generally however, most internal residual patches will be identified during operations.

Individual Residual Trees

The density and choice of individual living trees by species left on a site will be based on fire tolerance, silvicultural requirements and wildlife habitat value (**guideline**) and the number of dead (snag) trees that were able to be left given the Occupational Health and Safety Act (OHSA):

Fire tolerance:

Bf < upland Sp/Pj < Bw < lowland Sp < Po\Mh\Be\Oak < PwPr (only when super-dominants)

Operations should leave a minimum average of 25 well-spaced trees/ha of which at least 6 must be large-diameter, live, high-quality cavity trees or those with future potential to form cavities such as large trembling aspen or hard maple (follow guidance in the Great Lakes-St. Lawrence (GLSL) silvicultural guides or tree marking guides for individual residual trees in GLSL forest types). These trees will provide some semblance of the structure that would be left after a fire and provide a source of dead and down material in future (**standard**).

Beyond the 6 live (future) cavity trees, a range of tree species and diameters (> 10 cm in diameter and > 3 m in height including unmerchantable and unmarketable species) should be left to maximize biodiversity. Only where snags cannot be left, for safety reasons, must all 25

Table 3: The suggested percentage of internal and peninsular patch residual and the number of individual trees, on average, to be left by forest type to simulate fire structural components at the multi-stand (cut block) level.

Forest Types	Internal Patches[4] % area (ha)	Peninsular Patches[4] % area (ha)	Individual Living or Dead Trees (Snags)[1] (Trees/ha) (Standard)
Conifer Upland[2] (Sp, Pj, Bf)	2%	8%	At least 6 large live, high quality potential cavity trees, 25 total[3]
Conifer Lowland[2] (Sp, Ce, La)	4%	16%	
Upland Mixed (Sp, Pj, Bf, Po, Bw)	6%	24%	
Intolerant Hardwood (Po, Bw)	7%	27%	
Tolerant Hardwoods (Mh, Be, Oak)	8%	28%	
GL-SL Pines[2] (Pw, Pr)	2%	8%	
GL-SL Mixedwood (P, S, M, B, O)	5%	10%	

[1] The ratio of dead or dying trees to live trees will be a function of the number of dead or dying trees that exist in the stand(s) and that may be left under provisions of the OHSA.

[2] Where the silvicultural prescription calls for prescribed burning on white pine or jack pine sites, follow recommendations for appropriate # of seed trees/ha under the silvicultural guides. Where the silvicultural prescription calls for natural regeneration of black spruce follow the silvicultural guide re # of seed trees/ha.

[3] N.B. See pileated woodpecker and marten guidelines for species-specific requirements re: 6 trees/ha i.e. dead or dying (marten) or live cavity trees (pileated woodpecker).

[4] The varying amount of residual patch area is a function of different combustibility of the forest types. Species composition within patches should favour mixedwoods and lowland conifers as per Figures 15 and 16 of the Fire Analysis Results (OMNR 1997a). Total area of peninsulas is subject to 50% future harvest (with the exception of area in permanent reserves), or 50% perimeter harvest at 50% intensity (i.e. group selection) during first pass.

trees be living (see **Snags** below). Avoid leaving genetically inferior seed-bearing trees.

Follow these general rules for leaving living trees vs. snags (or killed trees) by species (**guideline**):

- on jack pine sites where prescribed burning is not to be used as the silvicultural treatment after harvest, leave mostly snags;
- on jack pine sites where prescribed burning is to be used, leave seed trees and treat with fire;
- in the absence of prescribed burning as the silvicultural treatment after harvest for black spruce, white spruce, white pine, or red pine leave snags and seed trees; and
- in white pine and red pine where prescribed burning is to be used, leave seed trees some of which will become snags.

Consult the *Forest Management Guidelines for the Provision of Pileated Woodpecker Habitat* (Naylor et al. 1996), the *Forest Management Guidelines for the Provision of Marten Habitat* (Watt et al. 1996), and Watt and Ceceres (1999) for information on the characteristics of good quality cavity trees. Experimental research in the Pembroke area suggested that the retention of 6 good-quality cavity trees per hectare resulted in significant differences in the post-cut bird community (OMNR, Southcentral Sciences Section, North Bay, unpublished data).

Snags

A large proportion of fires leave hundreds of dead trees (snags) per hectare standing on the site. Reproducing this structure is not economically viable. While there exists some data on the density of snags required for some cavity nesting species within a forest (see Watt and Caceres 1999), data on the biological threshold of snag density required in cutovers or burns are not available.

Due to economic constraints and limited biological data, a minimum of 6 large, living potential cavity trees (as above) and 19 others (in order of preference: snags, dying trees, and living trees of varying species and sizes > 10 cm in diameter and > 3 m in height) will be left on all sites (**standard**). Vary the spacing moderately, for diversity and machine maneuverability as required.

Where dead or declining trees cannot be left because of OHSA and Ministry of Labor requirements, and to prevent blowdown while providing additional fibre to companies, some snags may be "created" during mechanical harvesting by leaving as much of the bole of the tree as possible (**guideline**). This should only be done where there is danger of the tree blowing down since standing, intact, large-diameter trees do provide more niches for wildlife.

Downed Woody Debris (DWD)

The provision of downed woody debris is important to return nutrients to the soil, provide micro-sites for regeneration and to provide horizontal habitat structure for wildlife after harvest (see Bellhouse and Naylor 1996). While logging is typified by proportionally more horizontal than vertical structure when compared to fire, traditional logging still provides less DWD than fire in absolute terms (Lee et al. 1997).

Coarse woody debris (CWD)

- Provide CWD through cut-to-length or tree length harvesting systems, residual tree retention, leaving unmerchantable logs on site, redistribution of roadside chipping waste material/slash (**guideline**). In manual cut and skid operations, cutters should be encouraged to leave cull material at the stump (**guideline**).
- Use cut-to-length, or tree length harvesting techniques to leave slash on those sites sensitive to nutrient loss (**guideline**). See Page 29, *Forest Management Guidelines for the Protection of the Physical Environment* (OMNR 1997b).
- Avoid windrowing of coarse woody debris during site preparation operations (**guideline**).

Fine woody debris

Fine woody debris is normally consumed by wildfires, releasing much of the nutritional content (e.g. nitrogen) to the atmosphere. However, nutritional elements such as potassium, magnesium and calcium remain in significant quantities. For this reason, full-tree harvesting should be either discouraged on very shallow or very coarse-textured sites, or logging slash should be redistributed on the site after roadside delimbing or chipping (**guideline**). See the *Guidelines for the Protection of the Physical Environment* (OMNR 1997b) for further direction.

Where roadside piles of delimber slash cannot practically be returned to the cutover, piles should be burned since they provide little suitable habitat for wildlife. They also occupy prime tree growing space along roadsides (see Luke et al. 1993) and should be burned to facilitate prompt regeneration (**guideline**).

SILVICULTURAL CONSIDERATIONS

Prescribed Burning as a Silvicultural Tool

One of the most difficult aspects of fire to simulate through forest management is fire process. As an example, the rapid turnover of nutrients that occurs during fire does not happen in normal silvicultural treatments. It is only when sites are treated with prescribed burning that this natural nutrient flush and often different herbaceous regeneration can be stimulated. Subject to the consideration of the protection of other values, costs and practicality of conducting prescribed burns on individual sites, the importance of using prescribed burning as frequently as possible as a silvicultural treatment to better simulate what fire would do cannot be overemphasized (**guideline**).

Diversity of Forest Structure and Harvest Techniques

Silviculture should be directed by the diversity of forest types and structures on the landscape. Historically, individual stands in the boreal forest were shaped by the presence, absence, and intensity of fire. A diversity of silvicultural methods should be employed to more closely reflect this reality. The forest manager should not use the stand replacing fire as a default model for choosing an appropriate harvest technique.

Managers should also use harvest techniques that more closely simulate moderate and low intensity fires. The shelterwood system in white pine stands is an attempt to simulate periodic light to moderate understory burns and the positive influence that it has on white pine regeneration. Harvesting techniques should also be sensitive to the natural succession that occurs in forest types that are not

Post-harvest stand structure following CLAAG in a jack pine – black spruce/trembling aspen stand on coarse loamy soils V18/V20; Ecosite 20-21 intergrade (Brightsands – English River Forest)

burned for long periods of time. Application of the Careful Logging Around Advanced Growth (CLAAG) harvesting system in lowland black spruce stands is designed to help foster the natural regeneration that would occur in these stands after extended periods without fire disturbance.

In pure, but especially in mixed, stands it is natural to have some proportion of the forest in an uneven-aged state. This condition is typified by forests that have been subjected to light fires and partial canopy removal, areas considered to be overmature and mixed stands that are undergoing processes of natural succession (e.g. poplar canopy with developing spruce understory). The natural proportion of uneven-aged forests should be maintained within the bounds of natural variation (**guideline**).

This objective can be achieved through several complementary means (**guideline**):

- retention of old growth and natural age class structures as addressed through the development in the forest management plans;
- retention of older age classes within AOCs (the proportion from this source must be limited due to the fact that these are small, dispersed patches on the landscape); and
- partial harvest methods (HARP, CLAAG, patch cuts, harvesting with understory protection).

For more detail on silvicultural techniques other than clearcutting to use in boreal mixedwood types, consult the *Boreal Mixedwood Notes* (OMNR 2000).

Regeneration

- Natural and/or assisted natural regeneration should be the preferred method of regeneration, where it is proven reliable and appropriate to the species and site. Harvest methods should be chosen with this principle in mind.
- Wherever possible and silviculturally appropriate, prescribed burning should be employed to assist regeneration.

DISTURBANCES IN AREAS OF CONCERN (AOC)

The planning of forest management activities involves ensuring that forest values sensitive to forest disturbance are adequately protected. The areas around these sensitive sites are called AOCs and prescriptions are developed within these AOCs to protect the identified value. As an example, the identified nesting sites of bald eagles, great blue herons and ospreys are always protected with no harvest and restricted harvest buffers to ensure that disturbance to the nesting sites is minimized. If the coarse-filter attributes of the *Natural Disturbance Pattern Guide* will not adequately protect these nesting sites, the species-specific fine-filter guidelines will need to be applied (see Figure 2).

FIRE SALVAGE

The practice in Ontario has been to encourage utilization of fire killed and damaged trees and associated green or undamaged trees where appropriate. This guide suggests direction for a modification of this approach.

Depending on the occurrence and size of wildfires in any particular year, it usually is not feasible to salvage all burnt areas. However, forest managers are encouraged to avoid salvage logging in some areas to retain fire origin habitat, features and processes in the forest (**guideline**).

Where fire salvage operations are considered, they will take into consideration the minimum residual standards (i.e. internal/peninsular residual % area and individual tree/snag #/ha) as set out in this guide (**standard**). This will result in some wildfire areas being left as the fire left them (i.e. not being available for salvage) and will reduce the volumes of merchantable timber available from other wildfire areas. The unburned area included in a salvage proposal should be kept to a minimum wherever possible (**guideline**).

GUIDE APPLICATION

Geography

Parts of this guide include standards and guidance for two main forest regions in the province of Ontario. These two regions are the Boreal Forest and the Great Lakes - St. Lawrence Forest as defined by Rowe (1972).

Recognizing that there is a considerable transition zone between these two regions (and inclusions of both forest types within the other), planning teams preparing plans for management units which contain this transition zone (or inclusions) will determine, in consultation with regional advisors, the appropriate guidance to be applied within the transition zone (e.g. Site Region 4E). This determination will consider the dominant forest types and patterns as well as social and economic concerns to ensure that the appropriate guidance is applied.

The guide is not intended to be used as a mandatory requirement for private lands or for Crown lands which are not part of the landbase available for forest management. (e.g. parks)

Plan Year for Implementation

N.B. This guide replaces the direction in the interim technical note "Defining a Clearcut – Version 1, December 1999" with forest management plans as they are renewed.

Stand level guidance in this guide will be implemented with those forest management plans prepared for implementation April 1, 2003.

All aspects of this guide (i.e. landscape and stand level guidance) will be applied to/incorporated into all forest management plans, as they come up for renewal, beginning with those being prepared for implementation April 1, 2004. This guide must be considered early in the planning process to ensure appropriate influence of:

- the plan's strategic direction (Objectives and Strategies);
- the determination of the preliminary preferred management alternative;
- the selection criteria for harvest area;
- the identification of preferred and optional harvest areas for Stage 2 – First Information Centre;
- the remainder of the planning process as the above products of the planning process are refined and adjusted.

MONITORING FOR THE NATURAL DISTURBANCE PATTERN EMULATION GUIDE

Adaptive Management - Monitoring

The underlying rationale for this guide is that the most reasonable course for sustaining forests and their inherent biological diversity is to emulate the processes under which they have evolved (Baker 2000). Thus, the guide describes how forestry practices should be conducted to more closely emulate the effects of naturally occurring fire on the same landscape. However, fire and logging are fundamentally different - fire is essentially a chemical process while logging is a mechanical one. For this and other reasons, there is uncertainty about the ability of this guide to achieve its primary objective, acting as the coarse filter in the biodiversity conservation approach, effectively and efficiently.

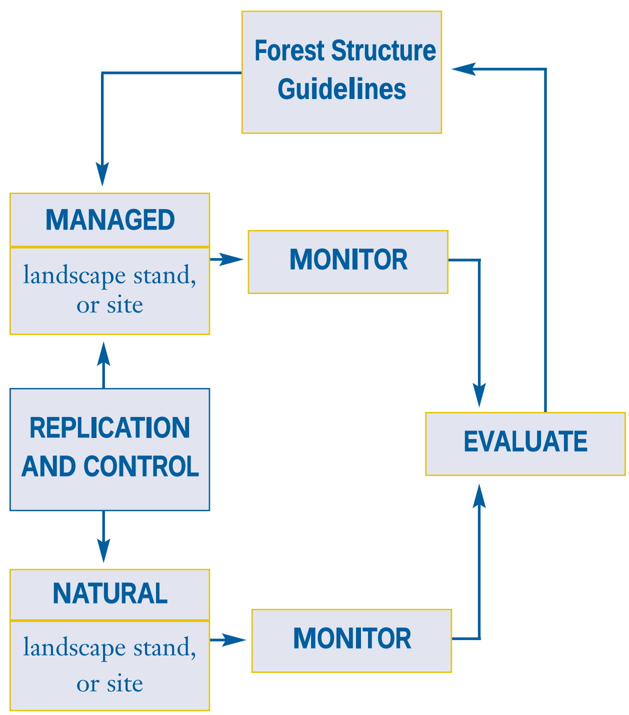
The direction contained in the guide should be tested for effectiveness using rigorous comparative or retrospective studies (see Baker 2000). Baker has argued convincingly that formal, rigorous adaptive management techniques have the greatest potential to yield clear results that lead to improved forest management.

A great deal of research was reviewed during the formulation of the guide. However, much of it was only indirectly applicable because it was conducted in other jurisdictions, on other or a limited set of forest types, or with another focus. Research is needed on all aspects of this guide, at the scale of the site, the stand and the landscape. To be helpful, the research questions must be formulated carefully and fitted into an adaptive management process (see Figure 7).

Research projects should compare disturbances created by logging to those created by fire, as well as the forests that develop subsequently. Relevant investigations should acknowledge (and control for) the great natural variability possible in the effects of fire due to: season, fire intensity, ecosite, forest age, regional climatic effects and physiography. Variation might also be attributable to exactly how the guide has been implemented on the ground and the prior history of forest management or fire suppression in the area. Replication must be adequate and the natural and managed landscapes must be as comparable as possible with respect to the factors that could obscure important relationships.

Most of the direction in this guide represents new and untested requirements. Consequently, it is important to receive feedback from practitioners with respect to the practicality of application of the guide during the development and implementation of plans, implications to wood supply and costs and effectiveness of the guide in meeting its intended objectives. Feedback from those planning teams who have gained experience from application of the guide will be sought to provide input into future revisions. If in the monitoring of the implementation of the guide it is determined that there are significant and unmanageable economic, ecological or social impacts, consideration will be given to a review and possible revision of the guide before the normal five year review.

Figure 7: The adaptive management framework



CURRENT UNDERSTANDING OF NATURAL FIRE DYNAMICS AT LARGE SCALES

Fire disturbance occurs at multiple spatial and temporal scales. These scales range from large forest regions of thousands of square kilometres to small areas of a few hectares and from gradual succession lasting hundreds of years to changes that occur in minutes or hours. Knowledge about the small-scale effects of fires has been used by foresters for silvicultural purposes since early in the 20th century. Although the impacts of large fires have been recognized primarily for their devastation, the idea of simulating the patterns and processes of large fires during forest management has been more recent. The concept of managing forests to incorporate natural variability has existed at least since the 1960's and attempts at imbedding the concept in management actions have accelerated during the 1990's (Landres et al. 1999).

In Ontario, forest harvesting patterns are creating patterns on the landscape that are quite different from patterns created by fire. Over the past 45 years, this difference has resulted in a tremendous increase in the amount of edge created by forest harvesting in Ontario's boreal forest compared to what fire would have created (Perera and Baldwin 2000). Edge effects on wildlife are common in forested landscapes (Manolis et al. 2000).

A legacy of fire suppression combined with forest harvesting in Ontario appears to be changing forest vegetation communities from that of natural fire regimes. Fire suppression in the boreal forest may be converting forests from fire-tolerant conifers to fire-sensitive, shade-tolerant species, while the diversity of understory vegetation is declining (Carleton 2000). In the Great Lakes-St. Lawrence forest, shade tolerant hardwood species are replacing fire-tolerant conifers (Carleton 2000).

These observations have precipitated the desire to change the spatial and temporal patterns and processes of forest harvesting to be more like those created by fire. In particular the observations about the differences in spatial patterns created by forest harvesting compared to fire has led many ecologists to believe that forest harvest patterns should move toward the more complex and larger patterns created by fire. A primary reason for assuming that this change should be undertaken is the potential impact on forest ecosystems, particularly wildlife. The changes in forest patterns and complexity created by forest harvesting might have long-term negative impacts on wildlife and other biota dependent on the structure and ecosystem processes produced by natural fire regimes (Hobson and Schieck 1999, Imbeau et al. 1999, Niemela 1999, Drapeau et al. 2000, Voigt at al. 2000). Research suggests that consolidating harvesting activities by making some larger cut patches (and thus producing a more natural distribution of patch sizes) on the landscape may help to provide for the habitat needs of a broader array of early and late-successional forest wildlife (Hagan et al. 1997) (see Figure 8).

A natural fire simulation approach should be viewed as a means of mitigating the unnatural aspects of preventive measure to avoid unknown, long-term impacts of harvesting on forest ecosystems. The Crown Forest Sustainability Act (1994) acknowledged this concern by imbedding the concept as a guiding principle into the act. However, given our current, incomplete understanding about natural variability, we need to proceed with caution, using the concept as a guide or framework, not as a deterministic solution (Landres et al. 1999).

If we are to emulate natural fire regimes, what is it that we should emulate? The major characteristics of fire regimes are fire frequency, fire return interval, size of disturbances, spatial distribution of fires and spatial patch dynamics created by fires both among fire disturbances and within fires. What follows is a summary of current knowledge about large scale fire dynamics. For fuller and more in-depth syntheses see Johnson et al. (1999), Li (2000) and Perera and Baldwin (2000).

Analytical Approaches to Understanding Fire Dynamics at Large Scales

There are two basic approaches to understanding fire dynamics at large scales. One approach is to use empirical data about past fire history and variability (Perera et al. 1998). Another approach uses fire process models to simulate fires at large landscapes and long temporal scales (Li et al. 1996, Li et al. 1997, Li 2000). Since we are dealing with the past and we cannot conduct real time experiments on large-scale fire dynamics we will never have reliable knowledge about the dynamics through classical hypotheses rejecting experiments. Rather, we need to use both approaches and compare predictions made from these approaches. When the predictions or logical outcome of the empirical data and models differ, a plausible explanation of the differences can strengthen our understanding of fire dynamics (Li 2000).

Predictions about natural fire dynamics are more valid at large spatial and temporal scales than at small scales. For example, one might be reasonably confident in assuming that most of a large area such as northwestern Ontario might burn every 70 years, but one would be much less confident in assuming that a particular forest stand would burn every 70 years in the region.

"Time Since Fire" maps for crown destroying fires are the usual sources of empirical data for estimating fire cycles. They are constructed from fire scars, tree rings, analysis of age class distributions of existing forests of natural origin and from sediment cores from lake bottoms (Cwynar 1978, Dansereau and Bergeron 1993, Johnson et al. 1999, Ward and Tithecott 1993, Van Wagner 1978, Larsen and MacDonald 1998, Paterson et al. 1998). These sources of data and/or known spatial fire history (Perera et al. 1998) can be used to study fire frequency and spatial dynamics to improve our understanding of fire dynamics at large scales (10^{4-6} ha).

Simulation models can be lumped into two basic approaches. One is analytical where empirical data are statistically analyzed to unravel historical patterns in fire frequency and/or fire sizes (Armstrong 1999, Li 2000). The other approach is to use simulation models that incorporate knowledge about large scale fire processes. These models are usually run over 100's and sometimes 1000's of years to simulate the long-term fire dynamics (Li et al. 1996, Li et al. 1997, Li 2000, Wimberely et al. 2000).

Fire Frequency

Fire frequency is the number of fires per unit time—say per year or per decade. The reciprocal of frequency is the fire return interval. Fire return intervals are important because knowledge of this parameter tells us something about how often a large landscape might be disturbed by fire. In the boreal forest, estimates of fire return intervals vary considerably between about 20 to 300 years (Johnson et al. 1999, Dansereau and Bergeron 1993, Gauthier et al. 1996, Ward and Tithecott 1993, Van Wagner 1978, Heinselman 1981, Cogbill 1985, Bergeron and Harvey 1997). In the transition zone between the boreal and Great Lakes-St. Lawrence forests, return times are estimated to average from 64 years to 128 years (Day and Carter 1991). Historically, in both the transition zone and in the Great Lakes-St. Lawrence forest zone, there was a higher frequency of ground fires that burned the duff and residual material on and near the ground but were not crown-destroying fires.

Expressing the historical fire return interval as an average can be misleading. Understanding the range of fire return times is important because variation in return times logically implies variation in historical age class distributions. Periods with short fire return times produce landscapes with a higher proportion of patches all at similarly young ages. Examination of fire history for only one point in time can lead to the erroneous conclusion that the fire return interval is constant.

Long return intervals produce landscapes with a higher proportion of patches with a variety of age classes among the patches (Boychuck and Perera 1997). For example, Bergeron et al. (1998) estimate the range of return intervals in the boreal forest of the western Quebec clay belt to be from 50 to 500 years. This range of return intervals means that we cannot emulate fires by assuming a constant return interval. (Bergeron et al. 1998, 1999, Johnson et al. 1999). Fire return intervals can also vary spatially creating an additional dimension of complexity in the reconstruction of historical natural fire regimes. Baker (1989) demonstrated that fire return intervals varied among landscapes within the boundary waters area of Minnesota and Ontario.

Fire Size Distribution

Knowledge of the proportional size distribution of fires on a landscape is important if we are going to emulate fire dynamics. The majority of fires in the boreal forest are small as confirmed by empirical studies in Ontario (available on CD-ROM, Perera et al. 1998) and in the western boreal forest (Armstrong 1999, Johnson et al. 1999). However, although large fires occur infrequently, they account for most of the disturbance caused by fires (Turner and Romme 1994, Armstrong 1999, Johnson et al. 1999, Li 2000, Perera and Baldwin 2000). Large fires can re-burn areas previously subjected to small fires, creating a mosaic of patterns and age classes on the landscape. A logical conclusion from these patterns is that, at least in the western Canadian boreal forest, older forest patches are imbedded in a matrix of younger forest patches (Johnson et al. 1999).

There is an obvious interaction between fire frequency and large fires (Li et al. 1999). In high fire years there is a higher probability of many large fires than in low fire years. The larger number of fires in high fire years causes more younger forest on a landscape, which in turn shifts the age distribution on the landscape and these areas continue to age until another extreme fire year occurs (Armstrong 1999). This pattern is not constant and in fact creates a non-equilibrium pattern of age classes on the landscape. Non-equilibrium fire return intervals and the evidence for variable fire sizes is inconsistent with the assumptions of a stable age class distribution (Boychuck and Perera 1997, Boychuck et al. 1997). The long-held assumptions of a negative exponential function of fire frequency and the consequent expectation of a stable negative age class distribution (Van Wagner 1978) are not supported, either by empirical evidence (Armstrong 1999, Johnson et al. 1999), or as a logical outcome of modelling fire patterns (Boychuck and Perera 1997, Armstrong 1999, Wimberely et al. 2000).

Large Scale Succession Patterns and Fire Dynamics

Large fires are important in shaping the legacy of landscape patterns in the boreal forest. The coarse and fine grain residual legacies following large fires provide additional complexity and diversity to naturally disturbed landscapes. Complexities in understanding post-fire succession patterns arise from non-equilibrium fire intervals and the variable patterns of fire occurrence at large spatial scales whereby some, and at times, many areas can experience long periods without fire (Armstrong 1999, Bergeron and Harvey 1997, Bergeron et al. 1998, Johnson et al. 1999). A consequence of this variability is that some patches of the boreal forest can become quite old even where there are relatively short fire return intervals. Succession patterns in such patches lead to gap phase dynamics and a shift in species composition as the forest ages and remains unburned. Bergeron and Harvey (1997) and Bergeron et al. (1999) have suggested what the proportion of these patches might be under a natural fire regime based upon their studies in the western clay belt of Quebec. Although their results probably apply to the adjacent clay belt of Ontario, there are no similar comprehensive studies for other parts of Ontario.

Patterns of succession are important to understand at large spatial and temporal scales because it is the state of the forest in the 60 to 100 year period after disturbance by logging and/or by fire upon which the forest industry depends. However, it is the 5 to 20 year period immediately after a fire or a clearcut when many people with various views on forestry become concerned. Foresters and the forest industry are concerned about whether or not their regeneration treatments are successful, while biologists and ecologists are concerned about maintaining habitat for wildlife and ecosystem processes. Thus, we need to learn more about how and why these processes and patterns differ between disturbance caused by fire and logging (Carleton 2000). This knowledge is necessary if we are to reliably predict the volume of timber, its value to the industry, the amount and quality of habitat for wildlife, and be confident that ecosystem processes are being maintained.

Conclusion – Current Understanding of Natural Fire Dynamics

We have to acknowledge that we are only now beginning to understand the spatial and temporal patterns of natural fire dynamics. These dynamics have historically produced and maintained landscape diversity. At large spatial and temporal scales we are reasonably confident of understanding these patterns. Natural fire regimes have produced non-equilibrium age class distributions and large infrequent fires have caused most of the historical disturbance in the boreal forest. A challenge for simulating natural fire dynamics is to maintain the apparent landscape diversity caused by these patterns of natural fire dynamics. Natural fire dynamics are probabilistic at all scales rather than deterministic. Thus, the challenge is to simulate these probabilities without invoking a deterministic set of rules that initiate a long-term, deterministic pattern on the landscape that ultimately produces another simplified landscape pattern to replace the current simplified pattern. Such an outcome would be inconsistent with simulating natural disturbance regimes. This speaks to the need for long–term monitoring at multiple scales on managed landscapes to ensure that our efforts to simulate the creation of natural landscapes is actually maintaining biological diversity.

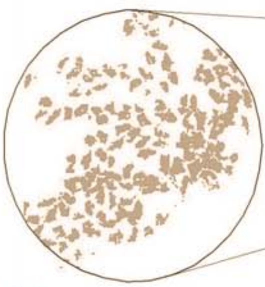
Figure 8: Fire and harvesting patterns

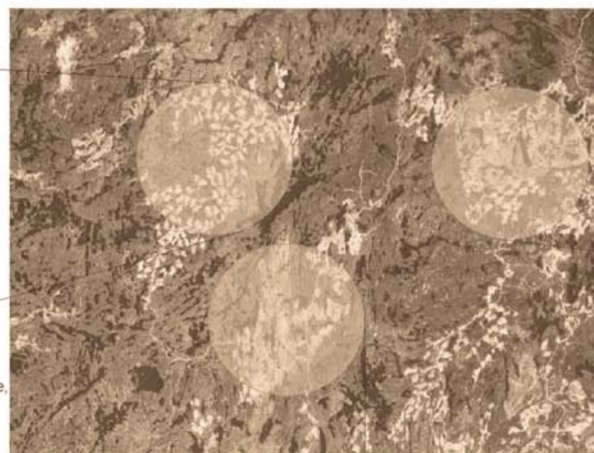
INTRODUCTION

Disturbances (i.e. wildfire) are critical in maintaining healthy and biologically diverse boreal forests. Forest harvesting practices also create disturbances. Although wildfire cannot be replicated, certain aspects can be simulated. Clearcutting can be implemented to mimic the size, shape and distribution of a natural disturbance.

LANDSCAPE PATTERNS

Many ecosystem functions such as habitat value, dispersal of seed, or fire are affected by the configuration of the landscape. These landscape patterns can be measured to provide information about the distribution of forest types, diversity of habitat or sustainability of planned forest operations. The image below shows three different landscape patterns; wildfire, patch clearcuts and a progressive clearcut.





PROGRESSIVE CLEARCUTS

- Harvest large areas and leave large areas unharvested
- Take place in contiguous blocks over several years
- Wildlife species such as woodland caribou, great grey owl and marten prefer characteristics of this landscape

PATCH CUTS

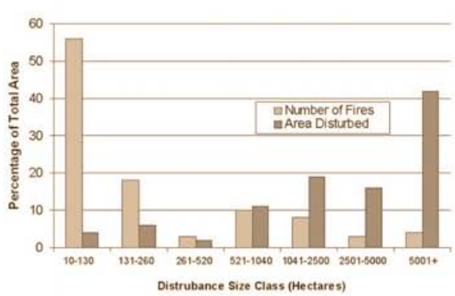
- Are small clearcuts that are closely spaced
- Can create a landscape with a lot of forest edge, and little core or interior area
- Wildlife species such as moose, grouse and black bear prefer characteristics of this landscape

WILDFIRE

- Is historically the dominant source of natural disturbance in the boreal forest
- Usually consists of a few big fires and many little fires
- Big fires account for most of the area burned
- Leaves many residual green patches unburned

ESTIMATED AREA DISTURBED AND NUMBER OF FIRES BY SIZE CLASS

Historically, fire pattern in northwestern Ontario has resulted in a few very large fires accounting for the majority of area disturbed. The many smaller fires account for a small amount of area disturbed.



IS ONE PATTERN OF CLEARCUTTING BETTER THAN ANOTHER?

The pattern of patch clearcuts meets the needs of a few specific wildlife species like moose. These cuts result in relatively small (< 260 ha), closely spaced clearcuts, creating a pattern that is "unnatural" as it concentrates the entire harvest into many small blocks and no larger blocks. It would be more appropriate to also include larger blocks when clearcutting, to more accurately reflect a natural pattern.

The forest manager's challenge is to establish the right size, shape and distribution of clearcuts to best approximate what would naturally happen in that particular forest. In this way, it is more likely that the natural diversity of all of the forest's life forms (biodiversity) will be maintained.

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APPENDIX 1: PRACTICAL ASPECTS OF DEFINING (MAPPING) FOREST DISTURBANCES AND CLEARCUTS

1. Forest Management Planning Manual (FMPM) Requirements

The Forest Management Planning Manual (OMNR 1996) (FMPM) has a number of requirements relating to forest disturbances and clearcuts that make it necessary to define (i.e. map) actual/planned forest disturbances and actual/planned clearcuts. Those requirements relate to:

(a) summarizing the analysis of **forest disturbances** for the assessment of sustainability: (i) predictively in the forest management plan and (ii) for reporting/evaluation purposes, in the report of past forest operations; and,

(b) summarization of: (i) **planned clearcuts** in the forest management plan and (ii) **actual clearcuts** in the annual report and report of past forest operations.

A forest disturbance, by FMPM definition, includes forest area that has been burned (wildfire) and clearcut. The definition of "clearcut" provided by the manual is "area harvested under the clearcut silvicultural system". The manual does not include the temporal (time) or spatial (distance) criteria necessary for mapping forest disturbances or clearcuts to meet these manual requirements.

An appropriate way to think of forest disturbances in the context of determining the area (i.e. hectares) is as a "gross" or inclusive polygon. An appropriate way to think of clearcuts is as a "net" or exclusive polygon(s). When mapped, the outside boundaries of a forest disturbance will be close to the outside boundary of a clearcut but there will be some differences.

2. Temporal, Spatial and Acceptable Break Standards

Temporal, spatial and acceptable break standards are provided in order to consistently map forest disturbances and clearcuts. The following provides these standards which are applicable for both forest disturbances and clearcuts.

Temporal Separation

The temporal separation standard is the time that it takes for regeneration of a wildfire or clearcut to develop into a young forest at least 3 metres in height and at least minimum stocking. When this condition is achieved, the temporal separation standard is met and the area is considered existing young forest. Depending on the site and predominant species, this may take as little as 5 – 10 years or as long as 20 years or more. A temporal separation of 20 years is acceptable for use as an alternative to the height/stocking based standard.

Spatial Separation/Acceptable Break

The spatial separation standard is at least 200 metres of forest. When this condition exists (in conjunction with the acceptable break standard), the spatial separation is met and two adjacent forest disturbance events are considered separate events.

The acceptable break standard provides the requirements for the minimum forest condition which must exist for spatial separation. This separation must consist of forest area at least 3 metres in height and meeting minimum stocking requirements and includes:

- existing forest stands which meet this standard, including protection forest;
- forest stands harvested under the shelterwood or selection silvicultural systems; and
- parks and/or protected areas and private land where existing forest stands meet this standard.

It may be necessary to provide for a distance of greater than 200 metres to obtain 200 metres of forest which meets the acceptable break standard. For example, the distance between two separate adjacent forest disturbances would need to be a minimum of 220 metres where that distance included a river that was 20 metres wide (the acceptable break must be forest area as described previously).

3. Measuring the Area (ha) of Forest Disturbances

The boundary of a forest disturbance may be determined by reviewing recent wildfire events, recent clearcut events and planned clearcut areas while considering the spatial, temporal and acceptable break standards described in Section 2. Figure A1 provides a simple example of a forest disturbance based on one clearcut event.

There are three time points where forest disturbances must be analyzed. The first two are included in the forest management plan and represent forest disturbances as of the plan start date and as projected to the first term end date. The third is after the end of the plan term when the report of past forest operations is prepared. When measuring forest disturbances, the gross or total area is considered (i.e. includes clearcut area, wildfire area, insular residual, peninsular residual, etc.).

It will be necessary to keep track of the different components of each forest disturbance to allow compliance with this guide (i.e. area of clearcut,% residual, etc.). A table may be prepared to summarize area for each forest disturbance based on the following components:

- actual burned (wildfire) area;
- actual clearcut area;
- planned clearcut harvest area in the current plan that is anticipated to be harvested by the scheduled renewal date of the next plan (for plan start date and first term end date analysis);
- planned clearcut area (first term of plan) (for first term end date analysis);
- insular residual forest area;
- peninsular residual forest area; and
- insular/peninsular residual non forest land area.

Note: Not all components will be present in any particular forest disturbance.

Future wildfire events cannot be predicted and therefore they cannot be included in any of the analysis of forest disturbances.

4. Measuring the Area (ha) of Clearcuts

Existing, planned and actual clearcuts are a component of the related existing, planned and actual forest disturbances. The temporal and spatial (including acceptable break) standards used to define the geographic extent of clearcuts are the same as for forest disturbances. However, when measuring the area of clearcuts only the net area of the clearcut is included (i.e. insular residual, peninsular residual, etc. are not included in the area)

There are several requirements for planned clearcuts in the Forest Management Planning Manual. The frequency distribution of planned clearcuts by size class and clearcuts greater than 260 ha (i.e. exceptions) must be documented in the forest management plan as per the requirements in the Forest Management Planning Manual. In accordance with the Timber Class EA approval and the Forest Management Planning Manual, rationale for those planned clearcuts that exceed 260 ha (i.e. exceptions) must be provided in the forest management plan.

Reporting on actual clearcuts is required in the annual report and the report of past forest operations (5 year report). In addition, actual clearcuts are required for the completion of Table FMP-6 (percentage productive forest area within second order streams clearcut or burned within the last 10 years) in the forest management plan.

Since these specific references in the FMPM are to clearcuts only and not forest disturbances, proximity to wildfires, temporally or spatially, is not considered in either the analysis of planned clearcuts or reports (annual or five year) on actual clearcuts.

5. Insular and Peninsular Residual Area

Insular and peninsular residual area will usually be comprised of mature or older forest area. The minimum requirement however is a young forest that is at least 6 metres in height and .3 stocking. Residual area may include protection forest area, production forest area or treed swamp as long as the height and stocking standards are met.

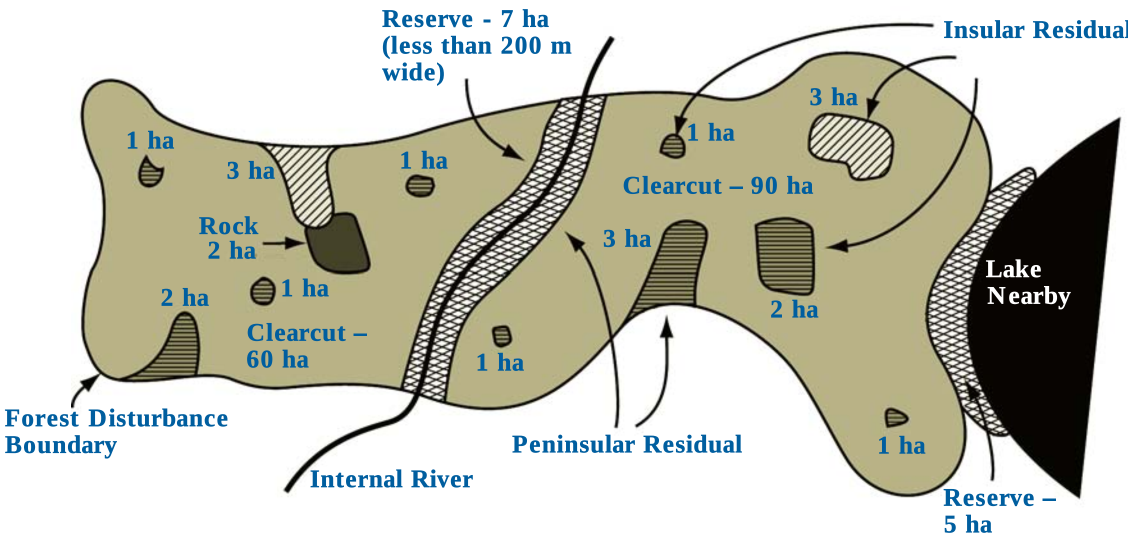
The reserve part of an area of concern can count as residual area as can the modified part as long as the height and stocking standards are met. Bypass areas (part of the forecast harvest area which is not harvested) may also count towards the residual area. Residual area may be part stands, whole stands or any combinations of part and/or whole stands.

A peninsular residual area is defined as an area that extends into the disturbance and has a base of less than 400 metres (clearcuts < 260 ha) or 1000 metres (clearcuts > 260 ha) and generally is longer than it is wide at the base. Figure A2 provides two examples to assist in the determination of a peninsular area.

In practice residual area (both peninsular and insular) may be mapped as small as is practical at a 1:20,000 scale to a minimum size of .25 ha.

To be considered an insular area, the distance from a residual patch to the edge of the clearcut must be at least 20 metres. If the distance is less than 20 metres the residual patch should be considered peninsular residual area.

Figure A1: Measuring/Summarizing Forest Disturbances/Clearcuts

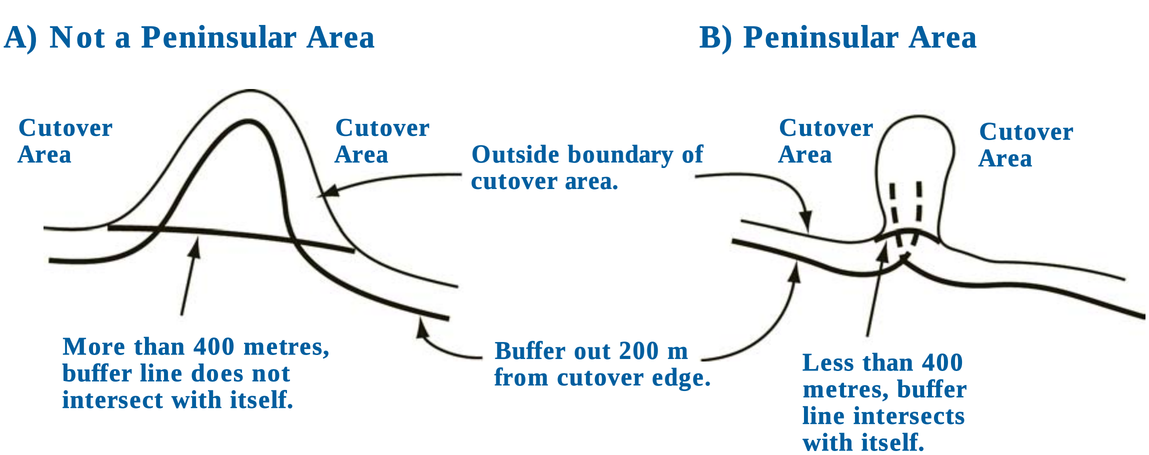


Residual Area	
Protection Forest	
Production Forest	
Non-Forest	
Reserve	

Area Summary			
Clearcut	**90+60**	**= 150 hectares**	**84%**
Insular Residual	1+2+3+1+1+1+1+1	= 11 hectares	6%
Peninsular Residual	2+3+7+3	= 15 hectares	9%
Insular/Peninsular Non-forest (Rock)		= 2 hectares	1%
Forest Disturbance		**= 178 hectares**	**100%**

Note: 5 ha reserve beside the lake is not part of the planned disturbance since it does not meet the definition of a peninsula.

Figure A2: Determining What to Include as Peninsular Area (clearcuts < 260 ha)



The determination of what would become a peninsular residual area is made by buffering out 200 metres from the cutover edge and finding those areas where the buffer line intersects with itself. Note the peninsula is much longer than it is wide at the base.

GLOSSARY OF TERMS

Biodiversity or Biological Diversity – The variability among living organisms from all sources and the ecological complexes of which they are a part; this includes diversity within species and of ecosystems.
Canadian Biodiversity Strategy (CBS). Canada's Response to the Convention of Biological Diversity, 1995.

Biodiversity Indicators – Indicators or measures that allow us to determine the degree of biological or environmental changes within ecosystems, populations or groups of organisms over time and space.
CBS, 1995

Clearcut Noun – An area that has been harvested using the clearcut silvicultural system.

Verb – The removal of most or all merchantable trees in a forest stand or group of stands in one operation.

Corridors – This term is used in a general sense to refer to measures that are taken to ensure the natural immigration and emigration of populations, species and gene flow. This may be a physical corridor, such as a terrestrial or aquatic migration route, a flyway, or it may refer to a particular management practice that allows a species and populations to continue patterns of movement.
CBS, 1995

Forest Disturbance – A natural (e.g. fire) or anthropogenic (e.g. timber harvest) event in the forest that alters the natural succession of a forest stand or stands.

Forest Stand – A community of trees possessing sufficient uniformity in composition, constitution, age, arrangement, or condition to be distinguishable from adjacent communities.

Ecological Management – The management of human activities so that ecosystems, their structure, function, composition and the physical, chemical and biological processes that shaped them, continue at appropriate temporal and spatial scales. Ecological management is sometimes called ecosystem management or an ecological approach to management.
CBS, 1995

Ecosystem – A dynamic complex of plants, animals and micro-organisms and their non-living environment interacting as a functional unit. The term ecosystem can describe small scale units, such as a drop of water, as well as large scale units, such as the biosphere.
CBS, 1995

Edge Effects – Environmental, biological and anthropogenic factors occurring within the ecotone between two habitat types. In a forested landscape, edge effects may extend from disturbed habitat into undisturbed habitat, making it less suitable for species adapted to interior forest conditions but more suitable for "edge loving" species.

Fire Cycle – The normal length of time between fire events for different types of forest.

Fire Pattern – The observable characteristics of wildfire events (includes distribution of burned and unburned patches on a forested landscape, shape and size of disturbances, residual trees, etc.).

Fire Process – Aspects of ecological function that are affected by the occurrence of fire in the forest. Ecological functions can be affected at many scales from the site level (e.g. nutrient cycling) to landscape scale (e.g. forest age class distribution)

Habitat – The place or type of site where an organism or population naturally occurs. Species may require different habitats for different uses throughout their lifecycle.

Interior Area – The core of an area of habitat that is free from edge effects. This can be considered the effective area for species requiring interior habitat.

Landscape – Complexes of terrestrial ecosystems in geographically defined areas. The forest management unit is the geographically defined area for the purpose of the Natural Disturbance Pattern Guide.
CBS, 1995. Forest Management Planning Manual, 1996

Monitoring – The collection and analysis of data over-extended periods of time to collect information on past and present ecological, social, cultural and economic trends and a basis for predictions about future conditions.

Natural – Established by nature.

Selection System – An uneven-aged silvicultural system where mature and/or undesirable trees are removed individually or in small groups over the whole area usually in the course of a cutting cycle.

Shelterwood (harvest method) – A method of harvest where mature trees are removed in a series of two or more cuts.

Seed-tree (harvest method) – Harvesting method where all trees are removed except for a small number of seed-bearing trees that are left singly or in small groups.

Roadlessness – The state of being unaccessed by roads.

Roadless area – An area of wilderness that has a road density below some critical threshold.

Silviculture – The science and art of cultivating forest crops, based on the knowledge of silvics.

Soil Sanitation – The neutralization of soil pathogens (i.e. agents of disease).

Sustainable Development – Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. CBS, 1995

Sustainable Harvest Rate – The rate of harvest that is within an ecosystem's natural ability to recover and regenerate.
CBS, 1995

Sustainable Use – The use of components of biodiversity in a way and at a rate that does not lead to their long-term decline, thereby, maintaining the potential for future generations to meet their needs and aspirations.
CBS, 1995

Traditional Knowledge – Knowledge gained from generations of living and working within a family, community or culture.
CBS, 1995

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