Oxford Natural Heritage Study

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Oxford County
growing stronger...together

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Preamble

Oxford County possesses many valuable assets including natural assets – forests, wetlands, streams and rivers. These natural resources provide innumerable values to society including purification of the air and groundwater, habitat for wild plants and animals, erosion protection, and recreational opportunities.

However, like any asset, wise management is the key to sustainability. Our forefathers thought the forests were inexhaustible and by the early 1900's, 90% of our forests were gone and the sandy soils were blowing away. An awakening to the impacts of this deforestation inspired many individuals, groups, agencies and government to take steps to ensure the long-term survival of these natural features.

In 2006, many groups and agencies are still working towards conserving and enhancing the County's natural features. Good information on the state of the Oxford's natural resources is critical to effective results. This study has inventoried Oxford's natural features both terrestrial (land) and aquatic (water) using the most up to date scientific methodologies and mapping tools.

The study findings show the County has many good quality streams, rivers and forests. Fish, lumber, animals can continue to be harvested sustainably. However, we also have many challenges in the form of poor quality watercourses and tiny forest fragments that cannot sustain the diversity of wildlife we know today. Natural areas, once removed, take generations and countless dollars to bring back.

We must credit those who have stewarded the land and water to date. We must also take steps to ensure more of the County's resources are maintained and enhanced. Council is a major player in the conservation and enhancements of these natural resources as outlined in the recommendations in this report

Our intent can be best described as a desire to protect and conserve the natural assets, our *green infrastructure*, for all time, for the use, health and enjoyment of future generations. To achieve this outcome will require the recognition of the important role of private landowners and that the County of Oxford is the enabling body with specific responsibilities.

My thanks to the many people who have contribute their time and efforts to the making of this study. It has been my privilege.

Michael Harding
Chair, Steering Committee
Oxford Natural Heritage Study

Executive Summary

The Oxford Natural Heritage Study examined the state of the terrestrial (land) and aquatic (water) resources of the County using scientific methods. The study also came up a set of recommendations to conserve and enhance these features.

The woodlands and natural areas were measured and assessed on a landscape level using ortho-imagery (air photos) and a Geographical Information System. Nine scientifically based criteria were developed to determine which patches were significant on the County scale. Maps were produced depicting which patches met at lest one criteria. In total, 2676 of 3368 patches met one or more criteria. Forest cover is 12.5% with an additional 1.8% meadow, totalling 14.3% cover. This amount is below the ideal of 20-30% cover to maintain species and watershed health, but within reach. Many woodland patches are small. With low forest cover, it is important to conserve and enhance what remains. Most of southwestern Ontario has low forest cover because the land is well suited to agriculture and urbanization. It must be recognized that the natural features have been preserved because landowners value the natural areas on their land.

Information on Oxford's watercourses (fish, habitat, benthic organisms) was compiled from earlier studies. Additional sampling was carried out at 140 sites to fill gaps. The watercourses were categorized into three system types and mapped. Fifty percent of the watercourses are System Type 1, meaning they have permanent flow, warm or cool/cold water and have sensitive or significant species. Thirty-one percent of watercourses are System Type 2, meaning they have permanent flow, warm water and support baitfish. Nineteen percent of watercourses are System Type 3, meaning they have intermittent flow, warm water, and are seasonally access by baitfish and other larger fish. Each system type can be enhanced to improve conditions for aquatic life, and even may move from one type 3 to 2 or type 2 to 1.

Over 40 years of water quality/chemistry data from 12 sites was compiled from the Provincial Water Quality Monitoring Network. The trends in the concentrations of six key parameters were plotted and discussed. The six parameters include: total phosphorus, nitrate, suspended solids (clarity), chloride, copper and bacteria. Nutrients such as nitrate and total phosphorus are routinely above guidelines at most sites. Nitrate and chloride are showing a steady rise in levels, a trend mirrored in other southern Ontario streams. Bacteria levels are also routinely high, but improvements have been shown in recent years. Copper is still within acceptable levels. Aquatic life are affected directly or indirectly by pollutants, and it is important to monitor the water chemistry to assist with the understanding of aquatic health. Pollutants in water reflect land use practices on the land, in both rural and urban settings.

A multi-stakeholder Implementation Advisory Committee (IAC) composed of 23 groups was assembled to bring various expertises and viewpoints and discuss ways of implementing the recommendations made from the terrestrial and aquatic teams. As natural heritage features are often situated on private land, it was important to get the input of groups representing private landowners (e.g. agricultural and urban). The IAC discussed and recommended several practical measures to achieve the conservation and enhancement of Oxford's natural resources. The IAC recognized that many tools or approaches were needed to achieve this large goal while still allowing landowners to make a living. Recommendations centred on incentives, regulation, education and outreach, securement and protection, and taxation measures. The IAC validated the work of the technical and steering committees and provided a unique grassroots perspective and buy-in to this technical study.

The Steering Committee, made of seven project partners, oversaw every aspect of the Oxford Natural Heritage Study and endorsed this report. The Steering Committee considered the

recommendations of the technical teams and the Implementation Advisory Committee and made several final recommendations. Some of the key recommendations include:

- formation of an ongoing Natural Heritage Advisory Committee to enable the recommendations to be delivered
- designation of patches that meet one or more criteria in the Official Plan
- expansion of the County's Clean Water Project to provide more incentives to landowners to improve environmental conditions on their land
- development of a communications strategy
- recognition of landowners with significant patches
- completion of urban natural heritage inventories
- exploration of tourism opportunities around natural resources and
- continued monitoring of aquatic and terrestrial resources in the County.

In summary, Oxford County has many good quality terrestrial and aquatic habitats, with large wetlands and several trout streams, but is also challenged by many poorer quality sites and low forest cover. Understanding the dynamics of all of the pieces of the system helps to plan for future conservation and augmentation. It will take generations to restore the natural heritage system to a level that is sustainable, and many actions have already been made. The findings of this study provide the impetus to start more concertedly on this path.

Acknowledgements

The Steering Committee would like to thank the consultants, the Upper Thames River Conservation Authority, for their thorough technical research and project management. We'd also like to thank the Grand River, Long Point Region and Catfish Creek Conservation Authorities for their in-kind support of the technical aspects of this study. Thanks also go to Human Resources Development Canada who funded contract staff who assisted the consultants in various aspects of the study.

The Steering Committee would like to thank the members of the Implementation Advisory Committee (IAC) for their valuable assistance and input into this study. Special thanks go to Jim Hayes, who chaired the IAC and Kim DeKlein for her efforts in facilitating process. The sharing of ideas certainly made this study much more comprehensive and open.

Finally, we would like to thank the financial backers of this study for their generous contributions and support of this work including:

- County of Oxford,
- Ontario Trillium Foundation,
- Ducks Unlimited Canada, and
- Stewardship Oxford.

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Chapter 1. Background

1.1 Introduction

The Oxford Natural Heritage Study (ONHS) addresses the need for information on the state of Oxford County's natural areas and watercourses. The study provides a landscape assessment of natural heritage features and assesses strategies for their protection and restoration.

The ONHS builds on two previous County wide natural heritage initiatives. An early report titled *Natural Areas in Oxford County: A Preliminary Survey* (Hilts, 1976) recommended 55 sites for designation as Significant Natural Areas. These sites were officially recognized in the County's planning documents. In the late 1990s, the *Oxford County Terrestrial Ecosystem Study* (OCTES), an innovative scientific study undertaken by the County and the Upper Thames River Conservation Authority, further defined the elements of woodland health at the landscape level.

The ONHS builds on the scientific methodology of the OCTES to provide a landscape level assessment of the County's woodlands. The study scope is expanded beyond woodlands to include aquatic natural heritage resources and to also assess the range of implementation options to protect and enhance natural heritage resources in the County.

Thames upstream of Woodstock

1.2 Study Goals and Products

The overall goal of the ONHS is to describe the health of Oxford County's terrestrial and aquatic natural heritage systems including woodlands, wetlands, streams, and rivers and to develop strategies for their long term protection and rehabilitation. The specific goals of the ONHS are to:

- generate an increased understanding of the location, significance and inter-dependence of the County's natural heritage features,
- develop land use planning information and policy that identifies protects and enhances the County's terrestrial and aquatic habitats, and
- provide information that can assist conservation groups and agencies working in the County to effectively target their programming to the areas most in need of protection or restoration.

The study's products include:

- accurate, detailed and comprehensive natural heritage systems mapping at a 1:10,000 scale that includes natural areas (woodlands, wetlands, prairies) and watercourses,
- criteria and associated rationale for determining significant terrestrial habitats (patches) at the County level and mapping showing patches that meet the criteria,
- County-wide fish and benthic monitoring information of selected watercourses, criteria and associated rationale for categorizing habitat types and mapping showing categories of watercourses across the County,
- metadata associated with each mapping layer, and
- implementation strategies / tools such as stewardship, education, demonstrations, incentives and regulatory measures (land use planning policy and tree cutting bylaws, etc.).

1.3 Study Area – Oxford County Description

Oxford County is situated in the agricultural heartland of southwestern Ontario, roughly halfway between Windsor and Toronto along Hwy 401 (see Figure 1). The County is largely agricultural, with three urban and five rural municipalities (see Figure 2). The County is situated in the extreme south of Canada and thus benefits from a long growing season and fertile soils, making agriculture the dominant land use. The three largest urban areas, Woodstock, Ingersoll and Tillsonburg, support the agricultural areas and have a manufacturing base.

Oxford County is approximately 2050 square kilometres in area with a population of about 106,000.

Figure 1. Oxford County within Southern Ontario

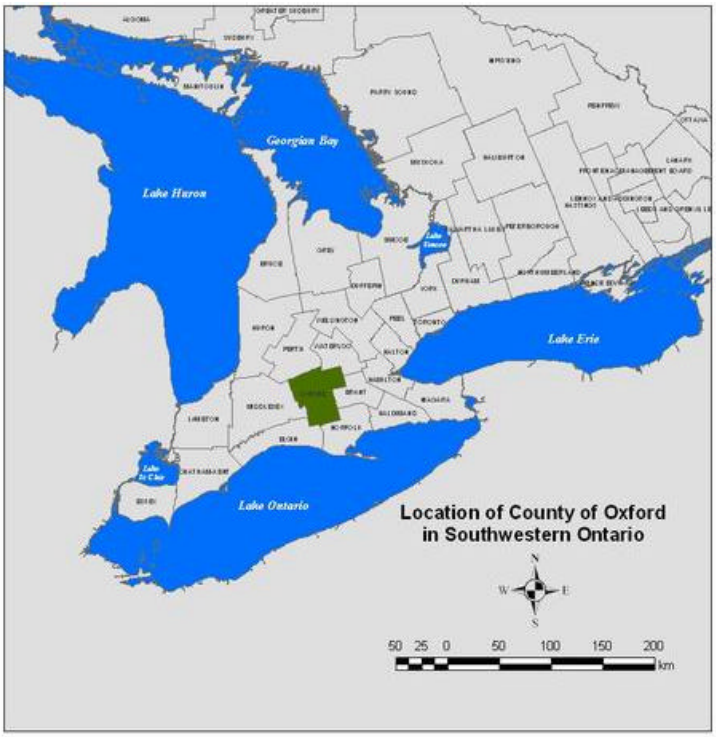
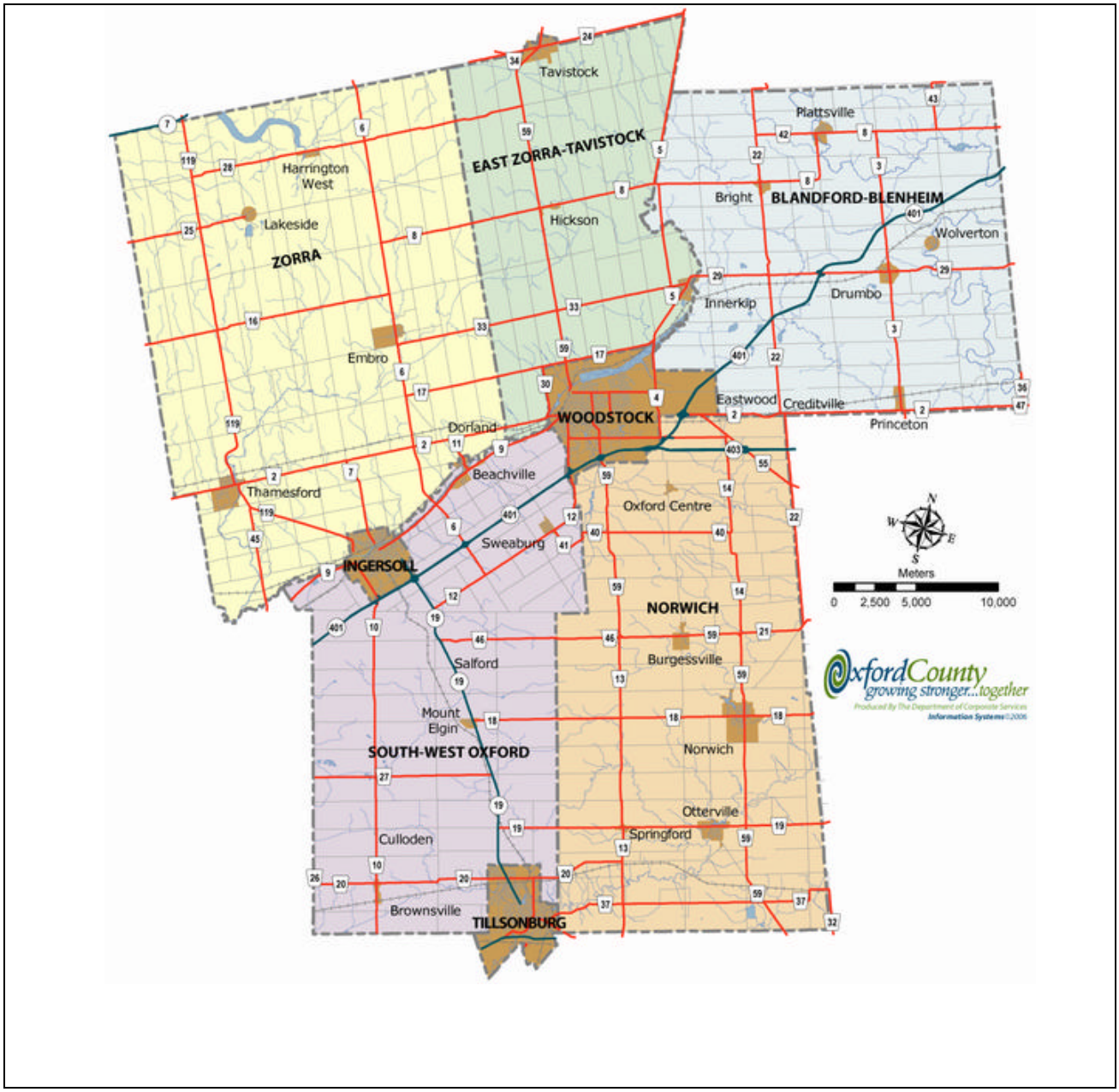


Figure 2. Oxford County Basemap

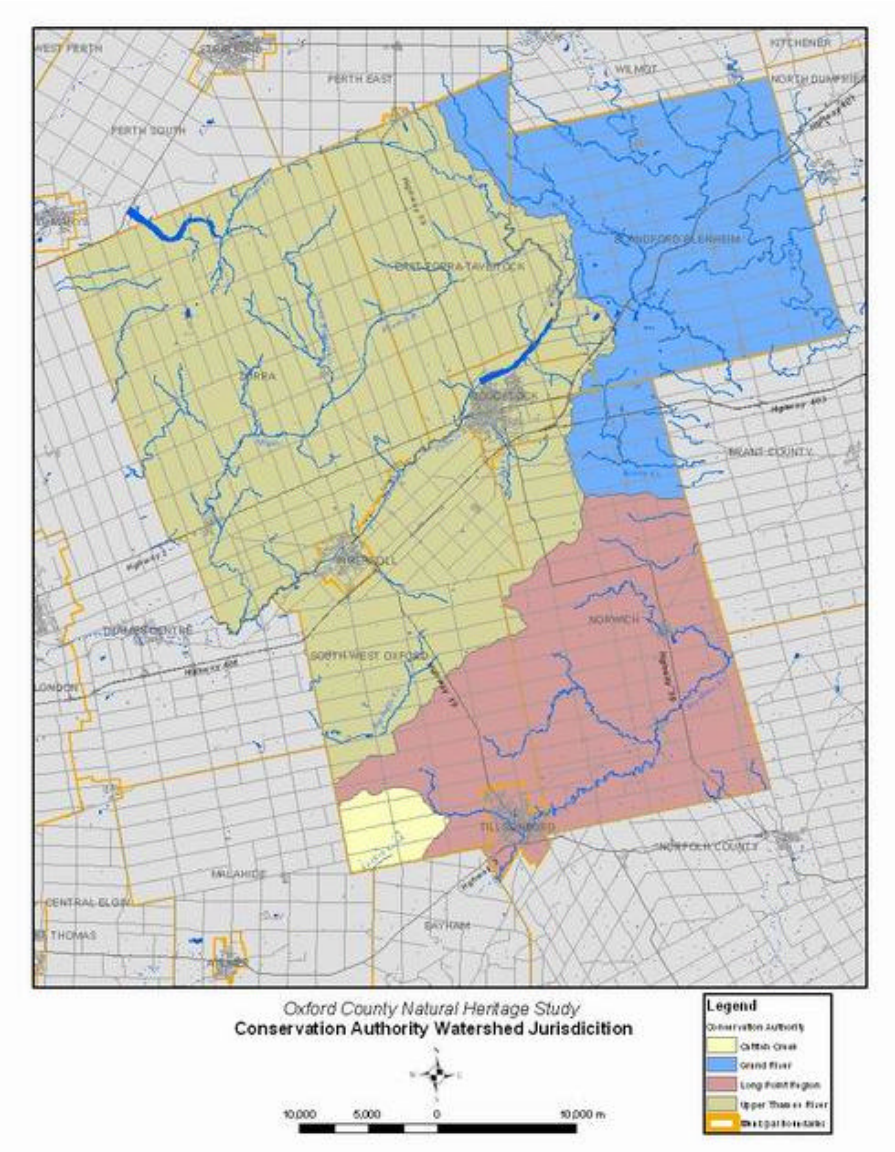


The County is within the watersheds of four Conservation Authorities (see Figure 3 and Table 1) within the Lake Erie basin. Big Otter Creek, Nith River (Grand River) and Catfish Creek drain into Lake Erie directly. The Thames River drains west into Lake St. Clair, which then drains into Lake Erie.

Table 1. Conservation Authorities of Oxford County

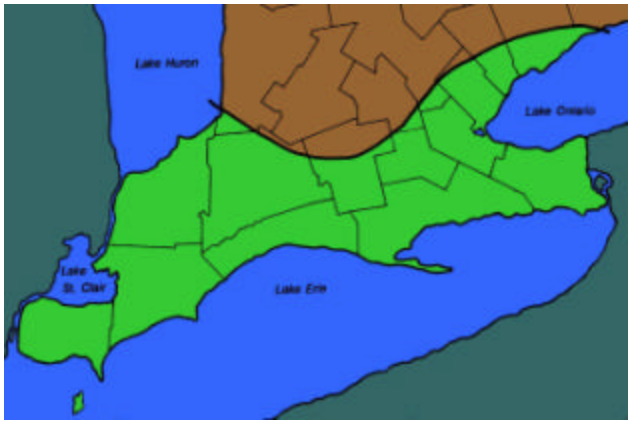
Watercourse	Conservation Authority	Percent of County
Thames River	Upper Thames River	55
Big Otter Creek	Long Point Region	22
Nith River	Grand River	21
Catfish Creek	Catfish Creek	2

Figure 3. Conservation Authorities within Oxford County



Oxford County is situated in the transition zone between the Lower Great Lakes - St. Lawrence Forest Region to the north and the Southern Mixed Deciduous Forest (Carolinian Floristic) Zone to the south (Figure 4). Despite intense agriculture and urban development, the area is still biologically rich with plant and animal species of both southern and northern affinity. For example, the County contains a significant proportion of southwestern Ontario's remnant trout streams and is home to several rare fish and mussel species. Despite these very productive and diverse fish communities, Oxford County still has many streams and rivers with poor water quality and aquatic habitat.

Figure 4. The Carolinian Zone in Southern Ontario *(map courtesy of Carolinian Canada)*



Although there are many healthy and productive natural areas and waterways in the County, the loss and degradation of woodlands, wetlands and waterways is a serious environmental concern. Across southern Ontario, woodland losses have exceeded those of almost any other major ecosystem. Forest cover across Oxford County is approximately 12.5%, one of the lowest in southern Ontario. The majority of these woodlands are small. The best available information suggests that 20-30% natural cover is needed to sustain species and protect soil, water and air quality (Environment Canada 2004).

1.4 History of Settlement and Forest Fragmentation

Oxford County was first settled by European immigrants in 1794 (Tchir and Johnson 2000). The forest at that time was dense, with only a few openings of marsh, bog and willow meadow and the trees were large, an average of 3 to 6 feet in diameter. The principle cover type of the original upland forest in Oxford County was sugar maple, followed by beech and elm. The presence of the maple-beech forest was an indication of where the best soil for producing profitable crops would be found. Norfolk and southern Oxford had enormous oaks and pines on well drained soils, both of which were in great demand for square timber. The timber industry thrived in the 1830's and 1840's and once these merchantable species were removed, the lands were settled.

Swamps and poorly drained soils were often located at the head waters and formed large natural surface water storage areas. Hemlock and cedar were found near the streams while the swamps were primarily composed of white elm, cedar and soft maple.

Major deforestation occurred fro 1850 to 1890. The attitude toward forests at the time was that they were obstacles to agriculture and development. It was also thought that timber was inexhaustible. By 1860, approximately 60% of the forests were depleted, and by 1910 over 90% of the forests were gone with the wood used for an ever growing number of uses.

In the early 1900's it was common to see abandoned farms throughout south Oxford because of the loss of organic material, which depleted the fertility of the sandy soils. Attention to the environment grew as a result of the over-clearing and government programs were introduced to reforest the marginal lands to conserve soil and protect water sources.

Wildlife species in Oxford County were a mixture of northern and southern species, reflecting the forest composition. Wildlife populations peaked as land was being converted from forest to agriculture. This initial clearing diversified the food and land cover, resulting in a landscape of cleared fields, forest edge and opened ungrazed woodlots. Eventually, wildlife populations were depleted because of lack of large forest tracts, intensive wood cutting, burning and grazing; as well as excessive hunting and trapping. Wolf, beaver, wolverine, passenger pigeon and bob white disappeared from southwestern Ontario.

Again, the loss of these species awoke a concern in the community and government, and many programs were initiated to conserve animal species. For example, there has been great success at the re-introduction of wild turkeys into southwestern Ontario. Hunting and trapping limits are regulated to keep pace with population levels. New issues continue to arise, such as the overabundance of white tailed deer due to the availability of food outside of forests and the lessening hunting pressure. Other species, especially Neotropical migrant birds such as warblers, are still declining due to loss of large habitats.

1.5 Benefits of a Healthy Environment

Woodlands, wetlands, meadows and other natural areas provide a wide range of functions to both humans and the environment. Well managed woodlots provide excellent revenue for landowners (Steve Bauer, Huron Study). Some of the benefits that woodlands and other natural areas provide include:

- reduction of soil erosion from wind,
- filtration of runoff,
- absorption of precipitation,
- protection of groundwater,
- purification of the air,
- habitat for wild plants and animals,
- education,
- recreational opportunities such as hiking, birding, hunting, fishing, and
- income for landowners (e.g. outfitting, guiding, lumber, maple syrup).

Rivers and streams are natural corridors for wildlife and provide habitat for a wide range of aquatic and semi-aquatic animals and invertebrates. They are also of great benefit to humans, providing water for irrigation and recreational opportunities such as fishing, canoeing and swimming.

Trees planted along roads and city streets do provide many benefits but they have very little wildlife habitat value and are not counted in the percent forest cover of a region. Urban wildlife such as squirrels, racoons and crows can live in the human environment, but the majority of Ontario's native wildlife cannot. Most wildlife species need blocks of natural area, with a large diversity of vegetation types and food sources to survive

1.6 Threats to a Healthy Environment

Today, less than 15% of the original forest or natural cover remains in the County. Most of this loss occurred over a century ago when the land was cleared for agriculture and settlement, then later for urban development. Tree planting and land retirement projects have resulted in some gains since the 1930s, but natural areas are still being lost today. Every small woodlot or buffer that is removed chips away at the small amount of natural habitat that remains.

The quality of the remaining terrestrial habitats is also under threat. Some threats to our woodlots include over-harvesting or poor logging techniques, ATVs that rip up vegetation and create innumerable trails, and garbage dumping. These disturbances have, in turn, allowed non-native invasive plant species to spread and displace native species. Many native birds, animals and insects cannot survive in degraded habitats.

Waterways can be degraded by drainage, channelization and hard surfacing (pavement), as well as by pollution from urban and rural runoff. Closing drains by burying them underground in pipes also results in the loss of habitat as fish and aquatic organisms cannot live without sunlight.

1.7 Urban vs Rural Pressures on Natural Heritage

Natural heritage protection is an important issue for both urban and rural areas and the challenges involved differ also. In general, there is more pressure to clear natural areas in urban growth centres where the cost of land is highest. In these areas, natural areas such as woodlots and stream buffers can be seen as impediments to new residential or commercial development.

In many cases, the remaining urban natural areas have been fragmented by previous development in the area or seriously degraded due to over use and activities such as dumping. As a result, remaining urban natural areas often do not meet the County wide landscape criteria to be considered significant. Nonetheless, these natural areas can be considered to be very important at the community and neighbourhood level. There is a growing expectation from the public that urban natural areas will be protected as development occurs and that that these areas will be maintained and be publicly accessible.

Municipalities must plan ahead for the management of their remaining natural areas in urban centres. This involves completing inventories of the remaining natural heritage areas to get an indication of how much, where and what natural heritage remains in the urban centre. With this information, the municipality can plan ahead for long term intended use and consider options such as designations and or acquisitions to protect important components of the natural heritage system. This planning can include official plan policy as well as management plans dealing with issues such as public access, trail linkages and liability.

Chapter 2. Project Management

The Upper Thames River Conservation Authority agreed to take on the role of project manager for the ONHS with the support of the Grand River, Long Point and Catfish Creek Conservation Authorities. Several Pre-Project meetings were held between Nov 2003 and Jan 2005 with staff from the Conservation Authorities and County of Oxford to plan the study.

2.1 Project Funding

The UTRCA drafted a budget for the project, which was expected to take approximately 18 months. The total cost was budgeted at $128,000 including in-kind contributions. The UTRCA also sought funding to cover the costs of the study. The County of Oxford led the way with a commitment of $20,000. Ducks Unlimited Canada agreed to support the project in the amount of $10,000 and offered to sponsor an application to the Ontario Trillium Foundation (OTF). The OTF approved a grant of $50,000. Stewardship Oxford also agreed to sponsor the study in the amount of $5,000. The budget is shown in Appendix A.

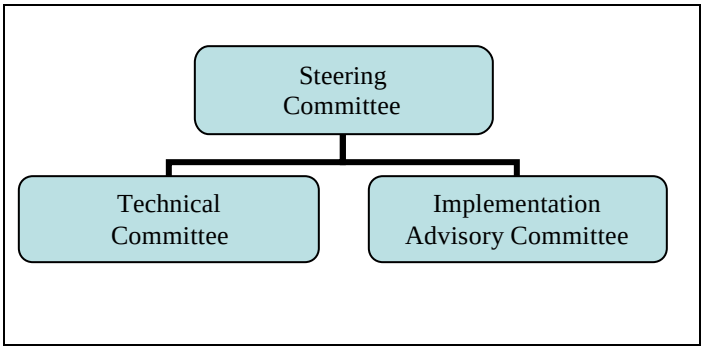
In-kind contributions in the form of staff time and resources were provided by each of the Conservation Authorities (UTRCA, GRCA, LPRCA, CCCA), as well as the Ministries of Natural Resources and Agriculture, Food and Rural Affairs. In-kind contributions in the form of time and expertise were provided by each member of the Steering Committee and Implementation Advisory Committee (IAC).

There was a budget shortfall due to extra work required to complete the many aspects of the study.

2.2 Governance Model and Committee Structure

The ONHS was overseen by a multi-partner Steering Committee with a Technical Committee and an Implementation Advisory Committee reporting to it. Figure 8 illustrates the relationship of the committees.

Figure 5. Governance Model



2.3 Steering Committee

The Steering Committee was formed to oversee overall project progression and to make the final recommendations to County Council. Membership included a representative from the project consultant and each of the funding partners, except the Ontario Trillium Foundation. The Oxford County Federation of Agriculture requested representation on the Steering Committee because of the potential impacts on the farming community and this was agreed. The chair of the Implementation Advisory Committee became the seventh member. A list of the Steering Committee members is given in Appendix B.

Several support staff routinely attended Steering Committee meetings as well including the County Planner and Project Manager. The Steering Committee met 14 times between March 2005 and October 2006

2.4 Technical Committee

The Technical Committee primarily consisted of staff from the conservation authorities with expertise in aquatic biology, ecology, water quality, planning and Geographic Information Systems (GIS). Other individuals from Ducks Unlimited Canada and the County joined the committee from time to time to discuss certain aspects of the work. Members of the Technical Committee are listed in Appendix B.

2.5 Implementation Advisory Committee

A large Implementation Advisory Committee (IAC) was formed to involve the broader community in coming up with a 'made in Oxford' plan for implementing the recommendations of the study.. This committee consisted of representatives from 23 groups and agencies including local environmental groups, farmers, anglers, government, etc. A list of members and summary of meetings is listed in Appendix B.

The IAC met eight times between September 2005 and July 2006. A separate IAC Report was produced to summarize the work of the committee and this report is included as Appendix F.

2.6 Communications

Communications was handled by ONHS project management staff and communications staff from the UTRCA. A communications plan was drafted that consisted of a media launch, presentations to local municipalities, news releases, fact sheets and website development. The goal of the communications plan was to keep residents and committee members up to date on various aspects of the study and to provide links to related information sources. A table summary of communications products is given in Appendix B.

Chapter 3. Terrestrial Study

This chapter summarizes the methodology and findings of the Terrestrial Study. A full description of the methodology, rationalization and findings is contained in Appendix C.

3.1 Methodology

The terrestrial study was a landscape level study aimed at identifying significant terrestrial patches (e.g. woodlots) based on a list of scientifically tested criteria. The work was primarily a mapping exercise.

There are two main reasons this landscape approach was taken. Firstly, in Oxford County, there are over 3000 patches and it would be impossible to sample each patch. Secondly, there is a growing trend in the ecological field to look at the habitats in a region as a system, with all the pieces interacting. Many species, for example, disperse widely and utilize a variety of habitats during their life cycle, and are not confined to a single site. Natural features need to be evaluated within the local context of the landscape.

In order to evaluate significance on a landscape scale, a number of criteria were developed. These criteria were based on the ecological literature and fine tuned for the Oxford County study. The nine criteria are listed in Table 2. In essence, the methodology evaluates the potential habitat value of each site, based on a set of scientifically tested parameters.

Detailed mapping was needed to run the criteria using the GIS system. Each woodland, wetland and meadow patch was reviewed manually and the boundaries corrected. The result is a much more accurate and detailed mapping layer than has previously existed.

3.2 Major Findings

The data generated from the mapping and GIS exercise revealed several interesting facts about Oxford County's terrestrial features, some of which are summarized below. Additional details on vegetation communities and the relationship of vegetation communities with soil types is contained in Appendix C.

3.2.1 Percent Cover

Forest cover in Oxford County was calculated to be 12.5%. This cover is comprised primarily of woodlands and wetlands (treed swamps, for the most part). Deciduous woodland is the most common vegetation type, with smaller amounts of coniferous and mixed coniferous/deciduous wood. Individual trees, boulevard or roadside trees are not included in this figure as they do not meet the minimum size requirement of a patch and do not function as a woodland or forest.

1952 forest maps were digitized and compared with 2000 mapping. Forest cover in 1952 was about 11%, indicating there has been a 1.5% increase in forest cover. Some of this increase may be attributable to better mapping technology, but tree planting programs and agricultural land retirement undoubtedly account for some of this growth.

An additional 1.8% of Oxford is meadow (non-treed habitats made up of permanent grasses, flowers or pasture). Thus, the total natural heritage cover in Oxford County is 14.3%. Scientific research indicates 20-30% natural cover is needed for the long term persistence of birds and other wildlife species. Thus, Oxford is below the sustainable threshold, but within reach.

Table 2. Criteria for Significance of Terrestrial Habitats

Ecological Function

1 **Patches that contain rare species**. Rare species are based on MNR's Natural Heritage Information Centre occurrences of species with federal, provincial, regional and local designations.

2. **Patches that contain habitat designated in the Official Plans of Oxford County**. These designated habitats include Life Science Areas of Natural and Scientific Interest or ANSIs, Environmentally Significant Areas or ESAs, identified wetlands including Provincially Significant Wetlands and Locally Significant Wetlands, other protected areas).

3. **Patches within 150m of designated, non-wetland habitats** in the Official Plans (e.g. Life Science ANSIs, ESAs, and other protected areas) or within 750m of designated wetland habitats in the Official Plan (e.g. PSWs and LSWs).

4. **Patches > 10ha in size**.

5. **Patches with interior habitat**. Interior is defined as the amount of habitat left after 100m have been removed from the inside perimeter. Thus, a habitat must be over 200 m across to contain interior.

6. **Patches that occur within well-head capture zones or intrinsic groundwater susceptibility areas**. These areas are identified in groundwater studies.

7. **Patches that contain an open watercourse or are within 50 m of an open watercourse**.

Representation

8. **Patches with the largest amount of area on each landform and soil type in Oxford County and all patches that occur on valley lands.** Valley lands are identified through the Conservation Authority slope stability and erosion lines.

9. **Patches that contain large amounts of each natural vegetation community type**: wet conifer > 4ha, wet mixed > 60ha, shrub > 4ha, wet deciduous > 45ha, conifer > 15ha and mixed > 45 ha, open wetland >10 ha and deciduous > 20ha. The cut-off thresholds were determined by plotting distribution curves of area and vegetation community types.

3.2.2 Patch Size

In general, woodlot patches are small in Oxford. Approximately 80% of patches are less than 10 hectares in size and together these small patches make up only 25% of the wooded area of the County. Most of these small patches do not contain important interior habitat. There are several large patches that make up the majority of forest cover in the County.

3.2.3 Patches Meeting Criteria

Table 3 below summarizes the number and area of patches that met various numbers of criteria. In total, 79% of patches meet at least one criteria of significance and 21% met no criteria at all. Area wise, however, only 6.4% of the natural area cover did not meet any criteria. Again, the very small patches make up the bulk of this category.

Figure 6 shows the patches that meet at least one ONHS criteria and those that do not across the County. This information is shown again for each local municipality in Figures 7-10.

Each of the County's Forest Tracts met four or more criteria. Most of the tracts are part of a larger vegetated patch or forest. Thus, these County-owned forested lands are an important part of the natural heritage system.

Table 3. Number of Patches that Meet 0-9 Criteria

Number of Criteria Met	Number of Patches	Percent of all Patches	Area (ha)	Percent Total Area
0	692	21	2038	6.4
1	929	28	2840	8.9
2	744	22	3252	10.2
3	453	13	4096	12.8
4	255	8	4821	15.1
5	184	5	6125	19.2
6	80	2	5296	16.6
7	28	1	3309	10.3
8	3	0	192	0.6
Total	**3368**	**100**	**31969**	**100**

The study findings reveal that the majority of the County's remaining natural areas are fulfilling some ecological or environmental function and are thus important. It is important to conserve the sites that remain and to augment and enhance the system so that it is sustainable in the long term.

3.3 Terrestrial Technical Guidance

1. **Any natural patch meeting at least 1 criterion is contributing to an ecological landscape function and needs to be protected**. Each criterion reflects some aspect of habitat value and complexity, so it is impossible to choose the 'best' criterion since they all measure something different. Sustainable activities such as maple syrup production, foot trails, hunting, fishing, trapping and selective tree harvesting can continue.

2. **All natural patches left in the County should be <u>maintained</u>**. Each patch supports wild plants and animals to some extent and adds to the diversity of the County. It is extremely costly to replant natural areas and takes generations for forests to develop. The County will slip further away from the sustainable goal of 20 – 30% forest cover if existing patches are not maintained.

3. **Natural cover should be <u>increased</u> to 20% (and an additional 10% into wetland / riparian cover) over the long-term**. The scientific literature suggests regions with low natural cover may not have sustainable ecosystems. Plant and animal species may become locally or regionally extinct unless there is a minimum amount of natural cover. Water quality, air quality, groundwater quality, etc. cannot be maintained in regions devoid of natural vegetation. Increasing natural cover will take generations, but it must start now. It may be best to develop a targeted restoration map to target where restoration is most needed.

4. a) For patches that do meet a criterion, all Terms of Reference for Environmental Impact Assessments should include confirmation of the attributes and / or functions for which the candidate significant vegetation patch was designated, recognizing that the patches that have been designated have been done so through the use of a study that compares vegetation patch characteristics within the context of the County as a whole. When reviewing these characteristics in a patch by patch basis, the features of individual vegetation patch cannot be evaluated without returning to the County context for those features that depend on representation in the County.

   b) Patches that do not meet a criterion should be evaluated by an Environmental Impact Assessment to determine their significance at the site-specific level.

5. In five years, a review should be undertaken of the science to ensure that new landscape techniques or theories are incorporated.

6. In ten years, a status report should be prepared that evaluates any changes to vegetation patch function in the intervening five years in terms of vegetation coverage, fragmentation, restoration or vegetation features.

7. A followup study should be undertaken to examine the meadow data to determine percent of watercourses with meadow buffers, the degreee to which other vegetation community types are joined by meadow communities, etc. This will help target protection work and target areas without many meadows.

8. Subwatershed targets should be developed for Oxford County such as:
    - 30% natural cover (upland and lowland) per sub watershed
    - 10% forest interior (>100m from forest edge) per sub watershed
    - 5% deep forest interior (>200m from forest edge) per sub watershed
    - 75% riparian area (habitat adjacent to streams, creeks and drains at least 30m wide) per sub watershed
    - 10% of sub watershed in wetlands
9. Examine the need to amend the Tree Cutting Bylaw to move away from Diameter Limit Cutting towards Basal Limit Cutting, through sampling of Oxford's woodlands.

Sugar Maple

Figure 6. Patches that meet one or more criteria in Oxford County.

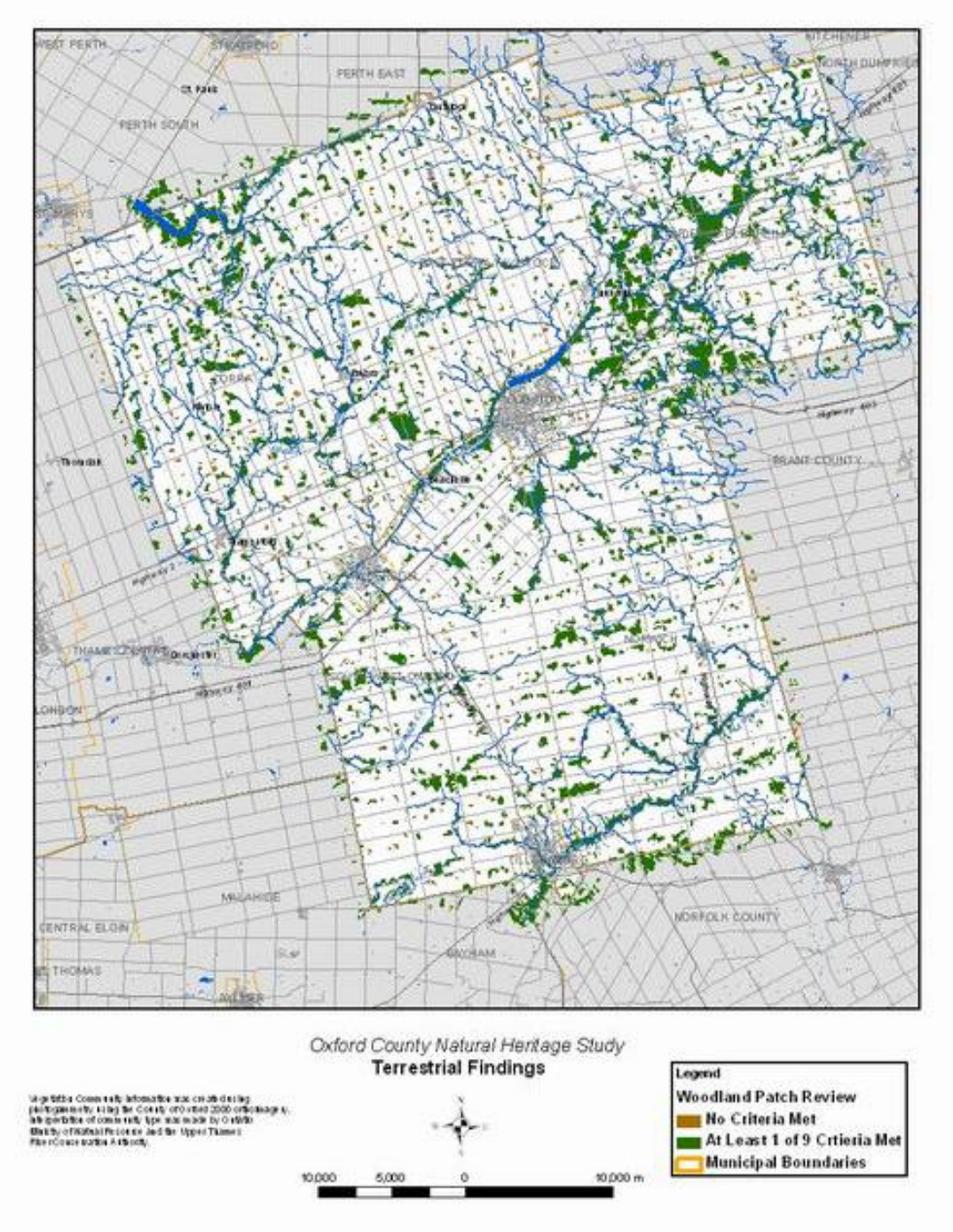


Figure 6. Patches that meet one or more criteria in Zorra and Ingersoll

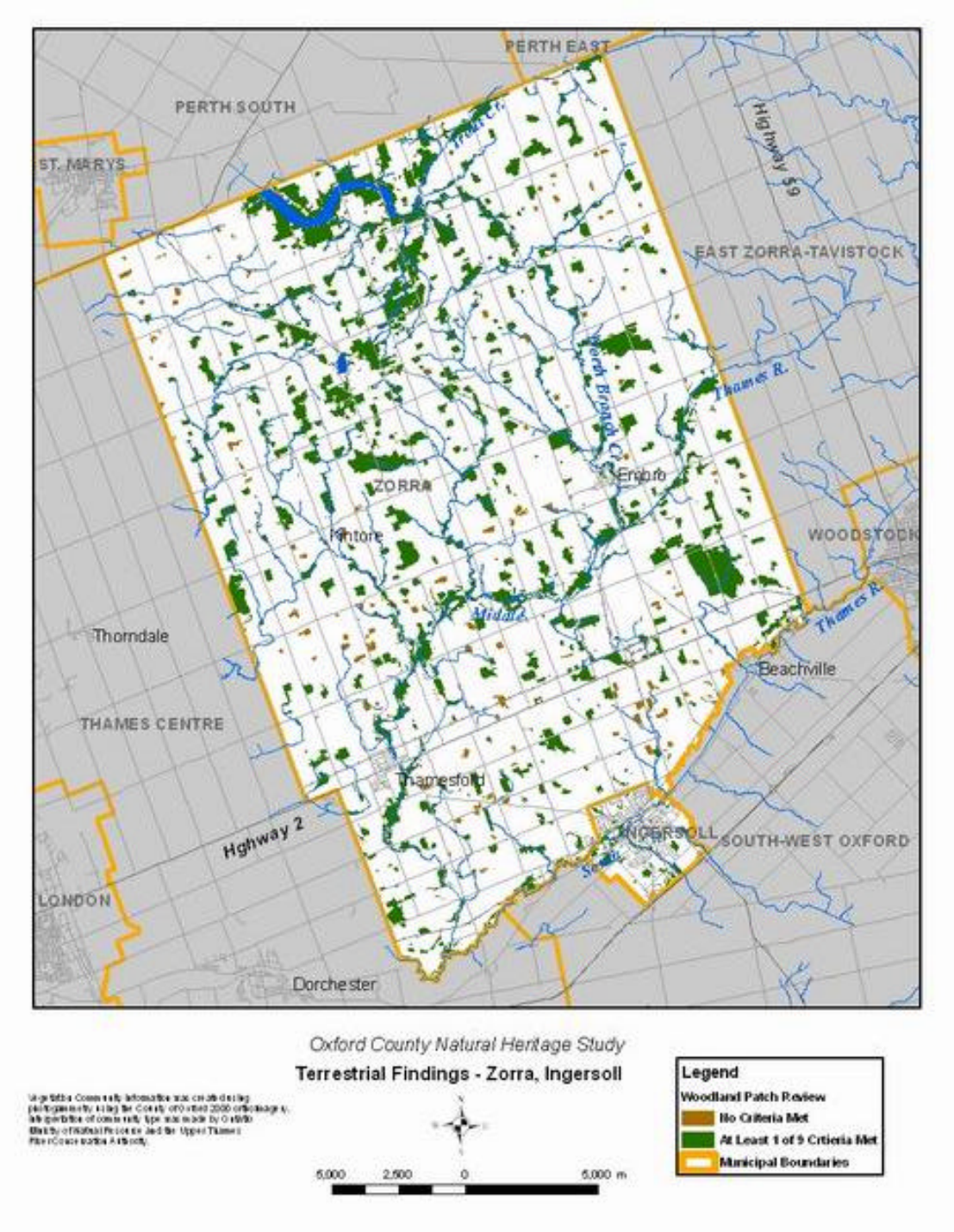


Figure 7. Patches that meet one or more criteria in East Zorra-Tavistock and Woodstock

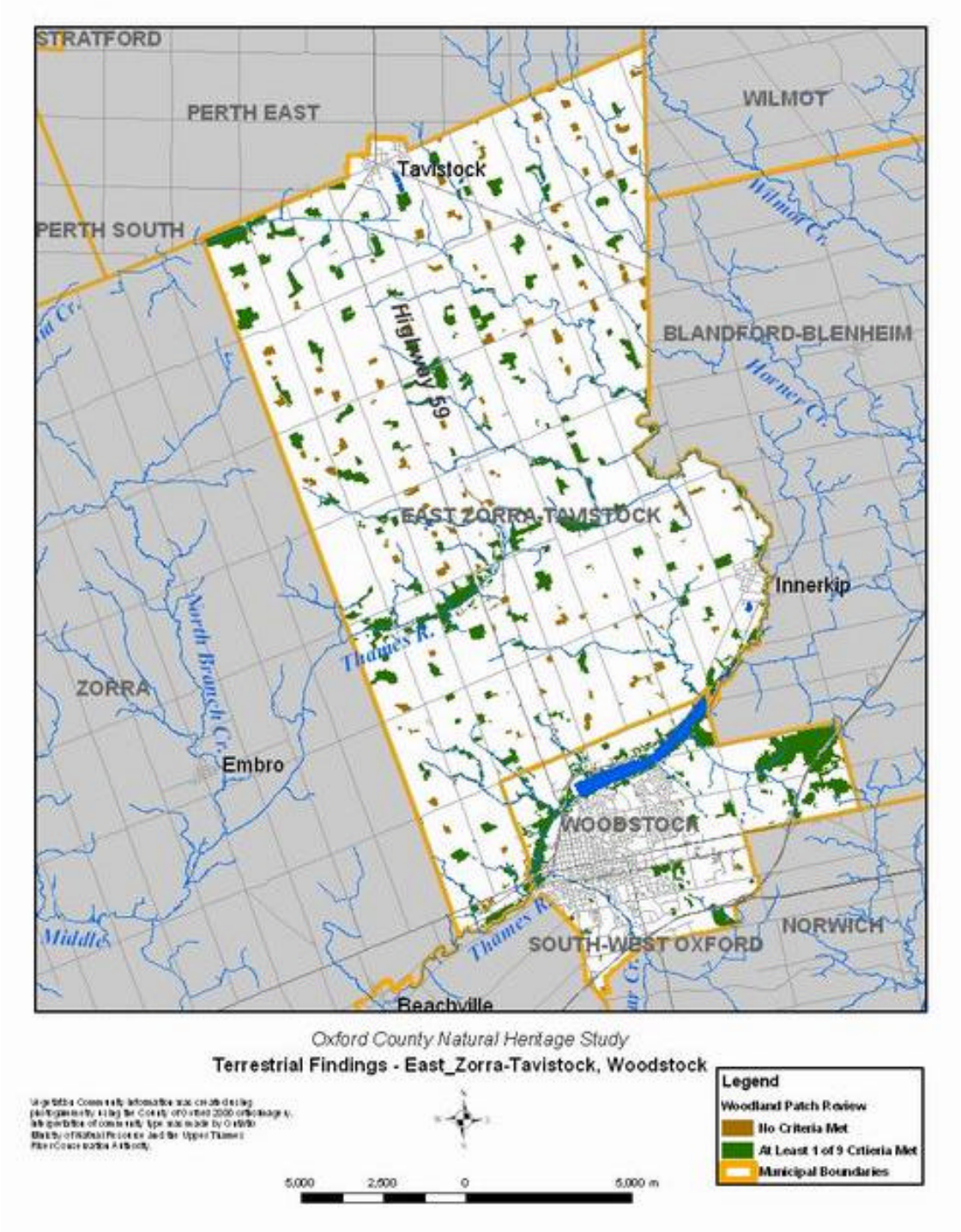


Figure 8. Patches that meet one or more criteria in Blandford-Bleneheim

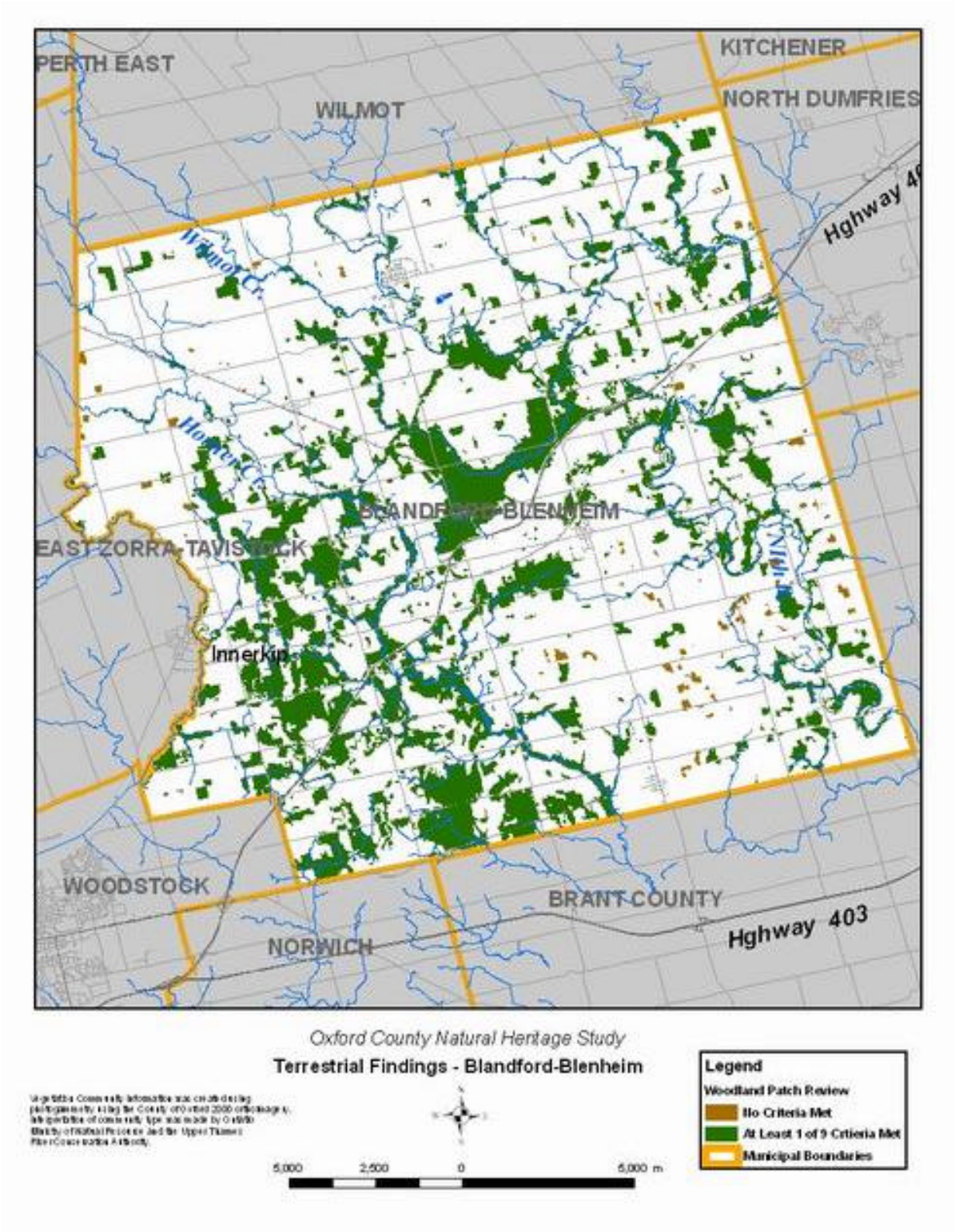


Figure 9. Patches that meet one or more criteria in Norwich

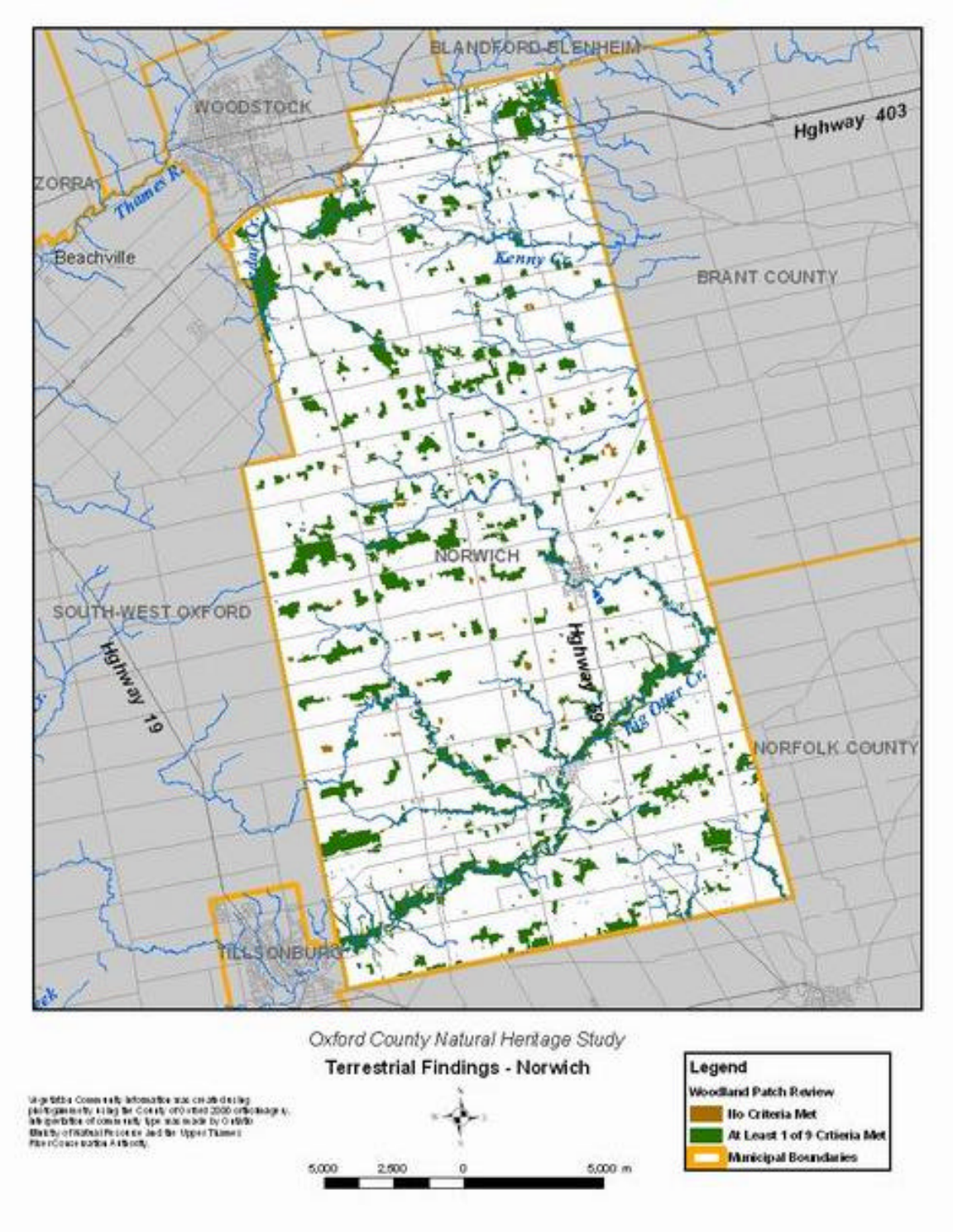
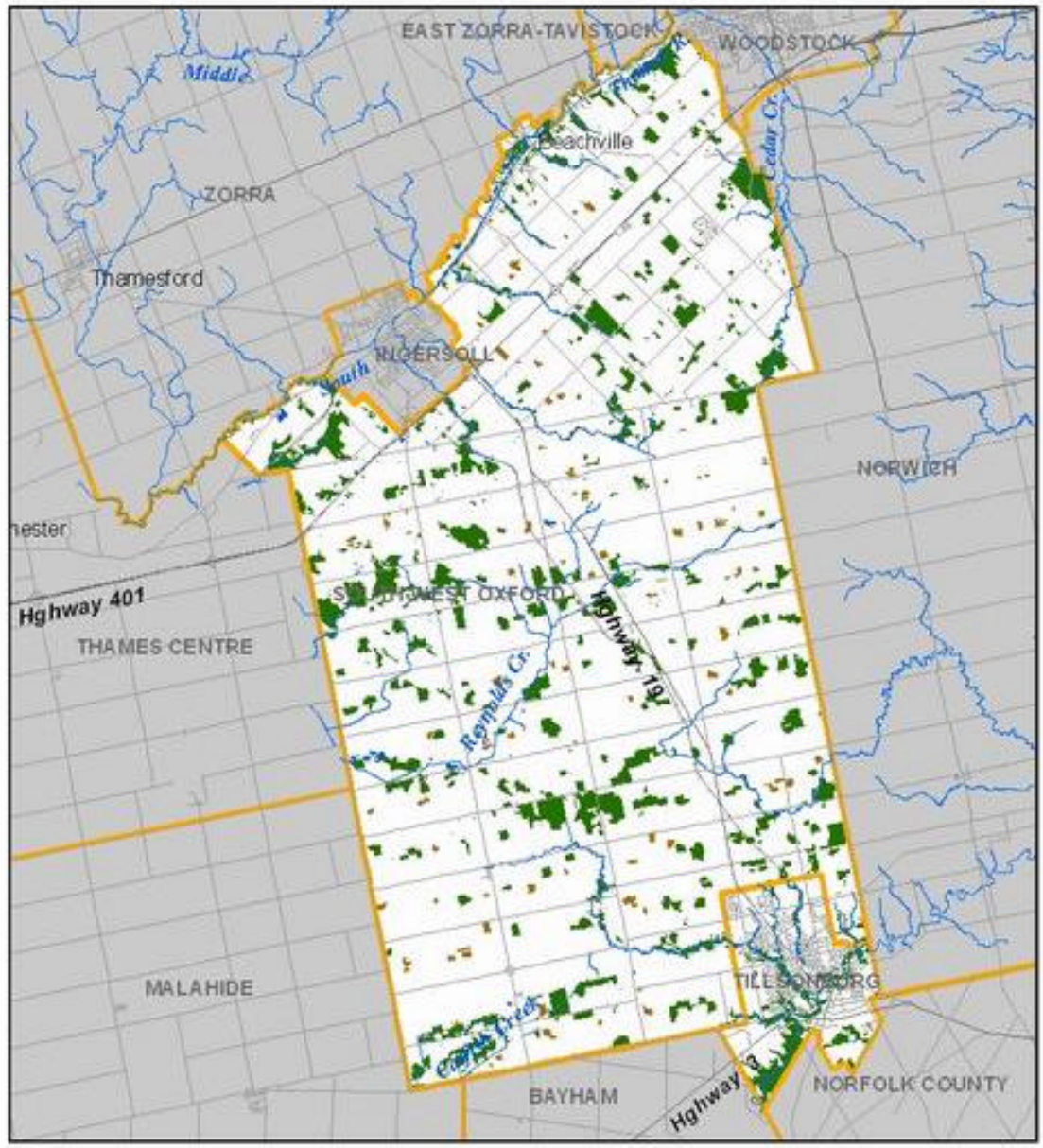


Figure 10. Patches that meet one or more criteria in Southwest Oxford and Tillsonburg



Chapter 4. Aquatic Resources

This chapter summarizes the methodology and findings of the Aquatic Resources Study. A full description of the methodology, rationalization and findings is contained in Appendix D and E

4.1 Purpose

The purpose of the aquatic component of the ONHS was to inventory and evaluate the current condition of the County's aquatic resources. In addition to the collection of baseline data for monitoring purposes, the intent of the study was to identify rehabilitation or restoration measures that could be employed to improve conditions for the County's aquatic resources. For the purposes of this study, aquatic ecosystems are defined as watercourses.

4.2 Value and Functions of Watercourses

Watercourses include streams, rivers, creeks, and open drains. Watercourses have been characterized as a depression that has flowing water for all or part of a year. A watercourse conveys water and this flowing water carries food, sediment, nutrients and debris. Many watercourses may be dry or reduced to standing pools of water during dry periods of the year and especially during periods of drought.

Watercourses provide habitat for aquatic and semi-aquatic species such as fish, reptiles, amphibians, birds, mammals, plants, and insects. Habitat can take the form of water itself, the river bottom, land surrounding it, in-stream vegetation and overhanging vegetation. This habitat supports all the life stages of aquatic species and some of the stages of semi-aquatic species. Watercourses provide habitat for feeding, cover to escape predation, areas to reproduce and the means to migrate between these habitats. Watercourses also provide travel corridors for many terrestrial species.

Watercourses are complex systems that are influenced by the surrounding land including the floodplain, the substrate (rocks, cobble, clay, sand, silt), the channel itself, water flow, water temperature, and several other factors. All of these factors combined help determine the type of aquatic community that is present Generally speaking the more complex and less impacted systems support sensitive or significant species such as federally designated Species At Risk (SAR), and gamefish such as trout, pike, and bass.

Cool water stream

4.3 Methodology

An Aquatic Technical Team was formed to guide the direction of the study. The study focused on compiling background information, filling data gaps, reporting on the current conditions, and providing recommendations to maintain and enhance the aquatic environment.

The study had two focuses: aquatic resources inventory and water quality information. The aquatic resources inventory of the study was the dominant focus and entailed field work. The water quality information component entailed compiling existing long term data from streams in the County to further define and describe water quality conditions in Oxford's watercourses.

Aquatic Resources Inventory

Historic and more recent fish, benthic and habitat data for Oxford County was collected from the various agencies including conservation authorities, Fisheries and Oceans Canada (DFO) and Ontario Ministry of Natural Resources (MNR) offices. After the information was compiled and assessed, data gaps were identified for additional field investigation. The following field work was completed:

- Fish sampling, using electro-shocking equipment, was completed at 80 sites following the Ontario Stream Assessment Protocol (OSAP).
- Benthic sampling (e.g. sampling the bugs that live on the stream bottom) was completed at 27 sites following the Ontario Benthos Biomonitoring Network (OBBN) protocol. Benthic animals provide a good indication of water quality as each species tolerates different levels of pollution or habitat quality.
- Habitat conditions were assessed at 63 additional sites following the Municipal Drain Classification Project (MDC) protocol.

All data gathered was compiled in a Microsoft Access database and transferred to a Geographical Information Systems (GIS) application.

Brook Trout

Water Chemisty

Data from the Provincial Water Quality Monitoring Network (PWQMN) of the Ontario Ministry of the Environment (MOE) was pooled for all stations in and around Oxford County. There are currently 12 stations monitored in the County with records dating back to 1964. The monitoring locations are illustrated in Figure 12. Eight samples per year are taken at each site in the ice-free months and the samples are analysed for 37 parameters at the Ontario Ministry of the Environment lab in Etobicoke. The PWQMN ceased analysing for bacteria so bacteria samples from the Thames watershed are analyzed at the Regional Health lab in London, Ontario. The PWQMN is funded by the MOE. Further details are contained in Appendix F.

The monitoring sites include 10 on the Thames River system, two on the Nith River, and two in the Long Point Region (Big Otter Creek and Spittler Creek). No additional water chemistry sampling was undertaken specifically for this study to fill gaps because a one-time sample is not sufficient to characterize a station or stream. Long term data is needed.

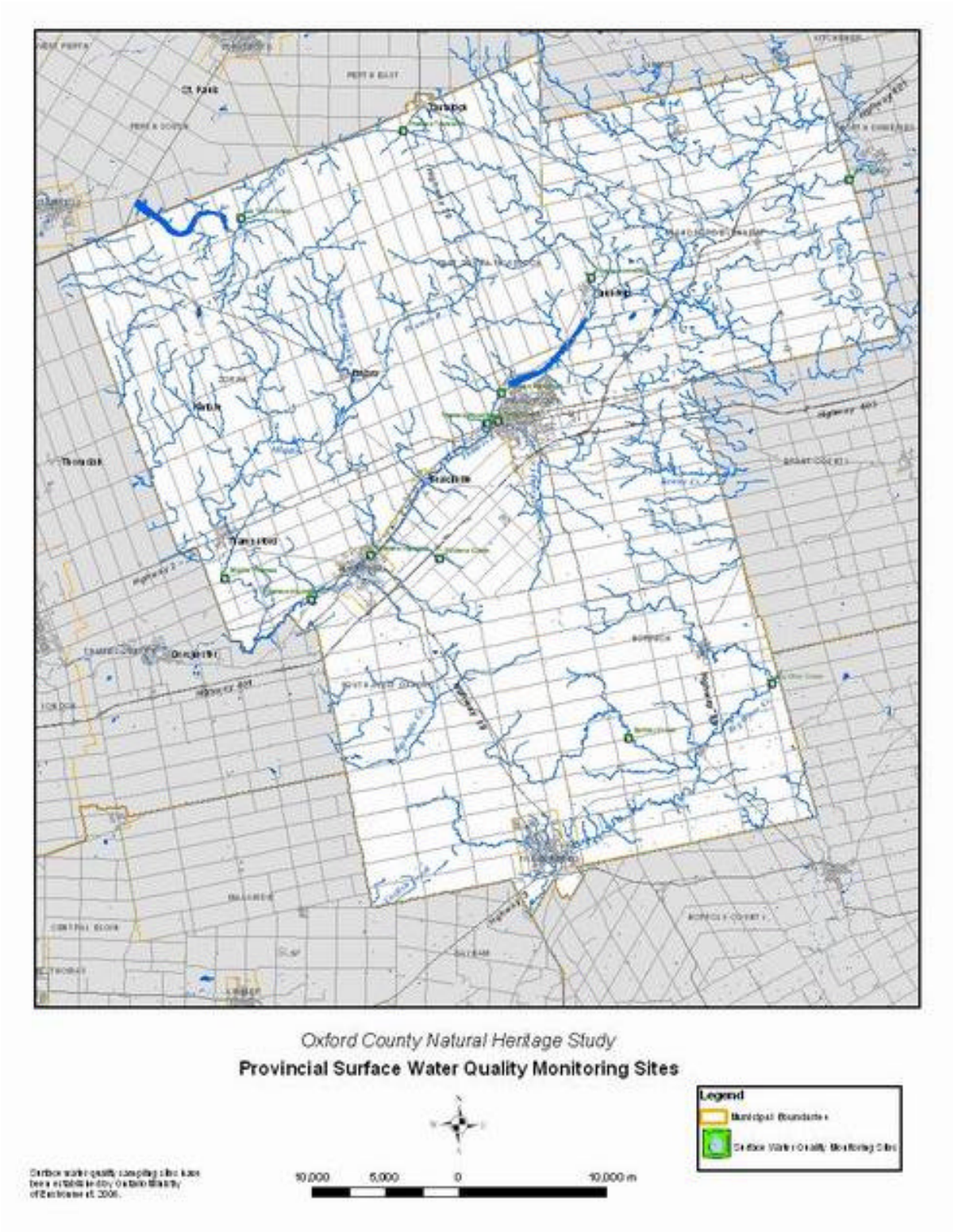
4.3.1 Categorizing Watercourses – System Types

Originally, a list of significance criteria was developed, to mirror the approach taken in the terrestrial component of this study. However, when the criteria were applied, every watercourse met at least one criterion, so another system was needed. A system of categorizing watercourses was developed for this study that built upon existing and standardized approaches. The three system types are described in Table 5.

Table 4. Summary of Categories of Watercourses

System Type	Species Supported	Flow	Temperature	Recommended Action
1	Sensitive or significant species: Species at risk, top level predators, sportfish, sensitive species or the habitat to support these species	Permanent	Warm or cold/cool water	Conserve, Protect, and Enhance
2	Baitfish, species resilient to change	Permanent	Warm water	Conserve, Rehabilitate, Enhance, and Restore
3	Seasonally accessed by baitfish and larger fish	Intermittent or ephemeral	Warm water	Conserve, Rehabilitate, Enhance, and Restore

Figure 11. Surface Water Quality/Chemistry Monitoring Sites



4.4 Results and Findings – Water Chemistry

The results of six key parameters that reflect land use activities and relate to aquatic health are explained and summarized in Appendix F. The six parameters are: total phosphorus, nitrate, chloride, suspended solids, bacteria and copper.

The nature of pollutant levels in water samples tends to be quite variable year to year, often as a result of weather conditions and changing activities on the land. The results are typical of many southwestern Ontario watercourses. Table 6 summarizes the key findings for the six pollutants.

Nutrients such as phosphorus and nitrate are increasing, and this may lead to more algal blooms in the future, which in turn, lowers oxygen levels. Sources of these elements include fertilizers, animal waste, soaps, wastewater and sewage. Toxic metals such as copper from plumbing, paints, fungicides and sewage are not a big concern today, but need to be monitored for any changes. These metals can be toxic to aquatic wildlife. Chloride from road salt is showing an increasing trend. This element needs to be monitored as it is toxic to aquatic life at high levels.

Good land stewardship is the key to preventing many pollutants from entering watercourses. Programs such as the Clean Water Program that give incentives to help change practices are needed. Innovate methods to reduce road salt application are also needed.

Table 5. Summary of Key Water Quality Results

Element	Trends and Findings
Phosphorus	Concentrations routinely exceed the Provincial Objective for the protection of aquatic life at all sites. Most sites have not changed since the 1970's. The Thames at Woodstock has recorded large reductions since the 1970s but remains very high.
Nitrate	Since the 1960s, nitrate levels at all long-term sites have shown a continual increase. This is a province-wide trend.
Suspended Solids	Overall levels of suspended solids have remained consistent over the long term at most sites. There is no standard.
Chloride	Since the 1960s, chloride levels have shown a continual increase at all sites, however they are still below aquatic health toxicity levels. This trend is province-wide. The highest loadings are downstream of urban areas due to road salt application.
Copper	Current copper concentrations fall well below Provincial Water Quality Objective for the protection of aquatic life at all sites. There has been a significant decrease in concentrations at some sites (Thames at Woodstock, Middle Thames) from above the guideline to below it. However, several sites are showing rising levels (e.g. Nith, Spittler).
Bacteria	Concentrations of *E. coli* bacteria are routinely above the Objective for recreational waters for all sites, except the Nith which remains low. Cedar Creek and the Thames at Ingersoll show the highest levels. All sites have shown some improvement over time.

4.5 Results and Findings – Aquatic Resources

Oxford County contains many very productive and diverse aquatic communities. A significant proportion of southwestern Ontario's trout streams occur in Oxford. The County's watercourses also support many fish and freshwater mussel species at risk. Several coldwater streams also exist. Numerous sites contained smallmouth and largemouth bass and a few sites contained pike.

Benthic
The results of the benthic study are described in Appendix E. Samples collected at 28 sites on the Catfish, Grand, Otter and Thames systems showed a wide range of conditions from excellent to very poor. The majority of sites were in the fair to fairly poor category. Further investigation of the benthic data is needed to tie these results with other water quality and fisheries indicators.

System Types
Table 9 summarizes the percentage of Oxford's watercourses that fall under each system type. These system types are mapped in Figures 13 - 17.

Table 6. Percentage of Watercourses under each System Type

System Type	% of Watercourses in Oxford
1	50
2	31
3	19

Half of the watercourses fall within **System Type 1**. Generally speaking, this system is considered to be the most desirable of the 3 system types. These watercourses should be conserved, protected, and enhanced where possible. Not all watercourses can become a type 1, nor should they be expected to be.

Thirty-one percent of the watercourses fall within **System Type 2**. With rehabilitation and restoration efforts some of these systems could become type 1's, although there is not an expectation that they all would. They are often fairly productive and diverse ecosystems.

Nineteen percent of the watercourses fall within **System Type 3**. These systems are very important for transporting sediment and nutrients downstream. Seasonally they provide habitat for fish and other species such as frogs, insects, and other amphibians. There is the potential for species such as pike to migrate to these areas to spawn and reproduce. These also provide food (e.g. frogs, crayfish, and larval insects) for other wildlife such as waterfowl. Many species have adapted to make use of this type of habitat (e.g. some invertebrates migrate downstream to find water or have terrestrial life stages during dry periods). Several of these watercourses could become type 2 or even type 1 watercourses if rehabilitation or restoration efforts were employed, however it is not expected that they all could.

4.6 Aquatic Technical Guidance

Below are listed several voluntary actions that could be undertaken to improve the quality of Oxfords watercourses and the fish and aquatic communities they support.

1. Protect, enhance and restore stream buffers
    - *Examples:* Where natural vegetation along a watercourse does not exist, it can be planted. Appropriate native species should be used. Permanent forage crops or well managed grazing pastures can also be planted, as long as they are not tilled. The land can also be retired, allowing wildflowers and grasses to grow up naturally.

2. Protect and improve stream habitat
    - *Examples*: Construct vortex weirs, rocky riffles and stream bank bioengineering, leave stream alone to heal itself, undertake natural channel design.

3. Control sediment inputs and siltation
    - *Examples*: conservation tillage, grassed waterways, sediment and erosion control, and storm water management

4. Protect and enhance water quality and quantity
    - *Examples:* storm water management ponds, nutrient and waste management at the farm site, wetland restoration, barrier (dam) mitigation and removal, improvements to sewage treatment plants, alternatives to road salt application, conversion of copper piping

5. Continuous Monitoring Programs
    - Monitor benthic, fish community, habitat, temperature, flow, and additional aquatic components such as mussels
    - Participate in the Provincial Water Quality Monitoring Network (PWQMN) to monitor water chemistry trends
    - Monitor areas where implementation activities will be concentrated to measure success.

6. Apply adaptive management
    - Regularly assess conditions to determine success and effectiveness of projects and adjust programs accordingly

Figure 12. Watercourses categorized by System Type in Oxford County

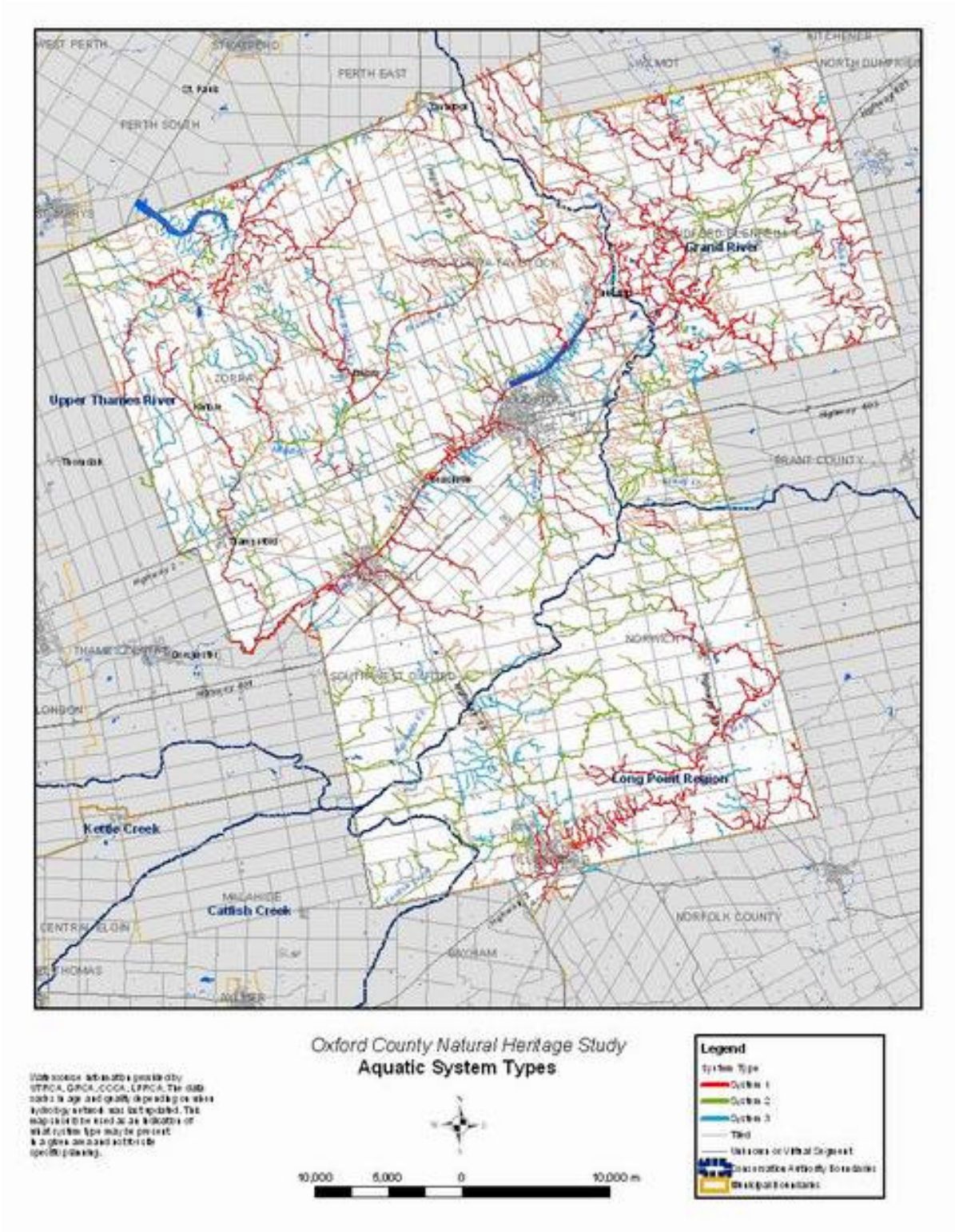


Figure 13. Watercourses categorized by System Type in Zorra and Ingersoll

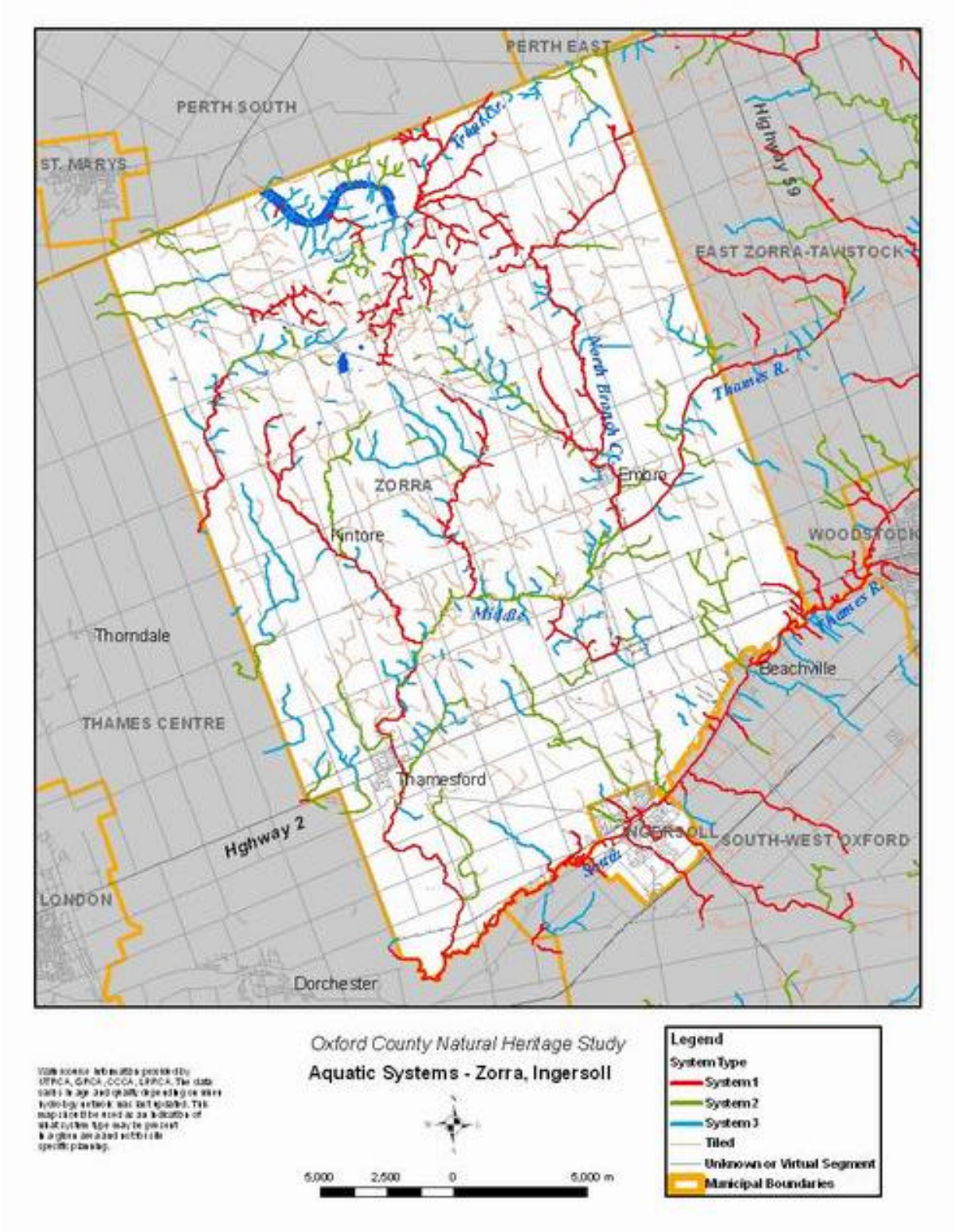


Figure 14. Watercoures categorized by System Type in East Zorra and Woodstock.

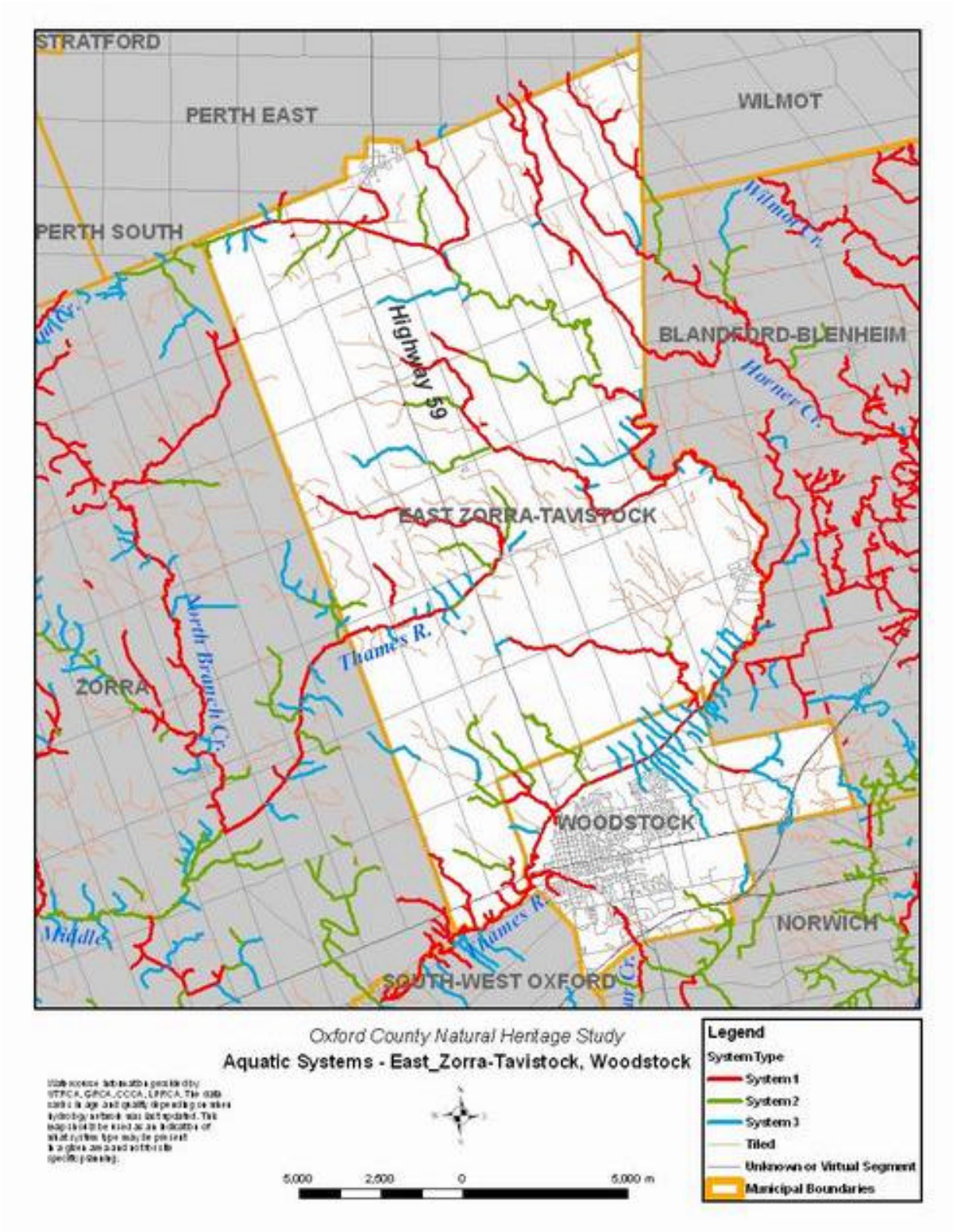


Figure 15. Watercourses categorized by System Type in Blandford-Blenheim.

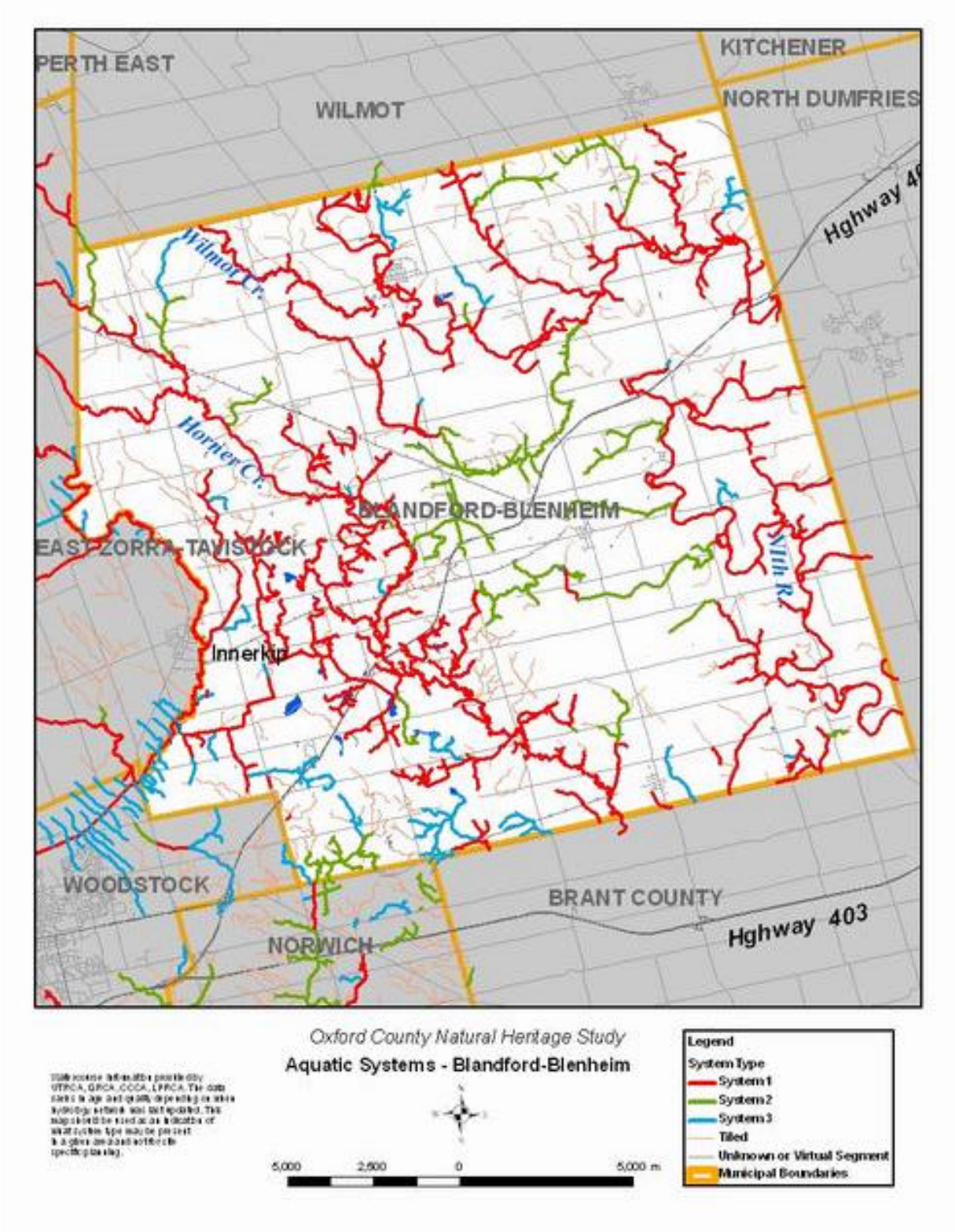


Figure 16. Watercourses categorized by System Type in Norwich

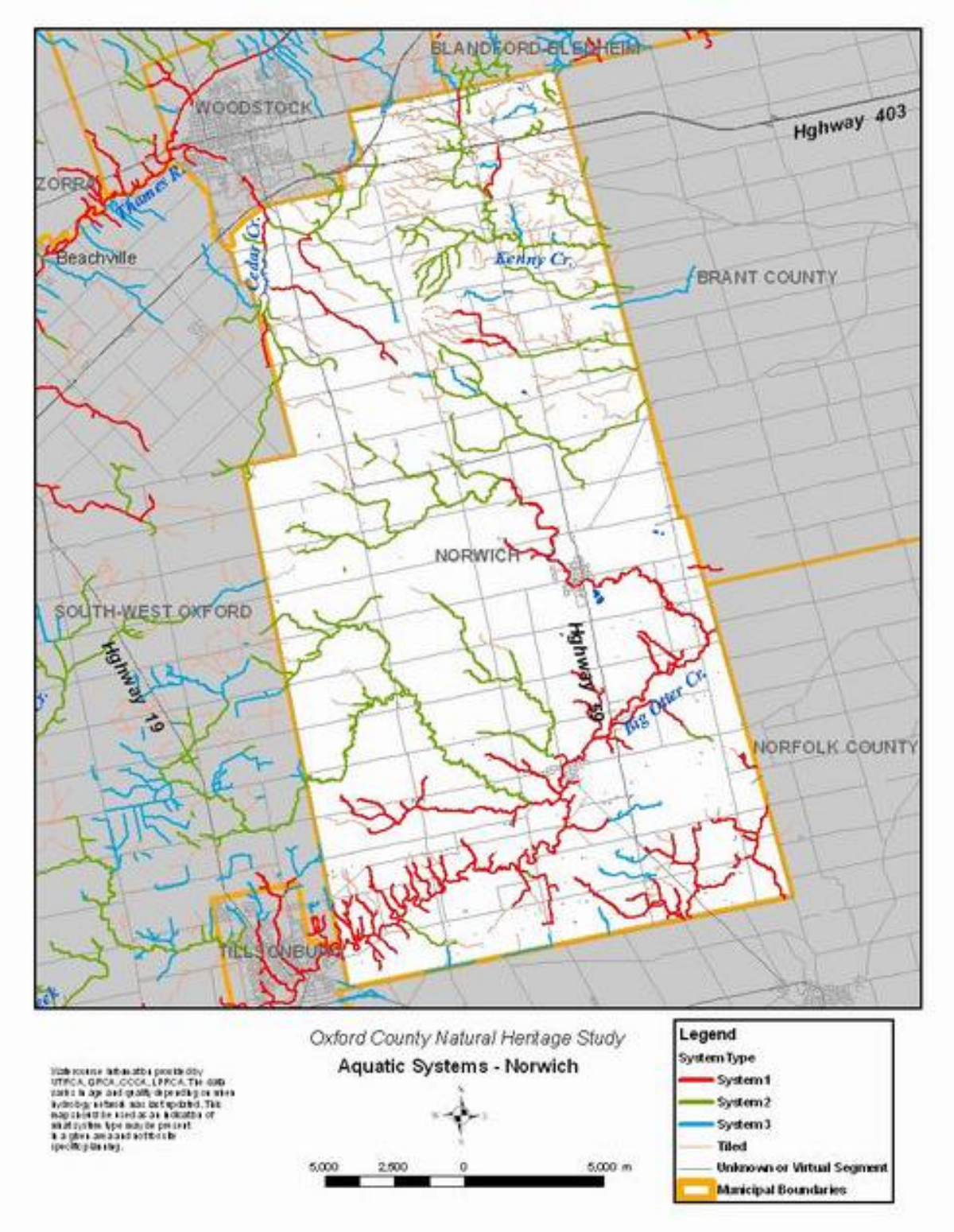
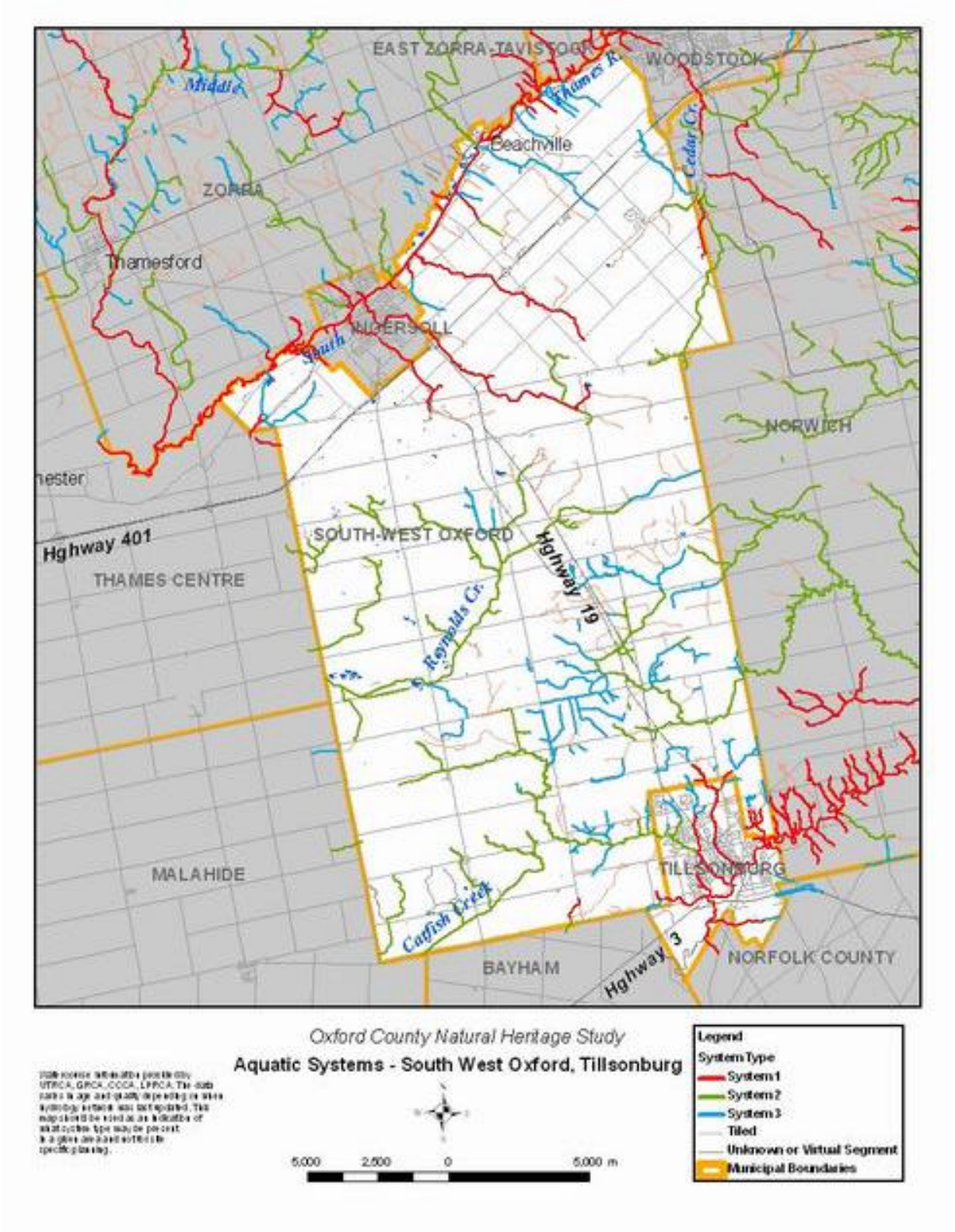


Figure 17. Watercourses categorized by System Type in Southwest Oxford and Tillsonburg



Chapter 5. Implementation Advisory Committee

The Implementation Advisory Committee (IAC) was formed to provide input from many perspectives to tackle the question of how the significant natural areas in the County could be preserved for the benefit of the entire region while respecting landowners and the rural and urban economies. This was a new approach, seldom taken in studies of this kind, but felt to be very important if the results and recommendations of the study were to be accepted by the community.

The Steering Committee invited representatives from agriculture, environmental stewardship agencies and groups, municipalities, provincial agencies and the development industry to sit on the IAC. Twenty-three groups accepted the invitation and agreed to send a representative. Jim Hayes, County Councillor and Mayor of South-West Oxford Township chaired the IAC and Kim DeKlein from the Ministry of Agriculture, Food and Rural Affairs worked as Facilitator. Staff from the Upper Thames River Conservation Authority and County of Oxford worked as support and technical staff, assisting the IAC.

A total of eight meetings were held between September 2005 and July 2006. The IAC worked on a parallel track with the technical part of the study. The IAC received the technical recommendations as they became available, discussed them at length, and developed their own set of implementation recommendations.

The IAC listed all of the possible tactics to achieve the technical recommendations in the form of Beneficial Management Practices (BMPs). The committee then proceeded to draw up a list of recommendations based on the following Implementation Measures:

- **Incentive Measures**: Cash, In-kind Assistance, Recognition programs, Funding from various levels of government and the private sector, User fees
- **Regulatory Measures**: Planning Act, Trees Act, Species at Risk Act, Municipal Act and Topsoil Preservation By-law, Drainage Act, Severances
- **Education and Outreach**: Workshops, Education, Trade Shows, Media, Official Plan Open House Process, Notification of landowners with designated patches, Natural Heritage Advisory Committee
- **Securement and Protection Measures**: Public Ownership, Conservation Easements
- **Taxation Measures**: Tax exemptions, incentives, rebates and reductions

The discussions and outcomes validated the work of the Steering Committee and Technical Committees. This was a robust approach that brought many different perspectives and experiences to the table to achieve the ultimate goal of recommending ways to implement natural heritage conservation and enhancement on the ground in Oxford County.

The full Implementation Advisory Committee (IAC) report is included as Appendix H.

Chapter 6. Recommendations

Recommendations for this study have been developed by the Implementation Advisory Committee and the Steering Committee based on the technical guidance provided by the aquatic and terrestrial technical committees. The IAC reviewed options and developed numerous recommended actions which were then prioritized. The Steering Committee brought forward the IAC's recommendations, built on the IAC work (see Appendix H) and also added a number of recommendations based on their comprehensive review and management of the project.

References to sections of the report that describe issues more fully are noted in brackets after the recommendations or background text.

Recommendation 1: Incentives

Incentives were identified by the IAC as an important means of maintaining and enhancing natural heritage in Oxford County. Incentives are well received by the community and are viewed as being very effective. Incentives are voluntary and they reward operators who want to employ good stewardship. Incentives educate through example, promote community buy-in and allow projects to be completed sooner rather than later. Since environmental protection is a benefit to society as a whole, it is appropriate that society pay at least partially for this benefit through taxes rather than leave the financial burden to individual landowners.

The Clean Water Project (CWP) is partially funded by Oxford County ratepayers and has been very effective and well-received by the Oxford County community. Tax dollars stay in the County through projects completed by landowners and local contractors. Baseline funding is critical to the continuance of the project, but there has been success at leveraging additional funding, which should continue. Information on the CWP is found in Appendix G. The CWP is robust enough to adapt to new directions and targets.

IAC recommendations are as follows:

1a. It is recommended that the County expand the current Clean Water Project (CWP) to add categories that target terrestrial and aquatic natural heritage protection and enhancement. The main additions to the program will need to be targeted to terrestrial natural heritage protection (e.g. woodlot management, expanded native species plantings). The results of the ONHS can be used by the CWP Committee to adapt the project to get the best environmental value for the dollars available.

1b. It is recommended that opportunities for additional government and non-government funding support of the Clean Water Project continue to be pursued.

1c. It is recommended that the County continue to endorse other incentive programs provided by other agencies as a means of protecting and enhancing the natural heritage resources of Oxford County.

1d. It is recommended that the County investigate options for providing tax relief to the owners of designated patches.

The Steering Committee concurs with the IAC recommendations related to incentives and offers the following additional recommendations:

1e. It is recommended that the County contribution to the Clean Water Project (CWP) be increased from $70,000 per annum to $200,000 to support the expanded eligible categories (see Recommendation 1b).

Recommendation 2: Ongoing Support for Natural Heritage Activities

The IAC recommended the creation of a County Natural Heritage Advisory Committee to oversee the ongoing implementation of the ONHS and to monitor and report on success. It was suggested that the Natural Heritage Committee should report to County Council and be made up of a cross section of stakeholders somewhat similar to the make up of the IAC.

2a. It is recommended that the County establish a Natural Heritage Advisory Committee that would report to County Council and oversee the ongoing implementation of the ONHS.

The Steering Committee supports the recommendation to establish a Natural Heritage Advisory Committee. The Steering Committee also discussed the need for ongoing staff support of natural heritage planning and implementation initiatives.

2b. It is recommended the County hire a permanent staff person to take the lead on natural heritage planning and implementation activities. This person would support the Natural Heritage Advisory Committee, coordinate other County efforts on natural heritage planning and implementation and assist the local municipalities with their natural heritage activities.

Recommendation 3: Education and Communication

The IAC identified Education and Communication as a high priority for action. Landowners need to be aware of the state of their local environment and what they can do to improve conditions. People will not be motivated to change or continue with good practices unless they are well informed.

There are a number of existing activities that can be built upon to increase the community's awareness of natural heritage issues and opportunities. It was noted that the rural non-farm audience should be specifically targeted in addition to the traditional target audiences (e.g. farmers, landowners).

3a. It is recommended that the County of Oxford develop a communications strategy on natural heritage that builds on, and links to, existing communications programs targeted to landowners.

The Steering Committee supported the IAC's recommendation on Education and Communications and offers the following additional recommendations:

3b. It is recommended that part of the communications strategy entail presentations to Oxford's local municipalities to raise awareness at this level.

3c. It is recommended that the County work with other agencies involved in communications regarding natural heritage issues.

Recommendation 4: Recognition of Landowners

Recognition of the owners of natural heritage was identified as a priority action by the IAC. The recognition may include formal acknowledgement of the contribution that their land makes to the areas natural heritage system.

4a. It is recommended that the County support the development of a recognition program for landowners who own and have conserved significant natural heritage areas.

Recommendation 5: Regulatory Measures

The use of regulatory measures, such as the Planning Act, to protect natural heritage was discussed by the IAC. There was agreement that the County must fulfill certain regulatory obligations but that the process should be considerate of landowner rights and the negative perception of regulation. While the IAC did conclude that designation of significant natural heritage areas in the official plan was acceptable, it was noted that this measure must be accompanied by incentive measures as outlined in Recommendation 1.

5a. It is recommended that the County of Oxford proceed to designate significant natural heritage areas (i.e. sites that meet one or more ONHS terrestrial criteria).

5b. It is recommended that the County directly advise affected landowners of the designation and provide an explanation of why their land is significant, outline permitted uses, identify incentives that are available and provide information on beneficial management practices that can be undertaken to further enhance natural features. This is part of the communications strategy that is referenced in recommendation 3a and needs to be provided prior to the Official Plan Amendment public meetings.

The Steering Committee supports the IAC's recommendations regarding Regulatory Measures. The Steering Committee also recommends that management activities that do not compromise natural heritage protection should be explicitly permitted (e.g. sustainable tree harvesting, maple syrup production, recreation trails, hunting, trapping and fishing in accordance with applicable legislation). It was also suggested that the impact of land designation which limits use should be offset by the development of new incentive opportunities for landowners. For example, the County could explore opportunities for tax exemptions for designated land or subsidize natural heritage management advice. The County is obligated to inform landowners about any designations and should take the extra step and provide additional information on services and incentives.

The Steering Committee also agrees with the IAC discussion that incentives for BMPs (Beneficial Management Practices) continue to operate on a voluntary basis when no change in land use is taking place (e.g. ongoing farm management). However, it is recognized that much of the pressure on natural heritage features occurs in urban areas where the pressure to clear and develop land is greatest. In this regard, the Steering Committee is recommending that BMPs should be mandated when there is a change of land use, primarily from rural to urban. Before the land is urbanized, natural heritage features (e.g. woodlands and watercourses) should be protected and buffered. For example, as part of the development approval process, vegetated buffers should be created on both sides of a watercourse to protect the aquatic habitat. It is recommended that additional work be carried out to develop such a policy framework.

5c. It is is recommended that the policy for the natural heritage designation in the County Official Plan explicitly permit uses such as sustainable tree harvesting, maple syrup production, recreational trails, hunting, fishing and trapping.

5d. It is recommended that designated properties receive first priority for incentives and tax relief . Cross reference recommendation 1e.

5e. It is recommended that official plan policy be developed to protect and enhance natural heritage features, such as existing watercourses, as urbanization occurs.

Recommendation 6: Public ownership

Public ownership of certain natural heritage resources was discussed by the IAC. It was agreed that public ownership continues to be an appropriate measure to protect natural heritage and to allow for public access recognizing that this is an expensive measure and that it may only be applicable to limited situations (e.g. very sensitive or significant properties or parts of properties). It was noted that the County already owns a number of County Forests which represent large tracts of natural heritage land. If situations arise where landowners face a loss of management control because of the unique environmental sensitivity of their land, the County should consider options for some form of public ownership or other compensation. It is noted that options can include outright ownership by various public bodies or restrictive covenants or easements with the land holding staying in private hands.

6a. It is recommended that opportunities for public ownership of significant natural heritage continue to be supported by the County of Oxford.

The role of the County as the owner of nine County Forest sites was discussed by the Steering Committee. It was agreed that an integrated plan for the County Forests should be developed. This plan should include consideration of the role of the County in owning County Forests, public access, risk management and natural resource management activities and opportunities.

6b. It is recommended that the County develop master plans for the County Forests and that as part of the process, the County determine its role in the protection of natural heritage as a landowner.

Recommendation 7: Urban Natural Heritage

The different challenges of identifying and protecting natural heritage in urban settings verses rural settings were discussed by the Steering Committee. The ONHS identifies significant natural areas on a County-wide, landscape scale, not a site-specific scale. Smaller patches in urban areas often do not meet the County-scale criteria and therefore, it is necessary to look at urban areas separately and at a finer scale.

The Woodstock Natural Heritage Inventory (2006) was discussed as an example of a detailed inventory that provides information about the natural heritage resources of an urban growth centre. It was acknowledged that there is public demand and expectation that the municipality will include natural areas in the City open space inventory but that there is limited planning in place about how these areas will be managed for natural heritage values, access, liability, etc.
.
It was also noted that while significant natural heritage patches need to be protected to be consistent with Provincial Policy, there is an expectation that areas of local and neighbourhood importance should also be protected from development. The expectation is that these areas should be protected for their natural heritage value, their visual amenity and community wellness value and for public access purposes. It is acknowledged that the desire or ability of the municipality to take on ownership of these areas and to manage them for these potentially conflicting goals is a complex issue.

7a. It is recommended that the local municipalities complete inventories of the remaining natural heritage areas within their urban growth centres.

7b. It is recommended that the local municipalities develop management strategies for the overall identification, ownership and management of significant and non-significant (locally important) natural heritage areas within their urban growth centres.

7c. It is recommended that local municipalities, at a minimum, have generic master plans for the ongoing management of publicly owned natural heritage areas, particularly in urban growth areas and that specific master plans be developed for each site as resources permit.

Recommendation 8: Woodland Conservation By-Law

The IAC and the Steering Committee discussed the role of sustainable forest harvesting practices in terms of maintaining quality woodlands in Oxford County. It is recommended that the County's Woodland Conservation Bylaw be reviewed within five years to incorporate current knowledge about the science of managing woodlands.

8a. It is recommended that the County review its Woodland Conservation Bylaw within five years.

Recommendation 9: Monitoring

The importance of monitoring data was discussed by the Steering Committee. It was agreed that monitoring data is very important for establishing benchmarks and measuring change over time. It was also agreed that regular reporting on the monitoring results is critical. Success depends on knowledge and this is gained through monitoring.

9a. It is recommended that the County of Oxford lobby the provincial government to continue to support the Provincial Water Quality Monitoring Network and Provincial Groundwater Monitoring Network programs.

9b. It is recommended that the County of Oxford request that the Conservation Authorities identify their specific monitoring services as a budget item and that the County continue to support the monitoring programs of the Conservation Authorities.

9c. It is recommended that the County of Oxford work with the Conservation Authorities to enhance the existing monitoring programs by adding new sites as appropriate and improving consistency of monitoring techniques between the Conservation Authorities.

9d. It is recommended that the Conservation Authorities provide a coordinated comprehensive report on monitoring for the County area on a regular basis.

Recommendation 10. Tourism

The high quality habitats within Oxford lend themselves to ecotourism and hunting/fishing opportunities. Woodlands, wetlands, meadows, streams and rivers have the potential to support sustainable economic ventures such as eco-tourism (hiking, birding, cross-country skiing) as well as fishing, hunting and trapping. Oxford does posses many excellent quality habitats that could be promoted to bring in tourist dollars that could in turn, assist landowners with maintaining their resources. This idea was explored by both the IAC and Steering Committee. The market needs to be examined.

10a. It is recommended that the County explore tourism opportunities related to natural heritage, such as hunting and fishing outfitting, examining models from other parts of North America.

Chapter 7: Implementation

Table 1:Oxford Natural Heritage Study Implementation Schedule	**Time Line**	**2007**	**2008**	**2009**	**2010**	**2011**	**ONGOING**
Recommendation 1: Incentives							
1a. It is recommended that the County expand the current Clean Water Project (CWP) to add categories that target terrestrial and aquatic natural heritage protection and enhancement. The main additions to the program will need to be targeted to terrestrial natural heritage protection (e.g. woodlot management, expanded native species plantings). The results of the ONHS can be used by the CWP Committee to adapt the project to get the best environmental value for the dollars available.							
1b. It is recommended that opportunities for additional government and non-government funding support of the Clean Water Project continue to be pursued.							
1c. It is recommended that the County continue to endorse other incentive programs provided by other agencies as a means of protecting and enhancing the natural heritage resources of Oxford County.							
1d. It is recommended that the County investigate options for providing tax relief to the owners of designated patches.							
1e. It is recommended that the County contribution to the Clean Water Project (CWP) be increased from $70,000 per annum to $200,000 to support the expanded eligible categories (see Recommendation 1b).							
Recommendation 2: Ongoing Support							
2a. It is recommended that the County establish a Natural Heritage Advisory Committee that would report to County Council and oversee the ongoing implementation of the ONHS.							* The implementation of the other recommendations relies on the early implementation of this recommendation.
2b. It is recommended the County hire a permanent staff person to take the lead on natural heritage planning and implementation activities. This person would support the Natural Heritage Advisory Committee, coordinate other County efforts on natural heritage planning and implementation and assist the local municipalities with their natural heritage activities.							* The implementation of the other recommendations relies on the early implementation of this recommendation.
Recommendation 3: Education Communicators							
3a. It is recommended that the County of Oxford develop a communications strategy on natural heritage that builds on, and links to, existing communications programs targeted to landowners.							
3b. It is recommended that part of the communications strategy entail presentations to Oxford's local municipalities to raise awareness at this level.							
3c. It is recommended that the County work with other agencies involved in communications regarding natural heritage issues.							
Recommendation 4: Recognition of Landowners							
4a. It is recommended that the County support the development of a recognition program for landowners who own and have conserved significant natural heritage areas.							
Recommendation 5: Regulation Measures							
5a. It is recommended that the County of Oxford proceed to designate significant natural heritage areas (i.e. sites that meet one or more ONHS terrestrial criteria).							
5b. It is recommended that the County directly advise affected landowners of the designation and provide an explanation of why their land is significant, outline permitted uses, identify incentives that are available and provide information on beneficial management practices that can be undertaken to further enhance natural features. This is part of the communications strategy that is referenced in recommendation 3a. and this needs to be provided prior to the Official Plan Amendment public meetings.							
5c. It is recommended that the policy for the natural heritage designation in the County Official Plan explicitly permit uses such as							

Chapter 7: Implementation

Table 1:Oxford Natural Heritage Study Implementation Schedule	Time Line	2007	2008	2009	2010	2011	ONGOING
sustainable tree harvesting, maple syrup production, recreational trails, hunting, fishing and trapping.							
5d. It is recommended that designated properties receive first priority for incentives and tax relief . Cross reference recommendation 1e.							
5e. It is recommended that official plan policy be developed to protect and enhance natural heritage features, such as existing watercourses, as urbanization occurs.							
Recommendation 6: Public Ownership							
6a. It is recommended that opportunities for public ownership of significant natural heritage continue to be supported by the County of Oxford.							
6b. It is recommended that the County develop master plans for the County Forests and that as part of the process, the County determine its role in the protection of natural heritage as a landowner.							
Recommendation 7: Urban Natural Heritage							
7a. It is recommended that the local municipalities complete inventories of the remaining natural heritage areas within their urban growth centres.							
7b. It is recommended that the local municipalities develop management strategies for the overall identification, ownership and management of significant and non-significant (locally important) natural heritage areas within their urban growth centres.							
7c. It is recommended that local municipalities, at a minimum, have generic master plans for the ongoing management of publicly owned natural heritage areas, particularly in urban growth areas and that specific master plans be developed for each site as resources permit.							
Recommendation 8: Woodland Conservation By-law							
8a. It is recommended that the County review its Woodland Conservation Bylaw within five years.							
Recommendation 9: Monitoring							
9a. It is recommended that the County of Oxford lobby the provincial government to continue to support the Provincial Water Quality Monitoring Network and Provincial Groundwater Monitoring Network programs.							
9b. It is recommended that the County of Oxford request that the Conservation Authorities identify their specific monitoring services as a budget item and that the County continue to support the monitoring programs of the Conservation Authorities.							
9c. It is recommended that the County of Oxford work with the Conservation Authorities to enhance the existing monitoring programs by adding new sites as appropriate and improving consistency of monitoring techniques between the Conservation Authorities.							
9d. It is recommended that the Conservation Authorities provide a coordinated comprehensive report on monitoring for the County area on a regular basis.							
Recommendation 10: Tourism							
10a. It is recommended that the County explore tourism opportunities related to natural heritage such as hunting and fishing outfitting, examining models from other parts of North America.							

Glossary

Aquatic – Pertaining to the water and the life that grows or relies upon a water habitat. Aquatic habitats include drains, rivers, ponds and lakes.

Benthic Organism – Insects and animals that live, for part or all of their life cycle, on or in the sediments at the bottom of a river, watercourse or lake.

Buffer – see Vegetated Riparian Buffer

Competition – The process whereby plants contend for limited space, light, nutrients and water. Some species are more successful at competing for these resources than others. Less successful species eventually disappear from a site.

Cool Season – Describes a plant that achieves most of its growth early in the growing season, and then later in the cool fall season.

Drainage System – A network of open or buried (tiled) waterways that carry off surplus water.

Groundwater – Water that occurs between soil spaces underground. Groundwater can be a source of drinking water when pumped to the surface or where it seeps out of the ground naturally as in an artesian well.

Habitat – The place where a plant or animal lives.

Herbaceous – Describes an annual, biennial or perennial plant that is not woody and dies back at the end of the growing season.

Inclusion – An unforested area that is neither a prairie nor a wetland and that is located within or immediately adjacent to a contiguous polygon. Inclusions that are either less than 20m in width or are greater than 20 meters in width but comprise less than 25% of the polygon area are considered part of the polygon. Inclusions greater than 20 meters in width and comprising greater than 25% of the polygon area are identified as unforested polygon types.

Invasive plant – A plant that reproduces so aggressively that it displaces other plant species in the area.

Meadow – An open, mostly treeless ecosystem dominated by wildlfowers such as goldenrods and Queen Anne's lace and field grasses. A successional or transitional community formed as a result of disturbance that will eventually succeed or mature into scrubland and forest.

Naturalization – Any effort to convert managed landscapes such as lawns or farm fields to more natural and naturally evolving landscapes. The effort can entail active planting of native species and/or simply ceasing the management practices (e.g. stop lawn mowing and allow plants to move in on their own).

Non-Native Species – Species that do not naturally occur in an area, but have arrived directly or indirectly as a result of human efforts. Also known as alien species.

Old Fields – Former agricultural lands that are no longer pastured or cultivated and that are dominated by early successional, sun-loving plants such as asters and goldenrod species (e.g. meadow species)

Patch – A block of woodland or natural area separate from other blocks of natural area. It can be a mosaic of one to many contiguous vegetation polygon types. A patch can be owned by one or more landowners as in the case of a 'back 40' woodlot that stretches between several properties, but is one continuous habitat. The outside boundary of the patch is the outside boundary of all contiguous vegetation community polygons considered to be part of the patch.

Polygon – A vegetation community that is greater than 0.5 ha in size. Polygons are considered unique if they are more than 20m apart from any other polygon or if they are separated by permanent structures and / or permanent land use (e.g. roads, buildings, railroads, and active agricultural fields). The designation of a discrete polygon had nothing to do with ownership boundaries as a polygon could be under the jurisdiction of many owners. Refer to Appendix ? for definitions of polygon vegetation types.

Point source Pollution – Pollution coming from a fixed and identifiable source such as a pipe outletting from a factory.

Prairies – Open, mostly treeless ecosystems dominated by native grasses and wildflowers on deep or arid soils. A mature, climax community maintained by disturbance (e.g. fire, grazing).

Prescribed Burn – A carefully planned and authorized controlled fire.

Remnant Prairie or Savanna – A small patch of native grassland in an area dominated by non-native vegetation, cropland or urban development.

Restoration – The human process of rebuilding or reviving a native plant community where it has been degraded, altered or destroyed.

Riparian – Pertaining to rivers and watercourses or the lands immediately adjacent to them.

Salmonids – Fish of the family Salmonidae including salmon and trout.

Savanna – Natural area dominated by prairie grasses and forbs (flowers) with scattered trees, mostly oak species.

Sedge – A grass-like herbaceous plant having stems that are triangular in cross-section; found mainly in damp and marshy habitats.

Significant – as defined in the PPS -

a) In the case of wetlands means an areas identified as provincially significant by the MNR using evaluation procedures established by the Province as amended from time to time.
b) In the case of endangered species and threatened species, means the habitat as approved by the MNR that is necessary for the maintenance, survival, and/or recovery of naturally occurring or reintroduced populations of endangered species or threatened species, and where those areas of occurrence are occupied or habitually occupied by the species during all or any part(s) of its life cycle.
c) In the case of woodlands, means an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history.

d) In the case of other features and areas including valleylands and wildlife habitat, it means ecologically important in terms of features and linkages, function representations or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system.

Stewardship – The process and attitude of taking responsibility for fostering a healthy environment and for passing such an environment on to future generations. Stewardship is an especially important aspect of landownership.

Succession – The natural process of change that occurs in an area over time as one community of living organisms replaces another. For example, a piece of bare ground succeeds into a meadow, then shrubland and eventually a climax or mature forest.

Terrestrial – Pertaining to the land and things growing on the land.

Vegetation – Collective term for plants (flowers, grasses, shrubs, trees, mosses, etc.)

Vegetation Community – A specific assemblage or grouping of plants that characterize a specific habitat. Woodlands often contain a mixture of vegetation communities, described best by the trees and shrubs that dominate. For example: maple-beech vegetation community is different from a silver maple-willow vegetation community.

Vegetated Riparian Buffer – The land immediately adjacent to an open watercourse that is covered with permanent vegetations such as grasses, shrubs or trees. These buffers provide many benefits to the watercourse and the life within it by providing shade, cover, pollution filtering, etc.

Watershed – An area of land where all the water drains towards one particular river system.

Weed – A plant out of place or where it is not wanted.

Wetland – Wetlands are land types that are commonly referred to as swamps, fens, mires, marshes, bogs, sloughs and peatlands. They occur intermittently across the landscape along lakes, rivers and streams, and in other areas where the water table is close to the surface.

Wildlife – Term for all wild living animals including birds, animals, insects, reptiles, etc.

Woodland – A plant community dominated by trees with over 35% canopy cover.

Woody Plant – Includes shrubs, vines and trees that go dormant in the winter and regrow in the spring.

Appendices

Appendix A. Budget

Table A.1 Preliminary Budget

Expenses		
Salaries, Benefits	$73,500	
Water Chemistry Analysis	$ 5,000	
Vehicle Rental	$ 1,500	
Inventory costs	$ 3,500	
Peer Review`	$ 1,500	**$85,000**
In-Kind Contributions		
Vegetation layer update	$24,000	
Administrative support	$ 9,000	
Committee members' time	$10,000	**$43,000**
Revenue		
County of Oxford	$20,000	
Ducks Unlimited	$10,000	
Ontario Trillium Foundation	$50,000	
Stewardship Oxford	$ 5,000	**$85,000**

Table A.2 ONHS Project Budget Breakdown by Category

Item	Cost
Project Management	$13,000
Terrestrial Component	$29,500
Aquatic Component	$27,000
Geographic Information Systems	$9,000
Materials and Expenses	$6,500
TOTAL	**$85,000**

Appendix B. Committees

Table B.1 Individuals involved in the Pre -Project Phase

Member	Title or Area of Expertise	Affiliation
Nancy Davy	Senior Planner	Grand River CA
Tony Zammit	Ecologist	Grand River CA
Samantha Mason	Aquatic Biologist	Grand River CA
Martin Newman	Supervisor of Terrestrial Resources	Grand River CA
Trisha Rosa	Planner	Grand River CA
Jennifer Wright	Aquatic Biologist	Grand River CA
Jeff Brick	Coordinator Hydrology & Regulatory Services	Upper Thames River CA
Tara Tchir	Ecologist	Upper Thames River CA
Cathy Quinlan	Terrestrial Biologist	Upper Thames River CA
Cathy Reeves	Aquatic Biology	Upper Thames River CA
Brenda Gallagher	Forestry and Vegetation Specialist	Upper Thames River CA
John Schwindt	Aquatic Biologist	Upper Thames River CA
Karen Maaskant	Water Quality Specialist	Upper Thames River CA
Terry Chapman	GIS Specialist	Upper Thames River CA
Brad Hertner	Community Partnership Specialist	Upper Thames River CA
Dave McLachlin	Conservation Programs Leader	Ducks Unlimited Canada
Bridget Schulte-Hostedde	Development + Policy Associate	Ducks Unlimited Canada
Paul Gagnon	Lands & Waters Supervisor	Long Point Region CA
Bonnie Bravener	Resource Technician	Long Point Region CA
Tony Defazio	Resource Planning	Catfish Creek CA
Allison Munro/Peter Dragunas	Resource Technician	Catfish Creek CA
Shelly Shain	GIS Specialist	County of Oxford
Mary Misek-Evans	Senior Planner	County of Oxford

CA = Conservation Authority

Table B.2 Steering Committee Members

Member	Affiliation
Michael Harding	Mayor of Woodstock, representing County Council (Chair)
Jeff Brick	Upper Thames River CA, representing Conservation Authorities in Oxford
Dave McLachlin	Ducks Unlimited
Tom Bird	Stewardship Oxford
Jim Magee	Oxford County Federation of Agriculture
Jim Hayes	Mayor SW Oxford, Chair of the IAC
Donald Woolcott	County Warden, County of Woodstock (Ex-Officio Member)
Support Staff	
Marg Misek-Evans	Oxford County, Senior Planner
Cathy Quinlan	UTRCA, Terrestrial Biologist (Project Manager for ONHS)
Dave Depuydt	Stewardship Oxford Coordinator, Ministry of Natural Resources

Table B.3 Technical Committee Members

Name	Title	Affiliation
Cathy Quinlan	Terrestrial Biologist	UTRCA
Tara Tchir	Ecologist	UTRCA
Terry Chapman	GIS Specialist	UTRCA
John Schwindt	Aquatic Biologist	UTRCA
Cathy Reeves	Aquatic Biologist	UTRCA
Jeff Brick	Planner	UTRCA
Brenda Gallagher	Vegetation Specialist	UTRCA
Karen Maaskant	Water Quality Specialist	UTRCA
Bonnie Bravner	Resources Technician	LPRCA
Paul Gagnon	Lands & Waters Supervisor	LPRCA
Alison Munro/Peter Dragunas	Resource Technicians	CCCA
Tony Difazio	Resource Planning	CCCA
Dave McLachlin	Conservation Programs Leader	DUC
Tony Zammit	Ecologist	GRCA
Nancy Davey	Senior Planner	GRCA
Samantha Mason	Aquatic Biologist	GRCA
Shelly Shain	GIS Specialist	County
Marg Misek-Evans	Senior Planner	County
Tammy Fehr	Planning Technician	County

Table B.4 Implementation Advisory Committee Members

Name	Affiliation
Cathy Bingham	Tourism Oxford
Tom Bird	Stewardship Oxford
Roger Boyd	Woodstock Field Naturalists
Howard Cornwell	Oxford County Agricultural Advisory Committee
Kevin Dolan, Bill Gibbons	Oxford County Bass Masters
Dwayne Evans	Ontario Ministry of Agriculture, Food and Rural Affairs
Ed Ecker	Oxford Woodlot Owners Association
Michael Harding	County Councillor
Jim Hayes	Councillor, Southwest Oxford
Brad Hertner	Upper Thames River Conservation Authority
Larry Jensen	Harrington Creek Eco Group
Michelle Kanter	Carolinian Canada
Bill Matheson	Oxford Soil and Crop Improvement Association
Arthur Murray	Ingersoll Nature Club
Jim Oliver	Long Point Region Conservation Authority
Russ Piper	Ontario Federation of Anglers and Hunters
Chris Powell	Woodstock Environment Advisory Committee
Darrell Randell	Ducks Unlimited Canada
Len Reeves	Development Industry
Tracey Ryan	Grand River Conservation Authority
Barry Smith	Perth-Oxford National Farmers Union
Nancy Walther	Oxford County Federation of Agriculture
Cliff Zaluski	Construction Industry
Facilitator	
Kim DeKlein	Ontario Ministry of Agriculture, Food and Rural Affairs
Support Staff	
Cathy Quinlan	Upper Thames River Conservation Authority
Jeff Brick	Upper Thames River Conservation Authority
Marg Misek-Evans	County of Oxford
Tammy Fehr	County of Oxford
Dave Depuydt	Ontario Ministry of Natural Resources

Table B.5 Summary of Communications

Item	Date	Details
Media Event: Official Study Launch	Mar 11, 2005	A News Release was issued to local media inviting them to the Vansittart Woods Environmental Education Centre. There were brief speeches from key partners to launch the study.
Municipal Presentations	May – Jun 2005	A 15 minute power point presentation was given to each lower tier municipality and the County to provide updates to the municipal councilors and staff on the project. Staff from the UTRCA as well as the Steering Committee Chair shared presentation duties.
Fact sheet	Mar 2005	One page fact sheet describing the study's goals and objectives.
Website	Mar 2005 - onward	The ONHS was hosted on the UTRCA website (www.thamresriver.on.ca/ONHS/ONHS.html)
News release	Fall 2005	A Media Release was issued to local media to announce the formation of the Implementation Advisory Committee.
County Council Presentation	Oct 2006	Final presentation of the ONHS to Oxford County Council

Appendix C. Terrestrial Habitat Study

C.1 Introduction

In settled landscapes, fragmentation of the original natural cover increases the significance of all the remaining natural heritage features and functions. Random conservation of natural heritage features cannot be relied on to ensure the survival of species or ecosystems since these measures fail to address how well the remaining natural features function or how effective they are in providing environmental benefits (Humke *et al* 1975). As well, there is a danger in assessing habitat patches only at the site scale, since ecosystems are not limited by the boundaries of individual habitat patches. Rather, natural features should be evaluated within the local context of the landscape where they occur given that they interact with each other and the surrounding landscape. Assessments at the site level only can lead to cumulative loss.

C.2 Landscape (Extrinsic) Study versus Site-Specific (Intrinsic) Inventory Study

Various methods have been used for assessing the significance of natural areas. Most evaluations use more than one criterion and include both landscape metrics such as size, connectedness, regional representation and hydrological function (Riley and Mohr 1994, Forman 1995); as well as site characteristics such as wildlife habitat, community and species diversity, quality, and condition. Management and planning issues such as immediate threats, ownership, manageability, and potential human use can also be used to assess conservation priorities (Duever and Noss 1990), but these are often cultural rather than ecological issues.

In general, regional scale natural heritage studies (such as County-wide studies), evaluate natural areas on their landscape metrics. Local scale natural heritage studies (such as city-wide studies), evaluate the specific composition of the natural area, and its role as a local refugium, corridor or habitat type. Composition and the frequency of the natural feature in the area as well as the condition of the natural feature (including natural and man-made disturbances and special features such as species, hydrology, aesthetic and social values) are important for municipal natural heritage features.

The location, size and shape of a vegetation patch have been identified as critical factors in the maintenance of species diversity and abundance where the natural vegetation cover has been disturbed or fragmented (Burgess and Sharpe 1981, Forman and Godron 1986, Harris 1984, Turner and Gardner 1991). These easily measured and remotely sensed metrics can act as surrogate measurements of more detailed or site specific characteristics (Schiefele and Mulamoottil 1987, Robbins *et al*. 1989, Hounsell 1989). However, these indicators provide only a partial picture of the complexity of ecosystem functioning.

Carter (2000) found that while relationships exist between intrinsic (site) and extrinsic (landscape) characteristics of a vegetation feature, there is a poor ability to account for one using the other. Only a small amount of variability in site specific features was being accounted for by landscape features and vice versa. Bowles (1997) found that no single feature can sufficiently measure the value of a natural feature. For example, using measures of interior such as size, core area and shape, Bowles found they all differed in their ability to predict the number of interior bird species within a woodlot.

Both of these studies (Carter 2000 and Bowles 1997) stress the importance of using multiple criteria to assess the characteristics of a natural feature and illustrate that the external characteristics of these features may not always reflect the internal quality of the sites studied, emphasizing the importance of studying all vegetation communities at both the landscape and site level so that important characteristics are not overlooked. Given the number of features on the County landscape, this type of analysis is not feasible. However, local municipalities are in a better position to evaluate their features at the site level and it is encouraged that they conduct more in-depth studies of their natural heritage features.

C.3 Other Terrestrial Inventories in Oxford County

Other, more site-specific studies have been carried out in Oxford County. In 2005, the UTRCA was contracted by the City of Woodstock to undertake a detailed inventory of every woodlot in the city in order to determine which were most significant. Where landowner permission was granted, a vegetation specialist inventoried the woods and recorded species, condition, and other forestry measurements. Landscape criteria were also used to determine significance. (UTRCA, in prep)

In 2004, the UTRCA was contracted to conduct a less detailed study of Ingersoll's woodlands. In this study, field work consisted only of a drive-by confirmation that wooded areas were natural or non-natural (e.g. mowed parkland). Landscape criteria were used to identify potentially significant woodland patches (UTRCA 2004).

C.4 Methodology

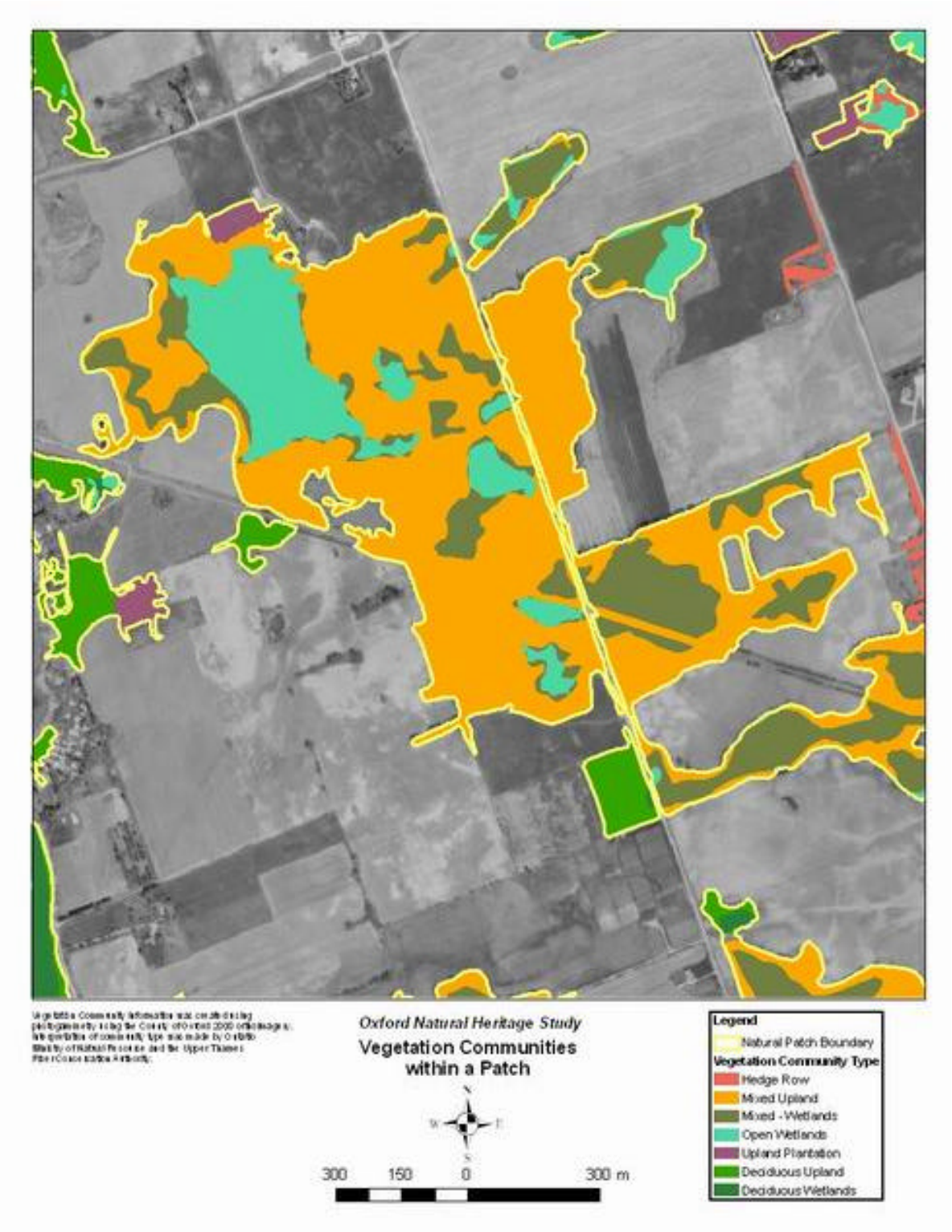
Before evaluation criteria can be applied, it is necessary to define which landscape features are included within the definition of terrestrial features and how individual polygons and patches are identified for evaluation. Such definitions can affect the application of some criteria (e.g. interior forest) and in most studies are assumed rather than specified.

The first step was to prepare detailed and comprehensive mapping at a 1:10,000 scale of the County's natural heritage system. The landscape was defined using spring 2000 aerial photography that was recently updated by Oxford County. Digital maps of habitat patches and vegetation communities (polygons) were developed using Geographic Information Systems (GIS).

A vegetation patch is a mosaic of one to many abutting vegetation polygons. Types of vegetation polygons include: woodlands, swamps, marshes, prairies, thickets and riparian habitat. The outside boundary of the vegetation patch is the outside boundary of all contiguous vegetation community polygons considered to be part of the patch (Figure 1). Therefore, vegetation polygons can be of different vegetation types and still form a single patch.

Vegetation patches were formed by dissolving all vegetation community polygon boundaries (all vegetation types except large open inclusions, orchards, nurseries, and hedgerows) into a single vegetation patch if they touched one another. The minimum mapping unit for a vegetation community polygon was 0.5 ha. Vegetation community polygon boundaries of large open inclusions that are greater than 20 meters in width were dissolved into the vegetation patch if they were completely surrounded by a vegetation community polygon and comprised less than 25% of the vegetation patch area.

Figure C.1 Example of a vegetation patch with different types of vegetation community polygons



Given that GIS is the principal tool for defining vegetation patches, the data is subject to some uncertainty due to mapping and scaling errors. For example, the mapping of woodlands may not reliably distinguish tall thickets from forests in all circumstances. As well, all data is a snapshot in time, and changes may have occurred in the intervening years from when the data was collected until it was analyzed in this study.

The next step was to develop a number of criteria that could be used to determine significance for all habitat features in Oxford County and then to determine thresholds appropriate for Oxford County. The criteria were developed using current principles of conservation biology and landscape ecology. Landscape characteristics of habitat patches were measured, evaluated and analyzed using Arc View GIS computer software. The data collected through aerial photography were entered into an electronic database. This type of analysis did not require field-collected data, but instead used existing land information databases, aerial photography and other remote sensing products. We then looked at cumulative frequency curves for each criterion to determine threshold values and used a GIS-based analysis to identify those habitat features that met the criteria. The final step was to generate maps of the significant terrestrial features based on the criteria and to prioritize areas for protection and restoration.

C.4.1 Woodland Vegetation Polygon/Community Mapping

Woodlands are deciduous or coniferous treed communities that have attained a height of 2 meters or greater with no visible rows (i.e. mature plantations are considered woodlands). For the purposes of this study, woodlands must be greater than 0.5 ha in size and greater than 50 metres in width (woodlands less than 50 m in width were considered a hedgerow).

The designation of a discrete polygon had nothing to do with ownership boundaries. A patch could be under the jurisdiction of many owners.

For the ONHS, the UTRCA acquired MNR's draft SOLRIS (Southern Ontario Land Resources Information System) mapping layer (2005). This layer included the identification of woodland polygons and was based on the Natural Resources Values Information System (NRVIS) vegetation layer. The NRVIS layer was stereoscopically interpreted from:

- 1:30,000 panchromatic aerial photography acquired for the Ontario Base Mapping (OBM) programme,
- 5 meter panchromatic imagery and 23 metre multispectral imagery of July and August acquired from the Indian Remote Sensing satellite (IRS) and orthorectified to NRVIS base standard of +/- 5m horizontal and +/- 1 metre vertical positional accuracy, and
- 0.25 meter resolution Airborne Orthophotography from the spring that was acquired using conventional 9" film format from low altitude aircraft. It was orthorectified to 1 metre horizontal and less than 1 metre vertical position.

A full description of this methodology is included below.

Step 1. All isolated woodland polygons that are less than 0.5 ha in size are removed from the vegetation polygon layer. A 10m buffer is placed around all polygon boundaries.

Step 2. Polygon boundaries are dissolved into a single polygon where the following three criteria are met: a) the polygons are less than 20 meters apart (i.e. the buffers touch), b) the polygons are of the same vegetation type and c) the polygons are not separated by permanent structures. Details and rationalization on each of these three criteria are discussed below.

a) 20 meters is the average width of a road. In a fragmented landscape, shrinking habitat size usually coincides with an increase in roads and traffic. Roads are one of the major impacts on the landscape (Noss 1995). They fragment and remove habitat, act as conduits for non-native species, serve as pollution sources and habitat disturbance, and create edge effects (i.e. increased predation, change in vegetation growth resulting from altered light and nutrient conditions, etc.). Roads and rights-of-way are particularly insidious because they include not only the paved surface of the road itself, but also the area along the median, the shoulder, the ditch and an allowance beyond the ditch up to the forest's edge. Even minor unpaved roads or wider trails through woodlands can have an impact on the natural functions of a forest. For example, when the layer of organic matter is cleared away or the ground is compacted as a result of road building or machinery movement, absorption occurs less readily.

   Distance from roads and traffic intensity influence the response of species. Many wildlife species alter their habitat use as a result of traffic, associated noise, or a combination of the two. A well used highway that bisects a forest can be an impassable barrier for wildlife, isolating small mammals, snakes, turtles, salamanders, and frogs inhabiting either side and restricting their movement among forest patches (Harris and Gallagher 1989). This is reflected in increased rates of road-kill, which are a primary known cause of death for all remaining large mammals other than White-tailed Deer, the populations of which are released as a result.

b) Vegetation types in Oxford County include:
   - *Hedgerows*: linear in shape and 30 to 50 metres in width. Hedgerows less than 30m in width were removed while those greater than 50 metres were classified as a different polygon type.
   - *Plantations*: regular in shape, rows discernable, with uniform structure and dark red or green tones. Conifer plantations can return to naturally-occurring woodland communities over time and have the potential to expand a core area or provide linkages. Mature conifer plantations will start to look natural (rows are filled in or not visible) and will be included as coniferous. Restored deciduous woodlands that have reached a height of 2 metres or more will be included as deciduous. Note that some plantations may not be true polygons since they are often a harvestable, standing crop. Orchards and Vineyards cannot be discerned and will be treated as young plantations.
   - *Open Inclusions*: unforested areas greater than 20 meters in width, partially or fully surrounded by woodland, that are greater than 25% of the polygon area and are not part of the identified wetland layer. It is unknown whether these areas are meadows, old agricultural fields, unidentified wetlands, etc. and are identified separately as unforested inclusions. Inclusions comprising less than 25% of the polygon area are considered part of the surrounding polygon.
   - *Deciduous Forest*: generally irregular in shape with billowy structure and bright red tones. Includes restored deciduous woodlands that have reached a height of 2 metres or more
   - *Coniferous Forest*: generally irregular in shape with moderate texture and dark red or green tones

Mixed: combination of deciduous and coniferous either as individual trees or as clumps (polygon inclusions) scattered throughout the patch

Shrub / Thicket: cast shorter shadows and similar shape and structure to natural vegetation. Based on air photo interpretation, it is difficult to differentiate tall thicket from treed communities and therefore shrubs or trees that have reached a height of 2 meters or greater will be considered a type of forest.

c) Permanent structures include roads, buildings, railroads, and active agricultural fields.

C.4.2 Wetland Vegetation Polygon / Community Mapping

Wetlands are natural habitats where water and land come together and include swamps, marshes, bogs and fens. Wetlands occur intermittently across the landscape along lakes, rivers and streams and in other areas where the water table is close to the surface or in low area where water pools. In Oxford County, the dominant wetland type is wooded swamps, with smaller numbers of bogs and marshes.

In the 1980s and 1990s, the Ontario Ministry of Natural Resources (OMNR) undertook a wetland mapping and evaluation program across southern Ontario, largely in response to the alarming loss of wetlands and the need to locate and conserve the best sites. All wetlands that were evaluated by the OMNR were classified as either Provincially Significant or Non-Provincially Significant (e.g. Locally Significant). Wetlands or wetlands complexes assigned a score of 600 points or higher were considered Provincially Significant (OMNR 1993). Municipalities have identified these wetlands in their Official Plans.

However, these designated wetlands do not represent all of the wetlands on the landscape. There are many pockets of wetland that have not been mapped or examined. Thus, there is not a true picture of the state of the wetland coverage. Getting a handle on how much wetland remains in Oxford was felt to be important for this study.

For the ONHS, the UTRCA acquired MNR's draft SOLRIS (Southern Ontario Land Resources Information System) mapping layer (2005). This layer did include the identification of some new wetlands, but it was in the draft phase was not complete enough for the purposes of the ONHS. Thus, the UTRCA opted to enhance the mapping further.

The UTRCA devised a desk-top methodology to identify wetlands on the landscape, without the huge expense of visiting each site in the field. The approach was based on the methodology established earlier by the Grand River Conservation Authority who had mapped their portion of Oxford County. The goal of the wetland mapping exercise was to map, with a reasonable level of confidence, all or most of the unidentified wetlands in the County. The wetlands were not given a class according the OMNR system since no field work was undertaken; but simply identified and mapped. There were no minimum size restrictions.

Wetlands were mapped 'manually' by visually examining black and white ortho-imagery. This air photo interpretation was aided by a GIS that displayed several additional features/layers including: watercourses, 1952 tree cover, imperfectly drained soils and organic soils, ground elevation and woodland height. In the end, most determinations were made using air photo interpretation combined with the 1952 Forest Cover layer. The other features/layers were less important diagnostically, but examined non-the-less to get a fuller picture of the local landscape. In cases where a determination was in doubt, two or three staff members were brought in for input. A full description of the methodology is included below.

Step 1. Air Photo Interpretation

Using the ortho-imagery of Oxford County, each woodlot was examined using basic air photo interpretation skills. The ortho-imagery was flown in April 2000, before the leaves are on the trees, allowing the tree branching pattern to be seen as well as the ground below. Swamps are the dominant wetland type in Oxford County. Swamps tend to have:

- darker tones (e.g. standing water absorbs light)
- less dense/ more open canopy cover (e.g. trees spaced more widely or irregularly)
- fluffier canopy tops due to a denser branching form that conceals the trunk of the tree; this is in contrast to sugar maples which have a translucent appearance such that their trunks can be seen through their canopies

Bogs are not common in southwestern Ontario, but there are some in the eastern and southern part of Oxford County. Bogs are generally dominated by conifers (black spruce, tamarack) and so the tree canopy has a darker, spiked appearance. Bogs often have a pond or low, open shrub community at the centre that is distinctive on air photos.

Marshes and fens are uncommon in Oxford County. They occur sporadically on the landscape, often as small patches adjacent to a waterbody. They lack trees and so are low and appear dark and granular, sometimes with a spotty texture in the case of a cattail stand.

Step 2. 1952 Forest Cover Information

In the early 1950's detailed information on forest cover was obtained by teams of foresters who examined every woodlot in the Upper Thames watershed and mapped the information onto air photos. The maps and tables are included in the *Upper Thames Valley Conservation Report 1952* (Dept of Planning and Development, 1952). Similar work was carried out in the Catfish Creek, Long Point Region and Grand River watersheds.

Stands were mapped according to forest cover types using a system developed by the Society of American Foresters. Most woodlots contained several cover/vegetation types (e.g. aspen, sugar maple, beech, yellow birch, black cherry, white cedar, , white elm, etc.).

In 2005, the UTRCA digitized these1950's maps so they could be used on the GIS. Cover types that are highly associated with wetlands (e.g. silver maple, black ash, and cedar) were assigned a value of 1 (one) and coloured in red. Cover types that are moderately associated with wetlands (e.g. white elm, tamarack) were assigned a value of 2 (two) and coloured in orange. The occurrence of the red and orange communities was one of the biggest clues as to the location of wetlands today and helped narrow the search or confirm an interpretation.

High Wetland Affinity	**Moderate Wetland Affinity**
Black Ash-White Elm-Red Maple	Aspen
Silver Maple-White Elm	Bur Oak
Tamarack	Cottonwood
Wet Scrub Land	Hemlock
White Cedar	Paper Birch
White Elm	Plantation
Willow	White Pine-Hemlock
	Yellow Birch

Step 3. Poorly Drained Soils

Wetlands often occur on organic soils or imperfectly drained soils. Imperfectly drained soils were mapped in blue and organic soils in brown. Organic soils are less common than the other soils and are formed under wetlands, so they are the best indicator of where a wetland is likely to occur. Imperfectly drained soils (e.g. clays) retain water longer than sands, but wetlands can occur on sands as well (e.g. perched water table). This feature was only moderately useful.

Step 4. Elevation

Intuitively, wetlands are thought to occur primarily in depressions or lowlands, so knowing where the dips in the ground occur may help one find wetlands.

Digital elevation data is available for most of Oxford County, except parts of the Long Point Region CA. The elevation of the ground at a potential wetland site was checked against the surrounding landscape to determine if the site was situated on higher or lower ground

This information did not prove to be helpful, primarilty because it was found that in Oxford County wetlands occurred at all elevation gradients: headwaters, along terraces or gentle slopes, along watercourses and near ponds. Thus, knowing the elevation did not help verify a site as being a wetland or not.

Step 5. Woodland Height

Wetlands may be shorter than surrounding wooded areas, especially when dealing with scrub wetlands (shrub) or marshes. Digital elevation data was available that gave woodland height. The height of a woodland could be compared to other woodlands in the vicinity.

Again, this information was not very useful. The woodland heights did not appear to be standardized as one moved across the County, making it difficult to define a shorter woodlot in absolute terms. Secondly, aside from scrublands, wooded swamps are similar height to other wooded communities.

Step 6. Ranking and Mapping

A boundary was drawn around each wetland parcel to create a polygon on the ortho-imagery. Once all of the layers were examined, an attribute table was filled in for each polygon and a final rank or determination was made based primarily on the air photo interpretation ranking (see table below). If a site was ranked as 'uncertain', another staff member (i.e. the vegetation specialist or ecologist) was brought in to give a second opinion and then the site was ranked as wetland or not wetland.

Soil Drainage	1952 Tree Cover	Elevation	Woodland Height	Air Photo Interpretation	Final Rank
1 – organic soil 2 – poorly drained 3 – n/a	1 – high wetland affinity 2—moderate wetland affinity 3 – n/a	1- lower than surrounding land 2- same as surrounding land 3 – higher than surrounding land	1 – lower than surrounding stands 2 – same as surrounding stands 3 – higher than surrounding stands	1 – looks like a wetland 2 – uncertain 3 – does not look a wetland	1 – wetland 2 – uncertain 3 – not a wetland

C.4.3 Floodplain Meadows Vegetation Polygon/Community Mapping

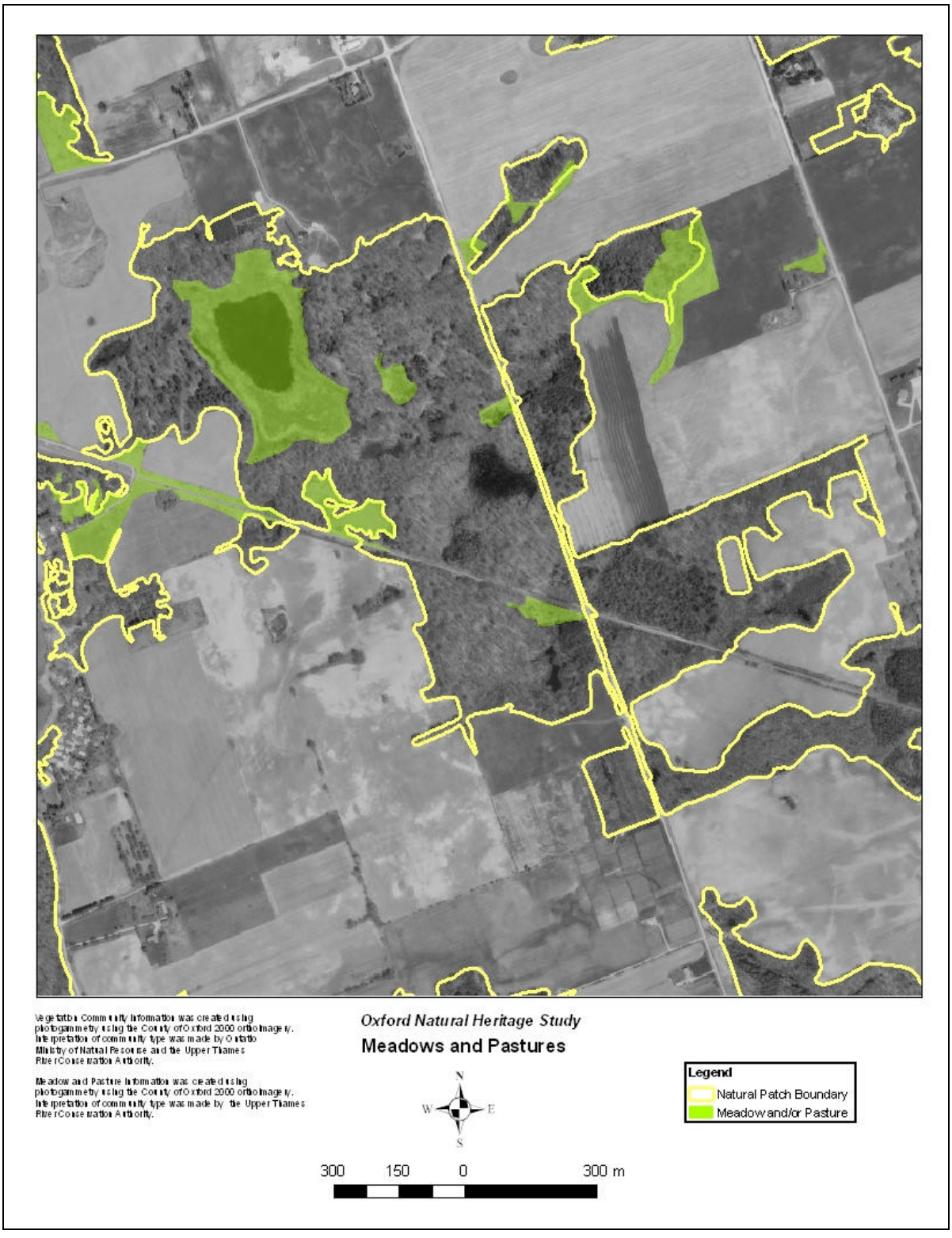
Meadows are permanent vegetation communities that are dominated by grasses, sedges and wildflowers, sometimes with a scattering of trees and shrubs (less than 35% tree canopy). Meadows occur naturally on the landscape in areas where soil is dry or thin, in woodland openings where trees have been blown over or died, along rivers where flooding and ice scour keeps out trees, along ponds, and on fallow fields (Figure 2). Some meadows may succeed into forests if conditions are favourable.

The greatest variety of species occurs in riparian meadows where water and land come together. The land-water interface is a rich ecosystem, usually with high biodiversity, providing essential aquatic resources and functions to both terrestrial and aquatic species. Many plants and animals benefit not only from the water, but also the high level of nutrients derived from overland flow (Harris and Gallagher 1989). A majority of North American wildlife depends on riparian and shoreline zones for survival. They are primary centres of bird activity. Riparian wetlands are also a critical breeding and foraging habitats for amphibians and reptiles, from which they can radiate seasonally or for longer periods, and in which they can seek refuge during other periods (Harris and Gallagher 1989, Harris 1984). Riparian vegetation also protects water quality by filtering out and using excess sediments and nutrients. Vegetated filter strips have been found to be effective in the attenuation of the effects of drainage on water quality, particularly the effects of phosphorous and suspended solids (Hilditch 1992).

Meadow along a river with woodland farther back

.

Figure C.2 Floodplain Meadow and/ or Meadow Examples from Ortho-Imagery



The SOLRIS mapping layer does not identify meadows and neither does the exisiting natural heritage maps. While not part of the original scope of this project, it was felt that meadows should be mapped to get a truer picture of the extent of other natural habitats on the landscape. Floodplain meadows function largely as watercourse buffers, so this data will be useful in the future to target restoration work.

To map this habitat type, a methodology was devised that was based largely on air photo interpretation. This approach is labour intensive, but relatively simple. A full description is included below. This work was completed late in the project and so many meadows were not used within the patch boundaries. It is recommended that future work be funded to examine this data more fully.

Methodology

Software. The software used was ArcMap

Layers. The following digital layers were used: Ortho-image (2000 spring), Evaluated Wetlands, Mapped Woodlands, Open Watercourses, County Boundary

Interpretation. In spring photography, meadows look somewhat like crop fields. However, farmland is barren in the spring, so farm fields appear flat and relatively featureless, except for linear drainage and tillage patterns. In comparison, meadows are taller and have some grainy texture. Meadows do not have linear drainage or tillage patterns. Meadows tend to occur within floodplains, as openings in woods, and along fencerows. Pastures are considered a type of meadow since the vegetation is permanent and, if left ungrazed, would be indistinguishable from a meadow. Roadside rights-of-way were excluded from this mapping exercise.

Tracing. Using the pencil feature, click around the perimeter of the meadow, tracing along the edges of the watercourse and any woodlands, fields or other edges.

Categories of Meadows

1. Floodplain Meadow - meadows along a watercourse and not pastured
2. Pasture - active pasture land along a watercourse or not (barns nearby are hints)
3. Pasture or Floodplain Meadow - meadows along a watercourse, but uncertain if pastured
4. Meadow - meadows not associated with a watercourse or farm; can be an opening in a woodlot

C.4.4 Criterian Development

The Terrestrial Technical Team met several times to develop a list of significance criteria for Oxford County. The team reviewed the literature and previous studies where significance criteria were developed, including the Middlesex Natural Heritage Study (UTRCA 2003) the Oxford County Terrestrial Ecosystems Study (UTRCA 1997) and Environment Canada's publication *How Much Habitat Is Enough*? *2nd Edition* (Environment Canada 2004).

The team developed nine criteria to identify "significant" patches in Oxford County. The criteria are listed in Table 1. The evaluation criteria are based on ecological function and representation. Ecological function refers to features that maintain biodiversity and ecosystem integrity over time, such as the size of the patch, distance to nearest neighbouring patch, and presence of hydrological features. Representation refers to features that are selected to represent the full diversity of habitat types found in Oxford County.

Table 1. Criteria for Significance of Terrestrial Habitats

Ecological Function

1 Patches that contain rare species. Rare species are based on MNR's Natural Heritage Information Centre (NHIC) occurrences of species with federal, provincial, regional and local designations.

2. Patches that contain habitat designated in the Official Plans of Oxford County. These designated habitats include Life Science Areas of Natural and Scientific Interest or ANSIs, Environmentally Significant Areas or ESAs, identified wetlands including Provincially Significant Wetlands and Locally Significant Wetlands, other protected areas).

3. Patches within 150m of designated, non-wetland habitats in the Official Plans (e.g. Life Science ANSIs, ESAs, and other protected areas) or within 750m of designated wetland habitats in the Official Plan (e.g. PSWs and LSWs).

4. Patches > 10ha in size.

5. Patches with interior habitat. Interior is defined as the amount of habitat left after 100m have been removed from the inside perimeter. Thus, a habitat must be over 200 m across to contain interior.

6. Patches that occur within well-head capture zones or intrinsic groundwater susceptibility areas. These areas are identified in groundwater studies.

7. Patches that contain an open watercourse or are within 50 m of an open watercourse.

Representation

8. Patches with the largest amount of area on each landform and soil type in Oxford County and all patches that occur on valley lands. Valley lands are identified through the Conservation Authority slope stability and erosion lines.

9. Patches that contain large amounts of each natural vegetation community type: wet conifer > 4ha, wet mixed > 60ha, shrub > 4ha, wet deciduous > 45ha, conifer > 15ha and mixed > 45 ha, open wetland >10 ha and deciduous > 20ha. The cut-off thresholds were determined by plotting distribution curves of area and vegetation community types.

The selection of evaluation criteria for determining significant natural areas in Oxford County was based on three principles:

- the criteria should identify a measure of the contribution of the patch to its landscape function at the County level,
- the criteria must be defensible and based on principles of landscape ecology and conservation biology, and
- the criteria must be measurable for all natural areas in Oxford County.

The criteria did not include measures of cultural value, such as important view sheds, historical landscape patterns, or landmark trees and stands; nor did it include site (intrinsic) criteria, since these two types of criteria are not measurable for all natural areas given the number of patches in the County. Below is a description of the rational behind utilizing each of the nine criteria.

Criteria 1. Patches that contain rare species

Species designated as threatened, endangered or special concern by the provincial (COSSARO – Committee on the Status of Species At Risk in Ontario) or federal government (COSEWIC – Committee on the Status of Endangered Wildlife in Canada) are very uncommon and are legislated for protection to ensure their long term survival. To protect these species, their habitat must be protected as well.

Criteria 2. Patches that contain habitat designated in Official Plans of Oxford County.

These sites have been identified in other studies for their ecological significance on the Oxford County landscape (e.g. Hilts 1976) and can be used as benchmarks for the remainder of features in Oxford County. Uncommon habitats contribute a disproportionate share of the diversity of wildlife found in a given place. Designated wetlands in particular are regarded as areas of high productivity and critical habitat for species.

Criteria 3. Patches within 150m of designated, non-wetland habitats in the Official Plans or within 750m of designated wetland habitats in the Official Plan.

Many conservation biologists believe that habitat fragmentation is the most serious threat to biological diversity and the primary cause of the present extinction crisis (Wilcox and Murphy 1985). Natural areas in the fragmented landscape resemble habitat islands both in size and isolation. These islands of green are core conservation areas that act as refugia, enhancing the resiliency of the landscape (Hilts et al 1986; Gartner Lee Ltd. 2002). They are also a source of potential colonists. However, these large areas are as vulnerable as true geographic islands. The occurrence of large natural habitat patches is not enough if there are relatively few such tracts, if they are widely dispersed, or if there are few natural corridors linking them (Riley and Mohr 1994). They will only continue to function properly in relation to the overall vegetation mosaic of the region. Ecological models show that an absence of surrounding vegetation for core areas can jeopardize their long-term stability. For example, the lloss of the connectivity would eventually have an effect on the larger patches as local extirpations occur due to stochastic (random) events.

Populations of native flora and fauna are reduced because fewer habitats are available when habitats are fragmented into small remnant pieces. Equally important, patches far away from each other tend to have fewer species than those close to each other. This is because the remaining populations become isolated, leading to a striking decline in native species diversity. Natural

features in close proximity to each other help to increase dispersal and act as habitat corridors. As distance from other sources of immigrants increase, colonization rates decline. This leads to inbreeding and population extinction (Riley and Mohr 1994).

One of the best ways to protect these natural areas is to develop strategies to establish natural corridors between them (Diamond 1975, Wilson and Willis 1975). Corridors serve to connect core natural areas, and by connecting one natural area to another, they increase the effective size of even small or fragmented areas. However, the identification of landscape connectivity within a given planning area is an evolving science. Though the literature strongly supports the concept that connectivity is species and landscape specific, it is not practical to determine a threshold for connectivity based upon the selection of a single species or even a group of species for the purposes of broad landscape planning. This is because it is not known how much resiliency wildlife and vegetation require for maintenance of populations. As well, concepts of corridor widths and design, habitat sizes, and the ability to overcome obstacles, are rudimentary at best. Thus, other approaches to landscape connectivity must be considered.

The density of natural habitat fragments on the landscape, and the overall proportion of habitat on the landscape, may be more critical in the long term than immediate habitat type or quality (Gibbs and Faaborg 1990, Bolger et al. 1991). The most recent research shows that a local landscape that includes large natural areas, linked to the regional landscape mosaic by a network of smaller interacting natural areas and corridors, offers the highest probability of maintaining overall ecological integrity on the landscape (Noss 1987a and b, Larson et al. 1999, Villard et al 1992).

Criteria 4. Patches > 10 ha in size

Size is one of the most important patch measures since the larger the size, the less important other landscape measures become (i.e. a single patch covering the entire landscape would make distribution, shape, connectivity, etc. irrelevant). Larger patches contain a greater diversity of interior and generalist species, are better buffered against edge effects (Saunders et al. 1991), support larger persistent populations because of reduced competition for space and resources (CCEA 1991, Andren 1994, Bender et al. 1998, Lee et al. 2002, Burke and Nol, 2000, Francis et al. 2000, Gartner Lee Ltd. 2002) and, in general, exhibit higher rates of immigration and lower rates of extinction (Adams and Dove 1989). Large sites are also a source of potential colonists.

The diversity and abundance of many species is lower in small, isolated patches for many reasons. Small patches contain a greater area of edge in relation to size, decreasing the number of interior species, while the number of edge species, predators and parasites increases (Adams and Dove 1989). Small patches also contain fewer niches, thereby increasing competition. As well, species richness can collapse in small patches because natural events, such as a harsh winter or disease outbreak, can cause a local extinction of small populations.

Species diversity increases asymptotically with increased patch area. According to Riley and Mohr (1994) and OMNR (1999), the size of a vegetated patch considered to be significant within the planning area is a function of the percentage of the vegetation cover type within that area. There is not one size that fits all since many factors affect the potential productivity of vegetated patches with respect to wildlife (i.e. each individual species varies in its response to patch size and other landscape metrics). That being said, there is general agreement that at 4 ha, opportunities for enhanced vegetated patch function occur (Riley and Mohr 1994), while at 10 ha, edge effects are mitigated by size (Sandilands and Hounsell 1994).

Forests below 10 hectares are unlikely to be productive for many forest-associated, area-sensitive and disturbance-sensitive wildlife species (Freemark and Collins 1992, Riley and Mohr 1994, Environment Canada et al. 1998). In Oxford County, a patch was more likely to have interior habitat if it was 10 ha in size or greater. Studies have shown that patches smaller than that are dominated by edge species, or short-distance migrants that are granivorous or omnivorous in their feeding (Adams and Dove 1989). Many specialized insectivorous bird species are limited to woodlands over 10 ha in size (Petty and Avery 1990) and 10 ha is the size at which functions associated with area-sensitive and disturbance sensitive wildlife species start to be seen (OMNR 2000, Henshaw and Leadbeater 1998).

For the ONHS, the 10 ha threshold for significant patch size was supported by distribution curves of percent landscape area by size (see section 1.10.3) and by comparing the proportion of patches with interior to patches without interior within a particular size class (Table 2). As Table 2 shows, patches less than 7.5 ha in Oxford County do not contain interior habitat, while all patches greater than 80 ha have interior habitat. Table 2 also shows that 10 ha is the size at which more than one-quarter of the patches consistently have interior habitat.

Table 2. Percent of Patches with Interior within a particular Size Class.

Patch Size (ha)	% of Patches with Interior
<7.5	0
7.5 – 8.0	12
8.0 – 8.5	12
8.5 – 9.0	21
9.0 – 9.5	23
9.5 – 10.0	29
10.0 – 10.5	26
10.5 – 11.0	38
11.0 – 11.5	45
11.5 – 12.0	42
12.0 – 12.5	48
12.5 – 13.0	38
13.0 – 13.5	27
13.5 – 14.0	50
14.0 – 14.5	52
14.5 – 15.0	53
15.0 – 20.0	67
20.0 – 30.0	73
30.0 – 40.0	92
40.0 – 50.0	92
50.0 – 60.0	90
60.0 – 70.0	93
70.0 – 80.0	92
80.0 – 90.0	100
90.0 – 100.0	100
100.0 – 150.0	100
150.0 – 200.0	100
>200.0	100

Criteria 5. Patches with interior habitat

Forest interior refers to the protected core area found inside a woodlot that many species, especially forest interior bird species, require to nest and breed successfully. Many warblers such as black and white warbler, Canada warbler, and black-throated blue warbler require large woodlands with forest interior. Other birds such as pileated woodpecker, hermit thrush, ovenbird and scarlet tanager have been shown to suffer population declines when forest interior habitat is reduced (Freemark 1999).

Birds are a particularly effective barometer of forest size and shape, since many of the native species need large expanses of interior habitat (habitat found 100m or further from the edge). Numerous studies have reported regional declines and extirpations of all types of forest interior birds throughout the fragmented landscapes of the deciduous and mixed forests of north eastern North America. The decline of Neotropical migrant birds is attributed to the widespread clearing and fragmentation of extensive forest tracts, both on their breeding grounds in north eastern North America, and on their wintering grounds in the Neotropics, as remnant woodlots become too small or isolated to support breeding populations.

Bowles (1997) found that core area was a better predictor of the number of interior birds than the total area of a woodlot, and that for larger patches; the size and core area of a woodlot were better predictors of forest interior bird species than was the shape of a patch. The Natural Heritage Reference Manual (OMNR 1999) also recognizes the importance of maintaining interior habitat in upland forest habitats wherever possible. The exceptions to this rule are riverine patches. These habitats can be thin and convoluted and still function.

Literature suggests that edge effects for forest interior birds penetrate at least 100 metres into the forest, including edges from large internal openings (Kendeigh 1944, Adams and Dove 1989, Wilcove 1987). This is because vegetation changes along forest margins favor invasions into the core habitat by edge species such as predators, parasites and alien plants. Foresters in the U.S. Pacific Northwest estimated that the physical edge effects of microclimate, sunscald, noise, wind, and desiccation extend three times the height of the trees into the forest (Wilcove 1987, Harris 1984). Edges are avoided by forest-nesting birds because of the increased risk of predation (predators find prey more easily in edge habitats), nest parasitism, inhospitable temperature / moisture conditions, insufficient food and increased human disturbance.

Criteria 6. Patches that occur within well-head capture zones or intrinsic groundwater susceptibility areas.

The Natural Heritage Reference Manual (OMNR 1999) suggests the significance of woodlands can be determined by their overlap with other natural heritage features. Since natural plant cover improves the quality of the water entering the groundwater by slowly percolating precipitation downward, instead of being directed away as runoff, vegetation cover should be protected on groundwater recharge zones. The new Clean Water Act recognizes the importance of preserving the quality and quantity of water sources.

Criteria 7. Patches that contain an open watercourse or are within 50 m of an open watercourse.

This criterion addresses the link between terrestrial and aquatic ecosystems. Riparian (along rivers and streams) and shoreline areas are important for the roles they play in water quality and landscape connectivity. Vegetated stream banks contribute to the maintenance of water quality by

removing (filtering) nutrients, sediments and toxins from surface water runoff and sub-surface flows; providing shade to maintain cool water temperatures (thermoregulation) and high quality habitat for fish species; moderating hydrographs by reducing the intensity and volume of storm water runoff and by maintaining stream flow; and stabilizing the soil to reduce erosion.

In addition to protecting water quality, vegetated buffer strips can also act as corridors for the movement of wildlife (Wegner and Merriam 1979). Corridors are elongated, naturally-vegetated areas that generally follow drainage systems or other biophysical breaks in the landscape. Some of the most obvious linear corridors on the landscapes of southern Ontario are the land-water edges found in valleys and along watercourses and shorelines. Larger corridors may contain significant features and functions themselves, can act as substantive passageways for plant and animal species, and can serve as protective setbacks from conservation lands and waters.

A number of studies have identified various widths of stream-side vegetation buffers, depending on adjacent land use and slope (reviewed in Castelle et al. 1994). Some have shown that vegetation strips 15-20 meters wide along streams should be enough to protect against sedimentation, erosion and increases in water temperature (Budd et al. 1987). Other references (Griffiths 2001, Steedman 1987) concluded that if 25% of the land within 100m of streams was natural, the water quality would be unimpaired, regardless of the surrounding landscape. Most studies, however, recommend a buffer of 30 m to protect water quality on gentle slopes and 50 m to encourage wildlife movement.

Criteria 8. Patches with the largest amount of area on each landform and soil type in Oxford County and all patches that occur on valley lands.

Different groups of trees and plants occur on different soil and landform types. For example, dry sandy soil supports oaks and pines while sugar maple and beech dominate loam areas. Different animal species are also supported by different types of vegetation and habitat. For example, badgers and hognose snakes require sandy habitats. Since the distribution of vegetation on the landscape is determined by abiotic conditions such as soil type and physiography (Bridge and Johnson 2000), this criterion is one way of capturing the full diversity of vegetation patch types in Oxford County.

Criteria 9. Patches that contain large amounts of each natural vegetation community type: wet conifer > 4ha, wet mixed > 60ha, shrub > 4ha, wet deciduous > 45ha, conifer > 15ha and mixed > 45 ha, open wetland >10 ha and deciduous > 20ha.

Representation approaches have become key concepts in developing methods to select the most significant of remaining natural areas in a scientifically credible, reproducible manner (CCEA 1991, Peterson and Peterson 1991). Since dissimilar habitats provide nutritional and reproductive requirements of different species, the diversity of species depends on diversity of habitats on the landscape. The objective is to identify a system of natural areas that best represent the full spectrum of vegetation-landform types that occur within Oxford County. This criterion is one way of capturing the full diversity of vegetation community types found in Oxford County.

C.4.5 Statistics

Cumulative frequency curves, which illustrate the number of patches that fall within a given interval for a specific feature, were used to establish thresholds for size-related criteria (i.e. criteria 4, 8 and 9). The configuration of patches on the Oxford County landscape determined the thresholds (e.g. distance to nearest neighbour, size of patch, etc.). Thresholds were based on specific cut-off points along the curve where the top 5% of patches were very high, 75% - 95% were high, 50% - 75% were medium, 25% - 50% were low and the bottom 25% were very low.

C.5 Findings – Characterization

C.5.1 Forest Cover

Approximately 12.5 % of Oxford County is in forest cover. This cover is comprised primarily of woodlands and wetlands (mostly treed swamps). An additional 1.8% is meadow. Therefore, the total natural heritage cover in Oxford County is 14.3% (Figure 3). Scientific research supports a 20 – 30% forest cover threshold for the persistence of birds and other wildlife species (Andren 1994, Fahrig 2001, Riley and Mohr 1994).

C.5.2 Vegetation Communities: 1952 vs 2000

Figure 4 below shows the proportion of vegetation types in Oxford County in 1952 versus today (2000 mapping). In 1952, there was approximately 11% vegetation cover in Oxford County. Approximately 4% of the County was deciduous upland, 3.5% was deciduous wetland, 1.5% was shrub wetlands, 1% was shrub uplands, and 1% coniferous wetlands.

Currently, there is approximately 12.5% vegetation cover in Oxford County (excluding meadows for comparison purposes as meadows were not mapped in 1952). This indicates a growth of 1.5% natural cover. While the mapping accuracy is superior today, the 1952 maps were quite detailed and so it is reasonable to conclude that the amount of natural cover has increased over the last half century up to 1.5%. Tree planting and marginal agricultural land retirement undoubtedly account for this growth in woodlant/natural cover.

The majority of this vegetation cover is still deciduous. Approximately 6.5% of the County cover is deciduous upland, while 2.5% is deciduous wetland. Mixed forests (coniferous, deciduous, upland and wetland) make up another 3%. Within the Carolinian Zone of Canada, broad-leaved decidous forests are the norm, while conifers exist in smaller numbers, often in specific cooler and/or wetter habitats. Most plantations are made up of conifers (pine, spruce) planted in rows, but there is a growing trend towards planting both conifers and deciduous trees together.

Figure C.3 The natural cover of Oxford County (2000 mapping)

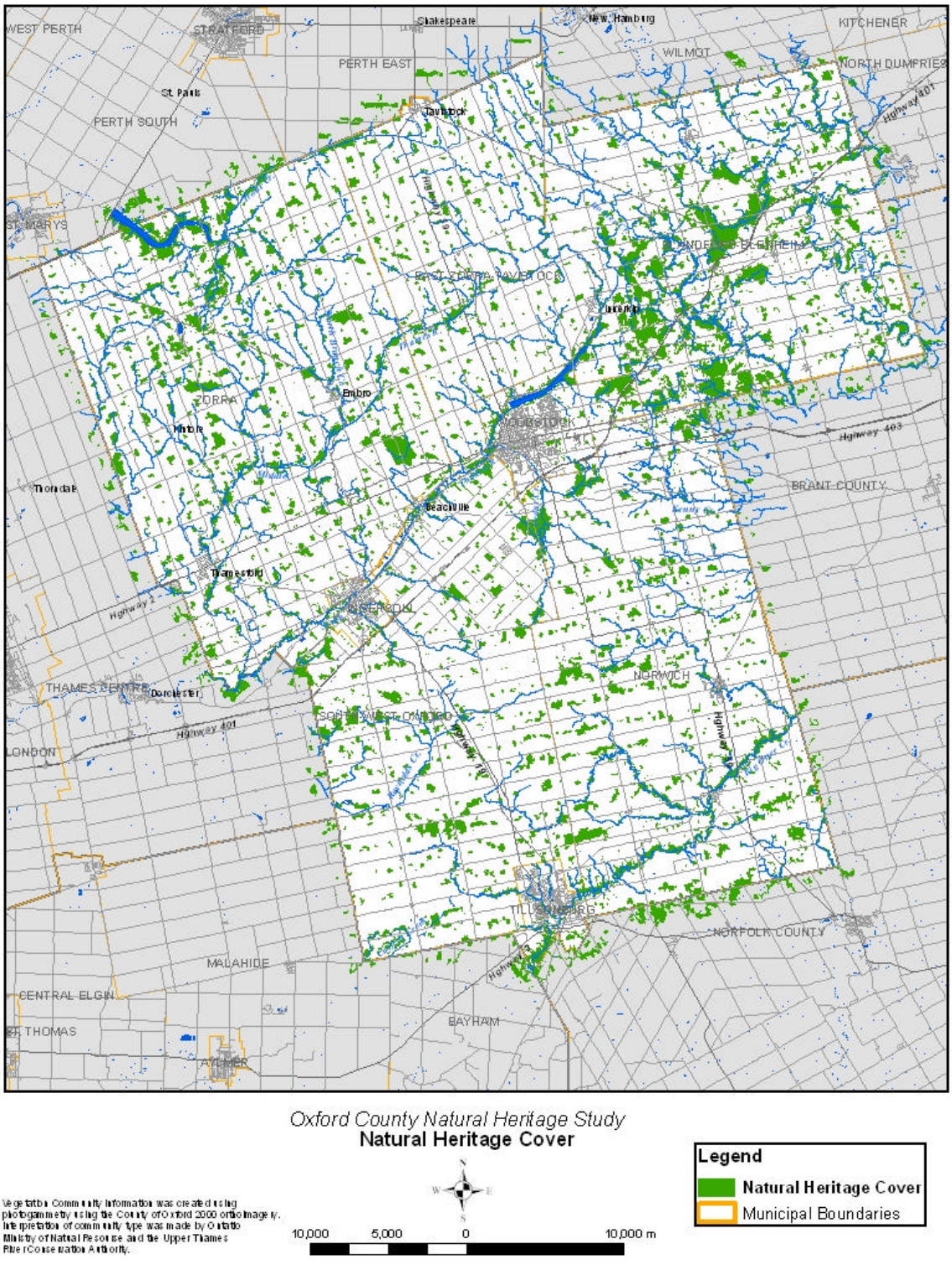


Figure C.4 Proportion of Vegetation Types in Oxford County

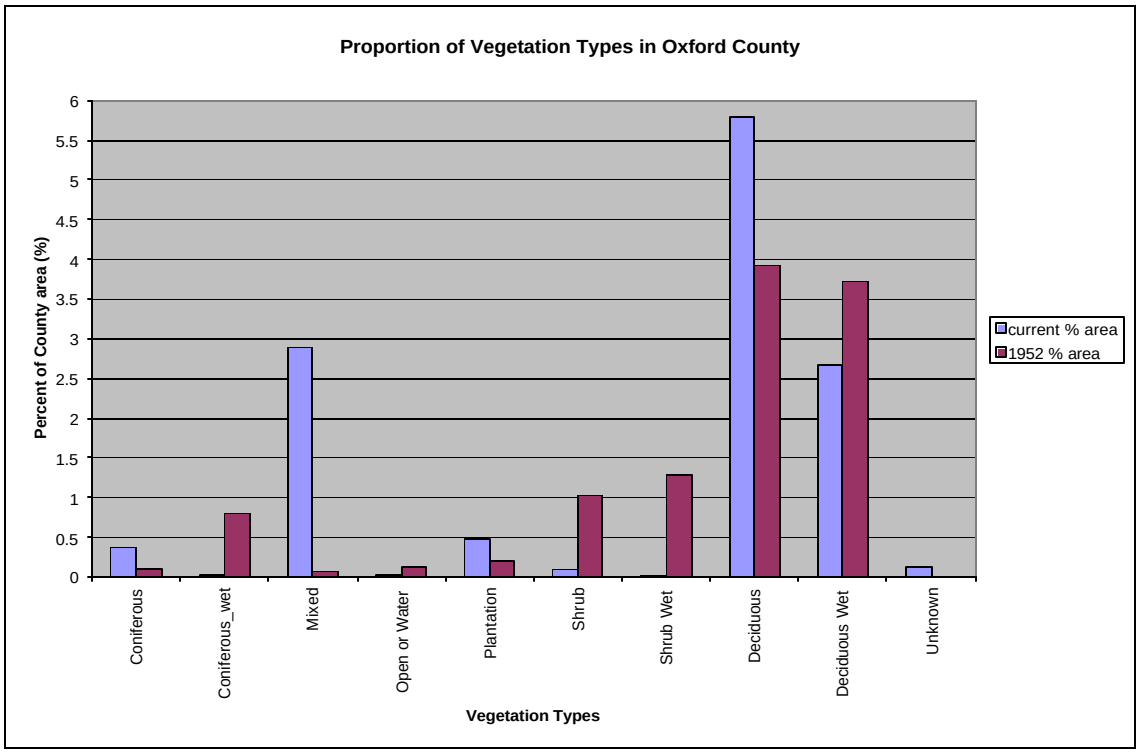


Table 3 shows the cumulative distribution of vegetation community types in 1952 by size class. In 1952, all vegetation communities were less than 50 ha in size at that time. Coniferous uplands and open wetlands were less than 20 ha in size while all mixed forests and plantations (upland and wetland) were less than 30ha in size. In addition more than half of all the habitats were less than 4 ha in size, while more than half of the open wetland and plantation were less than 1 ha.

Table 4 shows the current cumulative distribution of vegetation community type by size class in Oxford County. More than half of the remaining coniferous wetlands, hedgerows, open wetlands, upland plantations and upland shrub are less than 4 ha in size, while more than half of the remaining coniferous uplands, orchards, deciduous upland and deciduous wetland are less than 10 ha. All remaining coniferous wetlands and hedgerows are under 10 ha in size. All remaining upland shrub habitat is less than 20ha in size; while all remaining coniferous uplands are less than 30 ha in size, and all remaining orchards are less than 50 ha in size. However, Table ?? also shows that over 20% of the remaining mixed uplands, mixed wetlands, deciduous wetlands and wetland plantations are over 50ha in size. In fact, 7% of the remaining mixed wetlands are greater than 250 ha.

Table C.3 The cumulative distribution (percent area) in Oxford County by size class and vegetation community type based on 1952 data.

Type	<1 ha	<4 ha	<10 ha	<15 ha	<20 ha	<30 ha	<50 ha
Conifer upland	22	77	89	98	100	100	100
Conifer wetland	31	69	88	94	96	99	100
Mixed	16	53	74	85	96	100	100
Open wetland	67	90	96	98	100	100	100
Plantation	52	88	95	97	97	100	100
Wetland shrub	33	77	93	97	98	99	100
Upland shrub	32	73	91	95	97	99	100
Deciduous upland	24	72	94	98	99	99	100
Deciduous wetland	29	73	93	97	98	99	100

Table C.4 The cumulative distribution (percent area) in Oxford County by size class and vegetation community type based on 2000 data.

Type of vegetation	<1 ha	<4 ha	<10 ha	<15 ha	<20 ha	<30 ha	<50 ha	>50 ha	>100 ha	>150 ha	>200 ha	>250 ha
Conifer upland	6	36	67	85	96	100	100	0	0	0	0	0
Conifer wetland	20	51	100	100	100	100	100	0	0	0	0	0
Hedgerow	64	98	100	100	100	100	100	0	0	0	0	0
Mixed upland	3	11	29	42	49	65	76	24	10	3	0	0
Mixed wetland	3	13	25	32	40	44	73	27	11	11	7	7
Orchards	4	29	60	78	78	90	100	0	0	0	0	0
Open wetland	38	65	80	87	87	94	97	3	0	0	0	0
Upland plantation	23	60	77	82	87	90	93	7	0	0	0	0
Wetland plantation	9	15	29	29	29	29	55	45	0	0	0	0
Upland shrub	31	68	91	91	100	100	100	0	0	0	0	0
Deciduous upland	5	23	51	64	73	82	93	10	0	0	3	0
Deciduous wetland	8	31	51	58	65	70	79	21	7	4	0	0

C.5.3 Forest Cover on Soil Types

Oxford County is comprised of six main soil types. Figure 5 shows the spatial distribution of soil types across the County. The details are as follows:

Silt clay loam - 37%
Loams - 24%
Sand loam - 21%
Silt and clay - 13%
Organic - 3%
Bottomlands - 2%

Figure 6 shows the proportion of each soil type that was vegetated in 1952 and Figure 7 shows the current proportion. Not surprisingly, organic soils and bottomlands have the most natural cover (56% on organics, 24% on bottomlands) owing to the fact that these lands are difficult to drain or stabilize for agriculture or construction and thus are left in a natural state.

The majority of the loam soils had far less natural cover, between 7.5 and 16%, as they are suitable for agriculture and urban development.

Organic soils in Golspie Swamp

Figure C.5 The Soil Types of Oxford County

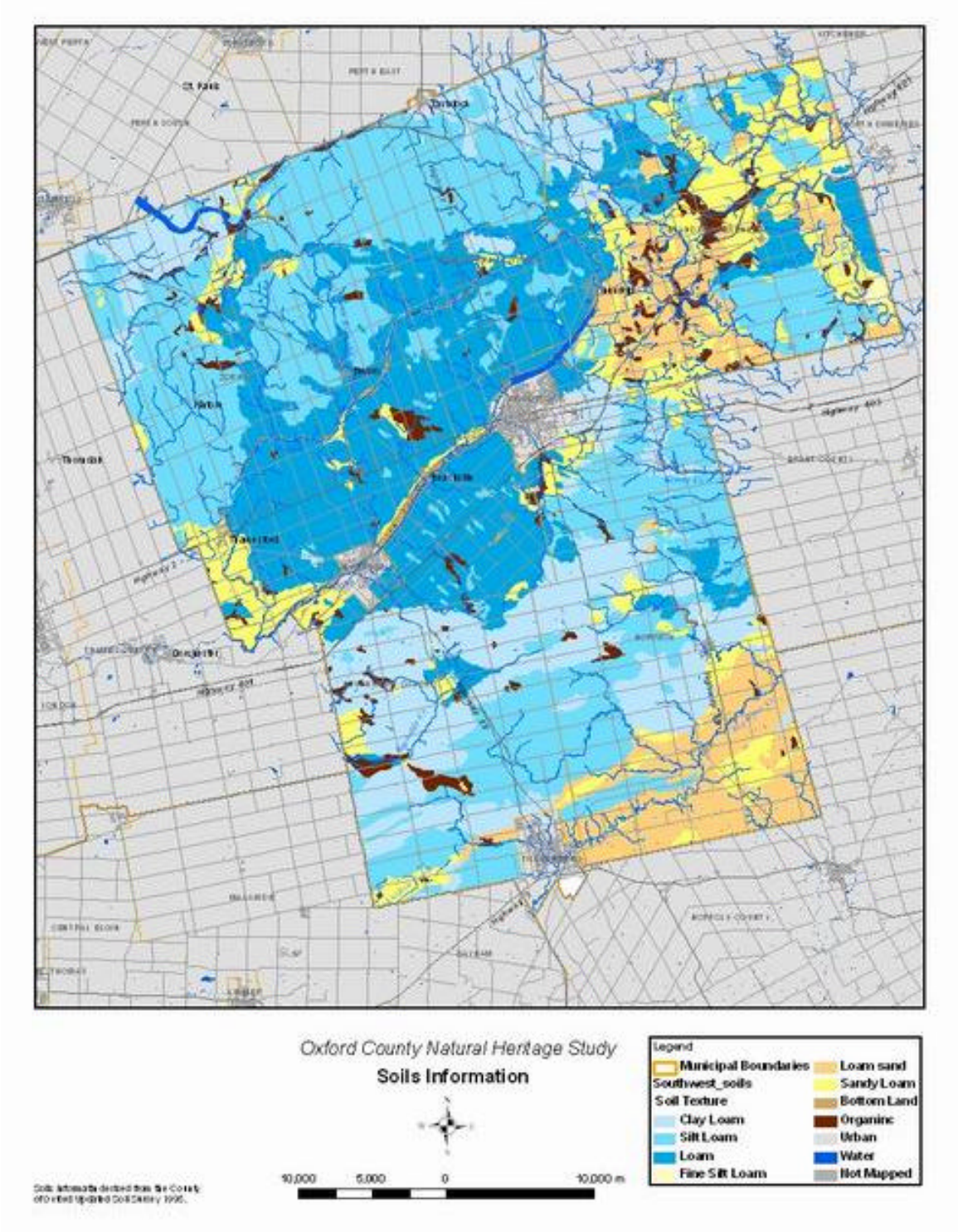


Figure C.6 1952 Proportion of Soils Types that are Vegetated

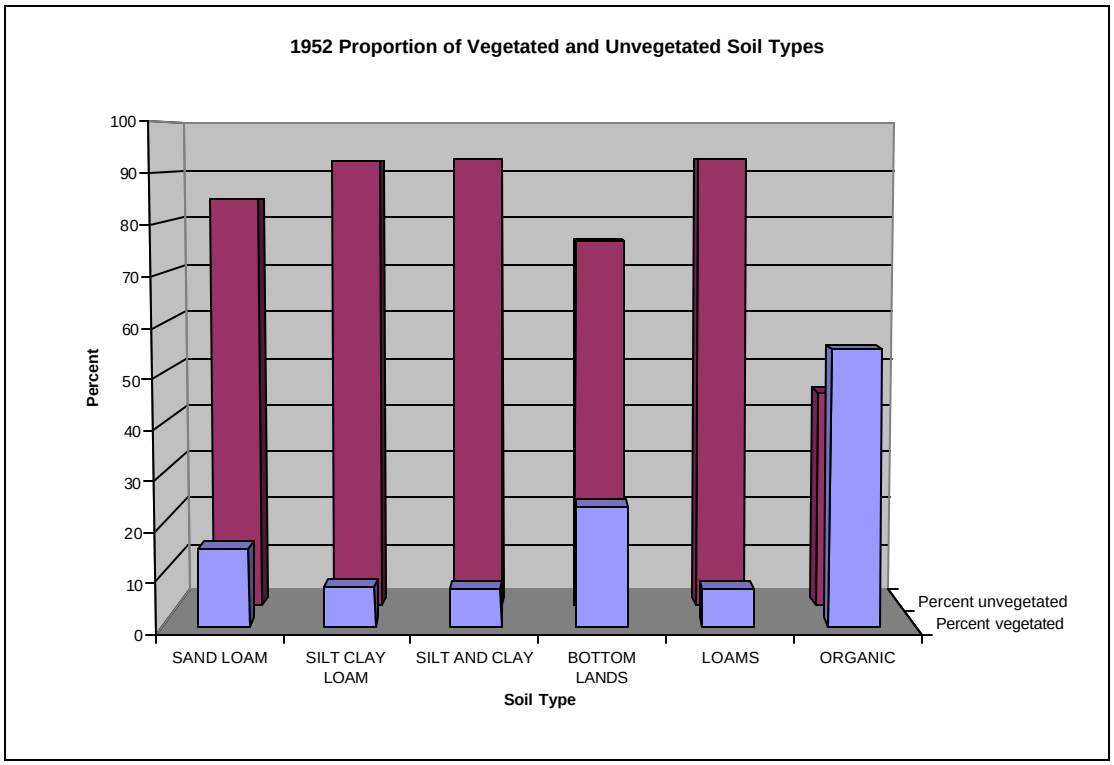


Figure C.7 Current Proportion of Soil Types that are Vegetated

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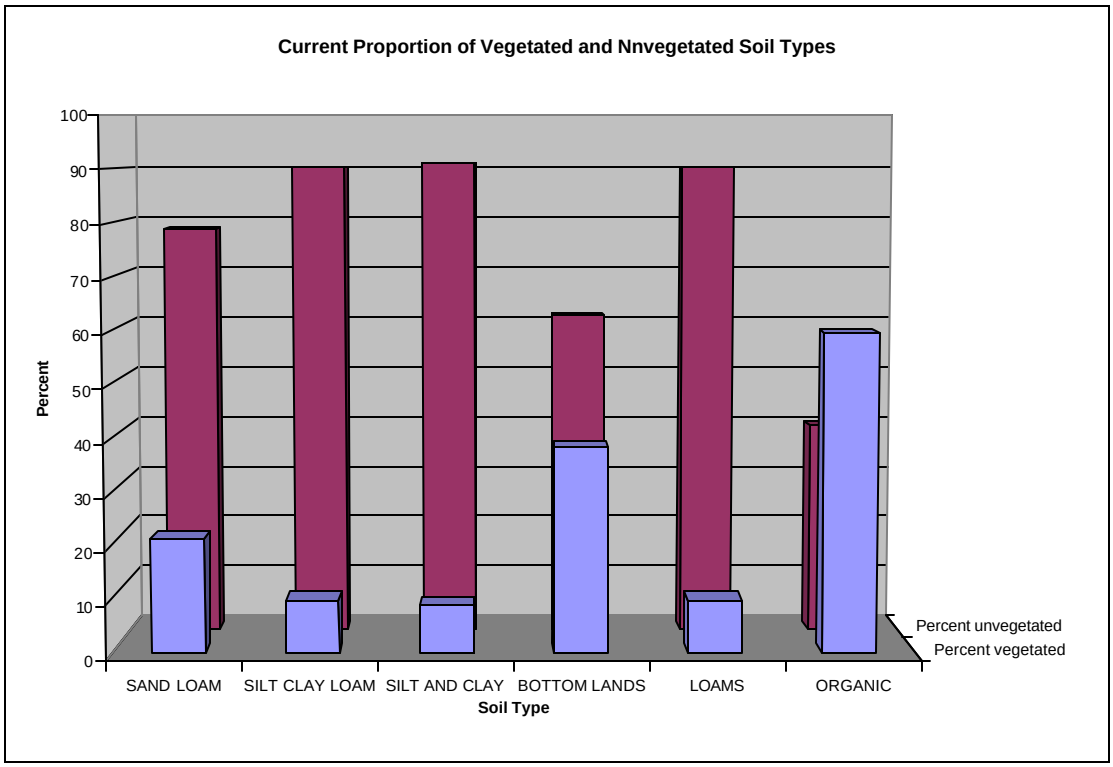


Figure 8 shows the composition of the vegetation (i.e. vegetation type) on each soil type in 1952. In general:

- 5% of vegetated sand loam soils were deciduous uplands. The remaining 95% was distributed equally among the other vegetation types.
- 6% of vegetated bottom lands were upland shrubs, 5% were deciduous wetlands, 4% were wetland shrub, 4% were deciduous uplands, and 4% were coniferous wetlands. The remaining 77% was distributed equally among the other vegetation types.
- 4% of the vegetated Silt, Clay and Loam soils were deciduous uplands and 3% were deciduous wetlands. The remaining 93% was distributed equally among the other vegetation types.
- 26% of the vegetated Organic soils were deciduous wetlands, 10% were deciduous uplands, 9% were coniferous wetlands, and 9% were wetland shrub. The remaining 46% was distributed equally among the other vegetation types.

Figure 9 shows the proportion of each soil type that is currently vegetated. In general:

- A large proportion of the poorly drained sites are still vegetated (60% of the organics and 38% of the bottomlands), while only 18% of sand loams, 10% of loams, 10% of silt clay loams and 9 % of silt clay are still vegetated.
- Organic soils are still the only soil type that had a larger proportion of its total area vegetated than unvegetated.
- 7% of vegetated sand loam soils are deciduous uplands, 4% are deciduous wetlands, 4% are mixed uplands and 3% are mixed wetlands. The remaining 82% of the vegetation is distributed equally among the other vegetation types.
- 14% of the vegetated bottom lands are deciduous uplands, 7% are mixed uplands, 6% are deciduous wetlands, 4% are mixed wetlands and 3% are open wetlands. The remaining 66% is distributed equally among the other vegetation types.
- 5% of the vegetated Silt, Clay and Loam soils are deciduous uplands. The remaining 95% is distributed equally among the other vegetation types.
- 25% of the vegetated organic soils are mixed wetlands, 11% are deciduous wetlands, 9% are mixed uplands, 8% are deciduous uplands and 5% are open wetlands. The remaining 42% is distributed equally among the other vegetation types.

Since 1952, all soil types have been re-vegetated to some degree. The largest amount of revegetation has been on bottomlands (an increase of approximately 14%).

Figure C.8 1952 Proportion of a particular soil type occupied by a particular type of vegetation.

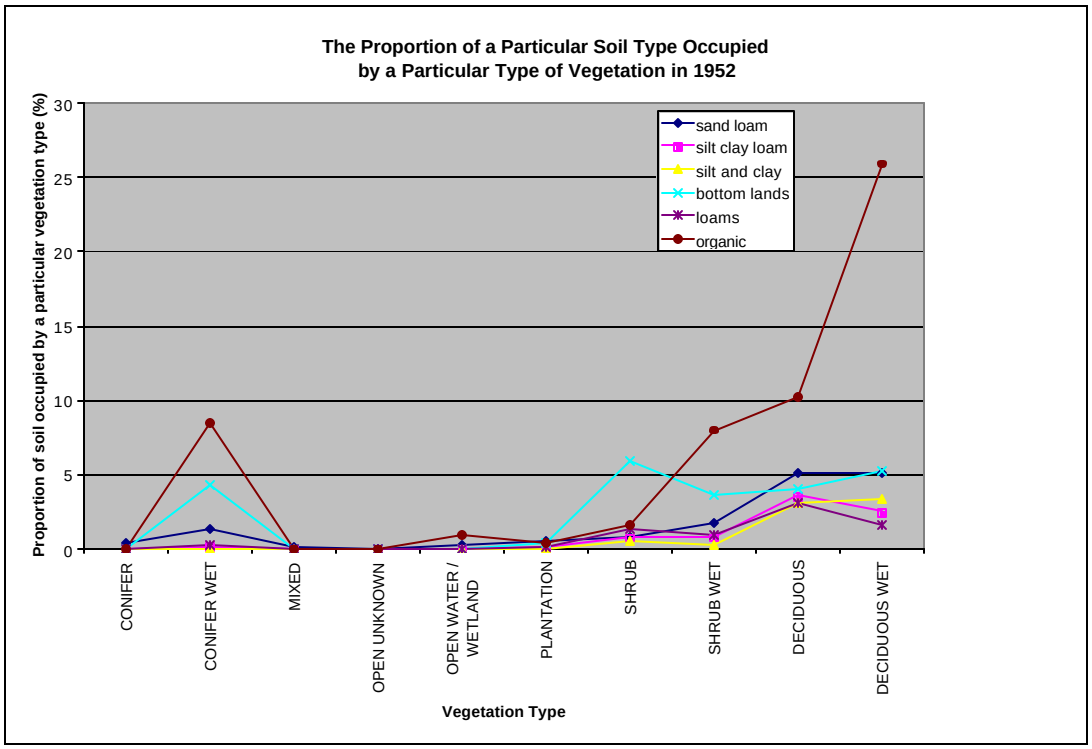
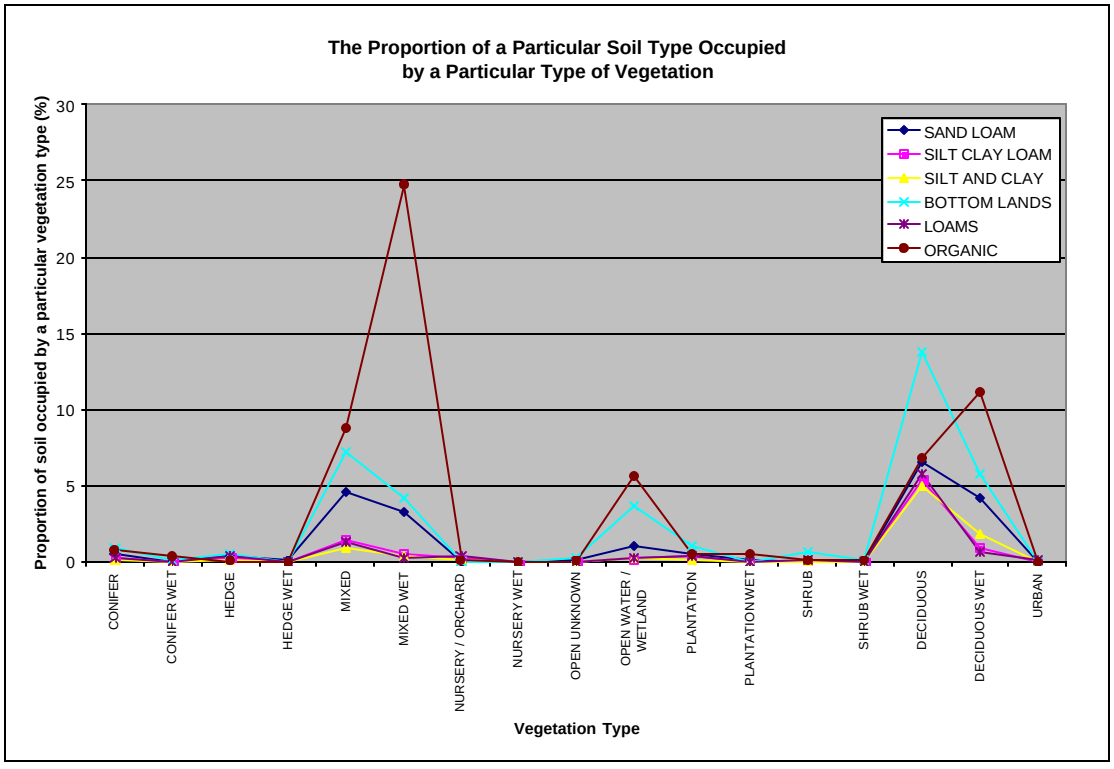


Figure C.9 Current proportion of a particular soil type occupied by a particular type of vegetation.



C.5.4 Vegetation Patches

Figure 10 shows the current and historic (1952) cumulative distribution of vegetation patches by patch size. Although the majority of patches are 20 ha or less, there were slightly more patches in the smaller size classes in 1952. This suggests that the smaller patches have either grown in size, or have disappeared, since 1952. The increase in forest cover from 11% in 1952 to 12.5% in 2006 suggests that the patches have grown.

Figure C.10 Cummulative distribution of patch numbers by patch size, 1952 vs current.

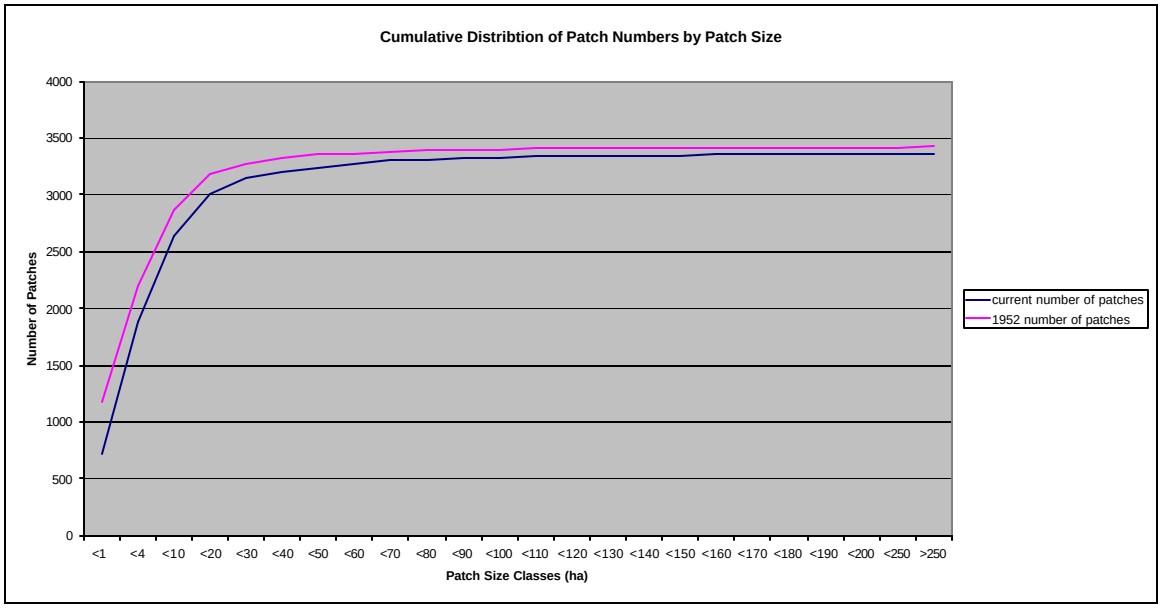


Figure 11 shows the distribution of patches by percent area and percent count for each size class. The largest number of patches is in the 4-10ha size class (35% of the number of patches), while the 10 – 15ha size class makes up the largest proportion of area (15%). Approximately 80% of the patches are < 10ha, yet they make up only 25% of the area.

Figure 12 shows the current and historic (1952) cumulative distribution of vegetation patches by patch interior. The majority of patches have less than 10 ha of interior. Recognizing that there were slightly more patches in the smaller size classes in 1952 (Figure 11), many of these patches do not have interior habitat.

Figure C.11 Patch Size Distribution

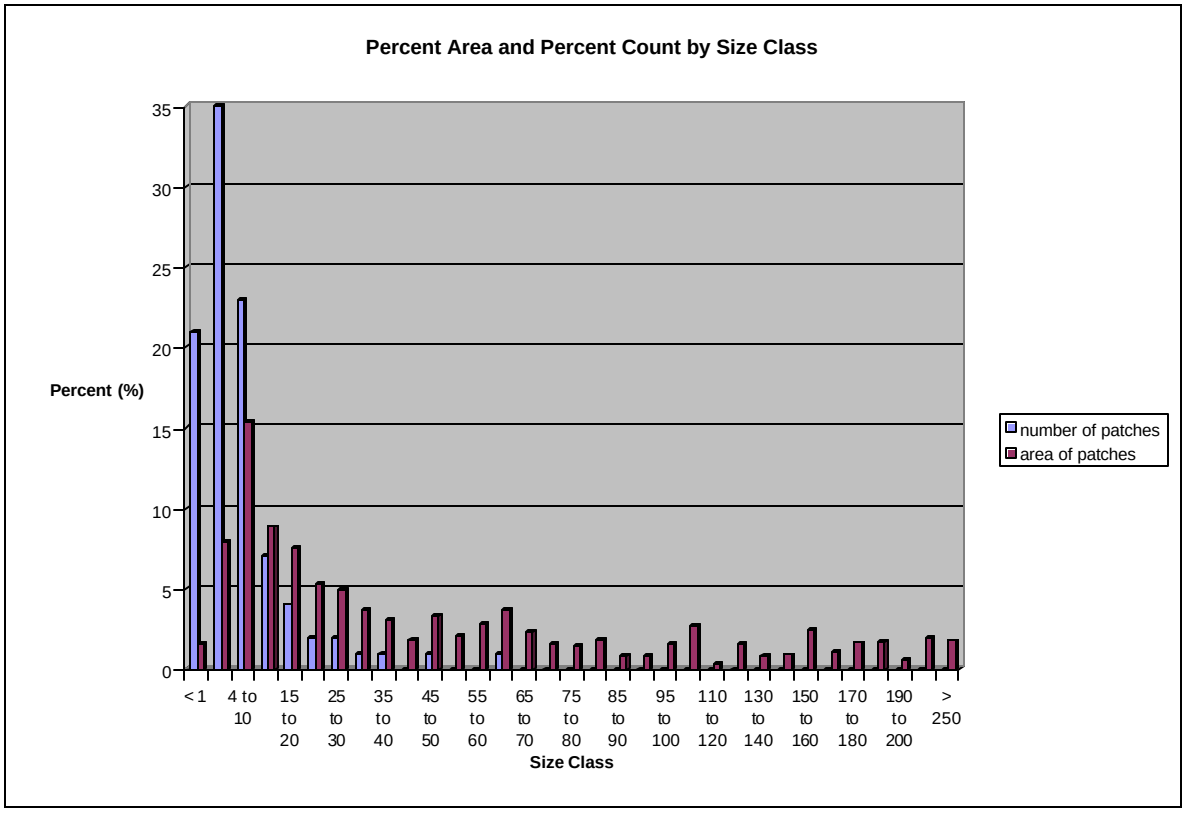


Figure C.12. Cummulative distribution of patch interior by patch size.

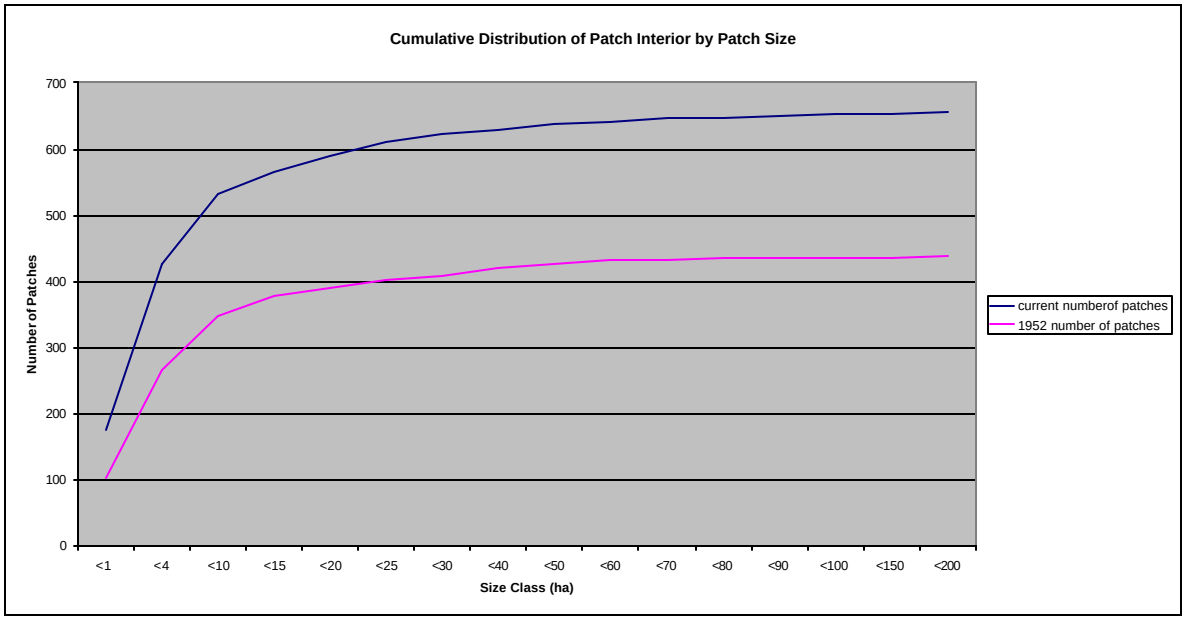


Table 5 shows the breakdown of patches by the number of vegetation communities found in each patch. The majority of patches (60%) have only one vegetation community. Approximately 9% of the patches have two vegetation communities, 22% have three vegetaion communities, and another 4% have four vegetation communities. Only eleven patches in Oxford County have more than ten vegetation communities. The largest number of vegetation communities in a patch is 13, and only one patch in Oxford County has 13 vegetation communities. In summary, most patches do not have a lot of variation in terms of different vegetation communities and this is probably due to the fact that most of the remaining patches are small. The loss of vegetation diversity may eventually lead to further loss of diversity in other species (e.g. birds, reptiles, etc.).

Table C5. Number of vegetation communities in a patch

Number of vegetation communities	Number of patches	Percent of Patches (%)
1	1971	60
2	312	9
3	750	22
4	137	4
5	87	3
6	45	1
7	33	1
8	12	0
9	10	0
10	4	0
11	3	0
12	1	0
13	3	0

C.6 Findings – Patches that meet Criteria

The criteria were run on the patches using the GIS. Table 6 summarizes the number of patches that met each specific criteria. Table 7 summarizes the number of patches that met 0 to 9 of the criteria (e.g. any criteria). No patches met all 9 criteria.

Approximately 80% of the patches (2676 of 3368) in Oxford County meet at least one criterion. Figure 13 shows the patches in Oxford County that meet one or more criteria.

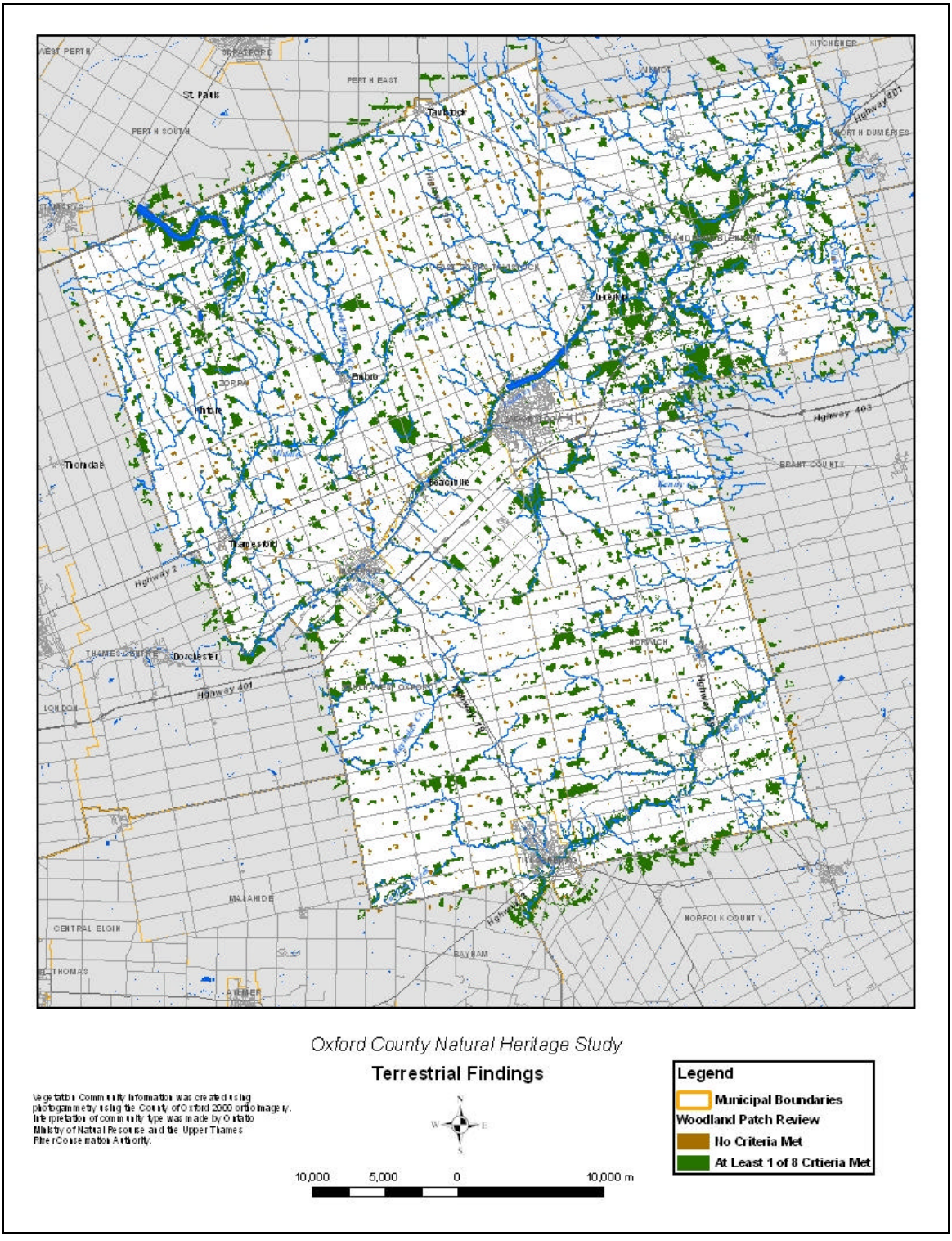
Table C.6 Number of Patches Meeting Each Criteria

No.	Criteria Description	No. of Patches	% of Patches	Area (ha)
1	Patches containing rare species	30	0.9	2047
2	Patches containing habitat identified in Oxford's Official Plan	512	15.2	14064
3	Patches within 150 m of Designated Habitat or 750 m of designated wetlands	954	28.3	7279
4	Patches greater than 10 ha in size	726	21.6	24025
5	Patches with Interior	795	23.6	20403
6	Patches on well-head capture zones or intrinsic groundwater susceptibility areas	1474	43.8	19503
7	Patches adjacent to an open watercourse	1568	46.6	23611
8	Patches with the largest amount of area on each landform and soil type	180	5.3	4702
9	Patches with the largest amount of area of each vegetation community type	159	4.7	10299
	Total number of patches in Oxford County	**(3368)**		

Table C.7 Patches Meeting a Certain Number of Criteria

Number of Criteria Met	Number of Patches	Percent of all Patches	Area (ha)	Percent Total Area
0	692	21	2038	6.4
1	929	28	2840	8.9
2	744	22	3252	10.2
3	453	13	4096	12.8
4	255	8	4821	15.1
5	184	5	6125	19.2
6	80	2	5296	16.6
7	28	1	3309	10.3
8	3	0	192	0.6
9	0	0	0	0
Total	**3368**	**100**	**31969**	**100**

Figure C.13 Woodland patches meeting one criteria or more.



C.6.1 County Forests Meeting Criteria

The County of Oxford owns nine forest tracts, formerly called Agreement Forests (see Figure 14 and Table 8). The Agreement Forest Program was a province-wide program whereby lands were acquired by counties, townships and conservation authorities, often with a substantial grant fom the province ,and then managed by the Ontario Ministry of Natural Resources (MNR) through a forestry agreement. This prgram began in 1922, largely in response to the failure of agriculture on blow sands in southern Ontario and the soil erosion and environmental degradation that followed (MNR, 1982). The tracts were replanted in pines and other fast growing conifers.

The forests were managed for wood products and wildlife habitat as well as erosion and flood prtection, protection of water supplies and recreation In 2001, the MNR turned these lands back to the counties and conservation authorities for management and cleared any debt that may have accrued from management. Lands for which a grant was received cannot be sold without Ministry approval.

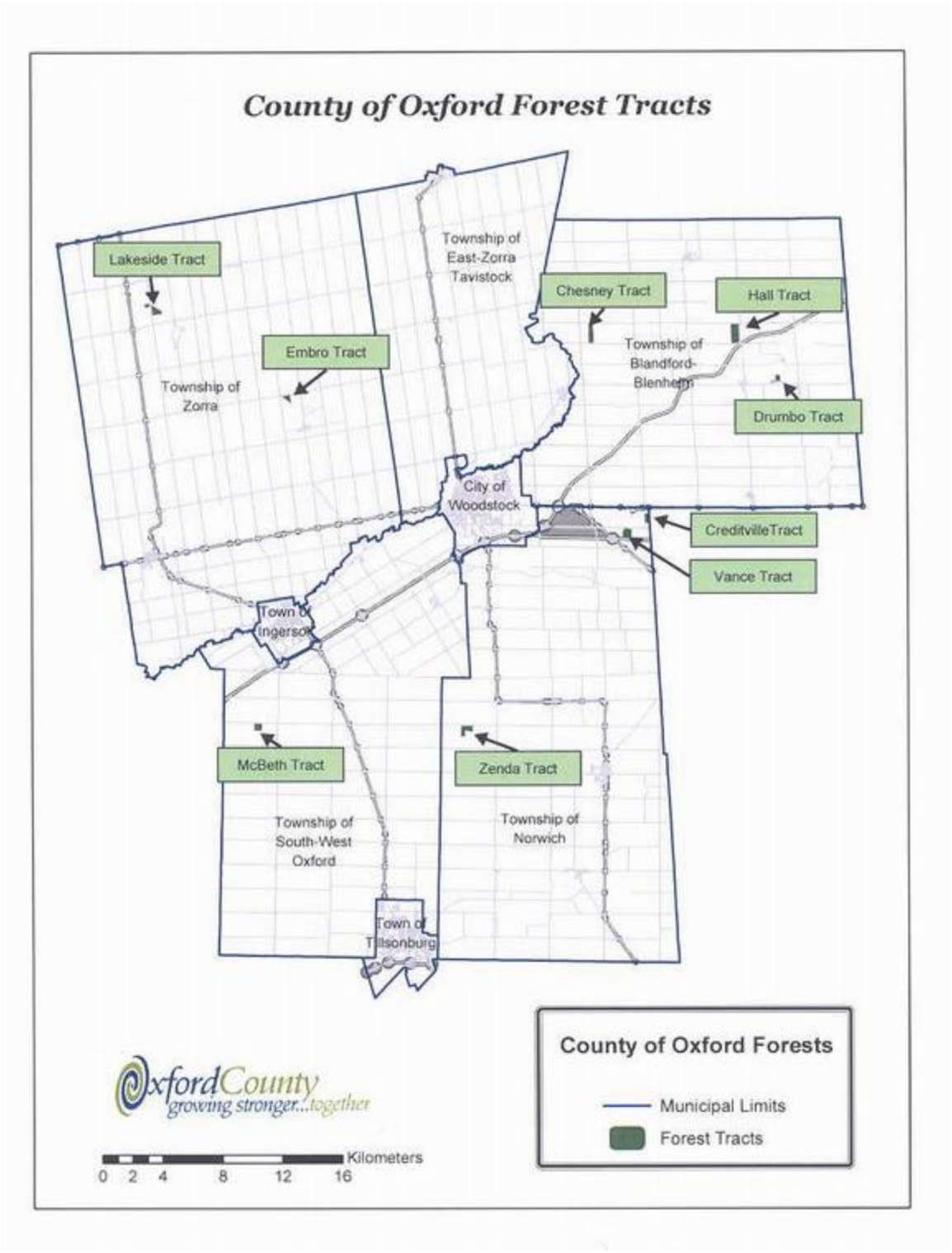
Most of the Oxford's tracts contain a variety of old plantation and natural woodland. The County ownes approximately 334 ha in nine tracts. Every tract met four or more criteria (Table 8). The tracts are all part of larger woodland complexes, and so the patch and not just the tract were evaluated against the criteria.

The County owned tracts are valuable pieces of Oxford's natural heritage system and should be maintained and enhanced. It would be prudent to produce Management Plans for each tract to determine the needs in terms of forestry, ecology and recreation.

Table C.8 County Forest Tracts and the Number of Criteria Met

Tract Name	No. Criteria Met	Criteria Met
Lakeside	5	2-designated habitat; 3-near designated habitat; 4-over 10 ha; 5-interior; 6-groundwater; 7-watercourse
Embro	4	4-over 10 ha; 5-interior; 7-watercourse; 9-vegetation community
Chesney	7	2-designated habitat; 3-near designated habitat; 4-over 10 ha; 5-interior; 6-groundwater wellhead; 7-watercourse; 9-vegetation community
Hall	6	3-near designated habitat; 4-over 10ha; 5-interior; 6-groundwater; 7-watercourse; 9-vegetation community
Drumbo	4	4-over 10 ha; 6-groundwater; 7-open water; 8-landform
Creditville	5	3- near designated habitat; 4-over 10 ha; 5-interior; 7-open water; 9-veg community
Vance	4	3-near designated habitat; 4-over 10 ha; 5-interior; 7-open water
Zenda	6	3-near designated habitat; 4-over 10 ha; 5-interior; 6-groundwater; 7-open water; 9-veg comm
McBeth	5	1-species at risk; 3-near designated habitat; 4-over 10 ha; 5-interior; 7-open water

Figure C.14 Location of County owned tracts in Oxford County



C.6.2 Meadows

The mapping of floodplain meadows and other meadows/pastures was carried out after woodland patch analysis was complete. As mentioned earlier, it would be beneficial to run the modeling again with the meadow communities added. In many cases, floodplain meadows connect woodlant patches, creating larger, continuous patches of green. This is excellent new data that did not exist before.

Table 9 below summarizes the extent of each meadow type. In total, meadows occupy about 1.8% of Oxford County, a significant percent when once considers there is only 13% forest cover. For the most part, thse meadows occur along watercourses, where flooding and ice scour keep tree growth out. These meadows are often long and sinuous, following meandering streams, and not present as large blocks of habita.

Additional analysis of this meadow data is needed to make full use of its potential. For example, it will be possible to measure how much of the watercourses have a buffer of meadow or forest. Up until this point, only wooded buffers along watercourses could be measured. This mapping will reveal where good buffers exist and where they do not.

Table C.9 Meadow Cover in Oxford County

Meadow Type	Area (ha)	Percent of Total Meadow	Percent of County*
Flooplain Meadow	2071.6	57.1	1.01
Meadow	421.9	11.6	0.21
Pasture **	146.8	4.0	0.07
Pasture or Floodplain Meadow	990.3	27.3	0.48
Total	**3630.6**	**100**	**1.77**

*Area of County is 204,987 ha. **Only pastures along watercourses were included.

Monarch Butterfly

C.7 Terrestrial Technical Guidance

1. Any natural patch meeting at least 1 criterion is contributing to an ecological landscape function and needs to be protected.
    - Each criterion reflects some aspect of habitat value and complexity. It is impossible to choose the 'best' criterion since they all measure something different.
    - Sustainable activities such as maple syrup production, foot trails, hunting, fishing, trapping and selective tree harvesting can continue.
    - There is concern about double counting if you take the approach that the vegetation patch has to meet more than one criterion to be significant.
    - It is likely that a number of relationships affect various components of a vegetation patch and therefore it is impossible to rank criteria against each other. Instead, the criteria are equally considered in the evaluation of a patch.
2. All natural patches left in the County should be maintained.
    - Each patch supports wild plants and animals to some extent and adds to the diversity of the County.
    - It is extremely costly to replant natural areas so it is best to preserve existing habitats.
    - It takes generations for forests to develop.
    - At 14.3% natural cover, Oxford County is far from the goal of 20 – 30% forest cover that ensures species survival.
    - That patches that do not meet a criterion be evaluated by an Environmental Impact Assessment to determine their significance at the site-specific level.
    - Examine the need to amend the Tree Cutting Bylaw to move away from Diameter Limit Cutting towards Basal Limit Cutting through sampling of Oxford's woodlands.
3. Natural cover should be increased to 20% (and an additional 10% into wetland / riparian cover) over the long-term
    - The scientific literature suggests regions with low natural cover may not have sustainable ecosystems. Plant and animal species may become locally or regionally extinct unless there is a minimum amount of natural cover.
    - Wildlife need to move between habitats. One habitat is not sufficient.
    - Water quality, air quality, groundwater quality, etc. cannot be maintained in regions devoid of natural vegetation. Climate change is also linked with a loss of forest cover.
    - Any new habitat is good. However, it may be best to target restoration projects around existing vegetation patches to bulk them up and increase forest interior.
    - Increasing natural cover will take generations, but it must start now.
    - For the patches that did not meet any criteria, they should be improved so that they meet at least one criterion. Develop a targeted restoration map for all natural features based on the eight criteria (e.g. focus restoration efforts in areas where a decrease in water quality has been identified, in headwater areas, etc).

4. That all Terms of Reference for Environmental Impact Assessments include: confirmation of the attributes and / or functions for which the candidate significant vegetation patch was designated, recognizing that the patches that have been designated have been done so through the use of a study that compares vegetation patch characteristics within the context of the County as a whole. When reviewing these characteristics in a patch by patch basis, the features of individual vegetation patch cannot be evaluated without returning to the County context for those features that depend on representation in the County.

5. That in five years a review be undertaken of the science: to ensure that it is still relevant.

6. That in five years a status report is prepared: that evaluates any changes to vegetation patch function in the intervening five years in terms of vegetation coverage, fragmentation, restoration or vegetation features.

7 That future work be funded to examine the meadow data: to determine percent of watercourses with meadow buffers, the degreee to which other vegetation community types are joined by meadow communities, etc. This will help target protection work and target areas without many meadows.

8 That sub watershed targets be developed for Oxford County such as: 30% natural cover (upland and lowland) per sub watershed, 10% forest interior (>100m from forest edge), 5% deep forest interior (>200m from forest edge), 75% riparian area (habitat adjacent to streams, creeks and drains at least 30m wide), 10% in wetlands.

Scarlet Tanager

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Appendix D. Aquatic Resources

D.1 Purpose

The purpose of the aquatic component of the ONHS was to inventory and evaluate the current conditions of the aquatic ecosystems such as rivers, streams, and drains within Oxford County. Additional rationale for completing an aquatic component of the ONHS was to determine whether current conditions meet their potential, to propose rehabilitation or restoration measures where appropriate, to conserve and protect significant aquatic resources, and to collect baseline data to allow monitoring of ecosystem changes throughout the County.

Coldwater Stream

D.2 Defining Scope of Study

For the purposes of this study, aquatic ecosystems are defined as watercourses which include streams, rivers, creeks, and open drains. Watercourses have been characterized as a depression that has flowing water all or part of the year. A watercourse conveys water and this flowing water carries food, sediment, nutrients, and debris. Many watercourses may be dry or reduced to standing pools of water during dry periods of the year and especially during periods of drought

Watercourses provide habitat for aquatic and semi-aquatic species such as fish, reptiles, amphibians, birds, mammals, plants, and insects. Habitat can take the form of water itself, the river bottom, land surrounding it, in-stream vegetation and overhanging vegetation. This habitat supports all the life stages of aquatic species and some of the stages of semi-aquatic species. Watercourses provide habitat for feeding, cover to escape predation, areas to reproduce, and migration routes. Watercourses also provide travel corridors for many terrestrial species.

Watercourses are complex systems that are influenced by the floodplain (surrounding land), the substrate (rocks, cobble, clay, sand, and silt), the channel itself, water flow, water temperature, and several other factors. All of these factors combined help determine the type of aquatic community that is present For example, coldwater systems support organisms that require cool temperatures and relatively high dissolved oxygen levels, while warmwater systems support organisms tolerant of higher water temperatures and lower oxygen levels. Generally speaking the more complex and less impacted systems support sensitive or significant species such as federally designated Species at Risk (SAR), and gamefish such as trout, pike, and bass.

D.3 Methodology

In developing the aquatic component of the ONHS, an Aquatic Technical Team (ATT) was formed to guide the direction of the study. It was determined that the ATT would concentrate on open watercourses, compile background information, fill data gaps, report on the current conditions, and provide recommendations to maintain and enhance the aquatic environment.

The ATT decided that standardised protocols would be followed in order to maintain consistency of information across federal and provincial agencies. These protocols included the Ontario Stream Assessment Protocol (OSAP), the Ontario Benthic Biomonitoring Network (OBBN), and the Municipal Drain Classification Project (MDC).

The ATT prepared several documents to assist in developing the OHNS. These include an ONHS ATT Terms of Reference, ONHS ATT Significance Criteria, ONHS ATT Aquatic Ecosystem Background Data Assimilation, Compilation, Current Assessment and Methodology, and the ONHS ATT Categorization of Aquatic Ecosystems. These documents are available from the ATT.

D.3.1 Background Data Collection and Assimilation

Historic and more recent fish and habitat data for Oxford County was collected from the various agencies including conservation authorities, Fisheries and Oceans Canada (DFO) and Ontario Ministry of Natural Resources (MNR) offices. After the information was compiled and assessed, data gaps were identified for further investigation.

D.3.2 Field Investigations

The ATT agreed that field investigations were required to further assess areas where current or recent information was lacking. UTRCA staff completed field surveys which included qualitative habitat assessments and fish sampling.

The Municipal Drain Classification (MDC) protocol was used to assess the current habitat conditions. The Ontario Benthos Biomonitoring Network (OBBN) protocol was followed to collect more detailed habitat information. The Ontario Stream Assessment Protocol (OSAP) guided the fish community sampling.

D.3.3 Data Management and Maintenance

All data gathered was compiled in a Microsoft Access database and transferred to a Geographical Information Systems (GIS) application. Conveniently, the MDC already provided the database and GIS application to house the current data collected in one location

Developing Categories of Aquatic Ecosystems

Initially, the Aquatic Technical team was following the direction of the Terrestrial team and formulated eight criteria to determine watercourse significance (see Table D-1). The criteria focused on the many functions and features of an aquatic ecosystem.

However, it was quickly evident that all watercourses met some or all of these criteria, so a different approach was needed for the aquatic component. The team proceeded with collecting information on the aquatic resources of the County and categorizing watercourses in a way that was more tangible and lent itself to structuring remedial work.

Table D-1. Aquatic Significance Criteria

1.	**Habitat** – Fish habitat, as defined in the Fisheries Act, means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes. The fish habitat definition can be expanded upon to incorporate aquatic and semi-aquatic species habitat. Therefore an inclusive definition of habitat is: Habitat means spawning grounds and nursery, rearing, food supply and migration areas on which aquatic and semi-aquatic species depend directly or indirectly in order to carry out their life processes.
2.	**Stream Morphology** – fluvial geomorphic processes, hydrologic functions, baseflow contributions, storage capacities, conveyance
3.	**Corridors** – provide access to spawning grounds and refuge areas; are migration routes
4.	**Cold/Cool Water** – thermal regime (water temperature), indicator species
5.	**Flow Regime** – permanent, intermittent or ephemeral
6.	**Sensitive Species** – do not respond well to habitat alterations, disruptions or destructions (HADDs); include species at risk (SAR), top-level predators, and sportfish, support a fishery
7.	**Fish/Aquatic Community** – fish have been define in the Fisheries Act to include parts of fish, shellfish, crustaceans, marine animals and any part of shellfish, crustaceans or marine animals; the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and fish habitat.
8.	**Hydrology** – hydraulics and hydrologic function; influence the hydrograph

The team then identified the need to define a system of categorizing watercourses suited to the purposes of this study. The team agreed they would build upon existing and standardized approaches, but enhance it for the ONHS.

D.3.4 Municipal Drain Classification Project

The team then identified the need to define a system of categorizing watercourses suited to the purposes of this study. The team agreed they would build upon existing and standardized approaches, but enhance it for the ONHS.

The municipal drain classification project (MDC), the Natural Heritage Reference Manual for Policy 2.3 of the Provincial Policy Statement and the Fish Habitat Protection Guidelines for Developing Areas provided the basis for categorizing the watercourses in Oxford because they are federal and provincial initiatives and aid in providing consistency between agencies.

The Ontario Ministry of Natural Resources (OMNR) prepared a Natural Heritage Reference Manual in 1999 and the Fish Habitat Protection Guidelines for Developing Areas in 1994. These two documents differentiate between 3 Types of fish habitat and these two documents provided guidance in categorizing watercourses for the OHNS.

The Municipal Drain Classification Project (MDC) provided current watercourse information for much of the County and a framework for organising this information and categorising aquatic ecosystems. The Department of Fisheries and Oceans Canada (DFO) federally funded the MDC, and all Conservation Authorities in Southwestern Ontario have completed this initiative. All data gathered through the MDC is stored and maintained in a standardised database at each CA. The data stored in the MDC database is linked to GIS. Although the MDC was designed specifically for municipal drains, it allows for the incorporation of data on natural or non-municipal drains.

Currently the MDC has six classifications based on permanence of flow, water temperature or thermal regime, fish species, and the time since major drain maintenance had occurred. For this study the classification system was extended beyond municipal drains to include natural watercourses, and the number of categories was reduced to three.

Simply put, more sensitive or complex systems with permanent flow were placed in one category called System Type 1, less sensitive systems with permanent flow were place in another category called System Type 2, and watercourses with intermittent flow were placed in the final category called System Type 3.

The three categories defined give a general overview of the current aquatic ecosystem conditions found throughout the County. They also allow for the development of general recommendations and management prescriptions for these categories. For example, System Type 1 streams have significant or sensitive features that need to be protected and conserved, while System Type 2 and 3 streams may be targeted for remedial activities.

Several components were used to develop the MDC classifications and were also used to create the categories of watercourses for the ONHS. These components include Species at Risk (SAR), fish community, aquatic and semi aquatic species, habitat, thermal regime/water temperature, permanent flow and the municipal drain classification. Table D-2 summarizes the results of the categorization exercise. The three system types are described by component.

Additional aquatic and semi-aquatic species such as mussels and plants are included in the system types; however, in the future these species may have additional considerations which could alter the category that they are currently found in.

The categories currently do not contain components for threats and issues such as invasive species, and dams or barriers. Water quantity and water quality components were not included as component of the system types. In the future, these will be given further consideration for incorporation into the system types of watercourses for the purpose of Oxford Natural Heritage features. Table 10 summarizes the results of the categorization exercise. The three system types are described by component.

Table D-2. Aquatic Categories Component Summary

Components	System Type		
	1	2	3
Species at Risk	Schedule 1 Threatened or Endangered (COSEWIC Status)	Other than Schedule 1 Threatened or endangered	NA
Fisheries	Sportfish / top predators / salmonids, sensitive and indicatory species, their surrogates/indicator species, and their habitat or spawning areas	With or without fish	With or without fish when inundated with water (may only be seasonally)
Species	Indicator species sensitive to habitat alteration, disruption or destruction, and cold/cool water	Resilient to habitat alteration, disruption or destruction	Ephemeral
Habitat	Identified to support Sportfish / top predators / salmonids, sensitive and indicator species as well as SAR. Complex, natural, or diverse habitat Supports significant areas that provide the life requirements of aquatic species	Supports species not identified in the first category Provides the life requirements of aquatic species	- Seasonally supports aquatic and semi-aquatic species when wet. - Provides cover and corridors and food source for terrestrial species - Provides the life requirements of aquatic and semi-aquatic species - Provides corridors for aquatic, semi-aquatic and terrestrial species (i.e.: migratory species, spawning areas)
MDC Classifications	A, B, E , & D	C	F
Thermal Regime	Warm, cold/cool	Warm	NA
Permanency	Permanent, or if intermittent based on spawning areas or critical habitat	Permanent, or Standing/Pooled water	Intermittent or Ephemeral

D.4 Results and Findings

This inventory provided current information on the aquatic systems within Oxford County. The information collected determined the current condition of the aquatic ecosystems to contain very productive and diverse aquatic communities. A significant proportion of southwestern Ontario's trout streams occur in Oxford. The County's watercourses also support many fish and freshwater mussel species at risk. However, there are many watercourses that could benefit from remedial work to make them more productive and thus support a greater diversity of aquatic life.

The ATT developed the criteria for defining the significance of the aquatic ecosystems, conducted field surveys, analyzed the results, and provided general recommendations for managing the aquatic ecosystems.

After the background data was compiled, it was evident that approximately 170 sites in Oxford County required further investigation. Of those, 80 fish community samples were completed. Table D-3 lists the fish species found throughout Oxford County

Central Stoneroller

Table D-3. Fish Species Sampling Summary – Oxford County

Species	Scientific Name	COSEWIC Status
American Brook Lamprey	Lampetra appendix	
Black Bullhead	Ameiurus melas	
Black Redhorse	Moxostoma duquesnei	THR
Blackchin Shiner	Notropis heterodon	
Blacknose Dace	Rhinichthys atratulus	
Blacknose Shiner	Notropis heterolepis	
Blackside Darter	Percina maculata	
Bluegill	Lepomis macrochirus	
Bluntnose Minnow	Pimephales notatus	
Brassy Minnow	Hybognathus hankinsoni	
Brook Stickleback	Culaea inconstans	
Brook Trout	Salvelinus fontinalis	
Brown Bullhead	Ameiurus nebulosus	
Brown Trout	Salmo trutta	
Central Mudminnow	Umbra limi	
Central Stoneroller	Campostoma anomalum	
Common Carp	Cyprinus carpio	
Common Shiner	Luxilus cornutus	
Creek Chub	Semotilus atromaculatus	
Emerald Shiner	Notropis atherinoides	
Fantail Darter	Etheostoma flabellare	
Fathead Minnow	Pimephales promelas	
Golden Redhorse	Moxostoma erythrurum	
Golden Shiner	Notemigonus crysoleucas	
Greater Redhorse	Moxostoma valenciennesi	
Green Sunfish	Lepomis cyanellus	
Greenside Darter	Etheostoma blennioides	SC
Hornyhead Chub	Nocomis biguttatus	
Iowa Darter	Etheostoma exile	
Johnny Darter	Etheostoma nigrum	
Largemouth Bass	Micropterus salmoides	
Least Darter	Etheostoma microperca	
Longear Sunfish	Lepomis megalotis	
Longnose Dace	Rhinichthys cataractae	
Mimic Shiner	Notropis volucellus	
Mottled Sculpin	Cottus bairdi	
Northern Brook Lamprey	Ichthyomyzon fossor	SC
Northern Hog Sucker	Hypentelium nigricans	
Northern Pike	Esox lucius	
Northern Redbelly Dace	Phoxinus eos	
Pearl Dace	Margariscus margarita	
Pumpkinseed	Lepomis gibbosus	
Rainbow Darter	Etheostoma caeruleum	
Rainbow Trout	Oncorhynchus mykiss	
Redfin Shiner	Lythrurus umbratilis	
River Chub	Nocomis micropogon	
Rock Bass	Ambloplites rupestris	
Rosyface Shiner	Notropis rubellus	
Shorthead Redhorse	Moxostoma macrolepidotum	
Silver Shiner	Notropis photogenis	SC
Smallmouth Bass	Micropterus dolomieu	
Spotfin Shiner	Cyprinella spiloptera	
Stonecat	Noturus flavus	
Striped Shiner	Luxilus chrysocephalus	
White Crappie	Pomoxis annularis	
White Sucker	Catostomus commersoni	
Yellow Perch	Perca flavescens	

COSEWIC Status: Status assigned by the Committee on the Status of Endangered Wildlife in Canada.
THR Threatened. A species likely to become endangered if limiting factors are not reversed.
SC Special Concern. A species of special concern because of characteristics that make it particularly sensitive to human activities

D.5 Summary of System Types and Recommended Actions

Table D-4 below summarizes the three system types and their attributes. Table D-5 summarizes the percentage of Oxford's watercourses that fall under each system type. Figure D-1 maps the system types for the County.

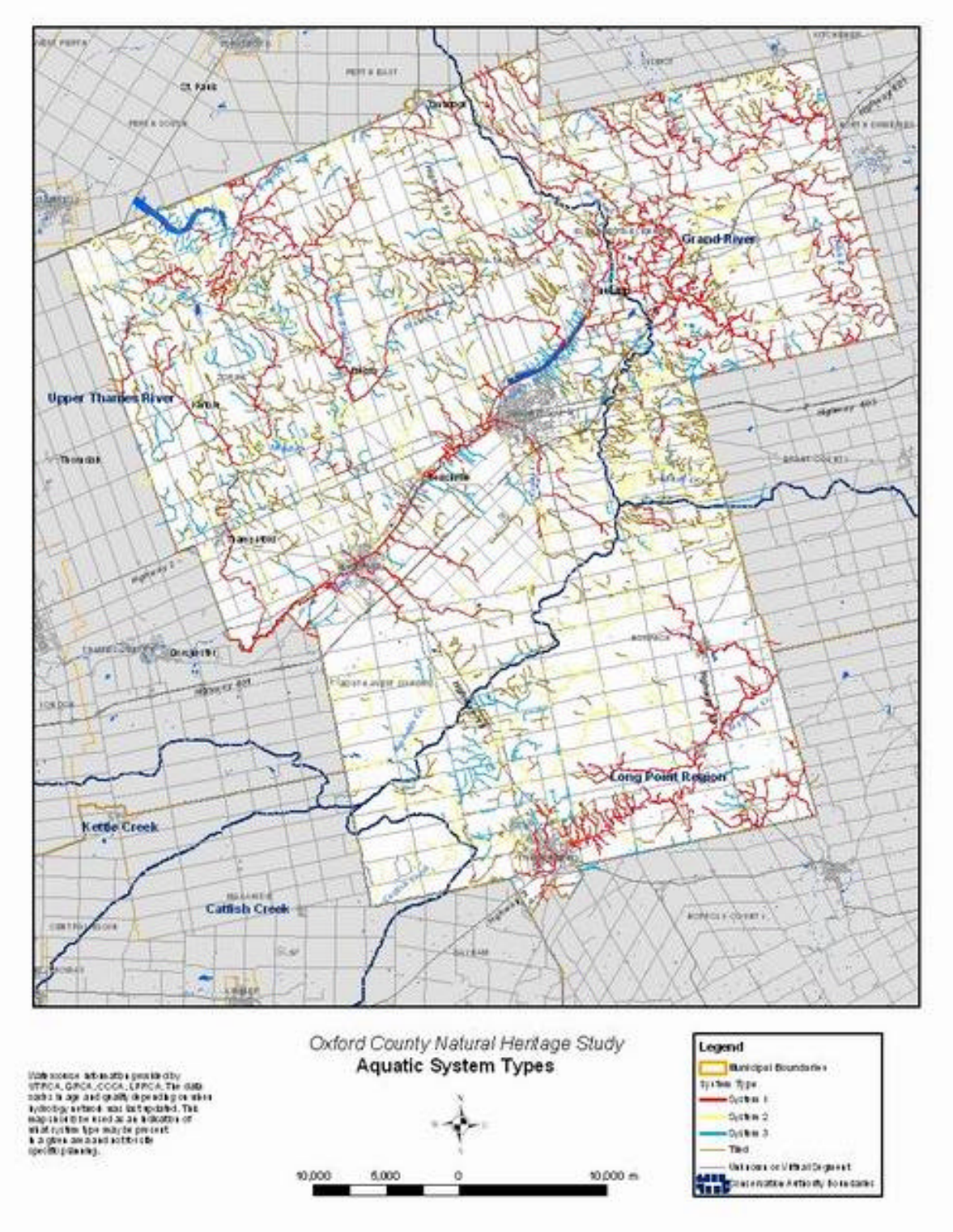
Table D-4. Summary of Categories of Watercourses

System Type	Species Supported	Flow	Temperature	Recommended Action
1	Sensitive or significant species: Species at risk, top level predators, sportfish, sensitive species or the habitat to support these species	Permanent	Warm or cold/cool water	Conserve, Protect, and Enhance
2	Baitfish, species resilient to change	Permanent	Warm water	Conserve, Rehabilitate, Enhance, and Restore
3	Seasonally accessed by aquatic species	Intermittent or ephemeral	Warm water	Conserve, Rehabilitate, Enhance and Restore

Table D-5. Percentage of Watercourses in Oxford under each System Type

System Type	Percent of Watercourses in Oxford
1	50
2	31
3	19

Figure D-1. Aquatic System Types for Oxford County



D.7.1 System Type 1

Sensitive or significant species such as species at risk, trout, pike, and bass are generally found in this category. These species have very specific habitat requirements, and are easily affected by a change in habitat such as change in temperature, pollution, loss of spawning grounds, and lack of food source.

Generally speaking, system type 1 can be considered to be the most desirable of the 3 system types. These watercourses should be conserved, protected, and enhanced when possible. Not all watercourses can become this, nor should they be expected to be.

D.7.2 System Type 2

Generally speaking, system type 2 is considered a permanent watercourse either with water flowing in it all year, or with pools of standing water year round. The fish species found in this category are usually referred to as baitfish. Baitfishes include minnows, suckers, darters, and many others. These species can withstand changes in habitat and might be able to spawn in more areas. These species can be found in almost all habitats. All watercourses in this category are warmwater, which means that they have an average temperature of greater than 25^{o}C.

With rehabilitation and restoration efforts some of these systems could become type 1's, although there is not an expectation that they all would. They are often fairly productive and diverse ecosystems.

D.7.3 System Type 3

This category has been presumed to be less important as these watercourses generally carry water only during rain events or after the snowmelt or spring runoff. They are considered to be intermittent or ephemeral systems because they do not have water in them year round.

These systems are very important for transporting sediment and nutrients downstream. Seasonally they provide habitat for fish and other species such as frogs, insects, and other amphibians. There is the potential for species such as pike to migrate to these areas to spawn and reproduce. These also provide food (e.g. frogs, crayfish, and larval insects) for other wildlife such as waterfowl. Many species have adapted to make use of this type of habitat (e.g. some invertebrates migrate downstream to find water or have terrestrial life stages during dry periods).

Several of these watercourses could become type 2 or even type 1 watercourses if rehabilitation or restoration efforts were employed, however it is not expected that they all could.

D.6 Aquatic Technical Guidance

The following reflect the need to protect and improve the health of Oxford's watercourses and are based on a sound understanding of the conditions, justified through science, considered best management practices, and in consistency with other agencies and organisations.

1. Protect, enhance and restore stream buffers

- *What:* A buffer is a swath of vegetated land on either side of a watercourse, also called a vegetated riparian buffer. A buffer can consist of any permanent vegetation such as trees, shrubs, grasses, wildflowers or forage crops. Current guidance from federal and provincial agencies should be followed when deciding on a minimum size of buffer width. Generally speaking, this recommendation is a minimum width of 15 to 30 metres on both sides of the watercourse (and research indicates that this may increase to 50 m).
- *Benefits:* Vegetated riparian buffers shade and cool water, filter pollutants in runoff, nutrient source, stores flood water and allows infiltration into the ground, improves flood connectivity, acts as a wildlife travel corridor
- *Examples:* Where natural vegetation along a watercourse does not exist, it can be planted. Appropriate native species should be used. Permanent forage crops can also be planted, as long as they are not tilled. The land can also be retired, allowing wildflowers and grasses to grow up naturally.
- Need an approach to achieve the ultimate goal and decide on timelines for completion.

2. Protect and imporve stream habitat

- *What:* Natural habitats usually consist of riffle/pool sequences and have diverse substrates (cobble, rocks, sand, gravel, clay). Streams have natural meander patterns which migrate over time.
- *Benefits*: diverse and productive self-maintaining aquatic communities, provides oxygen to the water.
- *Examples*: Can be achieved through passive means, by leaving the watercourse alone or aggressive means by physically manipulating and adding habitat through the construction of vortex weirs, rocky riffles and stream bank bioengineering.
- Natural channel design: Self maintaining to carry the sediment load

3. Control sediment inputs and siltation

- *What:* Urban and rural sources of nutrients, contaminants and sediment.
- *Benefits*: improved water quality and stream habitat
- *Examples*: conservation tillage, grassed waterways, sediment and erosion control, and storm water management

4. Protect and enhance water quality and quantity

- Reduce pollution sources, protect natural flows, increase water storage capacity and sustain base flow
- *Examples:* storm water management, nutrient and waste management, wetland restoration, barrier mitigation and removal

- **5. Continuous Monitoring**

  Continuous monitoring stations are necessary to track and compare results, measure success, monitor trends especially in the long term. There is also a need to monitor for the presence of indicator or sensitive species as these species inform us of the overall health of the system, to fill data gaps and supplement information such as habitat or

geomorphic analysis. This information should be fedback into the system to respond to the results, and be based on current information. Allows for the adjustment of programs and practices as necessary and aids in determing whether goals and objectives have been achieved.

Considerations: to monitor on an area where implementation activities will be concentrated as a means to measure success

- Monitor benthic, water quality, fish community, habitat, temperature, flow, and additional aquatic components
- Develop a continuous monitoring program that is long term, tracks biodiversity and health to determine whether the goals and objectives of the ONHS are being fulfilled. Long term monitoring is also needed to discount the short term affects of droughts or floods or long term climate changes.

- **6. Apply adaptive management**
  - Regularly assess conditions to determine success and effectiveness of projects and adjust programs accordingly
  - Due to unpredictable nature of restoration and conservation management strategies and policies must be flexible and adaptive to accommodate new knowledge and insights

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Appendix E. Benthic Water Quality

E.1 Background

Benthic macroinvertebrates (BMI) are bottom dwellinginsects and other small organisms that live in rivers, streams and lakes. They include the larval and adult stages of beetles,aquatic worms, dragonflies, damselflies, leeches, stoneflies, caddisflies, crustaceans, and mayflies. Generally speaking the BMI are abundant in most stream substrates and have fairly well known tolerances to pollution and habitat disturbances. They also provide a long term assessment of water and habitat quality as most are relatively sedentary, spend all or most of their lives in their aquatic environment and have life spans that last most of the year (or more). BMI are collected because they are relatively easy to sample and can be reliably identified at least to taxonomic levels suitable for monitoring purposes.

E.1.1 Background Data Collection and Assimilation

Historic benthic data for Oxford County was collected from conservation authorities and Ontario Ministry of Natural Resources (MNR) offices. After the information was compiled and assessed, data gaps were identified for further investigation.

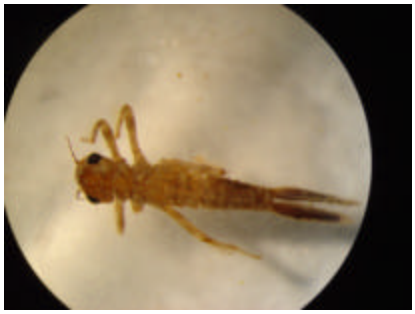
E.1.2 Field Investigations

The Aquatic Technical Team agreed that additional benthic monitoring and a current benthic assessment were required to compliment the water quality information. The Ontario Benthos Biomonitoring Network (OBBN) protocol was followed to collect benthic information and more detailed habitat information. The Ontario Stream Assessment Protocol (OSAP) also contains the procedure to collect and analyse the benthic community.

27 benthic samples were collected in the summer and fall of 2005 and these samples were analysed during the following winter months. Benthic samples were collected at the same sites as the Provincial Water Quality Monitoring Network (PWQMN), and additional samples were taken throughout the County to provide graphically distributed baseline data.

E.1.3 Data Management and Maintenance

All data gathered was compiled in a Microsoft Access database. The OBBN provides the database to house the current data collected through a web application.



Damselfly

E.2 Results and Findings

Results of the benthic analysis is summarised in Table E-1. The range of results of the benthic samples vary from excellent to fairly poor. Further investigation would be required to evaluate the indication of water quality in these streams. Future monitoring would also provide an indication of trends throughout the County.

Table E-1. ONHS Benthic Water Quality Sampling Summary

Conservation Authority	STREAM NAME	LOCATION	DATE	Family Biotic Index (FBI) Value	
Catfish Creek	Catfish Creek	College Line	10/31/2005	5.9214	Fairly Poor
Grand River	Alder Creek	Oxford Road 8	11/21/2005	4.8694	Good
	Horner Creek	Oxford Road 2 d/s bridge	10/26/2005	4.1032	Excellent
		MacGee Farm	10/13/2005	5.4505	Fair
		Oxford Road 8, West of Bright	10/26/2005	4.7817	Good
	Kenny Creek	Muir Road, South of Old Stage Road	10/26/2005	5.1921	Fair
	Nith River	U/S of Canning, Canning Rd, S. Twn Rd 3	10/26/2005	4.1827	Excellent
		Blenheim Road, North of Township Road 8	10/26/2005	3.9835	Excellent
		River Road, N. Plattsville	10/26/2005	5.0161	Fair
	Wilmot Creek	Oxford Road 42	10/26/2005	5.4176	Fair
	Washington Creek	Oxford Rd. 3, South of Washington	10/26/2005	6.4607	Fairly Poor
Long Point Region	Otter Creek	Bayham Road	10/31/2005	5.7862	Fairly Poor
		Rock's Mill New Road	10/31/2005	5.3211	Fair
		Maple Dell Road	10/26/2005	5.3582	Fair
		Evergreen Road	10/26/2005	6.8209	Poor
	Spittler Creek	Milldale Road	10/26/2005	5.6935	Fair
		Airport Road, Hwy 19	10/31/2005	6.5433	Poor
		Brownsville Road	10/31/2005	7.1818	Poor
Upper Thames River	Cedar Creek	Westend Park, Woodstock	5/18/2005	7.1004	Poor
	Middle Thames River	3 KM south of Thamesford	6/3/2005	5.7630	Fairly Poor
		Cty Rd 6 south of Embro	5/18/2005	5.9246	Fairly Poor
	Nissouri Creek	West of Embro	5/18/2005	5.0277	Fair
	Reynolds Creek	South of Putnam	6/3/2005	6.0507	Fairly Poor
	South Thames River	at Innerkip	5/18/2005	5.4907	Fair
			10/19/2005	5.3578	Fair
		South of Tavistock	5/18/2005	6.0178	Fair
		Downstream of Ingersoll	6/3/2005	7.3580	Very Poor
	Trout Creek	Below junction of main tributaries	5/26/2005	6.2078	Fairly Poor

Biotic indices are values assigned to benthic invertebrate taxa indicating their pollution sensitivity and tolerance on a scale from 0 to 10. Lower numbers indicate pollution sensitivity and high numbers tolerance. The Family Biotic Index (FBI) is the weighted average of the biotic index and number of bugs in each taxon in the sample. The water quality ranges for the FBI values are as follows: <4.25 = Excellent; 4.25-5.00 = Good; 5.00-5.75 = Fair; -5.75-6.50 = Fairly Poor; 6.50 – 7.50 = Poor; >7.50 = Very Poor.

E.3 Recommendations

The recommendations for the benthic monitoring are the same as those suggested for the Aquatic Resources in Appendix D. More emphasis would be placed on the continuous monitoring and adaptive management recommendations.

The information collected provides baseline data on aquatic ecosystems through a well distributed monitoring network in Oxford County. Further monitoring will allow for the assessment of changes over time, the evaluation of protective and remedial efforts and the recommendations for adaptive management.

Appendix F. Water Chemistry

F.1 Background

Since 1964, watercourses in Oxford County have been monitored for water quality as part of the Provincial Water Quality Monitoring Network (PWQMN) of the Ontario Ministry of the Environment (MOE). While there have been numerous other short term studies in Oxford that have involved site specific watercourse monitoring, this report focuses on the more comprehensive PWQMN data. The objectives of this monitoring program are to assess broad scale water quality trends, determine the general location and causes of water quality problems, and measure the effectiveness of broad pollution control water management programs

The long term nature of this data gives a valuable assessment of trends in Oxford County water quality over the past 40 years. There are currently 12 sites monitored in Oxford County which fall within the watersheds of the Upper Thames River, Grand River and Long Point Region Conservation Authorities (see Figure 1).

This chapter summarizes water quality results for the PWQMN data as well as current bacteria monitoring data collected as a partnership with the Ministry of Health at sites in the Upper Thames River watershed. These programs are not funded by the County.

F.2 Sampling Methods and Analysis

Under the PWQMN, eight samples per year are taken at each site in the ice-free months. An attempt is made to sample during a variety of stream conditions including storm events when most pollutant delivery occurs. PWQMN samples are analysed for 37 parameters at the Ontario Ministry of the Environment lab in Etobicoke. The bacteria samples are analysed at the Regional Health Lab in London, Ontario.

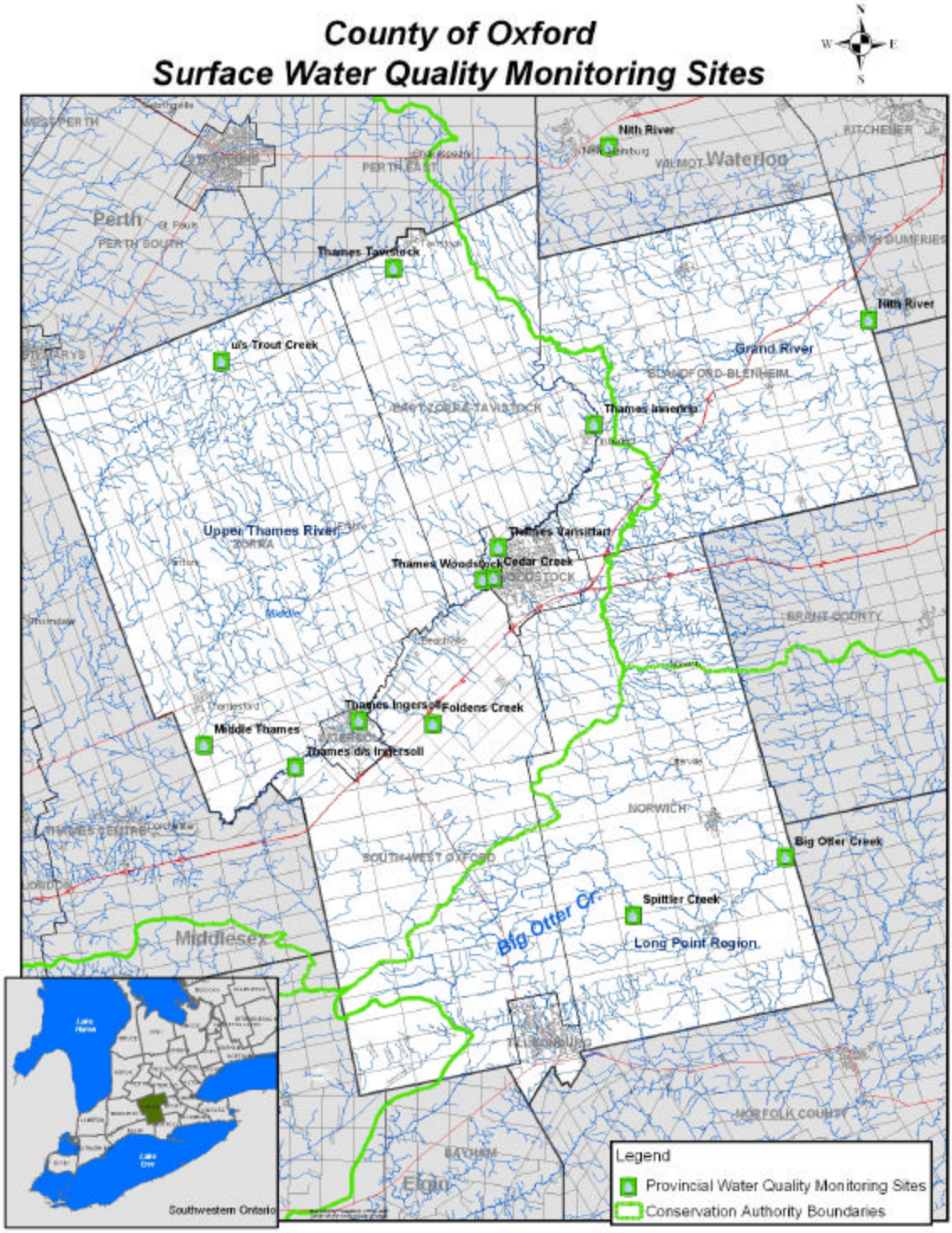
F.3 Findings

The results of six key parameters that reflect land use activities and relate to aquatic health are summarized in the sections below. The six parameters include: total phosphorus, nitrate, chloride suspended solids, bacteria and copper.

Figures 1 through 5 show the 75^{th} percentile for each five-year block of data for the years sampled. Figure 6 shows the geometric mean for each five year block of bacteria data. Sampling data tends to be dry weather biased and using 75^{th} percentiles (i.e. 75% of sample results are less than this value and 25% are higher) more accurately reflects true contaminant concentrations than by using average value. Results for current sites as well as several discontinued long-term sites are summarized below.

The nature of pollutant levels in water samples tends to be quite variable year to year, often as a result of weather conditions and changing activities on the land. This variability is seen in the data as shown in the graphs that follow.

Figure 1. Location of the 12 monitoring sites in Oxford County.



F.4 Total Phosphorus

***Fate and Behavior**:* While phosphorus is an essential nutrient for plant and animal life, excess phosphorus loading can result in significant increases in plant growth. Phosphorus is not directly toxic to aquatic life but elevated concentrations can lead to undesirable changes in a watercourse including reduced oxygen levels, reduced biodiversity, and toxic algae blooms which can be a health risk in recreational water and drinking water sources.

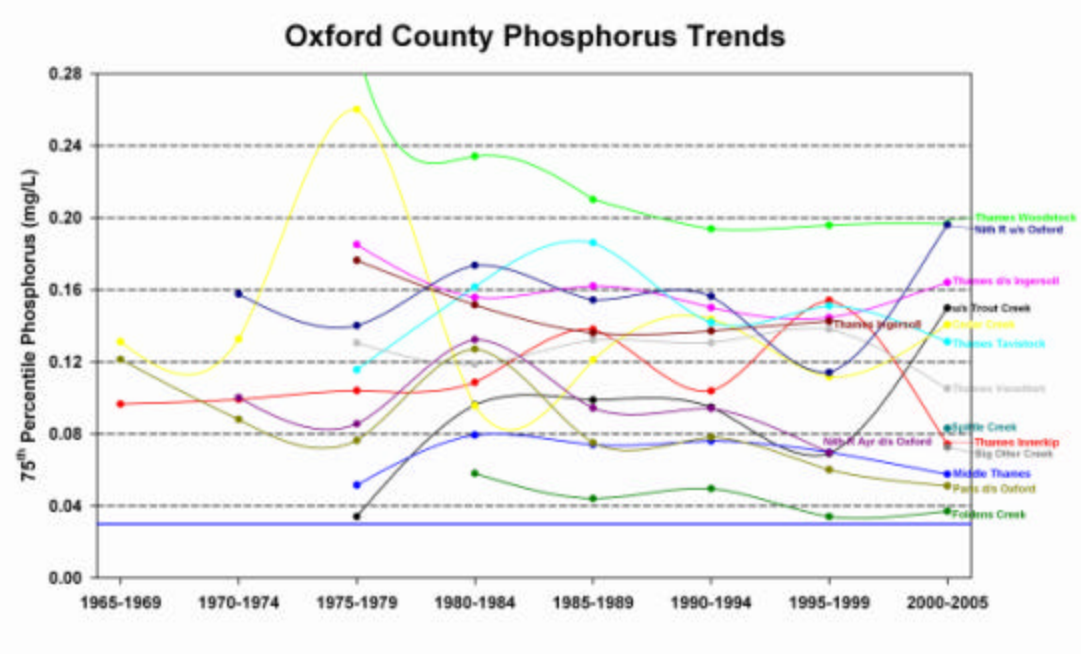
Sources: Phosphorus sources include commercial fertilizers, animal waste, domestic and industrial wastewater, including soaps and cleaning products. Phosphorus binds to soil and is readily transported to streams with eroding soil.

***Standards**:* Ontario's interim Provincial Water Quality Objective is 30 micrograms/L total phosphorus to prevent the nuisance growth of algae. There is no Ontario Drinking Water Standard.

Monitoring Results: Concentrations of total phosphorus routinely exceed the Provincial Objective for the protection of aquatic life at all sites in Oxford County

- Graph below shows, top to bottom: Thames Woodsotck, Nith R upstream of Oxford, Thames downstream of Ingersoll, upstream of Trout Cr., Thames Ingersoll, Cedar Cr., Thames Tavistock, Thames Vansittart, Spittler Creek, Thames Innerkip, Big Otter Cr, Middle Thames, Paris downstream of Oxford, Foldens Cr
- For many sites, phosphorus concentrations have shown little change since the 1970's. The exception is the Thames at Woodstock and Cedar Creek where large reductions in phosphorus occurred in the 1970's.
- Highest current levels of phosphorus (4 to 6 times the Provincial Objective) are at the following sites: Thames at Woodstock, Nith River upstream of Oxford, Thames downstream of Ingersoll, Trout Creek, Cedar Creek and Thames at Tavistock.
- Recent changes seen at the Nith R upstream of Oxford and Trout Cr with phosphorus levels doubling in recent years while the Thames at Innerkip has decreased by half.

Figure 1. Phosphorus Trends

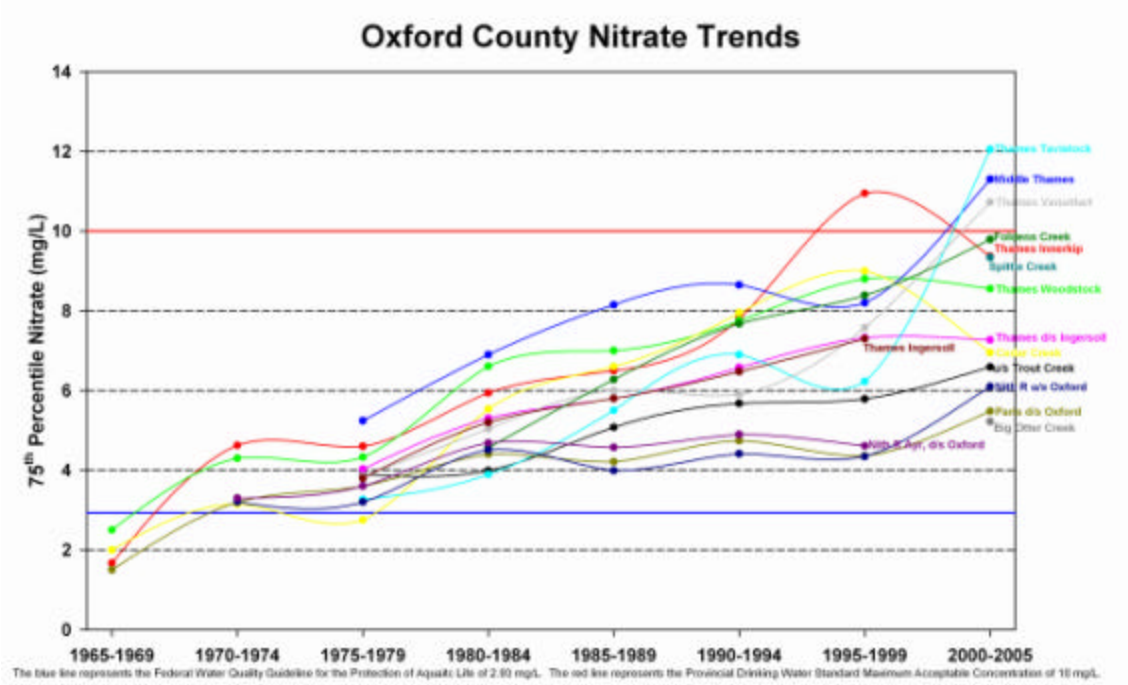


F.5 Nitrate

Fate and Behaviour: Nitrate is a nutrient that does not adsorb to sediment and moves readily through surface runoff to streams and through soil into groundwater. Elevated levels in a watercourse can be toxic to aquatic organisms, especially amphibians. A condition called blue baby syndrome can result from young children drinking water with elevated nitrates.
Sources: Nitrate sources include animal waste, commercial fertilizers, municipal waste water and septic systems, and atmospheric deposition.
Standards: The Ontario Drinking Water Standard for nitrate is a maximum acceptable concentration of 10 mg/L. The Province does not have an objective for aquatic life but the Canadian Environmental Quality Guideline to protect aquatic life from direct toxicity is 2.93 mg/L.
Monitoring Results: Since the 1960's nitrate levels at all long-term monitoring sites in Oxford County have shown a continual increase. This is a trend seen province-wide. Only the Thames at Innerkip and Cedar Creek have shown improvements in recent years.

- Graph below shows, top to bottom: Thames Tavistock, Middle Thames, Thames Vansittart, Foldens Cr, Thames Innerkip, Spittler Creek, Thames Woodstock, Thames downstream Ingersoll, Cedar Cr, Thames Ingersoll, upstream Trout Cr, Nith upstream Oxford, Paris downstream Oxford, Big Otter Cr, Nith R Ayr downstream Oxford
- Concentrations of nitrate routinely exceed the Canadian Guideline (CCME) for the protection of aquatic life at all sites in Oxford County. The majority of sites have nitrate levels below the Ontario Drinking Water Standard.
- Highest current levels of nitrate (3 to 4 times the federal aquatic life guideline) are at the following sites: Thames at Tavistock, Middle Thames, Thames at Vansittart in Woodstock, Foldens Creek, Thames at Innerkip and Spittler Creek.

Figure 2. Nitrate Trends



F.6 Chloride

Fate and Behaviour: Chloride moves easily with water and persists in the river system. Nearly all chloride added to the environment will eventually migrate to surface or groundwater. Chloride can be toxic to aquatic organisms at high concentrations, and affects growth and reproduction at lower concentrations.

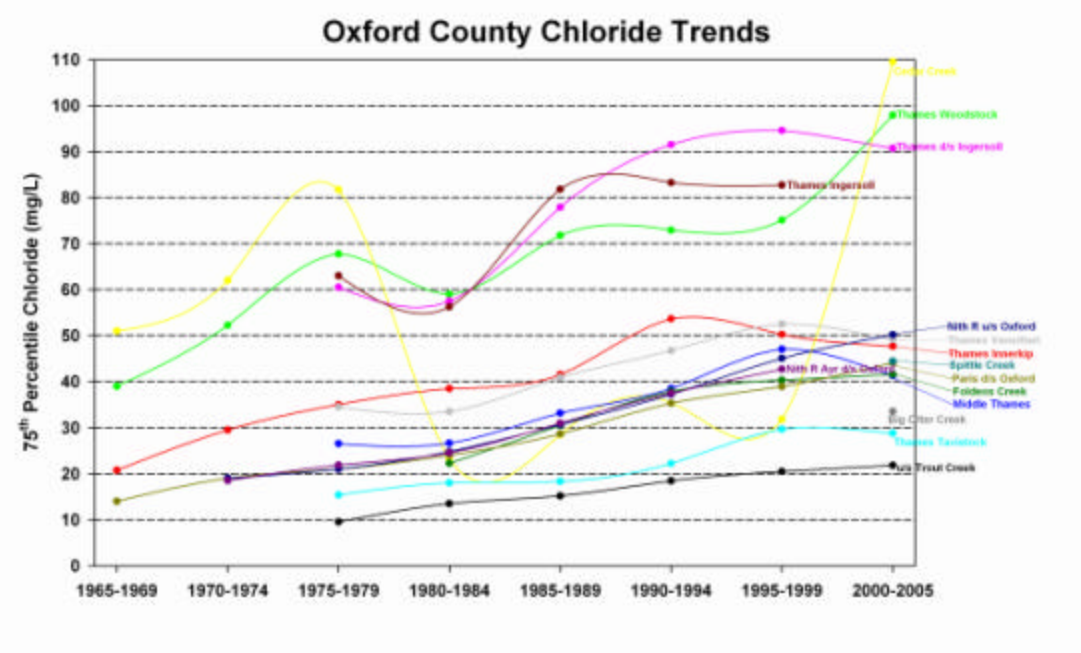
Sources: The highest loadings of chloride are typically associated with the application and storage of road salt (e.g. calcium chloride). Urban streams tend to have the highest chloride concentrations.

Standards: The Ontario Drinking Water Standard (aesthetic objective) is 250 mg/L. Ontario does not have a Provincial Water Quality Objective for aquatic life. An Environment Canada/Health Canada assessment report (2001) documents toxicity for sensitive aquatic species at 210 mg/L. British Columbia recommends a guideline of 600 mg/L for acute exposure and 150 mg/L (30 day average) for chronic exposure to protect sensitive aquatic species.

Monitoring Results: Since the 1960's and 1970's chloride levels at all long-term monitoring sites in Oxford County have shown a continual increase but concentrations remain below drinking water and aquatic health toxicity levels. This increasing trend is occurring across the Province. Most Oxford sites have doubled their concentration of chloride over this time period.

- Graph below show, top to bottom: Cedar Cr, Thames Woodstock, Thames d/s Ingersoll, Thames Ingersoll, Nith u/s Oxford, Thames Vansittart, Spittler Creek, Nith R Ayr, Paris d/s Oxford, Foldens Cr, Middle Thames, Big Otter Cr, Thames Tavistock, us Trout Cr
- Highest current levels of chloride are at Cedar Creek, Thames at Woodstock, and Thames downstream of Ingersoll. In recent years Cedar Creek has had a major increase in chloride levels.

Figure 3. Chloride Trends

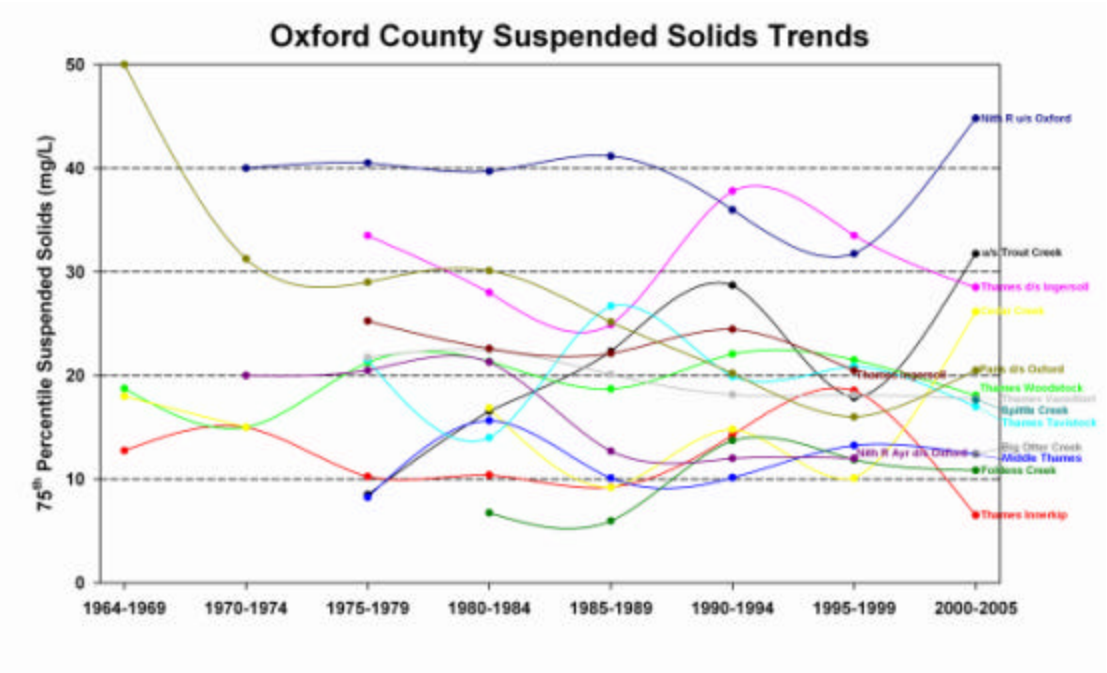


F.7 Suspended Solids

Fate and Behaviour: Suspended solids consist of silt, clay, and fine particles of organic and inorganic matter. These particles are significant carriers of phosphorus, metals, and other hazardous contaminants. Suspended solids can be detrimental to aquatic organisms including fish (spawning beds, damage gills, etc). Oxygen levels in the stream can be impaired by organic solids from sources such as wastewater treatment plants and storm sewers.
Sources: Soil erosion is the most common source of suspended solids to a watercourse. Suspended solids from urban sources appear in storm water and combined sewer runoff during storm events. Erosion of soil from cultivated land, construction/development sites and eroded stream banks all contribute sediment to surface water. Natural erosion of streambeds and banks are also sources.
Standards: There are no established standards for suspended solids. Turbid water is undesirable for water supplies, healthy aquatic life, recreation and aesthetics. Suspended solids can also transport quantities of trace contaminants.
Monitoring Results:

- Graph below shows, top to bottom: Nith R upstream Oxford, upstream Trout Cr, Cedar Cr, Paris downstream of Oxford, Thames Ingersoll, Thames Woodstock, Thames Vansittart, Spittler Creek, Thames Tavistock, Big Otter Cr, Nith R Ayr, Middle Thames, Foldens Cr, Thames Innerkip
- While there is fluctuation in concentrations, overall levels of suspended solids at most sites in the County have remained consistent over the long term.
- The site at Paris downstream of Oxford has shown decreasing levels of suspended solids since 1960's. Sediment levels in upstream Trout Creek have increased over the sampling period. Wildwood Reservoir acts as a sediment and nutrient settling basin, decreasing suspended solids in downstream Trout creek.

Figure 4. Suspended Solids Trends



F.8 Copper

Fate and Behaviour: Copper is an essential element that can be toxic to aquatic life at elevated levels. Metals including copper, lead, and zinc can bio-accumulate in fish, wildlife, and humans causing long-term health effects. Metals are long lasting in the environment where they tend to accumulate in streambed sediments.

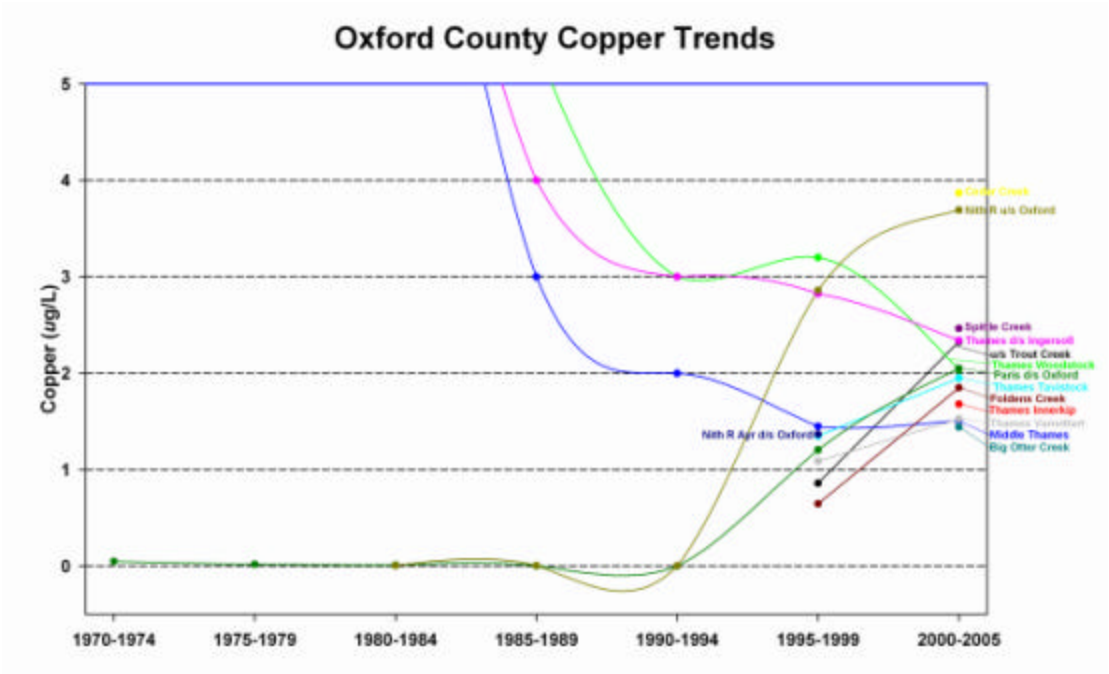
Sources: Anthropogenic sources which can impact on water quality include plumbing fixtures and pipes, textile manufacturing, paints, electrical conductors, wood preservatives, pesticides, fungicides, and sewage treatment plant effluent.

Standards: The Provincial Water Quality Objective for copper is 5 ug/L for healthy aquatic life. The Ontario Drinking Water Standard is 1mg/L (aesthetic objective).

Monitoring Results:

- Graph below shows, top to bottom: Cedar Cr, Nith upstream of Oxford, Spittler Creek, Thames downstream of Ingersoll, upstream of Trout Cr, Thames Woostock, Paris downstream of Oxford, Thames Tavistock, Foldens Cr, Thames Innerkip, Thames Vansittart, Middle Thames, Big Otter Cr
- Current concentrations of copper fall well below the Ontario Drinking Water Standard (aesthetic objective) and the Provincial Water Quality Objective for the protection of aquatic life at all Oxford County sites.
- Since the 1980's, there has been a significant decrease in copper concentrations at the Thames downstream of Ingersoll, the Thames at Woodstock, and the Middle Thames. These sites dropped from above the guideline for aquatic life to well below the guideline.
- In recent years copper in the Nith River upstream of Oxford and at Paris has been increasing but remains below guideline levels.

Figure 5. Copper Trends



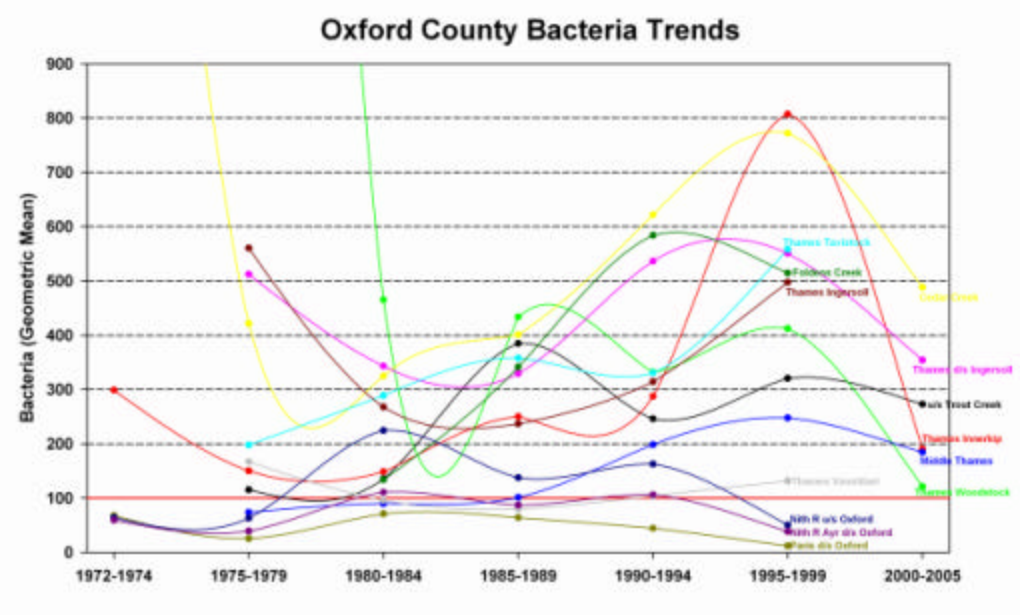
F.9 Bacteria

Fate and Behaviour: Escherichia coli (E.coli) is a type of fecal bacteria that is monitored as an indicator of other pathogens present in human and animal waste. Many of these pathogens such as Giardia and Cryptospiridium are more difficult to detect. Bacteria in surface water can also contaminate groundwater, putting drinking water sources at risk. Bacteria can enter a watercourse and survive for many months, especially in nutrient-rich sediments.
Sources: E. coli and other fecal bacteria are found in the feces of humans and animals. Potential sources of fecal bacteria include runoff from biosolids/sewage or livestock waste application, faulty private septic systems, inadequate manure storage, and urban storm water runoff.
Standards: The Provincial Water Quality Objective for recreational waters is 100 *E. coli*/ 100mL. The Ontario Drinking Water Standard for bacteria is that there should be no bacteria present in a drinking water supply.
Monitoring Results:

- Graph below shows, top to bottom: Thames Tavistock, Foldens Cr, Thames Ingersoll, Cedar Cr, Thames downstream of Ingersoll, upstream of Trout Cr, Thames Innerkip, Middle Thames, Thames Vansittart, Thames Woodstock, Nith R upstream of Oxford, Nith R Ayr, Paris downstream Oxford
- Concentrations of *E. coli* bacteria are routinely above the Provincial recreational guideline for all Oxford sites, except the Nith sites which are frequently low and below the guideline.
- Highest levels of *E. coli* are at Cedar Creek and Thames downstream of Ingersoll. These sites have 25% of samples over 3 times the recreational guideline.
- In recent years all sites have shown improvement.

The PWQMN discontinued bacteria monitoring in 1999 and only six long-term sites are currently monitored through a partnership with the Ministry of Health. Before 1995, the parameter monitored was fecal coliforms; then starting in 1995 the bacteria indicator became *E.coli*. Since the data is comparable, the data was pooled together to form a longer time series.

Figure 6. Bacteria Trends



F.10 Guidance

Continue to collect long-term monitoring data through the PWQMN at current sites to assess environmental change in Oxford County's rivers over time.

Implement programs that address point and non-point source pollution to reduce sediments, nutrients, chloride, and bacteria in watercourses in Oxford County.

References

Canadian Council of Ministries of the Environment. 2002. *Canadian water quality guidelines for the protection of aquatic life*.

Appendix G: Clean Water Project Summary

Funded by your local Municipalities and
delivered by your local Conservation Authorities

The County of Oxford has been a partner in the Clean Water Program since the program was launched in the fall of 2001. The Clean Water Program (CWP) is a technical and financial assistance program to improve and protect water quality. Rural landowners in the Counties of Middlesex, Oxford and Perth, the Cities of Stratford and London, and the Town of St. Marys are eligible for the program. The CWP also has a research and demonstration component to help develop and share new practices and solutions for surface water and groundwater quality issues.

Funding for the Clean Water Program comes from the participating municipalities. Other major financial supporters have included the Ontario Ministry of Agriculture and Food's Healthy Futures for Ontario Agriculture Program, the Great Lakes Renewal Foundation and Environment Canada's Habitat Stewardship Program.

Our accomplishments as of December 2006 include:

- $3.1 million investment generated $8.4 million in projects
- Over 1500 projects

The Clean Water Program has had a significant impact in this region and fits well into the recommendations of Justice O'Connor. It is an example of a positive action making a difference. From the onset, our local municipalities recognized that protecting clean water is a shared responsibility. They agreed that the Clean Water Program was an opportunity to work together for the collective good.

The CWP steering and review committee includes farm representatives and staff from the participating municipalities. The program is delivered by local Conservation Authority staff. In Oxford County, the Long Point Region, Grand River and Upper Thames River Conservation Authorities deliver the program.

This investment will work to safeguard public health through protection of drinking water supplies and provide public confidence in food safety. The cumulative impact of individual water quality improvement projects will not only improve local water quality but benefit the Great Lakes as well. The program provides an opportunity for rural and urban citizens to mutually invest in long term local water quality health.

A strength of the CWP is its flexibility to meet local issues and needs and therefore the opportunity to bring additional environmental benefits and grant dollars to the region. Examples of this include a recent focus on well decommissioning and wellhead upgrade projects, the participation of Environment Canada's - Habitat Stewardship Program, the involvement of the Great Lakes Renewal Foundation and currently the delivery of Agriculture & Agri-Food Canada's – Greencover Program.

A summary of the CWP activities in Oxford County, since 2001 follows.

Year	Number of Projects	Total Project Value ($)	Grant ($)	Oxford Contribution ($)	Other Contributions ($)*
2001	9	86,662	39,599	-	
2002	91	773,478	296,111	115,160	
2003	82	695,798	269,671	140,160	
2004	83	542,522	204,944	140,000	
2005	65	372,002	135,963	70,000	
2006 (to-date)	71	318,104	87,515	70,000	
TOTAL	**401**	2,788,566	1,033,803	535,320	498,483

*Other contributions include:
1. Habitat Stewardship Program $50,000
2. Great Lakes Renewal Foundation $140,000
3. Health Futures for Ontario Agriculture $218,483
4. City of London $90,000

In addition to the CWP, Conservation Authorities maintain tree planting and woodlot management programs throughout the region. Private landowner services includes tree planting plans, supplying appropriate stock, planting and maintenance and other woodlot management assistance. Among the other naturalization related services are the Communities for Nature Program which gives thousands of students and other volunteers a hands-on educational opportunity to enhance their local environment, the Trees for Tomorrow Program, Memorial Forestry Programs and site-specific naturalization efforts on public lands.

Appendix H. Implementation Advisory Committee Final Report

Oxford Natural Heritage Study

Implementation Advisory Committee

Final Report

August 2006

Prepared by:
Upper Thames River Conservation Authority

Prepared for:
The ONHS Steering Committee

Table of Contents

1.0 Introduction

The Oxford Natural Heritage Study (ONHS) was initiated in the spring of 2005 to identify the significant terrestrial and aquatic natural heritage features in the County and to develop strategies and recommendations for the long term maintenance and enhancement of these features. The Upper Thames River Conservation Authority took the lead on the project and worked as the project consultant. A Steering Committee, made up of representatives from the County of Oxford, Ducks Unlimited Canada, Stewardship Oxford, local Conservation Authorities and the Ontario Federation of Agriculture (see Appendix), oversaw the project.

2.0 Formation of the Implementation Advisory Committee

The Steering Committee recognized the need for input from many perspectives to address the question of how the significant natural areas can be protected for the benefit of the entire region while respecting landowners and the rural and urban economies. The Steering Committee decided to form an Implementation Advisory Committee (IAC) made up of a wide range of groups and agencies to consider the range of options for implementing the findings of the Oxford Natural Heritage Study (ONHS).

The Steering Committee invited representatives from agriculture, environmental stewardship agencies and groups, municipalities, tourism, provincial agencies and the land development industry to sit on an Implementation Advisory Committee (IAC). Twenty-three groups accepted the invitation and agreed to send a representative to sit on the IAC. A list of the members of the IAC is provided in Appendix A and a copy of the invitation letter is in Appendix B.

Jim Hayes, County Councillor and Mayor of South-West Oxford Township accepted an invitation from the Steering Committee to Chair of the IAC. Kim DeKlein from the Ministry of Agriculture, Food and Rural Affairs worked as Facilitator. Staff from the UTRCA and the County of Oxford worked as support and technical staff, assisting the IAC.

3.0 Process

A total of eight IAC meetings were held from September 2005 to July 2006. A summary of the IAC meetings is included in Appendix C.

The organizations participating on IAC were asked to outline their interest in Natural Heritage Planning and this information is summarized in Appendix D. A Terms of Reference for the IAC was approved by the Steering Committee and accepted by the IAC at the first meeting. The Terms of Reference is included in Appendix E. Meeting notes were recorded and approved by the IAC at each meeting.

The first few meetings of the IAC were spent familiarizing the committee with each other, their role and the ONHS's goals and objectives. Speakers were brought in to explain various implementation measures.

Several meetings were spent in small working groups, discussing advantages, disadvantages and applicability of a number of Beneficial Management Practices (BMPs) and Implementation Measures. The list of Evaluation Criteria developed by the IAC is included in Appendix F. The list of Pros and Cons of Implementation Measures is included in Appendix G. The broad background of the members gave much depth to these discussions.

The IAC meetings then moved from reviewing implementation measures in a general way into reviewing the specific results and recommendations of the Aquatic and Terrestrial Technical Teams. A copy of the terrestrial and aquatic technical recommendations is included in Appendix H.

This detailed review of the technical recommendations and discussion of specific recommendations was done with the IAC divided into two groups: a group for terrestrial and a group for aquatic. This process was followed to respond to the feedback of IAC members and progress made. The groups reviewed a matrix table that summarized the various implementation measures and the table was filled in with comments and recommendations.

After three meetings, the tables were complete and a draft final report was produced that summarized the recommendations and discussions. The IAC reviewed the document at the last meeting, made further refinements. The IAC asked support staff to merge the terrestrial and aquatic recommendations in the final report and remove duplication to make the document shorter more readable. The resulting recommendations and discussion notes are presented in the following section.

4.0 Implementation Recommendations

The recommendations that follow are divided into three parts.

- Part A summarizes the technical recommendations and are referenced in brackets beside the measure that they refer to or are impacted by.

- Part B summarizes the Beneficial Management Practices that can be used to achieve the technical recommendations. These BMPs are tactics or on-the-ground stewardship projects that have been shown to improve aspects of terrestrial and aquatic health.

- Part C summarizes the recommended Implementation Measures that can be used to encourage or mandate good stewardship.

Implementation Recommendations

Part A -- Summary of Technical Recommendations

Terrestrial

- T1 Maintain existing natural vegetation patches
- T2 Protect natural vegetation patches that meet 1 or more ONHS criterion
- T3 Increase natural cover

Aquatic

- A1 Protect, enhance and restore stream buffers
- A2 Protect and improve stream habitat
- A3 Control sediment inputs and siltation
- A4 Protect and enhance water quality and quantity

Part B – List of Beneficial Management Practices (BMPs)

- Create, protect and enhance vegetated riparian buffers (treed, grass, or hay) (T3, A1-4)
- Plant or seed native trees, shrubs, native grasses and wildflowers (T3, A1)
- Retire fragile or unproductive land (T3, A1-4)
- Undertake wildlife enhancement projects (T1, T2, A1, A3)
- Undertake wetland creation and restoration projects (T1, T2, A2, A4)
- Maintain & enhance groundwater recharge areas & protect discharge areas (T1-3, A2, A4)
- Protect wellhead areas (T1, T2, T3, A4)
- Utilize sustainable drain cleanout procedures (T1, T2, A1-4)
- Harvest trees in a sustainable manner (T1, T2)
- Undertake good forest stewardship (T1, T2, A4)
- Maintain existing woodlots and natural vegetation (T1, T2)
- Treat milkhouse washwater (A2,A4)
- Divert clean water away from manure yards (A4)
- Limit livestock access to watercourses (A1-4)
- Prepare and implement nutrient management plans (A1,A2,A4)
- Improve manure storage and handling (A4)
- Improve fertilizer, chemical or fuel storage and handling (A4)
- Repair faulty septic systems (A4)
- Decommission unused wells (A4)
- Control stream bank erosion (A1-4)
- Implement soil conservation measures (A1,A3,A4)
- Assess and mitigate watercourse barriers (A2,A3,A4)
- Undertake fisheries enhancement projects (A2,A4)
- Restore natural channel processes (A2,A3)
- Treat and manage urban stormwater (A3,A4)
- Prepare and implement sediment and erosion control plans for urban development (A1-4)
- Treat urban sewage (A4)

Summary of comments/considerations

- Generally, BMP's are voluntary actions, however, when land use changes from rural to urban, BMP's may be mandatory.
- Some debate about pros and cons of limiting livestock access to watercourses as row crops may replace pasture if farmers forced to fence.
- Debate about the recommended width of vegetated buffers. The scientific literature recommends 30-50 metres but landowners may view this as futile. Message to landowners should be that they are encouraged, but not required, to establish a 3 metre buffer along their watercourses to protect water quality and aquatic habitat.

Part C – Recommended Implementation Measures

Incentive Measures

Cash Incentives

- Adjust the County's Clean Water Program to include more money for projects such as land retirement, tree planting, woodlot management and buffer strip planting. Build in flexibility to allow for various methods of planting/seeding and various forbs/grasses including hay/pasture. (T1-3)
- Provide a higher incentive to achieve certain priority recommendations or to achieve targets. For example, provide a higher incentive for the first 3 metres of a buffer and less for the next 3 m and so on. Also, there could be a higher incentive for tree planting next to significant patches (sites that meet 1 or more ONHS criteria) (T2, A!, A2)
- Allow for combining of grant/incentive programs (A1-4, T3)
- Prohibit incentives for development-related BMPs.
- Factor in the value of the in-kind or technical assistance as part of the incentive (A1-4)
- Factor in the value of the land taken out of production as part of the incentive package.
- Reduce incentives to landowners who benefit from a project. For example, if a farmer gets a grant to create natural grasslands that could be used for grazing, some of the ongoing incentive (tax relief) for the owner should be reduced.
- Use existing county funds to leverage additional funds from outside sectors and foundations.

Subsidized Technical Assistance (e.g. services of a professional forester, ecologist, engineer)

- Provide technical assistance to landowners regarding the various approaches of creating new natural areas (e.g. self seeding, direct seeding, tree planting, weed control, etc.) (T3)
- Provide owners of significant patches (sites that meet 1 or more ONHS criteria) subsidized or free services for projects such as tree marking by a non-biased forester. (T1)
- Encourage outside groups and non-governmental organizations to provide their technical assistance programs to Oxford landowners (e.g. Ducks Unlimited Canada's Wood Duck Box Program) (T1, T2)
- Petition MNR to resume their woodlot marking services for landowners (T1, T2)

Recognition Programs

- Recognize developers who protect natural areas or re-plant areas (T1, T2, T3)
- Establish and promote demonstration sites (T1-3, A1-4)
- Recognize and promote success stories to educate others (T1-3, A1-4)

Tax Exemptions, Incentives, Rebates, Reductions

- Council should advocate for revisions to the Conservation Land Tax Incentive Program so that: (a) more lands are eligible, specifically, those that meet one or more ONHS criteria and (b) there is better cost sharing within the province so small municipalities with a lot of natural cover are not bearing a disproportionate cost.

Summary of comments/considerations

- Strong support for incentive measures as a means of encouraging a shift in practices. Incentives make sense since society as a whole benefits from the preservation of the environment, so the cost of tax exemption should be funded by society as a whole, not just the landowner.
- Some concern that good projects can be undone by future landowners.

- The County's Clean Water Program is a shining example of a great incentive program.
- Incentives and recognition programs need to consider both rural and urban landowners.
- Further analysis is needed to map out high priority or target areas for rehabilitation.
- Tax exemptions for significant patches are a first priority and a fundamental step to get landowner buy-in.
- Recognition programs for areas of Provincial significance - could have a similar tax incentive program to recognize locally significant wetlands, buffers etc. – can go hand in hand
- There are few incentives for the ongoing maintenance of natural areas that already exist (i.e. could work well with fragile land retirement component of current Clean Water Program).
- Ecogifts Program may be more appealing to landowners now given the recent change in Federal Budget making land donations Capital Gains exempt.

Regulatory Measures

Planning Act (Provincial Policy Statement, Comprehensive Municipal Official Plans and Zoning By-laws, requirements related to Planning Act amendments)

- Designate Significant Natural Areas (patches that meet one or more ONHS criteria) in the Official Plan along with a range of incentives and possibly in partnership with various partners. (T2)
- Designate Significant Natural Areas and other natural areas in the OP at the pre-annexation phase to prevent OMB challenges and price inflations (T1, T2)
- All non-significant patches (e.g. sites that do not meet one ONHS criteria) that are annexed into an urban growth area should be assessed as part of a secondary plan process. (T1)
- Establish policies to mandate the creation or protection of vegetated buffer strips along watercourses when there is a land use change from rural (agriculture) to urban (residential, commercial or industrial). (T1, T2)
- Calculate residential density on land area excluding natural features (watercourses, woodlands, etc.) so the developer is not penalized for the presence of the natural features. (T1, T2)
- Use density bonusing to augment existing woodland or riparian lands or for creating new natural cover (T1, T2, T3)
- When land use changes, require certain Beneficial Management Practices to be implemented as part of land use planning and development (A1–4, T3)
- Lobby the Province to allow for the inclusion of natural heritage protection in development charges (A1, A2, A4, T1-3)
- Allow severances for woodlot/natural area protection purposes so that someone can purchase only the woodlot portion of a property but not the buildings or farm fields. (T1, 2). (i.e. Conservation Authorities can create and acquire land-locked parcels for preservation purposes without going through the severance process.)

Trees Act – Woodland Protection By-Law, Forest Management

- § Review the Woodland Protection By-Law in a few years to incorporate the newest forestry science and review the exemptions in Section 3. (T1, T2)
- § Require an Environmental Impact Study if clear-cutting is proposed. (T1, T2)
- § If clear-cutting is permitted, mandate a replacement at 2:1 where twice as much area is planted to trees/vegetation as is cleared. Ensure the planting site has suitable soil for tree growth. (T3)
- § Apply the by-law equitably to all sites whether rural or urban, private or public. (T1, T2)
- § Ensure there is public input for municipal works that may impact natural areas. (T1, T2)

Conservation Authorities Act

- Require applicants to address habitat and sediment issues when applying for a Permit. (A2, A3)

Municipal Act, Topsoil Preservation By-Law

- Under the Topsoil Preservation By-law, do not permit removal of peat from wetlands (T1, T2)
- Require monitoring and assessment of the effects of peat extraction on groundwater subject to legislative authority (A4)
- Address problems associated with topsoil removal and compaction in urban developments that limit the ability of trees to grow.

Drainage Act

- Update protocols for cleanouts to proactively address woodlot/habitat issues so that vegetation removal is minimized. (T1, T2)
- Municipality should do its own study to develop science-based protocols for evaluating specific requests (T1, T2)
- Require vegetated buffers in drainage reports for new drains and updates (A1)
- Consider in-stream habitat improvements in drainage reports for new drains and updates (A2)

Fisheries Act

- Utilize a peer review committee approach before pursuing charges. (A1-4)

Ontario Water Resources Act (Permit to Take Water)

- Continue with the Irrigation Advisory Committee review process (A4)

Other Applicable Acts

- Species at Risk Act (T1, T2, A1-4)
- Environmental Protection Act (e.g. spills, A3, A4)
- Nutrient Management Act (A1, A4)
- Clean Water Act (Draft) (A2, A4)
- Environmental Assessment Act (A1-4)
- Aggregates Act (A3, A4)

Summary of comments/considerations

- The IAC decided not to recommend the designation of buffers as it may be counter productive and act as a disincentive. (A1)
- Trees Act could be used to protect treed buffers, however, concern that may be counter productive and act as a disincentive to planting trees along watercourses. Landowners should be educated about the reasons to maintain buffers in terms of shading/cooling the water and groundwater recharge. (A1, A2, A4) Trees Act does not apply to non-treed buffers.
- Conservation Authority Act has the ability to protect hydrologic function of wetlands and this is seen as a positive for water quantity and water quality (A4)
- Fisheries Act: Not a lot of local say over the implementation as senior level of government sets the policy. (A1-4).
- Feeling that dilution option is acceptable for municipalities but not to livestock access (A4)
- Regulation has a place in protecting the environment, but it is not popular as people feel over-regulated. Need to find strategies to make it more palatable and fair.

- Regulatory requirements for change in land use (urban development) are needed and justified. Most of the forest cover is lost when land goes to urban development so regulation is most effective here. (Some compensation from designation in the near urban fringe may be needed.)
- Generally, if a property is designated "environmental protection", there should be tax exemptions or incentives that go along with it.
- Very important to inform landowners of any designation of their property.
- There is a need for "one window" access for permits
- When there's a permit for selective cutting or other permits required, a process should be triggered whereby the landowner is given information on stewardship services available.
- The Woodland Protection By-law is effective if applied strictly
- The Drainage Act is a good piece of legislation if used properly.
- Urban means all settlement areas, not just large cities.

Education and Outreach (T1-3 & A1-4)

Workshops

- Host yearly workshops related to natural heritage protection or natural stewardship to allow interest to grow. Or, tie in with other workshops such as the Woodstock Integrated Pest Management Workshops.

Education

- Educate and update the skills of Drainage Superintendents regarding mitigation techniques to minimize impacts of drainage on wetlands.
- Educate Oxford County residents about rare species, what they are, how they are designated, etc.

Trade Shows

- Promote natural stewardship to rural and other residents at for example the Outdoor Farm Show, Outdoor Expo, and Fall Fairs
- Promote natural stewardship to recreational users at for example the Great Canadian Outdoor Expo (e.g. impacts of ATV's on natural areas and private land)

Media

- Publish articles on stewardship in farm magazines and newspapers

Official Plan - Open House Process

- Notify public of any designations.
- Invite IAC members to attend Open Houses

Notification of landowners with designated patches

- Inform landowners by letter with explanation and any incentives (T2)

Natural Heritage Advisory Committee for Oxford

- Form a county advisory committee that could meet twice a year to help set targets, time lines, measureables, prioritize projects, monitor uptake and outcomes and report to council on progress

Summary of Comments/ Considerations

- A variety of forms of education and outreach are needed, some of which are already happening. Education and outreach involves many agencies and organizations.

- Farm audience has been targeted well but other audiences have not been (e.g. rural non-farm, urban, golf course operators, real estate, aggregates, municipal staff, planners and the population in general).
- Ongoing monitoring and reporting is a type of education. A report card type format could provide some ongoing education for the public. Conservation Authorities could report back to the County with a County boundary report card – perhaps tie to the OP timeline. This project (ONHS) provides the baseline for these future report cards to measure back to.
- There should be a link on the Oxford County website to the ONHS. The ONHS webpage (hosted on the UTRCA website) should include links to other sites that provide information on natural heritage and eco-friendly projects (i.e. pasture management, re-mineralizing the earth). Set up links to the Lower Tier Municipalities as well.

- Need to distinguish between "natural heritage" and "heritage".
- Need to be careful with the confusion between short forms as IAC is both Implementation Advisory Committee and Irrigation Advisory Committee.

Securement and Protection Measures (e.g. Acquisition)

Public Ownership

- Secure some of the best natural sites (jewels). This could occur through a partnership between the county and other groups interested in natural heritage protection. (T2)

Conservation Easements

- Encourage easements for setbacks to leave agriculture or open space as the buffer between new developments and natural areas, especially natural areas that meet one or more criteria. (T2)

Summary of comments / considerations

- Acquisitions need to consider the purchase price and the cost of ongoing maintenance.
- There is a need for more publicly accessible natural areas. Public access may be a main reason for public ownership.
- Landowners should be made aware that the EcoGifts Program has been changed so that land donations are now Capital Gains exempt.

Umbrella Issues

- Need further analysis to determine target areas that are the highest priority to rehabilitate.
- County should consider ways to top-up the funds earmarked for acquisition or natural heritage projects (e.g. revenue from logging county forests).
- Companies need more tax breaks to make it easier for them to contribute to heritage programs.
- The ONHS recommendations should be integrated with the Oxford County Groundwater Study to assist with assessing projects such as Aggregates Resources Act proposals. This integration could happen through the implementation of Source Water Protection and the Clean Water Act.
- Comment about confusion between Clean Water Project (grants) and Clean Water Act (sourcewater protection legislation)

5.0 Priorities

At the last IAC meeting, the group identified a number of priorities from the long list of recommendations listed in the section above. These items were listed on a flip chart. Members were asked to identify their preferred options using red stick-on dots. Each person was given 3 dots and asked to place them next to their top items on the flip charts.

The results of the quick prioritization exercise are as follows: .

#1 **Incentives** (cash and subsidized technical services). It was stressed that incentives could be provided by many partners and delivered through enhanced Clean Water Program.

#2 **Education and Communications**. It was suggested that particular emphasis be placed on non farm rural landowners

#3 (tie) **Communication with and Recognition** of landowners with significant patches: create an education strategy

#3 (tie) **Compensation.** e.g. for land planted to a 3 m buffer, land within 2 year travel time of a well, extraction of topsoil

#4 **Natural Heritage Advisory Committee** to monitor success

#5 (tie) **Regulatory Controls (e.g. Planning Act)**

#5 (tie) **Identify most valuable patches** and provide incentives for those landowners and target public ownership of the best of the best

The point was stressed that grants and services are **voluntary** when there is no change of landuse.

APPENDICES

Appendix A

Implementation Advisory Committee Membership List

Member	Organization Represented
Nancy Walther	Oxford County Federation of Agriculture
Barry Smith	Perth-Oxford National Farmers Union
Bill Matheson	Oxford Soil and Crop Improvement Association
Dwayne Evans	Ontario Ministry of Agriculture Food and Rural Affairs
Howard Cornwell	Oxford County Agricultural Advisory Committee
Arthur Murray	Ingersoll Nature Club
Roger Boyd	Woodstock Field Naturalists
Larry Jensen	Harrington Creek Eco Group
Chris Powell	Woodstock Environment Advisory Committee
Ed Ecker	Oxford Woodlot Owners Association
Michelle Kanter	Carolinian Canada
Kevin Dolan, Bill Gibbons	Oxford County Bass Masters
Darrell Randell	Ducks Unlimited Canada
Michael Harding	County Councillor
Jim Hayes	Councillor, Southwest Oxford
Tom Bird	Stewardship Oxford
Jim Oliver	Long Point Region Conservation Authority
Tracey Ryan	Grand River Conservation Authority
Len Reeves	Development Industry
Cliff Zaluski	Construction Industry
Cathy Bingham	Tourism Oxford
Russ Piper	Ontario Federation of Anglers and Hunters
Brad Hertner	Upper Thames River Conservation Authority

Facilitator

Kim DeKlein	Ontario Ministry of Agriculture and Food

Support Staff

Cathy Quinlan	Upper Thames River Conservation Authority
Jeff Brick	Upper Thames River Conservation Authority
Marg Evans	County of Oxford
Tammy Fehr	County of Oxford
Dave Depuydt	Ministry of Natural Resources

Appendix B:
Invitation Letter

Michael Harding, Councillor
P. O. Box 397, 415 Hunter Street
Woodstock Ontario N4S 7Y3
Phone: 519-539-2382 x 811 • Fax: 519-539-3275
Email: mayor@city.woodstock.on.ca
Web site: www.county.oxford.on.ca

May 18, 2005

Dear :

As you may be aware, the County of Oxford is undertaking a natural heritage study with the assistance of the Conservation Authorities, primarily the Upper Thames River Conservation Authority. This study will look at the health of Oxford County's woodlands, wetlands, streams and rivers and develop strategies for their long-term protection and rehabilitation. Enclosed, you will find a fact sheet that describes the study and the main reasons such a study is needed. Additional information about the study can be found on the internet at

http://www.thamesriver.on.ca/ONHS/ONHS.htm.

The Oxford Natural Heritage Study (ONHS) got underway in March, 2005, lead by a Steering Committee of which I am Chair. Steering Committee members include representatives from agriculture, environmental stewardship agencies and the Conservation Authorities. In addition to the Steering Committee, the study will be guided by a Technical Committee and an Implementation Advisory Committee, both of whom will report to the Steering Committee. The Technical Committee is composed of the "science people" who will conduct the fieldwork and assess the County's natural heritage resources. We are currently looking for people to might be interested in taking a position on the Implementation Advisory Committee. During our discussions, the Steering Committee had identified you as an ideal candidate for this Committee. Let me explain why.

The Implementation Advisory Committee (IAC) is tasked with considering a range of options for *implementing* the study. Typically people relate implementation of such a study to a regulatory approach, and while we don't deny that this is one implementation tool, there are also many others. We are looking to the IAC to identify a range of options, including education, stewardship, incentives, acquisition and taxation exemptions that can be used to enhance and protect our natural resources. We are optimistic that the IAC will recommend a *'made in Oxford'* approach to implementation that will consider the concerns of affected private landowners. This is the fascinating part of the study – designing the implementation of science with a selection of appropriate tools.

We are approaching a number of organizations to invite onto the IAC – agriculture, our biggest land owner group; environmental stewardship agencies, our potential implementation partners; municipal

Councillors and provincial staff, our potential funding partners and regulatory agencies; and the development industry, representing our urban interests. We would be very pleased to have your expertise on the IAC.

The IAC will commence in the fall of 2005 and work over the winter to make recommendations for the final study report to be completed in the spring of 2006. We anticipate monthly meetings over that period, with some homework in between. The IAC will be supported by Conservation Authority and County staff and will have its own facilitator. We anticipate bringing in guest speakers and external expertise, as required, in order for the IAC to prepare informed recommendations. The pay is lousy – however, this is volunteerism at its best!

I sincerely hope that I have piqued your interest in serving on the IAC. We would be most appreciative of your time and expertise on this exciting project and, very much, look forward to working with you. Should you have questions about the study you can contact me or any of our partners noted below. The Upper Thames C.A. is assisting us in our search. Please respond to Cathy Quinlan, Project Manager, UTRCA, 519-451-2800 extension 234, quinlanc@thamesriver.on.ca regarding this invitation by the end of May, earlier if possible. If you are unable to commit the time, but can identify another person from your agency that is willing, please let us know who that is.

Sincerely,

Michael Harding
Oxford County Council
Chair, Oxford Natural Heritage Study
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Fax: (519) 539-3275
mayor@city.woodstock.on.ca

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/Encl.

Appendix C

Summary of IAC Meetings

No.	Meeting Date	Topics Covered
1	Sep 28, 2005	- Introduction of members - Review of IAC's Role and Terms of Reference - Presentation on ONHS goals and objectives (Jeff Brick and Marg Evans)
2	Nov 2, 2005	- Each member summarized their group's interest in the work of the ONHS - Brief review of Worksheet outlining various Best Management Practices (BMPs) and possible Implementation Measures (IM) - Presentations on various implementation measures: a) Provincial Policy Statement - Scott Oliver (MMAH) & Fiona Walker (MNR) b) Oxford's Official Plan Policy Framework – Marg Misek-Evans (County) c) Clean Water Program - Craig Merkley (UTRCA)
3	Dec 14, 2005	- IAC worked in three small groups and discussed advantages, disadvantages and applicability of each Best Management Practice and Implementation Measure (stewardship, regulation, education, acquisition, taxation)
4	Jan 31, 2006	- IAC worked in small groups to: add to notes from the previous meeting, identify areas where more information is needed and, develop a list of evaluation criteria to guide IAC in making recommendations - Aquatic findings were presented by John Schwindt (UTRCA) who focussed on the fish species found, habitat types and condition present, and draft maps.
5	Apr 11, 2006	- Presentations by Technical Teams: - Aquatic Findings and Recommendations - Cathy Reeves - Terrestrial findings and recommendations- Tara Tchir - IAC broke into an aquatic group and a terrestrial group and discussed how the technical recommendations could be implemented by going through the worksheet listing all the implementation measures;
6	Apr 25, 2006	- IAC broke into the aquatic and terrestrial groups to continue discussing implementation options by going through the revised worksheet
7	May 30, 2006	- IAC broke into the aquatic and terrestrial groups and finished up discussions on implementation options by reviewing the summary sheets - IAC reconvened as a whole. Jeff Brick summarized the aquatic implementation recommendations and Cathy Quinlan summarized the terrestrial. Discussion followed.
8	July 17, 2006	- IAC reviewed the draft IAC Report as a whole - IAC prioritized the recommendations to go to the ONHS Steering Committee - IAC was thanked for their valuable contributions

All meetings were held at the Woodstock OMAF Office except the Jan 31st meeting which was held at the Mount Elgin Community Centre.

Appendix D
IAC Member Organizations and their Interest in Natural Heritage Planning

Tourism Oxford: Part of the appeal of visiting Oxford County is the pastoral nature of our community. The combination of gently rolling countryside, streams, lakes and hiking trails provide a positive experience to those seeking outdoor experiences (e.g. flora and fauna interpretive signage, bird watching, fishing, camping, hiking, biking, cross country skiing).

Oxford County Bassmasters is committed to enhancing the natural heritage in Oxford County with a special emphasis on the fisheries, for future generations. Goal: "To be part of improving the quality of our watershed on an on-going basis. Issues: carp population, total fish populations and history, apparent lack of visibility of Conservation Officers, scheduling of raising and lowering the levels of lakes, cormorant population, and feasibility of moving pike from the river up to Pittock Lake.

The **Long Point Region Conservation Authority** (LPRCA) has among its objectives the protection and management of lands and waters across the watershed, including woodlands, wetlands, watercourses and natural habitats. Approximately 23% of Oxford County lies within the LPRCA watershed, and comprises about 16% of that regional watershed. The Authoirty strongly supports the protection, enhancement and expansion of natural areas within the LPRCA portion of the County in order to enhance water conservation and source protection, biodiversity and opportunities for outdoor recreation and Nature appreciation."

Ducks Unlimited Canada conserves, restores, and manages, wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people. This effort in Oxford County expects to see greater public appreciation of natural areas and opportunities to aid sustainable agriculture.

Carolinian Canada Coalition has coordinated a common vision of natural heritage protection among member groups in southwestern Ontario for over 20 years. The Carolinian zone is biologically the richest in the country, requiring careful attention to balance nature with a multi-use landscape and maintain a healthy environment for wildlife and people. The Coalition's Big Picture vision of a sustainable natural heritage network calls for cooperation among a wide range of stakeholders. The Oxford Natural Heritage Study is an excellent demonstration of Big Picture conservation and an opportunity to develop a local conservation plan that will link and contribute to the overall ecological health of Canada.

As the representative for the **Oxford Agricultural Advisory Committee** I feel that our organization should be aware of any features that might impact livestock farms in Oxford. Livestock density and Nutrient Management have a potential for significant impact on natural heritage features.

Grand River Conservation Authority: Our vision is one of leadership in ensuring a healthy and sustaining relationship between the natural environment of the Grand River watershed and the demands on this environment by all forms of life. Our mission is to work with partners to conserve the natural processes and resources that support a safe and healthy environment for future generations in the Grand River watershed. A healthy river is our greatest legacy to our children and the key to our continued economic growth and future prosperity. To protect our natural areas, we:

- Own & manage about 19,000 hectares (47,000 acres) of fragile lands.
- Work with partners to ensure long-term protection of natural areas.
- Deliver conservation stewardship services.
- Carry out restoration & rehabilitation projects.
- Regulate development in natural areas
- Operate a tree nursery & plant trees (27 million to date).

The **Woodstock Field Naturalists Club** began in 1934. It continues today to acquire knowledge of Oxford County's natural history. The Club's objectives include protecting and preserving wildlife and unique natural areas.

Ingersoll District Nature Club: The natural resources of Oxford County are varied and include prime agricultural lands, wetlands and wooded areas and as the population grows in Oxford county and an ever expanding residential and manufacturing base to support it, the Ingersoll District Nature Club is interested to learn how our group may promote, educate and enhance the natural resources of Oxford County.

The **Oxford County Soil and Crop** plans to assist by contributing a member to your meetings. Our organization's interest is ensuring sustainable natural heritage features by promoting the following:

- nutrient management programs
- pesticide, fungicide, insecticide use – always follow label or less
- promote soil erosion prevention programs
- ensure natural wetlands remain in our midst.

National Farmers Union/Barry Smith: Having never been to an NFU meeting I cannot quote their stance. I was involved with the OCFA when this was brought forth. Therefore my views "The compulsory addition of the results to the Official Plan must have consideration for the landowner". If society wishes to have certain areas designated, then consideration must be given to that landowner either through purchase of that land and/or tax elimination and annual compensation. As a landowner with woodlots and one open municipal drain (Big Creek) and another stream (Otter Creek) I personally understand the ramifications

The **Oxford Woodlot Association** membership is supportive of the intent (protection and enhancement of the significant terrestrial and aquatic features within Oxford County). Most members own and are actively involved with a woodlot in the County. The membership, however, is concerned about the impact on their property: more taxes, more rules/bureaucracy, more paperwork, loss of value, and more expense.

Oxford Community Partnership Specialist / UTRCA: The organizations I represent on this committee are community-based environmental groups. These are groups of Oxford County residents concerned about the natural heritage of their community, and who work with local partners to plan and implement enhancement projects directed at improving the County's forest cover, aquatic habitat, surface & groundwater quality while involving and educating the community. The information from the ONHS can help guide the restoration work we do.

The **Harrington Creek Eco Group** is interested in the Wildwood wetlands and their headwaters

Ontario Federation of Anglers + Hunters – their group worked on the Sally Creek Report (near Woodstock) and stream rehabilitation

Construction Industry – the construction industry has an interest in knowing where important features are

Ontario Ministry of Agricutlrue and Food – bring an agricultural perspective to natural heritage planning; it can impact farming and be impacted by it

Stewardship Oxford – would like to see county set funds aside for BMPs to better the local environment

Oxford County Federation of Agriculture – recognize the importance of the ONHS and would like to see private property rights preserved

Development Industry – land developers appreciate natural heritage and want to work with the agencies/groups instead of against them

Appendix E:

Oxford Natural Heritage Study
Implementation Advisory Committee
Terms of Reference

Purpose

The Implementation Advisory Committee (IAC) will consider the range of options for implementing the findings of the Oxford Natural Heritage Study. The IAC will be encouraged to research options and make recommendations to the Steering Committee regarding the future implementation of the project findings.

> ***Implementation Options***. Actual on-the-ground actions or policy instruments that can be used to protect and enhance the significant terrestrial and aquatic natural heritage features within Oxford County. Options may include stewardship, grants, land use planning controls, tax incentives, education and acquisition.

Membership

Members are volunteers and include representatives from a broad cross-section of stakeholder groups from the County of Oxford and area. The following sectors will be invited: agriculture, environment, recreation, agencies, municipal government, industry and development. Members will use their expertise and perspectives of their groups and associations to assist with the work of the IAC.

Process

Phase I - Understanding

$ Members are informed about the ONHS, its purpose, methodology, work to date, etc.

$ Members are informed about the results/findings/trends of the ONHS to date including significant terrestrial and aquatic sites/resources, etc.

$ Members are informed about the range of possible implementation options that could be examined. This may include workshops or presentations involving individuals and organizations with experience with different types of implementation.

Phase II - Assessing Options

$ With the assistance of a facilitator, members will:
- evaluate the pros and cons of each implementation option in the Oxford County context,
- consider any new or added options, and
- evaluate opportunities and barriers to the use of each option.

$ Sub-groups may be formed to explore different options to speed the work along. Further research may be assisted by bringing other technical experts to the meetings.

Phase III - Compiling Findings and Recommendations

$ Activities of the IAC will be summarized in a background report to the Steering Committee that will include recommendations.

Member Role

Members of the IAC represent their affiliated group/agency and the views therein. Members are expected to communicate back with their groups for feedback. Members shall work cooperatively with each other, respecting the varying views that may emerge. Decisions will be made on a consensus basis.

Participation Imperative

Members are expected to attend meetings and carry out any >homework= assigned (e.g. research). Attendance at meetings is imperative. Members are encouraged to send a
substitute or delegate from their organization if they are unable to attend a meeting

Chair The Chair of the IAC will be a member of the Steering Committee or the Steering Committee will select a chair from the available candidates.

Recording Secretary Staff of the UTRCA will serve as Recording Secretary. UTRCA will compile the background report for acceptance of the IAC.

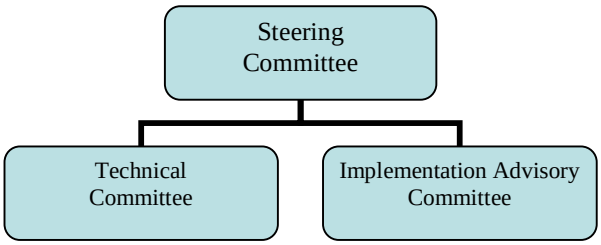
Communications All media contact will be coordinated through the chair of the committee. IAC members are asked to not speak to the media about the process without the prior approval of the chair.

Deliverables IAC will prepare a background report to the Steering Committee that includes recommendations regarding implementation measures for the ONHS.

Timeline IAC meetings will begin in September 2005. It is anticipated that meetings will be held approximately monthly until the work is complete. It is anticipated that the IAC work should be completed by the spring of 2006.

Meeting Dates Members will select the best time/place for meetings upon mutual consent. Every effort will be made to choose meeting times that accommodate the largest number of people. Meetings will take place on weekdays and usually during the day, though some evening meetings may be arranged if agreed upon.

ONHS Governance Model



Appendix F:

Evaluation Criteria

Effective	Does it actually help meet targets for preservation? Is it effective at saving environmental jewels and preserving environmental health?
Cost Effective	Is it the best bang for the buck?
Fair	Is it fair to landowners? There should not be a penalty to landowners involved in protecting natural benefits.
Revenue Neutral	Revenue neutral or revenue positive
Justifiable	Can it be justified to society in terms of best return on investment?
Visible	Can society see their money at work?
Saleable	Will the public support it?
Flexible	Can the program be changed to adapt to new science and new information?
Balance	Is there a balance of regulatory and incentive-type measures?
Goal Oriented	Does it lead to a goal, generations down the line?
Long Term	Will the program be offered continuously?
Targeted	Is the program able to prioritize or target high priority areas?
Stream-lined	Is there a one-window approach or a minimum amount of red tape?
Tool-specific	Are there different tools for different risks or objectives?
Spin offs	Are there potential negative spinoffs (e.g. forcing landowners to abandon one bad practice for a worse one)?
Cost sharing	Can landowner labour be a contribution as well as cash?

Appendix G

Pros and Cons of Implementation Measures

Incentives and Stewardship Measures

Advantages

- benefits do-gooder
- educates through example and peer pressure
- promotes community by-in
- gets things done sooner rather than later if financial incentives available now
- allows for landowner buy-in, especially those who couldn't afford to do so on their own
- for general public, shows taxes are working to conserve environmental health, legacy aspect should be promoted to the public; healthier environment benefits human health

Disadvantages

- targets mostly agricultural and rural population
- can be a lot of red tape
- no consistency over the years; programs come and go
- no compliance back-up
- possibly increase in taxes, ie. requires a government commitment
- potential is there to enforce landowners to have some set % of land in trees or natural cover (in return for or instead of)
- still have affordability problem where landowners can not afford his/her share

Regulatory Measures

Advantages

- Fair as it applies to all residents; democratic/British Common Law
- cheap
- forces compliance
- public process/review process available

Disadvantages

- inconsistencies between regulations (e.g. one regulation can trump another)
- policing is expensive and often not enough enforcement officers
- uncertainty about how regulation would be applied, i.e. definition of a wetland

Education and Outreach Measures:

- various options suggested: tradeshows, websites, County Arboretum as an education centre/showcase

Acquisition + Easement Measures:

Advantages

- forever; long term control over the land usage
- has teeth
- provides parkland and nature reserve for public too
- the community can be drawn together to support a cause to buy important land
- revenue possibilities for owner such as recreation uses or tree harvesting
- leasing may become an option; may keep costs down
- easements are cheap compared to acquisition
- easements have tax benefits to landowner

Disadvantages

- wills can be broken
- expensive to buy land; budget dependent
- ongoing maintenance and liability issues
- enforcement of an easement is difficult
- limits land usage
- if leasing were an option, there could be time frame issues; land title changing hands continuously, limited control of usage
- possibly limits area types that are of interest; average landscapes may be overlooked due to lack of "curb side appeal"

Taxation Incentive Measures

Advantages

- makes it more affordable for landowners
- can encourage positive development (e.g. hunting lodges)
- relatively simple
- immediate gratification, i.e. on retired lands
- available to everyone

Disadvantages

- not attractive enough for all landowners
- poorly promoted
- some don't like dealing with the government
- may have a negative effect on property value
- Municipal revenue/tax base may be affected
- lot of paperwork as must apply annually and there's a cost for documentation
- legally bonding

Appendix H
Technical Recommendations

Terrestrial

1. **All natural patches left in the county should be <u>maintained</u>.**
   - Each patch supports wild plants and animals to some extent and adds to the diversity of the county.
   - It is extremely costly to replant natural areas so it is best to preserve existing habitats.
   - It takes generations for forests to develop.

2. **Any natural patch meeting at least 1 criterion is serving an ecological landscape function and needs to be <u>protected</u>.**
   - Each criterion reflects some aspect of habitat value and complexity. It is impossible to choose the 'best' criterion since they all measure something different.
   - With only 13.5% natural cover in the county, the best of the best need to be given the most protection to ensure the long-term survival of these ecosystems.
   - Sustainable activities such as maple syrup production, foot trails, hunting and selective tree harvesting can continues.

3. **Natural cover should be <u>increased</u> to 20% (and an additional 10% into wetland / riparian cover) over the long-term**
   - The scientific literature suggests regions with low natural cover may not have sustainable ecosystems. Plant and animal species may become locally or regionally extinct unless there is a minimum amount of natural cover.
   - Wildlife need to move between habitats. One habitat is not sufficient.
   - Water quality, air quality, groundwater quality, etc. cannot be maintained in regions devoid of natural vegetation. Climate change is also linked with a loss of forest cover.
   - Any new habitat is good. However, it may be best to target restoration projects around existing woodlots and wetlands to bulk them up and increase forest interior.
   - Increasing natural cover will take generations, but it must start now.

Aquatic

1. **Protect, enhance and restore stream buffers**
   - A buffer can consist of any permanent vegetation. Minimum width suggested as 30 metres on both sides of the watercourse (research indicates that this may be 50 m).
   - *Benefits:* shade and cool water, filter pollutants, nutrient source, improves flood connectivity, wildlife travel corridor)
   - *Examples:* plant native vegetation, land retirement, altering landuse practices

2. **Protect and improve stream habitat**
   - Natural habitats usually consist of riffle/pool sequences and have diverse substrates (cobble, rocks, sand, gravel, clay). Streams have natural meander patterns which migrate over time.
   - *Benefits*: diverse and productive self-maintaining aquatic communities
   - *Examples*: vortex weirs, rocky riffles, bioengineering.

3. **Control sediment inputs and siltation**
   - Urban and rural sources of nutrients, contaminants and sediment.
   - *Benefits*: improved water quality and stream habitat
   - *Examples*: conservation tillage, grassed waterways, sediment and erosion control, and storm water management

4. **Protect and enhance water quality and quantity**
   - Reduce pollution sources, protect natural flows, increase water storage capacity and sustain baseflow
   - *Examples:* stormwater management, nutrient and waste management, wetland restoration, barrier mitigation and removal

5. **Continue to monitor**
   - Benthic, water quality, fish community, habitat, temperature and flow

6. **Apply adaptive management**

7. **Regularly assess conditions** to determine success and effectiveness of projects and adjust programs accordingly