YORK REGION SIGNIFICANT WOODLANDS STUDY

November, 2005

***Prepared For*:**
Regional Municipality of York
Regional Greening Strategy
Transportation and Works Department

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EXECUTIVE SUMMARY

Introduction and Purpose

Approximately 80% of southern Ontario's original woodland cover has been removed. Although this reduction in native woodlands is substantial, what may be more critical is that the remaining woodland patches are much smaller and younger than in the past, and they are often highly disturbed. As a result, woodland conservation in southern Ontario has become a high priority and many organizations, government agencies, including regional municipalities, are involved in programs to increase woodland cover. York Region was approximately 80% forest at the time of settlement. The current forest cover is approximately 23%, with a current goal to attain 25% cover. This study serves several purposes:

1. it assists in the implementation of York Region's Greening Strategy;
2. it will provide information to implement the Provincial Policy Statement; and
3. it fulfils obligations made in ROPA 37 to address the protection of significant woodlands in York Region.

The Greening Strategy is a corporate strategy developed to provide context for Regional decision making that affects the natural environment. This long-term Strategy is a multi-focused initiative intended to ensure that York Region's natural heritage is maintained for future generations. The findings of this study will indirectly serve a number of Greening Strategy initiatives, but is directly required to:

i. address Significant Woodlands policy within the Provincial Policy Statement;
ii. administer the Regional Forest Conservation By-law; and
iii. direct securement and naturalization initiatives.

In order to implement the Provincial Policy Statement (PPS), it is necessary to identify significant woodlands. The PPS does not allow development and site alteration in "*significant woodlands* south and east of Canadian Shield… unless it has been demonstrated that there will be no *negative impacts* on the natural features or their *ecological functions*" (Provincial Policy Statement 2005). However, the definition of significant woodlands provided in the PPS is not specific enough to enable precise identification of significant woodland patches, and indicates that municipalities can develop approaches that achieve or exceed the same objective.

The Regional Municipality of York (York Region) initiated ROPA 37 in 2001. Following public consultation, it was decided to postpone addressing the significant woodlands component until a study could be completed to serve as a basis for mapping and policy development. This provided the impetus for the present study. This study only addresses the identification of woodlands based from a scientific perspective. It did not address policy approaches to protecting woodlands, which is deemed to be a future task.

Methods

There are three main components to York Region Significant Woodland Study:

1. update the York Region woodland patch layer;
2. define criteria for identifying significant woodlands in York Region; and
3. identify opportunities for restoration and stewardship of regenerated and/or new woodlands in York Region.

The existing mapping of woodlands, which was undertaken by the Region based on 1999 colour aerial photographs, was updated using similar methods, but more recent, 2002, colour aerial photographs. The process focused mainly on identifying changes to woodland patches that resulted from development, and boundary revisions (including the inclusion of new patches) that resulted from the succession of young woody growth into young forests. Woodlands were defined using York Region's 1991 tree by-law. A review of other southern Ontario municipalities that have undertaken significant woodland studies was undertaken. From this, and in consultation with the Technical Advisory Team (TAT), a long list of possible criteria was assembled. This was then analyzed and after substantial discussion among team members and the TAT, a final set of criteria for identifying significant woodlands was determined. These criteria were applied to the updated woodlands mapping to identify those woodlands which should be considered significant. Not all the data required to fully apply the criteria are available, thus the identification of significant woodlands in only an approximation. In particular, on the Oak Ridge Moraine, the draft guidelines for identifying significant woodlands under development by the Ministry of Natural Resources will apply, and these will often require site-specific studies to apply. Based on the review of the scientific literature and other municipality's studies findings, a series of recommendations were developed. The Region's criteria for securement were reviewed and guidelines to assist with their implementation were provided. The study process also included two Public Open Houses, in which we presented the study purpose, input to the selection of criteria sought, and the draft findings of the study. Local area municipalities were also consulted in a workshop format to obtain input into the development of criteria for identifying significant woodlands.

Findings

The updated woodlands layer was developed digitally in a Geographic Information System and was provided as a digital product to the Region. The review of other studies as well as the evaluation of the long list of criteria are all documented in the final report for the study. The final list of criteria for identifying significant woodlands are as follows. Only one criterion needs to be fulfilled for a woodland to be identified as significant.

1. *Any woodland that supports any of the following:*
    - *i) any G1, G2, G3, S1, S2, or S3 plant or animal species, or community as designated by NHIC; or*
    - *ii) any species designated by COSEWIC or COSSARO as Threatened, Endangered, or of Special Concern.*
2. *Any woodland that is within 30 metres of a watercourse, surface water feature or evaluated wetland.*
3. *Any woodland over 2 ha:*
    - *i) that is within 100 metres of another significant feature, or*
    - *ii) that occurs within the Regional Greenlands System.*
4. *Any woodland south of the Oak Ridges Moraine that is greater than or equal to 4 ha in size.*
5. *Any woodland north of the Oak Ridges moraine that is greater than or equal to 10 ha in size.*
6. *Any woodland that occurs on the ORM will be evaluated for significance based on the requirements of the Oak Ridges Moraine Conservation Plan and associated guidelines (OMNR 2004, see Appendix 5)*

The application of the criteria identified approximately 97.5% of the total woodland area in the Region as significant. However, only 79.8% of all woodland patches are considered significant. This apparent discrepancy between area and number of patches is owing the very high proportion of patches that are very small (see Table below). Although 55% of all woodland patches in the Region are less than 2 ha, they accounts for only 5% of the area, and the substantial proportion of total woodland area that is considered significant excludes the large number of small patches. The mean size of significant woodland patches is 12.28 ha, which is larger than the mean size of all woodlands, as would be expected. The amount of significant woodland is similar to Halton Region, where 97% of all woodlands were considered significant. In Middlesex County, only 74% of all woodlands were considered significant.

The area of woodlands in each area municipality that are considered significant varies little from the Regional average of 97.5%. Some of the more urbanized municipalities have a very slightly lower proportion of woodlands considered significant (Aurora, 95.2%; Newmarket, 95.1%; Vaughan 96.3%; and Markham 91.2%) as a result of the higher proportion of smaller woodlands there. A slightly higher proportion of woodlands in the more rural municipalities are considered significant (Georgina, 97.8%; E. Gwillimbury; King, 97.4%; and Whitchurch-Stouffville, 98.4%). Richmond Hill falls in the middle, being an urbanized community, but with 97.1% of its woodlands considered significant.

Significant woodlands in each municipality and in the Region overall

Municipality	**Woodland cover (ha) and % cover of each municipality**		**# patches[1,2]**		**mean patch size (ha)**	
	Significant Woodlands	**All Woodlands[1]**	**Significant Woodlands**	**All Woodlands**	**Significant Woodlands**	**All Woodlands[1]**
Georgina	11,674.6 (38.4%)	11,942.5 (39.3%)	441	603	26.47	19.81
E. Gwillimbury	7270.1(29.4%)	7494.1 (30.3%)	461	621	15.77	12.07
King	8127.5 (24.1%)	8343.2 (24.8%)	747	845	10.88	9.76
Newmarket	330.5 (8.7%)	347.4 (9.1%)	73	91	4.53	3.82
Aurora	862.8 (17.5%)	906.6 (18.3%)	118	152	7.31	5.96
Richmond Hill	1360.4 (13.4%)	1401.0 (13.8%)	187	229	7.28	6.12
Whit-Stouffville	5981.3 (28.3%)	6077.4 (28.8%)	457	559	13.09	10.87
Vaughan	3185.8 (11.6%)	3306.9 (12.1%)	455	564	7.00	5.86
Markham	1180.6 (5.6%)	1294.7 (6.1%)	317	414	3.72	3.13
York Region	39,973.1 (22.5%)	41,013.84 (23.1%)[1]	3256	4078[1,2]	12.28	10.06[1]

1. The statistics on significant woodlands incorporates woodlands defined by MNR for the purpose of applying the significant woodland criteria for the ORM (OMNR 2004). The MNR criteria include woodlands not captured by the definition used by York Region, thus the total woodland area and number of patches reported in the statistics in Table 7 is greater than that used for discussing the woodlands update (*e.g.*, in Table 4). Please refer to section 3.4.1 for a discussion on the significant woodlands on the ORM as defined using MNR criteria.

2. The sum of the number of patches in each municipality is greater than the total in the Region since any patch which straddles a municipal boundary will be counted in both municipalities.

Recommendations

Several recommendations are provided that, if implemented will contribute to the attainment of the Regional forest cover target, and allow continued monitoring of woodlands in the Region.

1. *Refine Regional Official Plan policies to protect Significant Woodlands in York Region*
2. *Undertake additional GIS analyses to assist with determining 2-3 top priority areas for restoring large areas (>500 ha) of native woodland.*
3. *Continue to refine the regional forest layer to provide an accurate representation of the woodlands in York Region.*
4. *Continue to implement and expand Greening securement, naturalization and stewardship programs and partnerships using the Securement Guidelines recommended in this report.*

Securement Guidelines

In addition to the recommendations above, guidance was provided for future securement that will enhance the protection of significant woodlands in York Region. York Region is proactive in promoting the protection of woodlands and in facilitating an increase in the woodland cover of the Region through the securement of priority Greenlands. This includes protection through stewardship and management, as well as securement through donors, conservation easements and the land development process. Each guideline serves to enhance the protection of existing woodlands, or increase their conservation value. Securement of the existing remnant woodlands should be a priority for the Region, owing to the exceptionally long time (in most cases over 100 years) it takes to create true woodland conditions. These guidelines build on the Region's existing Securement Criteria. Since urban development limits the re-establishing of substantial woodland habitat, opportunities for restoration occur primarily on agricultural land. However, it is important to understand that this does not imply that all agricultural lands should be restored to woodland. Maintaining a viable and healthy agricultural community is also important, and the restoration of woodlands needs to decided on site by site basis, in co-operation with willing landowners.

Non-wooded areas that satisfy any one of the following guidelines are deemed to be a priority for securement.

Representation

Securement Guideline:

1. Any area that could support a woodland with a species association that is under-represented in York Region.

Increasing Woodland Patch Size

Securement Guideline:

2. Any area that would contribute to increasing the area of an existing woodland to over 16 ha.
3. Any area between existing woodland patches that are part of a group of woodlands (see section 3.1.3) that would facilitate the creation of a woodland greater than 100 ha in size.

Protection of Significant Species
Securement Guideline:

4. Any area that would increase the size of an existing woodland less than 4 ha containing a significant plant species, or less than 10 ha and containing a significant animal species (see Appendix 6 for definition of significant species).

Establishing/strengthening Connections with other Natural Features
Securement Guideline:

5. Any area that, if restored to woodland, would increase the connectivity among two or more existing woodland patches, or between one or more woodland patches and other significant natural features (see Appendix 6 for definition of significant natural features).

Upland Woodlands South of the Moraine
Securement Guideline:

6. Any area that would increase the size or number of upland woodlands south of the Oak Ridges Moraine.

Improving the Shape of Existing Woodlands
Securement Guideline:

7. Any area that, if restored to woodland, would either make an existing woodland patch more circular or square in shape (as opposed to long and narrow), or which creates smoother woodland edges through restoration of indentations in the boundary.

Restore Native Woodland Communities
Securement Guideline:

8. Encourage the conversion of non-native woodlands, especially conifer plantations, to native woodland communities.

1.0 INTRODUCTION

The woodlands[1] of southern Ontario are a high priority for conservation and in recent years there have been a number of initiatives to address their protection (*e.g.*, the Provincial Policy Statement, Kettle and Bates 1999, Larson *et al.* 1999, Halton Region Official Plan). The priority to develop polices for woodland protection stems from the loss of native woodlands throughout southern Ontario. Although wetlands (including wooded wetlands such as swamps and treed bogs) have received much conservation attention in the last 20 years, the conservation of woodlands, especially upland woodlands, has not been adequately addressed.

Larson *et al.* (1999) estimate that by 1920 less than 6% of the original pre-European woodland cover remained in Ontario, and that more has been lost since. Regeneration and reforestation has increased the overall woodland cover; about 13% having been added since 1920, 9% of which is upland "replacement woodland" (sensu Larson *et al.* 1999). However, these replacement woodlands generally have lower quality owing to the cultivation, grazing and erosion of soils that occurred when the land was treeless. Such areas may never support the biological diversity that distinguishes native woodlands. Some of these replacement woodlands have also been lost to development over the last 20 years (Puric-Mladenovic 2003).

Although this reduction in native woodlands is substantial, what may be more critical is that the remaining woodland patches are much smaller and younger than in the past, and they are often highly disturbed. Most current woodland patches are too small to develop the conditions that support interior woodland species (see section 3.2.2). Pearce (1992) reports that 80% of woodland patches between Woodstock, Brantford and Lake Erie are less than 3 ha in size. Interior woodland is now so rare now that any woodland containing interior conditions should be considered significant and special, despite the fact that this was the prevailing condition prior to European settlement, and was abundant throughout Ontario.

When we think of woodlands, most of us think of the woodlands in which we have hiked or camped in southern Ontario. However, these patches, with few exceptions, are a reflection of 200 years of land clearing and re-growth, woodland management, introduced pathogens and other disturbances that have transformed woodlands from their original state. Woodlands in southern Ontario have changed so much that few people, if any, alive today can really imagine what a typical pre-settlement Ontario woodland was like. The best we can do is piece together a notion of how they may have looked from various journals and notes of early explorers and surveyors (section 1.1). None-the-less, these records provide a perspective of what the woodlands of York Region were like in the past and help us in making judgments about what has to be protected and restored to provide woodlands for future generations.

It is unrealistic, and possibly undesirable to attempt to re-create a "pre-settlement" wooded landscape in southern Ontario. However, it is desirable to maintain functional examples of the

[1] The term woodlands is used throughout the report to describe the range of current wooded ecosystems in York Region. It is recognized that this term technically refers to an "open woods" (30 to 60 percent canopy cover), as defined in the Ecological Land Classification for Ontario (Lee *et al.* 1998), but is preferred to "forest" which suggests more expansive and less disturbed systems than most wooded patches in southern Ontario, or "woodlot" which is associated with traditional "working" woods of Ontario farms.

many ecosystems that comprise Ontario, woodlands included. This means that the full range of woodland types and ages should be preserved in sufficiently large patches in order to maintain biological diversity[2]. This does not mean that every woodland patch has to be left untouched. Responsible forestry practices can continue in many woodlands, as can other activities such as maple sugar production, berry and mushroom harvesting, and recreational activities. However, to maximize biodiversity, and perhaps re-create examples of the majestic woodlands of the past, it is desirable to manage some woods solely for conservation values.

Some woodlands, owing to their small size and/or history, have limited potential for maintaining biodiversity values. Such woodlands may still have value in a local context, but from a regional perspective (*i.e.*, Regional Municipality of York) may not be considered significant. One of the main intents of this study is to develop a suite of criteria that will identify those woodlands which should be considered significant from a Regional perspective. It is fully expected that additional woodlands will be identified by local municipalities and conservation authorities as worthy of protection at other, local scales, or for other reasons not emphasized in this study (*e.g.*, local community values, specific education opportunities).

1.1 The Character of Ontario Woodlands

Woodland was the prevalent vegetation cover in eastern North America prior to European settlement (Braun 1950), covering approximately 90% of southern Ontario (Riley 1999). York Region was approximately 80% woodland at the time of settlement (Puric-Mladenovic 2003). The woodlands were largely unbroken, with only small openings from natural disturbances such as fallen canopy trees, small areas of blowdown, and occasional understorey fires. They did not experience the massive, canopy-replacing fires of the boreal forests. Lady Graves Simcoe, who kept a detailed diary of her travels in Upper Canada from 1792-96, wrote:

"I walked this evening in a wood lately set on fire by … some persons who had encamped there, … Perhaps you have no idea of the pleasure of walking in a burning wood, but I found it so great that I think I shall have some woods set on fire for my evening walks. The smoke arising from it keeps the mosquitoes at a distance, and where the fire has caught the hollow trunk of a lofty tree the flame issuing from the top has a fine effect. In some trees where but a small flame appears it looks like stars as the evening grows dark, and the flares and smoke, interspread [sic] *in different masses of dark woods, has a very picturesque appearance…"* 7th July, 1792 (Robertson 1911, pg 115).

The pre-settlement woodlands were structurally diverse with "supercanopy" older growth trees, (mostly white pine) that pierced and rose above the more continuous, shade-tolerant canopy. Beneath the main canopy there was a sub-canopy of trees, as well as tall and short shrubs, forbs and grasses and ground layers of mosses, liverworts and low herbs. The lofty canopies created

[2] Biological diversity (biodiversity) does not mean just preserving the species that once occurred in Ontario (species richness). Preservation of biodiversity includes retention of native biological structure and function over all scales (genetic, species, community, landscape) and the ecological and evolutionary processes that keep them functioning (see Noss and Cooperrider 1994).

cathedral-like spaces beneath them. An idea of what it would be like to walk in such woodlands is provided by an early traveller:

"The grand forests present a more striking appearance than anything else to the eye of one just arrived from the Old World. No one entered their shadows or tread their long-drawn vistas of tall grey stems, spanned by over-arching roof of dark leaves, without the idea of a vast cathedral involuntarily rising in the mind. Like ruined columns, huge prostrate trunks lie strewn around, some but newly fallen, others moss-grown and verdant, with creeping plants; while many show only a dark line of decayed vegetable mould, the last and rapidly disappearing vestige of their former stateliness." (King. 1866., as cited in Larson *et al.* 1999)

Of interest in this quote, is the observation of the various states of decay of fallen deadwood, some acting as host trees to mosses and other woodland plants, some almost fully decayed and noticeable only as a "dark line of decayed vegetable mould". These are characteristics of what we now recognize as "old growth" woodlands, and are a necessary structural feature for capturing the biodiversity of native woodlands.

Not only were the woodlands expansive, but they were older and, therefore, contained much bigger trees. David Douglas, traveling through Ontario in the 1820s, wrote:

"… on the banks of the Detroit River, from Amherstburgh [sic] *to the junction of the Thames with the St. Clair in Upper Canada, and on the opposite banks, in Michigan Territory, on a deep alluvial rich black soil, these trees* [referring to white oak (*Quercus alba*)] *frequently measure from 20 to 25 feet in circumference* [approximately 195 to 240 cm in diameter] *at 8 feet from the ground, and are from 80 to 100 feet high* [24 to 30 metres]" (Douglas 1914 as cited by Fox and Soper 1954).

Similarly,

"One tulip tree near Kingsville yielded six thousand board feet of lumber. Chestnut trees have also been known to equal this… A giant walnut in Metcalf township locally know as 'King of the Forest' measured thirty-six feet in circumference [approximately 350 cm dbh] *one foot above the roots with very little loss of size in the first twenty feet."* (Ontario Lands and Forests. 1963. as reported in Larson *et al.* 1999)

These pre-settlement woodlands supported a very different fauna from the small woodland patches that characterize the current landscape. Top predators such as wolf and cougar were present and black bear were common throughout southern Ontario. Again, Lady Simcoe writes, *"Near the [Don] river we saw the track of wolves*[3]*, and the head and hooves of a deer"* (Robertson 1911, pg. 213)

Perhaps the large trees reported by contemporary travelers were exceptional, but nothing close to these giants remains today as part of a woodland ecosystem. A few woodlands such as the Kinghurst Forest, Marshall Woods, and the "home grove" in Awenda Provincial Park may be in

[3] This would be in reference to gray wolf, which was once common in the forests of southern Ontario.

a late successional stage, but even these lack the range of size classes, structural diversity, overall age and maturity to provide representative examples of pre-settlement woodlands. They are the most highly valued woodlands in southern Ontario and are a model for protection of other woodlands, but they are not sufficient.

A description of the original woodland composition and distribution in York is provided by Puric-Mladenovic (2003). She provides an account of the demise of the pre-settlement forest and the effects that clearing for agriculture, timber production, ash-production and subsequently urbanization had on the Region's woodlands. It is noteworthy that although most of York Region's forests were cleared by the turn of the 20th century, the more recent effects of urbanization (especially in the south) have degraded the remaining woodland patches through increased fragmentation, smaller woodland patch size, increase in the perimeter/area ratio (*i.e.*, more woodland edge and less woodland interior) and reduced connectivity.

The picture of the pre-settlement woodland with its multi-layers and giant canopy trees provides a worthwhile perspective when identifying significant woodlands in York Region (and elsewhere). The woodlands present today which we perceive to be mature ecosystems with "interior woodland", do not fulfill the same ecological roles or provide the high biodiversity which existed in the undisturbed, old-growth woodlands that dominated southern Ontario just 200 years ago. Our current perception that areas of southern Ontario are "well-wooded" because they have 30% or more woodland cover is misguided, because it does not accurately reflect the extensive woodland cover of the original landscape. When viewed from this perspective, all of the remaining woodlands of southern Ontario are important.

1.2 Purpose of the Study

York Region has a number of program areas that will significantly benefit from the products of this study. The Greening Strategy, which is a corporate strategy developed to provide a context for Regional decision making that affects the natural environment, comprehensively addresses a number of these initiatives. This long-term Strategy is a multi-focused initiative intended to ensure that York Region's natural heritage is maintained for future generations. The Greening Strategy provides the Region with a context for policy and implementation decisions that affect natural features. Essentially, the Greening Strategy functions as a platform for Regional initiatives to take place including policy planning, naturalization, Regional Streetscaping, Regional Forest Conservation By-law administration, education, and Property Securement. The Strategy ensures that all of these action areas rationalize and support each other and the policies of the Regional Official Plan. The findings of this study will indirectly serve a number of Greening Strategy initiatives, but is directly required to:

i. address Significant Woodlands policy within the Provincial Policy Statement;
ii. administer the Regional Forest Conservation By-law; and
iii. direct securement and naturalization initiatives.

In order to implement the Provincial Policy Statement (PPS), it is necessary to identify significant woodlands. The PPS does not allow development and site alteration in "*significant*

woodlands south and east of Canadian Shield… unless it has been demonstrated that there will be no *negative impacts* on the natural features or their *ecological functions*" (Provincial Policy Statement 2005, Sec 2.1.4 b); phrases in italics are defined in the policy). However, the definition of significant woodlands provided in the PPS is not specific enough to enable precise identification of significant woodland patches, and the PPS indicates that municipalities can develop approaches that achieve or exceed the same objective (page 36 of the 2005 PPS).

The Regional Municipality of York (York Region) initiated an Official Plan amendment (ROPA 37) in 2001 in which environmental mapping, including significant woodlands would be addressed. Following public consultation, it was decided to postpone addressing the significant woodlands until a study could be completed to serve as a basis for mapping and policy development. This provided the impetus for the present study.

There are three main components to York Region Significant Woodland Study (SWS):

4. update the York Region woodland patch layer;
5. define criteria for identifying significant woodlands in York Region; and
6. identify opportunities for restoration and stewardship of regenerated and/or new woodlands in York Region.

The first component consists primarily of updating the existing digital layer showing woodlands in York Region. This was accomplished solely through examination of aerial orthophotographs and is fully explained in the methods section. The second component involved a survey of other studies addressing the identification of significant woodlands in southern Ontario, review of the technical basis for determining significance, and development of a recommended suite of criteria for defining significant woodlands in York Region. The third and last aspect of the study entails the development of recommendations for securement, restoration and stewardship of woodlands in York Region, with the overall goal of creating a vision for Woodlands of the Future in the Region.

The focus of this study has been to identify woodlands that are significant at the Regional Level. The policies that will address how these woodlands will be protected will be developed subsequent to this report. Although there is an expectation that regionally significant woodlands will receive a high degree of protection, it is also expected that policies will identify how other woodlands can be incorporated into future development proposals such that impact to their ecological values is minimized. Also, since this study specifically focuses on Regional significance, there is the expectation that local municipalities will further evaluate woodlands in a local context, and go beyond the Regional criteria for significance where warranted. Thus woodlands that do not currently meet the Regional criteria for significance, may be identified as significant woodlands locally.

2.0 METHODS

2.1 Review of Background Information

The first step in the selection of criteria was to review the work done to date by other agencies and municipalities on identifying significant woodlands. Of great help in this regard was the work undertaken by Ontario Nature (2004) to survey Ontario municipalities and determine what initiatives had been undertaken for identifying and preserving woodlands in southern Ontario. Additionally, Ontario Nature (2004) has developed a set of criteria for identifying significant woodlands. The findings of the survey by Ontario Nature were used to identify municipalities who had completed studies on identifying significant woodlands, and/or developed policies to protect them. Environmental planners from each municipality and agency were contacted to discuss their experiences and secure any reports or policies. A list of individuals contacted is provided in Appendix 1. Based on these consultations, the findings from eight municipalities were reviewed and summarized.

In addition to contacting other municipalities, initiatives by the Ontario Ministry of Natural Resources were reviewed including:

- Natural Heritage Reference Manual for Policy 2.3 of the Provincial Policy Statement (OMNR 1999);
- Oak Ridges Moraine Technical Paper No. 7, Identification and Protection of Significant Woodlands on the Oak Ridges Moraine (OMNR 2004);
- Woodland Valuation System version 2.0 (Rowsell 2003); and
- Significant woodlands in the Greater Toronto Area, draft guidelines (Kowalyk pers. comm.).

This last paper is still undergoing review and has not been released for general circulation. The Terrestrial Natural Heritage System produced by the Toronto Region Conservation Authority (TRCA 2004) was also reviewed with respect to the criteria used to evaluate a range of natural heritage features.

From this review of work undertaken to date, a long list of 22 potential criteria were developed for consideration in the development of a suite of criteria for York.

2.2 Technical Consultation

This project was undertaken with on-going consultation with the project team at York Region, and a Technical Advisory Team (TAT). Meetings and telephone consultations were held with the York staff on an as-needed basis, whenever important decisions or guidance was needed on the project. Four meetings with the TAT were held to provide updates on the progress of the project, obtain feedback on preliminary findings and recommendations, and to review approaches for the upcoming tasks. Additionally, there was substantial dialogue on the development of criteria for assessing significance, most of which was undertaken using email. A meeting was also held with representatives from the area municipalities to update them on the project and to obtain input to the development of the criteria.

2.3 Public Consultation

Two public open house sessions (POH) were held during the course of the project and the project was posted on the Region's web site. The first POH session consisted of two events, one in the south part of the Region, and one in the north. The same presentation was made at both sessions. Attendance at the first POH was lower than expected, with 2 attendees at the south event and 13 at the north event.

The first session was undertaken near the outset of the project and included: introduction to the project; review of the methods and initial findings of the woodland layer update; input to the selection of criteria for significance.

The second POH consisted of one event and was held at the Regional municipal offices in Newmarket. Approximately 12 display boards were provided and the attendees had time to review the boards and ask questions of the Regional staff and consultant team. A presentation was provided that included the approach to the project, the updated woodlands layer and the criteria for identifying significant woodlands. This was followed by a formal question and answer period. Approximately 30 people attended the event.

2.4 Woodland Layer Update

2.4.1 Creation of Updated Woodland Layer

York Region had developed a digital woodland cover layer using aerial photograph coverage from 1999 (Lane *et al.* 2001). Although this was completed and refined over several years, it is referred to here as the "1999 layer" or "1999 update" in reference to the source on which it is based. Field studies accompanied this work to verify the accuracy of the Region's GIS work, and to gather additional field data, using a customized version of the Ecosystem Land Classification (ELC). Ultimately, the GIS coverage delivered by that project was a "snapshot" of woodlands as they existed in York Region in 1999.

The 1999 woodland coverage identified all areas that satisfied the definition of a woodland in the Region's Tree By-Law (Regional Municipality of York 1991[4], as cited in Lane *et al.* 2001). The regional Tree By-law defined a woodland as an area equal to or greater than 0.5 (0.2 ha) in size that achieved a density of either 1) 400 trees, of any size, per acre, 2) 300 trees, with a diameter > 5 cm, per acre, 3) 200 trees, with a diameter >14 cm, per acre or 4) 100 trees, with a diameter > 20 cm, per acre (Regional Municipality of York 1991). For the purpose of this definition, a tree was defined as any species of woody plant which has reached or could reach an average height of at least 15 feet at physiological maturity (Regional Municipality of York 1991).

[4] Note that the Regional Tree By-Law was updated in 2005, after the update component of this study was completed. The new by-law provides measurements in metric format (e.g., hectares), however, because the analysis in this study used the imperial measurements in the 1991 by-law, they are retained in the report when discussing the definition of a woodland.

The current study includes a review and update of York Region's 1999 woodland coverage using more recent (2002) digital orthophotos. The same definition of woodland was used. The extent of the current update was limited to 1) identifying new woodlands that had developed since the 1999 update, and 2) deleting or refining the boundaries of woodlands that had been altered or removed. New woodlands included areas of natural woodland succession extending out from the edge of an existing woodland patch, or the development of a new patch, as a result of natural succession and/or tree planting. Specifically, there was no intent to review the individual boundaries of every woodland patch in the 1999 woodland layer and refine them.

Basically, GIS technology was used to compare the Region's existing 1999 digital woodland coverage with the 2002 digital orthophotos to: 1) identify discrepancies between the 1999 and 2002 orthophotos, and 2) update the existing woodland information to reflect the most recent woodland conditions. Since there are 1959 orthophotos, covering nearly 2000 km^2, the update represented a formidable task and a succinct methodology was required to focus efforts to those areas where either recent development or succession had resulted in changes to woodland cover.

The comparison of woodland coverages and subsequent updates were all undertaken using ESRI's (Environmental Systems Research Institute) ArcView Geographic Information Systems (GIS). Each 2002 orthophoto was overlain with the woodland patches from the 1999 layer. These were visually scanned on-screen at a scale of 1:4800 to identify differences in woodland coverage between 1999 and 2002. These differences were subject to review and potential update. There are several reasons for differences between the 1999 and 2002 coverages:

1. a woodland may have been wholly or partially removed between 1999 and 2002;
2. succession may have occurred such that an open area present in 1999 developed sufficiently by 2002 to meet the definition of woodland noted above; or
3. the better resolution of the 2002 orthophotos provided increased ability to identify woodlands.

In addition to these explanations, there may be differences in woodland cover attributable to differences in the scale at which the orthophotos were viewed and/or interpreted by the analyst, especially with respect to the stage of succession at which the woodland definition is satisfied. The digital boundary of the Region was refined since the 1999 update study. For the 2002 analysis (*e.g.*, generating statistics), all patches were "cut" at the Regional boundary, thus for any woodland patch that straddles the Regional boundary, only the portion within York Region contributed to the calculation of statistics. However, the digital layer provided to the Region, includes the entire patch boundary, including any portions outside the Region.

The current study updated woodland information based solely on an examination of the 2002 orthophotos; no field studies or ground truthing was undertaken. In recognition of this, woodland patches that did not show obvious signs of disturbance or development between 1999 and 2002, were not modified, as the 1999 digital patch boundaries were assumed to be more accurate (based on the field studies undertaken as part of the 1999 study). For example, if an area appeared to satisfy the Region's definition of a woodland, in both the 1999 and 2002 orthophotos, but was not defined as such in the 1999 woodland coverage, we deferred to the existing coverage and did not update or refine the boundary. Similarly, if an area did not appear

to satisfy the Region's definition of a woodland, in either the 1999 or 2002 orthophotos, but was defined as a woodland in the existing woodland coverage, we did not perform an update or redefine the woodland's boundaries, on the assumption that the delineation was based on fieldwork as part of the 1999 update.

In addition to looking at the 1999 woodland layer (which consists of digitized polygons representing woodland boundaries), the 1999 orthophotos were also consulted to help understand decisions made in the 1999 exercise. By "toggling" between the 1999 and 2002 orthophotos, with the 1999 boundaries superimposed, decisions from the 1999 exercise were often clarified, and guidance provided on the appropriate refinement in this current update. To focus in on discrepancies, it was often necessary to magnify ("zoom into") the area in question on-screen, beyond the initial review scale of 1:4,800.

The comparison of orthophotos made it much easier to isolate those areas that strictly related to succession and development. The comparison was achieved by configuring our GIS to overlay: 1) 1999 orthophotos of the Region, 2) the 2002 orthophotos of the Region, 3) a non-editable, original version of the 1999 woodland coverage, and 4) an editable version (working copy) of the woodland coverage. Collectively, updates to the working copy eventually culminated in a revised woodland layer based on the 2002 orthophotos. Another coverage, which was labeled the index, was created to document and monitor the type and extent of updates performed to construct the new (2002) woodland coverage.

All updates to the working copy were performed on-screen at a scale no greater than 1:2000. Several types of updates were performed on the working copy of the woodland coverage to reflect recent conditions and were documented in the index as: 1) woodland boundary revisions (succession or a disturbance affecting a woodland); 2) woodland deletions (entire woodland was removed or reduced below an area of 0.5 acres [0.2 ha]); or 3) woodland additions (an entirely new woodland, disjunct from any existing woodlands). The general location where updates were performed and the nature of these updates were recorded in the index coverage. The index coverage was also used to flag and reserve controversial updates that were best resolved by group deliberation and/or consultation with the client and the Technical Advisory Team.

The woodland definition does not discriminate among naturally occurring woodlands, tree plantations or commercial tree-growing operations (Christmas tree farms, nurseries, *etc.*), all of which were included in the woodland layer. It would likely be beneficial to separate short-rotation commercial operations from natural woodlands and mature plantations for development of future policies. However, this is not possible based solely on the examination of orthophotos, since it is not possible to discriminate them from plantations.

2.4.2 Guidelines for Updating Patches

Any narrow woodland that served to connect two larger patches was automatically included within the boundaries of one of the woodland patches. Successional areas that met the size criteria of a woodland were examined by selecting 0.5 acres (0.2 ha) of representative growth in the patch. The stems of the young trees were counted within this representative sample area, by increasing the scale of magnification as necessary. Where the woodland patch ended abruptly (*i.e.* , formed a discrete edge) the edge of the woodland was easily recognized and was digitized

as the boundary of the woodland polygon. Woodland patches with "fuzzy" or non-discrete boundaries, such as might occur in an old field where natural succession is occurring, were more subjectively defined; nevertheless, a polygon boundary with the best possible fit was established that captured tree densities equal to or above 400 stems per acre (200 stems/0.5 acres [0.2 ha]) from the surrounding growth.

If the successional woodland occurred within 7 m of an adjacent woodland polygon, the boundary of the existing polygon was expanded to encapsulate the new successional woodland. Successional woodlands isolated by more than 7 m from adjacent woodlands were digitized as discrete patches and assigned a unique polygon identifier. There is no hard rule for establishing how far successional vegetation should be from an established edge before it constitutes a separate polygon. The 7 m was considered a reasonable distance and was based on professional judgement during the development of protocols for evaluating boundaries. When a successional woodland united two or more adjacent, but formerly disjunct, woodlands the identifier of largest patch was assigned to the amalgamated patch. Non-treed areas greater than 600 m^2 located within a woodland were excluded from woodland patches (this area was based on a typical opening associated with a residence within a woodland). Woodland patches that were reduced below 0.5 acres [0.2 ha] by a disturbance were deleted from the updated forest layer.

2.4.3 Short Rotation Commercial Woodlands

Following discussions with the project team from York Region, it was decided to include all plantations in the initial woodland layer. However, once the update was completed, some short rotation commercial woodlands were removed by utilizing the Ecological Land Classification (ELC) layer provided by the Lake Simcoe Region Conservation Authority (LSRCA). The LSRCA digital ELC layer was interpreted from orthophotographs, and also referred to the 1999 York woodlands layer. Specifically, woodland patches from the York layer were classified as woodlands in the LSRCA ELC, with a few exceptions where particularly small and sparse groupings of trees may occasionally been classified as "cultural woodland" in the LSCRA (Baker pers. comm.). The LSRCA work identified patches as small as 0.5 ha, and also included some fieldwork. Based on the fieldwork, some Christmas tree farms were classified as "intensive agriculture". Advantage was taken of this and the updated York woodland layer was overlain with the ELC. Any woodland patches, or portions of patches, that intersected with LSRCA's "intensive agriculture" polygons in the ELC were removed.

2.4.4 Quality Control

After updating the woodland patches, a series of quality control/quality assurance (QA/QC) techniques were implemented to find errors or omissions in the spatial data. New woodland patches were given an identifier value greater than 100,000 to distinguish them from the original woodland patches, thus allowing comparisons and checks to be made. A number of quality control routines were undertaken as noted below.

1. Patches in the updated 2002 woodland layer were checked to make sure that there were no "dangling" arcs and that all patches contained attribute data.
2. A random search was implemented to check the consistency in the attribute data between the updated woodland patches and the 1999 coverage.

3. Woodland patches that were not deleted were checked to ensure that the identifiers in the 2002 layer were the same as in 1999.
4. After the woodland cover update had been completed, all orthophotograph tiles from which a woodland patch had been deleted were reviewed a second time and the validity of each deletion re-assessed.
5. A random sampling of 98 tiles (5% of the total number) were overlaid with the updated forest layer. Each tile was reviewed to ensure 1) all woodland patches that should be captured were in the updated layer, 2) there were no woodland patches in the updated layer that should be deleted, and 3) and boundaries of woodland patches on the updated layer were appropriate.
6. A visual comparison was used as a quality control/quality assurance process to verify the deletions of woodland patches that fall within areas designated as 'intensive agriculture' in the Lake Simcoe Conservation Authority's ELC (see section 2.4.3). Using ArcInfo, areas designated as 'intensive agriculture' were used as a back coverage and the woodland polygons were coloured with a solid fill. Woodland patches that were deleted from the updated woodlands layer were also used as a back coverage, but in this case, only their outlines were used. The final woodland layer was overlaid on the other 2 layers. A check was made to verify that none of the patches found in the final woodland layer were situated within an area designated as 'intensive agriculture'. Similarly, the deleted woodland patches were checked to confirm that they fell into an area of 'intensive agriculture'. Since the updated woodland patches layer and the 'intensive agriculture' layer are from two different data sets, a check was made to see if adjacent woodland patch boundaries conformed to that of the 'intensive agriculture' boundaries with the 'intensive agriculture' boundaries taking precedence. A total of about 50 percent of the polygons where checked.
7. The "grouping exercise" (see section 2.4.6) was also checked. In total, there was 265 tiles randomly checked, 61 had no woodland patches and 204 had woodland patches. Out of the 204 tiles checked, approximately 50 of these tiles required on screen measurements to verify the separation between polygons was greater than 20 m or less than 20 m based on the grouping number. No errors were found.

2.4.5 Updating Woodland Cover Statistics

Once the woodland cover update was completed, descriptive statistics were generated on the number of woodland patches, their total area and mean patch size. In order to provide a better understanding of the distribution of patch sizes, the number of patches within several size classes was calculated (<2 ha, 2-4 ha, 4- 10 ha, 10-15 ha, 15-20 ha and >20 ha). These statistics were calculated for the whole Region, the area north of the Oak Ridges Moraine (ORM), the area on the ORM and the area south of the ORM (see section 2.5.3 for rationale for this breakdown), as well as by area municipality and by major watershed (Lake Ontario and Lake Simcoe).

Woodland communities had been delineated within some patches in the 1999 woodland layer. This resulted in some woodland patches being divided into smaller segments, each of which was assigned a unique identifier. To avoid each of the vegetation types being counted as a separate woodland patch, these internal divisions were deleted for the purpose of calculating statistics. A separate layer with these dissolved internal lines was not created.

In generating these statistics, the total land base of York Region was used, excluding those portions of the Region that encompass Lake Simcoe. This was perceived to be reasonable since the Lake has no capacity to support woodland and, as it is a sizeable area, its inclusion would result in an underestimate of woodland cover. Other surface water features were included in the area of the Region.

2.4.6 Conceptual Grouping of Patches

It is recognized that two or more woodlands in close proximity can, in many respects, function as one woodland patch (see section 2.6). Based on this, and following discussions with the TAT, it was decided that woodlands separated by less than 20 metres would be treated as a single, functional woodland patch. The 20 metres was chosen as it is slightly less than a standard road ROW, thus precludes including many gaps that contain roads. The draft guidelines for identifying woodlands on the ORM use a similar approach (section 4.3, MNR 2004). These grouped woodlands are referred to as the "ecological woodland patches" in recognition that it more accurately reflects the ecological values of woodland patches for many species. It is important to note, however, that some species are far more affected by even small openings in a woodland than others, and that this grouping of patches does not represent a functional woodland patch for such species.

The grouped patches are not used for calculating statistics (*e.g.*, number of patches, area of woodland, *etc.*). The ecological patches were only used for applying the criteria for significance.

To create the ecological woodland patches, each woodland patch in the updated coverage was buffered by 10 metres. Where buffers from two woodland patches intersected, the patches were associated with each other in an attribute table. Using this method it was found that in some areas a large ecological woodland patch was formed from 20 or more woodland patches, each of which was within 20 metres of at least one other patch. Each woodland patch in a grouping maintained it's original shape and attribute data. Unique identities were assigned to each group of woodland patches. The intervening areas of up to 20 metres between woodland patches were not included in statistics related to the "ecological woodland patch".

2.4.7 GIS Products and Metadata

Three GIS files were provided to the Region as part of this project. The first file, woodnew.shp, constituted the updated woodland layer. A second file, woodfin.shp, included the updated woodland patches, but with the short-rotation woodlands (*e.g.*, Christmas tree farms) removed (see section 2.4.3). The third file, sigfor.shp, applied the significant woodland criteria to the extent possible given the available data. Complete metadata were provided for all three files, the descriptive portion of which is provided in Appendix 7.

2.5 Criteria for Determining Significant Woodlands

2.5.1 Selection of Potential Criteria

An initial list of 22 criteria was assembled through a review of significant woodland studies and projects that had been completed elsewhere in southern Ontario. Additionally, phone interviews were conducted with the relevant, knowledgeable staff person in the following 8 municipalities/agencies:

- Halton Region;
- Durham Region;
- Niagara Region;
- Lambton County;
- Norfolk County;
- Middlesex County;
- City of Hamilton; and
- Grey-Sauble Conservation Authority.

This list was developed primarily through discussion with Michael Peppard from Ontario Nature, who was able to direct us to the municipalities that have made the most progress in protecting significant woodlands. A list of people contacted is proved in Appendix 1. Criteria from the City of London were also reviewed, but since North-South Environmental Inc. was currently working on the significant woodlands project in London, no interview was deemed necessary. Where municipal criteria had been developed, they were assembled into a summary table.

We also interviewed Michael Peppard with respect to Ontario Nature's project to promote the protection of significant woodlands, and reviewed the Ontario Nature report (Ontario Nature 2004). In addition, the following reports were reviewed and summarized:

- the Natural Heritage Reference Manual (OMNR 1999);
- the draft criteria developed for protecting woodlands on the Oak Ridges Moraine (OMNR 2004); and
- the criteria from the test application for identifying significant woodlands in Eastern Ontario (Rowsell 2003).

This process yielded an initial list of 22 potential criteria.

2.5.2 Review and Evaluation of Potential Criteria

The 22 potential criteria were initially evaluated based on the following five questions.

1. ***Is the criterion defensible?*** This question was evaluated by determining if there was a scientific rationale for the criterion. Preferably there are studies and/or published papers that can be used to justify the criterion being evaluated.

2. ***Can it be quantified?*** Criteria that could be quantified were viewed as being preferable to those that required a judgement and professional opinion for their application.

3. ***Are there data available to enable application of the criterion?*** Since it is the intent of this study to apply the criteria and determine the extent of significant woodlands, it was deemed preferable, but not essential, that data be available to enable application of the

criteria. However, it was recognized that the evaluation of a particular woodland could be done at a future date, such as at the time of an application for a development, at which point site-specific information could be collected. Therefore, a criterion would not be excluded from use simply because data were not currently available.

4. ***Are there known thresholds?*** Although some potential criteria reflect important ecological characteristics of woodlands, it is not always possible to determine at what point the criteria reflects significant values. For example, species richness may be a good descriptor of woodlands, but there are no clear standards that indicate when species richness becomes significant.

5. ***Are field data required to apply the criterion?*** This is similar to question 3, but relates specifically to the need to undertake field studies to collect data, as opposed to assembling information from remotely sensed data. Owing to the size of the Region and the cost of undertaking detailed field studies, it was thought that criteria that could be applied using data from remotely sensed sources would be preferable because these criteria are more cost effective than those requiring field studies.

These questions were used to determine the suitability of each of the potential criteria. The answers to the questions were not always "yes" or "no". For example, one criterion may be more defensible than another, but neither may be 100% defensible or completely indefensible. Likewise, thresholds may have been developed for some criteria, but they may not be well tested or widely used. None-the-less, these questions helped identify criteria that were very useful, those which would be completely unsuitable, and provided information about the rest that assisted in the selection of a final suite of criteria.

The original list of 22 potential criteria had been assembled into a matrix that indicated their source and the measures used to apply them. The matrix was presented to the public at the first set of Public Open Houses (POH) to solicit input. Participants at the POHs were each provided five sticky dots and asked to place one dot beside the 5 criteria they deemed most important. This activity did not necessarily inform the scientific credibility of each criterion, but it did inform the process by identifying characteristics and functions of woodlands that were considered important to the public.

The 22 initial criteria were then evaluated by the consultant team in a "brain-storming" session. The results of this session were then presented to the TAT in a day-long workshop for further input and review. As a result of these evaluations, the list was refined by combining a few similar criteria, and eliminating a few which were felt not suitable for further consideration for application in York Region, and adding others. This eventually resulted in 24 potential criteria.

The initial 22 potential criteria were also presented to the area municipalities in York Region in a half-day workshop. Strengths and weaknesses of each criterion were discussed and input provided on the suitability of each for inclusion in a final list. One general finding of this exercise was that the significance of woodlands at the Regional and Local scale (referring to the area municipalities) may well be different. It was agreed that the Regional criteria need to reflect the much larger area of the Region, and that the area municipalities may need to respond more to

local values that reflect the desires of residents at the community level. To accommodate this, local municipalities may need to "go beyond" the criteria used to establish Regionally Significant woodlands and include woodlands that are significant at the local scale.

Based on the evaluations and consultations of the long list of potential criteria, the consulting team selected a suite of draft criteria that focus on scientific defensibility and application at the Regional scale. This draft list was further refined through dialogue with the Regional study team and TAT members, primarily through email.

2.5.3 Recognition of Regional Differences

York Region is one of the larger municipalities in southern Ontario. In the south it includes the urbanized local municipalities of Markham, Richmond Hill and Vaughan, while the more northern area municipalities such as East Gwillimbury and Georgina are predominantly rural in nature. The Region is also more or less bisected by the Oak Ridges Moraine, development on which is subject to the Oak Ridges Moraine Act, and associated regulations and Conservation Plan.

It was decided early on in the project that the final suite of criteria should recognize the coarse regional differences in settlement patterns, current land use and physiography. Approaches to accounting for these differences were discussed with the TAT, and it was agreed that the Region should be sub-divided into 3 broad zones: north of the ORM, on the ORM and south of the ORM. This approach is similar to that taken for the Halton Region Significant Woodlands Study (Gartner-Lee 2002), which recognized urban areas, rural areas below the Niagara Escarpment and areas above the escarpment as being distinct.

It is important to note that in evaluating and developing the final suite of criteria, a Regional focus was maintained. The decision to use the three zones for developing criteria is a reflection of broad Regional differences. It is the expectation of this study that area municipalities will review the woodlands within their jurisdictions and evaluate the need for protection that reflects local values. The intent of this study was to assess significance at a Regional level.

2.6 Application of the Significant Criteria

In order to provide a more ecological focus for the application of criteria, many woodland patches in close proximity to each other were grouped together and treated as one patch for the purpose of applying the criteria (section 2.4.6). The ecological rationale for this is that woodland patches which are very close (<20 m) function as a single patch for many species of wildlife and plants. For example, a narrow cut in woodland patch (*e.g.*, for a telephone line corridor) generally would have resulted in the delineation of two discrete patches in the updated forest layer. However, most birds, many small mammals, probably most plants, etc, would have no difficulty in crossing the opening, thus functionally treating both patches as one woodland. It is noted, however, that such openings are undesirable as they change woodland characteristics such as light, moisture, temperature, *etc.*, and provide access for humans, predators and edge species, thus inhibiting interior forest conditions developing and introducing impacts. Also, there are some wildlife species for which such openings are barriers, and this may also impact dispersal of

plant seeds. Thus while openings are undesirable, if they are narrow, the adjacent woodlands can function as one patch for many species.

The land cover within the openings is probably very important in determining the extent to which it is a barrier. Since this could not be easily determined, it was decided, though discussion with the TAT, to use a distance of 20m as the criterion for grouping woodland patches. Such a narrow width precludes some of the land uses which would limit movement between patches. For example, since a standard right of way for a 2-lane road is approximately 20m, this would ensure that the opening could not support wide arterials or roads with developed lots either side. The Natural Heritage Reference Manual considers woodlands continuous if separated by space of less than 21 metres (OMNR 1999, pg 76).

The significance criteria were applied to the grouped woodland patches. Thus the size criterion for north of the moraine, which identifies all woodlands over 10 ha as significant (see section 3.3) would include all patches in a group if the sum of all those patches exceeded 10 ha. Thus two 6 ha patches within 20 m of each other would be considered significant as they were considered to function as one 12 ha woodland for most species. Similarly, a 2 ha patch that was within 20 metres of a woodland greater than 10 ha would be considered significant since it would be grouped with the larger woodland patch. However, the areas in between patches was not counted in woodland area, and patches were considered discrete when counting number of patches and determining mean patch size. Thus the grouping did not create another larger patch, but simply associated existing patches within 20 m of each other.

3.0 FINDINGS

3.1 Update of Regional Woodland Cover

3.1.1 Summary of Changes between 1999 and 2002

Of the 1959 orthophoto tiles, there were deletions in 33, additions in 316, and boundary revisions in 587. A total of 1204 tiles did not have any modifications in them. Many of these were tiles which covered primarily urban areas, with little or no woodland cover. The tiles in which changes were made were distributed fairly evenly across the Region. The digital boundary of York Region was refined from the 1999 update, and as a result, 8 small patches amounting to 2.13 ha which were formerly included within the Regional boundary are now excluded, as was an additional 9.63 ha of woodland in patches that straddled the boundary.

Table 1 provides a summary of the distribution of woodlands in York Region and a comparison with the 1999 woodland layer. The update resulted in a net addition of 271woodland patches in 2002. This overall increase in patches resulted from a number of woodland patch deletions, additions and numerous revisions to patch boundaries. The overall woodland cover was virtually the same as in 1999, there being a small reduction from 22.69% to 22.54% cover. This is equivalent to a difference of 259.35 ha of woodland in the Region. The mean size of woodlands was also virtually the same, with an decrease of only 0.83 ha.

Table 1: Summary of woodland cover in the York Region in 1999 and 2002

	total area (ha)	**total woodland area (ha)**		**% woodland**		**# of patches**		**mean patch size**	
		1999	**2002**	**1999**	**2002**	**1999**	**2002**	**1999**	**2002**
York Region	177,550.26	40,284.73	40,025.38	22.69	22.54	3864	4171	10.43	9.60
North of the ORM	66,515.27	-	20,278.58	-	30.49	-	1494	-	13.57
On the ORM	55,757.32	-	14,636.42	-	26.25	-	1819	-	8.05
South of the ORM	55,277.68	-	5110.39	-	9.25	-	1103	-	4.63

Given the changes in the methods used to identify woodland between the 1999 update and the present update, it is not possible to assign any importance or assume any trend based on the slight differences between 1999 and 2002. First, the substantially better resolution of the 2002 orthophotographs permitted more accurate boundary delineation. Although boundaries of all patches in the 1999 layer were not refined (see section 2.4.1), some were, as it was convenient to make corrections when doing some boundary revisions. The boundary delineations from 1999 tended to be generous, and likely slightly over-estimated woodland cover.

Caution should be used when examining changes in patch numbers between 1999 and the present update. Some of the patches that were deleted may have been a result of development. In other cases the amalgamation of two or more woodland patches may have occurred where the boundary of a larger patch was re-drawn to subsume one or more smaller patches due to the fact that natural succession resulted in the presence of woodland within the intervening space. Thus, not all patch deletions reflect a reduction in woodland area.

Table 2 shows a breakdown of woodland north, on and south of the ORM. The lower woodland cover south of the ORM (9.24%) reflects the more urban environment present. Woodland cover increases to the north with 26.25% woodland cover on the ORM and 30.49% north of the ORM. The big difference in woodland cover is clearly between the area south of the ORM and the two areas to the north. The change in mean patch size is also consistent with the more rural character of the north part of the Region, patches in the south averaging 4.63 ha in size (Table 1), while north of the moraine they average 13.57 ha. Although the overall woodland cover on and north of the ORM is comparable, it is interesting that there are more, but on average, smaller patches on the moraine itself. This suggests greater woodland fragmentation on the moraine than to the north.

Looking at the Region as a whole, the cumulative percent increase in woodland cover from one category to the next is very similar among size classes less than 20 ha (1-2%), suggesting that proportionally, no one size class in small to medium sized woodlands contributes substantially more to overall woodland cover than any other. However, there is a trend for the smaller woodlands to contribute less to the overall woodland cover from north to south, despite the much

Table 2: Distribution of woodlands in York Region by size category

Size Category	# of Patches % of total	Area (ha), % of area	Cumulative Area (ha)	Cumulative % of entire Region
All of York				
< 2ha	2278 (55%)	2012.52 (5%)	40,025.38	22.54%
≥2ha to ≤4ha	681 (16%)	1945.10 (5%)	38,012.86	21.41%
>4ha to ≤10ha	611 (15%)	3849.51 (10%)	36,067.76	20.31%
>10ha to ≤15ha	181 (4%)	2177.84 (5%)	32,218.25	18.15%
>15ha to ≤20ha	89 (2%)	1533.73 (4%)	30,040.41	16.92%
>20ha to ≤50ha	192 (5%)	6000.24 (15%)	28,506.67	16.06%
>50ha to ≤100ha	78 (2%)	5590.48 (14%)	22,506.43	12.68%
>100 ha	61 (2%)	16,915.96 (42%)	16,915.96	9.53%
all areas > 20 ha	331(8 %)	28,506.68 (71%)	-	-
Total	4171 (100%)	40,025.38(100%)	-	-

Size Category	# of Patches % of total	Area (ha), % of area	Cumulative Area (ha)	Cumulative % of entire Region
On Moraine				
< 2ha	1063 (58%)	885.62 (6%)	14,636.42	26.25%
≥2ha to ≤4ha	272 (15%)	786.29 (5%)	13,750.80	24.66%
>4ha to ≤10ha	233 (13%)	1450.35 (10%)	12,964.51	23.25%
>10ha to ≤15ha	73 (4%)	892.98 (6%)	11,514.16	20.65%
>15ha to ≤20ha	37 (2%)	635.62 (4%)	10,621.18	19.05%
>20ha to ≤50ha	86 (5%)	2717.41 (19%)	9985.55	17.91%
>50ha to ≤100ha	34 (2%)	2387.88 (16%)	7268.14	13.04%
>100 ha	21 (1%)	4880.26 (33%)	4880.26	8.75%
all areas > 20 ha	141 (8%)	9985.55 (68%)	-	-
Totals	1819 (100%)	14,636.42 (100%)	-	-

North of Moraine				
< 2ha	809 (54%)	656.30 (3%)	20,278.58	30.49%
≥2ha to ≤4ha	215 (14%)	607.36 (3%)	19,622.28	29.50%
>4ha to ≤10ha	210 (14%)	1330.89 (7%)	19,014.91	28.59%
>10ha to ≤15ha	65 (4%)	783.37 (4%)	17,684.02	26.59%
>15ha to ≤20ha	42 (3%)	737.75 (4%)	16,900.65	25.41%
>20ha to ≤50ha	78 (5%)	2374.36 (12%)	16,162.90	24.30%
>50ha to ≤100ha	36 (2%)	2601.21 (13%)	13,788.54	20.73%
>100 ha	39 (3%)	11,187.33 (55%)	11,187.33	16.82%
all areas > 20 ha	153 (10%)	16,162.90 (80%)	-	-
Totals	1494 (100%)	20,278.58 (100%)	-	-

South of Moraine				
< 2ha	599 (54%)	540.04 (11%)	5110.39	9.24%
≥2ha to ≤4ha	204 (19%)	587.19 (12%)	4570.34	8.27%
>4ha to ≤10ha	186 (17%)	1167.58 (23%)	3983.16	7.21%
>10ha to ≤15ha	50 (5%)	587.51 (12%)	2815.57	5.09%
>15ha to ≤20ha	21 (2%)	362.47 (7%)	2228.07	4.03%
>20ha to ≤50ha	34 (3%)	1084.13 (21%)	1865.60	3.37%
>50ha to ≤100ha	8 (1%)	648.61 (13%)	781.47	1.41%
>100 ha	1(<1%)	132.86 (3%)	132.86	0.24%
all areas > 20 ha	43 (4%)	1865.6 (37%)	-	-
Totals	1103 (100%)	5110.39 (100%)	-	-

greater proportion of woodland patches in these size classes. The small patches (<2 ha) contribute relatively little to overall woodland cover in each area, ranging from only 3% north of the moraine to 11% south of the moraine. In comparison, the relatively fewer large patches (>20 ha) contributed most to overall woodland cover, even in the south where they contributed 37% of all woodland cover. This is most striking in the north where 80% of the woodland cover is contributed by woodlands >20 ha. These trends emphasize the influence of the very large woodland patches, especially north of the moraine.

The number of woodland patches in the 2-10 ha classes constituted a slightly greater proportion of the total woodland cover in the area south of the moraine (36%), than on the moraine (28%) or north of the moraine (also 28%). The proportion of patches in the <2 ha class is amazingly similar in all three areas and in the Region as a whole (55% in the Region, 54% north and south of the moraine, and 58% on the moraine). Not surprisingly, most of the very large woodlands (>50 ha) are on or north of the moraine. For instance over half of the 61 woodlands >100 ha are north of the moraine (39), and there is only one woodland >100 ha south of the moraine.

3.1.2 Breakdown of Woodlands by Municipality and Watershed.

Table 3 shows the breakdown in woodlands between the two main drainages in York Region. Not surprisingly, the Lake Simcoe drainage in the north has a larger mean patch size, has a much higher proportion of woodland cover, and contributes a high proportion to the regional cover, than the Lake Ontario watershed.

Table 3: Summary of the woodland cover in the main watersheds in York Region

	woodland area (ha)	**No. patches**	**mean patch size (ha)**	**% total woodland area in Region**	**% total land area of watershed**
L. Ontario watershed	9,034.95	1757	5.14	22.57	11.48
L. Simcoe watershed	30,990.43	2437	12.72	77.43	31.34
Total	40,025.38	4194*			

* note total number of patches is greater than the total number in the Region since any patch which straddles the watershed divide will count as a patch in both watersheds.

Table 4 illustrates the breakdown of woodland cover by municipality. Trends in this table are consistent with the breakdown of woodlands north, on and south of the moraine; and when compared by watershed. The southern, more urbanized municipalities of Markham, Vaughan, Richmond Hill and Newmarket have the lower proportion of their land area in woodland (6% to 12%). Aurora, although fairly urbanized, has an intermediate woodland cover (17%), while the less urbanized municipalities of Whitchurch-Stouffville, King, East Gwillimury and Georgina have the highest woodland cover (23% to 39%). Similarly, the municipalities with the largest mean patch sizes are the two northern areas of Georgina and East Gwillimbury. The proportion to which each municipality contributes to the Regional woodland cover has to be interpreted carefully, as it is dependant on the size of each municipality. Thus Newmarket contributes the least to Regional woodland cover at least in part because it is the smallest municipality.

Table 4: Summary of woodland cover in each municipality in York Region

Municipality	area of municipality ha (% of Region)	woodland area ha (% woodland cover/municipality)	No. patches	mean patch size ha	% woodland cover of Region
Georgina	30,399 (17.1%)	11,942.5 (39%)	603	19.81	6.73
E. Gwillimbury	24,762 (14.0%)	7,447.8 (30%)	629	11.84	4.19
King	33,665 (19.0%)	7,748.8 (23%)	928	8.35	4.36
Newmarket	3,819 (2.2%)	341.6 (9%)	93	3.67	0.19
Aurora	4,943 (2.8%)	860.4 (17%)	168	5.12	0.48
Richmond Hill	10,152 (5.7%)	1,261.9 (12%)	265	4.76	0.71
Whitchurch-Stouffville	21,119 (11.9%)	5,896.5 (28%)	588	10.03	3.32
Vaughan	27,432 (15.5%)	3,233.7 (12%)	574	5.63	1.82
Markham	21,259 (12.0%)	1,292.3 (6%)	413	3.13	0.73
Totals	177,550 (100%)	40,025.4 (22.5%)	4261*	9.57	-

* note total number of patches is greater than the total number in the Region since any patch which straddles the municipal boundary will count as a patch in both municipalities.

3.1.3 York Woodlands based on "Ecological Patches"

As discussed in the methods (section 2.4.6), woodland patches were considered as an ecological group if they were within 20 m of each other. This substantially changes some of the woodland characteristics as shown in Table 5. The total number of patches is reduced by 1629, and the mean patch size is increased from 9.60 ha to 15.75 ha. The actual number of grouped patches is 532 (*i.e.* , this is the number of groups containing more than 1 patch); the remaining 2010 patches are discrete. The groups contain varying numbers of patches, some being just two patches in a group, and most consisting of fewer than 10 patches in a group. However the three largest groups contain a surprising 104, 50 and 49 patches each. These groups are respectively 2,749 ha, 3,926 ha and 2,711 ha in size. For some mobile groups of species (for which 20 m gaps are not a barrier), these grouped woodland patches may provide substantial woodland habitat. The definition of woodland used in the update must also be kept in mind, as many of the woodland patches may be younger successional woodlands occurring in old fields. These large groups of patches might thus be best considered potential future woodlands.

Table 5: Characteristics of grouped versus un-grouped woodland patches

No. patches		mean patch size	
un-grouped	**grouped**	**un-grouped**	**grouped**
4171	2542	9.60 ha	15.75 ha

One valuable outcome of this exercise is that it may provide guidance on where restoration efforts could produce substantial gains in the size of continuous canopy cover with very large areas of interior woodland. Figure 1 illustrates the distribution of woodlands in York Region and highlights grouped woodlands that are between 100 ha and 500 ha, and those over 500 ha in size. The ability to restore the 20 gaps that separate woodland patches within these groups will largely depend on ownership, the nature of intervening lands and the geometric relationship of the patches within the group. However, the immense conservation value of having several woodlands over 100 ha in size, and one or more woodlands over 500 ha in size in the future (even the distant future) justifies the investigation of the feasibility to pursue this suggestion and hopefully a long term strategy to create such woodlands.

3.2 Criteria for Identifying Significant Woodlands

3.2.1 Review of Other Agencies and Municipalities

Appendix 2 summarizes the results of the survey of four agencies and organizations and Appendix 3 summarizes the review of criteria used, or proposed for use by the municipalities reviewed. These surveys resulted in the identification of 22 potential criteria. Only one criterion, size, was recommended by all the agencies and municipalities. Three criteria, interior woodlands, proximity and contribution to surface water quality/quantity were recommended by three of the four agency reports, all other criteria being recommended in only one or two of the reports. Interior woodland and contribution to surface water quality/quantity were the only criteria recommended by all the municipal reports. Linkage was recommended by one, and age by four municipalities, with all other criteria being recommended by three or fewer municipal reports.

The TRCAs (2004) Terrestrial Natural Heritage Study uses similar criteria to assist in the evaluation of natural areas. The system design principles include: size, biodiversity, shape and connectivity, all of which are used by municipalities in our survey, as well as: quantity (percent of natural cover), distribution, and matrix influence.

If one were to assemble a list of recommended criteria solely on precedent based on 75% concurrence of either the agency reports and municipalities, it would include: size; interior woodland, age, linkage, proximity to other natural features, and contribution to surface water quality/quantity.

insert Figure 1

Figure 1: Woodlands in York Region

3.2.2 Description and Evaluation of Potential Criteria

This section provides a brief description each criterion. The initial 22 criteria were refined, with some criteria being merged (*e.g.*, protection of recharge/discharge areas and groundwater quantity and quality, social/economic values with recreational values), and a few criteria being added (*e.g.*, representation of different aged woodlands, protection of significant landforms) to provide a total of 24 criteria. The description of each criterion varies in length since the ecological importance of some of the potential criteria (*e.g.*, size, and age) is well documented, whereas others (*e.g.*, buffering capacity, quality) are less well defined. Also, some potential criteria generated more discussion with the TAT than others.

This section mainly discusses the merits of the criteria and indicates whether each is recommended for use in identifying significant woodlands. The final suite of criteria that emerges from this analysis is presented in section 3.3, along with more detailed descriptions of the actual thresholds recommended.

Size

The size criterion is based on the well accepted principle that large woodlands are more valuable than smaller woodlands from a conservation perspective. All significant woodland studies reviewed included size as a criterion.

Southern Ontario was originally dominated by a woodland landscape, however, removal of woodland for agricultural and urban development has fragmented the once extensive woodland tracts. This has resulted in a patchwork of woodland fragments that vary in size from less than a hectare, to several hundred hectares. Most woodland patches in York Region are less than 2 ha (table 2).

Fragmentation of woodland is one of the most serious threats to biological diversity (Burgess and Sharpe 1981, Harris 1984, Marzluff and Ewing 2001, Meffe and Carrol 1994, Noss and Cooperrider 1994). It reduces the overall amount of habitat, and also creates small patches out of larger remnant woodlands. Smaller woodlands lack the ability to support species that require woodland interior conditions and species that are area sensitive. Larger woodland patches are more resilient to natural disturbances. A 1 ha blowdown in a 100 ha woodland becomes part of the natural mosaic, however, in a 4 ha or smaller woodland it would remove 25% of the habitat and will likely result in a serious reduction of woodland diversity. Riley and Mohr (1994) note that woodland patches greater than 4 ha can begin to develop interior woodland conditions assuming the patch shape is appropriate and disturbance minimal. It should be noted that the term “interior woodland” is used quite generally and the habitat requirements for different species are specific. While 4 ha may be the point at which appropriate habitat may start to develop for species that are edge-intolerant, there are many more conservative species for which this is inadequate. Environment Canada *et al.* (1998, Table 4) conclude that woodlands of 4 ha will only support very few common edge bird species and that even 10 ha woodlands are still dominated by edge species and may have only very small areas of interior which support numbers of woodland interior/edge species. Notwithstanding this, TRCA staff have found in their jurisdiction, that some area-sensitive species will inhabit smaller than normal woodlands when there is no optimal habitat, providing the surrounding land uses are not too incompatible. Some flora typical of interior woodlands may also persist for some time in smaller woodlands,

but will not likely survive in the long term unless smaller woodland patches are expanded and/or connected within an ecologically functioning system.

The Natural Heritage Reference Manual (OMNR 1999) provides guidance on size standards for woodlands to be protected on the basis of general woodland cover. It recommends woodlands of 4 ha in size be protected where the woodland cover is between 5% and 15%, and 40 ha where the cover is between 15% and 30%. Ontario Nature (2004) suggested more stringent guidelines for identifying woodland significance with respect to size as follows:

Woodland Cover	Minimum Patch Size for Significance
< 5%	all woodlands
5-10%	2 ha
11-15%	4 ha
16-20%	10 ha
20-30%	15 ha
31-50%	25 ha
>50%	40 ha

Hamilton and Durham Region use the Ontario Nature guidelines in their determination of significance, whereas others have used minimum size criteria ranging from 2 ha (Norfolk and Halton) to 10 ha (Middlesex). London considers woodlands less than 2 ha to be of low value, those between 2 and 9 ha to be of medium value and those greater than 9 ha to be of high value. In York Region, woodland cover is 30% north of the ORM, 26% on the ORM and 9% south of the ORM (table 1).

Smaller woodlands (<4 ha), although generally less valuable ecologically (assuming they have no special features such as rare plants, or special functions such as connection or thermoregulation of a watercourse), may be important in the context of surrounding land use (*i.e.*, in urban landscapes where there is little woodland cover) and may serve as a nucleus for restoration and rehabilitation efforts. Thus a woodland of 1 or 2 ha in an urbanized area may be more significant than the same area of woodland in a rural landscape, that overall has a greater amount of woodland cover.

Based on the importance of woodland size in maintaining biodiversity, it is selected as a criterion for determining significance.

Presence of Woodland Interior

The edges of woodlands are known to have different ecological characteristics than the interior of woodlands. For example, temperature, wind, humidity, proportion of non-native species, numbers of nest predators, human impacts, *etc.* are all characteristics which change near woodland edges (Matlack 1993, Riley and Mohr 1994, Burke and Nol 1998). The distribution of flora and fauna is affected by the edge and in particular some species of fauna favour woodland interior conditions (Riley and Mohr 1994, Hounsell 1999, McCracken 1999). Edge effects have

been shown to extend hundreds of metres into woodlands (Noss and Cooperrider 1994, Meffe and Carroll 1994, Larson *et al.* 1999), however, these effects diminish with distance from the edge and 100 metres has been used by a number of authors (Riley and Mohr 1994, Hounsell 1999, Gartner-Lee 2002) as a distance beyond which there is the potential for interior woodland conditions to exist. All of the programs reviewed (see Appendices 2 and 3) had significance criteria related to identifying woodlands with interior woodland.

The maintenance of woodlands with interior woodland is especially important when viewed in relationship to the historical extent of woodland and the fauna that it supported, and the present day fragmented distribution of woodland in the landscape. As noted previously, the development of southern Ontario has resulted in highly fragmented woodlands. There is an abundance of small woodlands and subsequently "edge-type" woodland habitat is common. What is uncommon are large patches of woodland that have substantial areas of interior woodland that support populations of interior and area demanding species.

It is important to note the relationship between interior woodland and size. Using the definition that interior woodland must be at least 100 metres from an edge, interior woodland will start to be defined in a patch greater than 3.14 ha, if it is a perfect circle, or greater than 4 ha if it is square. For a circular woodland patch to have 2 ha of interior habitat it must be 10.15 ha in size, and to have 4 ha of interior habitat it must be 14.2 ha in size. Thus if an interior woodland criterion determined significance based on the presence of 4 ha of interior woodland, it would only discriminate those woodland patches larger than 14.2 ha. If the final suite of criteria included a size criterion that protected all woodlands greater than 10 ha, the interior woodland criterion would be redundant, as all woodlands with 4 ha of interior will already be protected by the size criterion.

Based on the importance of interior woodland habitat for protecting biological diversity, it is recommended that it be used as a criterion for determining significance, providing that it will discriminate new woodlands not captured by other criteria.

Age and Old Growth

These two potential criteria are discussed together since they are inter-related.

While age itself may not be an ecologically valuable attribute, the conditions that tend only to occur in old and undisturbed woodland are very significant. The value of using age as a criterion is not to protect old trees. The intent would be to use age as a surrogate to identify woodlands with mature characteristics such as:

- an uneven-aged canopy;
- a range of size classes, with a large proportion of trees in larger size classes;
- gap succession processes are the principal form of woodland renewal
- the presence of undisturbed soils;
- the presence of habitat that supports interior woodland species; and
- the presence of substantial standing and fallen deadwood, with the fallen deadwood present in a range of decay classes.

The ultimate expression of a mature woodland is called "old growth". The characteristics described above are best expressed in old growth woodlands. For example, Ontario Nature (2004), in recommending significance criteria for their Level 3 evaluation, include woodlands exhibiting older-growth characteristics including: old trees, pit and mount topography, significant woody debris, little evidence of human disturbance, significant numbers of snags and den trees, *etc.*

Old woodlands (including old growth) produce very different environments than younger ones, and support species and communities of flora and fauna that are unique. They are also considered to be more valuable than young woodlands because there are fewer of them and it takes a substantial length of time to replace them. Old woodlands also serve as scientific benchmarks and reference sites. To maximize biodiversity and to maximize representation of woodland types and species composition, examples of old, mature woodlands should be protected.

The mean age of woodlands in southern Ontario has been decreasing over time (Larson *et al.* 1999), that is, Ontario woodlands are getting younger. This is mainly owing to forestry practices which strive to maximize timber yield by promoting short-rotation harvesting (Forbes 1997). Larson *et al.* (1999) estimate that there is about 1% of mature woodland (they use the term "older growth") left in Ontario, and only "trace" amounts of old growth. There are no woodlands in York Region that would be considered "old growth" (Puric-Mladenovic pers. comm.). However, there are a few woodlands: Joker's Hill, Baker's Bush and a few others on private land, that approximate what the old growth in this area may have looked like. These woodlands have big trees and some characteristics of old growth woodland. Given the lack of old growth woodlands in southern Ontario, a woodland patch with old growth conditions should be considered significant.

Although conservation of any remaining old growth is a desirable goal, it is also important to protect mature woodlands that have the capacity of achieving old growth conditions if protected and managed appropriately. Hagan and Whitman (2004) refer to these mature woodlands as "late successional forest" and the term "older growth" (Larson *et al.* 1999) has also been used. Conservation of late successional or mature woodland is important since old growth woodland cannot be easily created. There is a difference of opinion on the extent to which current silvicultural practices can be used to hasten the development of old growth attributes. The Society of American Foresters (1984, as cited in Riley and Mohr 1994, p. 28) note: "*With present knowledge it is not possible to create old-growth stands or markedly hasten the process by which nature creates them*". However, Jenkins et al. (2004, pg 35) note, "*The application of these same* [silvicultural] *practices to restore old-growth characteristics in eastern coniferous and mixed hardwood forests remains largely theoretical. Nevertheless, it seems warranted that some of these practices, judiciously applied under closely monitored conditions, could be employed to reset the successional trajectories of stands toward old-growth*." The difficulty in reproducing the conditions that characterize old growth and the exceptionally long time for replacement (>100 years), infers value on older, mature woodlands, which have the capacity to develop old growth characteristics.

One of the issues with using age is the appropriate threshold for applying the criterion. Hagan and Whitman (2004), reporting on hardwood and softwood woodlands in Maine, define the beginning of their late successional woodland at approximately 95 years; Forbes (1997), notes the onset of maturity within tolerant hardwood mixed woodland in the Greater Fundy Ecosystem in New Brunswick at 120 years. In Ontario, mid to late successional woodlands were identified as occurring at 60 to 100 years of age, and old-growth at over 100 (Riley and Mohr 1994). MNR (1999) recommends that any woodland with an uncommon characteristic, such as age, that is represented by less than 5% of the woodland in a planning area should be considered significant, as should woodlands over 100 years of age.

The development of a woodland environment associated with mature woodlands is not a function of age alone. A mature woodland environment would only develop where interior woodland conditions prevail (i.e., it is not expected that mature forest conditions would develop in small or narrow woodlands where edge habitat prevails). Interior woodland is discussed above, but generally a minimum of 4 ha is required before interior conditions can theoretically begin to appear, and to sustain just 2 ha of interior woodland usually requires just over 10 ha of woodland overall. The Natural Heritage Reference Manual (OMNR 1999) suggests that interior conditions begin to appear at about 10 ha, and the Significant Wildlife Habitat Guidelines (OMNR 2000) suggest at least 4 ha, and preferably more, of interior woodland for area-sensitive forest species. Thus, since the intent of the age criterion is to capture an area representative of mature woodland conditions (*i.e.* , not just a point), 10 ha should be considered the minimum size of woodland patch that is worthy of consideration when applying the age criterion.

Whatever the nomenclature and threshold for definition, the rationale for preserving old woodland is the same:

- woodlands are getting younger and thus mature woodland should be protected to preserve the biodiversity associated with it;
- mature woodlands are temporally closer to developing “old growth” conditions, and thus warrant protection; and
- mature woodland is not easily replaced as it takes a long time to develop.

Old growth presents problems in application as it is difficult to measure and the thresholds for determining old growth are not well documented and are different for different woodland communities. Thus, a cedar woodland will have different old growth characteristics than one dominated by maple and beech. Old growth seems to be most often identified using age, often 120 years (*e.g.*, MNR 1994). Old growth was recommended only by Ontario Nature, for their Level 3 evaluation, and Durham, who adopted the Ontario Nature criteria. No other municipalities used old growth as a significance criterion. For these reasons, it is recommended that old growth not be used as a criterion for identifying significant woodlands.

The Technical Advisory Team for this project was divided on the merits of using age as a criterion for establishing significance. The TAT agreed that the biodiversity values associated with older, mature woodlands were appropriate for identifying significance, but were not convinced that age was a good surrogate for directly measuring the conditions which accompany maturity. It was suggested at the TAT that another measure of biodiversity be used to identify mature woodlands, but no such criterion was agreed to as being appropriate. The main concerns

of the TAT with respect to age were: 1) difficulty of establishing an appropriate threshold, and 2) lack of an appropriate method for establishing the age of the community. Defining an appropriate threshold age, although feasible, is contentious, as is the method for determining woodland age in the field (in the context of this project). However, we feel that other methods, such as using tree size classes, are equally problematic, because although they are relatively easy to measure in the field, it would be difficult to define thresholds (*e.g.*, what size classes should be used to define mature woodland, and what proportion of the total basal area should be in each size class?). Lastly, there are no data currently available to allow application of either criterion.

Notwithstanding the difficulties, the importance of mature woodlands from a conservation perspective warrants serious consideration of age as a potential criterion for identifying significant woodlands. Four municipal studies on significant woodlands, recommended using age in some form as a criterion (Appendices 2 and 3), as does the Natural Heritage Reference Manual (OMNR 1999) and Ontario Nature (2004) as part of their Level 3 evaluation. Age is positively correlated with maturity and all mature or old growth woodlands would be considered old relative to the majority of woodland patches that remain in southern Ontario.

However, age should only be included in a suite of criteria for determining significance if it discriminates new woodland patches. As noted above, there is a minimum area required for mature woodland conditions to develop (10 ha is recommended). If all woodlands of the size needed to protect a reasonable area of mature woodland conditions are captured through the size criterion, then there is no need to include the age criterion in the suite. In the final analysis (see section 3.3), all woodlands greater than 10 are captured, thus the age criterion, though important, is not needed in the final suite of criteria for identifying significant woodlands.

Slope

It has been suggested that woodlands on slopes assist in erosion control and thus such woodlands should be considered significant. Of the 11 significant woodlands studies reviewed, 5 used this as a criterion, but 2 of those (Eastern Ontario Woodland Evaluation and Durham) used the criteria from the Ontario Nature (2004) study. It was included by Ontario Nature in part because it was a criterion that could be applied using available digital data (Peppard pers. comm.). Although woodlands on slopes may play a role in stabilizing the slope overall, they do not necessarily inhibit surface erosion as is often claimed. Ground vegetation beneath woodland canopies is generally sparser than open fields or grasslands, and thus does not function as well for erosion protection. The deep root systems of woodlands may play a role in preventing massive slope failure. Gartner-Lee (2002, page 15) point out that, *"… the erosion of a soil mass is a complex process… to be able to simplify this process by relating just two factors, such as vegetative cover and slope, can be scientifically criticized."* We do not consider there to be strong reasons to use slope as a criterion and it is recommended that it not be used for identifying significant woodlands.

Quality

The quality criterion generally refers to the degree of human disturbance within a woodland, the idea being that woodland with little disturbance is more significant than woodland with extensive disturbance. The types of human disturbance encompass a wide range of activities including: management practices such as timber harvesting and maple sugar production, cattle grazing, and

recreation activities such as hiking (especially the development of *ad hoc* trails), mountain biking, BMX circuits (Bicycle Moto-cross), horse riding, fort building, dumping of garbage and garden refuse, removal of plant material, *etc.* The use of motorized recreational vehicles such as all terrain vehicles (ATVs) and motorcycles also appear to be coming more prevalent in woodlands. Some of these activities are acts of vandalism and may not be legal, while others may be appropriate management activities. The extent and type of human disturbance has been studied (*e.g.*, Matlack 1993) and generally is most severe near edges, and declines in severity away from the edge. TRCA (2004) also takes into account the land uses that occur around the edge of a woodland patch to infer it's quality.

A second component of this criterion is related to biological quality. This is usually expressed in terms of the number of non-native species that have invaded a woodland and/or the quality of the vegetation (*e.g.*, is there a high proportion of native invasive species, which are usually plants of more open environments). The Floristic Quality Index (FQI) was developed to measure such changes and is discussed later in this section of the report.

The Quality of a woodland is often correlated with its size and historic use. Proximity to human habitation also has a substantial influence on bird species composition and breeding success (Friesen 1998, Friesen *et al.* 1995). There are several difficulties with this proposed criterion:

- thresholds for some parameters related to the degree of human disturbance are difficult to determine;
- evaluation requires site-specific information that is not available; and
- the criterion does not account for the regenerative capacity of woodlands and that a woodland with considerable human disturbance could, with appropriate management, could recover over time.

Owing to these difficulties, this criterion is not recommended for use in determining significance. The TAT concurred with this recommendation.

Linkage

This criterion recognizes the importance of woodlands that are part of a linked system of natural features. This includes consideration of Natural Heritage Systems, where the long term vision is one of a connected landscape. Woodlands that provide linkage to other natural features are more significant than those that are isolated, all other factors (size, age, rare species, *etc.*) being equal. All but one of the municipal studies on significance that were reviewed included linkage, or contribution to connectivity as a criterion.

As was discussed with the size criterion, fragmentation is one of the greatest threats to woodlands. Although keeping woodlands intact is the best approach to preventing fragmentation, the impacts of fragmentation can be mitigated to some extent by establishing linkages between them. Such linkages between woodlands should be composed of similar habitat to the areas being linked, to provide opportunities for the movement and dispersal of obligate woodland animals and plants. Thus, woodlands that serve a linkage function in the landscape by connecting two or more other patches are particularly valuable from a conservation perspective. Based on this, it is recommended that linkage be used as a criterion to determine significance. Linkage is partially accounted for by the protocol for delineating boundaries, as

any narrow woodland that served to connect two larger patches was automatically included within a woodland boundary.

This criterion is strongly related to the "proximity" criterion, since if a woodland is providing a linkage function it is generally going to be proximate to another natural feature.

Proximity

The general rationale for this criterion is that woodlands that are near to another valued natural feature may be significant for maintaining species diversity and abundance (Pearce 1993). Proximity of woodlands to each other and to other natural features may increase the habitat available to mobile species. This provides for more robust populations by reducing the likelihood of local extinctions through facilitating the re-colonization of woodland patches where species have been eliminated through random events (weather, predation, disease, *etc.*). Proximity also provides opportunities for the dispersal of young wildlife species, as well as plants. In effect, populations in two or more woodland patches that are proximate to each other interact and behave like one large population, referred to as a "metapopulation" by ecologists (Noss and Cooperrider 1994).

In the Middlesex Natural Heritage System study (UTRCA 2003), a significant negative correlation was found between native plant species richness and distance between natural features and ANSIs. Thus the shorter the distance between a woodland and an ANSI, the greater the species richness. Woodland patches closer to ANSIs were also found to have fewer non-native species and fewer aggressive species. The wetland evaluation system (OMNR 1993) recognizes the ecological value of proximity, as it permits the complexing of small wetland patches that are as much as 750 m distant from each other. TRCA (2004) also uses a proximity criterion in the evaluation of "matrix influence" for defining Natural Heritage Systems.

There are several issues to consider in evaluating this criterion:

- the distance between features and the nature of the intervening land influences the functional relationship between and among features that are close to each other; and
- the availability and suitability of nearby habitat will vary among species (depending on their vagility and habitat needs), and the greater the distance between features, the fewer species will benefit.

Both Norfolk County and Middlesex County recommended the use of proximity to other features for identifying significance, suggesting distances of 50 metres and 750 metres respectively. In a landscape where woodlands are fragmented, the ability for organisms to move and disperse amongst natural areas is important for maintaining biological diversity. Woodland patches that are proximate to each other and facilitate such movement are therefore important. Proximity is thus recommended as a criterion for determining woodland significance.

Representation (community)

The intent of this criterion is to protect the full range of woodland types that are native to York Region. This is related to the biodiversity criterion, as the protection of a greater range of native woodland types would be expected to provide greater biological diversity.

The concept of using representation as a basis for designating natural features is well established and is a fundamental component of protected area programs such as the National Parks System (Parks Canada 1972) and the provincial protected areas programs (Provincial Parks, Conservation Reserves, ANSIs, *etc.*) (Crins and Kor 2000). In addition to maintaining biodiversity values, capturing representative examples of the range of biotic and abiotic features of the Region provides examples of the pre-settlement landscape an thus has a cultural heritage value as well.

Notwithstanding the merits of a representation criteria, its application requires a knowledge of the full range of features, in this case woodland communities, to be able to evaluate the extent to which they are included in a system of significant sites. Representation is generally based on pre-settlement characteristics (*i.e.* , the intent is to capture the range of woodland types that existed prior to most of their removal). Extensive work has been undertaken to model the "potential vegetation" of York Region (Puric-Mladenovic 2003), based on modelling exercises. Although this provides a good approximation of the potential pre-settlement vegetation, it may not be sufficient to designate significance. The historical record is not complete enough to accurately document the pre-settlement vegetation. In addition, there is no clear guidance on how to determine when a particular community type is under-represented and thus warrants designation as significant, *i.e.* , how much of each community is needed? No defensible threshold could be determined.

Possibly owing to the difficulty of implementation, none of the municipal studies on woodland significant reviewed used representation as a criterion. Ontario Nature (2004) recommended it for their Level 3 evaluation, but did not provide any specific measures.

In view of the difficulty with implementation, representation of communities was not selected for identifying significant woodlands. It should be noted that some under-represented communities may be captured through the significant features criterion.

Representation (age)

The intent of this criterion would be to ensure that woodlands encompassing a range of ages are identified as significant. It is recognized that woodlands at various stages of development will support different assemblages of flora and fauna. To maximize biodiversity, it is therefore important to capture all ages of woodlands. This criterion overlaps with the age and old growth criteria.

It was determined that there is no need for this criterion since the range of ages is captured through the definition of woodlands used in this study. The definition (Appendix 4) includes all areas that support tree species in specified densities. The definition does not eliminate young woodlands; for example, a regenerating abandoned field with a high density of white ash saplings only 2 metres high would be considered woodland. Thus, any woodland that meets any of the selected criteria will be considered significant regardless of age. This should ensure that a full range of woodlands with respect to age will be considered significant.

None of the municipal or other studies on significant woodlands used a criterion to ensure a full range of woodland ages were defined as being significant.

Shape

The rationale for a shape criterion is to capture woodlands that are of such a shape that they have the potential to support interior woodland conditions. For example Pearce (1993) used a perimeter/area index to classify woodlands in southern Ontario. This was used to characterize woodland patches and showed the proportion woodlands that were primarily "edge" as opposed to "interior" woodland.

The value of interior woodland is discussed earlier in this section and it was recommended as a criterion for determining significance (pending the size criteria selection). Issues associated with shape are addressed through inclusion of a interior woodland criterion, thus a separate shape criterion is not required.

Ecological Functions

This criterion was intended to generally recognize that woodlands that provide specific ecological functions such as: surface water storage, shading of surface water, wildlife habitat, carbon sequestration, improvement of air quality, *etc.* should be considered significant. Although these are important considerations, this criterion was considered too wide ranging and too inclusive to evaluate and apply. For example, there are some woodland functions which were widely accepted when discussed by the consultant team and TAT (*e.g.*, contribution to surface water quality), and others which were more contentious (*e.g.*, groundwater protection function). Additionally a number of woodland functions are captured by other criteria. For these reasons, ecological functions was rejected as criterion for determining significance.

Surface Water Quality and Quantity

The intent of this criterion is to recognize that woodlands associated with surface water features perform a significant role in enhancing their quality, quantity and function. These functions include: thermoregulation, filtering of surface water run-off, soil stabilization, attenuation of surface flows, contribution of organic matter, addition of structural diversity (in-stream snags, *etc.*), nutrient flows and provision of wildlife habitat. These functions are well documented in the literature (*e.g.*, Welsch 1991, Osbourne and Kovacic 1993, Vought *et al.* 1995). Gartner-Lee (2002, section 4.3) provide a good discussion of the relationship between surface water and woodlands. Their findings include:

- thresholds for the distance at which woodlands influence water quality range from 4 m to 1000 m;
- predation of fish and other aquatic organisms by terrestrial species results in a nutrient transfer from the surface water feature to adjacent woodlands; and
- recommended distances for woodlands influencing thermoregulation, filtering of sediments and pollutants and erosion control ranged from 4 m to 300 m;

All of the studies on significant woodland criteria examined in the review included a criterion that recognizes the role of woodlands in protecting surface water quality and quantity. The measures ranged from simple distances (*e.g.*, Halton and Hamilton use 30 m, Middlesex recommended 50 m) to broader measures such as: catchments of first order streams (Durham), within first 3 orders of watershed catchment (Norfolk), or hydrological features/functions present (London).

Based on the important role woodlands play in contributing to surface water quality and quantity, proximity to a surface water feature is recommended as a criterion for determining woodland significance.

Groundwater Quality

The role of woodlands in protecting groundwater resources received substantial debate among members of the TAT. Generally, it was accepted that woodlands can serve to protect areas important for groundwater by precluding any activities or land uses (*e.g.*, urban development or agriculture) that may be harmful to groundwater recharge. However, the actual role of woodlands in the protection of groundwater is not clear, and the evidence on the importance of woodlands in groundwater protection is conflicting.

Trees actually limit the amount of precipitation that reaches the ground as leaves and trunks intercept raindrops, thus reducing ground water infiltration. Also, evapotranspiration from woodlands may reduce the volume of water that is infiltrated. Gartner-Lee (2002) reviewed the literature on the relationship of woodlands to groundwater protection and conclude that the data are conflicting and that, *"… there was no rationale for designating woodland function on hydrogelogically sensitive areas as being more significant than on areas not sensitive …"*

There has also been discussion of the role of woodlands in protecting steam baseflow and channel stability via "subsurface flow regimes" (*i.e.* , shallow lateral groundwater movement). The suggestion has been made that streams in wooded watersheds have less "peaky" hydrographs; such that following storm events, flows elevate more gradually and do not dissipate as rapidly as in non-wooded watersheds. Buttle (1996) suggests that reforestation in the Ganaraska River watershed may have ameliorated maximum and minimum daily run-off. However, he also points out that the effect of woodland cover changes on peak and low flows are inconclusive (citing Hewlett 1982). Booth (2000) discusses at length the relationship of watershed imperviousness to stream impacts, but the imperviousness is generally a result of land development without *"..much, if any, effective stormwater protection."* Booth also discusses the relationship between the percent of a watershed which is wooded and stream degradation. He notes that there are few empirical data which show a direct correlation in this regard, but reports that modelling studies suggests the retention of 65% woodland cover may be needed to achieve stream channel stability in rural areas. No information is given on the non-wooded land use and the actual role of woodland is still uncertain from such studies. For example, Patchett and Wilhelm (1999), report on the tremendous capacity of native grasslands in the midwest United States to absorb and recharge precipitation, suggesting that it is not woodlands *per se* which are required to protect groundwater recharge functions, but the type and extent of ground cover, treed or other wise.

The Province is currently developing a process to implement watershed-based Drinking Water Source Protection Planning. The final report of the expert's committee for this initiative (Technical Experts Committee 2004) identifies three types of "vulnerable areas" with respect to groundwater, and recommends that any woodlands within any of the areas produced as part of the Source Protection Planning process be identified as significant. Mapping showing the location of these areas will be forthcoming shortly from the Province.

Halton and Middlesex were the only two municipalities where groundwater was recommended as a criterion for identifying woodland significance. The ORM guidelines for identifying significant woodlands (OMNR 2004) also use the presence of hydrogeological sensitive features as a criterion.

No evidence was found that specifically shows that woodlands protect groundwater resources or that sensitive groundwater resources confer significance on woodlands. The only caveat to this may be where there is groundwater discharge (springs and seeps), or where shallow water tables produce swamps. However, these situations are addressed by the surface water criterion, and such woodlands would be considered significant. It is recognized that leaving woodlands in place protects groundwater resources by precluding development, and that if woodland protection is warranted for this reason it be implemented as part of groundwater protection planning. For the purposes of this study it was concluded that the presence of significant groundwater resources should not be used at this time as a criterion to identify significant woodlands.

Riparian Function

See text on surface water quality and quantity.

Diversity of Communities and Species

This criterion refers to the widely accepted commitment to protecting, and where possible increasing biodiversity values. The loss of biodiversity is a major conservation concerns (Soule and Wilcox 1980, Noss and Cooperrider 1994, Meffe and Carroll 1994) and maintenance and improvement of biodiversity is one of the main principles behind most environmental protection initiatives. The native flora and fauna of southern Ontario has been greatly impacted by the loss of native woodlands (Riley and Mohr 1994, Larson *et al.* 1999, Cadman 1999) and the future protection of significant woodlands is needed to prevent further biodiversity losses.

It is recognized that woodlands with many species or communities are more significant than those with fewer (all other concerns like rarity being equal). Several of the other criteria (*e.g.*, protection of larger woodlands, protection of interior woodland, protection of woodlands with rare species) are all directed at the overall goal of biodiversity protection. However, as pointed out in the introduction, biodiversity is more than just protection species. Biodiversity can be defined as, *"The variety of life and its processes; it includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting."* (Noss and Cooperrider 1994). This definition includes the nutrient and water cycles, soil ecosystems, micorrhizal fungal associations, and other poorly understood and hard to measure ecosystem components that operate in woodlands.

Although their importance is understood, it is not easy to measure these parameters. For many measures that we can quantify (*e.g.*, species richness of many types of organisms such as vascular plants, birds, herptiles, mammals) we do not always have good baseline data to allow us to determine significance thresholds. Also, the collection of these data require detailed field investigations.

Only one of the municipal significant woodland studies examined (London), recommended using a diversity measure to establish significance. The City of London, owing to the size of the jurisdiction, has been able to conduct extensive field studies and has established thresholds for determining woodland significance. Norfolk also suggested using biodiversity but did not provide specific measures and noted additional field work was necessary.
Based on the difficulty of implementing this criterion, it is not recommended for inclusion in the suite of criteria. Also, it is noted that since other recommended criteria will capture large woodlands, both young and mature, and those with interior conditions, much of the woodland biodiversity of the Region should be captured.

Existing Designations
Existing natural heritage designations had been suggested as a criterion on the basis that if a woodland had been designated as part of another program (*e.g.*, an Environmentally Sensitive Area Study, wetland evaluations, ANSI studies, Greenlands Study, ORM Conservation Plan, *etc.*) it should be considered significant. Natural heritage designations are also necessary to apply the proximity criterion (discussed earlier in this section).

It was decided that these programs have been well researched and have been used as the basis for many planning decisions in the past, and that they are important for recognizing the added value of identifying woodlands that are proximate to other natural features. Based on this, it was decided that existing designations be used where appropriate for identifying significant woodlands. It is not the intent to recommend that all existing natural heritage features that are woodlands be identified as significant, but that existing natural heritage designations be used within a suite of criteria for identifying significant woodlands (e.g., woodlands that are proximate to a designated natural heritage feature).

Significant Species and Communities
This proposed criterion would confer significant status on woodlands that support rare or otherwise significant vegetation communities, or species of flora or fauna. The presence of valued species that are designated as rare, threatened, endangered, vulnerable or of conservation concern are often used to evaluate the significance of natural features. A similar criterion is used in the Ontario wetland evaluation and is a key component of MNR life science inventories which are used to identify provincially significant features such as ANSIs and Nature Reserves. There are a number of well established programs for establishing the status of Ontario's communities and species. These include the program administered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), as well as the evaluations used by MNR's Natural Heritage Information Centre (NHIC). Recently, Species at Risk (SAR) legislation has been enacted which obligates government agencies (federal and provincial) to protect the habitat of SAR on their properties.

Plant and animal species, as well as communities, occur in particular places because the conditions (soil, moisture, climate, aspect, elevation, *etc.*) are suitable for their growth and survival. This implies that the habitat where a valued species or community is found is suitable for their persistence. In order to protect and maintain these species and communities, it is necessary to maintain the habitat in which they occur. Thus, where rare or otherwise significant species and communities are found in woodlands, it can be assumed that the woodlands provide

sufficient (but not necessarily ideal) conditions for their continued persistence, at least in the short term. Such woodlands should be considered significant. This does not preclude the possible need to enable some management to ensure the right conditions continue to occur, especially in smaller woodlands subject to external stresses.

This criterion is recommended for use in identifying significant woodlands. In applying this criterion with respect to fauna, the woodland must provide habitat for breeding or foraging, and/or contribute to the conditions necessary for the ongoing persistence of a population. It is not meant to infer significance on a woodland patch where there has been an incidental sighting of a particular species. Unless the woodland patch is routinely used by a species during migration, this would not be considered a condition necessary for the ongoing persistence of a population. This criterion will require site specific field investigations to be applied. The approximate locations of some significant species are available from MNR, however, exact locations are generally withheld owing to the sensitivity of the information.

Economic/Social Value

This criterion recognizes that woodlands have social and economic values for a variety of uses such as recreation, passive enjoyment, timber extraction, and non-timber woodland products. For example, woodlands that are important for an existing recreational use such as horse riding or hiking may be considered significant. Also, some social values may conflict with ecological values. For example, a conflict is possible between the desire to maintain examples of natural environments with minimal disturbance and the desire of some groups to use woodlands for more intense activities such as mountain bike riding and horse riding. This criterion is considered difficult to measure and has a wide range of values and thresholds. The Natural Heritage Reference Manual (OMNR 1999) recommends that managed woodlands may provide economic and social value and could be considered as a criterion for assessing significance. None of the municipalities used economic and/or social values to determine the significance of woodlands.

Owing to the difficulties in assessment, and the emphasis in this study on identifying ecological criteria, economic and social values was rejected as criterion for determining significance.

Buffering Capacity

This potential criterion has been applied to young woodlands which act as a buffer to a larger more mature woodland. The definition of woodland patches for this study includes woodlands of all ages. Also, young woody vegetation around the periphery of individual patches was included within patch boundaries. Because of this, any buffering function of young woody vegetation is already incorporated in patches and a separate criterion is not needed to capture it. This criterion was not used to determine significance by any of the municipal studies reviewed. It is recommended that this criterion be rejected for identifying significant woodlands.

Floristic Quality Index

The Floristic Quality Index (FQI) is a method for assessing the quality of vegetation based on the intrinsic characteristics of the species which compose the vegetation being evaluated. It places a high value on species which are "conservative", that is their habitat requirements are quite specific and they occupy only a narrow range of conditions. Species that only occur in

woodlands, and especially those that require interior woodland, generally rank highly. Woodlands containing these species would thus score high FQI values and would be considered significant.

The FQI is a robust method which has been calibrated for use in southern Ontario, however it has not yet been widely applied. Establishing sound thresholds for discriminating significant woodlands would require knowledge of the range of values for the entire Region. This requires detailed, Region-wide field investigation, which is not feasible for application at the scale of York Region. Ontario Nature (2004) recommends this as a criterion for their Level 3 evaluation (which requires field work). The City of London was the only municipality reviewed that uses the FQI. Owing to the difficulty in implementation requiring detailed data from across the Region, the FQI is rejected as criterion for use in identifying significance.

Significant Landforms

This criterion would serve to protect woodlands associated with significant landforms thereby precluding land uses that would involve surface grading or other activities that would impact the landform. This criterion does not rely on intrinsic characteristics of the woodland to ascribe significance. Since the focus of this study was to determine criteria for woodland, not landform significance, this criterion was rejected as for use in determining woodland significance. However, if the presence of a landform feature resulted in a rare woodland type, or provided the conditions that supported rare or significant species, then the woodland could be considered significant for those reasons.

Aspect

This criterion would ascribe significance based on the presence of woodlands on slopes with a particular aspect (*i.e.* , north-facing, south-facing, *etc.*). The value of this criterion is that it would help capture the range of woodland types that might develop within different microclimates produced by a range of aspects. This criterion is much like the community representation criterion in that it attempts to capture representation of the full range of woodlands in York Region, thus contributing to maximizing biodiversity protection. However, it is difficult to develop thresholds because there is no way to know how much of a particular aspect needs to be captured to provide representation of all community types. This criterion is therefore rejected for determining woodland significance.

Certified Woodlands

This criterion would recognize woodlands that are certified under a recognized certified sustainable woodland management program (*e.g.*, Forest Stewardship Council) as significant. Only one municipality (Norfolk County) recommended using certified woodlands to assign significance. Although certified sustainable woodland management may protect the biodiversity values of a woodland, it was felt that the primary goal of such programs is still timber harvesting, and this is not seen as a rationale for assigning significance. Also, certification refers to the management regime, not the characteristics of woodlands themselves. Based on this, certification of sustainable woodland management is not recommended as a criterion for determining significance.

Woodland Distribution

This criterion assigns significance based on the characteristics of the landscape matrix in which a woodland is situated. Thus, a woodland that is part of a cluster of woodland patches that would have value on a landscape scale that would be considered significant. Only one municipality (City of London) uses this criterion to assess significance of woodlands.

It was felt that the value of woodlands that are proximate to each other is probably better assessed through a direct proximity measurement (as recommended earlier in this section). This criterion is not recommend for use in determining woodland significance.

3.2.3 Summary of Selected Criteria for Evaluating Woodland Significance

Six criteria were selected for incorporation into a suite for evaluating significant woodlands: size, linkage to other natural features, proximity to other natural features, contribution to surface water quality and quantity, protection of significant species and communities, and existing designations related to environmental significance. Additionally, two criteria, presence of interior woodland habitat and age, would be included in the suite of criteria if they discriminate additional woodland patches.

3.2.4 Public Review of Potential Criteria

The results of the public review of the potential criteria are provided in Table 6. Since the public open houses took place before the evaluation described above, this was based on the original 22 potential criteria derived from the review of agencies and municipalities.

Table 6: Evaluation of 22 potential significance criteria by the public. See section 2.5 for methods. Total number of respondents = 13.

Potential Criterion	No. and proportion of respondents who thought it important
Size	6 (46%)
Interior Woodland	3 (23%)
Age	0
Presence of Old Growth	0
Connectivity	8 (62%)
Slope	0
Proximity to other Features	2 (15%)
Biological Diversity	7 (54%)
Recharge/Discharge Area Protection	7 (54%)
Groundwater quality and quantity Protection	6 (46%)
Surface Water quality and quantity	6 (46%)

Potential Criterion	No. and proportion of respondents who thought it important
Special Features	7 (54%)
Floristic Quality Index	0
Rare Species and Communities	2 (15%)
Representation	0
Early Successional Woodland	3 (23%)
Social or Economic values	0
Recreation	3 (23%)
Certified Woodland	1 (8%)
Lack of Human Disturbance	0
Landscape Richness	2 (15%)
Woodland Distribution	1 (8%)

Total number of responses was 65 = 13 respondents (*i.e.* , 5 responses per respondent).

3.3 Final Suite of Criteria for Identifying Significant Woodlands

The evaluation provided in section 3.2.2 identifies eight criteria that were considered useful for identifying significant woodlands in York Region. It is recognized that this selection reflects a particular application for York Region, and that different criteria may work well in other municipalities because, for example: they may be smaller (making it feasible to undertake field work), they may work within a different municipal structure (there are 9 local area municipalities in York Region that can protect woodlands at a local level), or they may have different landscape features that need to be taken into account.

The suite of criteria presented here have been selected to identify significant woodlands at a regional level. As pointed out in section 2.5.3, the criteria do take into account differences within the Region from north to south, but they do not attempt to incorporate local level woodland conservation priorities. It is expected that area municipalities will go beyond the regional-level significance provided by these criteria.

The MNR has defined draft criteria for identifying significant woodlands on the ORM (OMNR 2004 - Appendix 5). These, and Regional significant woodlands designations shown in the Regional O.P. (as amended by ROPA 41), will continue to apply to woodlands on the ORM, unless those defined here are more restrictive. The MNR draft criteria for significant woodlands on the ORM should be read in conjunction with the criteria provided below.

Many of the criteria are inter-related (*e.g.*, size and interior woodland) and are best presented as a suite of criteria that work together as presented below. Only one criterion needs to be satisfied in order to define a significant woodland.

Woodlands satisfying any of the following are recommended as being significant in York Region (words or phrases that are underscored are defined in Appendix 6).

7. *Any woodland[5] that supports any of the following:*
   - iii) *any G1, G2, G3, S1, S2, or S3 plant or animal species, or community as designated by NHIC; or*
   - iv) *any species designated by COSEWIC or COSSARO as Threatened, Endangered, or of Special Concern.*

8. *Any woodland that is within 30 metres of a watercourse, surface water feature or evaluated wetland.*

9. *Any woodland over 2 ha:*
   - i) *that is within 100 metres of another significant feature, or*
   - ii) *that occurs within the Regional Greenlands System.*

10. *Any woodland south of the Oak Ridges Moraine that is greater than or equal to 4 ha in size.*

[5] Woodlands are defined as in the York Tree cutting by-law (Appendix 4), thus with respect to size they will include woodlots and woodlands over 0.5 acres (0.2 ha).

11. *Any woodland north of the Oak Ridges moraine that is greater than or equal to 10 ha in size.*

12. *Any woodland that occurs on the ORM will be evaluated for significance based on the requirements of the Oak Ridges Moraine Conservation Plan and associated guidelines (OMNR 2004, see Appendix 5)*[6]

Since all woodlands over 10 ha will be defined as significant if these criteria are applied, it was deemed unnecessary to include criteria for interior woodlands or age, since these two criteria would not result in the designation of any additional patches, as discussed in section 3.2.2.

3.3.1 Rationale for Recommended Criteria

1. Significant Species and Communities
All species and communities that are rare, threatened or endangered should be protected, thus there is no lower limit on the size of woodland that would be deemed significant if it fulfilled this criterion. This is consistent with the PPS (Provincial Policy Statement 2005) which does not permit development or site alteration in the significant habitat of endangered or threatened species. The presence of any significant species or communities suggests that conditions exist for that resource to persist at present, regardless of the size of the woodland. There is no way to determine if the conditions in small woodlands will be robust enough to allow any disturbance and protect the species in the long-term. Thus, application of the precautionary principle is recommended and the woodlands should be deemed significant. If the significant species or community does not persist, and disappears for natural reasons (*i.e.* , is not deliberately removed), the designation may be reviewed. Deliberate removal of a feature is not cause for removal of a significance designation as the conditions still exist for the feature to be re-established or restored.

2 i) Surface Water Quality
The discussion of this criterion in section 3.2.2 provides the rationale for it's inclusion. The distance of the woodland to a watercourse is a key factor in determining the contribution of the woodland to surface water protection. The ability of woodlands to provide functions such as thermoregulation (through shading by the canopy), contribution of in-steam structure and contribution of detritus diminishes with distance. Mitigating surface erosion and filtering functions are also enhanced when woodlands are close to the edge of the water feature. For these reasons, 30 metres is recommended as the threshold distance for significance, since this approximates the canopy height of a mature woodland and is a distance that allows a wide range of functions to be fulfilled. The criterion would be met if the edge of a woodland patch is within 30 m of a surface water feature (*i.e.* , the whole woodland does not have to be within the 30 m).

3. Woodlands with Special Features Greater than 2 ha
Smaller woodlands have less capacity for maintaining high quality conditions than large woodlands. In isolation, a 2 ha woodland is susceptible to edge impacts and is not large enough

[6] The MNR criteria for identifying woodlands on the ORM are provide in Appendix 5.

to provide interior woodland conditions. However, it can still provide important functions in association with another natural feature (see discussion of criteria related to surface water, proximity and linkage in section 3.2.2). Smaller woodlands (*e.g.*, 1 ha) have less capacity to provide woodland functions, even if in association with other natural features. It was decided that below 2 ha the contribution that a woodland could make was not of Regional significance, although it may well be locally important and woodlands smaller than 2 ha could be designated as significant by local area municipalities.

3 i) Proximity to Another Significant Feature

This criterion was recommended as woodland patches that are proximate to significant woodlands or other natural features provide functions that would not occur if the woodland was isolated. Examples include provision of wintering habitat for tree frogs if near breeding ponds, provision of additional foraging habitat for birds and mammals, and supporting metapopulations by provision of supplementary breeding habitat. Middlesex County (UTRCA 2003) includes any size woodland where 50% of the patch is within 750 metres of a significant natural heritage feature. This was based on analyses that showed a strong negative correlation in native plant species diversity and increasing distance between woodlands and ANSIs. The 750 metres was based on arguments in the Southern Ontario Wetland Manual (OMNR 1993). Middlesex County also used a 100 metre distance for identifying significant woodlands as, *"…this is the distance at which linkages between woodland patches start to appear."* (UTRCA 2003, p 35). This report also cites Nathan *et al.* (2002) as claiming this is the distance that most seeds can disperse by wind.

In this study, 750 metres was considered too great a distance to support the proximity criterion. The ability for mobile species to utilize woodlands that are near each other is not only dependant on distance but also the intervening habitat. The more urbanized areas of the south parts of York Region offer greater resistance to movement than the generally more rural areas of Middlesex. It was decided that the majority of bird species, as well as many species of mammals and amphibians could traverse 100 metres, even through inhospitable habitat. For example, there are data on salamanders in York Region migrating well over 100 metres to breeding ponds, and crossing roads to do so. Thus 100 metres was selected as a conservative, but reasonable distance to select for conferring significance on woodlands over 2 ha that are proximate to a significant natural feature (as defined in Appendix 6).

3 ii) Linkage

The linkage criterion is partially fulfilled through the proximity criterion discussed above, since woodlands within 100 m of each other are considered to be ecologically linked, at least for mobile species. The rationale for including all woodlands within the Greenlands System is that it is a vision for a future landscape that provides connectivity throughout the Region. Any woodland within the Greenlands System potentially contributes to the long-term vision and should be considered significant.

4. Size South of the ORM

The 4 ha size criterion south of the ORM, as opposed to 10 ha north of the ORM, is recommended owing to the reduced woodland cover there (9.25% south compared to 30% north of the moraine). The Natural Heritage Reference Manual (OMNR 1999) recommends all

woodlands over 4 ha be protected in areas with woodland cover of between 5% and 15%. Interior woodland theoretically can begin to occur in woodlands over 4 ha (applying the rule that interior woodland can occur at distance greater than 100 m from any edge). Environment Canada *et al.* (1998) conclude that woodlands of 4 ha will only support "a very few common edge birds", suggesting that, with respect to birds, the 4 ha limit may be too low. However, the OMNR (2000) Significant Wildlife Technical Guidelines note that sharp-shinned hawks, which generally prefer woodlands greater than 30 ha, can nest in woodlands as small as 4 ha, indicating that these smaller woodlands have some ecological value in areas where woodland cover has been depleted. Application of this criterion alone would result in approximately 7.21% of the area south of the moraine being designated as significant woodland.

It should be noted that the recommendation to use 4 ha is based on the focus of identifying regionally significant woodlands. Although the overall woodland cover south of the ORM is 9.25%, this is biased toward valleyland woodlands, since these have been better protected from development. Upland woodlands account for less than 2.3% of the woodland cover south of the ORM, thus if the OMNR (1999) guidance on the area of woodland to be preserved were to be applied only to uplands, a threshold of 2 ha may be more appropriate. This lower threshold should be considered by local area municipalities when determining woodland significance at a local level. Additionally, it is noted that the focus of this study was on the ecological value of woodlands, and that other values such as social, aesthetic and economic values also need to be considered.

5. Size North of the ORM

North of the moraine, 30% of the landscape is wooded. Owing to the increased woodland cover, smaller woodlands are not as significant, and the higher threshold of 10 ha for identifying significant woodland is recommended. Although 10 ha is not large enough to provide much interior woodland habitat, in some situations, where there is little disturbance and woodlands are mature, there may be sufficient habitat to support some species that prefer interior habitat (theoretically 2 ha of interior can occur if the shape is circular). The AOC Framework for Habitat Rehabilitation (Environment Canada *et al.* 1998) reports that even 10 ha woodlands will be dominated by edge species with only small areas of interior, although small areas of interior may begin to form that will support forest interior/edge species such as Hairy Woodpecker and White-breasted Nuthatch). Middlesex (UTRCA 2003) report that there is general agreement that woodlands smaller than 10 ha are unlikely to be productive for many forest-associated species (based on work by Freemark and Collins 1992 and Riley and Mohr 1994). The Middlesex study found that "… most of the quality indicators do not express themselves consistently until woodland patches are at least 10 ha in size." (UTRCA 2003, pg. 34). The Significant Wildlife Habitat Technical Guide (OMNR 2000) notes that red-shouldered hawks, an area sensitive species that prefers woodlands of at least 100 ha in area, will occur in woodlands small as 10 ha, supporting this size as a lower threshold.

3.4 Significant Woodlands of York Region

This section discusses the significant woodlands of York Region. Statistics are provided on the proportion of woodlands that are significant in each municipality, as well as the Region as a whole. However, these are only approximations for a number of reasons:

1. there are no data to apply some of the significance criteria (*e.g.*, there are no rare species data for most of the study area; and
2. the criteria and methods used for identifying significant woodlands on the ORM are different from those used for areas off of the ORM (see section 3.4.1 for explanation of limitations).

A breakdown of significant woodlands by municipality is shown in Table 7. A comparison of the significant woodland and all woodlands shows that overall, approximately 97.5% of the total woodland area in the Region is considered significant. However, only 79.8% of all woodland patches are considered significant. This apparent discrepancy between area and number of patches is owing the very high proportion of patches that are very small (see Table 2). Although 55% of all woodland patches in the Region are less than 2 ha, they accounts for only 5% of the area, and the substantial proportion of total woodland area that is considered significant excludes the large number of small patches. The mean size of significant woodland patches is higher than the mean size of all woodlands, as would be expected, since size was one of the criteria used to determine significance from a Regional perspective, resulting in the exclusion of smaller woodlands.

The amount of significant woodland is similar to Halton Region, where 97% of all woodlands were considered significant (Gartner Lee 2002; note that the criteria on which this figure was based were subsequently modified slightly when incorporated into the Halton OP). In Middlesex County, only 74% of all woodlands were considered significant.

The area of woodlands in each area municipality that are considered significant varies little from the Regional average of 97.5%. Some of the more urbanized municipalities have a very slightly lower proportion of woodlands considered significant (Aurora, 95.2%; Newmarket, 95.1%; Vaughan 96.3%; and Markham 91.2%) as a result of the higher proportion of smaller woodlands there. A slightly higher proportion of woodlands in the more rural municipalities are considered significant (Georgina, 97.8%; E. Gwillimbury; King, 97.4%; and Whitchurch-Stouffville, 98.4%). Richmond Hill falls in the middle, being an urbanized community, but with 97.1% of its woodlands considered significant.

Table 7: Significant woodlands in each municipality

Municipality	Woodland cover (ha) and % cover of each municipality		# patches[1,2]		mean patch size (ha)	
	Significant Woodlands	All Woodlands[1]	Significant Woodlands	All Woodlands	Significant Woodlands	All Woodlands[1]
Georgina	11,674.6 (38.4%)	11,942.5 (39.3%)	441	603	26.47	19.81
E. Gwillimbury	7270.1(29.4%)	7494.1 (30.3%)	461	621	15.77	12.07
King	8127.5 (24.1%)	8343.2 (24.8%)	747	845	10.88	9.76
Newmarket	330.5 (8.7%)	347.4 (9.1%)	73	91	4.53	3.82
Aurora	862.8 (17.5%)	906.6 (18.3%)	118	152	7.31	5.96
Richmond Hill	1360.4 (13.4%)	1401.0 (13.8%)	187	229	7.28	6.12
Whit-Stouffville	5981.3 (28.3%)	6077.4 (28.8%)	457	559	13.09	10.87
Vaughan	3185.8 (11.6%)	3306.9 (12.1%)	455	564	7.00	5.86
Markham	1180.6 (5.6%)	1294.7 (6.1%)	317	414	3.72	3.13
York Region	39,973.1 (22.5%)	41,013.84 (23.1%)[1]	3256	4078[1,2]	12.28	10.06[1]

1. The statistics on significant woodlands incorporates woodlands defined by MNR for the purpose of applying the significant woodland criteria for the ORM (OMNR 2004). The MNR criteria include woodlands not captured by the definition used by York Region, thus the total woodland area and number of patches reported in the statistics in Table 7 is greater than that used for discussing the woodlands update (*e.g.*, in Table 4). Please refer to section 3.4.1 for a discussion on the significant woodlands on the ORM as defined using MNR criteria.

2. The sum of the number of patches in each municipality is greater than the total in the Region since any patch which straddles a municipal boundary will be counted in both municipalities.

3.4.1 Significant Woodlands on the ORM Defined using MNR Criteria

As noted in section 3.3, significant woodlands on the ORM were defined using criteria developed by the MNR (OMNR 2004) as part of the protection accorded the ORM. These are in addition to the York criteria, so that the most restrictive of the two sets of criteria apply. A data layer was provided to this project that identifies significant woodlands based on the MNR ORM criteria. However, this introduces some problems in calculating and reporting statistics for municipalities that fall wholly or partially within the ORM boundaries. It should also be noted that this data layer is only an approximation of the identification of significant woodlands and that future Natural Heritage Evaluations may identify additional ones.

The ORM Significant woodlands layer provided to us was created by York Region using data supplied by the MNR, as part of the ORM conformity exercise. The MNR provided York with the set of draft criteria and a data layer showing all woodlands, as defined by the MNR. The date and protocol MNR staff used for identifying the woodlands on the ORM is not known, however, it was done prior to the availability of 2002 orthophotographs. The MNR-derived ORM data layer is thus somewhat dated compared to the woodland layer developed for this current project, as it would have used older orthophotographs (probably the 1999 images), which had much poorer resolution. Additionally, the MNR derived woodland layer includes some woodland patches not identified using the York Region definition. We overlaid some of the MNR

woodland polygons, the 2002 orthophotographs and the woodland patches defined as part of this current project, and noted a number of differences including:

- the MNR layer included some hedgerows, especially where they were extension of woodland patches, that are not included using the York Region definition;
- the MNR layer included some plantations which were excluded using the LSRCA ELC data (see section 2.4.3); and
- the MNR layer includes some small woodland patches that were not included in the original York data layer, and thus were not updated as part of this study.

Another issue with the significant woodland layer created using the MNR ORM criteria, is that it was based on an early draft set of criteria. Although the data layer created by York Region was approved by the Ministry of Municipal Affairs and Housing (MMAH), and subsequently used as a basis for an amendment to the Region's Official Plan (ROPA 41, the Oak Ridges Moraine Conformity Amendment), the criteria for defining woodlands were subsequently refined by MNR, most recent draft being released in 2004 (OMNR 2004). The MNR criteria are still draft and thus could change in the future.

The main repercussion of using the MNR-derived significant woodland layer in this project is that it results in more significant forest identified on the ORM than the total amount of forest identified on the ORM as part of the update exercise in this study. Therefore, the total woodland area in each municipality (except Georgina which does not intersect the ORM) is greater in the statistics reported in the discussions of significant woodlands (*e.g.*, Table 7), than in the discussion of total woodlands which are based solely on the update work undertaken in this study. Additionally, there are inconsistencies in the identification of woodland patches that are attributable to different operators doing the analysis, because of the different criteria used, and the different tools available (e.g., use of more recent ortho-photography).

4.0 RECOMMENDATIONS

4.1 General Recommendations

In the course of undertaking the research and analysis of this study, a number of recommendations were developed that are directed at improving the quality and quantity of woodland in York Region. These are provided below.

4.1.1 Policies to Protect Significant Woodlands

Recommendation: *Refine Regional Official Plan Policies to Protect Significant Woodlands in York Region.*

This report provides the rationale for determining woodlands in the Region of York that are significant from a regional perspective. In order to provide protection for these woodlands, policies and schedules should be developed as was envisaged with ROPA 37. Additionally, the current Regional target to achieve 25% woodland cover should be reviewed. The Framework for Guiding Habitat Rehabilitation in the Great Lakes Areas of Concern (Environment Canada 2004) provides a review of various studies and reports on the amount of an area that needs to be

maintained as forest cover and recommends that 30% of their study area (Great Lakes Areas of Concern) be forested. Middlesex County (UTRCA 2003) and Durham Region (Durham Region Planning Department 2003) also have recommended 30% forest cover as a Regional targets for forest cover. Any recommendation for changes in the Regional forest target should be applied on a Regional basis. Each of the area municipality should not have to attain the Regional target, as this is clearly unrealistic for the more urbanized areas such as Richmond Hill, Markham and Vaughan. However, it is still incumbent on each municipality to maximize forest protection and contribute to the Regional target to the extent possible.

4.1.2 Establish Priorities for Restoring Gaps between Woodland Patches

Recommendation: *Undertake additional GIS analyses to assist with determining 2-3 top priority areas for restoring large areas (>500 ha) of native woodland.*

Section 3.1.3 discussed the potential for restoring minor gaps that separate woodland patches, thus creating large, continuous woodlands. The restoration of these gaps, all of which are less than 20 m wide, should be investigated to establish priority areas for stewardship, rehabilitation, and securement.

It is recommended that further GIS analysis be undertaken to identify the gaps with the greatest promise for restoration. A first step would be to identify which of the gaps are occupied by roads, hydro corridors or other uses which preclude, or at least limit, re-establishment of forest cover. A second step might be to overlay ownership to identify any gaps that are in public ownership and thus offer opportunities for rehabilitation. It is suggested that gaps that are within urban boundaries be identified, as these are likely ones that are most in threat of being developed, with a resultant loss of the opportunity to rehabilitate them. Such woodland gaps should be considered as part of the review of any development applications that would result in a land use change that hinders restoration of the woodland gaps. The analysis should also include an overlay with future roads and especially road upgrades. As explained in section 2.4.6, the 20 m was selected in part to preclude most roads, and those lined with development. Any future roads or upgrades to existing roads that would preclude the development of these large woodlands should be re-examined to explore other alternatives.

Once these further analyses are completed, it is recommended that two to five grouped woodlands over 500 ha be selected that have minimum impediments to restoration and that these be made a priority for securement and rehabilitation.

4.1.3 Further Refine Regional Woodland Layer

Recommendation: *Continue to refine the regional forest layer to provide an accurate representation of the woodlands in York Region.*

The original forest layer created using the 1999 ortho-images and this subsequent update study have provided York with an exceptional tool for protecting and restoring woodlands in the Region. The Region should continue to refine the woodlands layers to more accurately reflect area and distribution of native woodlands. This could include the following.

- Determine the extent and location of short rotation woodlands (*e.g.*, Christmas tree farms) and identify these within the woodland layer so they do not get counted as long

term forest cover (note that it is worth reporting them separately as existing forest cover, as they do offer habitat for breeding birds and wildlife habitat, especially small mammals).

- Review the digitized boundaries of woodland patches from the original woodland cover based on the 1999 orthophotos, and refine them to increase consistency and accuracy. For example, some hedgerows were included, whereas others were not.
- Articulate an explicit set of rules for delineating boundaries, building on those provided in sections 2.4.1, 2.4.2 and 2.4.3. This could include: identifying the size/area at which a gap within a woodland patch is digitized; and specifying the scale at which boundaries are delineated.
- Undertake a field verification of new woodland patches that capture early succession areas.

4.1.4 Expand and Implement Greening Securement

Recommendation: *Continue to implement and expand Greening securement, naturalization and stewardship programs and partnerships using the Securement Guidelines recommended in this report*.

The ongoing protection of significant woodlands through the existing securement program should continue. Based on new analysis provided in this report, guidelines are provided that will focus securement initiatives on significant woodlands such that protection of biodiversity in York Region is enhanced.

4.2 Planning for Forests of the Future.

York Region is proactive in promoting the protection of woodlands and in facilitating an increase in the woodland cover of the Region through the securement of priority Greenlands. Securement includes protection through stewardship and management, as well as securement through donors, conservation easements and the land development process. Securement initiatives may be undertaken in partnership with other agencies such as the conservation authorities, Ontario Nature or the Nature Conservancy of Canada. The Region currently has a goal to achieve 25% forest cover in the Region.

The intent of this section of the report is to provide guidance to the Region in identifying sites that contribute the most toward the conservation of York Region's woodlands. A number of guidelines are provided, each of which serves to enhance the protection of existing woodlands, or increase their conservation value. It should be noted that securement of the existing remnant woodlands should be a priority for the Region. Woodland restoration initiatives should be encouraged and promoted, however, it takes a very long time (in most cases over 100 years) to create woodland conditions that proximate natural systems, thus preservation of existing woodlands is critical for the protection of biological diversity.

Most of the guidelines build on the Region's Securement Criteria (York Region 2003). The criteria include strengthening east-west and north-south connections among Greenlands core

areas, and strengthening green nodes by protecting core natural heritage features or functions and/or through forest rehabilitation. These criteria are inherent in the guidelines provided below.

Since urban development limits the re-establishing of substantial woodland habitat, opportunities for restoration occur primarily on agricultural land. However, it is important to understand that this does not imply that all agricultural lands should be restored to woodland. Maintaining a viable and healthy agricultural community is also important, and the restoration of woodlands needs to decided on site by site basis, in co-operation with willing landowners.

Non-wooded areas that satisfy any one of the following guidelines are deemed to be a priority for securement. There was no attempt made to prioritize areas based on the application of the guidelines, since one guideline is not deemed to be more important than another. For example, there is no rationale to prioritize two opportunities, one which would double the size of a woodland with a provincially rare plant, and another that increases a woodland from 10 to 16 ha, thus providing opportunity to create 4 ha of interior woodland conditions. Both these actions are beneficial to the environment in different ways. The only time when opportunities may be prioritized is if one fulfills several guidelines (*e.g.*, has a provincially rare species, is in the Greenlands system and increases woodland size to over 16 ha), and another opportunity only fulfils one guideline.

Not all these guidelines are discrete. For example, securing and restoring any under-represented upland woodland south of the Oak Ridges Moraine could meet guidelines 1 and 7. However, this is not perceived as a problem because these are only guidelines, and are not being used to confer significance or serve as a basis for protection policies.

4.2.1 Representation

Securement Guideline:

1. Any area that could support a woodland with a species association that is under-represented in York Region.

Although there is insufficient information to establish representation thresholds for significance criteria (section 3.2.2), maximizing representation is an important consideration in setting priorities for securement and restoration. The work undertaken by Puric-Mladenovic (2003) was used to identify areas with potential to restore woodland types that are currently under-represented in the Region. She determined the distribution of the woodland species associations that occurred in York prior to settlement through a modelling exercise. This was compared to existing land cover (gap analysis) to determine which species associations are under-represented. Puric-Mladenovic developed a model and mapped these areas (the digital layer was provided by York Region for this study). Three different models were developed and the reader is referred to her PhD. dissertation for a full explanation of them. For this evaluation, the layer referred to as "species assemblage level 3" was used. The species assemblages that are under-represented are identified in Puric-Mladenovic (2003, Table 23). These were determined through a gap analysis where the predicted species associations were overlaid on a layer depicting existing land cover. Those species associations that comprised less than 25% of their original predicted cover were deemed to be under-represented and should be a priority for restoration. The digital image

provided by Puric-Mladenovic can assist in locating these lands. The analysis was undertaken separately for the areas north, south and on the Oak Ridges Moraine.

Based on her work, the following species associations are deemed to be under-represented in the three main physiographic regions of York Region.

North of the Oak Ridges Moraine (10 species assemblages)
beech
cedar
cedar mixed
deciduous mixed
elm mixed
maple
maple-beech
maple-beech-oak
maple mixed
oak mixed

On the Oak Ridges Moraine (3 species associations)
beech
maple
maple beech

South of the Oak Ridges Moraine (10 species associations)
beech
cedar
cedar mixed
deciduous mixed
elm mixed
maple
maple-beech
maple-beech-oak
maple mixed
oak mixed

4.2.2 Increasing Woodland Patch Size

Securement Guideline:

2. Any area that would contribute to increasing the area of an existing woodland to over 16 ha.
3. Any area between existing woodland patches that are part of a group of woodlands (see section 3.1.3) that would facilitate the creation of a woodland greater than 100 ha in size.

A recommendation to identify priority areas for restoring gaps between woodlands is provided above (section 4.1.2), along with suggestions for additional GIS analysis to help define those priorities. This guideline is more general in nature and is intended to be used to assist with further priority setting among opportunities for rehabilitation. With a few exceptions, (*e.g.*,

remnant prairie, grasslands that support valued species, *etc.*) any increase in forest cover is deemed to be beneficial. However, there are situations where increasing the size of a woodland has special ecological benefits. With respect to guideline 2, section 3.2.2 notes the value of creating woodlands with 4 ha or more of interior woodland conditions. This requires woodland of approximately 16 ha or larger. Thus any area that, if restored to woodland, increases the size of an existing woodland from less than 16 ha to over 16 ha, is deemed to be a priority for securement. The shape of the resulting woodland should also be considered, as it should create 4 ha that is at least 100 m from any edge.

With respect to guideline 3, section 3.1.3 discusses the grouping exercise that was undertaken to identify woodland groups for applying the significance criteria. As a result of that analysis, 60 groupings were identified that exceeded 100 ha in size (see Figure 1). At least 5 of these are over 1000 ha in size. Since each woodland patch in a group is no more than 20 m from another existing woodland patch, there is substantial opportunity to create very large, continuous woodlands by restoring areas no greater than 20 m in width. The resulting woodlands would have substantial ecological value.

4.2.3 Protection of Significant Species

Securement Guideline:

4. Any area that would increase the size of an existing woodland less than 4 ha containing a significant plant species, or less than 10 ha and containing a significant animal species (see Appendix 6 for definition of significant species).

The protection of significant species is deemed to be important for the conservation of the Region's biodiversity. The significant species data reviewed for this project was not complete, however, some significant woodland species without doubt occur in small woodlands and are thus vulnerable to extirpation. In order to reduce this risk, these small woodlands should be expanded wherever there is opportunity.

4.2.4 Establishing/strengthening Connections with other Natural Features

Securement Guideline:

5. Any area that, if restored to woodland, would increase the connectivity among two or more existing woodland patches, or between one or more woodland patches and other significant natural features (see Appendix 6 for definition of significant natural features).

Maintaining and increasing the functional connectivity among natural features increases the function of the landscape by providing for the dispersal and movement of obligate woodland species among existing wooded patches. This is one of the criteria in the York Region Securement Guidelines. Thus any opportunity to provide for additional connection by restoring woodland between existing natural features should be considered a priority.

4.2.5 Upland Woodlands South of the Moraine

Securement Guideline:

6. Any area that would increase the size or number of upland woodlands south of the Oak Ridges Moraine.

Puric-Mladenovic (2003) notes that most of the upland forests in the Lake Erie Lowland Region (which is primarily south of the moraine) have disappeared. Thus any area south of the Oak Ridges Moraine that could be restored to an upland woodland condition should be considered to be a priority for securement.

4.2.6 Improving the Shape of Existing Woodlands

Securement Guideline:

7. Any area that, if restored to woodland, would either make an existing woodland patch more circular or square in shape (as opposed to long and narrow), or which creates smoother woodland edges through restoration of indentations in the boundary.

Woodlands with small perimeter to area ratios minimize the amount of edge habitat present, and thus reduce the many negative attributes of edges. Smaller perimeter/area ratios also tend to increase the opportunity for the development of interior woodland conditions. By restoring woodland in indentations along edges, or restoring woodland adjacent to existing patches to make them more square or circular, perimeter to interior ratios are minimized.

4.2.7 Restore Native Woodland Communities

Securement Guideline:

8. Encourage the conversion of non-native woodlands, especially conifer plantations, to native woodland communities.

In addition to creating more woodland overall, any program directed to creating future forests should encourage the conversion of conifer plantations to plant communities that were native to York Region. Conifer plantations were planted to help stabilize soils, and while they do perform some environmental functions and offer limited wildlife habitat, they are simple ecosystems that often will not self-replicate and have very low species diversity. The MNR has developed strategies for encouraging the establishment of native hardwoods in plantations (e.g., OMNR Extension Notes undated) and they should be adopted by the Region to contribute toward increasing regional biodiversity.

The emphasis in restoration of all habitats should be to re-create native ecosystems. It is a fundamental tenant of ecology that plant and animal species are adapted to specific conditions (soil, moisture, light, nutrients, temperature, *etc.*). When habitat conditions are changed, so will the species composition. Conversely, to restore native ecosystems and increase biodiversity, the natural conditions must be re-created, recognizing that for some ecosystems the exact conditions cannot be created and the goal is get as close as possible to the original habitat. If restoration is attempted without first establishing the appropriate conditions for native species, the plant community often defaults to non-native species, which are well adapted to the disturbed environments that generally occur when native plant communities have been altered or removed.

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APPENDIX 1: LIST OF PEOPLE CONTACTED

Appendix 1. List of People Contacted for Survey of Existing Studies on Significant Woodlands

Paul Attack, Regional Municipality of Halton
Chris Darling, Regional Municipality of Durham
Don Campbell, Niagara Region
Quinten Lang, Lambton County
Scott Peck, Norfolk County
Cathy Ploz, City of Hamilton
Lori Riviere, Regional Municipality of Durham
Andrew Sorensen, Grey-Sauble Conservation Authority
Durk Vanderwerff, Middlesex County

APPENDIX 2: PROVINCIAL ORGANIZATION/AGENCY CRITERIA

Appendix 2: Criteria for identifying significant woodlands recommended by provincial organization or agency.

Criteria	Natural Heritage Ref. Manual (OMNR 1999)	Ontario Nature (FON 2004) [1]	ORM Significant Woodlands (OMNR 2004)[2]	Eastern Ontario Woodland Valuation System (Rowsell 2003)[3]
Size	• dependant on forest cover: <5% - 2 ha 5-15% - 4 ha >15% - 40 ha	• dependant on forest cover: < 5% - all woodlands 5-10% - 2 ha 11-15% - 4 ha 16-20% - 10 ha 20-30% - 15 ha 31-50% - 25 ha; >50% - 40 ha	• ≥ 4 ha in Countryside or Settlement Areas of the ORMCP • ≥ 0.5 ha in Natural Core or Natural Linkage Areas of ORMCP	• in urban setting: ≥ 4 ha (3); 2-4 ha (2); ≤ 20 ha (1) • in rural setting: ≥ 200 ha (3); 20-200 ha (2); ≤ 20 ha (1)
Forest Interior (sometimes inferred from shape)	• select woodlands with more interior where patches are the same size	• 4 ha of interior • where forest cover is <10%, then any woodlands with interior		• ≥ 4 ha remains after 200m edge removed (3) • ≥ 4 ha remains after 150m edge removed (2) • ≥ 4 ha remains after 100m edge removed (1) • < 4 ha remains after 100m edge removed (0)
Age	• protect older woodlands			
Old Growth		• old growth characteristics[1]*		
Contributes to Connectivity (Linkage)	woodlands with the following features: • one or more natural heritage features within boundary • have potential to form link to another feature, area, water or woodland • opportunity exists to restore linkages to adjacent areas	• any woodland that falls within or overlaps a core area or corridor in any identified NHS		
Slope		• on slopes >10%		• ≥ 30% slope (3) • 15%-30% slope (2) • ≤ 15% slope (1)
Proximity to other Woodlands or Natural Features	• closer woodlands of more value if size is equal • overlap with other natural features		• ≥ 0.5 ha in key natural heritage or hydrologically sensitive feature or their vegetation protection zone	• closest edge between patches ≤ 100m (3) • closest edge between patches 100m-250m (2) • closest edge between patches ≥ 250m (1)
Diversity	• higher diversity			

Criteria	Natural Heritage Ref. Manual (OMNR 1999)	Ontario Nature (FON 2004) [1]	ORM Significant Woodlands (OMNR 2004)[2]	Eastern Ontario Woodland Valuation System (Rowsell 2003)[3]
Recharge/ discharge	• close to discharge, recharge or headwater areas			
Groundwater quality and quantity	• close to, adjacent to groundwater discharge, recharge or headwater region			
Surface water quality and quantity (hydrology)	• woodlands that occupy most of a watershed	• streams, wetlands, lakes; • headwater sources • catchments of 1st order streams		• inside or ≤ 30m of a water feature's shore • between 30m-50m of a water feature's shore • ≥ 50m from a water feature's shore
Special features	• unique composition; age, or site quality representing <5% of planning area • representative of uncommon type	• uncommon characteristics[1]* • uncommon woodland types[1]*		• located on island (3)
Floristic Quality Index		• measures not provided [1]*		
Rare Species		• presence of rare species[1]*		
Representation		• measures not provided [1]*		
Succession/buffering		• measures not provided [1]*		
Social or Economic	• long-term management agreements in place	• measures not provided[1]*		

Notes

1. Ontario Nature's (FON) approach has 3 levels: 1) select woodlands with known designations; 2) use GIS tools to apply criteria using readily available data; and 3) criteria that require detailed in-field analyses. Examples of level 3 criteria provided by ON are marked with an (*) in the table.
2. ORMCP defines woodlands as having a tree cover >60% and classified as forest according to ELC (Lee *et al.* 1998); or as having a tree cover >10% and considered as treed according to ELC with specific density and diameters requirements
3. Woodland Valuation System ranks patches between a score of 0 (no value) to 3 (high value) and weighes the criteria evenly relative to one another. A patch is defined as a contiguous area of woody vegetation.

APPENDIX 3: CRITERIA USED BY OTHER MUNICIPALITIES

Appendix 3: Criteria for identifying significant woodlands recommended by municipality.

Criteria	Halton (Gartner-Lee 2002)[1]	Durham (Riviere pers. comm.)[2]	Norfolk (Norfolk County 2003)[3]	Middlesex (UTRCA 2003)	Hamilton (City of Hamilton 2004)	London (City of London 2003)[4]
Size	• urban >2 ha* • rural: below escarp. >4ha* above escarp. >10ha*	• dependant on forest cover: < 5% - all woodlands 5-10% - 2 ha 11-15% - 4 ha 16-20% - 10 ha 20-30% - 15 ha 31-50% - 25 ha >50% - 40 ha	• woodlands >2ha	• woodlands >10ha	• dependant on forest cover: <5% - 1ha 5-10% - 2ha 11-15% - 4 ha 16-20% - 10ha 21-30% - 15ha	• >9 ha (H) • 2-9ha (M) • <2ha (L)
Forest Interior (sometimes inferred from shape)	• 4 ha of woodland > 100 m from an edge*	• 4 ha of interior • where forest cover is <10%, then any woodlands with interior	• comparison with circle based on perimeter/area ratio • forest greater than 50m or 100m from an edge, and circular in shape	• <10 ha with >0.05 ha more than 100m from an edge	• interior greater than 100m from an edge	• presence of habitat >100m from an edge, or perimeter/area ratio <1.5 (H) • no interior habitat but has P/A ratio 1.5 - 3.0 (M) • no interior habitat & P/A ratio >3.0 (L) possible breeding conservative bird species[5] • 1+ level 1species, 2+ level 2 species, or 5+ level 2-4 species (H) • 1 level 2 species, or 2+ level 3 species or 4+ level 3-4 species (M) • 1-3 level 3-4 species (L)
Age	• >99 years old*		• >150 years old[3]* trees only - not woodlands		• trees >100 years old	• older growth community present (H) • middle-aged community present (M) • woodland of pioneer age (L)
Old Growth		• old growth characteristics[1]*				
Contributes to Connectivity (Linkage)	• within 50m of watercourse* • within 150m of escarp. edge* • specified major valleys*	• any woodland that falls within or overlaps a core area or corridor in any identified NHS	• within 120m of another woodland • specific measures not provided[3]*		• intersects with the Hamilton NHS	• connected by riparian features, contiguous or semi contiguous habitat (H) • indirectly connected by various features (M) • not connected (L)

Criteria	Halton (Gartner-Lee 2002)[1]	Durham (Riviere pers. comm.)[2]	Norfolk (Norfolk County 2003)[3]	Middlesex (UTRCA 2003)	Hamilton (City of Hamilton 2004)	London (City of London 2003)[4]
Slope	• on slopes >10%	• on slopes >10%				• on slopes >25%, or on remnant slopes not continuous with the river system (H) • on erodable soils >10 and < 25% slope (M) • on slopes <10% or slopes >10 and <25% on less erodable soils (L)
Proximity to other Woodlands or Natural Features			• within 50m of significant biotic, or other designated features	• 50% is within 750m of a Natural Heritage Feature • within 100m of another woodland >10 ha • within specified NHS corridors and not within 50m of a watercourse		
Diversity			• specific measures not provided[3]*			• contains 6+ communities[5] (H) • contains 3-5 communities (M) • contains 1-2 communities (L) • 3+ ecosites[5] , or 4+ veg. types, or 3+ topo features (H) • 2 ecosites, or 3 veg. types or 2 topo. features or 1 veg. type with inclusions or complexes (M) • 1 ecosite or 1-2 veg. types on 1 topographic feature (L) • 4+ amphibian sp., or 3+ critical habitat components (H) • 2-3 sp. of amphibians, or 2 critical habitat components (M) • 1 amphibian sp. or 1 critical habitat component (L) • conifer or mixed forest present, or swamp with >25% native conifer cover (H) • conifer or mixed plantations of native species (M) • no conifers, or plantations of non-native conifer sp. (L)
Recharge/ discharge						
Groundwater quality and quantity	• within headwaters as indicted by location in catchments of 1st order streams			• on porous soils (porous soils are identified)	• see below	

Criteria	Halton (Gartner-Lee 2002)[1]	Durham (Riviere pers. comm.)[2]	Norfolk (Norfolk County 2003)[3]	Middlesex (UTRCA 2003)	Hamilton (City of Hamilton 2004)	London (City of London 2003)[4]
Surface water quality and quantity (hydrology)	• within 30m of a watercourse	• streams, wetlands, lakes; • headwater sources • catchments of 1st order streams	• within the first 3 orders of watershed catchments • site-specific measures not provided[3]*	• containing or within 50m of a watercourse	• >0.5ha and within 30m of a hydrological feature (headwater area, stream, wetland, lake, groundwater recharge /discharge area)	• hydrological features/functions present (watercourses, floodplains, stream and ravine corridors, wetlands >2ha, recharge/ discharge areas) (H) • within 3 m of watercourse or contains wetland <2ha (M) • no hydro. feature (L)
Special features			• within designated Carolinian Canada Life Zone sites			
Floristic Quality Index						• coefficient of conservatism (CC) of community >4.6 or patch >4.5 (H) • CC of communities 4.2 to 4.5 or CC of patch > 4.0 to 4.5 (M) • CC of communities < 4.2 or CC of patch <4.0 (L)
Rare Species			• Species at Risk[3]*		• rare, vulnerable, threatened or endangered plants or wildlife	• presence of Species at Risk (H)
Representation						
Succession/ buffering						
Social or Economic						
Recreational			• within 50m of, or containing specific recreation functions (parks, trials, *etc.*)			
Certified Forests			• managed through certified forest programs[3]*			
Human Disturbance						• few mostly light and local (H) • mostly moderate to light and local (M) • mostly moderate to heavy and widespread (L)

Criteria	Halton (Gartner-Lee 2002)[1]	Durham (Riviere pers. comm.)[2]	Norfolk (Norfolk County 2003)[3]	Middlesex (UTRCA 2003)	Hamilton (City of Hamilton 2004)	London (City of London 2003)[4]
Landscape Richness						% cover of vegetation in 2km radius of woodland centre: • 13% cover (H) • 7-13% cover (M) • < 7% cover (L)
Woodland Distribution						• woodland clusters > 40ha or is a "meta core" or patch >20 ha (H) • clusters 20 - 40 ha or is an "island core" or patch > 10ha and < 20ha (M) • cluster < 20ha or patch < 10 ha

Notes

1. Criteria for Halton are derived from a background report (Gartner-Lee 2002). Those criteria which were eventually incorporated into Official Plan policies are marked with an (*) in the table.
2. Durham uses the criteria proposed by Ontario Nature (2004) (Riviere pers. comm..)
3. Norfolk County has "Landscape Level Criteria" which can be generally applied using GIS and available data, and "Site-specific Criteria" which use data collected in the field, usually collected through the EIS process. The latter are marked with an (*)
4. The City of London has a comprehensive set of criteria each of which is evaluated as "high", "medium" or "low", shown as H, M or L in the table. Only patches > 4ha, or smaller patches within 100m of each other if together they exceeded 4ha were evaluated. Woodlands achieving "high" evaluations in 3 criteria, or 4 "medium" evaluations are considered significant. Conservative bird species level determined using Couturier (1999). For Diversity, London has used the ELC classifications, which define community series, ecosite, *etc.*

APPENDIX 4: DEFINITION OF WOODLANDS IN YORK REGION

For the purpose of this project, the definition of "woodland" and "tree" was that used by York Region in the Regional Tree By-Law (By-Law No. TR-1-91-154). the tree by-law uses "woodlot" rather than "woodland", but for the sake of this definition the terms are considered synonymous.

"woodlot" means an area not having less than:

i) 400 trees of any size per acre;
ii) 300 trees measuring more than two inches in diameter per acre;
iii) 200 trees measuring more than five inches in diameter per acre;
iv) 100 trees measuring more than eight inches in diameter per acre;

"tree" means any species of woody plant which has reached or can reach an average height of at least 15 feet at physiological maturity;

APPENDIX 5: ORM DRAFT CRITERIA

OAK RIDGES MORAINE TECHNICAL PAPER	MNRT.P.7
SUBJECT: Identification and Protection of Significant Woodlands on the Oak Ridges Moraine	Date: Feb, 2004- Final Draft

1. Purpose:

The purpose of this paper is to provide technical assistance in the identification, delineation and protection of significant woodlands as described in the Oak Ridges Moraine Conservation Plan (ORMCP).

2. Background:

Section 22 of the ORMCP describes "significant woodlands" as one of eight categories of "key natural heritage features" that must be protected from development or site alteration.

More specifically, section 22(2) of the ORMCP requires that:
"All development and site alteration with respect to land within a key natural heritage feature" (I.e. significant woodlands,) "or the related minimum vegetation protection zone is prohibited, except for the following:

1. Forest, fish and wildlife management.
2. Conservation and flood or erosion control projects, but only if they have been demonstrated to be necessary in the public interest after all alternatives have been considered.
3. Transportation, infrastructure, and utilities as described in section 41, but only if the need for the project has been demonstrated and there is no reasonable alternative.
4. Low-intensity recreational uses as described in section 37."

The Table in the Plan specifies the minimum vegetation protection zone for significant woodlands to be "all land within 30 metres of the base of outermost tree trunks within the woodland subject to clause 23(1)(d) if a natural heritage evaluation is required." Lands within this zone are generally subject to the same development and site alteration prohibitions as the feature itself.

An application for development or site alteration on lands within 120 metres from the significant woodlands must be accompanied by a natural heritage evaluation as described under section 23 of the ORMCP. This evaluation may identify the need for additional limitations beyond those specified in Section 22 of the ORMCP.

The ORMCP defines additional terms that are pertinent to a proper understanding of the ORMCP as it relates to significant woodlands including:

"woodland" means treed area, woodlot or forested area, other than a cultivated fruit or nut orchard or a plantation established for the purpose of producing Christmas trees;"

and

"significant" means identified as significant by the Ministry of Natural Resources, using evaluation procedures established by that Ministry, as amended from time to time."

Section 35 (4) of the ORMCP provides that:
"an application for a mineral aggregate operation or wayside pit with respect to land in a key natural heritage feature may be approved if,
(a) the key natural heritage feature is occupied by young plantations or early successional habitat; and
(b) the applicant demonstrates that,
(i) the long-term ecological integrity of the Plan Area will be maintained, or where possible improved or restored,
(ii) the extraction of mineral aggregates from the area within the key natural heritage feature will be completed, and the area will be rehabilitated, as early as possible in the life of the operation, and
(Hi) the area from which mineral aggregates are extracted will be rehabilitated by establishing or restoring natural self-sustaining vegetation of equal or greater ecological value."

3. Definitions:

"Basal area" means the cross-sectional area of tree stems at breast height (indicated in the Forestry Act to be 1.37 metres above the ground) and basal area per hectare can be determined from the number of trees in a prism sample.

"Diameter" (of trees) means diameter of tree stems at breast height (1.37 metres above the ground).

"Compatible openings" means areas with less tree cover than required for a significant woodland located between treed areas and may consist of: recent cutovers; meadows; wetlands; flooded and eroded areas, or narrow access trails or utility corridors. This would not include features/areas such as buildings and associated developed openings, and parking lots.

"Plantation" means an artificially reforested area established by planting or by direct seeding. Plantation includes the cultural plantations described in the Ecological Land Classification (ELC) for Southern Ontario (Lee et al. 1998).

"Top height," means the average height of the 100 largest trees per hectare.

"Tree community" means a woodland section separated out on the basis of identifiable uniformity of species, origin and soils.

"Trees" means woody plant species that are able to reach unassisted a height of 4.5 metres, following the definition of Trees in Canada (Farrar 1995).

4. Significant Woodlands:

4.1 Identification of Significant Woodlands

For the purposes of applying the policies of the ORMCP, significant woodlands shall mean woodlands that have either:

(a) have a tree cover of over 60, considered "forest" in the Ecological Land Classification (ELC) for Southern Ontario (Lee et al. 1998); or
(b) have a tree cover of over 10, considered "treed area" in the Ecological Land Classification (ELC) for Southern Ontario (Lee et al. 1998) and satisfy the following criteria:
- 1,000 trees of any size per hectare, or
- 750 trees measuring over five centimetres in diameter, per hectare, or
- 500 trees measuring over 12 centimetres in diameter, per hectare, or
- 250 trees measuring over 20 centimetres in diameter, per hectare.

And the diameter of a tree shall be measured at breast height (1.37metres from the ground) in regenerating fields and must have achieved that height to be counted.

And which are:

(a) 4 hectares or larger in size located in the Countryside or Settlement Areas of the ORMCP; or
(b) 0.5 hectare or larger in size located in the Natural Core or Natural Linkage Areas of the ORMCP; or
(c) 0.5 hectare or larger located wholly or intersecting within a key natural heritage or hydrologically sensitive feature or their vegetation protection zones.

4.2 Exceptions

(a) Notwithstanding section 4.1, significant woodlands shall not include tree communities where:
- the majority of the trees were planted and are managed for production of nursery stock or other tree products with an average rotation of less than 20 years (e.g., hybrid poplar); or
- it is a plantation having a current top height of less than two metres; or

- it is a regenerating field where the majority and tallest trees are non-native species with a current top height of less than three metres; or
- the treed area is relatively narrow having a consistent width of less than 40 metres to crown edges.

Note: the ORMCP already excludes from the definition of woodlands, a cultivated fruit or nut orchard or a plantation established for the purpose of producing Christmas trees.

(b) Notwithstanding subsection 4.1, woodlands smaller than 4 hectares in size may be determined by the approval authority not to be "significant" where the woodland does not constitute or provide one or more of the following features or functions:

- a natural woodland which has supported woodland cover for at least 100 years;
- a woodland in which naturally regenerated trees among those listed in Table A constitute the woodland;
- a key natural heritage feature or hydrologically sensitive feature for purposes other than a significant woodland (including Significant Wildlife Habitat);
- important protection, supporting habitat or ecological linkage to a nearby key natural heritage feature; or
- an important connecting link between two or more key natural heritage features.

4.3 Delineation of Significant Woodlands

In delineation of significant woodlands, the following criteria shall be applied:

(a) if compatible openings less than 40 metres across occur between 2 or more woodlands, the woodlands will be treated as one woodland area. However, where two woodlands more than 40 metres apart are wholly or partially connected by a band of trees with an average width of less than 40 metres, the woodlands shall be considered two separate woodlands and the connecting band of trees will not be included in the calculations of either woodland area;

(b) if compatible openings within a woodland area are less than 0.5 hectare in area and less than 25 of the qualifying treed portion, they can be considered part of the woodland;

(c) where woodlands are crossed by a road, with a right-of-way of 21 metres or less, owned and maintained by a road authority, the road area should not be measured as a woodland part but the areas of the separated treed portions should be combined and measured as one woodland;

(d) woodland portions outside the Plan Area shall be included in the area calculations for determining significance notwithstanding the fact that the policies of the ORMCP are required to be applied only to the portion of the woodland within the Plan Area;

ELC can be used for the delineation of different tree communities. However, for the purpose of delineating the outside boundaries of significant woodlands, different abutting tree communities (i.e. ELC polygons) should be combined.

5. Significant Woodlands Considered for Mineral Aggregate Operation and Wayside Pits:

As noted in Section 2 of this paper, the ORMCP allows that aggregate extraction within a key natural heritage feature may be approved if the key natural heritage feature is occupied by "young plantations" or "early successional habitat", subject to conditions and approvals. This section provides criteria for determining whether woodlands qualify as "young plantations" or "early successional habitat".

5.1 Young Plantations

"Young plantations" shall mean plantations in which:

(a) naturally regenerated trees listed in Table A do not constitute a significant woodland (as identified by Section 4.1); and

(b) there is less than two square metres of basal area per hectare in trees at least 25 centimetres in diameter. (Note: two square metres of basal area corresponds to 41 trees 25 centimetres in diameter or 10 trees 50 centimetres in diameter).

5.2 Early Successional Habitat

"Early successional habitat" means an area recovering from disturbance in which:

(a) naturally regenerated trees listed in Table A do not constitute a significant woodland; and

(b) there is less than 10 square metres of basal area per hectare in trees at least 10 centimetres in diameter from any combination of species listed in Table A plus white ash (Fraxinus americana), black cherry {Prunus serotina) or white-cedar (Thuja occidentalis). (Note: 10 square metres of basal area corresponds to 1,274 trees 10 centimetres in diameter, 204 trees 25 centimetres in diameter or 51 trees 50 centimetres in diameter.)

6. Effect of Tree Removal on the Status of Significant Woodlands

Except where permanent removal is permitted in accordance with the ORMCP, a woodland considered significant on or after November 17, 2001 should continue to be identified and managed as a key natural heritage feature in accordance with the policies of the ORMCP even if trees are removed or destroyed due to human or natural causes. Such removal, including accommodation of mineral aggregate extraction in accordance with section 35(4) of the ORMCP, shall not constitute a reduction in size or outer boundaries of the significant woodland for land use planning purposes. Areas of tree removal will be returned to a natural vegetated state in accordance to the policies of the ORMCP.

7. References

Farrar, J.L. 1995. Trees in Canada. Fitzhenry & Whiteside Limited and the Canadian Forest Service, Natural Resources Canada. 502 pp.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral Science Section Field Guide FG-02. 225 pp.

Oldham, M.J., W.D. Bakowsky and D.A. Sutherland. 1995. Floristic Quality Assessment System for Southern Ontario. Ontario Ministry of Natural Resources, Natural Heritage Information Centre. 69 pp.

Ontario. 1998. Forestry Act. R.S.O. 1990, c. F.26, as amended.

Ontario. 2002. Oak Ridges Moraine Conservation Act, 2001, Ontario Regulation 140/02, Oak Ridges Moraine Conservation Plan.

Ontario Ministry of Natural Resources. 1999. Natural Heritage Reference Manual for Policy 2.3 of the Provincial Policy Statement. 127 pp.

Table A - Tree List

Native Shade-tolerant or Long-lived Tree Species with Restricted Natural Regeneration on Disturbed Sites in the Oak Ridges Moraine Area

Abies balsamea	Balsam Fir
Acer nigrum	Black Maple
Acer pensylvanicum	Striped Maple
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple
Acer saccharum	Sugar Maple
Acer spicatum	Mountain Maple
Betula alleghaniensis	Yellow Birch
Carpinus caroliniana	Blue-beech
Carya cordiformis	Bitternut Hickory
Carya ovata	Shagbark Hickory
Fagus grandifolia	Beech
Fraxinus nigra	Black Ash
Juglans cinerea	Butternut
Juglans nigra	Black Walnut
Larix laricina	Tamarack
Ostrya virginiana	Hop-hornbeam
Picea glauca	White Spruce
Picea mariana	Black Spruce
Pinus resinosa	Red Pine
Pinus strobus	White Pine
Quercus alba	White Oak
Quercus macrocarpa	Bur Oak
Quercus rubra	Red Oak
Quercus velutina	Black Oak
Tilia americana	Basswood
Tsuga Canadensis	Hemlock

Notes:

1. Compiled through consideration of species characteristics with confirmation that none of these species was assigned in Floristic Quality Assessment System for Southern Ontario by Oldham et al. (1995) a coefficient of conservatism of 0 to 3 given to plants found in a variety of plant communities, including disturbed sites.
2. Hybrids to be considered of same value as parent species.

APPENDIX 6: DEFINITIONS USED FOR SIGNIFICANCE CRITERIA

Appendix 6: Definitions Used in Suite of Significance Criteria

G1, G2, G3, S1, S2, or S3 plant or animal species, or community: the Natural Heritage Information Centre assigns a rarity ranking of 1 to 5 to species of plants, animals and communities in Ontario. Provincial status (*e.g.* provincially rare species) are known as "S ranks", and global rankings as "G ranks". For the purpose of this report, rankings of 1, 2 or 3 are considered rare.

G1: Extremely rare; usually 5 or fewer occurrences in the overall range or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.

G2: Very rare; usually between 5 and 20 occurrences in the overall range or with many individuals in fewer occurrences; or because of some factor(s) making it vulnerable to extinction.

G3: Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.

S1: Extremely rare in Ontario; usually 5 or fewer occurrences in the province or very few remaining individuals; often especially vulnerable to extirpation.

S2: Very rare in Ontario; usually between 5 and 20 occurrences in the province or with many individuals in fewer occurrences; often susceptible to extirpation.

S3: Rare to uncommon in Ontario; usually between 20 and 100 occurrences in the province; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances. Most species with an S3 rank are assigned to the watch list, unless they have a relatively high global rank.

COSEWIC or COSSARO, Threatened, Endangered, Vulnerable or of Special Concern: The definitions used by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and COSSARO (Committee on the Status of Species at Risk in Ontario) to designate species are very similar. The COSEWIC definitions are:

Endangered. A species facing imminent extirpation or extinction.

Threatened. A species likely to become endangered if limiting factors are not reversed.

Special Concern. A species that is particularly sensitive to human activities or natural events but is not an endangered or threatened species.

The COSSARO definitions are:

Endangered. Any native species that, on the basis of the best available scientific evidence, is at risk of extinction or extirpation throughout all or a significant portion of its Ontario range if the limiting factors are not reversed.

Threatened. Any native species that, on the basis of the best available scientific evidence, is at risk of becoming endangered throughout all or a significant portion of its Ontario range if the limiting factors are not reversed.

Vulnerable. Any native species that, on the basis of the best available scientific evidence, is a species of special concern in Ontario, but is not a threatened or endangered species.

Significant Feature: all evaluated wetlands; all life science ANSIs (regionally and provincially significant); all significant valleylands as determined by the MNR, TRCA or LSRCA, Environmentally Significant/Sensitive Areas (ESAs), and ORM Key Natural Heritage Features and their associated vegetation protection zones.

Evaluated Wetland: This refers to any wetland that has been evaluated using the Provincial Wetland Evaluation Manual and which has been approved by MNR.

Watercourse: The definition of a watercourse will be that contained in Black's Law Dictionary: "A body of water flowing in a reasonably definite channel with bed and banks."

Surface Water Features: This includes lakes, woodland ponds, watercourses, springs, seeps, reservoirs *etc.* which provide ecological functions. It is not intended to include small surface water features such as farm ponds or stormwater management ponds, which would have limited ecological function. Some judgment will have to be exercised when assessing eligibility of features for the application of this criterion.

APPENDIX 7: METADATA PROVIDED FOR THE GIS FILES

The technical specifications of the GIS files were provided to the Region as part of the product delivery. This appendix provides just the text description of the three files that was contained in the final GIS metadata.

WOODNEW.SHP

General
2002 orthoimagery provided by the York Region was used to update the existing woodland coverage. The focus of the exercise was to refine woodland patch boundaries that had actually changed since 1999 owing to: 1) removal of woodland resulting from development or other reasons, 2) expansion of existing woodland patches owing to forest succession, and 3) identify new patches that resulted from woodland succession. The 2002 orthoimagery has superior resolution compared to the 1999 imagery used for the existing woodland layer. This allows better interpretation of whether successional areas meet the definition of woodland (which is that provided by the Region in the Tree By-Law), as well as more accurate delineation of woodland edges. However, there was no attempt made to systematically refine all existing woodland boundaries because of the increased resolution, changes were generally only made if there had been actual changes to the woodland patch in the field. Only in some cases, where a woodland patch was being refined for one of the 3 reasons noted above, were some boundaries adjusted to make them more accurate. The existing woodland layer was also based on substantial field checking, where as the update based on the 2002 orthoimagery was not, therefore, where there was doubt regarding whether an area of succession met the definition of a woodland, the 1999 boundaries were retained..

Step Process
Each 2002 orthophoto was overlain with the woodland patches from the 1999 layer. These were visually scanned on-screen at a scale of 1:4800 to identify differences in woodland coverage between 1999 and 2002. These differences were subject to review and updated for the following reasons:

- where a woodland was wholly or partially removed between 1999 and 2002;
- where succession occurred such that an open area present in 1999 developed sufficiently by 2002 to meet the definition of woodland noted above; or
- where the better resolution of the 2002 orthophotos provided increased ability to identify woodlands.

Some of the resulting differences between the 1999 and the 2002 interpretations may be attributable to differences in the scale at which the orthophotos were viewed and/or interpreted by the analyst, especially with respect to the stage of succession at which the woodland definition is satisfied.

The current study updated woodland information based solely on an examination of the 2002 orthophotos; no field studies or ground-truthing was undertaken. In recognition of this, woodland patches that did not show obvious signs of disturbance or development between 1999 and 2002, were not modified, as the pre-existing 1999 digital update study boundaries were assumed to be more accurate (based on the field studies undertaken as part of the 1999 update

study). For example, if an area appeared to satisfy the Region's definition of a woodland, in both the 1999 and 2002 orthophotos, but was not defined as such in the existing woodland coverage (*i.e.* , 1999 update study digital boundary), we deferred to the existing coverage and did not update or refine the boundary. Similarly, if an area did not appear to satisfy the Region's definition of a woodland, in either the 1999 or 2002 orthophotos, but was defined as a woodland in the existing woodland coverage, we did not perform an update or redefine the woodland's boundaries, on the assumption that the delineation was based on fieldwork as part of the 1999 update.

In addition to looking at the 1999 woodland layer, the 1999 orthophotos were also consulted to help understand decisions made in the 1999 exercise. By "toggling" between the 1999 and 2002 orthophotos, with the 1999 boundaries superimposed, the boundary delineations from 1999 were often clarified, and guidance provided on the appropriate refinement in this current update. To focus in on discrepancies, it was often necessary to magnify ("zoom into") the area in question on-screen, beyond the initial review scale of 1:4,800.

The comparison of orthophotos made it much easier to isolate those areas that strictly related to succession and development. The comparison was achieved by configuring our GIS to overlay: 1) 1999 orthophotos of the Region, 2) the 2002 orthophotos of the Region, 3) a non-editable, original version of the woodland coverage (2001), and 4) an editable version (working copy) of the woodland coverage. Collectively, updates to the working copy eventually culminated in a revised woodland layer based on the 2002 orthophotos. QA/QC procedures are provided in North – South Environmental Inc. (2005).

WOODFIN.SHP

General

A final, updated woodland layer was created (woodfin.shp) based on the initial update layer (woodnew.shp), by deleting some areas known to be short-rotation woodlands such as Christmas tree farms or nurseries. Since such woodlands are not deemed to be permanent, there was a desire to remove them from the updated woodland layer. The deletion of these short-rotation woodlands was achieved by using the Ecological Land Classification (ELC) undertaken by the Lake Simcoe Region Conservation Authority (LSRCA). In the ELC exercise, the LSRCA had undertaken some field reconnaissance to identify short-rotation woodlands, which were subsequently classified as "intensive agriculture". Patches so designated were clipped out of the "woodnew.shp" file. Since the two datasets where not consistent in terms of positional accuracy of the arcs, a visual check was carried out on the entire layer and sliver polygons were identified and deleted. Note that this exercise could only be undertaken for that portion of the Region that is within the LSRCA jurisdiction.

Step Process

The Ecological Land Classification (ELC) shape file produced by the Lake Simcoe Region Conservation Authority (LSRCA) was overlaid on the updated woodlands layer "woodnew.shp". All woodland patches that were within areas designated as 'Intensive Agriculture' in the ELC were clipped out of the woodlands layer. Since the two datasets were not consistent in terms of

the positional accuracy of the arcs, the clipping resulted in slivers being left wherever the ELC woodland patch boundary was outside the intensive agriculture patch boundary. This was simply a result of the digitizing process, not a reflection of actual field conditions, therefore the slivers were undesirable. Subsequently, a visual check was carried out on the entire layer and sliver polygons were identified and deleted. QA/QC procedures are provided in North – South Environmental Inc. (2005). Note that this exercise could only be undertaken for that portion of the Region that is within the LSRCA jurisdiction.

The "woodfin.shp" file was used to calculate statistics on the woodlands of York Region. Prior to doing this, the layer was cut against a boundary of the Region. This was done since some patches from the existing forest layer generated from the 1999 orthoimagery were partially or wholly outside the Region. However, these woodland patches were retained in the "woodfin.shp" file. There are also some patches that are smaller than 0.5 acres [0.2 ha] from the original woodland layer, which, therefore, do not meet the definition of a woodland.

SIGFOR.SHP

General
The final updated woodlands layer "woodfin.shp" as used as a basis for determining woodlands that should be considered significant in York Region. A set of criteria for identifying significant woodlands were developed by North – South Environmental Inc. These were used to develop a set of procedures using available digital data that identified the woodlands depicted in the "sigfor.shp" file.

It is important to note that for ecological reasons, woodland patches that occurred within 20 m of one another were deemed to function as one woodland. Thus, for applying the significant criteria, a "grouping exercise" was undertaken to associate all woodland patches within 20 metres of one another. This grouping is not a criterion per se, but was used as a tool to identify woodland patches that, based on their proximity, are considered one functional woodland group.

Details of the selection, rationale and description of the significant criteria are provided in the Significant Woodland Report (North – South Environmental Inc. 2005). The criteria and procedures are summarized below in the step process.

Step Process
1) The first criteria was based on rare species designated by NHIC or by COSEWIC or COSSARO ranking. Any woodland patch that contained ranked species of plants or wildlife would be considered significant.

2) Any woodland that is within 30 metres of a watercourse, surface water feature or evaluated wetland was considered significant.

3) Any woodland over 2 ha:
i) that is within 100 metres of another significant feature, or
ii) that occurs within the Regional Greenlands System

4) Any woodland south of the Oak Ridges Moraine that is greater than or equal to 4 ha in size.

5) Any woodland north of the Oak Ridges Moraine that is greater than or equal to 10 ha in size.

6) Any woodland that occurs on the Oak Ridges Moraine will be evaluated for significance based on the requirements of the Oak Ridges Moraine Conservation Plan and associated guidelines (OMNR 2004, see Appendix 4)

The resultant woodland patch layer after the application of the criteria is the significant woodland coverage for York Region

The final, updated woodland layer "woodfin.shp" was used to apply a series of procedures to identify the significant woodland patches depicted in the "sigfor.shp" file.

First, for reasons summarized above, and explained more fully in the Significant Woodland Report (North – South Environmental Inc. 2005), all woodland patches within 20 metres of each other were associated in groups. This was achieved by applying a 10 metre buffer around all patches in "woodfin.shp". Where buffers intersected, they joined, effectively identifying all patches within 20 metres of each other. This could create a "chaining" effect that resulted in many woodland patches being associated within one group. All patches associated within the same group were assigned a unique identifier, the GROUP field in the attribute table.

A set of procedures was developed to apply the significance criteria developed by North – South Environmental Inc. The criteria are reproduced below from the North – South report . Underlined words are defined in the report. The procedures were applied to the grouped patches, *i.e.* , with respect to area, the sum of the areas of all patches within a single group was used for applying criteria (note, the area between patches was not included in this area, just the sum of the patches within each group). Thus this would only influence criteria that used area for identifying significance.

13. Any woodland that supports any of the following:

- *v) any G1, G2, G3, S1, S2, or S3 plant or animal species, or community as designated by NHIC; or*
- *vi) any species designated by COSEWIC or COSSARO as Threatened, Endangered, or of Special Concern.*

Digital data for significant species was only available for the area on the Oak Ridges Moraine, thus this criterion was not applied off the ORM for the purposes of producing the "sigfor.shp" file. Any woodland patch that contained rare species of plants, communities or wildlife as defined was be considered significant. Any woodland patches that intersected with this criterion were retained.

14. Any woodland that is within 30 metres of a watercourse, surface water feature or evaluated wetland.

A layer containing watercourses was provided by the Region. All watercourses were buffered by 30 metres and overlaid on the final updated woodlands layer. All woodland patches that intersected a watercourse or its buffer were retained.

15. Any woodland over 2 ha:

i) that is within 100 metres of another significant feature, or

ii) that occurs within the Regional Greenlands System.

Digital layers containing significant areas were provided by the Region. All significant areas were buffered by 100 metres and overlaid on the final updated woodlands layer. All woodland patches greater than 2 ha that intersected a significant feature or its buffer were retained. For 3ii), woodland patches were overlaid on the Regional Greenlands System. Any woodland patch over 2 ha that intersected the Greenlands System was retained.

16. Any woodland south of the Oak Ridges Moraine that is greater than or equal to 4 ha in size.

Any grouped woodland patches that occurred south of the Oak Ridges Moraine, and whose sum was equal to or greater than 4 ha were retained. The boundary of the Oak Ridges Moraine was supplied by the Region.

17. Any woodland north of the Oak Ridges moraine that is greater than or equal to 10 ha in size.

Any grouped woodland patches that occurred south of the Oak Ridges Moraine, and whose sum was equal to or greater than 10 ha were retained. The boundary of the Oak Ridges Moraine was supplied by the Region.

18. Any woodland that occurs on the ORM will be evaluated for significance based on the requirements of the Oak Ridges Moraine Conservation Plan and associated guidelines (OMNR 2004, see Appendix 4)

The woodland patches considered significant on the ORM were based on a digital layer developed by the Region labeled "orm_woodlots.shp", which was completed as part of the ORM conformity exercise. It was based on an early version of the ORM criteria for identifying significant woodlands. Woodland patches from the orm_woodlots file were combined with those identified using criteria 1, 2, and 3 and retained.

The resultant layers produced by applying all the criteria above were unioned together to form the significant woodlands layer. QA/QC procedures are provided in North – South Environmental Inc. (2005).