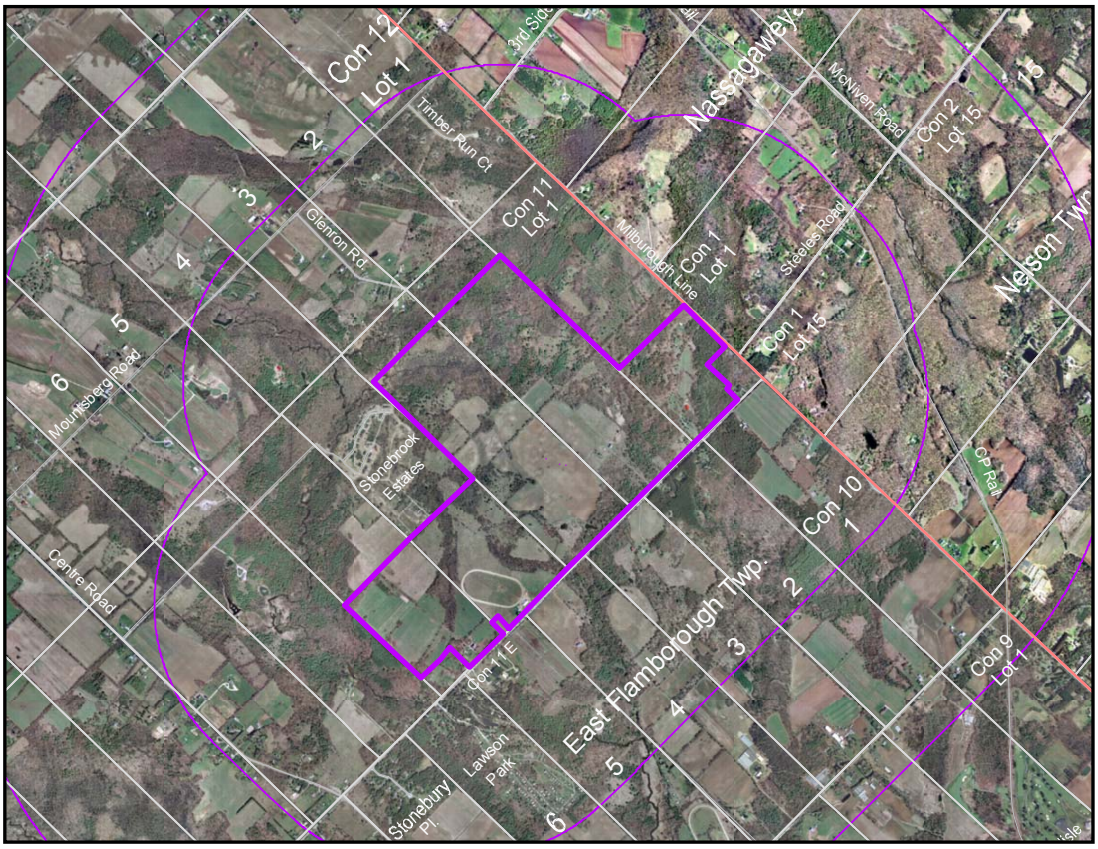
Preliminary Report of the Environmental Features and Potential Impacts associated with the Proposed Lowndes Quarry, City of Hamilton

June, 2005



Prepared For:
Friends of Rural Communities and the Environment (FORCE)
Lawson Park Ltd., Box 15,
RR # 1, Freelton, Ontario
L0R 1K0

Prepared By:
North-South Environmental Inc.
35 Crawford Crescent, Unit 5
P.O. Box 518,
Campbellville, ON,
Canada L0P 1B0

Preliminary Report of the Environmental Features and Potential Impacts associated with the Proposed Lowndes Quarry, City of Hamilton

Executive Summary

INTRODUCTION AND PURPOSE OF REPORT

Lowndes Holdings owns property that comprises parts of Lots 1 through 5 on Concession 11 East of the former Township of East Flamborough, now a part of the City of Hamilton, and bordering the Region of Halton. The property has been identified as having surficial aggregate resources as well as Amabel dolostone underlying the surficial deposits. The proponent, Lowndes Holdings, intends to develop the property for a limestone aggregate development that would extract aggregate material from below the groundwater table**.**

The subject property and contiguous lands are rich in natural features and complex in terms of interconnected linkages. It is difficult to contemplate that these features could become subject to industrial extraction activity. Indeed, the significant potential ecological impacts to natural areas on and surrounding the property have been identified as one of two major issues raised by the proposed aggregate development.

The intent of this report is to describe those natural heritage features and functions that exist within the Lowndes Holdings property and to examine how these are ecologically linked to other contiguous natural areas within the landscape. The report also specifically examines the current ecological designations that apply to these natural heritage features and the evidentiary basis upon which these designations have been made. This examination is intended to provide early assessment of the kinds of environmental issues that may arise from the proposed aggregate development. Current and evolving regulatory standards that apply to this aggregate development proposal are described in the main body. The report is intended to serve as one input to review of the proponent's application. It does not, however, constitute a detailed critique or specific consideration of any applications filed under applicable legal regimes, such as the *Planning Act* (submitted by the proponent on 09/20/04), the *Aggregate Resources Act*, the *Ontario Water Resources Act* and the *Conservation Authorities Act*. Such analysis will be submitted under separate cover.

The present report has been prepared through review of existing data sources, including referenced inventories and reports, aerial photographs of the region, the FORCE GIS mapping prepared by Hunter GIS, as well as through field visits to the roadside areas surrounding the site and locally. Information regarding the proposed extraction of aggregate from the property owned by Lowndes Holdings has been limited. Although an application was recently filed with the City of Hamilton to seek required *Planning Act* approvals, the studies supporting this application are preliminary only and, given their limitations, have not been used for the present report in favour of more

detailed existing data by third party sources. To date, no application, with more detailed studies, has been filed under the Aggregate Resources Act.

This summary and the main body are organized on the basis of common section headings.

MAJOR ENVIRONMENTAL PRINCIPLES

There are three core principles of conservation biology to be considered where human development is proposed to alter the natural landscape:

1. Maintain Biological Diversity;
2. Avoid Habitat Fragmentation; and
3. Promote Corridors and Linkages.

OVERVIEW OF EXISTING SITE-SPECIFIC AND REGIONAL SETTING

The Lowndes Holding property is situated on approximately 220 ha (544 acres). Prime agricultural soils are present on about half of the property and much of this land has been in production as pasture and row crops. Current agricultural facilities include four farm homesteads and an oval horse trotting track.

The remaining half of the site has a diverse natural vegetation cover, including mature upland deciduous and mixed forests and wetland areas dominated by treed swamp communities composed of deciduous, mixed or coniferous tree species. The areas of natural vegetation located within the site are contiguous and/or form good functional terrestrial and aquatic ecological linkages with upland forests and wetlands located off the site. There are a large number of significant natural features [11 Environmentally Significant Areas (ESA), 5 Provincially Significant Wetlands (PSW) and 3 Locally Significant Wetlands (LSW), 5 Areas of Natural and Scientific Interest (ANSI), and 1 natural area – see tables below] within and adjacent to the site which must be considered. The main body of the report provides brief descriptions of natural areas, outlining why they are considered significant and how they are linked.

Five creeks are also present on site and form important ecological linkages with wetland and terrestrial features on and off site. These include the headwaters of three tributaries of Mountsberg Creek which is part of the Bronte Creek watershed (two tributaries are described as coldwater streams (Dwyer 2003)). A fourth creek which is also a tributary of Mountsberg Creek, flows in a southwest direction through a wetland located in the northern portion of the site. The fifth creek is a coldwater tributary of Flamboro Creek flowing in a southerly direction as it passes through a wetland located on the west side of the property.

Municipal or Provincial Program	Natural Area Designations within and adjacent to the Lowndes Holdings Site
City of Hamilton Ecologically Sensitive Areas program (Dwyer 2003)	• Mountsberg East Wetlands (Hamilton ESA Flam-36) • Carlisle North Forests (Hamilton ESA Flam-38) • Mountsberg Wildlife Area (Flam-29) • Freelton Esker Wetland Complex (Flam-30) • Progreston North Swamp (Flam-40) • Puslinch Southeast Swamp (Flam 27) • Beverly Swamp (Flam 23) • Strabane North Wetlands (Flam 31) • Bronte Creek Ravine (Flam 43)
City of Hamilton Official Plan (Hamilton 2003)	• Natural Heritage System • Linkage and Restoration Areas
Ontario Ministry of Natural Resources Wetland Evaluation Manual for Southern Ontario (OMNR 2002a)	• Lower Mountsberg Creek PSW Complex • Crawford Lake and Calcium Pits PSW Complex • Guelph Junction PSW Complex • Beverly Swamp PSW Complex • Mountsberg Reservoir Marsh PSW • Kilbride Swamp LSW Complex • Carlisle LSW Complex • North Progreston Swamp LSW
Ontario Ministry of Natural Resources Big Picture Project (NHIC/NCC 2002)	• Core Natural Area and Linkage Area
Ontario Ministry of Natural Resources ANSI program	• Calcium Pits Meltwater Channel Earth Science ANSI • Calcium Pits Life Science ANSI • Freelton Esker Earth Science ANSI • Kilbride Swamp Life Science ANSI • Mountsberg Wildlife Area Life Science ANSI
Ontario Ministry of Municipal Affairs and Housing draft Greenbelt Plan (MMAH 2004a, 2004b, 2005)	• Protected Countryside and Natural Heritage System
Region of Halton Natural Areas	• Twiss Natural Area

INFORMATION GAPS

Existing inventory and designation data for the natural areas located within and contiguous to the proposed quarry site shows rich species and community diversity and complex interconnections. **Sufficient information has been gathered to determine significant natural areas are present within and around the proposed quarry site**. Additional field work will, however, serve three goals. First, it will further our understanding of the significant woodland, wetland and other critical terrestrial and aquatic habitat areas as more is learned about the plant and animal species inhabiting these areas, the variety of plant communities present, the surface and groundwater hydrology and ecological linkages, and the functioning and inter-relationships of all of the features present. Second, it will likely increase the designation significance of the features present. These two advancements will then inform the third goal which is the long term protection needs for a resilient natural heritage system of high ecological integrity.

ENVIRONMENTAL IMPACT ANALYSIS ISSUES

Documenting the impacts that may be associated with the development of the proposed Lowndes Holdings quarry will require a significant amount of research to provide a complete understanding of the natural environment and of the impacts that may result from the development of aggregate resources, particularly hard rock mining below the water table.

Impacts to natural features in aggregate development applications are most often considered in relation to the *structural change* that results within the environment; for example a forest is removed and the species diversity associated with the forest is lost. What must also be considered is the "ecological system" and how a structural impact results in *functional changes* both within the immediate environment where the structure change has occurred and to adjacent natural features which are seemingly removed from the direct impact, *e.g.* a maple-beech forest is removed, this may result in functional changes such as the loss of ecological linkage between adjacent natural areas, or changes to the regional water balance due to greater runoff of rainwater, less infiltration of groundwater and less evapotranspiration.

It is clearly also is important to consider the effect of each new development in relation to their **interactions and cumulative impacts** of land use change within a region.

Key ecological issues of concern and impact analysis considerations consistent with the preceding principles are outlined in the main body under a series of headings:

- ecological features and functions
- hydrologic features and functions
- biological diversity
- ecological linkages and
- long-term ecological change.

PRELIMINARY CONCLUSIONS

The Lowndes Holdings property contains significant provincially, regionally and municipally designated natural features that contribute to the biological diversity and ecological integrity of the site and the broader region. This conclusion is based on the geographic extent of natural features present, the diversity of communities represented, the quality of the natural areas, the hydrologic attributes of wetlands and creeks, and the interconnectedness of the natural areas. **Few areas of southern Ontario have this combination of natural attributes**. These ecological designations are based upon strong and defensible criteria developed and assessed by technical personnel. Further study of the significant woodlot and critical habitat can only strengthen these designations. Furthermore, Natural Heritage Systems have been adopted and are being implemented as the most effective strategy to protect and restore significant natural features over long periods of time.

The proposed development of a hard rock aggregate development operating below the ground-water table within the Lowndes Holdings property would have serious environmental implications for the existing ecologically designated natural features. **It is critical that evaluations of the proposed land use changes consider both structure and function, at a range of biological scales ranging from genetic, to species, communities and landscape, as well as a range of geographic and temporal scales to fully appreciate the qualities that characterize integral, dynamic ecosystems resilient to internal and external forces. The evaluations must also consider the cumulative impacts**. It is noted further that the proposed aggregate development is contrary to the land use planning documents and designations that have been prepared to protect these natural heritage features including the current and draft Provincial Policy Statement, the Hamilton-Wentworth Official Plan, the Flamborough Official Plan, and the draft Greenbelt Plan.

Acknowledgements

Garry Hunter, Hunter and Associates
Dr. Kent Novakowski of Queen's University
Kenneth G. Raven, M.Sc. and P.Eng., INTERA Engineering Ltd.

Report Author: Dr. Brent Tegler, North-South Environmental Inc. (2005)

Table of Contents

Figures

Preliminary Report of the Environmental Features and Potential Impacts associated with the Proposed Lowndes Quarry, City of Hamilton

1. INTRODUCTION

Lowndes Holdings owns property that comprises parts of Lots 1 through 5 on Concession 11 East of the former Township of East Flamborough, now a part of the City of Hamilton, and bordering the Region of Halton. The property has been identified as having surficial aggregate resources as well as Amabel dolostone underlying the surficial deposits. From the documentation currently available, the proponent, Lowndes Holdings, intends to develop the property for a limestone quarry that would extract aggregate material from below the groundwater table.

The present report has been prepared to document the landscape so that decision makers may understand:

- the ecological nature of the site and adjacent ecological features,
- the factual and evaluative bases for the ecological designations, and
- the assessments necessary to obtain a complete understanding of the site and how it would be affected by the proposed aggregate development.

This report does not constitute a detailed critique nor consideration of any applications filed under applicable legal regimes, such as the *Planning Act* (as submitted 09/20/04), the *Aggregate Resources Act*, the *Ontario Water Resources Act* and the *Conservation Authorities Act*. Such analysis will be submitted under separate cover.

1.1 Purpose of Report

The intent of this report is to describe the natural heritage features and functions that exist within the Lowndes Holdings property and to examine how these are ecologically linked to other natural areas within the landscape. The report also examines the current ecological designations that apply to these natural heritage features and the basis on which these designations have been made. This assessment is intended to provide early assessment of the kinds of environmental issues that may arise from the proposed quarry and the current and evolving regulatory standards that apply to this quarry proposal.

Potential ecological impacts to natural areas on and surrounding the property have been identified as one of two major issues raised by the proposed quarry. Work is also proceeding on the identification of potential hydrogeological impacts that may be associated with the proposed quarry. Ken Raven, M.Sc. and P.Eng. of INTERA Engineering Ltd., has been retained for his expertise in dealing with fractured rock hydrogeology, building on the leading academic work of Dr. Kent Novakowski of Queen's University.

1.2 Author's Expertise and Experience

Dr. Brent Tegler has a Bachelor of Science degree from the University of Toronto (1977), a Master of Science degree from McMaster University (1980), and a Doctor of Philosophy from the University of Guelph. Dr. Tegler has published papers in refereed journals in the general field of ecology and given numerous papers at academic conferences. Dr. Tegler is also a lecturer in ecology at universities in Canada and overseas and currently is appointed to Special Graduate Faculty at the University of Guelph to sit on the M.Sc committee of a student in the School of Environmental Design and Rural Development.

Dr. Tegler's work experience includes providing environmental consulting services for over 24 years within Canada and internationally. He has managed and been the principal report author for numerous projects including field inventories, environmental impact analysis, and environmental management design studies for sustainable resource utilization and protection in a wide range of environments including tropical, temperate and arctic ecosystems. Dr. Tegler has demonstrated abilities in applied research, project management and formal and non-formal training as a result of positions held within universities, government, and environmental consulting. Currently, Dr. Tegler is a principal partner and owner of North-South Environmental Inc. His *Curriculum Vitae* is provided in Appendix A to this Report.

1.3 Structure of the report

The present report has been prepared through review of existing data sources, including referenced reports and inventories, aerial photographs of the region, and the FORCE GIS mapping prepared by Hunter GIS, as well as through field visits to the roadside areas surrounding the site and locally. Information regarding the proposed extraction of aggregate from the property has been limited. Although an application was recently filed with the City of Hamilton, the studies supporting this proposal are preliminary only, and given their methodological and seasonal limitations, have not been used for this report in favour of more detailed existing data prepared by third parties.

In addition to the Introduction the report contains the following sections.

Section 2. Major Environmental Principles: This section establishes guiding principles for sustainable development based on ecological principles from the science of conservation biology.

Section 3. Existing Setting: The environmental features and functions present within the proposed quarry property and the surrounding lands are described using available reports.

Section 4. Review of Applicable Standards: This section provides an overview of official environmental policies of the province and municipalities that apply to the Lowndes Holdings property and to the surrounding lands.

Section 5. Major Issues: A preliminary assessment of major and minor environmental issues is provided that arise through a consideration of conservation biology principles, the environmental features and functions present within the study area and the application of government policies and regulations.

Section 6. Information Gaps: Gap analysis summarizes the findings, to date, in terms of significance. The limitations of existing environmental information on natural features and functions within and surrounding the proposed quarry site are noted as are the analyses that may be undertaken to better understand the potential impact of the operation of the proposed quarry.

Section 7. Preliminary Conclusions

2. MAJOR ENVIRONMENTAL PRINCIPLES

Conservation biology principles have emerged over the past twenty years in direct response to efforts aimed at the long-term conservation of natural areas within landscapes containing high levels of human activity. Conservation biology is addressing the fact that many of the natural areas that have been set aside for the protection of native plants and animals are nevertheless showing a decline in the presence and/or quality of the natural attributes that were originally present. The science of conservation biology has provided insights into why some of these declines occur and what efforts can be made to stop and/or reverse the trends observed.

There are three core principles of conservation biology to be considered where human development alters the landscape:

1. Maintain Biological Diversity;
2. Avoid Habitat Fragmentation; and
3. Promote Corridors and Linkages.

2.1 Primacy of Maintaining Biological Diversity

One of the principal aims of conservation biologists is the preservation or where degraded, improvement of the biological diversity of the planet. The exponential growth of human populations has, and continues to place huge stresses on the natural environment as the demand for human livelihoods, food, transportation, and recreation increases. This is exacerbated by the affluent lifestyle of residents in the northern hemisphere, who consume a disproportionate amount of resources, with negative consequences for habitat conservation both in the northern and southern hemispheres. All of this adds up to what has been labeled the sixth great global extinction, as species are currently disappearing at up to one thousand times higher than normal on a global scale (Leakey and Lewin 1996, Primack 1998).

BRONTE CREEK VISION STATEMENT

Our vision for the Bronte Creek is a healthy creek in a healthy watershed. A watershed that supports a rich diversity of plants and animals in extensive, interconnected forests, wetlands, meadows, valleys and Niagara Escarpment features within both the rural and urban landscape. Through sustainable human activities, carefully planned development and stewardship inititiatives, there will be a place for nature, community, agriculture and recreation. Our citizens will be stewards protecting, enhancing and restoring the watershed for future generations.

The loss of species is a global phenomenon. Although the loss is not evenly distributed across the globe, it is ubiquitous and results from the incremental conversion of predominantly natural habitat to human-dominated lands that support fewer species of plants and animals. Moreover, the loss of biodiversity is not something that is happening “somewhere else”, it is an issue in our own backyards. Habitat conversion is

most evident within the urban environments of southern Ontario where in many cities less than seven percent of the landscape supports any form of native ecosystem (City of Mississauga Natural Areas Report - North-South Environmental 2000).

Beyond the issue of the global and local loss of species, there is also an issue of local responsibility for biodiversity and sustainable development. The landscape in which we live constitutes part of our heritage. The current settlement patterns, industry, and economies we enjoy have developed to a large degree in response to the opportunities that were presented by the natural environment that our predecessors encountered. Yet there is a difference between the habitat and species that frequented southern Ontario prior to European settlement and the converted habitat that is now present. More significantly, the habitat and species characteristic of southern Ontario's converted landscapes are now more abundant than the pre-settlement habitat and species that once existed. Thus, *every acre of conversion of natural landscape to human landscape is a threat to the native biodiversity of the region*.

The vegetation and animals that are indigenous to the area, along with the climate and landform, define the place in which we live. Unless the present generation takes responsibility to ensure that this natural heritage is preserved, future generations will not have this heritage present in the environment we leave for them. *Thus, sustainable development includes not only the protection of rare and endangered species that we value, but also the habitats that are representative or typical of the local landscape*.

A large number of plant and animal species inhabit a diverse range of natural areas within and in close proximity to the proposed quarry site. This creates an area of high biodiversity within a region of intense human development. Within the region, biodiversity continues to be threatened as the total area of available habitat declines. In addition, the remaining habitats that support biodiversity become further fragmented, isolated from one another and degraded due to onsite impacts such as trails, logging, and grazing and due to offsite impacts such as invasive plants, competition from "edge species", and the effects of pollution. The protection and restoration of features within the site and the surrounding area can provide for the long-term protection of its plants and animals and provide an opportunity to further enhance local biodiversity.

John Riley of the Nature Conservancy of Canada states….
"*We hope that communities begin to recognize that they have almost no examples of woodlands, large or small, that come close to the woodlands experienced by settlers and native peoples. This is a heritage issue and, for those of you who have visited some of the magnificent old growth upland forests elsewhere in the Great Lakes basin, it is not too much of a stretch to suggest that we should invest in some of our best woodlands now, with a goal to growing great old-growth forests for future generations.*"

2.2 Importance of Minimizing Habitat Fragmentation

From an ecological perspective, the change in land use in southern Ontario since the beginning of European settlement can be characterized as a fragmentation of natural habitat. In recent centuries, Ontario has experienced two large-scale conversions of its pre-settlement landscape. The first conversion was the large-scale conversion of forested lands to agricultural lands. The second conversion was the large-scale conversion of agricultural lands to urban and industrial land uses. While there are also many instances of agricultural lands reverting to natural uses, southern Ontario in the Greater Golden Horseshoe is more often seeing agricultural lands converted to urban land uses, usually for residential or employment uses. The overwhelming impact of these land use conversions of natural habitat is a phenomenon called habitat fragmentation. Noss and Cooperrider (1994, citing Burgess and Sharpe 1981, Noss 1983, 1987a, Harris 1984, Wilcox and Murphy 1985) notes that habitat fragmentation is the greatest threat to biodiversity worldwide.

Numerous studies, including research in the Region of Waterloo (*e.g.*, Friesen *et al.* 1995, and Friesen 1995) and several other studies in Ontario (*e.g.*, Burke and Nol 1998, Villard *et al.* 1999, Riley 1999), and wider ranging studies (Trombulak and Frissell 2000), have documented the negative effects of fragmentation on natural areas. These impacts include:

- loss of habitat for native species;
- macro and micro climate alterations;
- hydrologic disruptions, including lower or higher water tables;
- reduction in the size of remnant habitat patches;
- increases in the distance between remnant habitat patches;
- increase in the amount of habitat associated with “edges” and concurrent decrease in habitat associated with large unbroken patches (*e.g.*, interior forest or core forest);
- impact on the ability of flora and fauna to migrate in response to climate change;
- decreases in the availability of breeding sites and food;
- where fragmentation is associated with new roads, increases in mortality for some species, and reduction in local movement patterns for some species;
- the inability to re-populate sites following local extinction;
- reduced viability of animals requiring migration to move between sites to complete life cycle requirements; and
- reduction in the exchange of genetic material to prevent deleterious impacts associated with in-breeding in isolated gene pools.

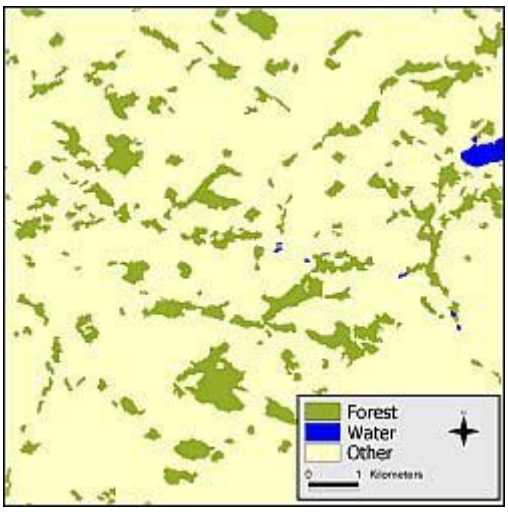
Several of these impacts relate to **functional attributes** of the natural landscape (*e.g.*, species movement requirements for migration, dispersal, re-colonization, genetic mixing, *etc.*). Such impacts are often overlooked in impact assessments in favour of focusing on impacts related to **structural attributes** of the environment (*e.g.*, woodlands, wetlands, individual species). It is much easier to suggest mitigation or design that avoids particular structural elements in the landscape. This ignores, however, the vital role that functional attributes make to ecosystem integrity and the long-term protection of biodiversity.

Ecological Structure and Function

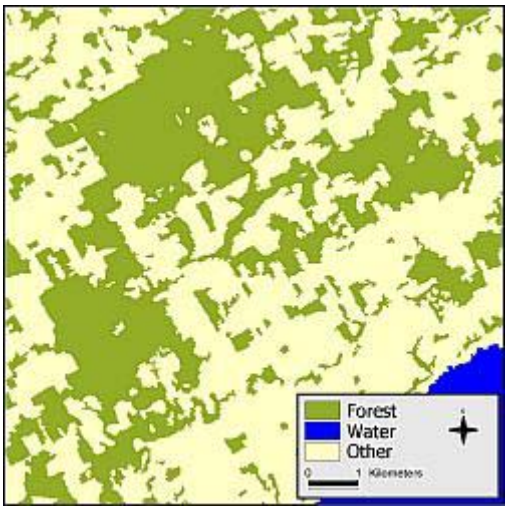
It is critical that evaluations of proposed land use changes consider both structure and function, at a range of biological scales ranging from genetic, to species, communities and landscape, as well as a range of geographic and temporal scales to fully appreciate the qualities that characterize integral, dynamic ecosystems resilient to internal and external forces.

Southern Ontario is generally characterized by low forest cover and a moderate degree of forest fragmentation as shown in Figure 3. Within the Hamilton-Wentworth area woodland/scrubland cover (excluding swamps) was 22.4 % in 1978; this represents a 76 % reduction of the original extent of the woodland/scrubland cover that existed prior to European colonization. In the vicinity of the proposed quarry there are many areas of significant woodlands and wetlands that have been protected from agricultural development, the former as a result of shallow soils associated with the Niagara Escarpment and the latter due to seasonal/permanent flooding. The continued protection of and conservation investment in natural areas within the proposed quarry site and within the region represents an outstanding opportunity to maintain an area with large, contiguous wetland and woodlands that offer the best possible opportunity to ensure long term protection of southern Ontario's native biodiversity.

Bird Studies Canada (BSC) has used data from the Ontario Breeding Bird Atlas (OBBA) study to demonstrate the impact of forest fragmentation on biodiversity within woodlots that are relatively close to each other in southern Ontario (www.bsc-eoc.org/organization/giswork.html). The maps on the next page show a substantial 35% reduction in the number of species of breeding birds as the total forest cover and more importantly interior forest cover declines.



Map A
A landscape with a low to moderate degree of forest cover and moderate fragmentation within one UTM square (10,000 ha), located near Guelph, Ontario.



Map B
A landscape with a high degree of forest cover and low fragmentation within one UTM square (10,000 ha), located near Long Point, Ontario.

The landscape in Figure 3 is approximately 13% (1287 ha) forested, with only 11% (142 ha) of the forested area providing "interior forest" habitat. During the OBBA study, a total of 77 different species of birds were identified as probable or confirmed breeders in this UTM square, with an additional 7 species classified as possible breeders.

The landscape in Figure 4 is approximately 38% (3812 ha) forested, with a substantial 45% (1712 ha) of forested area providing "interior forest" habitat. During the OBBA study, a total of 107 different species of birds were identified as probable or confirmed breeders in this UTM square, with an additional 23 classified as possible breeders.

2.3 Protection and Restoration of Corridors and Linkages

The idea that connections between patches of remnant habitat be maintained as a conservation strategy is a logical extension of the tenets of island biogeography (MacArthur and Wilson 1967), as proposed in the early seventies by Wilson and Willis (1975). The importance of connections in terrestrial landscapes is predicated on the species equilibrium theory, which is based on studies in marine environments with scattered islands. These studies have shown that species extinctions (*i.e.*, declining biodiversity) and species immigration (*i.e.*, increasing biodiversity) on each of the islands will, over time, reach equilibrium. Based on this theory, islands that are closer together experience higher immigration of new species from neighbouring islands and high biodiversity, while widely spaced islands have lower rates of immigration and low

biodiversity. By extension, this theory applies to developed landscapes such those found in southern Ontario, where habitat "islands" with good connections result in high biodiversity and habitat "islands" with poor connections result in low biodiversity.

In an island environment, this species equilibrium theory has clear factual support. Studies of terrestrial environments show that these habitats, though in some respects similar to islands, can be more complex. While remnant patches of natural habitat may be analogous to true islands in some ways, there can be substantial differences in the quality of the intervening landscape. In some cases the intervening terrestrial landscape may not impose the near absolute barrier to migration as would large water bodies to island residents. For example, many (but not all) animal species can move between habitat patches when the intervening landscape consists of agricultural lands. Consideration of the intervening lands, referred to as the landscape "matrix", is therefore an important factor to consider when evaluating the functional attributes of a landscape. Some of the issues that need attention include the following:

- the existing species present in a given area and a knowledge of their movement abilities and behaviour;
- the quality of the landscape matrix; is the landscape matrix acting as source for predators, parasites and disease that enter 'islands' of native habitat through corridors and edges;
- the degree to which the existing matrix imposes a complete or partial barrier, or no barrier to the resident vegetation and animals;
- the long-term viability of resident plant and animal species that will be substantially or completely isolated (confined) in a habitat 'island' due to a change in land use;
- how proposed changes to the existing land use will impact the existing ability of animals and vegetation to disperse and/or move among remnant patches; and
- the existence and importance of linkages beyond the immediate study area to the larger landscape through regional connections (*e.g.*, south-central/southwestern Ontario).

It should be emphasized that a landscape composed of remnant patches of natural habitat in an agricultural and/or urban matrix is far from ideal and it is not a desirable conservation end point. Not only will there be numerable species for which the matrix is a barrier or partial barrier, there will also be undesirable species present in the agricultural/urban matrix whose spread and impact on natural habitat will be facilitated. Many of the non-native, invasive weeds that impact our native vegetation and reduce biodiversity evolved in the predominantly agrarian ecosystems of Europe and Asia. These species are highly adapted to the disturbance cycles associated with agricultural practice as well as the edge habitats that prevail in small remnants typical of agricultural landscapes. These species will disperse readily through these landscapes and establish in remnant natural areas, generally with negative consequences.

Corridors act to increase the frequency of immigration. Thus, in a typical southern Ontario landscape where fragmentation has resulted in small islands of remnant habitat

and the movement of animals is impeded, the establishment of corridors is likely beneficial. The role of corridors as agents of re-colonization has been termed the *rescue effect* by Brown and Kodric-Brown (1977). Corridors play an indispensible role, therefore, in mitigating the impacts of habitat fragmentation. Connections can facilitate the re-population of areas subject to local extinctions of particular species; they can facilitate the dispersal of young to new habitats in the post-breeding season and will provide the connections necessary to allow certain species to fulfill lifecycle requirements such as feeding and breeding. They also provide for the less frequent long distance migration of individual animals among populations necessary for maintaining genetic health at the population level.

Survival of Fragmented Woodland Systems in Southern Ontario
By Gray Merriam in FON (1999)

Consider a ten acre farm woodlot surrounded by cultivated fields in all directions for five kilometres. Now consider some species that require woodland habitat, for example, ruffed grouse, red-backed salamanders, chipmunks, trout lily, and round-lobed hepatica trying to survive in fragmented woodlands.

How can these species survive in the woodlot that we have visualized? What are the main problems in their struggle for survival? First, in small woodlots, numbers in a population will be small. With small numbers, the chance that all the individuals will be lost at once is remarkably high. So, sometime soon, all the individuals, or all those of one sex, will die and the woodlot will have suffered a 'local extinction'. The populations in the wooded fragments can 'blink off', like little lights on a computer game. For the population to survive it must be able to 'blink on' again.

Because the woodlot is surrounded by cropland which can be threatening and hazardous to woodland species, immigration of new colonists to replace the lost species will be constrained - more so for trout lilies and red-backed salamanders than for ruffed grouse and chipmunks.

Unless individuals of the lost species can immigrate from other patches of woodlands, our one woodlot will not be re-colonized. If this process repeats itself in additional woodlots without re-colonization, the 'local extinction' will spread and become regional.

Dr. Gray Merriam, a world leader in Conservation Biology research on the effects of forest fragmentation, recently retired from Carleton University in Ottawa.

It should also be recognized that corridors perform similar ecological functions for vegetation. Many plants disperse their seeds through animal vectors (*e.g.*, forest ants disperse the seeds of trilliums found in Ontario woodlands). Thus, linkages are needed for the animals to carry seeds to new environments. Other plants may spread by the

incremental establishment of seedlings just metres away from the parent plant. For such species to spread, there needs to be an unbroken connection of suitable habitat. If the plant is one that requires interior forest to establish (*e.g.*, American beech), the connection must have continuous interior forest habitat.

Notwithstanding the intuitive appeal of establishing corridors as a conservation strategy, some researchers (Simberloff and Cox 1987, Soulé and Gilpin 1991) have noted potential negative impacts associated with corridors. Both the potential advantages and disadvantages of corridors (as outlined in Noss 1987) should be considered in an overall conservation framework. While these advantages and disadvantages apply to varying degrees in Ontario**, it is widely recognized that most existing natural areas in southern Ontario are too small to maintain natural ecological processes and populations of species over the long term. In light of this, the incorporation of corridors in conservation strategies, as a means of facilitating movement of biota among remnant areas, is considered highly desirable.** While conservation strategies should be cognizant of the disadvantages of corridors reported in the literature, these are by far outweighed by the advantages that mitigate the impacts of fragmentation.

Conservation biologists throughout North America are therefore designing bioregional conservation plans that utilize corridors and linkages to restore connections among habitat fragments (*e.g.*, "A2A" – Algonquin to Adirondack Conservation Initiative; "Y2Y" - Yellowstone to Yukon Conservation Initiative; Crown of the Continent Ecosystem; The Wildlands Project in Florida). At the regional and local level, corridors are equally important and southern Ontario has many examples such as the Richmond Hills Corridor Study (Geomatics 1998), St Clair Natural Heritage System (Geomatics 1997b), Georgian Bay Islands Greater Park Ecosystem Study (Geomatics 1999), Rouge-Duffins Natural Heritage Strategy (Geomatics 1997a), Oak Ridges Moraine Natural Heritage Study (Geomatics 1993) and the Natural Environmental Systems study for the Region of Ottawa-Carleton (Geomatics 1995), *etc*.

The functionality of corridors is directly related to their quality. Corridors based on hedgerows, (even with enhancements such as widening), will only ever accommodate species that are highly vagile (*i.e.*, able to move about freely), tolerant of disturbed conditions (*i.e.*, not interior forest species) and are not prone to easy predation. These species are generally those that are already abundant throughout the highly fragmented environment of southern Ontario. Emphasis should be placed, therefore, on establishing substantial connections between high quality core areas that contain interior forest species, as these are generally the species most in need of conservation attention.

Conservation Priorities for Woodland Birds in Southern Ontario

Specifically, this involves protecting the largest forest tracts; maintaining woodlot shape to minimize the extent of edge and concentrating restoration efforts in areas with extensive forest in the landscape.

(Francis and Austen 1999)

The ecological dispersal requirements of plants of interior forest habitats are complex and particularly restrained by unsuitable open conditions associated with fragmentation. For example, forest insects, such as ants and beetles, disperse the seeds of many forest plants and the presence of symbiotic (mutually beneficial) fungi in the soil may be essential to a plant's health. In the same manner that forest plants depend on interior forest conditions, so too do the insects that disperse these plants and the symbiotic fungi that sustain them. The fundamental requirement for the dispersal, germination and survival of forest plants is therefore, continuous interior forest conditions within core areas and along corridors intended to provide ecologically functional connections.

3. OVERVIEW OF PROPOSAL AND EXISTING SETTING

3.1 Current Information Base

For the present report, information regarding the proposed extraction of aggregate from the property owned by Lowndes Holdings has been limited. As noted above, although an application was recently filed with the City of Hamilton to seek required *Planning Act* approvals, the studies supporting this application are preliminary only and, given their methodological and seasonal limitations, have not been used for the present report in favour of more detailed existing data. To date, no application, with more detailed studies, has been filed under the Aggregate Resources Act.

Thus, the present report has relied upon several sources of recent information describing the ecological features within and around the lands currently held by Lowndes Holdings, including the following:

1. Nature Counts Project. Hamilton Natural Areas Inventory (Dwyer 2003);
2. Environmentally Sensitive Area Study. Regional Municipality of Halton (Geomatics 1993, North-South 2003);
3. Natural Areas Reports. Available from the Natural Heritage Information Centre (NHIC) website of the Ontario Ministry of Natural Resources (www.mnr.gov.on.ca);
4. Wetland Data Records and Evaluations. Available from the Ontario Ministry of Natural Resources (Guelph and Aurora Offices);
5. Bronte Creek Watershed Study. Main Report and five Appendices. (Conservation Halton 2002);
6. Greenbelt Plan, 2005 (http://www.mah.gov.on.ca/userfiles/HTML/nts_1_22087_1.html);
7. Big Picture 2002 Project. Produced by the Natural Heritage Information Centre and the Nature Conservancy of Canada (NHIC/NCC 2002) in collaboration with Ontario Nature and Carolinian Canada (www.carolinian.org)

The following figures are provided at the end of section 3 illustrating the natural features and ecological linkages discussed in this section of the report:

Figure 1 Regional Setting
Figure 2 Designated Natural Areas
Figure 3a Official Plan Environmental Designations
Figure 3b Original Township Fabric and Orthophoto
Figure 4 Site Environmental Features

3.2 Current description of proposed quarry site

The Lowndes Holding property is situated on approximately 220 ha (544 acres) located in the northeast corner of the City of Hamilton, within the former Town of Flamborough. The proposed site also borders to the east, the Regional Municipality of Halton. Prime agricultural soils are present on about half of the property and much of this land is currently in production as pasture and row crops. Current agricultural facilities include four farm homesteads and an oval horse trotting track. The proponent has initially proposed to situate its quarry on approximately 160 ha within the eastern part of the site. However the proponent has also explicitly indicated its intent to expand the proposed aggregate operation to approximately 60 ha on the property west of the application's proposed excavation, subject to required approvals.

The remaining half of the site has a diverse natural vegetation cover, including mature upland deciduous and mixed forests, wetland areas dominated by treed swamp communities composed of deciduous, mixed or coniferous tree species, and early successional forests and meadows on abandoned agricultural land. The areas of natural vegetation located within the site are contiguous and/or form linkages with upland forests and wetlands located off the site.

In addition to the upland and wetland vegetation present on site, riparian ecosystems are also represented in five creeks present within the site. These include the headwaters of three tributaries of Mountsberg Creek that arise within portions of the upland forest present within the site (Tributaries B, C and D shown on Figures 3 and 4). These three tributaries flow out of the property in a southerly direction, where approximately 100 to 300 metres offsite, they link up with the main channel of Mountsberg Creek which is part of the Bronte Creek watershed. It is noteworthy that tributaries C and D are described as coldwater streams (Dwyer 2003). A fourth creek, which is also a tributary of Mountsberg Creek, flows in a southwest direction through a wetland located in the northern portion of the site. The fifth creek is a coldwater tributary of Flamboro Creek flowing in a southerly direction as it passes through a wetland located on the east side of the property.

The natural heritage features present on the site have various, overlapping, natural area designations based on the following municipal and provincial programs. Descriptions of these designations are provided below.

Municipal or Provincial Program	Natural Area Designations within the Lowndes Holdings Site
City of Hamilton Ecologically Sensitive Areas program (Dwyer 2003)	• Mountsberg East Wetlands (Hamilton ESA Flam-36) • Carlisle North Forests (Hamilton ESA Flam-38)
City of Hamilton Official Plan (Hamilton 2003)	• Natural Heritage System • Linkage and Restoration Areas
Ontario Ministry of Natural Resources wetland evaluation manual for Southern Ontario (OMNR 2002a)	• Lower Mountsberg Creek Provincially Significant Wetland Complex
Ontario Ministry of Natural Resources Big Picture Project (NHIC/NCC 2002)	• Core Natural Area and Linkage Area
Ontario Ministry of Municipal Affairs and Housing Greenbelt Plan (MMAH 2004a, 2004b, 2005)	• Protected Countryside and Natural Heritage System

3.3 Current description of regional setting

The Lowndes Holdings property is located within a region of southern Ontario that has a relatively high percentage of woodland vegetation cover (14 %) characterized by large, high quality forests with good ecological linkages. The natural areas present within the proposed quarry site have been identified in the Big Picture 2002 study (NHIC/NCC 2002) and Greenbelt Plan mapping (MMAH 2004a, 2004b, 2005) as core areas that form part of much larger regional natural area corridors associated. Figure 1 shows four corridors with connections to the Lowndes Holdings property. These include: the Niagara Escarpment corridor associated with the abundant natural cover protected within the Niagara Escarpment Plan Area; the Bronte Creek – Great Lakes Coast connection provided by natural areas occurring along Bronte Creek valleylands to Lake Ontario; the Paris-Galt Moraine corridor formed by the high proportion of natural cover on this glacial feature; and the Erie–Carolinian corridor linking natural areas eastward as promoted by Carolinan Canada (Reid and Carolinian Canada 2002, OMNR 2002b). The City of Hamilton Regional Official Plan (see Hamilton 2003, Appendix Map 3) has also identified ecological linkages within a Natural Heritage System that runs through natural areas present on the site as well as linkages within natural areas that are contiguous with the proposed quarry site (see Figure 3a).

Within a 5 km radius of the Lowndes Holdings property there are a large number of natural areas (11 ESAs, 5 PSWs, 3 LSWs wetlands, 5 ANSIs, a Conservation Halton Natural Area and a MNR designated Deer Wintering Area) within and linked to the site for which due regard must be given. This section of the report provides a brief description of local natural areas and outlines some of the reasons why these areas are considered significant based on the available information in existing reports.

City of Hamilton Ecologically Sensitive Areas (Dwyer 2003)

The Nature Counts Inventory Project was undertaken by a team of professional biologists that identified plants, animals, birds, butterflies, fish and other significant species in order to identify important habitats for protection based on strong and defensible ESA criteria developed by a technical steering committee (Dwyer 2003). Two ESAs, *Mountsberg East Wetlands* and *Carlisle North Forests,* are located, in part, within the Lowndes Holdings property. Three ESAs are located within close proximity to the site, *Mountsberg Wildlife Area* (2.5 km northwest of the site), *Freelton Esker Wetland Complex* (0.5 km southwest of the site) and *Progreston North Swamp* (2 km southeast of the site) and four additional ESAs (Puslinch Southeast Wetland, Beverly Swamp, Strabane North Wetlands, Bronte Creek Ravine) located within the 5 km radius circle shown on Figure 2.

Mountsberg Wildlife Area (Flam-29) A 650 ha site that includes riparian areas that serve as a link between natural areas, habitat for 30 significant species, wetlands that provide essential staging and breeding areas for waterfowl, large core natural areas with interior forest habitat, and rare biotic communities. The area has a significant hydrologic function given the wetlands and reservoir that store water and maintain base flow. With an environmental education centre widely used by schools the ESA has significant educational and research value. This ESA is also designated by OMNR as an ANSI and PSW.

Located approximately 2.5 km northwest of the Lowndes Holdings site, Mountsberg Wildlife Area is functionally connected by contiguous natural vegetation joining the two ESAs and by the hydrologic connection of Mountsberg Creek and its tributaries.

Freelton Esker Wetland Complex (Flam-30) A 390 ha site that contains a provincially significant esker with wetlands and upland woods that provide habitat for 12 significant species including essential nesting habitat for the colonial nesting species great blue heron and interior forest habitat. This ESA is also designated by OMNR as an ANSI and PSW.

Located approximately 0.5 km southwest of the Lowndes Holdings site, the Freelton Esker Wetland Complex is functionally connected by contiguous natural vegetation that crosses Centre Road linking the two ESAs and it is hydrologically connected as Mountsberg Creek is a part of the watershed of Bronte Creek which flows through the Freelton Esker ESA.

Mountsberg East Wetlands (Flam-36) A 768 ha site that consists of aquatic, wetland and terrestrial communities with interior forest habitat, a provincially significant wetland and a linkage function between other natural areas in Flamborough and neighboring Halton Region. Fourteen significant species are reported within this ESA. The following excerpts from Dwyer (2003) highlight the significant hydrologic functions of this ESA:

> *Groundwater recharge occurs at this site; the area has a high susceptibility to groundwater contamination due to the combination of steeply rolling topography and shallow, coarse soils.* (Dwyer 2003, page 270)
>
> *A combination of overland flow and local groundwater discharge likely support the riparian wetlands at this site. The natural vegetation at this site helps maintain water quality in the upper Bronte Creek system.* (Dwyer 2003, page 270)

This ESA occupies the northwest portion of Lowndes Holdings property and extends off-site to the northwest, west and southwest. This ESA is contiguous with the Carlisle North Forests ESA located within the southeast portion of the Lowndes Holdings property and it provides linkage northward to the Mountsberg Wildlife Area ESA, westward to the Freelton Esker Wetland Complex ESA and eastward to the Guelph Junction Woods Environmentally Sensitive Area designated by Halton Region.

Carlisle North Forests (Flam-38) A 340 ha site that encompasses the headwaters of three parallel, south flowing coldwater streams. The ESA *encompasses part of an extensive network of interconnected natural areas comprised of upland and wetland forests and stream corridors in the upper Bronte Creek watershed* (Dwyer 2003, page 39). It supports 11 significant species, contains interior forest habitat, serves a linkage function to other natural areas and has significant hydrological functions given the coldwater streams and wetland present.

This ESA occupies the eastern and southeastern portion of Lowndes Holdings property and extends off-site to the south. Two of the coldwater streams within this ESA have headwater areas located within the central portion and eastern portions of the Lowndes Holdings property. Similar to the Mountsberg Wildlife ESA, Carlisle North Forests provide linkage eastward to the Guelph Junction Woods Environmentally Sensitive Area and the Twiss Natural Area, they also provide linkage southward to the Progreston North Swamp ESA, multiple linkages through the Lowndes Holdings property and along the western boundary of the property to link the Mountsberg Wildlife ESA, there may also be linkages eastward to the Freelton Wetland Complex.

Progreston North Swamp (Flam-40) A 115 ha site that encompasses a group of wetlands along the upper section of Bronte Creek, as well as associated terrestrial communities. The ESA provides habitat for 8 significant species and contains interior forest habitat. The OMNR have designated the wetlands provincially significant.

Located 2 km to the south of the Lowndes Holdings property suggests that there are important hydrologic connections associated with the creeks flowing southward, contributing to the maintenance of the high quality aquatic habitat present within the headwaters of Bronte Creek.

Region of Halton Ecologically Sensitive Areas (Geomatics 1993, North-South 2003)

The Region of Halton Ecologically Sensitive Areas (ESA) program has designated two natural areas that are functionally connected to the Lowndes Holdings property by areas of continuous vegetation cover consisting of upland forests and swamp wetlands. The Calcium Pits (ESA 19) is located approximately 1.5 km to the west and Guelph Junction Woods (ESA 20) is located approximately 1km to the northwest. Connections to these areas contribute to local and larger regional connections (see Section 4.5).

Calcium Pits (ESA 19) A 370 ha site that contains a significant groundwater discharge that supports wetland vegetation, which in turn contributes to surface water quality. The site supports 7 provincially rare species and 23 locally rare species. Calcium Pits is a regionally significant Life Science ANSI, a provincially significant Earth Science ANSI, a PSW and part of the Niagara Escarpment UNESCO MAB Reserve.

Calcium Pits is linked to the Lowndes Holdings property through a wide corridor (800^{+} metre wide) of natural areas associated with the Carlisle North Forests (Flam 38) ESA, Kilbride Creek and the Twiss Natural Area.

Guelph Junction Woods (ESA 20) An extensive 747 ha site that contains a diverse range of wetland and upland communities protecting groundwater recharge and discharge areas and surface water quality. One provincially rare plant and 18 regionally rare plants are present. The Guelph Junction Wetland Complex is provincially significant. The site is also part of the Niagara Escarpment UNESCO MAB Reserve.

This large natural area is connected to the Lowndes Holdings property by two wide (approximately 300 m) forested corridors one to Mountsberg East Wetlands ESA in the northeast and a second to the Carlisle North Forests in the southeast.

Wetlands (MNR NHIC files)

Lower Mountsberg Creek Wetland Complex A 299 ha PSW complex made up of 27 individual wetlands, composed of two wetland types (95% swamp and 5% marsh). This wetland complex is an overlapping designation associated with the Mountsberg East Wetlands (Flam 36) ESA, Freelton Esker Wetland Complex (Flam 30) and the Carlisle North Forests (Flam 38) ESA; several of the individual wetlands of the PSW complex are present within and along the border of the Lowndes Holdings property.

Mountsberg Reservoir Marsh A 209 ha PSW composed of two wetland types (1% swamp and 99% marsh). This wetland is an overlapping designation with the Mountsberg Wildlife Area (Flam 29) ESA which is located 2.5 km to northwest and is linked to the Lowndes Holdings property by continuous upland

and riparian natural areas associated with Mountsberg Creek and Mountsberg East Wetlands (Flam 36) ESA.

Kilbride Swamp Complex An 18 ha locally significant wetland complex made up of two individual wetlands composed of one wetland type (100% swamp). This wetland has riparian linkage to the Progreston North Swamp (Flam 40) ESA and an overlapping designation associated with the Kilbride Swamp Life Science ANSI.

Carlisle Wetland Complex An 11 ha locally significant wetland that is an overlapping designation with the Carlisle North Forests (Flam 38) ESA which in part is located on the Lowndes Holdings property. The Carlisle Wetland Complex is located approximately 1.5 km to the south of the Lowndes Holdings property and is linked to the property by contiguous natural areas associated with Mountsberg Creek and its tributaries.

Crawford Lake and Calcium Pits Wetland Complex A 116 ha PSW made up of 19 individual wetlands composed of two wetland types (98% swamp and 2% marsh). The wetland complex is part of the Crawford Lake ESA (Halton ESA 19) located approximately 1.5 km west of the Lowndes Holdings property and is linked to the property by a substantial natural forest corridor.

ANSI's (MNR NHIC files)

The OMNR ANSI program designates representative examples of earth and life science features to capture the full range of expression of Ontario's natural heritage. Three Life Science and two Earth Science ANSIs are designated within close proximity to the Lowndes Holdings property. As noted below, the ANSIs are associated with other designated natural areas that are functionally linked to the Lowndes Holdings property.

Calcium Pits Meltwater Channel Earth Science ANSI An abandoned glacial meltwater channel complex extending from north of Crawford Lake southward toward Kilbride. This ANSI is associated with the Crawford Lake and Calcium Pits Wetland Complex and the Calcium Pits ESA (Halton ESA 19). It is located approximately 1.5 km east of the Lowndes Holdings property and is linked to the property by a substantial natural forest corridor.

Calcium Pits Life Science ANSI The area includes a wide variety of biological communities including upland Escarpment forest, a limestone rock outcrop and a wet Escarpment trench containing a high quality wetland bog. Similar to the Calcium Pits Earth Science ANSI this area is associated with the Crawford Lake and Calcium Pits Wetland Complex and the Calcium Pits ESA (Halton ESA 19) which is located approximately 1.5 km east of the Lowndes Holdings property and is linked to the property by a substantial natural forest corridor.

Freelton Esker Earth Science ANSI The four km long Freelton Esker consists of an uneven, low, winding ridge of gravelly deposits from two to ten metres in

thickness considered to be the best example of an esker landform in the Hamilton area. This ANSI is associated with the Freelton Esker Wetland Complex (Flam 30) which is located approximately 0.5 km southwest of the Lowndes Holdings site to which it is functionally connected by contiguous natural vegetation.

Kilbride Swamp Life Science ANSI A 142 ha area with a variety of communities including upland forest dominated by sugar maple, mixed forests of white cedar, white birch and trembling aspen, and white cedar talus communities and wetlands consisting of marsh and swamp communities. This ANSI is associated with the Calcium Pits ESA (Halton ESA 19) which is located approximately 1.5 km east of the Lowndes Holdings property and is linked to the property by a substantial natural forest corridor.

Mountsberg Wildlife Area Life Science ANSI A 650 ha area that encompasses a varied landscape including well-drained rolling drumlins, hummocky ground moraine with mature upland woods, plantations and early successional communities, there are also deciduous and coniferous swamps as well as extensive marsh wetlands associated with the Mountsberg reservoir. This ANSI is associated with Mountsberg Wildlife Area (Flam 29) ESA which is located 2.5 km to northwest of the Lowndes Holdings property to which it is functionally linked by continuous upland and riparian natural areas associated with Mountsberg Creek and the Mountsberg East Wetlands (Flam 36) ESA.

Halton Conservation Areas

- Twiss Natural Area is a 21 ha resource management area

MNR Deer Winter Area

- During the winter month's deer congregate in areas that provide additional cover from winter storms while also providing a winter food supply. Deer wintering areas identified and mapped by the OMNR are present within the Lowndes Holdings property as shown on Figure 4. These areas provide important habitat during the winter season when survival can be tested by harsh weather conditions.

Figures 1, 2, 3a, 3b, and 4 follow

Figure 1 Regional Setting

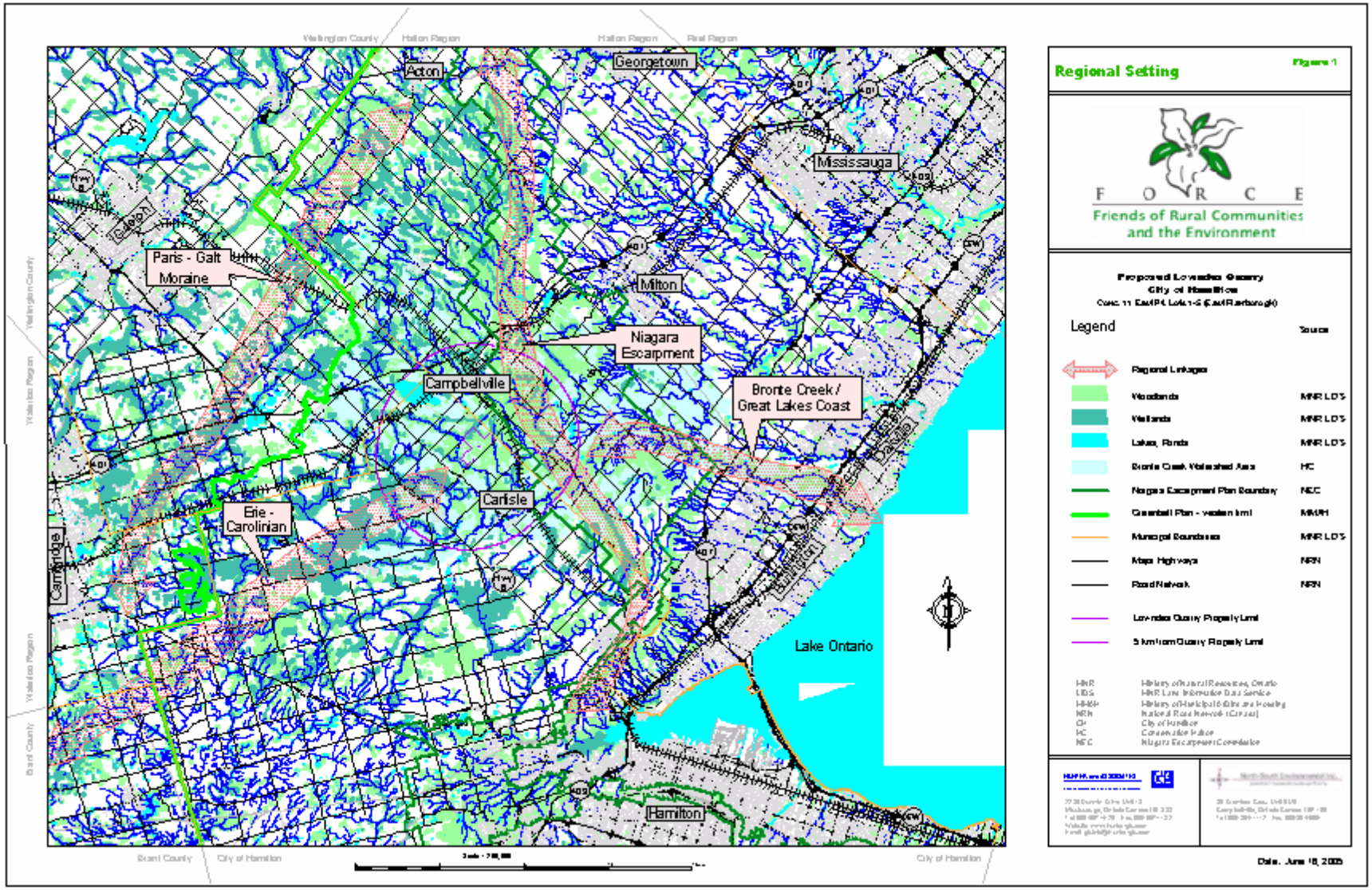


Figure 2 Designated Natural Areas

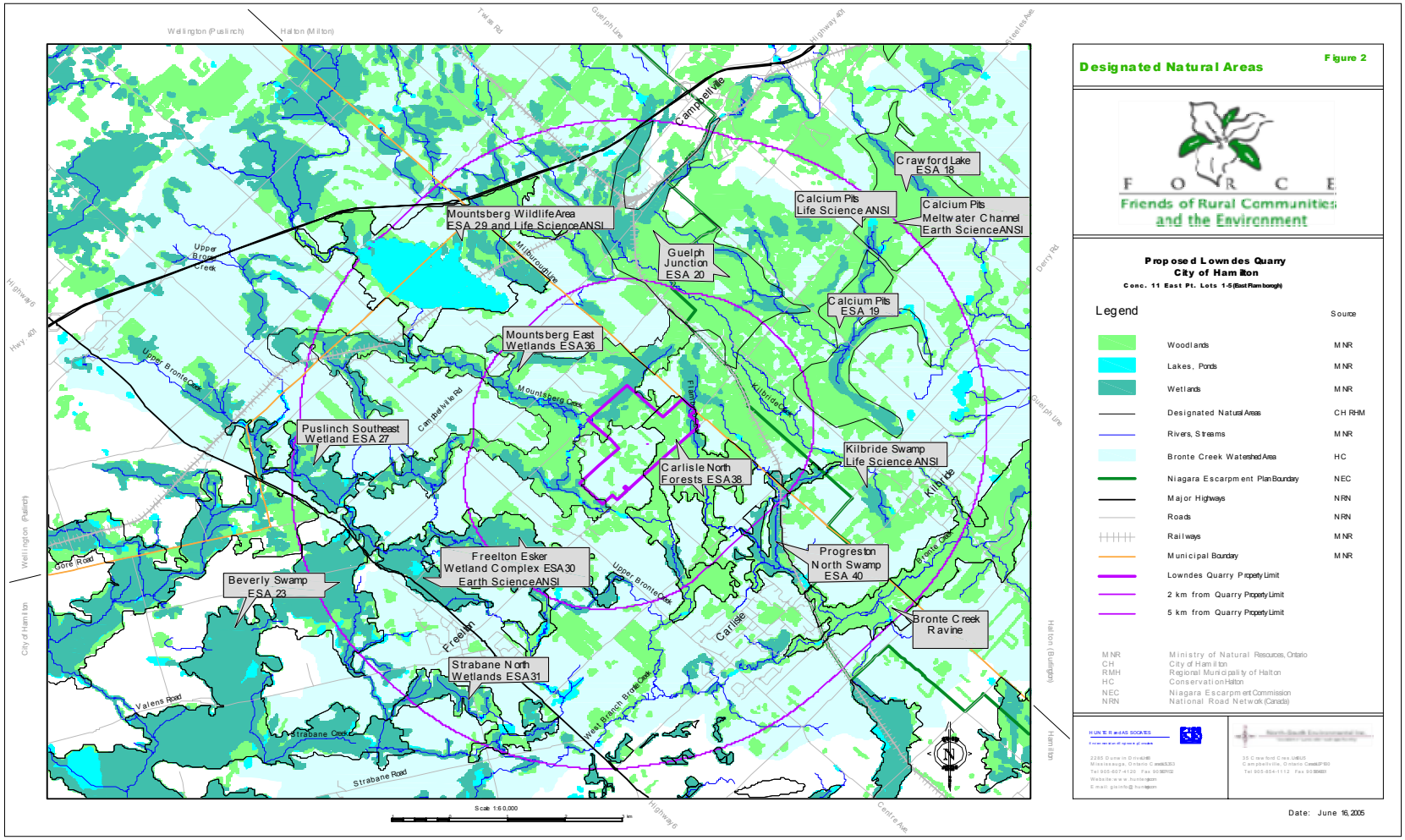


Figure 3a Official Plan Environmental Designations

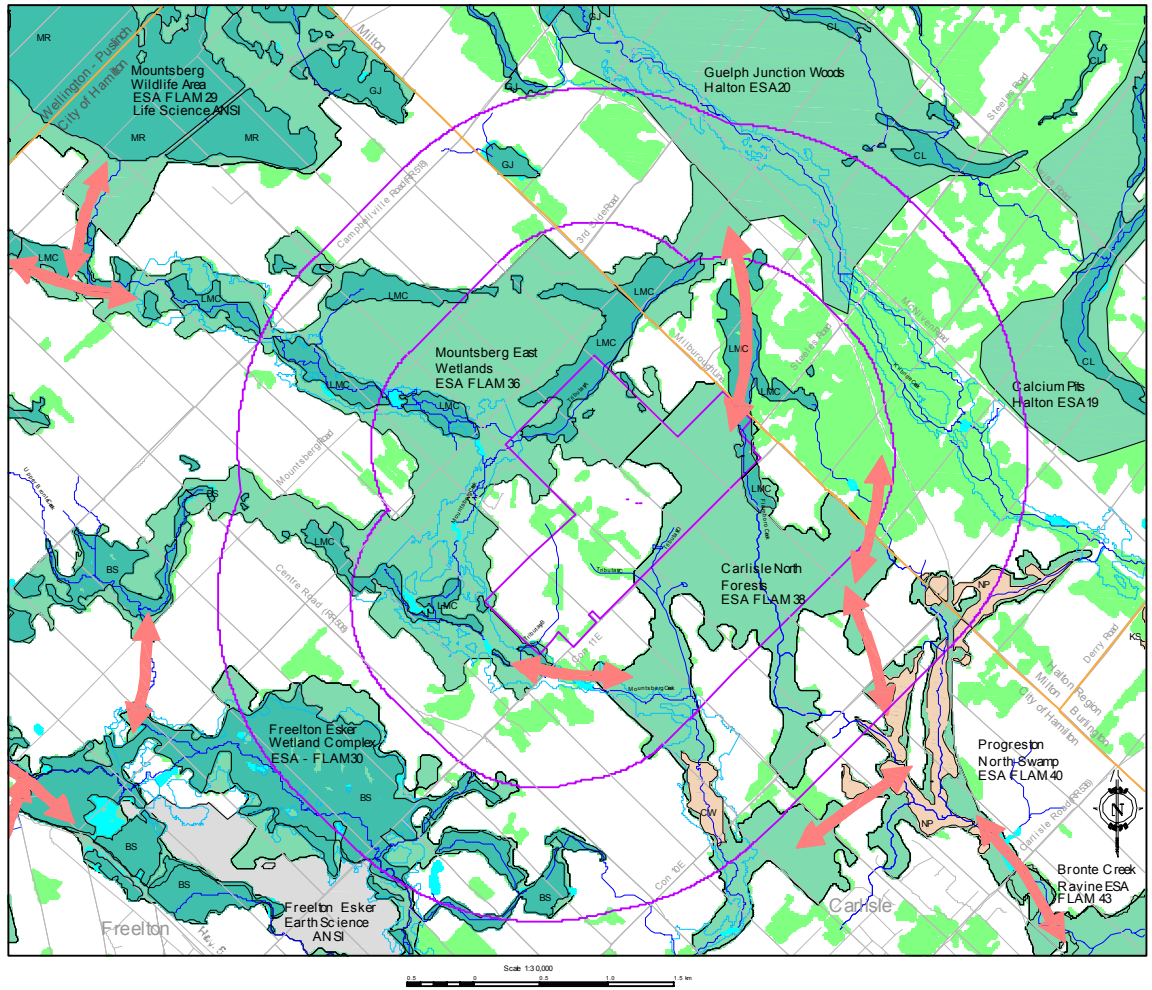


Figure 3b Original Township Fabric with Orthophoto

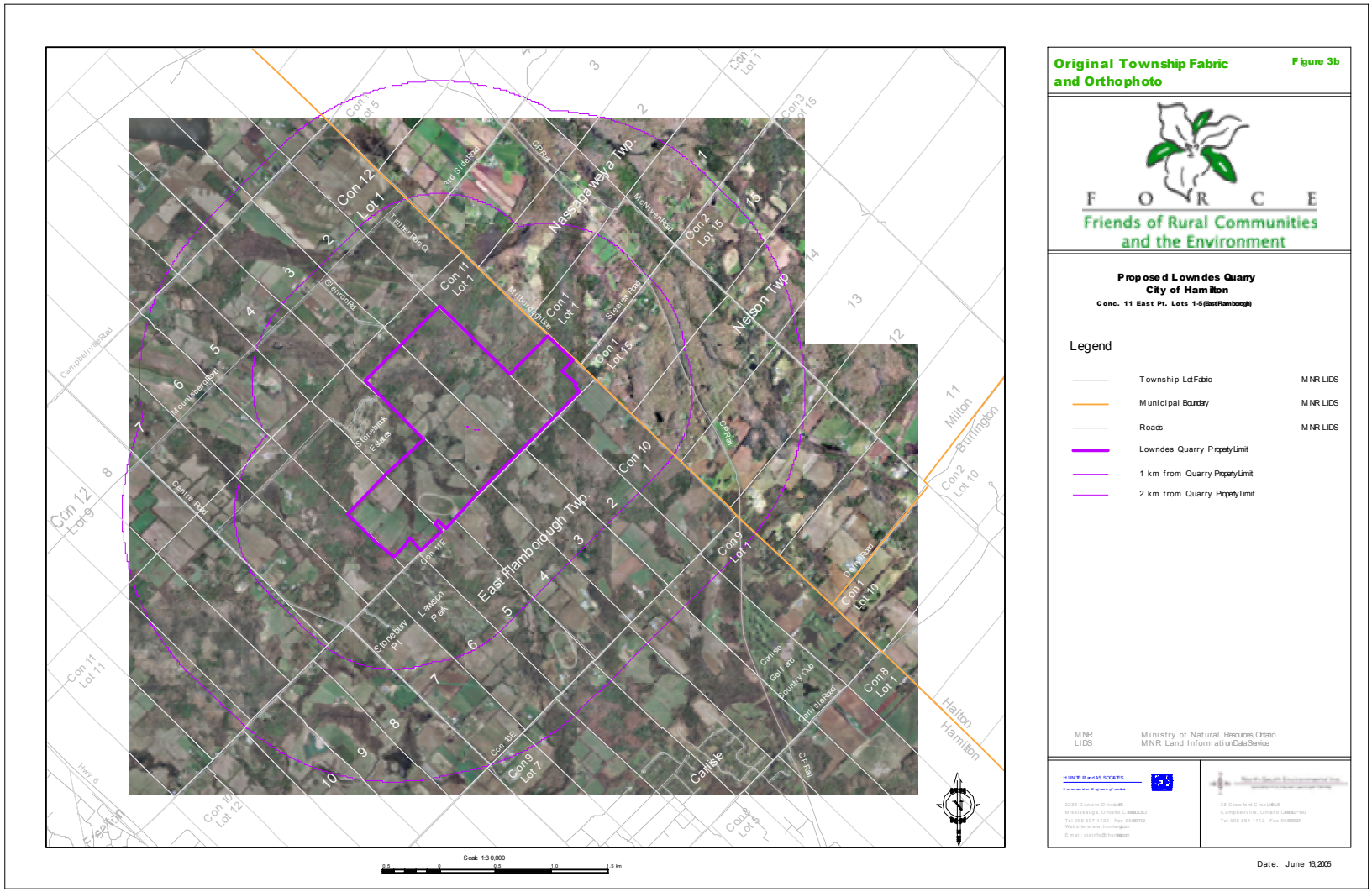
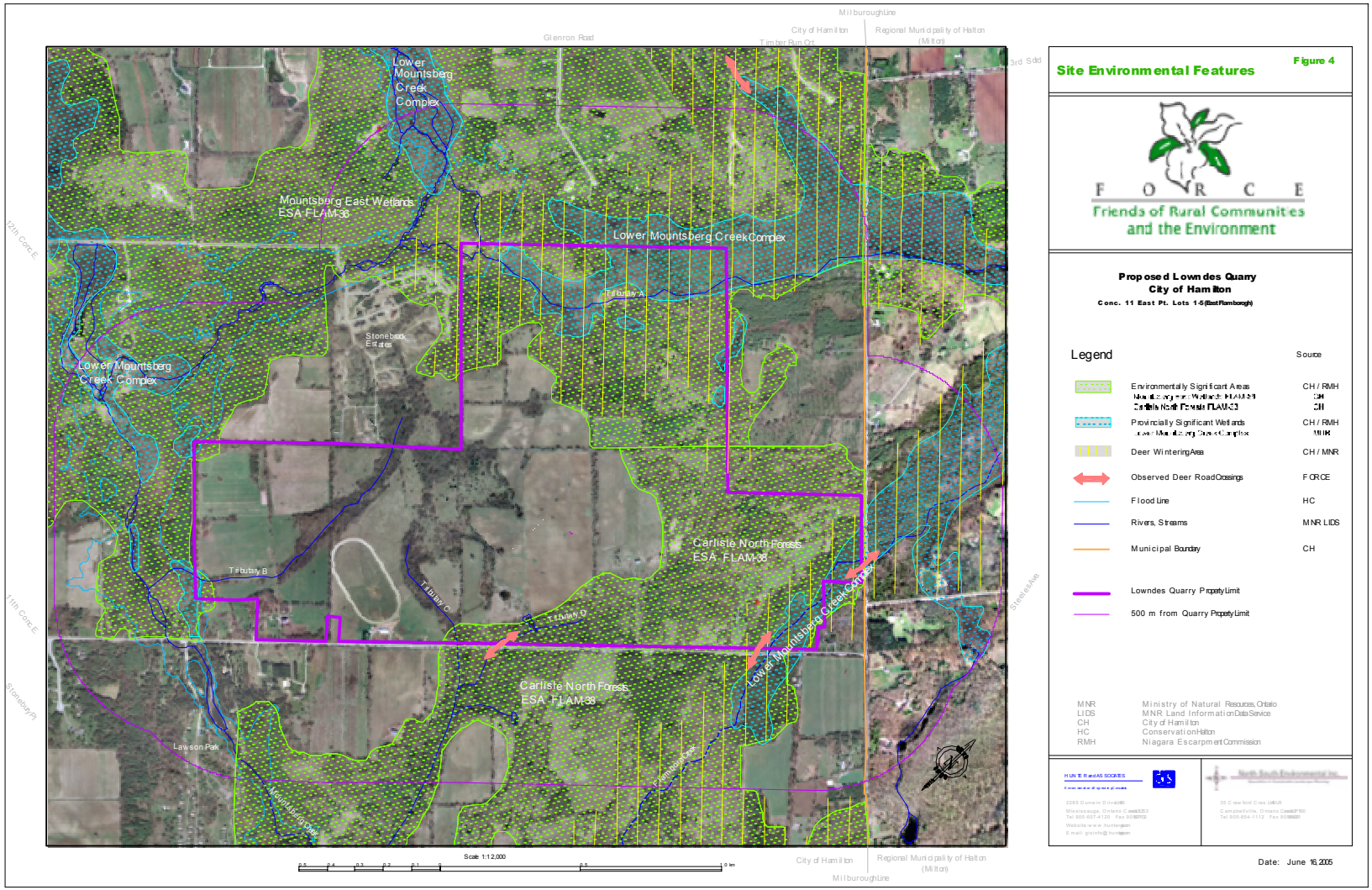


Figure 4 Site Environmental Features



4. REVIEW OF APPLICABLE STANDARDS

4.1 *Planning Act Standards*

The Planning Act provides several kinds of standards applicable to the proposed quarry in regard to assessing and mitigating potential environmental effects. The key to triggering the Act is the requirement that any new development comply with the applicable zoning by-law. In this case, the applicable zoning by-law is that of the former Town of Flamborough. It zones the site for two purposes:

- Agriculture; and
- Environmental Management.

Neither of these zones permits aggregate extraction. Therefore the proposed quarry will require re-zoning of one or both of the current zones. Where a development requires re-zoning, it requires amendment to the zoning by-law. However, the Act prohibits the passage of any by-law or by-law amendment that does not conform to the applicable official plans for the area. In this case, there is an official plan for the former Town of Flamborough, as well as the Regional Municipality of Hamilton-Wentworth.

The Planning Act also makes provision for consideration of provincial interests. Section 2 of the Act provides a general list of matters of provincial interest that must be given regard for all decisions made under the Act. Additionally, Section 3 makes provision for the development of a Provincial Policy Statement (PPS) issued by Cabinet that provides more specific guidance on topics of provincial interest. PPS Policy 2.1 Natural Heritage as it relates to the proposed quarry is discussed below (see Section 4.1.1).

The PPS issued in 1996 recently underwent a five year review and new Policies were released in March of 2005. In addition, the Province has made an amendment to the Planning Act; the amendment strengthens implementation of the PPS by making it mandatory that all planning decisions "***shall be consistent with***" the PPS (as opposed to the previous wording of "*shall have regard for"*). This change in wording creates a more demanding test of planning practices and makes it mandatory for planning decisions made by the City of Hamilton to adhere to the policies of the PPS.

For the present report, we have considered the 2005 PPS, particularly as the policies relate to Natural Heritage. It is our understanding that, where the PPS is more recent than an applicable official plan, a decision-maker must address the PPS specifically.

4.1.1 Provincial Policy Statement (2005)

Relevant sections of the new PPS are provided below in italics; quotations are used to denote words that are defined in the PPS. The issues that arise from these PPS sections in regard to an application to re-zone the Lowndes Holdings property for

aggregate extraction are provided in a bulleted list following relevant sections of the PPS.

2.1 Natural Heritage

2.1.1 Natural features and areas shall be protected for the long term

2.1.2 The diversity and connectivity of natural features in an area, and the long-term "ecological function" and biodiversity of "natural heritage systems", should be maintained, restored or, where possible, improved, recognizing linkages between and among "natural heritage features and areas", "surface water features" and "ground water features."

- This new section has been added to the PPS. This section utilizes Conservation Biology principles (*e.g.* diversity, connectivity, ecological function, linkages, restoration, natural heritage systems, *etc.*) as a foundation for Natural Heritage policies;
- This section recognizes the importance of considering natural heritage as an ecological system of interconnected parts both aquatic and terrestrial, above ground and below that must be linked for long-term ecological functions;
- The statement also acknowledges that while natural heritage may currently be in a degraded state, it may be protected so that it may be restored and improved, thereby contributing to the long-term ecological function of natural heritage systems.
- The site has "*natural heritage features and areas"* as defined in the PPS as well as "*surface water features"* and "*groundwater features*" and it is part of a defined "*natural heritage system*" providing linkage between features that should be maintained and some of which may be restored and improved;
- Further studies may reveal additional "*biodiversity*" and a more detailed understanding of natural connections associated with the site.

2.1.3 "Development" and "site alteration" shall not be permitted in:

a) "significant" habitat of "endangered species" and "threatened species";
b) "significant wetlands" in Ecoregions 5E, 6E and 7E; and;
c) "significant coastal wetlands".

- A portion of the habitat of the threatened species of fish, redside dace (*Clinostomus elongates*) is reported from the Mountsberg East Wetlands (FLAM 36) Environmentally Significant Area which is located, in part, including tributaries of Mountsberg Creek, within the site;
- A Provincially Significant Wetland is present within the site and on adjoining lands;

2.1.4 Development" and "site alteration" shall not be permitted in:

a) "significant wetlands" in the Canadian Shield north of Ecoregions 5E, 6E and 7E;

b) "significant woodlands" south and east of the Canadian Shield;
c) "significant valleylands" south and east of the Canadian Shield;
d) "significant wildlife habitat"; and
e) significant areas of natural and scientific interest

unless it has been demonstrated that there will be no "negative impacts" on the natural features or their "ecological functions".

- Woodlands that may be considered significant are located within the site; and
- Wildlife habitat that may be considered significant is located within the site.

2.1.5 "Development" and "site alteration" shall not be permitted in "fish habitat" except in accordance with "provincial" and "federal requirements".

- Fish habitat is present within the site;

2.3.2 "Development" and "site alteration" shall not be permitted on "adjacent lands" to the "natural heritage features and areas" identified in policies 2.1.3, 2.1.4 and 2.1.5 unless the "ecological function" of the "adjacent lands" has been evaluated and it has been demonstrated that there will be no "negative impacts" on the natural features or on their "ecological functions".

- The proposed quarry site is adjacent to areas identified in policies 2.1.3, 2.1.4 and 2.1.5 and as such negative impacts may occur as a result of a reduction in the total size of the features, noise, vibration, dust, light, alteration of ecological linkages, and through changes to surface and groundwater hydrology, *etc.*

The 2005 PPS provides several new definitions italicized terms (shown in quotes above); some of the defined terms most relevant to an assessment of the proposed quarry are provided below in italics with comments following in bulleted lists:

Hydrologic Function: *means the functions of the hydrological cycle that include the occurrence, circulation, distribution and chemical and physical properties of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere , and water's interaction with the environment including its relation to living things.*

- Water is clearly acknowledged as a varied and critical component of abiotic and biotic functions in the environment; and
- Consideration of hydrologic function in land use planning is very complex.

Natural heritage system*: means a system made up of natural heritage features and areas, linked by natural corridors necessary to maintain biological and*

geological diversity, natural functions, viable populations of indigenous species and ecosystems.

- The key component of the definition is the acknowledgement of the environment as a natural system with interrelated parts that function collectively to maintain viable populations and ecosystems; and
- Looking at it from another perspective, natural heritage features should not be isolated nor should interactions and inter-dependencies with other components of the environment be neglected in environmental planning.

Negative impacts: *means:*

a) *in regard to policy 2.2, degradation to the quantity or quality of water, sensitive surface and groundwater features and their related hydrologic functions, due to single, multiple or successive development or site alteration activities;*
b) *in regard to fish habitat, the harmful alteration, disruption or destruction of fish habitat, except where, in conjunction with the appropriate authorities, it has been authorized under the Fisheries Act, using the guiding principle of no net loss of productive capacity; and*
c) *in regard to other natural heritage features and areas, degradation that threatens the health and integrity of the natural features or ecological functions for which an area is identified due to single, multiple or successive development or site alteration activities.*

- the definition “a)” has been added based on the Province’s increased recognition of the importance of surface and ground water protection largely in relation to the protection of water supplies for human use; and
- definitions “a)” and “b)” acknowledge the importance of considering cumulative impacts on the environment to examine the sum total of impacts currently occurring or likely to occur in the future.

Sensitive: *in regard to surface and ground water features, means areas that provide important functions in the maintenance of water quality and quantity and are vulnerable to the loss or reduction of those functions.*

- This definition provides further emphasis on the importance of surface and ground water features by designating areas sensitive based on their contribution to the maintainance of water quality and quantity; and
- The surface and ground water features of the proposed Lowndes quarry site would be assessed in regard their contribution to the maintenance of surface and ground water quality and quantity and in turn the sensitivity of the site.

Significant:

b) *in regard to the habitat of endangered and threatened species, means the habitat, as approved by the Ontario Ministry of Natural Resources, that is*

necessary for the maintenance, survival, and/or the recovery of naturally occurring or reintroduced populations of endangered 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 regard to 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;*

- In adding "b)" to this definition the Province is responding to an increased national concern regarding species at risk, and the need to protect appropriate habitat for these species that takes in to consideration all of their life cycle requirements; and
- The new definition "c)" recognizes the widespread impact human land use has on woodlands and the ecological importance of retaining those woodlands based on such factors as species and community representation, age, contribution to regional woodland cover and connectivity.

Surface Water Feature: *refers to water-related features on the earth's surface, including headwaters, rivers, stream channels, inland lakes, seepage areas, recharge/discharge areas, springs, wetlands and associated riparian lands that can be defined by their soil moisture, soil type, vegetation or topographic characteristics.*

- Another definition intended to capture the many different ecological features and functions associated with water. In this case surface water is defined based on the varied forms it may take which in turn are related to its ecological functions in the environment; and
- This provides a broad context of surface water features that are to be considered as part of land use planning.

4.1.2 City of Hamilton Official Plan

The City of Hamilton Official Plan places a high priority on the protection of ecological features and functions as the section *Natural Setting* states:

> "*Features such as the Niagara Escarpment, environmentally significant areas, forests, wetlands, soil and water resources and other features are part of our natural setting which need to be protected and preserved for future generations.*"

Part C of the City of Hamilton Official Plan the *Land Use Strategy,* provides direction for the implementation of planning polices intended to achieve a sustainable region. Several Sections in the Official Plan are relevant to the proposed quarry site owned by

Lowndes Holdings. While there is considerable detail that should be referred to in the Official Plan, the most pertinent sections are provided below (in italics) with issues that arise from these sections bulleted after excerpting relevant sections:

Section 1.1 Regional Natural Heritage or Greenlands System

(f) require that existing natural areas within the Natural Heritage System (i.e. Core Natural Areas, which include Environmentally Significant Areas, as well as Linkages and Restoration Opportunities) be identified and that appropriate policies for their conservation be developed in secondary or neighborhood plans, watershed plans and other policy documents.

- Environmentally Significant Areas, Linkages and Restoration Opportunities have been identified on the proposed quarry site

Section 1.2 Environmentally Significant Areas

The majority of features included within the Core Natural Areas grouping warrant protection from development. These areas are described as Environmentally Significant Areas.

In regard to the required land use change associated with the proposed quarry the following policies are particularly important.

Section 1.2.2 *Apply the following policies in assessing the merits of proposed changes in land use within and adjacent to Environmentally Significant Areas;*

a) land use changes in or adjacent to Environmentally Significant Areas will only be permitted where, in addition to meeting other policies in this plan, such development:
- *i) will not adversely affect, degrade or destroy any of the qualities which are the basis for the area's designation;*
- *ii) will not cause any significant impacts upon water quality and quantity; and,*
- *iii) will not adversely affect the implementation of any resource protection policies or plans.*

b) proposed changes will be referred to the Environmentally Significant Areas Impact Evaluation Group (ESAIEG) for review. ESAIEG will advise Regional Environment staff on whether the proposed changes satisfy the intent of Policy C-1.2.2.

d) land use changes will not be permitted within Provincially Significant Wetland Areas as shown on Appendix Map No. 1, and as updated from time to time by the MNR. Development on land adjacent to a provincially significant wetland (land within 120 meters of a wetland area or lands connecting individual wetland areas within a wetland complex), with the exception of existing agricultural activities, will be prohibited unless it can be demonstrated through

an Environmental Impact Statement, prepared in accordance with Provincial guidelines, that it does not result in any of the following:

i) loss of wetland functions;
ii) subsequent demand for future development which will adversely affect existing wetland functions;
iii) conflict with existing site-specific wetland management practices; and,
iv) loss of contiguous wetland area.

- It is important to note Section (d) makes specific reference to *lands connecting individual wetland areas within a wetland complex.* The Provincially Significant Lower Mountsberg Creek Wetland Complex consists of numerous wetland areas with some wetland areas located within the site and other wetland areas located along portions of the north, south, east and western boundaries of the site.

Section 1.3 *Hazard Lands* of the Official Plan refers to areas designated based on hazards related to flooding or erosion on steep slopes.

1.3.2 Require the Area Municipalities to have appropriate zoning for Hazard Lands which:

a) prohibit uses other than agriculture, conservation, forestry and wildlife management.

- The delineation of flood lines within and around the Lowndes Holdings property appears to be incomplete. Flood line mapping may be required for areas associated with Mountsberg Creek, the Lower Mountsberg Creek Wetland Complex and for the tributaries of Mountsberg Creek and Flamboro Creek

4.1.3 Town of Flamborough Official Plan

Under the Town of Flamborough Official Plan, a portion of the Lowndes Holdings property is designated mineral aggregate resource lands (Schedule J). Excerpts from the Town of Flamborough Official Plan policies associated with regulation of the development mineral aggregate areas are provided below in italics with bulleted points for consideration relevant to the Lowndes Holdings property.

Policy B.7 Extractive Industrial

Objective: To ensure that aggregate extraction occurs with minimal social and environmental effects and that extraction sites are rehabilitated to an after-use which conforms to this Plan.

- Section 3 of this report outlines significant ecological features and functions identified within and adjacent to the site. Given the number of significant

ecological features present (11 ESAs, 5 PSWs, 3 LSWs, 5 ANSIs, and Natural Heritage System core and linkage/corridor areas identified by OMNR, MMAH, City of Hamilton and Conservation Halton), it would not be possible to develop and operate the proposed quarry without substantial environmental effects.

Policy B.7.3 requires that "*The establishment of new pits and quarries …shall require an amendment to this Plan and to the Zoning By-law.*" Thus, the proposed quarry requires amendment to the Town O.P. and Policy B.7.4 provides a list of the "*matters*" to be evaluated by Council for such an Official Plan Amendment (OPA). The list includes:

i. compatibility with adjacent existing and planned land uses;
ii. demonstration of the need for, and benefit of additional aggregate resource extraction;
iii. potential impacts on the environment, including measures required to minimize any adverse impacts;

- Consideration of the significant ecological features present within and adjacent to the Lowndes Holdings property will be required in regard to "*compatibility*" and "*potential impacts*"

Additionally, through Policy B.7.5 the Town O.P. specifies that:

All applications for amendments to the Plan shall include the following:
i. the location, dimensions, topography, size and description of the site proposed for a Mineral Resource Extraction Area;
ii. the location, height, dimensions and use of all buildings or structures existing or proposed to be erected on the site;
iii. the location, quality and estimated quantity of the mineral resources;
iv. the use of all land, and the location and use of all buildings and structures lying within a distance of 150 metres (500 feet) of the boundaries of the site;
v. existing and anticipated final grades of all lands and excavation and the limits of excavation within the site;
vi. surface water diversion, storage and drainage provisions;
vii. all entrances, exits and proposed routes to be used by associated transport;
viii. locations of stockpiles for stripping and mineral resources;
ix. proposed tree screening and berming;
x. sequential and final rehabilitation plans;
xi. extent of adjacent property holdings which may be intended for future mineral resource extraction operations, where appropriate; and
xii. hydrology, soil, wildlife or vegetation studies which may be required by Council due to specific site concerns;

- This Policy section highlights the type of development activities associated with aggregate extraction to be considered in an application.

C.3 Environmentally Significant Areas
The Regional Official Plan assumes the responsibility of identifying, establishing and amending Environmentally Significant Areas, and provides the policy framework for conservation, protection and enhancement of the environment.

- The Town of Flamborough relies on the policy framework of the City of Hamilton to identify and protect Environmentally Significant Areas (Refer to the discussion of ESA's within report section 3.2.2 City of Hamilton Official Plan).

C.3. Land abutting Environmentally Significant Areas shall be developed in a manner which blends and complements the natural attributes of the Area.

- The proposed quarry site includes and abuts two City of Hamilton Environmentally Significant Areas and a third Region of Halton Environmentally Sensitive Area.
- Development and operation of the proposed quarry can not be regarded as "blending or complementing the natural attributes of the Area".

4.2 ARA Standards

The Aggregate Resources Act (ARA 1990) for Ontario provides a list of matters to be taken into account by decision-makers, including the OMNR and the Ontario Municipal Board (OMB), in assessing applications for aggregate licences. These matters include:
(a) the effect of the operation of the pit or quarry on the environment;

Additionally, in 1997, the Province passed regulations which incorporate by reference approved Application Standards for all categories of quarry licence applications. Under these standards, the proposed quarry fits within Category 2, as a quarry that seeks to extract aggregate material from below the established groundwater table. The Application Standards specify standards for the development of a Site Plan as well as the preparation of specific reports dealing with the natural environment.

Relevant Site Plan Standards

Having regard to the site plan requirements, the following standards will be of particular importance when considering ecological features and functions. Text in italics is taken from the ARA (1990), bulleted text presents issues that apply to the relevant section.

In regard to *1.1 Existing Features*

1.1.14 the use and existing zoning of land on and within 120 metres of the site;

- A portion of the lands in question are designated as Provincially Significant Wetland, Environmentally Significant Area in the Hamilton-Wentworth Official Plan and Environmentally Sensitive Area by the Regional Municipality of Halton.

1.1.15 the topography of the site illustrated by a one or two metre contour interval, expressed as metres above mean sea level;

- Topographic information assists in the interpretation of surface water flows internal and external to the site.

1.1.19 the elevation of the established groundwater table on site;

- Plant communities and the associated fauna develop in association with the natural groundwater regime both on drier and wetter sites. Of particular importance is an understanding of seasonal fluctuations and year to year fluctuations to understand both seasonal and long term (year to year) cycles.

1.1.20 existing surface water drainage and drainage facilities on and within 120 metres of the site;

- Five creeks have been identified on site, Mountsberg Creek is located within 120 metres of the site in two locations where it flows past the northern and eastern boundaries
- Three creeks have headwaters areas within the site in association with the areas where the creeks originate
- Three of the creeks present on the site are designated cold water streams

1.1.22 the location of existing tree cover (i.e. wood lots and hedgerows) on the site and within 120 metres of the site;

- A substantial portion of the site and areas within 120 m of the site are tree covered and have hedgerows

1.1.27 significant natural features on and within 120 metres of the site;

- Lower Mountsberg Creek Wetland Complex (Provincially Significant Wetland);
- Mountsberg East Wetlands (Flam-36) a City of Hamilton Environmentally Significant Area;
- Carlisle North Forests (Flam-38) a City of Hamilton Environmentally Significant Area;

- Guelph Junction Woods (ESA 20) a Region of Halton Environmentally Sensitive Area;
- Core Natural Area and Linkage Area, as part of OMNR Big Picture 2002 Natural Heritage System;
- Provincially and Locally significant species of plants, butterflies, fish, herpetofauna, and birds associated with natural features present on the site and within 120 m of the site.

In regard to *1.2 Operations*

1.2.4 main internal haul roads on the site;

- Roads have significant impact on natural areas due to the direct loss of habitat, fragmentation of natural areas, changes to surficial hydrology, pathways for the introduction of invasive species, death of animals crossing roads, *etc.*

1.2.5 the location of every proposed entrance to and exit from the site;

- Entranceways will have similar impacts to those described above for internal haul roads.

1.2.6 the elevation of the established groundwater table on the site;

- As described under Section 1.1.19, plant communities and their associated fauna develop in association with the natural groundwater regime. Thus, alteration of the natural groundwater regime can result in both local and regional impacts to the ecological features and functions of terrestrial and aquatic environments.
- Operations to extract dolostone will require blasting to remove rock. Blasting may result in closure of fractures and/or the creation of new rock fractures that can significantly alter pre-existing groundwater infiltration patterns resulting a rise and/or fall of the groundwater table with subsequent impacts to existing natural areas.

1.2.7 any proposed water diversion and points of discharge to surface water;

- As described under Section 1.1.20, five creeks are present on the site, three of these are cold water streams as well, and three of the five streams have their origin within headwater areas present on site.
- Operation of the proposed quarry will require de-watering. Water that is pumped from the quarry will result in an alteration to the quality (temperature, chemical composition, sediment load) and quantity (volume, temporal variation) of the receiving natural areas (creeks, wetlands).

1.2.8 the location, type and installation schedule or phasing for any proposed fencing around the licensed boundary of the site;

- The site currently provides opportunities for wildlife movement through forests and fields that have good linkages and limited physical barriers to wildlife movement.
- For the purposes of security and safety, the operation of the proposed quarry will require the installation of chain link fence that will restrict wildlife movement.

1.2.9 the location of any proposed buildings and other structures to be erected on the site;

- Proposed buildings or structures that are located within existing natural areas will result in impacts of direct habitat loss and habitat fragmentation.

1.2.10 the location of any proposed stockpiles of topsoil and overburden on the site;

- Proposed stockpiles of topsoil and overburden on the site that are located within existing natural areas will result in impacts of direct habitat loss and habitat fragmentation.

1.2.11 the location of any proposed aggregate stockpile area(s), including any recyclable materials on the site;

- Proposed aggregate stockpile area(s) on the site that are located within existing natural areas will result in impacts of direct habitat loss and habitat fragmentation.

1.2.12 any proposed scrap location(s) on the site;

- Proposed scrap location(s) on the site that are located within existing natural areas will result in impacts of direct habitat loss and habitat fragmentation.

1.2.13 the location of any proposed fuel storage area(s) on the site;

- Proposed fuel storage areas are of concern due to potential fuel spills that may contaminate soils or aquatic environments where they are located in proximity to creeks or wetlands.

1.2.14 the area in hectares to be extracted;

- The size and location of the area to be extracted will determine the extent to which the natural features present on the site will be impacted.

1.2.15 the location and labelling of all excavation setbacks from the licensed boundary;

- Significant natural features are present along much of the boundary of the area currently owned by Lowndes Holdings and proposed for quarry development.

1.2.16 the final extraction elevation of the site using spot elevations;

- Excavation will result in a permanent alteration of the landscape, such that it will not be possible to restore the existing terrestrial and aquatic environments impacted by the proposed quarry.

1.2.17 the location of any proposed permanent and/or temporary processing area(s) on the site;

- Any proposed processing area(s) on the site that are located within existing natural areas will result in impacts of direct habitat loss and habitat fragmentation.
- Processing will result airborne dust emissions that can impact terrestrial and aquatic vegetation and fauna.

1.2.18 the location of any proposed berms and the minimum height;

- Any proposed berm(s) on the site that are located within existing natural areas will result in impacts of direct habitat loss, habitat fragmentation and potential impediment to wildlife movement patterns.

1.2.20 the general types of equipment that will normally be used on site;

- There will be concerns related to the impact of noise on wildlife in the surrounding natural areas. The type and size of equipment will influence the degree to which noise will be an impact.

1.2.22 details on the hours of operation of the site taking into account all facets of the operation which involves the actual physical movement of aggregate;

- The hours of operation will determine the extent to which noise and artificial light impact the surrounding natural areas.

1.2.23 details of how trees and stumps shall be disposed of or utilized;

- As suggested by this section where trees are present they will be removed.

1.2.26 details of frequency and timing of blasts;

- Blasting will impact wildlife directly due to impacts associated with noise and vibration.
- Other concerns arising from blasting operations have to do with the fracturing of dolomite with potential alteration of groundwater infiltration. The impact of changes to the groundwater regime have been discussed under Section 1.2.6.

Relevant Standards Respecting Required Reports

In regard to the preparation of reports the following applicable standards from the ARA (1990) are relevant to the protection of ecological features and functions:

2.2.3 Natural Environment Level 1: determine whether any of the following features exist on and within 120 metres of the site: significant wetland, significant portions of the habitat of endangered or threatened species, fish habitat, significant woodlands (south and east of the Canadian Shield), significant valley lands (south and east of the Canadian Shield), significant wildlife habitat and significant areas of natural and scientific interest;

- It has been determined that a provincially significant wetland Lower Mountsberg Creek Complex is present on the site and that this wetland extends offsite within the 120 m zone and beyond;
- The threatened species of fish, redside dace (*Clinostomus elongates*) is reported from the Mountsberg East Wetlands (FLAM 36) Environmentally Significant Area which is located, in part, including tributaries of Mountsberg Creek, within the site.
- The five creeks present on site, result in the presence of fish habitat on site.
- The forest vegetation on site is contiguous with large forest areas off site that constitute significant woodlands.
- Significant Wildlife Habitat is present given that in total 38 significant wildlife species are recorded in the summaries for the two Environmentally Significant Areas present, in part, on site and the Environmentally Sensitive Area located, in part, within 120 m of the site.

2.2.4 Natural Environment Level 2: impact assessment where the level 1 identified any features on and within 120 metres of the site in order to determine any negative impacts on the natural features or ecological functions for which the area is identified and any proposed preventative, mitigative or remedial measures;

- An impact assessment will be required to determine the negative impacts on the natural features and ecological functions noted in Section 2.2.3.

2.2.8 If extraction and/or processing facilities are within 500 metres of a sensitive receptor, a noise assessment report is required to determine whether or not provincial guidelines can be satisfied;

- Rural residences located in close proximity to the Lowndes Holdings property suggest extraction and/or processing facilities may be located within 500 m of a sensitive receptor (*i.e.* residences) and that these residences could be impacted by noise, as such an assessment of noise impacts will be required.

2.2.9 A Blast Design report is required if a sensitive receptor is within 500 metres of the limit(s) of extraction to demonstrate that provincial guidelines can be satisfied; and

- Blasting is located within 500 m of significant natural areas that will be impacted by noise and vibration, as such an assessment of blasting impacts to wildlife will be required.
- Additional concerns regarding the impact of blasting have been noted in Sections 1.2.6 and 1.2.26.

4.3 Conservation Authority Fill Standards

The purpose of the Conservation Authorities Act is to control flooding, pollution and the conservation of land. Section 3 of the Act states the following:

> ***3.*** *Unless permission has been obtained under section 4, no person shall,*
> *(a) construct any building or structure or permit any building or structure to be constructed in any pond, swamp or area susceptible to flooding during a regional storm;*
> *(b) place or dump fill or permit fill to be placed or dumped in the areas described in the Schedules whether such fill is already located in or upon such area, or brought to or on such area from some other place or places; or*
> *(c) straighten, change, divert or interfere in any way with the existing channel of a river, creek, stream or watercourse. R.R.O. 1990, Reg. 150, s. 3.*

Through Regulation (R.R.O. 1990, Regulation 150), the Halton Region Conservation Authority ("Conservation Halton") regulates fill, construction and alteration to waterways within areas designated by fill line mapping. Several portions of the proposed quarry site are fill regulated as shown on Conservation Halton scheduled mapping.

The Regulation uses the following definition of "fill":

> *fill means any material, whether originating on the site or elsewhere, used or capable of being used to raise, lower or in any way affect the contours of the ground;*

This definition thus includes alteration of ground contours through either the lowering of contours from the removal of fill as well as the raising of existing contours through the addition of fill.

In general, the operation of the proposed quarry will result in the lowering of ground contours as aggregate is removed and shipped off site. Additionally, the operation of a quarry may result in the raising of ground contours as overburden is removed and stockpiled or through the creation of berms used as sound or visual barriers.

Operation of the proposed quarry will result in activities such as the construction of buildings, the placement or removal of fill and the alteration of waterways and these activities may occur within fill regulated areas within the site.

To obtain a fill permit, the HRCA will evaluate the following information on the proposed development supplied with the permit application:

- does the development involve a structure or minor addition;
- does the development involve a new building/major addition ;
- will the development require the placement of fill;
- will the development alter a watercourse by constructing a pond, a crossing, a drain, a storm outfall, a dam, a channel, erosion protection, a diversion or other modification;
- a description of proposed works is required; and
- the proposed starting date and completion date for the development.

4.4 Greenbelt Recommendations

In December 2003 the Government of Ontario introduced Bill 27, the Greenbelt Protection Act, which created the Greenbelt Study Area. A Greenbelt Taskforce representing a diverse group of stakeholders developed recommendations on the establishment of a greenbelt; they hosted public consultations; and in October 2004 the Government released a draft Greenbelt Plan (MMAH 2004b) in response to the Task Force's recommendations. Excerpts from a discussion paper from May 2004 (MMAH 2004a) described the greenbelt as follows:

> *The Greenbelt is a cornerstone of Ontario's proposed Greater Golden Horseshoe Growth Plan, an overarching strategy that will provide clarity and certainty about what should be built and where, and what must be protected for our own and future generations*
>
> *The additional Protected Countryside lands identified in this Plan, which link and enhance the Niagara Escarpment and Oak Ridges Moraine to create the Greenbelt, have been identified through a combination of the best science available, a consideration of existing and future patterns of urbanization, and local knowledge and advice.*

This Protected Countryside is made up of an Agricultural System and a Natural System, together with a system of settlement areas.

The Natural System identifies lands that support both natural heritage and water resource features and functions, while maintaining connections to the broader natural systems of southern Ontario.

The final Greenbelt Protection Plan was released on February 28th, 2005 (MMAH 2005) and the Greenbelt provided legislation that ensured the proposed Lowndes quarry is covered by the Plan (Ontario Regulation 59/05), placing it under new strengthened aggregate development rules. In the final Greenbelt Plan (MMAH 2005) the Lowndes Holdings property is designated *protected countryside* and within this designation the property is further designated *Natural Heritage System, Inside Greenbelt Boundary* [see Figure 5a showing a regional perspective of the Greenbelt Plan and Figure 5b showing a more detailed map of the final Greenbelt Plan (MMAH 2005)].
http://www.mah.gov.on.ca/userfiles/HTML/nts_1_22087_1.html

The goals of the Greenbelt Plan in regard to environmental protection are as follows:

a. *Protection, maintenance and enhancement of natural heritage, hydrologic and landform features and functions, including protection of habitat for flora and fauna and particularly species at risk;*

b. *Protection and restoration of natural and open space connections between the Oak Ridges Moraine, the Niagara Escarpment, Lake Ontario, Lake Simcoe and the major river valley lands, while also maintaining connections to the broader natural systems of southern Ontario beyond the Golden Horseshoe such as the Great Lakes Coast, the Carolinian Zone, the Lake Erie Basin, the Kawartha Highlands and the Algonquin to Adirondacks Corridor;*

c. *Protection, improvement or restoration of the quality and quantity of ground and surface water and the hydrological integrity of watersheds; and*

d. *Provision of long-term guidance for the management of natural heritage and water resources when contemplating such matters as development, infrastructure, open space planning and management, aggregate rehabilitation and private or public stewardship programs.*

Figure 5a. Regional view of the Lowndes Holdings property in relation to the Greenbelt Plan for Ontario (MMAH 2005). (Note: location is approximate)

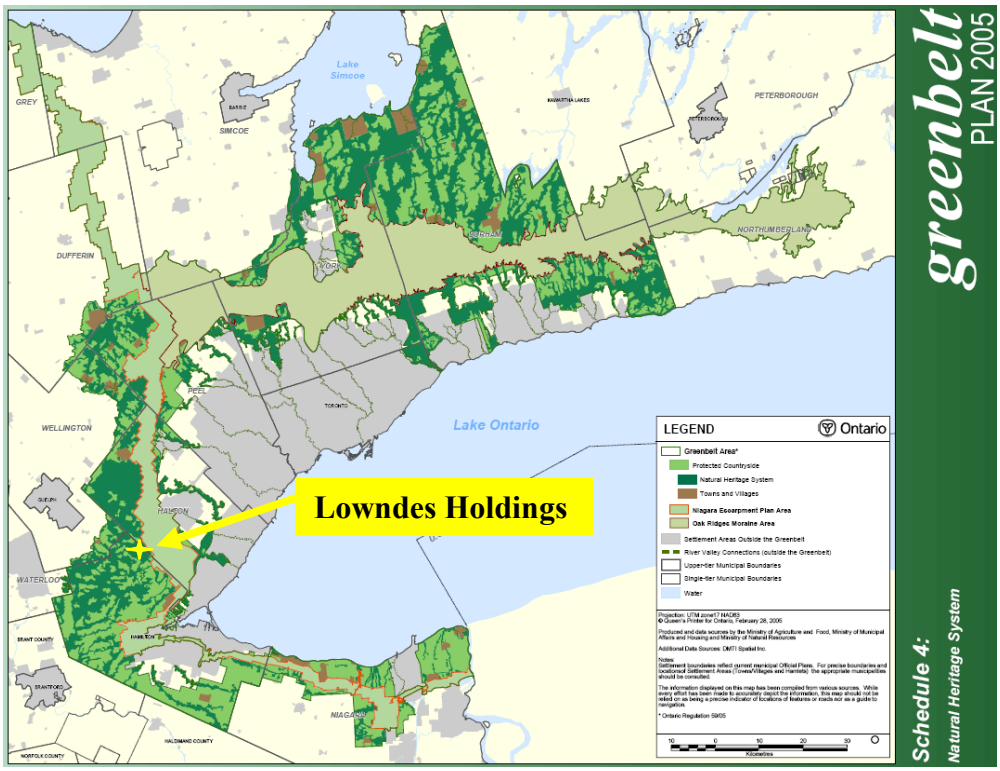
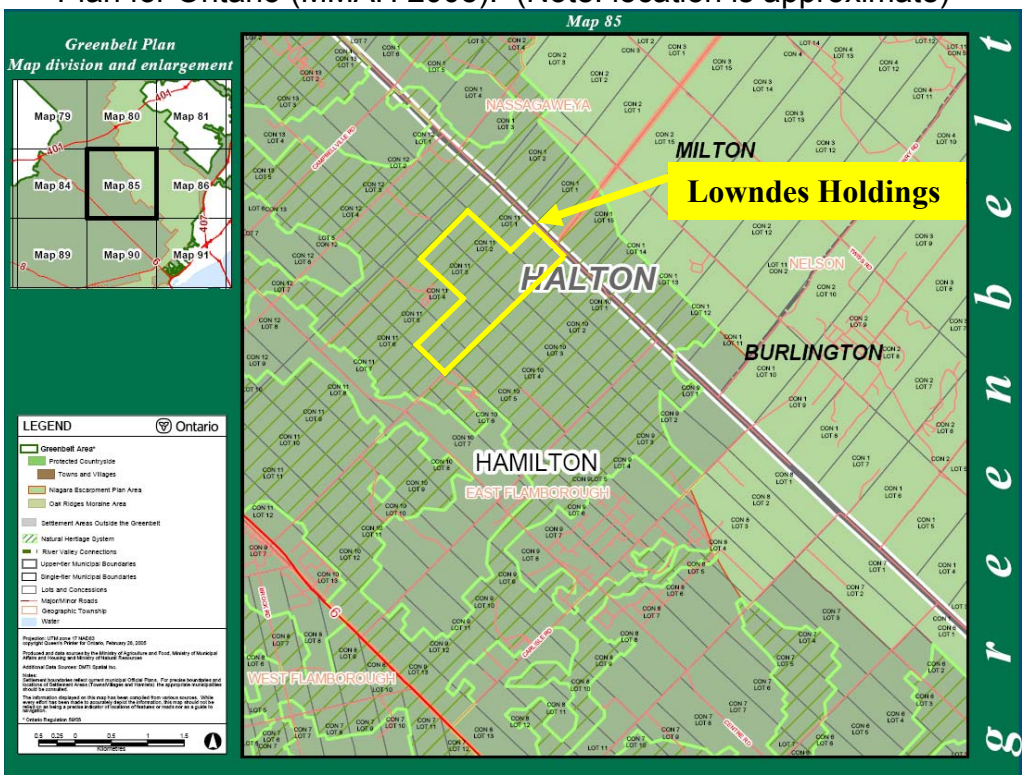


Figure 5b. Local view of the Lowndes Holdings property in relation to the Greenbelt Plan for Ontario (MMAH 2005). (Note: location is approximate)



The policies of the Greenbelt Plan in regard to development within the designated Natural Heritage System are as follows (words in quotations are defined in the Greenbelt Plan):

> *New "development" or "site alteration" in the Natural Heritage System (as permitted by the policies of this Plan) shall demonstrate that:*
>
> a. *There will be no negative effects on "key natural heritage features" or "key hydrologic features" or their functions;*
>
> b. *"Connectivity" between "key natural heritage features and key hydrologic features" is maintained, or where possible, enhanced for the movement of native plants and animals across the landscape;*
>
> c. *The removal of other natural features not identified as "key natural heritage features and key hydrologic features" should be avoided. Such features should be incorporated into the planning and design of the proposed use wherever possible; and*
>
> d. *The disturbed area of any site does not exceed 25 percent, and the impervious surface does not exceed 10 percent, of the "total developable area", except for uses described in and governed by sections 4.1.2 and 4.3.2. With respect to golf courses, the disturbed area shall not exceed 40 percent of the site.*

The Greenbelt Plan contains the following policies specific to mineral aggregate operations within areas designated Natural Heritage System follows (words in quotations are defined in the Greenbelt Plan):

> *Notwithstanding the Natural System policies of section 3.2 of this Plan, within the Natural Heritage System, "mineral aggregate operations" and wayside pits and quarries are subject to the following:*
>
> *b) No new "mineral aggregate operation" and no wayside pits and quarries, or any ancillary or accessory use thereto will be permitted in the following "key natural heritage features" and "key hydrologic features":*
> - *i. "Significant wetlands";*
> - *ii. "Significant" habitat of "endangered species" and "threatened species"; and*
> - *iii. "Significant woodlands" unless the woodland is occupied by young plantation or early successional habitat (as defined by the Ministry of Natural Resources). In this case, the application must demonstrate that the specific provisions of policy 4.3.2.5 (c), (d) and 4.3.2.6 (c) have been addressed, and that they will be met by the operation;*

c) *An application for a new "mineral aggregate operation" or new wayside pits and quarries may only be permitted in other "key natural heritage features" and "key hydrologic features" not identified in 4.3.2.3 (a) and any "vegetation protection zone" associated with such other feature where the application demonstrates:*
   i. *How the Water Resource System will be protected or enhanced; and*
   ii. *That the specific provisions in 4.3.2.5 (c), (d) and 4.3.2.6 (c) have been addressed, and that they will be met by the operation; and*

d) *Any application for a new "mineral aggregate operation", or the expansion of an existing "mineral aggregate operation" shall be required to demonstrate:*
   i. *How the "connectivity" between "key natural heritage features" and "key hydrologic features" will be maintained before, during and after the extraction of mineral aggregates;*
   ii. *How the operator could immediately replace any habitat that would be lost from the site with equivalent habitat on another part of the site or on adjacent lands; and*
   iii. *How the Water Resource System will be protected or enhanced; and*

e) *An application for the expansion of an existing "mineral aggregate operation" may be permitted in the Natural Heritage System, including "key natural heritage features" and "key hydrologic features", and in any associated "vegetation protection zone" only if the related decision is consistent with the PPS.*

These policies will require careful consideration due to the presence of *significant wetlands*, *significant woodlands*, the possibility of the presence of *significant habitat of threatened species, key natural features*, *connectivity* and *key hydrologic features* within the Lowndes Holdings property, including Provincially Significant Wetlands, Significant Woodlands, Fish Habitat, streams, possibly seepage areas and springs and connectivity of natural features within and external to the proposed quarry. Further, as the Lowndes Holdings proposed quarry is intended to operate below the groundwater table it would not be possible to rehabilitate that portion of the site impacted by excavations to a predevelopment natural heritage condition.

5. INFORMATION GAPS

The most detailed information available for the natural areas located within and around the proposed quarry site comes from the recently produced Nature Counts report (Dwyer 2003) that studied Environmentally Significant Areas within the City of Hamilton. It should be noted that for the field studies conducted within the Mountsberg East Wetlands (Flam 36) ESA and the Carlisle North Forests (Flam 38) ESA that are located, in part, within the proposed quarry site, the Nature Counts report states there has been inadequate coverage for plants, ecological land classification (ELC), and mammals.

This is due to the fact that it was not possible to obtain permission to conduct ecological surveys on private land. Only 15% of private land owners granted access to natural areas located on their property; as such access proved to be a major obstacle to conducting field inventories of plants and animals.

In other words, while sufficient information has been gathered to determine significant natural areas are present within and around the proposed quarry site, additional field work will further our understanding of the significance of these areas as more is learned about the plant and animal species inhabiting these areas, the variety of plant communities present, the surface and groundwater hydrology and ecological linkages and the functioning and inter-relationships of all of the features present.

Key information gaps are as follows:

- Knowledge of the presence of significant species not yet recorded within natural areas within and adjacent to the Lowndes Holdings property;
- Knowledge of the abundance, distribution and habitat requirements of new significant species that may be located wholly or partially on-site and/or within adjacent areas;
- Knowledge of the hydrologic balance maintaining wetlands in and around the proposed quarry site;
- Knowledge of headwater areas for 1st order watersheds;
- Flood line mapping not yet completed for areas in and around the proposed quarry site;
- Knowledge of fish habitat present in and around the proposed quarry site; and
- Knowledge of the function of local and regional ecological linkages.

6. ISSUES

A discussion of the environmental issues associated with the proposed quarry is based on the existing knowledge base related to the natural features present both within and around the Lowndes Holdings property. This information is used to assess natural features in terms of their location, biodiversity, ecological significance, and their sensitivity to development impacts. Individual natural areas are assessed based on their own merits and based on their interactions and interdependencies with other natural areas, *e.g.* the relationship between a wetland as breeding habitat and upland as foraging habitat for amphibians, or the importance of protecting headwater areas to ensure the maintenance of base flow of creeks downstream, or the multiple linkages of habitats in the landscape that facilitate the movement of animals and plants from place to place at temporal scales that range from hours to years.

Impacts to natural features in development applications are most often considered in relation to the *structural change* that results within the environment, *e.g.* a maple-beech forest is removed and the species diversity associated with the forest is lost. **What must also be considered is how an impact results in *functional changes* both within the immediate environment where the structure change has**

occurred and to adjacent natural features which are seemingly removed from the direct impact, *e.g.* a maple-beech forest is removed, this may result in functional changes such as the loss of ecological linkage between adjacent natural areas, or changes to the regional water balance due to greater runoff of rainwater, less infiltration of groundwater and less evapotranspiration. The natural environment is an **"ecological system" made up of structural parts that are functionally interrelated**. If one of the parts is removed, the other parts of the environment that are functionally related will also be affected by this removal.

It is also important to consider the effect of each new development in relation to the cumulative impact of land use change within a region. For example, as development proceeds within a region there are cumulative impacts to groundwater, as there may be a need to supply domestic water supplies, and new commercial development takes a significant quantity of water (*i.e.* a spring water bottling company or golf course), urban land use reduces the capacity of the environment to infiltrate and replenish groundwater, and some development has the potential to contaminant groundwater (*i.e.* residential development, factory farming, chemical industry, row crop agriculture). These impacts may be geographically distributed in the environment and individually may not be considered a significant impact on groundwater. Collectively, however, they may result in a cumulative impact on groundwater that exceeds its threshold to supply the quality and quantity of water needed to sustain a healthy ecological system for plants, animals and humans.

> ***Nature Counts Project***
> ***The cumulative impacts of land use change on the groundwater regime and significant aquatic habitat in the upper Bronte Creek watershed should be monitored.*** (Dwyer 2003)

6.1 Ecological Issues of Concern

Documenting the impacts that may be associated with the development of the proposed Lowndes Holdings quarry will require a significant amount of research to provide a more complete understanding of the natural environment and of the impacts that may result from hard rock mining below the water table.

The information currently available identifies the presence of significant natural areas, and provides a limited understanding of the structural and functional aspects of these natural areas. When comprehensive ecological studies are performed through multiple field visits over all seasons of the year, ideally over multiple years, there is a much greater understanding of the plant and animal species present, the habitats that are utilized and the changes that can occur in population numbers and habitat use. The dynamic nature of the environment is reflected in alternating weather patterns, natural disturbance events and fluctuations due to predator-prey relationships, inter-species competition, and natural succession, *etc.* Recognizing dynamic ecosystems processes is a part of assembling the information needed to develop strategies that protect functioning ecological systems characterized by high ecological integrity.

The available information on the ESAs, wetlands, ANSIs, creeks and rivers, and natural heritage systems (ecological linkages) raises a number of issues that require further study to both fully characterize the natural features and functions of the areas in question and to begin to evaluate the impact the proposed quarry may have, locally and regionally. Key ecological issues of concern are outlined below under a series of headings; while these issues are treated separately there is also a need to consider their interactions and cumulative effects.

Hydrologic Features and Functions

There are significant hydrologic features and functions represented within and around the Lowndes Holdings property (wetlands, creeks, headwater catchments, *etc.*). The proposed quarry may have a direct impact on these through development within a headwater or wetland area or indirect impacts through changes to the quality and quantity of the downstream watershed and/or changes to the groundwater regime that may be important to the maintenance of the water balance ecologically linked to the surrounding natural areas (particularly wetlands). Of particular concern are the following:

- Changes that may take place in quality and quantity of surface water and groundwater that will in turn affect wetland features and functions and terrestrial communities both in the short and long term;
- The removal of vegetation and topsoil and the creation of a excavation pit below the water table that will affect headwater catchment areas and headwater creeks leading to impacts on quantity and quality water that flows to creeks locally and to the receiving creeks, fish habitat and wetlands downstream; and
- The de-watering (pumping of groundwater, diversion of surface water flow) associated with the operation of a quarry that will also result in changes to water quantity and quality of the receiving streams and wetlands, including several coldwater streams constituting valuable fish habitat.

Biological Diversity

The biological diversity of the Lowndes Holdings property and of the surrounding natural areas has been only partially documented. There is no comprehensive Ecological Land Classification (ELC) mapping that identifies the diverse range of communities present or the rarity of the communities as listed by the Natural Heritage Information Centre (NHIC). More intensive three season biological inventories are needed to provide more comprehensive lists of plants, terrestrial and aquatic insects, mollusks, amphibians, reptiles, fish, birds, and mammals and the habitat requirements of resident species, particularly those with special designation such threatened or endangered, regionally rare, or area demanding, *etc.*

- The Lowndes Holdings property is located within an area characterized by high biological diversity as noted by the variety of natural heritage features present.

There is however insufficient information documenting the diversity of communities and species present and the long protection needs for these. The impact of existing development in the area and proposed future development must be considered in terms of cumulative impacts in order to assess the proposed development of a quarry.

Ecological Linkages

The Lowndes Holdings property is within an area of linked terrestrial and aquatic ecological systems. Linkages that contribute to the long term ecological integrity of the region have been identified by the City of Hamilton and the Ontario Ministry of Natural Resources in association with the natural areas within and around the Lowndes Holdings property. With increased understanding of the distribution of communities and species it is possible to better define the function ecological linkages and the structural connections required to maintain these functions. Issues associated with proposed quarry development and its impact on ecological linkages are as follows:

- There is a need to better understand the ecological linkage functions associated with the Lowndes Holdings property in order to assess the impacts of the proposed quarry to on-site and off-site ecological linkages;
- Additional biological inventories are needed to assess impacts to the more demanding species that may be present on site or present in the large connected forest and wetland habitats, for example amphibian species that move between wetlands and uplands in the landscape or snakes that utilize hibernacula within the study area; and
- There is need to consider how existing or new/upgraded roads created to accommodate increased truck traffic will lead to additional and more significant fragmentation of natural areas within the region.

Long Term Ecological Change

Effective protection of natural areas is best achieved when land use decisions are based on environment first principles applied within an environment where the remaining natural areas are large, are of high quality and are well connected. As part of a “system of natural areas” the Lowndes Holdings property falls within this definition and environment first principles have been applied insofar as a natural heritage system has been identified within the region. In addition to the direct and indirect impacts considered above there is a need to consider impacts to the natural environment that less direct, impacts which accumulate over time or which constitute part of regional cumulative impacts. Some of these impacts include the following:

- There are periodic and continuous noise and light impacts associated with quarry operations and truck traffic that can impact the surrounding natural areas and/or animals that may move across the proposed quarry site;

- There is the noise and vibration impact associated with the blasting of rock that has is particularly detrimental to aquatic organisms and has the potential to fracture rock leading to dramatic changes in surface and ground water flow;
- There is a reduction in air quality as dust affects plants and animals and dust fallout affecting water quality and vegetation; and
- There is an increase in truck traffic on local roads that will lead to an increase in the number animals which die crossing the roads each year.

7. PRELIMINARY CONCLUSIONS

The environment of southern Ontario has been significantly altered from its original pre-European state. In much of southern Ontario the biological diversity of the remaining natural areas is significantly less than it once was and it is continuing to decline. In response to the varied and continuing impacts of development the province and municipalities have adopted Natural Heritage Systems as a more effective strategy to protect and restore natural features and functions over long periods of time.

The Lowndes Holdings property contains significant natural features and functions that contribute to the biological diversity and ecological integrity of the region. This is based on the geographic extent of natural features present, the diversity of communities represented, the quality of natural areas, the hydrologic attributes of wetlands and creeks and the interconnectedness of the natural areas. Few areas of southern Ontario have this combination of natural attributes and it is for this reason that so many natural heritage features have been designated by programs such as the Areas of Natural and Scientific Interest (ANSI), the Environmentally Significant Areas (ESA) program of the City of Hamilton, the Environmentally Sensitive Areas (ESA) program of the Region of Halton, the Wetland Evaluation Manual for Southern Ontario that designates Provincially Significant Wetlands (PSW), the Greenbelt Taskforce, the Big Picture project, and the Bronte Creek Watershed study of Conservation Halton.

There currently exists an acknowledgement of the many natural heritage features represented in association with the Lowndes Holdings property and there are many designations intended to protect and enhance the natural features present as noted in Section 3. As such, the proposed development of a hard rock quarry operating below the ground-water table within the Lowndes Holdings property would have serious environmental implications for the existing ecologically designated features. It is critical that evaluations of the proposed land use changes consider both the structure and the function, at a range of biological scales ranging from genetic, to species, to communities and landscape, as well as a range of geographic and temporal scales to fully appreciate the qualities that characterize integral, dynamic ecosystems resilient to internal and external forces. The evaluations must also consider cumulative and long term impacts. It is also noted that the proposed aggregate development is contrary to the existing land use planning documents that have been prepared to protect the forests and wetlands present including the Provincial Policy Statement, the Hamilton-Wentworth Official Plan, the Flamborough Official Plan, and the Greenbelt Plan.

8. REFERENCES

Brown, J.H. and A. Kodric-Brown. 1977. Turnover rates in insular biogeography: effect of immigration on extinction. Ecology 58: 445-449.

Burgess, R.C. and D.M. Sharp (eds.). 1981. Forest Island Dynamics in Man-dominated Landscapes. Springer Verlag, New York.

Burke, D.M. and E. Nol. 1998. The influence of food abundance, nest-site habitat, and forest fragmentation on breeding ovenbirds. The Auk 115 (1): 96-104.

Conservation Halton. 2002. Bronte Creek Watershed Study. Prepared by the staff of Conservation Halton. Includes main report and 7 appendices.

Dwyer, J.K.(ed.). 2003. Nature Counts Project. Hamilton Natural Areas Inventory. Prepared by Hamilton Naturalists' Club in partnership with the City of Hamilton and the Hamilton Conservation Authority. Includes two volumes, volume one summary reports of study sites and volume two species checklists for study sites.

Federation of Ontario Naturalists (FON). 1999. Southern Ontario Woodlands. The Conservation Challenge. Conference Casebook compiled by Andrea Kettle, Conference held at Trent University Jun 9-10, 1999. Available form the Federation of Ontario Naturalists, 355 Lesmill Road, Don Mills, ON. www.ontarionature.org

Francis, C. and Austen, M. 1999. Effects of Forest Fragmentation on Woodland Birds in Southern Ontario.

Friesen, L.E. 1995. Landscape Ecology and its Application to Land Use Planning in Southern Ontario." Working Paper Series No. 34, School of Urban and Regional Planning, University of Waterloo.

Friesen, L.E., P.F.J. Eagles an R.J. MacKay. 1995. Effects of residential development on forest-dwelling neotropical migrant songbirds. Conservation Biology 9(6):1408-1414.

Geomatics International Inc. 1993. Natural Heritage System for the Oak Ridges Moraine Area: GTA Portion. Background Study No.4 To the Oak Ridges Moraine Planning Study. Prepared in association with Paul Rennick and Associates. Prepared for the Oak Ridges Moraine Technical Working Committee.

Geomatics International Inc. 1995. Natural Environment Systems Strategy for the Regional Municipality of Ottawa-Carleton. Stage 1 Regional Information Base and Ecological Profile. Prepared for Planning and Property Department, Regional Municipality of Ottawa-Carleton.

Geomatics International Inc. 1997a. Rouge-Duffins Draft Natural Heritage System. Prepared for Ministry of Natural Resources, Aurora.

Geomatics International Inc. 1997b. Natural Heritage System for the St. Clair River Watershed. Prepared for the Ministry of the Environment.

Geomatics International Inc. 1998. Richmond Hill Corridor Study. Prepared in association with Sorensen Gravely Lowes, Bill Blackport and Associates and DS Lea and Associates. Prepared for Planning and Development Department, Town of Richmond Hill.

Geomatics International Inc. 1999. Georgian Bay Greater Ecosystem Bioregional Study. Prepared for Georgian Bay Islands National Park.

Geomatics International Inc. 1993. Evaluation of Environmentally Sensitive Area Program in Halton Regional Municipality. 1990-1993. Consultants report prepared for the Regional Municipality of Halton.

Harris, D.E. 1984. The Fragmented Forest: Island Biogeography Theory and the Preservation of Biotic Diversity. University of Chicago Press. Chicago. 211pp.

Hamilton-Wentworth. 2003. Towards a Sustainable Region Official Plan for the Region of Hamilton-Wentworth. Office Consolidation, July 2003.

Leakey, R. and R. Lewin. 1996. The sixth Extinction: Patterns of Life and the Future of Humankind. Doubleday, New York

MacArthur, R.H. and Wilson, E.O. 1967. The Theory of Island Biogeography. Monographs in Population Biology. Princeton University Press, Princeton, New Jersey. 203pp.

MMAH. 2005. Greenbelt Plan 2005. Ministry of Municipal Affairs and Housing. 57pp, plus maps.
http://www.mah.gov.on.ca/userfiles/HTML/nts_1_22087_1.html

MMAH. 2004a. Toward a Golden Horseshoe Greenbelt. Greenbelt Taskforce Discussion Paper. A Framework for Consultation. May 2004. Ministry of Municipal Affairs and Housing. 32pp.

MMAH. 2004b. Greenbelt Draft Plan. October 2004. Ministry of Municipal Affairs and Housing. 34pp, plus maps.

NHIC/NCC. 2002. Big Picture 2002. Prepared by the Natural Heritage Information Centre of the Ontario Ministry of Natural Resources and the Nature Conservancy of Canada.

North-South Environmental Inc. 2003. Review of Environmentally Sensitive Areas (ESAs) in Halton Region. 2001-2002. Consultants report prepared for the Regional Municipality of Halton.

North-South Environmental Inc. 2000. Mississauga Natural Areas Study Report. Consultants report prepared for the City of Mississauga.

Noss, R.F. 1983. A regional landscape approach to maintain diversity. BioScience 33: 29-40.

Noss, R.F. 1987. Corridors in real landscapes: a reply to Simberloff and Cox. Conservation Biology 1(2):159-164.

Noss, R.F. and A.Y. Cooperrider. 1994. Saving Nature's Legacy. Protecting and Restoring Biodiversity. Island Press. 416pp.

OMNR. 2002a. Ontario Wetland Evaluation System – Southern Ontario, Covering Hill's Site Regions 6 and 7. 3rd Edition, Revised December, 2002. Ontario Ministry of Natural Resources, Queen's Printer, ISBN MO-7778-0997-4.

OMNR. 2002b. Big Picture 2002. Ontario Ministry of Natural Resources, Natural Heritage Information Centre, Peterborough. http://nhic.mnr.gov.on.ca/MNR/nhic/projects/BP/bigpict_2002_main.cfm

Primack, R.B. 1998. Essentials of Conservation Biology, 2nd ed. Sunderland: Sinauer Associates Inc.

Reid, R. and Carolinian Canada. 2002. Practical Options for the Greening of Carolinian Canada. Report prepared by Ron Reid, Boblink Enterprizes in collaboration with The Carolinian Canada Coalition. http://www.carolinian.org/ConservationPrograms_greeningsummary.htm

Riley, J. 1999. Southern Ontario woodlands: the conservation challenge. Pp. 9-22. In: Federation of Ontario Naturalists (FON). 1999. Southern Ontario Woodlands. The Conservation Challenge. Conference Casebook compiled by Andrea Kettle, Conference held at Trent University Jun 9-10, 1999. Available form the Federation of Ontario Naturalists, 355 Lesmill Road, Don Mills, ON. www.ontarionature.org

Simberloff, D. and J. Cox. 1987. Consequences and Costs of Conservation Corridors. Conservation Biology 1(1):63-71.

Soulé, M.E. and M.E. Gilpin. 1991. The theory of wildlife corridor capability. Pp. 3-8. In: D.A. Saunders and R.J. Hobbs (eds.). Nature Conservation 2: The Role of Corridors. Surrey Beatty & Sons Pty Limited, Australia.

Trombulak, Stephen C. and Frissell, Christopher A. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1):18-30.

Villard, M.A., Trzcinski, M.K. and Merriam, G. 1999. Fragmentation Effects on forest birds : relative influence of woodland cover and configuration on landscape occupancy. Conservation Biology, v13.

Wilson, E.O. and E.O. Willis. 1975. Applied Biogeography. Pp 522-534. In: M.L. Cody and J.M. Diamond (eds.). Ecology and Evolution of Communities. Harvard University Press, Cambridge, M.A.

Appendix A: Curriculum Vitae Dr. Brent Tegler

PERSONAL DATA
Citizenship: Canadian
Languages: English, Melanasian Pidgin, West African Krio
Birthdate: 14 April 1954

EDUCATION

Ph.D.	University of Guelph (1993), Doctor of Philosophy, Ecology
M.Sc	McMaster University (1980), Master of Science, Ecophysiology
B.Sc	University of Toronto (1977), Bachelor of Science, Honours Ecology

APPOINTMENTS

Special Graduate Faculty	University of Guelph, School of Environmental Design and Rural Development
Senior Associate	The Heron Group international consulting team

CAREER SUMMARY

North-South Environmental Inc. (1999 to present), Applied Ecologist & Partner
North-South addresses the varied needs of sustainable landscape planning related to wildlands, sustainable forestry, agriculture lands and urban lands. North-South Environmental Inc. emphasizes the development of environmental management designs that meet human needs within landscapes that maximize the ecological integrity of self-sustaining natural systems with high native species diversity.

Geomatics International Inc. (1991 to 1999), Applied Ecologist
Applied terrestrial ecologist specialising in the description and interpretation of biological features and processes in natural and anthropogenic landscapes. Duties include report writing, project management, field work and data analysis. Project areas include sustainable forest management, environmental impact assessment, protected areas selection and design, cumulative effects monitoring, rare plant monitoring, environmental restoration, fire management and non-formal education.

Western Province, Solomon Islands (1993 to 1995), **Environment Officer**
Environmental Advisor to the government and people of Western Province to assist with the development of resource management policies, impact studies, legislation and environmental education programs.

University of Guelph (1987-1991), Ph.D. graduate student
Ph.D. student in the Departments of Environmental Biology and Geography at the University of Guelph. Thesis topic: Vegetative control of wind erosion in the Sahel Region of West Africa.

Ontario Ministry of Natural Resources (1986-1987), Research Plant Ecologist
Researcher and author of a report on the role of fire in the ecology of the vegetation of Pinery Provincial Park leading to the preparation of a five year prescribed burn plan for the restoration of Oak Savanna in the Park.

Papua New Guinea Forestry College (1983-1985), Head of Botany Department
Administrator of Botany Department, including staff, arboretum, herbarium and research. Supervised and taught ecology, dendrology, introductory botany, soils and geology, and wildlife biology. Conducted ecology field trips in wilderness environments with college students.

University of Sierra Leone, Africa (1981-1983), Ecology Lecturer
Responsible for lecturing and curriculum development of courses in Introductory and Advanced Ecology and field courses in the Ecology of Savanna Woodland.

World Wildlife Fund-US (1982-83), Research Botanist
Field research and report prepared on the vegetation of Kilimi National Park, Sierra Leone.

INTERNATIONAL FIELD EXPERIENCE

Senegal training staff from Senegalese non-government organizations in the use of GeoNetWeaver NRM analysis software to assess and monitor ongoing development projects in Community Based Natural Resource Management.

Nigeria over a three-year period completed field studies involving a nation-wide forest resource inventory in mangrove, swamp, tropical high forest and savannah ecosystems leading to preparation of sustainable forest management plans.

Solomon Islands two years as an in-country advisor developing and implementing resource management guidelines, environmental education awareness programs and environmental legislation for sustainable use of tropical forest and marine ecosystems.

Mali three field seasons completing an ecological description of sahel vegetation and recording measurements of near surface wind-flow for research on desertification.

Papua New Guinea two and one half years as head of the botany section of the PNG Forestry College leading to field studies in the ecology of tropical montane systems, and environmental impact assessments of logging and mining operations.

Sierra Leone two years as senior lecturer at the University of Sierra Leone included field studies on the ecology and management of Guinea Savannah for the countries first national park and environmental impact assessments of bauxite and rutile mining operations.

PROJECT EXPERIENCE

Ecological Monitoring

- Developing a Monitoring Strategy for forests in the Region of Halton. 2005 (ongoing)
- Enhancing Community Based Monitoring in Canada: Exploring the role of Environment Canada. 2004
- Monitoring Fire Management at Rondeau Provincial Park – 2002
- Criteria and Indicators to Monitor Sustainable Ecosystem Management - 2002
- Developing an Approach to Inventory, Monitor, Assess and Report on Long Term Ecological Health and Integrity and the Cumulative Effects of Human Activities in Ontario's Provincial Parks and Conservation Reserves – 2001
- Torrance Creek Sub-watershed Plan Monitoring Strategy - 2001
- Core Monitoring Variables for Tracking Ecosystem Change - 2001
- Workshop on Cumulative Effects Assessment and Management, 1999
- Efficacy Testing of Core Monitoring Variables. 1999
- Selecting Core Monitoring Variables for Tracking Ecosystem Change at EMAN Sites. 1999
- Niagara Escarpment Cumulative Effects Monitoring. 1996
- Rare Plant Monitoring Program - Georgian Bay Islands National Park. 1992

Natural Areas Evaluation and Management

- Significant woodland study in the Region of York. 2005 (ongoing)
- Assessing the significance of woodlands in the rural areas of the City of London. 2005 (ongoing)
- Ecological Land Classification in the Hudson Bay Lowlands. 2004
- Ondo State (Nigeria) Ecologically Sensitve Area Study - 2003
- Killarney Signature Site Detailed Life Science Inventory – 2003
- Development of a Tallgrass Prairie and Savannah Prescribed Fire Expert System – 2002
- Management Framework for Cruickston Park, Cambridge, Ontario – 2001
- Evaluation of the Ecological (Life Sciences) Values of the Lake Nipigon Basin Provincial Parks/Conservation Reserves/Enhanced Management Areas – 2001
- Algoma Headwaters and Adjoining Waterway Provincial Parks and Spanish River Provincial Park Including Biscotasi Provincial Park Life Science Study Report – 2001
- Importation Control of Alien Species Entering Canada. 2000
- Integrated Protected Areas and Conservation Management in Romania. 1997- 1998.
- Georgian Bay Islands Greater Park Ecosystem Study. 1994-1998
- Rouge Park Vegetation Management Plan. 1996
- Gap Analysis and Candidate Area Selection for Life Science Representation in Site District 4E-3. 1994
- Evaluation of Environmentally Sensitive Area Program in Halton R.M. 1990-1993.
- Identification and Prioritization of Wetland Habitats in Georgian Bay Islands N. P., 1993.
- Zone 1 and Environmentally Sensitive Site Designation - St. Lawrence Islands

National Park. 1992.
- Zone 1 and Environmentally Sensitive Site Designation - Georgian Bay Island National Park. 1991.
- Massasauga Wildlands Provincial Park Supplementary Life Science Inventory. 1991.

Natural Heritage Systems
- North Pickering Land Exchange Natural Heritage System 2005 (ongoing)
- Richmond Hill Corridors Study. 1998
- St. Clair Natural Heritage System. 1997.
- Rouge Duffins Natural Heritage System. 1996.

Sustainable Forest Management
- Caribou Forest Independent Forest Audit 2005 (ongoing)
- Assessing the Role Forests in Parks and Protected Areas and Private Woodlands in meeting Canada's objectives under the Kyoto Protocol. 2003.
- Forest Resources Study - Nigeria 1996-1999

Ecological Restoration
- Restoration of DiBiase property watercourse 2005 (ongoing)
- Brighton Beach Power Ecological Restoration. 2003.
- Vegetation Restoration Planning. Sandbanks Provincial Park – 2003
- Red Cedar Savannah Restoration Plan - Point Pelee National Park. 1993-4

Sustainable Urban Environments
- York District Secondary Plan Development 2005 (ongoing)
- Mitchell Farm Phase II, Stage 1 Environmental Implementation - 2001
- Review of Cawthra Woods Urban Forest Management Plan. 1996
- Huron Environmental Area Co-operative Project, Kitchener. 1992

PROFESSIONAL PUBLICATIONS AND PAPERS

Tegler, B. 2004. The Role of Industry in Community Based Monitoring. Paper prepared for special session *Linking Ecological Monitoring to Decision-Making at Community and Landscape Scales* at the CAMESA Monitoring Science and Technology Symposium, Denver CO, Sept 21-24, 2004.

Tegler, B. 2004. Woodland Management for Ecological Values. Paper prepared for the Carolinian Canada Conference, Kings College, London ON, May 11, 2004

Tegler, B. 2003. Science in Support of Community and Landscape/Seascape Sustainability: Concepts of Sustainability. Paper prepared for the EMAN National Science Meeting, Halifax, NS, November 28, 2003.

Tegler, B. 2003. Tallgrass Prairie and Savanna Prescribed Fire Decision Support System. Paper prepared for Tallgrass Ontario Conference, Ridgetown College, Ridgetown ON, 2003.

Tegler, B. 2003. Monitoring Forest Management Unit Scale Sustainability. Paper prepared for the World Forestry Congress, Quebec City PQ, Sept 20-28, 2003.

Tegler, B. and Brdar, C. 2003. Vegetation Restoration Planning at Sandbanks Provincial Park. 2003 PRFO Proceedings. Heritage Resources Centre, University of Waterloo.

Johnson, M. A. and Tegler, B. 2002. Monitoring Fire Management of Oak Savanna and Tall Grass Prairie in Rondeau Provincial Park. 2002 PRFO Proceedings. Heritage Resources Centre, University of Waterloo, pp 269-282.

Akindele, S. O., J. Dyck, B. Tegler, F. F. Akindunni, P. M. Papka and O. A. Olaleye (2001). *Estimates of Nigeria's Timber Resources*. ***In***: Popoola, L., J. E. Abu and P. I. Oni (Editors). *Forestry and National Development*. Proceedings, 27th Annual Conference of Forestry Association of Nigeria, Abuja, Nigeria September 17 – 21, 2001. pp. 1 – 11.

Sharp, M. and Tegler, B. 2001. An Approach for Monitoring in Ontario's Provincial Parks and Protected Areas. Ecological Integrity and Protected Areas, 2001 PRFO Proceedings. Heritage Resources Centre, University of Waterloo, pp 363-369.

Tegler, B., M.J. Sharp and M. Johnson. 2001. Ecological Monitoring and Assessment Network's Proposed Core Monitoring Variables: An Early Warning of Environmental Change. Environmental Monitoring and Assessment vol. 67, pp 29-56.

Tegler, B., M.J. Sharp and M. Johnson. 1999. Georgian Bay Greater Park Ecosystem: A bio-regional approach to conservation. Paper presented to the Parks Research Forum of Ontario Conference, April 22nd, 1999, Guelph, Ontario.

Tegler, B and D. Ramsay. 1998. Terrestrial Ecology Monitoring and Regional Landscape Planning: The Niagara Escarpment Experience. Paper presented at the Natural Areas Association Conference, October 6-10, 1998, Mackinac Island, Michigan.

Tegler, B. and J. Robinson. 1995. Western Province Resource Management Ordinance. Gizo, Solomon Islands, 24pp..

Tegler, B. 1995. Forest Management Policy, Western Province, Solomon Islands. 4pp..

Tegler, B. 1994. Canary in a Coal Mine: Environmental Change in the South Pacific. Environmental Video, 31min.

Tegler B. 1990. Measurement of wind profiles in plant communities of Mali, West Africa. Paper presented to the Canadian Association of Geographers in Ontario, February 1990.

Tegler B. 1990. Desertification: Is the cause climate or human? Video presentation produced for CUSO Guelph, 57min.

Tegler B. 1984. Woody Regeneration in Anthropogenic Grassland, Papua New Guinea. Conference paper, Ninth meeting of PNG Botanical Society, Madang, Papua New Guinea.

Tegler B. & Kershaw K.A. 1981. The Seasonal Variation of the Heat Stress Response of *Cladonia rangiferina*. New Phytologist v.87, pp395-401.

Tegler B. & Kershaw K.A. 1980. The control of seasonal rates of net photosynthesis by moisture, light, and temperature in *Cladonia rangiferina*. Canadian Journal of Botany, v.58(17), pp1851-1858.