

THE REGIONAL NATURAL HERITAGE SYSTEM FOR THE GROWTH PLAN FOR THE GREATER GOLDEN HORSESHOE
SUMMARY OF CRITERIA AND METHODS



The mapping of the National Heritage System is Supplementary Direction to the Growth Plan for the Greater Golden Horseshoe. It was issued by the Province on February 9, 2018 and takes effect immediately.

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1.0 Introduction

Initiated in 2015, Ontario's Coordinated Land Use Planning Review examined the natural heritage policies of the Growth Plan for the Greater Golden Horseshoe. When phase 2 of the public consultation of this review was initiated in May 2016, the government announced that the Province would lead the development and mapping of a Natural Heritage System (NHS) for the Growth Plan for the Greater

Golden Horseshoe. In the 2016 mandate letter to the Minister of Natural Resources and Forestry, a summer 2017 timeline was established to complete this mapping. Released in May 2017, the revised Growth Plan¹ also states that the Province will map an NHS for the Greater Golden Horseshoe, beyond the Greenbelt Area.

2.0 Purpose

This summary document provides a definition and overview of NHSs in general. It then identifies the principles, criteria and methods used to develop the NHS map for the Growth Plan area of the Greater

Golden Horseshoe. A more comprehensive technical document with a detailed description of methods and data sources as well as the digital shapefiles are also available².

3.0 Scope

The criteria and methods used to develop and map the NHS were selected to identify a system at a regional landscape scale. While developed for the Growth Plan area, these criteria and methods have a broader application and could be used in other divided or fragmented landscapes of southern Ontario. The criteria and mapping were not intended to identify or connect all natural areas and features

that may be important to consider at a local or smaller scale. These smaller features and areas can be incorporated into a local NHS that complements and connects to this Regional NHS. The summary document is not intended to address policies that apply to the NHS; those are described in the *Growth Plan for the Greater Golden Horseshoe, 2017*.

1 Ontario Ministry of Municipal Affairs. 2017. Growth Plan for the Greater Golden Horseshoe, 2017. Queen's Printer for Ontario. Toronto, ON.

2 Ontario Ministry of Natural Resources and Forestry. 2018. The Regional Natural Heritage System for the Growth Plan for the Greater Golden Horseshoe – Technical Report on Criteria, Rationale and Methods. Available at: <https://www.javacoeapp.lrc.gov.on.ca:443/geonetwork?uuid=bd4d1354-22bf-45ac-a19b-a140e1c906ec>.

4.0 What is a natural heritage system?

Natural heritage systems are connected networks of natural features and areas identified to help conserve biodiversity including species, ecosystems and ecological functions. Robust NHSs can enhance the resilience of ecosystems to threats such as habitat loss and climate change, and can provide vital ecosystem services that the residents of Ontario depend on (e.g., pollination, flood control, air and water purification). In southern Ontario, where habitat loss and fragmentation have been high, the identification and protection of NHSs in land use plans are essential conservation tools.

The *Growth Plan for the Greater Golden Horseshoe, 2017* defines an NHS as:

“A system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. These systems can include key natural heritage features, federal and provincial parks and conservation reserves, other natural heritage features and areas, lands that have been restored or have the potential to be restored to natural state, associated areas that support hydrologic functions, and working landscapes that enable ecological functions to continue.”

The Growth Plan NHS supports a comprehensive, integrated, and long-term approach to planning for the protection of the region’s natural heritage and biodiversity.

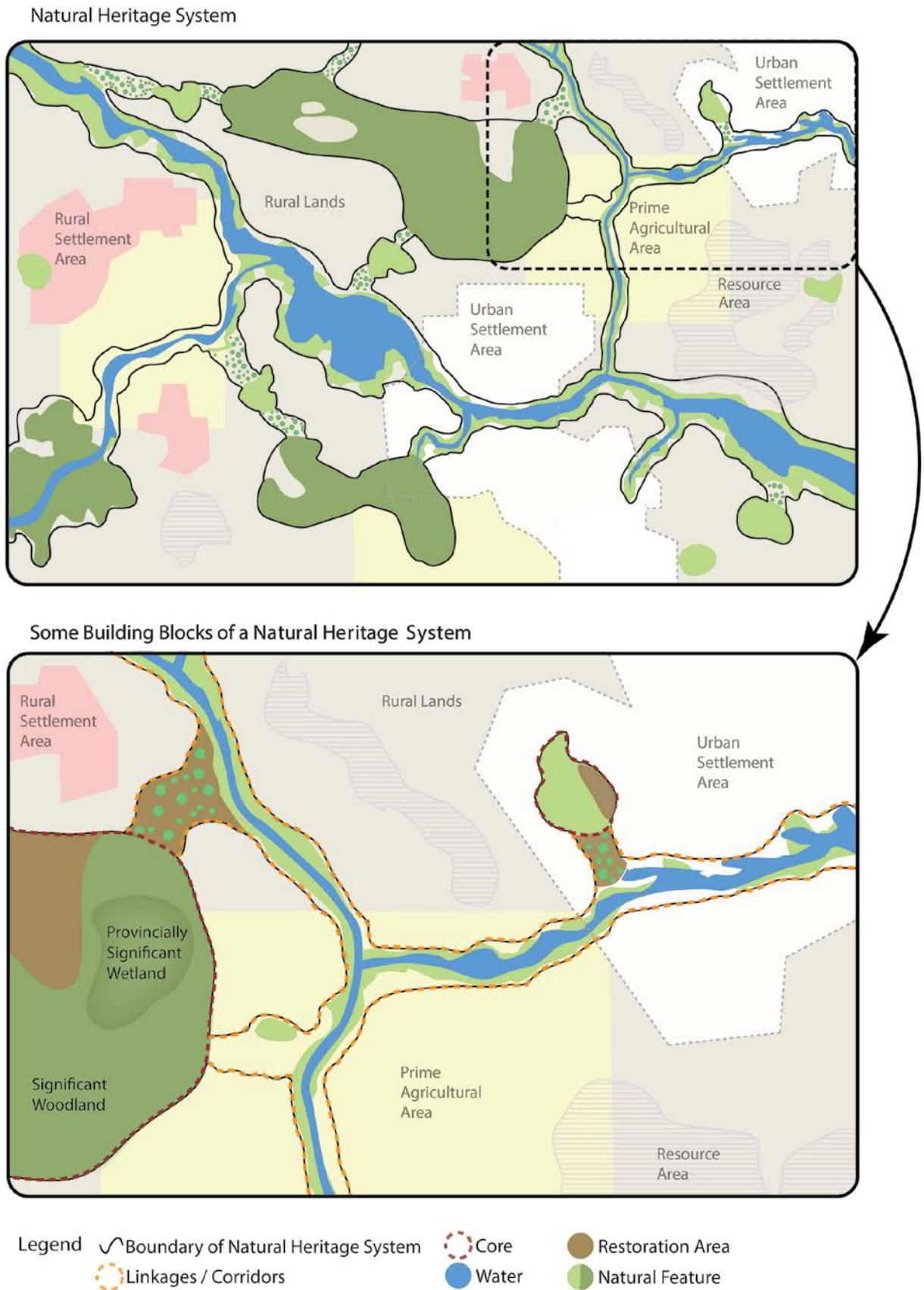
A key concept in the development of an NHS is that everything is connected. The primary components of the system are core areas and linkages (see figure 1).

Core areas are the building blocks of an NHS and should be the most enduring natural areas within the landscape. They are usually the least disturbed and largest of remaining natural areas.

Linkages are the connections between core areas that provide corridors and functional routes for the movement and survival of populations of plant and animal species. Linkages enable ecological processes to continue across a landscape by reducing habitat fragmentation and isolation.

In settings where natural features are limited in size or are widely dispersed, core areas and linkages may include lands without natural features but with the potential to be restored to enhance habitat and connectivity. These lands may also be identified as working landscapes that enable ecological functions to continue.

Figure 1. Schematic diagram of a natural heritage system on the landscape (Inset – shows core areas and linkages).



5.0 Developing the Natural Heritage System – Principles

Several key principles were established to guide the development of the Regional NHS for the Growth Plan for the Greater Golden Horseshoe. The methodology is intended to be transparent, with well-defined criteria and rationale, and is based on an automated and repeatable process. These key principles will reduce or eliminate the bias that is sometimes associated, whether intentionally or not, with individuals determining the mapping boundaries based on their knowledge or expertise.

During the development of the automated process, the following general principles were used to guide the work:

- Well-documented and clearly explained criteria, rationale and methods are to be used.
- Scientific and empirical evidence are to be used to support decisions where possible.
- Consistency with current provincial NHS planning criteria and guidance (e.g., Natural Heritage Reference Manual³ and Greenbelt Natural Heritage System) is to be maintained.
- Defendable and repeatable methodology is to be used (i.e., the same map would result from someone else using the same criteria and methods).
- Scale of the regional system is to focus on identifying larger core areas and broader linkages within a regional landscape context.
- Connection of the NHS mapping to existing regional mapping in adjacent areas is to be made as much as reasonably possible (i.e., connect to other natural heritage systems in adjacent planning areas).

- The criteria and methods are to have potential for application in another similar geography (i.e., could potentially be applied to other areas of southern Ontario).

5.1 Criteria for developing the Natural Heritage System

The objectives of the Regional NHS are to maintain and restore the overall biodiversity and ecological functions over the long term, and are not tailored to a particular species or species group. Therefore, core areas and linkages need to be large enough to encompass a wide range of species, habitats and ecological functions. The Natural Heritage Reference Manual provides general guidance for the development of NHSs, but does not recommend specific criteria for the size of core areas and linkages. The reference manual does note that minimum size thresholds should consider the particular landscape context, such as identifying smaller core sizes in areas where the landscape is highly fragmented and there is limited natural cover (e.g., forests, wetlands, grasslands, lakes and streams).

There was a need to develop a system that is based on consistently applied criteria and methods across the Growth Plan for the Greater Golden Horseshoe. Prior to developing criteria for the Regional NHS, literature on effective sizes of core areas and linkages and criteria used in other NHSs were reviewed. Existing NHSs have used different criteria and methods at various scales that were not beneficial to adopt directly for the Regional NHS. To be consistent with regional planning approaches in adjacent Provincial Plans, the criteria used for core areas and linkages in the Greenbelt Plan and the Oak Ridges Moraine Conservation Plan were used as a base.

3 Ontario Ministry of Natural Resources. 2010. Natural heritage reference manual for natural heritage policies of the Provincial Policy Statement, 2005. 2nd edition. Queen's Printer for Ontario, Toronto, ON.

5.1.2 Core area criteria

Criteria for the composition and size of core areas and accompanying rationales are summarized in table 1.

Composition of core areas – In the patchwork of southern Ontario’s landscape, there are very few large natural areas, so groupings of habitat patches were included in core areas. In such a fragmented landscape, core areas that contain groups of habitat patches can identify areas to target rehabilitation or restoration efforts that would contribute to a more robust and resilient NHS. Public lands⁴ are also important, as they are often composed of natural features such as wetlands and forests or offer opportunities for restoration. A minimum amount of 50 per cent natural cover or public lands was used for the composition of core areas. This threshold is consistent with adjacent Provincial Plans and ensures that core areas are dominated by natural features.

Size of core areas – Core areas for the Growth Plan area were initially mapped with a minimum size of 500 hectares (ha), consistent with approaches in the Greenbelt Plan and Oak Ridges Moraine Conservation Plan. These areas are large enough to include a wide range of habitats and ecological functions. However, this approach left large gaps in the NHS within much of the southern portion of the Growth Plan area.

The degree of landscape fragmentation and amount of natural cover was assessed across the Growth Plan area to identify areas where smaller thresholds for minimum core area size should be applied. A minimum core size of 100 ha was used in areas with high levels of fragmentation and low percentages of natural cover (figure 2). The lower minimum size threshold in these highly fragmented areas provides habitat to fill gaps in the system where little natural habitat remains.

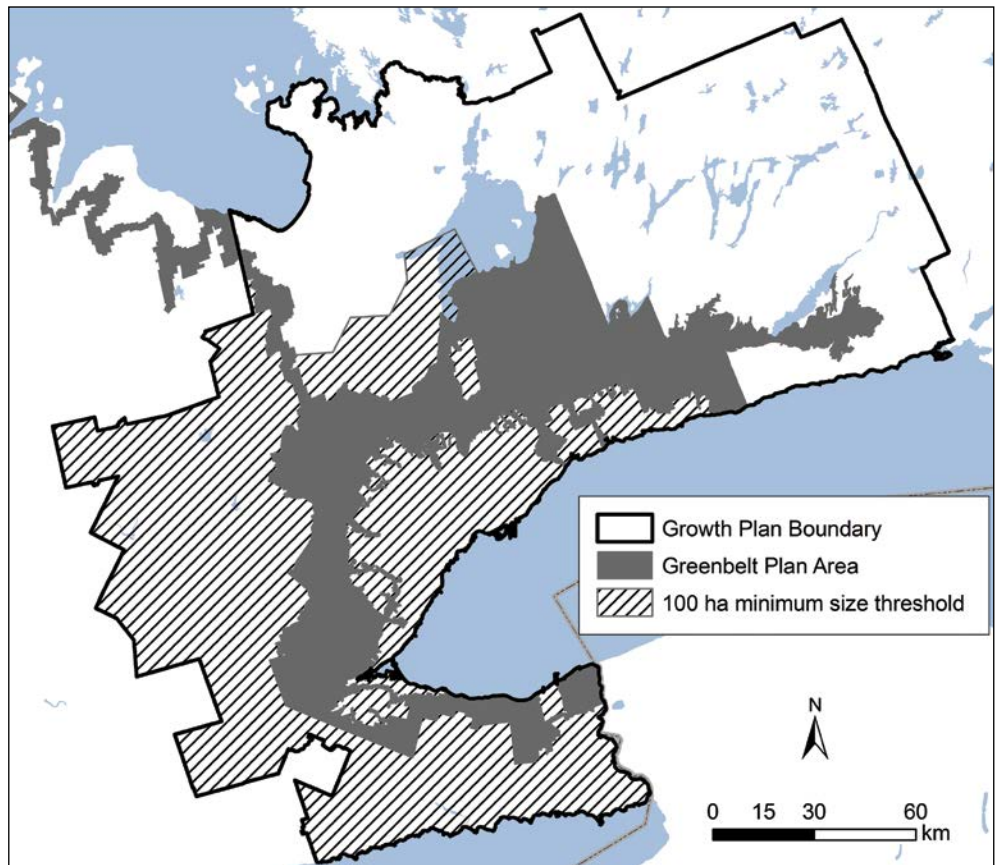
Table 1. Criteria for identification of core areas.

Attribute	Criterion	Rationale
Composition	At least 50% natural cover or public lands	Ensures that natural features are the predominant type of cover in core areas consistent with Oak Ridges Moraine Conservation Plan and Greenbelt Plan.
Size	Minimum size of 500 hectares	Sufficient size to encompass a wide range of species, habitats and ecological functions [equal to minimum size in Oak Ridges Moraine Conservation Plan and Greenbelt Plan].
Size in fragmented landscapes	Minimum size of 100 hectares in areas with low natural cover that are severely fragmented	Provides habitat and addresses Natural Heritage System gaps in portions of the planning area that have little natural cover remaining [The Natural Heritage Reference Manual recommends adjusting minimum core size based on landscape context].

4 Public lands include Provincial Parks, Conservation Reserves, Wilderness Areas, National Parks, National Wildlife Areas, Migratory Bird Sanctuaries, Crown Lands and Agreement Forests.

Figure 2.

Growth Plan for the Greater Golden Horseshoe – core areas have a minimum size of 100 ha in cross-hatched area and 500 ha in the rest of the Growth Plan area.



5.1.3 Linkage criteria

Criteria for the identification of linkages and accompanying rationales are summarized in table 2.

Composition and connectivity of linkages –

Wherever possible, linkages that consist of natural features with the ability to facilitate the movement of plants and animals were identified. In many cases, continuous natural cover was not present between core areas, so connections were made through patches of natural features as ‘stepping stones’ between core areas. The portions of linkages around these patches of natural habitat, particularly in a more fragmented landscape, could identify areas for restoration that would contribute to a stronger and more resilient NHS.

A high value was placed on natural cover in riparian areas (i.e., areas bordering rivers and streams) to build linkages, because these habitats serve as important natural corridors for most plants and animals. Linkages avoid barriers such as major highways and developed urban areas that have

no natural features. Each core area has multiple linkages to provide options for movement and to serve as a safety net in case one of the linkages becomes weakened. The NHS is connected to core areas and linkages within the Greenbelt Plan as well as to natural features beyond the boundary of the Growth Plan for the Greater Golden Horseshoe.

Length and width of linkages – There is no predetermined minimum or maximum length for linkages in the NHS. The length of linkages is driven by the shape and arrangement of core areas on the landscape combined with the position of natural features between core areas. There are several considerations associated with the NHS that support having wide linkages:

- Wide linkages are required where surrounding lands have limited natural habitat and are heavily influenced by human use.
- Linkages that function at the landscape scale should be several hundred metres or more in width (Natural Heritage Reference Manual).

- Linkages intended to function over decades or centuries need to be wide to facilitate functions such as the dispersal of slow-moving species, gene flow and shifts in the geographical range of species in response to climate change.
- Linkages designed to facilitate movement of multiple species and entire communities need to be wide.
- Wide linkages provide increased natural habitat and reduce edge effects⁵ that can hinder movements of sensitive species and promote widespread common species as well as invasive species.

A minimum linkage width of 500 metres (m) was used for the NHS in the Growth Plan for the Greater Golden Horseshoe. In some cases, linkages are wider where there are adjacent natural features. In other cases, linkages are inevitably narrower where they are bordered by barriers such as highways and urban development.

River Valleys – The valleys of major stream systems were included in the NHS, recognizing their importance to biodiversity (i.e., the variety of species, ecosystems and ecological functions) and hydrologic (water) functions. Stream systems also provide linkages between core areas and Lake Ontario, similar to the approach used for the NHS in the Greenbelt Plan.

Table 2. Criteria for the identification of linkages.

Attribute	Criterion	Rationale
Composition	Consist of natural features and rural/agricultural lands without barriers to animal and plant movement	Natural features provide best dispersal routes for plants and animals. Where continuous natural cover is not available to connect cores, natural features used as stepping stones. Linkages are not created where there are permanent and substantial barriers to movement.
Connectivity	Multiple connections between core areas Connections to NHSs in adjacent lands	Multiple linkages provide options for species movements and provide a safety net in case linkages are lost. Linkage to adjacent regional NHS ensures connectivity beyond the landscape planning area.
Length	No minimum or maximum length	Length determined by distances between core areas and the distribution of natural cover between core areas.
Width	500 m + natural features that extend beyond boundary	Wide linkages are required for landscape-scale NHSs intended to conserve biodiversity and ecological functions over the long term. Wide linkages also minimize edge effects.

5 Edge effects are changes in population or community structures at the boundary of two habitats.

6.0 Methods for mapping the Natural Heritage System

Data Sources – NHS mapping was based on several data sources available through Land Information Ontario:

- Southern Ontario Land Resources Information System (SOLRIS) version 2.1 – land cover for southern Ontario current to 2011 (15-m resolution)
- Ontario Hydro Network (OHN) version 1.2 – line and polygonal data for streams and waterbodies (1:10,000 scale)
- Ontario Road Network (ORN) Segment with Address version 3 – line network data identifying natural heritage barriers such as highways and freeways and passageways such as bridges over streams (+/- 10 m)
- Where The Trees Are (WTTA) – areas that have had successful afforestation from the 50 Million Trees Program, but are not included as natural areas in SOLRIS
- Current aerial imagery

In addition to these sources available through Land Information Ontario, Annual Crop Inventory data from Agriculture and Agri-Food Canada were used to identify grasslands and shrublands not identified in SOLRIS. Several Conservation Authorities provided fine-scale ecological data that were used to refine the boundaries of the NHS.

6.1 Identification of core areas

Core areas were identified using a Geographic Information System (GIS) based on concentrations of natural features. Natural feature mapping for the analysis was extended for 10 kilometres (km)

beyond the Growth Plan outer boundary as well as into the Greenbelt Area, so that connections could be made across the Growth Plan boundaries. The amount of natural cover within 1 km of each 15-m pixel was used to create a contour map showing the spatial average natural feature cover by percentage. A contour threshold of 40 per cent was used to identify core areas because it maximized the number and total area of core areas that had 50 per cent or more natural cover with a minimum size of 500 ha. A smaller core area size of 100 ha or larger was used in portions of the Growth Plan area that are heavily fragmented with low natural cover (figure 2). Public lands that intersected core areas were included.

Barrier features (e.g., major highways, urban development without natural cover) were removed from identified core areas. Holes smaller than 250 ha and without barriers were included in core areas. With the exception of hedgerows⁶, natural features extending beyond identified boundaries of core areas were included. Core area boundaries were also extended to include a 30-m zone around the edge of natural features.

Core areas were reviewed against the most recent aerial imagery available through Land Information Ontario. In a few instances, the imagery revealed that there were small areas of land cover that had not been correctly classified in the base data. In some of these cases, there had been changes to the landscape after the latest land cover update in 2011. Boundaries of the NHS were adjusted (expanded or reduced) accordingly, based on the imagery.

6 Linear, treed areas between 10 and 30 m wide that can be natural or planted.

6.2 Identification of linkages

Linkages were mapped using the GIS tool Linkage Mapper⁷. This automated tool identifies linkages between neighbouring core areas based on the landscape's resistance (i.e., providing barriers) to movement by plants and animals. Natural features were given low resistance values, rural areas had intermediate resistance and developed areas and major highways had the highest resistance. Natural features in riparian areas (areas bordering rivers and streams) were given the lowest resistance value, making these areas the preferred route for linkages where available. For major highways, bridges over streams were eligible to be included in linkages. Linkage Mapper was set to four linkages per core area to ensure that multiple connections were created. After linkages were initially mapped, the Linkage Mapper tool was used to connect the NHS to any portions of the Greenbelt NHS that had been left unconnected. Because the mapping tool limited connections to four linkages per core, larger core areas were subdivided into smaller cores to ensure appropriate connections could be made.

Centrelines of identified linkages were buffered by 250 m on each side to produce 500-m-wide linkages. Barrier features (e.g., major highways, urban development without natural cover) were removed from identified linkages, and small holes without barriers were included. Natural features (excluding hedgerows) and public lands extending beyond identified boundaries of linkages were included. Linkage boundaries were also extended to include a 30-m zone around the edge of natural features. All identified linkages were reviewed against the most recent aerial imagery available through Land Information Ontario. In a few cases, review of the imagery identified linkages that needed to be remapped using Linkage Mapper or simply deleted, as they crossed highly developed areas.

6.3 Additional natural features

River Valleys – The valleys of major stream systems (streams greater than 15 m wide) were included in the NHS. Although most of these stream systems were already included, a few streams and portions of others were not. The adjacent lands of these

stream systems were identified in a similar fashion as linkages such that 250 m on either side of the stream plus adjoining natural features were included in the NHS. Stream systems were also used to provide linkages between core areas and Lake Ontario in Northumberland County. In this region, the barrier of Highway 401 created obvious gaps, and the Linkage Mapper tool was unable to identify linkages.

Natural Features Adjacent to the Greenbelt Boundary – Outside the Greenbelt Plan Boundary, natural features that were continuous with the NHS in the Greenbelt were included in the NHS of the Growth Plan for the Greater Golden Horseshoe. These areas are small portions of forests or wetlands that straddle the Greenbelt Plan boundary but were not originally identified as part of a core area or linkage in the Growth Plan area. The same approach was taken to include natural features that straddle the boundary of urban river valleys in the Greenbelt Plan that connect core areas to Lake Ontario.

Additional refinements of identified areas – Life Science Areas of Natural and Scientific Interest (ANSI), provincially significant wetlands (PSW) and rare plant communities that overlapped or were adjacent to the NHS were added to the system including a 30-m zone around the edge of natural features.

6.4 Additional modifications

As a result of consultation and feedback received the final map shows the NHS across the entire Greater Golden Horseshoe outside the Greenbelt. As per policy 4.2.2 of the Growth Plan, the NHS does not apply to lands within settlement area boundaries that were approved and in effect as of July 1, 2017. For the precise boundaries and locations of settlement areas, please refer to the Official Plan that was in effect on July 1, 2017. Portions of the NHS that fell within strategic settlement employment areas and economic employment districts in the Simcoe Sub-area of the Growth Plan were removed.

7 [Linkage Mapper GIS Tool](#) [Accessed 9 March 2017].

6.5 Municipal refinement

Growth Plan policy 4.2.2.5 identifies that municipalities may refine provincial mapping with “greater precision” in a manner that is consistent with the Plan through a municipal comprehensive review (MCR):

4.2.2.5. In implementing the *Natural Heritage System*, upper- and single-tier municipalities may, through a *municipal comprehensive review*, refine provincial mapping with greater precision in a manner that is consistent with this Plan.

Upper- and single-tier municipalities will incorporate the provincially issued NHS mapping into their official plans through an MCR.

Refinements that are consistent with the policies of the Growth Plan are as follows:

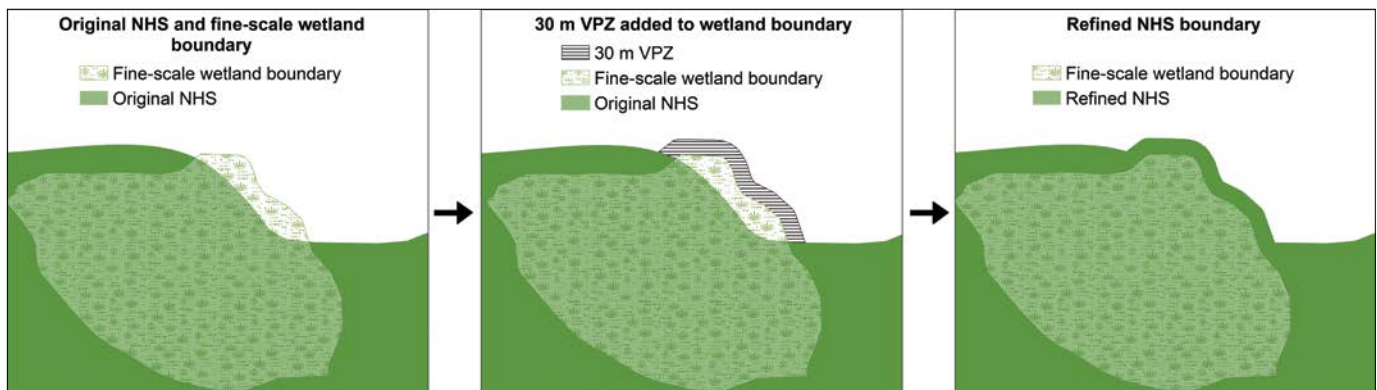
- Minor, technical adjustments (e.g., to account for distortion from map projections, discrepancies based on map scales);
- Addition of natural features⁸ continuous with the boundary of the provincially mapped NHS. When natural features are added, the

boundary of the NHS will be extended to include a 30 m vegetation protection zone beyond the edge of the feature consistent with the methods used for provincial mapping (see figure 3);

- Removal of small portions of the provincial NHS where there is built-up impervious development or infrastructure⁹ (that would act as barriers) that was not identified and stamped out of the provincial mapping;
- Removal of small, isolated portions of the NHS that protrude from the Greenbelt Plan boundary or settlement areas provided these areas have no natural features *and* are not connected to the larger provincial NHS.

Proposed refinements to the NHS shall be accompanied by supporting documentation, including any fine-scale mapping of natural features or infrastructure that was used to adjust the boundaries, and shall be submitted to the Province for review along with the proposed official plan or official plan amendment implementing the results of the MCR process.

Figure 3. Refinement of the Natural Heritage System to account for a natural feature that is shown to extend beyond the original boundary based on fine-scale data.



8 Natural features include the following classes: beaches, sand dunes, alvars, open bedrock, tallgrass prairie and savannah, all forested (excluding hedgerows) and wetland classes, and open water.

9 The built-up impervious class is defined in [SOLRIS](#) (Southern Ontario Land Resource Information System) as buildings, pavement and other impervious anthropogenic structures in urban areas with a threshold of at least 10 buildings/500 m or 4/ha. This class does not include constructed features such as farmsteads (silos, barns, and houses) or extraction sites.

7.0 Assessment of the Natural Heritage System

The total area of the NHS excluding settlement areas is about 1.18 million ha or 45 per cent of the Growth Plan for the Greater Golden Horseshoe (figure 4). Seventy-two percent of the NHS consists of natural cover (land or water).

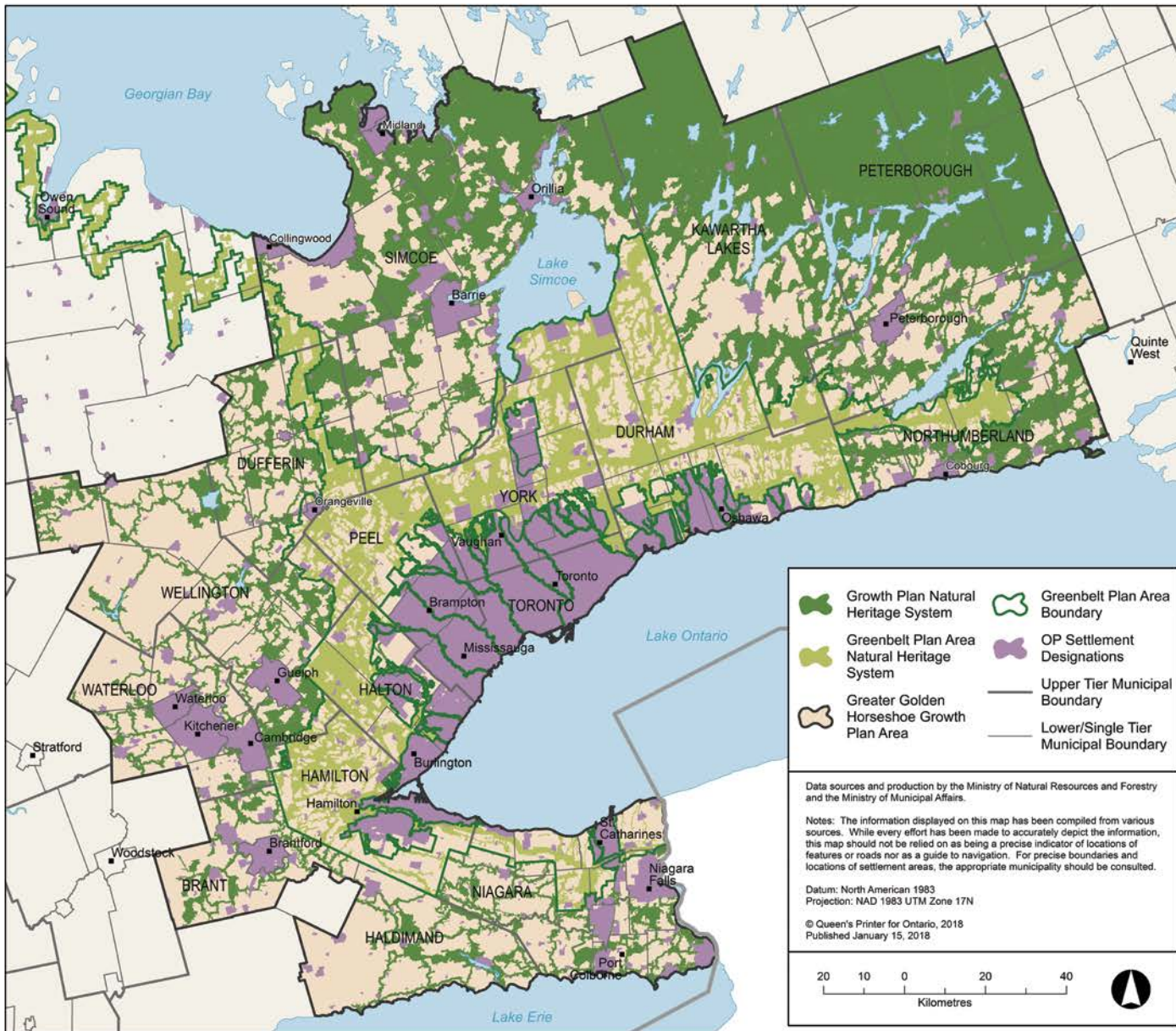
The NHS captures most of the significant natural features (table 3). The remaining natural features not captured were generally small and isolated, and therefore did not meet the criteria for inclusion in the regional system. Many of these features will be protected by the policies of the *Provincial Policy Statement, 2014* and could also be included in local NHSs.

Table 3. Quantities of natural features in the Growth Plan area (excluding settlement areas) and the Natural Heritage System (NHS)

Feature	Amount in Growth Plan	Amount in NHS	Percentage of feature in NHS
Provincial Parks	69,706 ha	69,618 ha	99.9
Conservation Reserves	1,061 ha	1,061 ha	100
National Wildlife Areas	47 ha	47 ha	100
Life Science ANSI*	66,560 ha	65,916 ha	98
Wetlands	336,418 ha	290,607 ha	86
PSWs* only	145,567 ha	130,402 ha	90
Tracked species records	1,275 EOs*	1,105 EOs	87
E&T species* only	601 EOs	530 EOs	88
Rare communities	1,811 ha	1,721 ha	95
Coldwater streams	5,837 km	4,287 km	73

* ANSI – Area of Natural and Scientific Interest
 PSWs – Provincially Significant Wetlands
 EOs – Element Occurrences
 E&T species – Endangered and Threatened Species

Figure 4. Regional Natural Heritage System for the Growth Plan for the Greater Golden Horseshoe.



Regional Natural Heritage System

- Growth Plan Natural Heritage System
- Greenbelt Plan Area Natural Heritage System
- OP Settlement Designations
- Greenbelt Plan Area Boundary
- Upper Tier Municipal Boundary
- Lower/Single Tier Municipal Boundary
- Greater Golden Horseshoe Growth Plan Area

Data sources and production by the Ministry of Natural Resources and Forestry and the Ministry of Municipal Affairs.

Notes: The information displayed on this map has been compiled from various sources. While every effort has been made to accurately depict the information, this map should not be relied on as being a precise indicator of locations of features or roads nor as a guide to navigation. For precise boundaries and locations of settlement areas, the appropriate municipality should be consulted.

Datum: North American 1983
 Projection: NAD 1983 UTM Zone 17N
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 Published January 15, 2018

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 Kilometres

Note: The information displayed on this map is not to scale, does not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise boundaries, the appropriate municipality should be consulted. For more information on Greenbelt Area boundaries, the Greenbelt Plan should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.