

3. Identification of the Natural Heritage Network (NHN) – A Made-in-Vaughan Approach

The natural heritage network includes:

1. Core natural features that must be included in the system without option; and,
2. Those supporting lands whose functions must be maintained and/or enhanced to link the system or enhance core features.

It was therefore necessary to clearly identify these core features embedded in the complementary natural heritage systems identified through other processes as they are represented in the City. On that foundation, the need for further additions to the Network can be identified to ensure that the environmental quality of the City of Vaughan continues to improve with time.

3.1 Goal and Objectives of the Natural Heritage Network

The ultimate goal of the NHN is the protection and enhancement of ecosystem health, with emphasis on terrestrial and aquatic biodiversity. Further, it is the goal to structure the NHN in order to support the implementation of the City of Vaughan's Community Sustainability and Environmental Master Plan: Green Directions (2009).

The objectives of the NHN include:

- a) Protect, enhance and manage all features that have been identified through OPA 600 and subsequent land use planning processes in the network;
- b) Protect, enhance and manage features identified through provincial processes (Key Natural Heritage Features; Key Hydrologic Features and updated Provincially Significant Wetlands);
- c) Protect, enhance and manage key concentrations of biodiversity;
- d) Ensure that the framework for the Natural Heritage Systems identified through other natural heritage planning processes that include lands within the City of Vaughan are incorporated;
- e) Provide the basis for the identification of ecosystem functions to support the implementation of the City of Vaughan's Community Sustainability and Environmental Master Plan: Green Directions.
- f) Establish the minimum limits to a defined system, and promote the extension of ecosystem functions throughout the City (e.g., enhancement of the urban forest; naturalization of private and/or public property).

In order to accomplish these objectives, the following process was undertaken:

1. Review the natural heritage features identified in OPA 600, together with policies for their protection and the outcomes of mechanisms to add features (e.g., additional evaluation of woodlands);
2. Update the information provided in OPA 600 and subsequent documentation (e.g., recent wetland evaluations; outcomes from recent transportation projects)⁴;
3. Integrate these important features with the network of watercourses within the City;

4. *This detailed information will be important when land use changes are contemplated in order to provide direction for the necessary background investigations and analysis prior to approval.*

4. Integrate the TRCA watershed Terrestrial Natural Heritage Systems for the Don and Humber Watersheds with those of the Greenbelt (including the Oak Ridges Moraine system) and compare to the emerging York Region Greenlands System (Draft OP 2009);
5. Overlay the natural heritage features important to Vaughan (from steps 1, 2 and 3) including potentially important hydrogeologically sensitive areas and refine the network;
6. Refine the integrated “systems” layer in order to incorporate updated information (e.g., East Humber Wetland Complex), established land use patterns and identify alternate or enhanced pathways of connectivity and other enhancement areas;
7. Recognize that additional refinements are anticipated based on additional factors that are important to the City of Vaughan (e.g., land use planning interests of the City).

3.2 TRCA Terrestrial Natural Heritage Systems for the Don and Humber Watersheds

The targeted TRCA Natural Heritage Systems for the Don and Humber Watersheds were the primary data sets used as the framework around which a “made-in-Vaughan” core system was organized. The model builds on the conventional assemblage of wetlands, woodlands, valleylands, watercourses and wildlife habitat to identify opportunities to create linkages, minimize the effect of negative land uses adjacent to natural areas and linkages, and enhance the patch shapes and sizes of natural areas in support of not only important natural heritage functions, but also external ecosystem functions, such as improved water quantity management, air quality improvement or carbon sequestration and storage. This baseline model of the targeted system was overlain by the additional data sets available from the City of Vaughan, TRCA, MNR and from other environmental studies where available.

The TRCA targeted system includes areas of “potential natural cover” that would enhance the system, however, given that the underlying land use is often agricultural, there is often more than one way to achieve the system benefits. The landscape of the City of Vaughan is dynamic and constantly evolving. Areas of “potential natural cover” that were defensible in 2005 may no longer be candidates in 2009 due to intervening development processes.

The resulting overlay of mapping of features was compared to the TRCA Targeted Terrestrial Natural Heritage Systems. The areas not included in the TRCA TNHS include some of the smaller watercourses, lands under agricultural use and Built-up Valleylands. Built-up Valleyland has been identified in the Draft Natural Heritage Network as a unique part of the valley continuum where streetscaping and backyard biodiversity maintain linkages among protected areas. Elsewhere, the agricultural lands provide unique habitat for open country fauna, potential habitat for flora and provide a low barrier to wildlife and plant movement. It is the intent of the NHN study to recognize the natural heritage functions provided by these lands.

The TRCA TNHS has suggested enhancements to the system to achieve shapes, sizes or connectivity based on principles of landscape ecology. However, some of those opportunities are not unique, and therefore the approach of growing the Network based on targets is intended to encourage the achievement of these enhancements in a less prescriptive but no less rigorous way with consequent benefits to the landowners. The draft Natural Heritage Network has recommended linkages based on the same principles as those used to generate the TRCA TNHS, but in some cases, located elsewhere. Some of the areas recommended in the model were not included in the final Draft NHN due to advances in land use or transportation planning (e.g., the large area between Langstaff and Rutherford Road west of Hwy 27 will be bisected by the new Highway 427 corridor, therefore does not provide a good candidate for connectivity). Others are subject to municipal parks planning (e.g., Maple Valley Park). Extensive areas within the Greenbelt and/or Oak Ridges Moraine were not identified through the overlay, but have since been added to the Network because they provide habitat for grassland species, and/or opportunities for forest enhancement that may someday achieve size thresholds for enhanced forest bird populations.

3.3 Targets for Landscape Restoration

Policies have evolved at the Federal, Provincial, regional and local scale through time in recognition that the attributes of the land base need to be managed in order to protect a viable future on social, economic and environmental terms. From a natural heritage perspective, the paradigm has shifted from one where natural heritage was a consequence of urban planning, relegated to “waste” areas that could not be developed. The consequences of filling and draining wetlands on water management and the loss of wildlife habitat led to an emphasis on preservation of wetlands due to the alarming rate at which they were being removed. Science tackled the issues of the needs of wildlife and the principles of landscape ecology as core considerations in maintaining natural heritage function on the landscape. The concept of an “ecosystem approach” has been around since the 1990s, but never before has the emphasis been so securely placed on the need to manage the *system* in ecosystem, even more than the individual features within and extend that system to include social and economic considerations.

The systems approach seeks to overcome the inability of features-based planning to maintain and enhance biodiversity, because viability depends on a complex of environmental functions and interactions that cannot be preserved only by isolation from human activity, and the increase in human activity and the effects on natural heritage cannot be mitigated through the preservation of protected area alone (Bennett and Wit, 2001).

The reality of climate change has inserted another level of concern. Historical policies were created in a time when water shortages were not anticipated; that air quality was not linked to functioning ecosystems and that so much natural heritage was identified for protection that the need to trade off one feature against another became a possibility to make the most of dwindling resources in the face of increasing use. The policies have placed us in a position where there is a recognition that natural features must be preserved and enhanced. However, in order to achieve the natural heritage outcome identified by the policy, recognizing the need to manage Natural Heritage Networks is as important as identifying them. Without management, the negative impacts created by non-native invasive species (plants, worms and pets), air quality (increased nitrogen deposition) and mechanical human impacts (trails, recreation) will defeat the maintenance of these features and functions that we value.

The focus on environmental outcomes requires planning to integrate among environmental, social and economic factors and incorporates the importance of long-term management of the system in order to achieve a specified outcome. Outcomes based planning is characterized by the spatial identification of natural heritage system, and by the organizational component; the programs required for conservation, management and celebration of the system (City of Edmonton, 2007).

In spite of various provincial, regional and municipal attempts to maintain natural heritage areas, when compared to healthy, functioning ecosystems, natural heritage in the City of Vaughan falls far short of thresholds identified for percent natural cover of watersheds and prevention of further degradation of aquatic habitat and resources (Table 2).

Table 2. Estimated Natural Cover in the City of Vaughan

Cover Type	% of City of Vaughan	Recommendation for Ecosystem Health
Natural Cover (%)	20 ⁵	42 ⁶
Forest Cover (%)	16	30 to 40 ^{7,4}
Wetland Cover (%)	1	10 ⁸
Meadow Cover (%)	6	6 ⁹
Successional Cover (%)	1	1 ⁵

5. Note that there is overlap between forests and forested wetlands, and the data are subject to rounding errors. For this reason, these data are not additive.

6. Derived from targets for the Humber River Watershed

7. American Forests

8. Environment Canada (2004)

9. Derived from City of Vaughan data to maintain current levels of function (2009)

Identification of thresholds beyond which it is possible to identify meaningful improvement in ecosystem health have been the “Holy Grail” for many investigations, including Environment Canada and American Forests. The recommendations listed in Table 2 have been identified based on a number of resources and reflect many references in the literature. The Humber River Watershed Plan suggests a total natural cover target of 42% over the watershed in order to enhance watershed health. American Forests suggests that the average tree cover across all zones for a study focused on east of the Mississippi and in the Pacific Northwest to be 40% forest cover. Environment Canada and others suggest that 30% forest cover is the threshold at which populations of expected breeding birds decline and impairment effects are noticed in watercourses. York Region has identified a target of 25% forest cover. Watershed studies suggest that reforestation of headwaters provide enhanced improvement to watersheds as compared to reforestation elsewhere. These are thresholds which should ideally be exceeded to allow for variability in ecosystem function and stochastic events that will create negative impacts to the systems.

The concept of a threshold is extremely useful to identify a framework of outcomes for land use planning to achieve over appropriate time lines. For certain ecological themes the land base may no longer provide the capacity to achieve a particular threshold. This focuses efforts on priority areas to make the biggest gains in target achievement while also promoting innovation to ultimately reach the target over longer time lines. An unattainable threshold should emphasize the urgency to maintain existing features, and implement enhancement efforts to maximize beneficial ecosystem functions.

Environment Canada (2004) provides guidelines for forest restoration within a watershed (Table 3).

Table 3. Forest Habitat Guidelines (Environment Canada 2004)

Parameter	Guideline
Size of Largest Forest Patch	A watershed or other land unit should have at least one 200 ha forest patch that is a minimum 500 m in width.
Percent of Watershed that is Forest Cover 100 and 200 m from Forest Edge	The proportion of the watershed that is forest cover 100 m or further from the forest edge (i.e., “interior” should be greater than 10 percent. The proportion of watershed that is forest cover 200 m or further from the forest edge should be greater than five percent.
Fragmented Landscapes and the Role of Corridors	Connectivity width will vary depending on the objectives of the project and the attributes of the nodes that will be connected. Corridors designed to facilitate species movement should be a minimum of 50 m to 100 m in width. Corridors designed to accommodate breeding habitat for specialist species need to be designed to meet the habitat requirements of those target species.
Forest Quality – Species Composition and Age Structure	Watershed forest cover should be representative of the full diversity of forest types found at that latitude.

The Vaughan landscape is fragmented to the point where contiguous forest of the sizes and with interior forest characteristics are rare. The benefit of achieving these thresholds is in the recovery of elements of biodiversity that is at best stressed, or at worst, extirpated from the City of Vaughan. These centres of biodiversity, including headwater areas, are the areas where forest restoration has the best potential to recover ecosystem functions, supported by landscape connectivity and corridors.

If all of the natural heritage network were to be reforested, 35% forest cover in the City could be achieved. Conceptually, the threshold of 40% would require reforestation of all of the Greenbelt, including the Oak Ridges Moraine. This will not occur due to competing requirements for agriculture and settlement areas. However, the planting and management of a healthy, sustainable urban forest contributes to that target, as does planting native gardens and implementation of strategies to reduce the generation of air pollutants. The function of the threshold is to identify a tangible objective to which all processes should contribute, allowing for innovation and scientific discovery to aid in the process. The policies should empower the creation of new ideas and remove roadblocks to innovation. Natural heritage is not confined to the valleys and woodlots. It threads its way into the neighbourhoods

and backyards and wildlife is responding. An array of ecosystem functions should be investigated to fill the void between threshold and reality. Therefore policies should identify and reward efforts to maintain those functions and achieve desired future outcomes outside of the identified natural heritage network.

The valley corridors are critically important refuges of biodiversity and ecosystem function that require linkages across the tableland to provide resiliency. Threats to the integrity of these refugia include the expansion of the transportation network and increased trail development and use by people.

Watershed modelling by TRCA (2008b) has demonstrated that:

A “business-as-usual” approach to future development will result in continued losses of environmental quality, biodiversity and cultural heritage, along with considerable costs to address the health, social and economic consequences of degraded environmental conditions and damaged infrastructure and property.

The identification, management and enhancement of the Natural Heritage Network seeks to avoid this outcome.

3.4 Components of the Natural Heritage Network

The International Association for Landscape Ecology defines the science as, “the study of spatial variation in landscapes at a variety of scales. It includes the biophysical and societal causes and consequences of landscape heterogeneity. Above all, it is broadly interdisciplinary.” Simply put, it is the study of the relationships among patches of the landscape (i.e., forests to wetlands; valleys to headwaters). The literature surrounding the science of landscape ecology emphasizes the importance of connecting the landscape in order to maintain healthy, native biodiversity. Approaches to natural heritage planning incorporate these principles that include the need to not only protect and enhance patches on the landscape, but the need to connect them in a system, or referred to in this study: a network.

However, in order to provide a structure in support of policies within the Official Plan, it is necessary to identify those parts of the network that cannot be replaced and provide important ecosystem functions, and/or are defined through external planning processes (e.g., the Greenbelt Plan). Therefore, the constituent components were identified and mapped in order to understand the character of the network at any one place in the Network (Table 4).

The core components of the network are the main anchors to which the network is folded over. The delineation of the components is determined by protocols identified by the Province, TRCA, and or the City. The combined functions of the core components within the network is greater than the functions as separate entities and therefore their functions must be evaluated in terms of a system as a whole. While there is some relative flexibility within the network as identified in Chapter 4, however, the real extent and function provided must not be undermined.

3.4.1 Valley and Stream Corridors

Valley and stream corridors are defined as “natural resources associated with river systems characterized by their landform, features, and functions (Figure 1). Valley and stream corridors are distinguished from other physiographic features or resources by their connectivity to the river system as a whole.” (TRCA Valley and Stream Corridor Management Program 1994)

Table 4. Components of the Vaughan Natural Heritage Network

Network Component	Rationale
Woodlands	Woodlands are defined as treed areas which include woodlots or forested areas and vary in their level of significance. All woodlands identified by the City of Vaughan, TRCA and York Region have been included in this layer.
Wetlands	Wetlands are provided protection by an array of instruments including Provincial Policy Statement (Provincially Significant Wetlands), The Greenbelt Plan, the Oak Ridges Conservation Plan, Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, and City of Vaughan OPA 600. All wetlands identified by the TRCA TNHS and the MNR wetlands evaluation layer have been included in this layer.
Fish Habitat and Watercourses	Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. Note that headwater drainage that may exist at larger scales must be identified through site specific studies.
Valleylands¹⁰	Toronto and Region Conservation Authority (TRCA) Valley and Stream Corridor Management Program (VSCMP) does not support development below crest of slope ¹¹
Buffers to Valleylands	City of Vaughan policy: The TRCA VSCMP requires naturalization of a 10 m buffer adjacent to the limit of the valley corridor. The Greenbelt Plan requires a 30 m vegetation protection zone adjacent to the stable top of bank.
Buffers to wetlands	Many of the wetlands are located within the Greenbelt and a minimum 30 m buffer is required by the policies of the Greenbelt Plan, as well as the regulations within the Oak Ridges Moraine Conservation Plan. 30 m has been applied to all wetlands.
Floodlines	Estimated floodlines have been provided to the study team however they are subject to change through revisions in flood modelling studies. In some areas where the floodline includes built areas (e.g., perhaps the result of an undersized culvert downstream) the limit of the feature has been reduced to a watercourse buffer however additional study will be required to confirm the limits. (TRCA VSCMP as well as Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses)
Natural Heritage Linkage Areas	These areas have been identified to provide increased opportunity to connect the various features that comprise the Natural Heritage Network allowing increased movement of flora and fauna across the system. Enhancements recommended via TRCA TNHS; AGRA (2001); AMEC (2002); Approved Block Plans; Provincial Policy Statement (Section 2.1.2), The Greenbelt Plan, the Oak Ridges Conservation Plan. These linkages are 60 m corridors or the width of the features they connect, whichever is greater
Natural Heritage Expansion Areas	These areas have been identified as Natural Heritage Expansion Areas. They will provide opportunity to expand the Natural Heritage Network providing additional natural cover and habitat area to strengthen biodiversity and the resilience of the Natural Heritage System as a whole. e.g., Kleinburg between watercourses; east of Hwy 427. Identified as part of a review process with TRCA, City of Vaughan and Region of York and reflected in the TRCA systems modelling process.
Stormwater Management Ponds	Although SWMP should <i>never</i> be substituted for natural heritage features, they do provide natural heritage functions and at a minimum, they provide water supply to downstream watercourses. They are subject to facility management on a periodic basis and policies should be flexible to provide latitude for future innovative design and future improvement of existing facilities
Golf Courses	When portions of the golf course is below top of bank or within defined floodlines, Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses and the VSCMP applies. Ongoing golf course operation would be acceptable, however long term, the contribution to the natural heritage network must be maintained.

10. Note: Where there was no identified crest of slope adjacent to a watercourse, the floodline was used to define the system.

11. The terms "crest of slope" and "top of bank" are used interchangeably in this document.

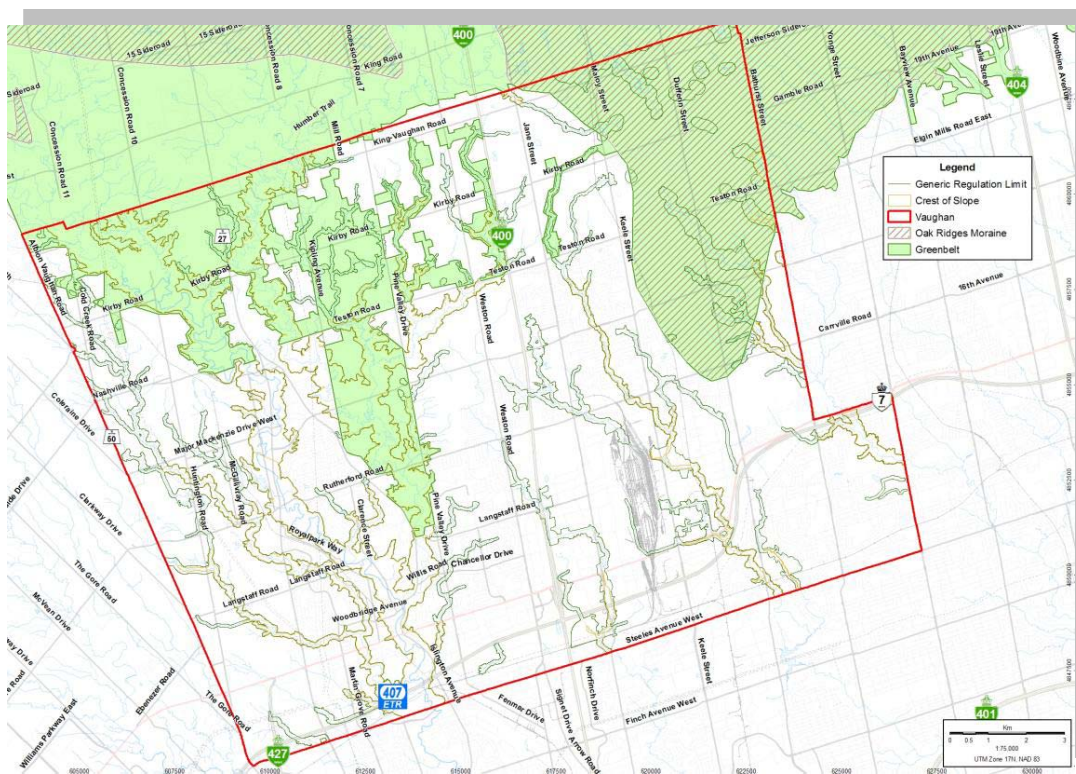


Figure 1. Greenbelt, Oak Ridges Moraine and Valley Corridors

These corridors function as natural water collection systems. The largest within the City of Vaughan are the Humber River, East Humber River, and the Don River (City of Vaughan OPA 600). They are an important links between the headwaters, mid-reaches and lower reaches of watercourses (City of Vaughan OPA 600). They are an important feature connecting the Oak Ridges Moraine in the north with Lake Ontario to the south.

As outlined in the TRCA Valley and Stream Corridor Management Program (1994), they are formed by dynamic natural processes which are constantly influencing their landforms, features and functions. They also are an integral component of numerous ecological functions including but not limited to nutrient and sediment transport; provision of fish and wildlife habitat and migration routes; air quality improvement; and maintenance of a genetic pool for native flora and fauna. They provide both biological and physical linkages, which also connects many of the provincially, regionally and locally designated significant natural areas.

On the Oak Ridges Moraine, Significant Valleylands are defined as:

- all streams with well defined valley morphology (i.e., floodplains, meander belts and valley slopes) having an average width of 25 m or more;
- all spillways* and ravines with the presence of flowing or standing water for a period of no less than two months in an average year. Such features must be greater than 50 metres in length; 25 metres in average width with a well defined morphology (i.e., two valley walls of 15% slope or greater with a minimum height of 5 metres, and valley floor), and having an overall area of 0.5 ha or greater; and
- additional features identified by the approval authority, that are consistent with one or more of the functions described above.

(ORMCP Technical Paper 1 – Identification of Key Natural Heritage Features)

The Planning Act also allows the local municipality to designate significance where appropriate. The Humber and Don Rivers are historically, culturally important in addition to the functions they provide from a natural heritage perspective. On this basis, it is recommended that the valleys of these rivers be considered in the context of the Provincial Policy where there is a well defined valley morphology throughout the watersheds, with flowing or standing water for a period of no less than two months in an average year without a requirement for length. Evaluation of the function of the valleylands identified within the NHN must be undertaken on a site by site basis.

These features were mapped within the NHN through the inclusion of all valley and stream corridors as provided by the TRCA interpreted from a digital elevation model. The NHN mapping incorporates a minimum 10 m buffer for all valley and stream corridors outside of the Greenbelt, and 30 m within the Greenbelt Plan Area, including the Oak Ridges Moraine from the Crest of Slope (Top-of-Bank) However in practice the stable top-of-bank must also be calculated if an application to change land use is contemplated, and if greater than top of bank, then the buffer must be applied from the stable top of bank as per TRCA policy.

3.4.2 Wetlands

Wetlands are lands that are either seasonally or permanently covered by shallow water, this also includes lands where the water table is close or at surface level (PPS 2005). This creates the necessary conditions for the creation of hydric soils and will favour the dominance of water tolerant plant species.

Wetlands play not only a critical ecological role, but a hydrological and habitat role as well. A large number of the wetlands found within Vaughan are located within the headwaters of the Humber and Don Rivers, however wetlands occur along the floodplains of watercourses and in kettles (Appendix C). From an ecological perspective wetlands are the interface between aquatic and terrestrial ecosystems and they are one of the most productive and biologically diverse habitats in Ontario (MNR Natural Heritage Reference Manual 1999). Among some of the benefits of wetlands, they play an integral role in the recharge and discharge of groundwater, flood damage reduction through control and storage of surface water by absorbing peak flows, provide important habitat to plants, fish, and wildlife and influence the quality and temperature of water flowing through them (MNR Natural Heritage Reference Manual 1999, City of Vaughan OPA 600).

These features were mapped within the NHN through the inclusion of all wetlands as identified by the TRCA TNHS and MNR wetlands evaluation layer. The NHN incorporates a minimum 30 m vegetation protection zone buffer. Within the Oak Ridges Moraine and Greenbelt Plan Areas, a 30 m Vegetation protection zone buffer is required.

3.4.3 Woodlands

The Provincial Policy Statement (2005) describes woodlands as treed areas which include woodlots or forested areas and vary in their level of significance.

Woodlands have a number of important ecological functions which enhance the overall health of the Natural Heritage System. Through reducing the intensity and volume of stormwater runoff, they reduce soil erosion and improve water quality (MNR Natural Heritage Reference Manual 1999). They also function to remove excess nutrients, sediments, and toxins from surface water runoff (MNR Natural Heritage Reference Manual 1999) and from the air. When surrounding wetlands and watercourses the shade provided directly affects water temperatures, helping to keep water temperatures cool and leaves dropping in the water are a source of nutrition to aquatic ecosystems. When studied at the landscape level, they function as important links to other woodlands helping to maintain woodland integrity and promote the survival of host species dependent upon them (MNR Natural Heritage Reference Manual 1999).

These features were mapped within the NHN through the inclusion of all woodlands as identified by woodland analyses prepared for the City of Vaughan, the TRCA, the Region of York and the MNR. Currently, the City of Vaughan is conducting an Urban Forest Inventory. This information will be used in future updates. The NHN incorporates a minimum 10 m vegetation protection zone buffer. Within the Oak Ridges Moraine and Greenbelt Plan Areas, a 30 m Vegetation protection zone buffer is required around all woodlands.

3.4.4 Significant Wildlife Habitat and Significant Habitat of Endangered Species, Threatened species, and Species of Concern

The Provincial Endangered Species Act protects Endangered species; species at risk of becoming extinct and threatened species; those at risk of becoming endangered throughout all or a portion of its Ontario range if the limiting factors are not reversed (PPS 2005). The updated Species at Risk Act is Federal legislation and is in place to prevent Canadian indigenous species, subspecies and distinct populations of wildlife from becoming extirpated or extinct; and to provide for the recovery of these species.

One critical component to protecting many of these species is habitat protection. The PPS (2005) defines Significant Wildlife Habitat as areas where plants, animals, and other organisms live, find adequate amounts of food, water, shelter, and space required to sustain their populations. Also, specific wildlife habitats of concern may include areas where species concentrated at a vulnerable point in their annual life cycle; and areas which are important to migratory or non-migratory species. The PPS states that:

Development and site alteration shall not be permitted in...significant wildlife habitat...unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions. And further, that development and site alteration shall not be permitted on adjacent lands to... [significant wildlife habitat]... 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.

It is the responsibility of the local planning authority to identify significant wildlife habitat. The City of Vaughan has not undertaken such a study; however Appendix C includes a summary of the existing wildlife occurrences, a data set that is not comprehensive but is sufficient to indicate where at least some major centres of biodiversity are located in the City (Figure 12 from Appendix C). The limits of these concentrations are poorly defined, and for the purposes of identification of the NHN, woodlands, wetlands and valleylands are surrogates for the limits.

A study will be required In order to obtain a more complete identification of Significant Wildlife Habitat within the City of Vaughan. In the interim, any application must provide a detailed opinion as to whether a candidate Significant Wildlife Habitat occurs in the context of the PPS. The ESA and SARA also apply and further studies may be required as required by the Ministry of Natural Resources and Environment Canada respectively.

The areas where high species diversity and abundance, sensitive hydrological features and high quality woodlots overlapped were identified as concentrations of geo/biodiversity (from Appendix C). Three main centres of geo/biodiversity exist within the City. Six features were overlapped (hydrogeologic sensitivity, areas of enhanced aquatic habitat function, terrestrial vegetation, wetlands, wildlife habitat for birds and amphibians) to identify patterns of biodiversity in the City (Figure 2). It should be noted that each layer includes functions that are uniquely important, and such a tool should not be interpreted to suggest that areas where there are few overlapping functions is less important for that *function*.

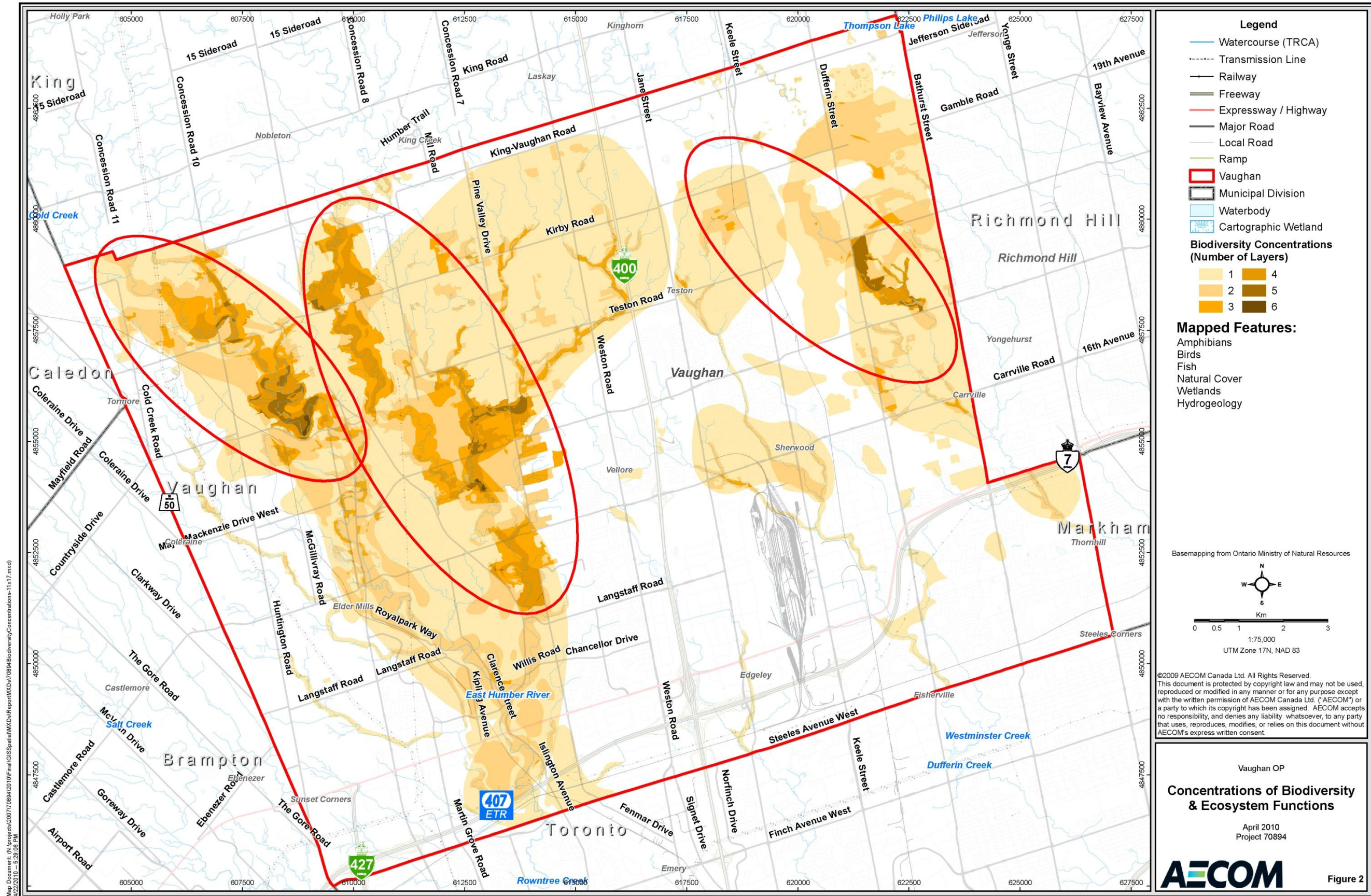


Figure 2. Concentrations of Biodiversity and Ecosystem Functions

One of these areas is located along the upper reaches of the Main Humber River, north of Nashville Road. The area in the northwest corner of the City near the terminus of Kirby Rd and Huntington Road is largely undeveloped and is predominantly natural cover. The wildlife in this area benefit from the absence of roads crossings this large contiguous block of habitat. If Kirby Road or Huntington Road were to be extended in the future, many of the ecosystem functions would be lost in this natural centre of enhanced function.

The second natural heritage centre of geo/biodiversity also occurs in the Humber River watershed. This centre is associated with the East Humber River valley and extends north from Langstaff Road. The area north of the terminus of Pine Valley Drive is a focus for bird and amphibian breeding. If Pine Valley Drive were to be extended there would be disruption to this habitat block.

The third centre is found in the Don River Watershed, in the headwaters of the East Don in the area north of Major Mackenzie. These coldwater tributaries are important for the Don River as a whole, by providing year round flow, even in dry periods. The features on the Oak Ridges Moraine are unique in the City and require special consideration.

This approach has been provided to emphasize the location of important diversity of natural heritage functions in the City of Vaughan. Arguably all of the City north of Teston Road where the headwaters arise and where kettle wetlands occur could be added to the analysis, and habitat for Species at Risk must receive emphasis where ever it occurs. These are areas where it will be especially important to ensure that sensitive features are identified, linkages are determined and well-designed mitigation measures be applied if land use change is being contemplated.

3.4.5 Fish Habitat (including watercourses)

Fish habitat is defined as the spawning grounds, nursery, rearing, food supply and migration areas on which fish depend either directly or indirectly to carry out their life process (PPS, 2005). Habitat includes all watercourses which act as corridors allowing fish to move from one area to another (MNR Natural Heritage Reference Manual 1999).

The fish and their habitat are a critical component of the Natural Heritage Network. They contribute to the value of other natural areas and are strongly influenced by the protection they are provided during the planning process (MNR Natural Heritage Reference Manual 1999). They play an important role in the food chain both above and below they place in different trophic levels. Fish depend upon clean water, groundwater discharge areas, and fish communities are greatly influenced by water temperature regimes, which directly impact species composition (MNR Natural Heritage Reference Manual 1999). Fish and their habitat are important indicators of the overall health of their environment and ecosystem as a whole.

Watercourses and wetlands are either direct fish habitat or contribute to fish habitat. Wetlands plus buffers have already been mapped (Section 3.3.4). Fish habitat is therefore completed by mapping within the NHN, all watercourses as identified by the TRCA and MNR. Watercourse buffers have been applied that are based on thermal regimes as they have been reported by TRCA and MNR, however the final buffers must be determined on a site by site basis. Warm water watercourses have a 15 m minimum buffer incorporated on both sides (total 30 m buffer), while cold and cool water watercourses have a 30 m minimum buffer incorporated in the mapping on both sides (total 60 m buffer). Within the Oak Ridges Moraine and Greenbelt Plan Areas, a 30 m minimum vegetation protection zone is required adjacent to all watercourses (total 60 m buffer) regardless of thermal regime.

Note that it is the intent that natural hazards (floodplains, meander belts and steep slopes) also be included in the NHN, and since they are associated with the watercourses, they were mapped as part of this component. Meander

belts and the stable tops of bank (or crests of slope) were not available for incorporation into the mapping and must be applied on a site by site basis. Floodplain mapping was available, and a 10 m buffer was applied. The greater of floodplain plus buffer, the physical top of bank and/or watercourse plus buffers was used to map this component which captures fish habitat.

3.4.6 Environmentally Significant Areas (ESA) and Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest (ANSI) are defined as areas of land and water containing natural landscapes or features that have been identified as having life science or earth science values (PPS). They have been identified as provincially or regionally significant by the MNR using specific evaluation procedures (MNR Natural Heritage Reference Manual 1999). Environmentally Significant Areas (ESA) are natural areas that have certain geological or landform characteristics, hydrological or hydrogeological functions or which support rare, threatened or endangered species and provide high quality wildlife habitat or provide a significant linkage function. They are the products of early approaches to the protection of natural heritage and often combine more than one of the components discussed in Sections 3.3.1 through 3.3.5.

In both cases, these areas generally have significant segments of Ontario's biodiversity and landform features including forests, wetlands, valleys, native plants and animals; much of their environment is relatively undisturbed. They are highly correlated with the concentrations of biodiversity identified as candidate significant wildlife habitat.

All ESAs and ANSIs identified by the TRCA, MNR, and the City of Vaughan were included within the NHN.

3.4.7 Creating the Network: Enhancement Areas

Freemark *et al.* (1995) observed that "...approaches for regional decision-making and cross-boundary management...need to be developed. Otherwise, the "tyranny of small decisions" will prevail with many local, relatively unimportant land use decisions cumulatively resulting in profound landscape changes in the longer term..." The Natural Heritage Network is a tool to integrate decision making that will result in the protection and enhancement of natural heritage functions in City of Vaughan.

The mapping of the components described above were overlaid using a Geographical Information System. Opportunities were then identified to expand, strengthen, and improve biodiversity of the Natural Heritage System through restoration or re-naturalization of specific natural features in consultation with the TRCA, the City of Vaughan and The Regional Municipality of York. The Natural Heritage Systems identified by TRCA for the Humber and Don watersheds were valuable templates used to guide this exercise. These features have been identified in the form of Natural Heritage Expansion Areas and Natural Heritage Linkage Areas. The Natural Heritage Linkages have been identified to provide connectivity and increased opportunities for movement of flora and fauna throughout the Natural Heritage Network and overall System.

Existing vegetation units in southern Ontario have been highly fragmented by agricultural land, residential subdivisions and roads. Fragmentation results in the reduction of total habitat available, and the isolation of remaining patches (Noss 1987). Retaining connections between the remaining vegetation units can protect the functionality of these communities and in theory minimize some of the negative impacts associated with habitat fragmentation. Landscape connectivity is defined as the "degree to which the landscape facilitates or impedes movement across habitat patches" (Taylor et al. 2006). Due to intense habitat loss and increasing fragmentation of existing habitat patches in southern Ontario, habitat connectivity should be considered an important component of Natural Heritage Networks.

These identified areas have been included within the Natural Heritage Network. Included in these areas are Urban Stormwater Management Ponds when they are directly connected to watercourses as identified by the City of Vaughan and in Block Plans. They are considered enhancement areas because their aquatic and terrestrial features provide direct and indirect input into the Natural Heritage Network. Their quality and influence on the Natural Heritage System as a whole can be improved. Also included are tableland linkage areas; these areas have been identified to connect linkages between and within watersheds allowing for greater movement across the System. Furthermore, enhanced natural areas were identified by the TRCA NHS for watersheds and supported by surrounding land use natural features

3.4.8 Summary

The features that have been captured by the Network are as follows:

- Valley and Stream Corridors;
- Wetlands;
- Woodlands;
- Fish Habitat (including all watercourses);
- Ecologically Significant Areas (ESA) and Areas of Natural and Scientific Interests (ANSI);
- Natural Heritage Expansion Areas and Natural Heritage Linkage Areas
- Natural Hazards (floodplains, meander belts and steep slopes)

Although it is the intent that Significant Wildlife Habitat and Significant Habitat of Endangered Species, Threatened Species, and Species of Concern be captured within the Network, a study to identify these components on a City-wide basis has not been undertaken. Habitat is highly correlated with woodlands, wetlands and valley corridors therefore it is expected that the majority has been captured within the Network. Ongoing study is required to improve the inclusion of species habitat, especially those who are urban tolerant and likely to occur outside of the Network as identified,

In total the Natural Heritage Network as identified in this document, comprises almost 9,600 ha which represents 34.8% of the land base in the City of Vaughan (Table 5); with the core features forming the majority of that land area (23.6%).

Table 5. Summary of Natural Heritage Network Classification Outcomes

Classification	Area (ha)	Percentage
Category 1 = Core Features	6,487	23.6%
Category 2 = Enhancement Features	513	1.9%
Category 3 = Built-up Valleylands	169	0.6%
Category 4 = Other Supporting Lands within the Greenbelt and NHN	2,412	8.8%
Total NHN within the City of Vaughan	9,581	34.8%

The Natural Heritage Network in Vaughan represents an interconnected system of natural features and their respective functions. It is the core features that are the anchors for this network; and it is the interaction of these core features within the network that will keep the integrated system as a whole, healthy and resilient. By establishing these core features in concert with enhancing and linking designated areas, this defines the minimum amount of area that the City of Vaughan needs to protect and manage into the future.