

**An Analysis of the Effectiveness of the  
Niagara Escarpment Plan in Maintaining  
and Enhancing Natural Corridors and  
Linkages in the Township of Mulmur,  
Dufferin County, Ontario**

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## Background and Study Purpose

The Purpose of the Niagara Escarpment Planning and Development Act and of the Niagara Escarpment Plan (NEP) is:

*“to provide for the maintenance of the Niagara Escarpment and the land in its vicinity substantially as a continuous natural environment, and to ensure only such development occurs as is compatible with that natural environment”*

The importance of connecting natural corridors and linkages in maintaining the ecological viability of significant natural areas and species at risk has been well established by biogeographers and population biologists over the past 35 years. The NEP was one of the first land use plans to recognize the importance not only of natural areas but also of natural corridors and linkages.

The land use policies in Part 1 of the NEP are one means by which the Plan seeks to protect natural areas and corridors along the Escarpment. Lands designated Escarpment Natural Area include the Escarpment slopes and related landforms that are in a relatively natural state, as well as forest areas extending 300 metres back from the brow, provincially significant Areas of Natural and Scientific Interest (ANSI) and provincially significant wetlands. In order to maintain the most natural Escarpment features, the range of permitted uses within the Escarpment Natural Area is limited and severances are generally not permitted within this designation.

The Development Criteria in Part 2 of the NEP provide specific policies aimed at protecting natural areas and corridors and maintaining the continuous natural environment. The objective of Section 2.7 – New Development Within Wooded Areas is *“to preserve as much as possible of wooded areas”*. Section 2.8 – Wildlife Habitat aims *“to protect rare vulnerable and endangered plant and animal species”*. While the objective of Section 2.9 – Forest Management is *“to maintain and enhance the forests and associated plant and animal habitat”*. Other policies that protect ANSI & wetlands and that restrict development on steep slopes and establish setbacks from slopes and watercourses, also aim to provide protection to natural areas and corridors.

This study examines how effective the NEP has been in maintaining and enhancing natural areas, corridors and linkages along one portion of the Escarpment. The study area is within and immediately adjacent to the Township of Mulmur in Dufferin County. Both those parts of Mulmur within the NEPA and those areas outside the NEPA were analyzed, with the lands outside the NEPA providing a basis for comparison, or control, against which to evaluate changes within the NEPA.

## **Methodology**

Using 1974 aerial photography and 2000 satellite imagery, changes in forest cover between 1974 and 2001 were measured for lands within and outside the Niagara Escarpment Plan Area (NEPA) in and adjacent to the Township of Mulmur. Other factors that affect the health and wildlife habitat quality of natural corridors and areas such as fragmentation, gaps in forest cover and encroachment of development were also examined. Specific details regarding the methodology are provided below.

### ***Study Area***

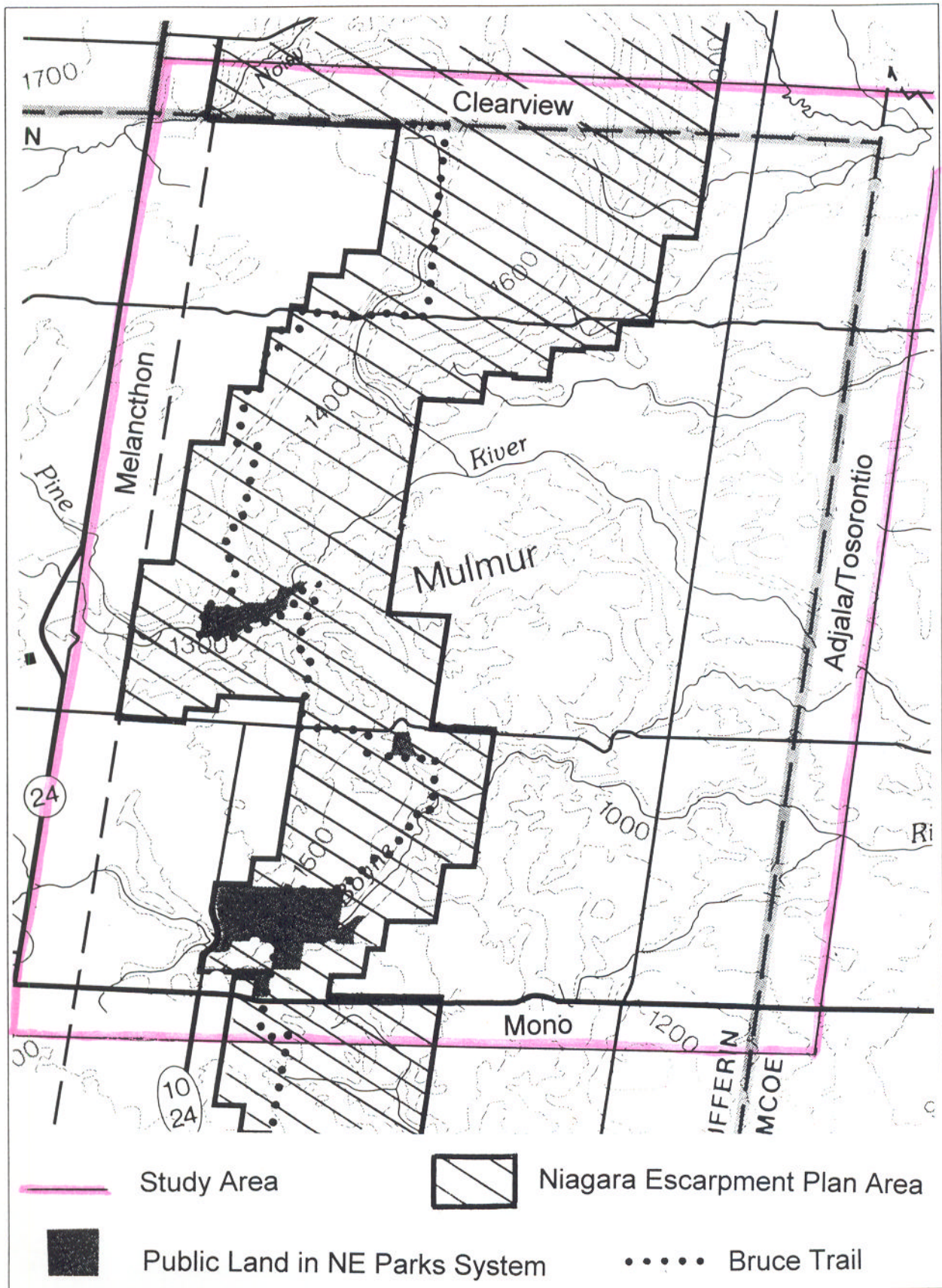
To provide a valid basis for comparison between lands within and outside the NEPA it was necessary to identify a study area where lands within the NEPA and adjacent areas outside the NEPA have similar landscape characteristics; land uses; and, levels of urbanization and/or development densities. Ideally, lands within and outside the NEPA would have comparable amounts of natural areas and similar types of natural corridors.

Along most of the Escarpment, lands within the NEPA tend to be topographically distinct from surrounding areas, due in large part to the presence of the Escarpment slope. This is especially true where the cliff face of the Escarpment is exposed. One exception is in the central portions of the Escarpment In the Region of Peel and Dufferin County. This is an area where a number of moraines intersect with the Niagara Escarpment. Here, the landscape both within and east of the NEPA is characterized by rolling hills with frequent vistas and broad river valleys and very few exposed Escarpment outcroppings.

The Township of Mulmur features two major river valleys, the Boyne and the Pine; which flow in a north-easterly direction across the Township. These broad valleys are major natural corridors that begin west of the NEPA and extend east of the NEPA, to beyond the limits of the Township. Mulmur is largely rural with relatively few established settlements and no sizable urban centres.

Due to these characteristics Mulmur Township was selected as a suitable study area. In order to include more of the headwater areas of the Boyne and Pine Rivers as well as north-south natural corridors along the eastern boundary of Mulmur, the study area extends beyond the boundaries of the Township of Mulmur approximately 1.3 km (the width of two township lots or one concession) on all sides. The study area includes parts of the Town of Mono (to the south),; and the Townships of Adjala-Tosorontio (to the east), Clearview (to the north), and Melancthon (to the west). A map of the study area is included on the following page.

# Study Area



The study area is approximately 102,000 acres (41,300 hectares) in size, not including public roads and road allowances. About 28,500 acres (11,500 hectares) of the study area falls within the NEPA.

### ***Study Time Frame/ Data Sources***

The study examines changes in the landscape between April 1974 and August 2000. The availability of aerial photograph and satellite imagery corresponding to these two dates was a key factor in establishing the two reference dates for the study. The April 1974 air photography provides a good snap shot of the landscape around the time that the Niagara Escarpment Planning and Development Act was approved (1973) and the initiation of Niagara Escarpment Development Control (1975). The August 2000 satellite imagery is the most recent data that can be easily compared to the April 1974 aerial photography.

Niagara Escarpment Commission staff generously provided access to the aerial photos and satellite imagery used in the study. Over 125 aerial photos (scale 1:15,840) were used to determine conditions in 1974. The satellite imagery utilized is a product of 5 metre resolution IRSpanochromatic data fused with 30 metre resolution LandSAT 7 data, reproduced at a scale of 1:25,000.

### ***Analysis of Aerial Photos & Satellite Image***

The 1974 air photos were viewed side by side with the 2000 satellite image and compared township lot by township lot for changes in forest cover and the presence of new development. New developments and changes in forest cover were plotted on a paper reproduction of the satellite image, with notations as to whether the changes in forest cover were losses or gains. Minor changes in the exterior boundaries of forested areas such as outward expansion of the forest edge by under 30 metres were not plotted. Recent plantations were included in the areas counted as forested for both dates. The changes in forest cover were later colour coded to distinguish new wooded areas from areas that had been deforested, with no replanting since 1974.

The boundaries of the NEPA were plotted on the base image and decisions were made on how best to categorize the data spatially. The objective was to identify the principal natural corridors and the secondary linkage areas and measure change in forest cover for each corridor or linkage area.

The Boyne River and Pine River Valleys are the most prominent wooded corridors within the study area. Both valleys are associated with continuous forested corridors that

extend from west of the NEPA to the eastern limits of the study area. Forest cover changes within the contiguous forested corridors associated with these river valleys were recorded for the following categories: Boyne Corridor West of NEPA, Boyne Corridor East of NEPA, Boyne Corridor Within NEPA, Pine Corridor West of NEPA, Pine Corridor East of NEPA and Pine Corridor Within NEPA.

South of the Boyne Corridor, there are linkages with natural areas in Mono Township. The lands south of the Boyne Corridor, called the Boyne-Mono Linkage included wooded corridors, with varying levels of fragmentation and gaps as well as isolated forested blocks. Changes were measured for the portions of this linkage outside of the NEPA and within the NEPA, and recorded accordingly. A separate record of the results east and west of the NEPA was not kept for the Boyne-Mono Linkage, because there was very little forested area west of the NEPA and because proportionally the change in forested area was similar on either side of the NEPA. A similar approach was taken for the lands located north of the Pine Corridor, called the Pine-Clearview Linkage.

In the area between the Boyne Corridor and the Pine Corridor, called the Boyne-Pine Linkage, a number of linkages and many isolated forest blocks are present. Changes in forest cover in the Boyne-Pine Linkage were recorded separately for the areas east and west of the NEPA and for lands within the NEPA. The location of the corridors and linkages are shown on the satellite image included on the following page.

Changes in forest cover were measured by hand and eye using a transparent grid with 4 acre squares, allowing for an accuracy of plus or minus 2 acres or less for each measurement. A limited amount of ground truthing was undertaken to confirm forest cover and identify the nature of changes on the ground.

The total amount of forest cover was also measured for each of the parts of the study area mentioned above. A coarser, 25 acre grid was utilized for this measurement, owing to time limitations. As a result these measurements are more approximate.

### ***Lot Fabric***

Schedule A of The Township of Mulmur's 2001 Zoning Bylaw is a map showing the boundaries of all lots within the township, except for designated settlement areas. Using this source the number of lots within and outside the NEPA (excluding settlement areas) was tabulated and the average lot size calculated. This allowed for comparison between areas within and outside the NEPA and provided an opportunity to examine possible connections between lot density and the protection of natural areas and corridors.

Corridors & Linkages (Satellite Image)

## Results

### *Changes in Forest Cover*

There was a net gain in forest cover between 1974 and 2000 in all of the corridor and linkage areas identified within the study area. Overall, forest cover increased 21.5% within the NEPA and 9.4% in the portion of the study area outside the NEPA. The complete results, broken down by the various corridor and linkage areas are summarized on the chart on the following page.

Within the NEPA, all areas experienced an increase in forest cover of over 15%. The largest increases occurred within the linkage areas, where the area of forest cover was much smaller proportionally than within the Pine and Boyne corridors. Forest cover in the Boyne-Pine Linkage increased 146.4% from about 250 acres to over 600. Only a few very small areas, totalling about 10 acres, were deforested within the NEPA. The total net gain in forested area was 1,970 acres. Forested areas made up about 38.8% of the lands within the NEPA in the study area in 2000, compared with about 31.9% in 1974.

Outside the NEPA, there was also a net increase in forest cover for all areas, although increases were much smaller on average than in the NEPA. The Boyne Corridor east of the NEPA was the only area outside of NEPA where the percentage increases in forest cover was higher than for the same corridor or linkage within the NEPA (18.9% increase vs. 16.6%). In the Boyne Valley Corridor West and the Pine Valley Corridor East there were substantial areas (totalling 236 acres) that were deforested between 1974 and 2000, although these losses were more than made up by gains through reforestation. The total net gain in forested area outside the NEPA was 1,982 acres, an increase of 9.4% in the amount of forested land. Forested areas made up about 18.1% of the landscape outside the NEPA in 1974. This increased to about 20.1% in 2000.

### *Lot Fabric*

Average lot size and lot density were almost identical for rural areas within and outside the NEPA. When settlement areas were excluded the average lot size within the NEPA was 48.46 acres, while outside the NEPA the average size was 48.65 acres, with similar results both east and west of the NEPA. On this basis it appears that density and/or fragmentation of ownership has not had a variable influence on landscape changes within and outside the NEPA. Similarly, there is proportionally about the same amount of publicly owned land within and outside the NEPA, although most of the public land outside the NEPA is County Forest, while most of the public land within the NEPA is part of the Niagara Escarpment Parks and Open Space System.

**Changes in Forest Cover Within NEPA, 1974 - 2001**

<b>Location</b>	<b>Approx. Forested Acres 1974</b>	<b>Gain in Acres</b>	<b>Loss in Acres</b>	<b>Net Gain</b>	<b>% Gain</b>
Boyne Valley Corridor	1,700	282	0	282	16.6%
Boyne-Mono Linkage	400	105	0	105	26.3%
Boyne-Pine Linkage	250	366	0	366	146.4%
Pine Valley Corridor	3,450	543	4	539	15.6%
Pine-Clearview Linkage	3,300	674	6	668	20.2%
<b>Total within NEPA</b>	<b>9,100</b>	<b>1,970</b>	<b>10</b>	<b>1,960</b>	<b>21.5%</b>

**Changes in Forest Cover Outside NEPA, 1974 - 2001**

<b>Location</b>	<b>Approx. Forested Acres 1974</b>	<b>Gain in Acres</b>	<b>Loss in Acres</b>	<b>Net Gain</b>	<b>% Gain</b>
Boyne Valley Corridor West	1,125	120	78	42	3.7%
Boyne Valley Corridor East	1,775	336	0	336	18.9%
Boyne-Mono Linkage	1,300	306	0	306	23.5%
Boyne-Pine Linkage West	525	27	0	27	5.1%
Boyne-Pine Linkage East	900	212	0	212	23.6%
Pine Valley Corridor West	350	45	0	45	12.9%
Pine Valley Corridor East	10,900	761	158	603	5.5%
Pine-Clearview Linkage	1,625	175	0	175	10.8%
<b>Total Outside NEPA</b>	<b>18,500</b>	<b>1,982</b>	<b>236</b>	<b>1,746</b>	<b>9.4%</b>



## Analysis

The fact that the percentage of forest cover increased throughout the study area between 1974 and 2000 is not surprising given changes in land use that have occurred over this period. The amount of land actively farmed has diminished in recent decades as the viability of less productive and difficult to work lands has become marginal. At the same time many properties have been purchased for recreational and/or residential purposes, increasing prices beyond what farming can support. Properties with views or in attractive natural settings have been in particularly high demand for residential and recreational uses. Reforestation, or simply allowing natural regeneration provide low maintenance alternatives to agriculture that are particularly appealing to the increasing number of landowners that are weekend residents, or retirees, most of whom have no background in farming. This trend was established even before 1974. Government programs to encourage reforestation have doubtless helped increase the rate of conversion of fields to forests. Natural succession of abandoned fields has also played a significant role.

Due to the higher proportion of good agricultural land and the larger number of settlements outside the NEPA, it was not unexpected that the percentage of the landscape forested in 1974 was higher in the NEPA (31.9%) than outside (18.1%).

What is significant is the much higher rate of reforestation that has occurred within the NEPA. While the increase in acres of forest was similar within and outside the NEPA, this was due to the much larger area outside the NEPA (about 72.1% of the study area). As a percentage of 1974 forest cover the forested area within the NEPA increased at more than double the rate found outside the NEPA (21.5% vs. 9.4%). An even more dramatic difference was observed in the percentage of the landscape that was forested, with lands within the NEPA increasing by 6.9 % from 31.9% to 38.8%, while lands outside increased by only 2.0% from 18.1% to 20.1%.

There were very few losses of forest cover within the NEPA and the total area deforested was negligible (about 10 acres). Deforestation was also limited outside the NEPA, with a total area of 236 acres lost (about 1.3% of the forested area in 1974). Some of the losses outside the NEPA were due to recreational development, including a golf course, and residential development, while others appear to have been due to forestry practices that utilized small-scale clear cutting.

A very high percentage of the reforested areas both within and outside the NEPA have resulted in eliminating gaps and fragmentation within both the Boyne and Pine corridors and strengthening and widening the linkages from these corridors with other natural

areas. This is important ecologically as many wildlife species require continuous or almost continuous forested corridors for movement. Likewise, some species need large blocks of natural area without gaps. For example several bird species require interior forest habitat located a minimum of 100 metres from the forest edge to breed. Other species refuse to travel across gaps in the forest and have a strong preference for wider forested corridors. Generally speaking, larger core areas, wider primary corridors and secondary linkages, more interconnections between natural areas, fewer gaps, and, less fragmentation are all desirable characteristics for enhancing wildlife habitat for many species at risk and improving the long-term viability of natural areas and the health of the ecosystem as a whole.

The widening of the Boyne-Pine Linkage within the NEPA has been particularly significant; as has the widening of the Boyne Corridor at a previously narrow point located Lots 5, 6 & 7, Concession 3 EHS, Mulmur, within the NEPA. Here the corridor width increased from under 200 metres to over 500 metres. Overall, the location of the additional forested areas has been highly desirable in terms of minimizing fragmentation and gaps within natural areas and strengthening existing corridors and linkages. Gaps and fragmentation still exist, especially within the north-south linkages in the NEPA.

One factor that currently limits the ecological value of many reforested areas is that many of these areas are monoculture plantations of conifers that do not represent the natural forest cover of the area. Conifer plantations were intended to be a preliminary stage in re-establishing native forest communities, many of which are hardwood dominated (hardwoods are also much more valuable commercially). Because most hardwoods require the protection of surrounding forest cover to grow successfully, conifers were planted in open field areas with the idea that they would be thinned in later years to allow an understorey of hardwoods and other native species such as hemlock, aspen and cedar to grow and eventually replace most of the conifers. However, many of the plantation areas have received little or no thinning or other management. These plantations tend to be ecological deserts when compared with natural forest communities. They allow very little light to penetrate to the forest floor, and they build up a thick layer of duff (leaf and needle litter), that further inhibits the growth of native species in the forest understorey. These areas are of limited value as wildlife habitat and may actually provide obstacles to movement for some species.

From analysis of the 1974 and 2000 data, it was evident that the vast majority of new development within the NEPA since 1974 has been sited so as to minimize the impact on forested areas, watercourses, steep slopes and significant natural areas, in accordance with the objectives of the NEP. New developments in forested areas have been located near the edge of the forested areas and clearing sizes have been kept to a minimum. Outside the NEPA there are a number of examples where new developments have led to fragmentation of natural corridors or linkages and loss of forest cover.

## Conclusions

The significant increase in forest cover and the very limited deforestation of specific areas that has occurred within the NEPA suggest that the NEP has succeeded thus far in maintaining and enhancing forests and preserving wooded areas in Mulmur Township. This conclusion is supported by the significantly lower increase in forested areas that have occurred in the portion of the study area outside the NEPA. Reforestation within the NEPA has significantly reduced gaps and fragmentation within core natural areas and primary corridors, as well as widening ecological corridors and linkages. While gaps and fragmentation still exist, especially in north-south linkages, the interconnectivity of forested areas has improved significantly.

New development within the NEPA that occurred between 1974 and 2000 appears to have been located in a manner that minimizes impact on the Escarpment environment and helps maintain forested areas and a continuous natural environment. Development outside the NEPA has had a greater negative impact on forested areas and the maintenance of natural corridors; indicating that the NEP has had a positive effect in achieving its objectives to maintain and enhance forested areas and protect wildlife habitat and significant natural areas, within Mulmur Township.

Notwithstanding the apparent success of the NEP, the Plan could not have succeeded in significantly enhancing forested areas and natural corridors without individual private landowners making decisions to naturalize their properties, since only a small proportion of the increase in forest cover has been on public lands. It may be that the NEP has helped provide public recognition of the ecological significance of the Escarpment environment that has encouraged landowners to take action. Other government and non-government programs that have encouraged and supported reforestation and naturalization have doubtless also played a role.

The challenge now is to continue the trend. There is the potential to establish a truly continuous natural environment, with well-established ecological linkages throughout the NEPA in Mulmur Township. For the ecological value of the increased forest cover achieved since 1974 to be fully realized, it is important that conifer plantations be more actively managed to allow a transition from primarily monoculture plantings to more natural and diverse forest communities. This will require continued support and encouragement for private landowners, as well as management actions on public lands.

Future studies of this nature on a broader scale would be useful in providing insights into the effectiveness of the NEP in maintaining and enhancing natural corridors throughout the NEPA. Such studies could assist in setting priorities for land acquisition and private land stewardship programs. The use of Geographic Information System technology could enhance the accuracy and applicability of future research.