The East Holland River Subwatershed Management Plan 2000

Completed by The Lake Simcoe Region Conservation Authority in partnership with

[Logos of various municipalities]
ACKNOWLEDGEMENTS

The successful completion of the State of the Watershed Report would not have been possible without the support and participation of the members of the Steering Committee, Public Advisory Committee and the public who attended the Open Houses or provided comments. The Lake Simcoe Region Conservation Authority would like to thank the following for their cooperation, support, and input throughout the study:

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Special thanks to the summer and co-op students for their help throughout the project:
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Introduction and Goals

The Holland River watershed is located in the southwest corner of the Lake Simcoe watershed. It is composed of two major tributaries, the East Holland and the Holland\Schomberg Rivers. The East Holland River is the smaller of the two areas draining approximately 243 km$^2$ or 41% of the total Holland River Subwatershed area.

The East Holland River Subwatershed is located almost entirely with the Regional Municipality of York. It contains portions of the Municipalities of Whitchurch-Stouffville, King, East Gwillimbury, Georgina, Newmarket and Aurora. There is a small portion of the south-east section of the Subwatershed that lies in the Township of Uxbridge in the Regional Municipality of Durham.

Human activities within the Subwatershed have had a significant impact on the health of the ecosystem. In addressing the current health of the Subwatershed and developing a strategy for the future it was important that a balance be found between the environmental health of the Subwatershed and future urban growth. To this end two guiding principals were adopted, they are:

CTo Protect What Is Healthy, and
CTo Rehabilitate What Is Degraded.

Developing A Management Plan

In the first report examining the East Holland River Subwatershed entitled The State of the Watershed Report, the health of the subwatershed was examined and problems defined. In this second report a management plan is developed outlining the steps towards the rehabilitation of the East Holland Subwatershed.

Protecting What is Healthy
Following the two guiding principals listed above the first part of the Management Plan deals with protecting existing resources. To this end the Official Plans for each municipality, as well as York Region, were examined for the presence of a greenland system and planned urban growth. All municipalities were found to have either approved a greenland system or are in the process of doing so. An approved greenland system in an official plan will assist in protecting important natural features from future development.
Another useful tool in identifying and protecting natural features is an environmental screening map. For this reason a screening map was prepared as part of this report that identifies areas protected under a provincial policy statement or deemed an important natural feature. This map can be used by municipal planners and developers to determine areas best suited to development or protection.

Municipal policies, by-laws and land use designations were also examined as they pertain to the protection of natural resources. Where key policies, by-laws or land use designations were missing recommendations were made that the municipality investigate the benefits of adopting it.

Rehabilitating What is Degraded
The rehabilitation of the natural environment of the East Holland River Subwatershed is an important component of this report. For this purpose a comprehensive guide to Best Management Practices (BMPs) was compiled. The resource areas covered by these BMPs include water quality, water quantity, terrestrial habitat, aquatic habitat, and recreation and aesthetic amenities.

The first step in the rehabilitation of the East Holland River Subwatershed was to adopt resource targets and timelines where they exist and develop them where they do not. These targets cover the five resource areas focussed on in this study; water quality, water quantity, terrestrial habitat, aquatic habitat and recreational and aesthetic amenities.

In an effort to better understand and quantify sources of phosphorus to the river system, a water quality model was employed. This assists in analysing present day conditions, predicting the impacts of proposed development as well as the benefits of implementing BMPs.

A variety of Environmental Opportunities were also examined that would assist in the rehabilitation of the East Holland River Subwatershed. These included river buffering, stormwater retrofit projects, agricultural projects, surface water, groundwater, streambank erosion stabilization, coldwater fisheries, addressing on-line ponds, instream obstructions, reforestation and recreation and aesthetic improvement opportunities. Where possible the cost for these opportunities was estimated and the associated benefits and phosphorus reduction approximated. The locations of these opportunities within each catchment was identified and is displayed in a series of 13 Environmental Opportunities maps.
Implementation

The health of the East Holland River ecosystem largely depends on the successful implementation of the recommendations set out in the management plan. There are a variety of tools that can be used to assist in this process, such as: the Official Plan of each municipality in which their land use goals and objectives can be outlined, municipal policies and by-laws and legislation employed by other agencies that could be used to implement recommendations. Some provincial and federal policies were identified that could be revised or updated to improve existing operational efficiency as well as obstacles that have been encountered in the past that has impaired project implementation. Solutions to these obstacles were also examined and include: assigning a lead agency, defining roles and responsibilities, developing a governance model and involving all stakeholders in the decision making process, obtain funding and promoting public awareness and community involvement.

Monitoring is also an important component of the implementation stage. Monitoring serves to continually update the health of the subwatershed, to determine the effectiveness of remedial measures and whether resource targets are being met.

It is important that the recommendations of this report are given priority as they will help to offset the impact of future development planned in the East Holland River Subwatershed and ensure that the natural features of this area will be enjoyed by future generations as well.
PART I INTRODUCTION

Chapter 1 Background

In 1991, the Lake Simcoe Region Conservation Authority (LSRCA) initiated its first watershed plan. This plan was for Lovers Creek and Hewitts Creek and was prepared in cooperation with the City of Barrie and the Town of Innisfil. Like many other plans, this one was initiated due to concerns about increasing development in the watershed. The majority of the work done to prepare this plan was conducted by the consulting firm of Cumming Cockburn Limited and was completed in 1995.

In 1996, the LSRCA began work on developing a watershed plan for the Uxbridge Brook. This work was requested by and done in cooperation with the Township of Uxbridge in response to growing pressures on the local sewage treatment plant and local concerns for the protection and enhancement of the natural environment. With the exception of the hydrogeology work, this plan was prepared entirely by the Conservation Authority. This plan was completed in 1997 and is currently being implemented in cooperation with the Uxbridge Brook Watershed Committee which has been appointed by the Township of Uxbridge Council.

The LSRCA began work on a Remedial Strategy for the Maskinonge River Subwatershed in cooperation with the Town of Georgina in 1998. This plan was motivated by the poor water quality in the Maskinonge River that was leading to excessive growth of duckweed which chokes the river and results in lost recreational opportunities and revenue. Like the Uxbridge Brook Watershed Plan, this strategy was developed entirely by the LSRCA with the assistance of a consultant for the hydrogeology components. The Town is currently implementing recommendations from the Remedial Strategy and is making significant progress in improving water quality both in the river and in Lake Simcoe.
The planning process for the East Holland Subwatershed Plan was initiated in 1998 by the local municipalities who recognized the pressure that the rapid local growth was placing on the natural environment. This is yet another LSRCA project with hydrogeology support from the Ontario Ministry of the Environment. Field work and the development of an organizational structure were done during the summer of 1999. Data compilation and report preparation took place during the Fall/Winter/Spring of 1999/2000.

The LSRCA Watershed Planning Model has been evolving over the last nine years of work. Currently, a three stage model for developing and implementing watershed plans is being used as follows:

**Stage 1**  The preparation of a “State of the Watershed Report” which provides a summary of the natural and cultural resources in the watershed providing sufficient data to identify areas requiring protection or rehabilitation. Participation of a technical Steering Committee as well as a Public Advisory Committee begins during the final part of this Stage.

**Stage 2**  The primary work of the Steering Committee and the Public Advisory Committee begins in this Stage as the watershed management plan is developed. The work done in Stage 1 provides the background to develop a strategy to protect natural features and rehabilitate degraded areas.

**Stage 3**  The Steering Committee and Community work together to guide the implementation of the Watershed Management Plan and monitor progress towards goals set out in the Plan. Implementation is adaptive to ensure that issue are addressed and the community stays informed, involved and supportive.

This report detailing the East Holland River Subwatershed Management Plan completes
Stage 2 and provides information on the recommended actions that should be taken to rehabilitate degraded resources and protect healthy and valuable resources within the Subwatershed. The report has been developed using an ecosystem approach and indicates where linkages exist between resources and where efforts may have multiple benefits. It will provide those working to implement the Subwatershed Management Plan with sufficient information to carry out the recommended actions.
Chapter 2  Watershed Planning Principles

The ecosystem approach to environmental management takes into consideration all components of the natural environment including land, water and air. It also considers the flow of energy throughout the system and since humans have such a significant impact on the environment, we are also included in the ecosystem. Scale is also an important aspect of ecosystems since they can range in size from a small pond to the entire planet. Therefore it is extremely important when undertaking an ecosystem based study to be sure and select the most appropriate scale for the study objectives.

To manage natural resources using an ecosystem approach it is essential to establish biophysical boundaries. Watersheds have been identified as the best “fit” for the implementation of an ecosystem study because they are virtually self contained water based ecosystems (OMOE & OMNR, 1993c). Watersheds are defined as the area of land drained by a watercourse and subsequently, the land draining to a tributary of the main watercourse is called a subwatershed. Watershed processes are controlled by the hydrologic cycle (Figure 2.1). This movement of water influences topography, climate and life cycles. It is due to this connectivity that any change within the watershed will impact other parts of the watershed.

Figure 2.1 The Hydrologic Cycle (after OMOE & OMNR, 1993c.)
Watershed planning is an integrated approach that takes into consideration all socio-economic, physical and biological factors. A well-prepared subwatershed plan will contain the following components:

- The delineation of the subwatershed boundaries;
- The relationship of the subwatershed plan to other planning documents;
- The identification of form and function of natural systems;
- The resource management objectives for the subwatershed;
- Recommendations for protection, rehabilitation, and enhancement;
- An implementation plan including a strategy for future monitoring.

The resulting plan will protect the existing natural resources, facilitate more informed planning decisions, improve the efficiency of the development review process and ultimately, save money for all stakeholders. It is important for all to remember that it is much more beneficial, both financially and ecologically, to protect resources from degradation rather than try and undo the damage once it has been done.
Chapter 3  The East Holland River Subwatershed

The Holland River watershed is located in the southwest corner of the Lake Simcoe watershed. It is composed of two major tributaries, the East Holland and the Holland-Schomberg Rivers. The East Holland River is the smaller of the two areas draining approximately 243 km$^2$ or 41% of the total Holland River Subwatershed area (Figure 3.1). Like many of the rivers which drain into the Lake Simcoe, the headwaters of the East Holland River originate in the Oak Ridges Moraine.

The Oak Ridges Moraine is one of the major physiographic features in Southern Ontario that was formed during the Wisconsin era of glaciation. A moraine is a linear ridge of rock debris that was pushed in front of the glacier and then left behind when the glacier retreated. The coarse, well-drained composition of the Oak Ridges Moraine makes it a very important component of the local hydrogeologic system. Infiltration of surface water allows for the recharge of both deep and shallow underground aquifers. Many of the streams in the area, including the East Holland, depend on the discharge of the shallow groundwater system to maintain baseflow. In addition, many local communities rely on the deep groundwater aquifers for their drinking water. The moraine terrain is characterized by a combination of irregular hills and many depressions. These depressions are complemented by “kettles” which are formed when partially buried remnant ice chunks are left behind by the receding glacier. As the ice chunk melts, a depression is left behind, some of which are large enough to form small lakes. Musselman Lake is an excellent example of a “kettle lake” within the East Holland Subwatershed.

The areas north of the Moraine have also felt the effect of extensive glaciation. Large quantities of glacial till, which is a conglomeration of rock, sand and clay, was deposited over the region. As a result, the bedrock below has had little influence over the physiographic development of the region. Another significant physiographic feature in the study area is the Schomberg Clay Plain which was formed when sediments were deposited by an ancient glacial lake called Lake Schomberg. This clay was deposited over the existing till plain and
The East Holland River Subwatershed Study

Figure 3.1
Study Area

Legend
- East Holland Subwatershed
- Road
- River
- Town Boundary

Scale
1 0 4 km

Legend
- East Holland Subwatershed
- Road
- River
- Town Boundary

Scale
1 0 4 km
obscures some typical till plain features such as drumlins.

Unlike physiographic features, municipal boundaries are not readily discernable across the landscape. The East Holland River Subwatershed is located almost entirely within the Regional Municipality of York. It contains portions of the Towns of Whitchurch-Stouffville, King, East Gwillimbury and Georgina and all of the Towns of Newmarket and Aurora. There is a small portion of the south-east section of the Subwatershed that lies in the Township of Uxbridge in the Regional Municipality of Durham. Human activities within the Subwatershed have had a significant impact on the health of the ecosystem. Some of these activities occurred long ago but the repercussions are still influencing the Subwatershed today. It is important therefore to understand the past history of the area to gain an understanding of existing conditions.
Chapter 4  The History of the East Holland River Subwatershed

Exploration and Early Settlement

The region has been inhabited by humans since the retreat of the Wisconsin Glacier more than 3500 years ago. The native inhabitants included nomadic hunters, the Laurentian Indians and the Woodland Indians. Just prior to the arrival of the Europeans, the Iroquois occupied the region. This group had a strong presence in the area since the 12th Century. These original inhabitants were responsible for establishing the Rouge, Humber and Don Trails all of which served to connect Lake Ontario and Lake Huron via the Holland River and Lake Simcoe. These trails were of great significance to the later development and settlement of the area. These original inhabitants did not have a significant environmental impact as they generally tried to live in harmony with nature.

The first European in the region was Etienne Brûlé who arrived in 1615 as part of Champlain’s campaign against the Iroquois. Most European activity during this period was centred around the fur trade. In 1792, John Graves Simcoe, first Lieutenant-Governor of Upper Canada established York County. It was at this time that land grants started being issued to the settlers.

As a part of this early settlement, it was determined that a road connecting Lake Ontario to Lake Huron would be required to replace the current trails. This “Military Street” would eventually become Yonge Street named after Sir George Yonge, secretary of war in the British Cabinet. The road was completed to Holland Landing on February 20, 1796. While the road was still very rough, it did provide an efficient route for
settlers and connected York to Lake Huron.

With the completion of Yonge Street came the development of several small communities along its length including the two largest in the East Holland Subwatershed, Aurora and Newmarket. Newmarket was the faster growing of the two due to its proximity to Holland Landing. With the construction of grain and saw mills to supply the growing number of settlers, Newmarket became the major trading centre north of York.

It was during this time period that the Holland River was given its current name. The different native peoples that inhabited the area each had their own name for the river. Prior to European settlement, the river was known both as the River Escoyondy and Miciaguean. In 1793, it was named Holland’s River after Major Samuel Holland, Surveyor General of Upper Canada. The name was eventually shortened to Holland River.

The environmental impact of early settlement was related mostly to tree clearing activities associated with road building. Also, as more people moved into the area, there were impacts due to the clearing of land for homesteads as well as the increases in human related wastes. Erosion would likely have been becoming a problem as the bare ground would have been quite susceptible.

Forest to Farmland
All of the communities experienced a period of growth in 1853 when the Ontario, Simcoe and Huron Railway was completed. This rail line was later renamed the Northern Railway and eventually ran from Toronto to Collingwood on Georgian Bay. Newmarket only experienced minor growth since it was already a major centre. However, Aurora was much more significantly impacted and experienced growth both in numbers of inhabitants and in the variety of industries present. Holland Landing experienced some growth as the continuing main access point to Lake Simcoe, but never would feel the same surge in development as other areas did. The overall result was further settlement within the East Holland Subwatershed with the increased ability of people and goods to move easily to and from York.
The detrimental effects of development became apparent in the late 1800’s when soil erosion was a significant problem in many parts of Southern Ontario. The East Holland Subwatershed was part of an area which was known as the Great Canadian Pine Belt. Lumber mills were the source of the first gainful employment for a large number of settlers with several mills located throughout the Subwatershed. Extensive tree cutting for the construction of homesteads, export to Britain and the United States as well as clearing for agriculture left soils vulnerable to wind and water erosion. The ability of the land to store water was lost and severe spring flooding resulted. The summers brought intense droughts to the area. Wind erosion was so severe that some roads were blocked by the shifting sands. This collapse in forest resources resulted in the decline of the lumber industry with the majority of sawmills ceasing operations.

During the 1870’s, farmers were encouraged to plant trees along roadways to reduce the wind erosion. These efforts were encouraged by the municipalities through a 25 cents per tree subsidy. Reforestation efforts were formalised in 1911 with the passing of the Counties Reforestation Act and subsequently by the Reforestation Act which was passed in 1921. The Reforestation Act enabled the establishment of tree nurseries and the supply of tree seedlings in addition to planting and management by the province. Counties were able to purchase barren farmland and place it under “management agreement” with the Department of Lands and Forests. This eventually led to the establishment of municipally run reforestation areas such as York Regional Forest tracts which exist today.

**Industrialization - From Rails to Roads**

Most existing roads in the early 1900’s were nothing more than simple reinforced earthen paths which usually turned into rivers of mud after a rainfall. The increasing demand to
transport people and goods prompted the construction of better roads and alternative modes of transportation throughout the Subwatershed. One such alternative was the "radial system", an electric railway which was built in 1899 by the Metropolitan Toronto Street Railway Company. It ran up Yonge Street from North Toronto through Richmond Hill, Aurora, Newmarket and eventually all the way to Sutton. It provided an efficient mode of transportation for daily commuting, shopping trips, social events and farmers taking goods to market. The radial system so improved the access to Lake Simcoe that it is attributed with the promotion of the local tourist industry. It was not long after the radial railway was established that the number of seasonal residences, resorts and cottages around the lakeshore increased dramatically.

The enhancements made to the transportation network benefited other aspects of the Subwatershed’s economy, especially the manufacturing and agricultural industries by significantly reducing the cost and time involved with the transportation of goods. New industries like the Office Specialty Company and the Davis Leather Company established factories in Newmarket and began to flourish. It became practical to transport large quantities of locally produced eggs, butter and milk to the Toronto markets. It was during this time that the movement towards mass production, and the redistribution of the rural population towards urban centres began.

The advent of the automobile foretold the end of the radial system. The ensuing popularity of the automobile as a cheap, independent form of travel resulted in further road reconstruction
projects throughout the Subwatershed. In 1919, significant improvements were made along Yonge Street from Toronto to Barrie. As more and more people bought automobiles, the numbers using the radial railway declined and, in 1930, twenty one years after its completion, the last car arrived back at Hogg's Terminal in Toronto and the Lake Simcoe radial service was discontinued.

In the early 1900's, the idea to construct a canal connecting the Holland River to the Trent Valley Canal system was resurrected. Construction on the Newmarket Canal Project began in 1906 with the dredging of the first part of the canal from Lake Simcoe to Holland Landing. In 1908, construction began on a series of three locks, four bridges, a dock and a turning basin to be located in Newmarket. However, the project was continually plagued by design problems, and construction delays and the resulting cost overruns led many to question the benefit and feasibility of the project. A study was commissioned as a result and it indicated that once complete the canal operations would be extremely limited due to a lack of water. As a result, on January of 1912 the project was abandoned.

Environmental impacts during this period would have been related to increasing population and industrialisation. Water and air pollution would have been present as a result of the larger population and discharges from local factories. As the urban area grew, there would have been increases in stormwater discharges due to a decrease in vegetation and an increase in impermeable ground. The stormwater would have carried pollutants from the streets into the river and increased the flow causing erosion.

A Trend Towards Urbanization
The onset of the Second World War established the need to mass produce equipment and materials to support the war effort. This resulted in further industrialisation and improvements
to transportation networks. When the war finally ended, the area was witness to a massive influx of people. During this period, population growth was focussed primarily in the urban centres like Aurora and Newmarket. As these urban centres expanded so did the supporting infrastructure with the construction of new roads, storm sewer systems and sewage treatment plants. This improvement in infrastructure would have had environmental benefits as sewage facilities could be centralised and the effluent treated rather than hundreds of individual rudimentary household septic systems.

Agriculture also underwent a change as small mixed farms began to slowly disappear as new machinery allowed farmers to increase production. During the forty year period between 1941 and 1981 the number of farms throughout the area decreased significantly. This was due to a cycle of economic pressure to produce more for less which forced farmers to adopt new farming methods and practices. The use of chemical fertilizers to improve crop yield had become a common practice, livestock operations increased the size of their herds and fence rows were removed to create larger fields. The net effect was fewer, larger, very intensively managed farms which used up the soil resources and concentrated livestock waste resulting in a detrimental effect on the environment.

In the early 1980’s, an increase in the popularity of the suburban communities within the Subwatershed combined with economic prosperity resulted in a further increase in the rate of population growth. This trend of high growth levels is expected to continue well into the next century (Figure 4.1).
The Regional Municipality of York is one of the fastest growing municipalities in all of Canada and has been described as one of the most desirable places to live within North America. Due to this fast pace of urban growth, it was critical that a holistic and comprehensive Subwatershed Plan be initiated to protect existing natural resources and, where possible, rehabilitate or enhance ecosystem health. To this end, the Municipalities of Newmarket, Aurora, East Gwillimbury, Whitchurch-Stouffville, King and the Regional Municipality of York agreed to develop this Subwatershed Management Plan in partnership with the Lake Simcoe Region Conservation Authority.
Chapter 5  Management Plan Goals and Objectives

The goals of the East Holland River Subwatershed Plan are as follows:

To maintain, protect and rehabilitate the health and quality of the East Holland River and its ecosystem by developing a plan that minimizes impacts associated with future urban growth and addresses existing activities degrading the environment.

These goals can be achieved by meeting the following objectives:

1. Involve all partner agencies and the public through active participation.
2. Integrate disciplines, policies, mandates and requirements of all agencies and interests.
3. Identify the location, area, extent, present status, significance, function and sensitivity of the existing natural environment within the watershed.
4. Identify the location and type of development constraints within the watershed.
5. Identify sources of surface water contaminants from agricultural, urban, rural and natural areas and areas where there is a potential for rehabilitation.
6. Evaluate potential impacts on water quality and on the natural environment associated with future development in the watershed.
7. Identify remedial measures and control options to rehabilitate ecosystem health. Prioritize measures and options based on their cost/benefit and produce an implementation strategy, which identifies agency roles and responsibilities and a schedule for completion.
8. Identify opportunities for community involvement.
9. Assess the impact associated with future urban growth on the health of the East Holland River ecosystem and develop a strategy to minimize and/or eliminate these impacts.
10. Provide direction for the protection and rehabilitation of natural heritage features.

12. Outline requirements for monitoring, and a mechanism to involve and inform the public of the results.

13. Provide information regarding potential organizational structures for implementation, identify potential sources of funding and recommendations pertaining to management options (ie. changes in policy, by-laws).

14. Encourage Municipalities by whatever appropriate means to adopt the final Subwatershed Plan and its recommendations into official policies and through the direction of funds for the undertaking of capital works.

The goals of the study have been simplified into two guiding principles which are:

1. **Protect What is Healthy**

   Protect the ecosystem of the East Holland River by:

   T Protecting water resources and ecological functions,

   T Protecting natural linkages that still exist in the East Holland River Subwatershed.

2. **Rehabilitate What is Degraded**

   Restore damaged resources within the Subwatershed by:

   T Restoring the River and its tributaries by initiating remedial projects, education programs and community involvement,

   T Improving water quality,

   T Restoring degraded habitats,

   T Enhancing existing wildlife and recreational areas by establishing linkages,

   T Involve the community and have them take responsibility for the East Holland River.
These two simple principles provide a vision for the future of the East Holland River Subwatershed that everyone can identify with and understand. People must begin to regard the whole of the Subwatershed as home and realize that their activities, however minor they might seem, may have broader consequences to ecosystem health. This is especially true when you consider the number of people living within the Subwatershed and cumulative impact they could have by planting a tree, reducing the amount of fertilizer they use or by disconnecting a downspout. While the large capital remedial projects may get the headlines, we cannot discount the enormous benefit from the countless smaller projects undertaken by individual residents.

The continuing human tendency to try and master nature by altering the landscape to fit our needs must stop and efforts taken to preserve ecological functions and the processes associated with a healthy natural landscape. This will be accomplished through proper planning and design of the future urban landscape to achieve a balance. This means establishing a balance between future urban growth and the needs of the East Holland River Subwatershed.
PART II DEVELOPING THE MANAGEMENT PLAN

Chapter 6 Subwatershed Issues Summary

The following list summarizes key environmental issues identified through both the public process and scientific investigations within the East Holland River Subwatershed (Figure 6.1). These issues are important as they provide the Steering and Public Advisory Committees, and resource managers with the direction needed to develop a strategy to protect and rehabilitate the East Holland River Subwatershed ecosystem. A more detailed description of the management issues and the public process and scientific investigations used to identify them is contained in the State of the Watershed Report for the East Holland River.

**LAND**

<table>
<thead>
<tr>
<th>Natural Corridors</th>
<th>T</th>
<th>Natural corridors are required to maintain the ecological functions of many areas.</th>
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<tbody>
<tr>
<td></td>
<td>T</td>
<td>A lack of natural corridors exists in many areas, particularly linking upland forests.</td>
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<td>T</td>
<td>Retaining and enhancing corridors generally requires participation from private landowners.</td>
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<td>T</td>
<td>Reinstating natural corridors along watercourses provides the greatest ecological benefit.</td>
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<td></td>
<td>T</td>
<td>The protection of existing corridors is difficult given existing legislation and planning processes.</td>
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<table>
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<tr>
<th>Wildlife Habitat</th>
<th>T</th>
<th>A highly fragmented landscape of habitat areas exists.</th>
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<tr>
<td></td>
<td>T</td>
<td>Wetlands are prime habitat areas and are at risk.</td>
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<td></td>
<td>T</td>
<td>Many habitat remnants are too small to support viable populations.</td>
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</tbody>
</table>
Figure 6.1
East Holland River Catchments

Legend
- Catchment
- Road
- River
- Town Boundary

Scale
1 0 4 km

The East Holland River Subwatershed Study
<table>
<thead>
<tr>
<th>Aggregate Resources</th>
<th>T</th>
<th>Areas designated suitable for aggregate extraction will often also be groundwater recharge areas and are extremely sensitive to development.</th>
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</thead>
<tbody>
<tr>
<td>Woodlands</td>
<td>T</td>
<td>A target of 25% forest cover target has been established by the York Official Plan. Forest cover currently ranges from 2.1% to 37.1% in the subcatchments with an overall of 19.1%.</td>
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<td>T</td>
<td>Reduced forest cover will result in increases in runoff and subsequent erosion and reduction in flood storage capacities.</td>
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<td>T</td>
<td>Loss of forest area continues to occur due to land use changes.</td>
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<td></td>
<td>T</td>
<td>Many forest areas are too small to sustain basic ecological functions.</td>
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<td></td>
<td>T</td>
<td>Private woodlands are often degraded by inappropriate management practices.</td>
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<td></td>
<td>T</td>
<td>Invasive exotic species become more widespread as urbanization increases.</td>
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<td></td>
<td>T</td>
<td>Forest areas often provide excellent passive recreation opportunities which are in high demand.</td>
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<td></td>
<td>T</td>
<td>Available information is often inadequate to make appropriate land use decisions.</td>
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<tr>
<td>Wetlands, ESAs &amp; ANIS</td>
<td>T</td>
<td>Increasing development is placing additional pressure on these sensitive natural areas.</td>
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<td></td>
<td>T</td>
<td>Some of these areas are being degraded due to existing human land use activities within the watershed.</td>
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<td></td>
<td>T</td>
<td>Comprehensive and consistent policies need to be in place within the entire East Holland Subwatershed within all municipalities.</td>
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</tbody>
</table>
## WATER

### Water Quality

- **T** Water quality is poor with 12 of the 18 parameters examined exceeding their PWQOs.
- **T** Water quality is significant enough to impair the aquatic ecosystem and limit recreation opportunities.
- **T** Urban areas and the associated stormwater runoff appear to be the primary source of pollutants.
- **T** Further monitoring is required to more effectively address the sources of some of the pollutants.

### Hydrogeology

- **T** Areas of groundwater vulnerability, recharge and discharge, need to be protected to ensure the availability of clean drinking water as well as the maintenance of baseflow in the East Holland River.

### Water Quantity

- **T** Increases in impervious area associated with urbanization are causing increases in runoff volume resulting in downstream flooding and erosion.
- **T** Decreases in base flow are also being observed due to reduced groundwater infiltration.
<table>
<thead>
<tr>
<th>Aquatic Environment</th>
<th>T</th>
<th>Water quality is limiting to the aquatic environment, decreasing fish populations and diversity.</th>
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<tbody>
<tr>
<td></td>
<td>T</td>
<td>Water quantity changes, such as significant reductions in base flow, or highly fluctuating water levels can be detrimental to aquatic habitat. Channel shape and integrity can also be affected by changes in water quantity.</td>
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<td></td>
<td>T</td>
<td>Thermal pollution due to the presence of ponds, warmed water draining from urban areas and reduced riparian (streambank) cover has significantly reduced the amount of cold water fish habitat, and has also had impacts on warm water habitats.</td>
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<td></td>
<td>T</td>
<td>Erosion and the resulting stream sedimentation has destroyed cold water spawning areas and reduced nursery habitat, reducing the populations of more sensitive aquatic species.</td>
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<td>T</td>
<td>Pollutants - excess nutrients, herbicides, pesticides, metals, and various manufactured compounds entering watercourses can have detrimental effects on aquatic life and their habitats.</td>
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<td>T</td>
<td>Obstructions to fish passage, such as dams, weirs and pond level control structures reduce access to habitat, and cut off migration routes for fish and other aquatic animals.</td>
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<td></td>
<td>T</td>
<td>Artificially hardened shoreline areas (retaining walls, etc.), can destroy important shallow water habitats.</td>
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</table>
COMMUNITY

Recreation & Trails

T  Degradation of natural resources reduces recreation opportunities due to reduced aesthetics.

T  The misuse of pesticides and herbicides in recreation areas is degrading water quality.

T  An emphasis on manicured parks is reducing the naturalized portion of these green spaces and leaving streams and other natural areas un-buffered.

T  Abuse of parks by the public is leaving them damaged and full of litter which can be a hazard to wildlife.

Natural Hazards

T  Development should continue to be directed outside of natural hazard areas.

Urban Growth and Infrastructure

T  Urban growth represents a dramatic change in land use which will significantly influence environmental health.

T  Expanding infrastructure to service the increased urban area represents a dramatic change in land use which will significantly influence environmental health.

T  Many changes cannot be mitigated and result in a loss of habitat or the resource (example: building a highway through a wetland)

As is implied through the use of an ecosystem approach, many of these factors are related to each other. In an effort to illustrate these interconnections table 6.1 was developed. In the case where two factors are related, a check has been placed in the corresponding box.
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<thead>
<tr>
<th>Natural Corridors</th>
<th>Wildlife Habitat</th>
<th>Aggregate Resources</th>
<th>Woodlands</th>
<th>Wetlands, ESA s &amp; ANIS</th>
<th>Water Quality</th>
<th>Hydrogeology</th>
<th>Water Quantity</th>
<th>Aquatic Environment</th>
<th>Recreation &amp; Trails</th>
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<th>Urban Growth</th>
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Chapter 7  Protecting What is Natural

The major land use changes anticipated to occur within the East Holland River Subwatershed are associated with further urbanization and the subsequent infrastructure development. It is also safe to assume that the amount of land used for agriculture will decrease as the demand for growth continues. The types of farms and farming practices utilized within the East Holland River Subwatershed are also likely to remain the same. Therefore, urban expansion represents the greatest risk for the future destruction and degradation of existing natural areas, their functions and processes as they relate to the health of the East Holland River ecosystem.

To protect against this threat, it is imperative that plans for future urban development within the Subwatershed and their repercussions on the ecosystem be well understood. This involves a review of the Town of Whitchurch-Stouffville, Town of Aurora, Township of King, Town of Newmarket, Town of East Gwillimbury, Town of Georgina and the York Region Official Plans which outline the forecasts for future populations and land use in relation to the natural resources present within the East Holland River Subwatershed.

7.1 Existing Conditions

There is a significant amount of urban area within the East Holland River Subwatershed including the rapidly growing Towns of Aurora and Newmarket. These and other urban centres currently occupy 7,455 hectares which represents approximately 30% of the total area within the subwatershed. This area is projected to grow to 11,431 hectares or 46% within the next ten to twelve years based on the Official Plans of each Municipality.

In addition to Official Plans, all Municipalities within the Subwatershed have undertaken or are in the process of completing Greenland or Natural Heritage studies. The Region of York, the Town of Georgina and the Town of East Gwillimbury have all completed their studies. The Town of Whitchurch-Stouffville and the Township of King are both in the process of finalizing their own projects. The recommendations from these studies are generally incorporated into
Official Plans for implementation.

7.1.1 Official Plan Designations
Planning responsibilities within the East Holland River Subwatershed are shared between the Regional Municipality of York, the Town of Whitchurch-Stouffville, the Town of Aurora, the Township of King, the Town of Newmarket, the Town of East Gwillimbury and the Town of Georgina. Some of the details of the planning documents follows.

Official Plan for the Regional Municipality of York
The York Region Official Plan was approved by the Minister of Municipal Affairs and Housing on October 17, 1994. The Plan provides direction to the lower tier Municipalities with respect to urban development and Greenland Systems as well as other policy areas. Of particular interest for the East Holland River is the identification of the River and its valley lands as portions of the Greenland System that assist in defining the regional structure. The York Region Greenland are depicted in Figure 7.1.

Town of Whitchurch-Stouffville Official Plan
The Official Plan for the Town of Whitchurch-Stouffville was approved by the Minister on August 18, 1982. Only limited growth is proposed for the rural communities of Vandorf and Ballantrae. The main growth area is anticipated to occur in the community of Stouffville which is located outside the study area. Of the 6,287 hectares of Whitchurch-Stouffville that lie within the East Holland Subwatershed 487 hectares (8%) is developed. This is anticipated to increase to 847 hectares (14%) within the next ten years.

Town of Aurora Official Plan
The Official Plan for the Town of Aurora received final approval by the Minister of Municipal Affairs on June 7, 1993. Of the 4,711 hectares of Aurora that lie within the East Holland Subwatershed 2,402 hectares (50%) is developed. This area is projected to grow to 3,374 hectares (71%) in the next ten years.
The East Holland River Subwatershed Study

Figure 7.1
York Region Greenland System

Legend
- Greenlands
- Road
- River
- Town Boundary

Scale
1 0 4 km
**Township of King Official Plan**

Any urban area or anticipated urban growth in the Township of King is outside the study area therefore no assessment of the Official Plan was required.

**Town of Newmarket Official Plan**

The current Official Plan for the Town of Newmarket replaced the original 1977 document on December 5, 1996. The plan anticipates that all of the Town area identified will be converted to urban development with the exception of a section in the South West corner of Town. Of the 3,529 hectares of Newmarket that lie within the East Holland Subwatershed 2,925 hectares (83%) is developed. This number is anticipated to increase to 3,384 hectares (96%) in the next ten years.

**Town of East Gwillimbury Official Plan**

The Official Plan for the Town of East Gwillimbury is currently in effect under Amendment #95 which was adopted by Council on July 14, 1997. Communities in the Town and within the study area include Holland Landing, Sharon and Queensville. Of the 7,379 hectares of East Gwillimbury that lie within the East Holland Subwatershed 1,489 hectares (20%) is developed. This area is projected to expand to 2,660 hectares (36%) within the next ten years. The largest proportion of this growth is expected to take place in the Queensville area.

**Town of Georgina Official Plan**

The Official Plan for the Town of Georgina was approved by the Ministry of Municipal Affairs and Housing on March 12, 1982. The only urban area in Georgina within the study area is at the South end of Keswick. This area has a Secondary Plan which is Amendment #71 to the Official Plan for the Town of Georgina and was approved by MMAH on March 8, 1996. Only 542 hectares of Georgina lie within the East Holland Subwatershed, of this area 151 hectares (28%) is developed. This developed area is expected to grow to 292 hectares (54%) urban area. This percent growth seems large, but one must keep in mind that Georgina is a very small part of the East Holland River Subwatershed and the actual number of hectares is quite small.
7.2 Management Policies and By-Laws

Management policies and by-laws are the mechanisms used to safeguard against potential safety and environmental problems associated with human land use activities. As preventative measures, they fulfill the first guiding principle of the Subwatershed Plan which is “to protect what is healthy”. The following section is a brief description of existing and proposed management policies.

Floodplain and Fill Regulations
Section 28 of the Conservation Authorities Act allows a Conservation Authority to prohibit or regulate the construction of any building or structure in any area susceptible to flooding during a regional storm. This regulation is currently applied within the East Holland River Subwatershed by the Lake Simcoe Region Conservation Authority. The construction of buildings in the floodplain can result in two major problems. The first is that buildings constructed in flood prone areas are susceptible to major damage during severe flooding events. Inhabitants of these structures would also be exposed to personal risk. Secondly, construction and other types of filling in the floodplain results in a loss of channel capacity and flood storage. This means that flood waters that would normally have occupied a filled in area will occupy other areas to compensate for the loss of storage. This generally results in increases in flooding in upstream or downstream areas of the altered floodplain.

Tree Cutting By-Law
The Region of York has a Tree Cutting By-Law that regulates, prevents and or limits the cutting of trees. An exception to the tree cutting by-law is required before cutting activity commences. The review undertaken to authorize an exemption will ensure that all parties are aware of a proposed cut.

Topsoil Conservation By-Law
A Topsoil Conservation By-Law allows a municipality to control the stripping and removal of topsoil thereby reducing erosion and sedimentation from construction activities. The by-law also makes provision for the revegetation of lands stripped for development should
construction not begin within a prescribed period of time. The Town of Aurora has a Topsoil Conservation By-Law in place. The Town of Newmarket, Town of East Gwillimbury, the Town of Georgina, the Town of Whitchurch-Stouffville and the Township of King presently do not have such a by-law, and it is recommended that they adopt one to help minimise erosion and sedimentation resulting from construction activities.

**Fill Control By-Law**
Fill control by-laws allow municipalities to regulate or control filling in areas within their boundaries. All towns within the study area have fill by-laws, with the exception of East Gwillimbury. It is recommended that the Town of East Gwillimbury evaluate the benefits of adopting such a by-law.

**The Development Review Process**
In the development review process both the Conservation Authority and the local municipality have adopted policies that require development proponents to meet stringent stormwater management requirements. These reports also provide information on sediment and erosion controls to be implemented during construction as well as the proposed water quality treatment for site runoff after the development is completed. Currently, SWM reports within the East Holland River Subwatershed must be approved by the local municipality and the Lake Simcoe Region Conservation Authority. The MOE has set standards for the treatment of stormwater runoff and they are based on the sensitivity of the stream to which the runoff is drained. The Conservation Authority, in cooperation with the MOE, is currently requiring that the highest level of stormwater quality protection “Level 1” be provided for all new development within the East Holland River Subwatershed to protect the aquatic resource not only within the river but of Lake Simcoe as well.

**Groundwater Recharge**
As part of the East Holland Subwatershed Study areas of groundwater vulnerability and recharge were identified. At present there are no municipal by-laws protecting these areas. The Conservation Authority does however, have its own Watershed Development Policies that
requires an Environmental Impact Statement be completed to address groundwater quality and quantity concerns prior to the commencement of any works.

**Ontario’s Wetland Policy**

Wetlands are extremely important in maintaining a healthy watershed. They contribute to ground water recharge, filter sediment and nutrients, store large volumes of water, and are essential habitat to a large variety of wildlife. Provincially significant wetlands are afforded some degree of protection through Ontario’s Wetland Policy. Activities such as cattle grazing, peat removal, or dredging do not require an application under the Planning Act yet can still be quite destructive. Small wetlands and others which are not recognized as provincially significant are also important and should be protected where possible. Buffer zones of 120 metres from the wetland edge should be maintained where they exist and developed where they do not.

### 7.3 Land Use Protection

**Official Plan and Secondary Plan Land Use Designations**

Land use designations such as Environmental Protection, Open Space and Parkland can be used to protect significant resources, establish linkages and enhance trail systems. All of the Municipalities within the study area including York Region have completed Greenland Strategies, the results of which have been incorporated into the rehabilitation plans.

**Recharge Zone Protection**

Urban development within recharge zones should be permitted only where it is assured that infiltration rates will not be affected and that pollutants will not enter the ground water system. The Conservation Authority’s Environmentally Significant Areas Study and the Oak Ridges Moraine Strategy are examples of attempts to protect significant recharge areas. Given that the East Holland River Subwatershed has had significant groundwater problems it is important that the recharge areas identified are protected such as through land use designations.
discussed above.

**Groundwater Discharge Zone Protection**

Groundwater discharge zones (areas where ground waters surface) are particularly sensitive habitat areas and contribute cold, clean water to the East Holland River which sustains the aquatic ecosystem. These areas must be maintained and vegetated buffer zones maintained.

### 7.4 Environmental Screening Map

One of the guiding principles of the East Holland River Subwatershed Study is to “protect what is healthy”. To assist resource managers and planners to accomplish this, an environmental screening map was produced for the Subwatershed area using a geographic information system. The analysis involved identifying lands which are protected from future development, and/or where special conditions should be imposed before development can take place, to mitigate any associated harmful environmental impacts. The analysis divided land uses into two categories; those which are legislated through a Provincial Policy Statement, and those areas which have significant environmental value and are the domain of the region or local municipality.

Lands protected by provincial policy often cannot be developed and have been considered as high constraint areas. This includes: floodplains, aggregate resources and provincially significant wetlands. The second category is comprised of areas of environmental importance in which development should be carefully managed to ensure that there will be no detrimental impact on these features and the health of the Subwatershed. Features in this category include locally significant wetlands, valley lands, warm and cold water streams, significant forest stands, prairie grasslands, recharge/discharge areas, fill regulated areas, Environmentally Significant Areas (ESAs), Areas of Natural and Scientific Interest (ANSIs) and areas of ground water vulnerability.

The majority of tributaries and entire main branch of the East Holland River have floodplains that fall under the Provincial Policy Statement. These floodplains have been determined from
computer modelling to the Regional Storm (Hurricane Hazel) level and development within these areas is forbidden because it would place the occupants at risk.

Aggregate resources, sand, gravel and stone deposits are protected by the province. Aggregate resources identified under the screening exercise consisted of licenced aggregate extraction pits and areas targeted for future extraction. As these areas are often sources of groundwater recharge their management is an important consideration in the preservation of groundwater quality and quantity. It is important to stress that the resources are protected not for their environmental significance, but in anticipation of their future use.

There are four provincially significant wetland complexes either partially or fully within the East Holland Subwatershed as well as six wetland complexes that are considered locally significant. Wetlands were included in the screening map because of the important role they play in filtering water, storing water and reducing sediment loading. As well, wetlands provide habitat for a variety of plant and animal life. Thus the preservation of wetlands positively contributes to both the ecological health and water quality of a watershed. It has been generally recognized by past provincial policy that land use practices up to 120 metres from the edge of a wetland will affect the health of the wetland. For this reason, a 120 metre buffer from wetland edges was included in the screening map as an area where development, should it be proposed, must be carefully managed if allowed.

Riparian corridors need to be maintained to ensure the protection of aquatic habitat for both warm and cold water fisheries. Any development that occurs on or directly along the river can have a negative impact on the health of the river. Damage can result from the removal of vegetation which can act to filter runoff entering the river, provide shade, and as a source of insects for food. Restriction to flow, increases in temperature or increased sediment loads may also occur. The river and buffer around it also serve as valuable habitat for a variety of wildlife species. To this end, all warm water tributaries and branches of the East Holland River were given a 15 metre buffer and cold water a 30 metre buffer on each side of the watercourse.
The forest resource layer was included in the screening map because of the important role forests play in maintaining the health of an ecosystem. Forests provide habitat for a variety of plant and animal species. Along rivers, forests act to filter runoff entering the river, provide shade to keep the water cool and provide shelter and nutrients through debris that may fall into the river. While forests are not regulated to the same extent as the three previous layers, they play an important role in maintaining the health of a river system.

A majority of the East Holland River tributaries as well as the entire main branch of the river is fill regulated. Fill lines are areas within which the placement of fill is regulated. The placement of fill in these areas, including fill used in levelling or in construction, can alter the floodplain along the river increasing height and damage incurred during a flood. Therefore these areas must also be carefully regulated. This does not exclude these areas from development rather any proposed works must obtain a permit from the Authority usually conditional on undertaking special mitigating measures before alterations can be considered.

Environmentally Significant Areas (ESAs) are exactly what the name suggests, areas which are extremely important to the natural environment and ecosystem of the Subwatershed. Areas of Natural and Scientific Interest (ANSI) are areas of land and water containing natural landscapes or features which have been identified as having values related to protection, natural heritage, scientific study or education (Lindsay, 1984). Both designations were included in the screening map as areas that development should avoid.

Areas of groundwater vulnerability in the Subwatershed were identified as a part of this study by Singer, Cheng and Solovykh, and the Ministry of the Environment, Environmental Monitoring and Reporting Branch. It has been determined that development within these areas can adversely affect the quality and quantity of groundwater, therefore the Lake Simcoe Region Conservation Authority is in the process of updating their resource mapping to include these areas in their watershed development policies. Once completed, proposed development within these areas will be required to complete an Environmental Impact Statement documenting how the proposed development will protect the integrity of the existing...
groundwater resources. Development will only be allowed to proceed once all concerns have been addressed.

Through the application of the resources factors described above the environmental screening map was created. The individual resource layers were mapped using a geographic information system to display the data within the context of the watershed boundary. These maps were then overlain and new areas or polygons created where two or more of these different areas overlapped. The results of the screening map exercise are shown in Figure 7.2. The purpose of the map is to provide resource managers and planners with the necessary information to flag potential environmental concerns associated with any new development.
The East Holland River Subwatershed Study

Figure 7.2
Environmental Screening Map

Legend
- Areas of Environmental Importance
- Areas Covered by Provincial Policy Statement

Scale

Data Source: LSRCA, MNR, MOE

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Chapter 8  Rehabilitate What Has Been Degraded

The guiding principles for the East Holland River Subwatershed Management Plan are to “Protect What is Healthy” and to “Rehabilitate What is Degraded”. In the previous sections management issues and concerns were identified for the resource factors. Management policies and municipal by-laws were also evaluated to determine how they can be used to assist in protecting natural areas and minimising impacts associated with urbanization. This section will focus on efforts needed to rehabilitate what is degraded. This involves evaluating both urban and rural remedial measures and control options to address previously raised issues and concerns.

8.1  Best Management Practices (BMPs)

The term Best Management Practices (BMPs) has been adopted to describe currently used “state of the art” remedial works and practices. The following is a description of both urban and rural BMPs which are practical and cost-effective ways of addressing the management issues associated with water quality, water quantity, aquatic and terrestrial habitat and recreation and aesthetic amenities. Table 8.1 lists a realistic range of BMPs which can be applied within the East Holland River Subwatershed and indicate the potential benefits associated with these measures. A brief description of the individual BMPs is also provided.

An example of a stormwater management pond
<table>
<thead>
<tr>
<th>Best Management Practice</th>
<th>Environmental Benefits</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Quality</td>
<td>Water Quantity</td>
<td>Aquatic Habitat</td>
<td>Terrestrial Habitat</td>
</tr>
<tr>
<td>Septic System Replacement</td>
<td>!</td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>Street Cleaning/Reduce Salt &amp; Sand Use</td>
<td>!</td>
<td></td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Urban Stormwater Control Facilities</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Bank Stabilization</td>
<td>!</td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>Removal of Instream Barriers</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>Fish Habitat (Instream Cover)</td>
<td>!</td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>Cropland Field Management</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Naturalization and Reduced Pesticide Use</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Manure Storage and Handling</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>Restrict Livestock Access to Streams</td>
<td>!</td>
<td></td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Establish Buffer Strips</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Retirement of Fragile/marginal Land</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Reforestation and Forest Management</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Recreational Boating BMPs</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
</tbody>
</table>
Septic System Inspections and Replacement

Older, poorly designed or maintained septic systems are a potential source of contamination of ground and surface waters. Phosphorus, bacteria, nitrates, chlorides and other substances may result from leaking systems. Septic systems in areas of high ground water pollution potential that may be suspect should be inspected. Systems located adjacent to the East Holland River should also be investigated. New systems should be installed where required.

Increase Street Cleaning and Reduce the Use of Road Salt and Sand

The use of road salt and sand on road and street surfaces is necessary to ensure public safety during winter months. Reducing the use of these products should only be considered if it poses no threat to human safety. Alternative products are presently being produced and marketed, however, any new product should be evaluated based on potential environmental impacts. An enhanced street cleaning program should be initiated especially in late winter before the spring thaw washes materials into nearby sewers or the East Holland River. This will remove contaminants, reducing the associated water quality impacts and maintenance cost of stormwater control facilities.

Urban Stormwater Runoff Best Management Practices

Urban BMPs for water quality control focus primarily on addressing the issue of stormwater runoff. Existing urban areas which do not have adequate stormwater quality control facilities represent one of the best opportunities to reduce harmful pollutants entering the East Holland River. Urban stormwater contains numerous contaminants. The following Table 8.2 shows unit area loadings of urban stormwater for seven typical contaminants on an annual basis for residential and commercial areas. The values for suspended solids and biochemical oxygen demand are based on research done in the City of Guelph (James, 1993). The values for zinc, lead and copper were obtained from Schueler (1987). Phosphorus loadings are a combination of wet weather and dry weather flow and are based on the BEAK Consultants Limited model developed for the entire Lake Simcoe Watershed.
Table 8.2  Pollutant Loadings in Urban Stormwater

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Residential Pollutant Loading (RC=.45) (kg/ha/yr)</th>
<th>Commercial Pollutant Loading (RC=.85) (kg/ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspended Solids</td>
<td>840</td>
<td>1993</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>3.2</td>
<td>4.4</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>25</td>
<td>34</td>
</tr>
<tr>
<td>BOD</td>
<td>38.8</td>
<td>184</td>
</tr>
<tr>
<td>Zinc</td>
<td>1.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Lead</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Copper</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Note: RC = run off coefficient

Given that the East Holland River has consistently high concentrations of nutrients such as phosphorus and nitrogen, the development of the management plan included a review of the state of the art BMPs for the removal of nutrients in urban stormwater. Table 8.3 outlines the BMPs available and the average efficiency of each. The maximum assumed removal rates for modelling purposes was 50% with the exception of the sand filter with extended detention wetland which was assumed to have an 80% removal efficiency. The table also ranks the land requirements from 1 to 5 with 1 being the least amount of area required. Only BMPs with a land requirement of 1 are suitable for installation within existing road right-of-ways. These BMPs function by providing a settling area for contaminants, filtering out large particles and establishing an area where biological uptake of pollutants can occur.
Table 8.3 Summary of Stormwater Runoff Best Management Practices

<table>
<thead>
<tr>
<th>BMP</th>
<th>Average Nutrient Removal (%)</th>
<th>Land Requirement</th>
<th>Cost per Upstream ha.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Pond with Extended Detention (ED)</td>
<td>60</td>
<td>3</td>
<td>$50 per m$^3$ of wet storage</td>
</tr>
<tr>
<td>Wetland with ED</td>
<td>87</td>
<td>5</td>
<td>$50 per m$^3$ of wet storage</td>
</tr>
<tr>
<td>Wet Pond</td>
<td>46</td>
<td>3</td>
<td>$50 per m$^3$ of wet storage</td>
</tr>
<tr>
<td>Dry Pond with ED</td>
<td>36</td>
<td>3</td>
<td>$7000 per ha. of u/s area</td>
</tr>
<tr>
<td>Dry Pond</td>
<td>19</td>
<td>3</td>
<td>$7000 per ha. of u/s area</td>
</tr>
<tr>
<td>Oil Grit Separator (OGS)</td>
<td>10</td>
<td>1</td>
<td>$20,000 to $50,000 (max 5 ha.)</td>
</tr>
<tr>
<td>Infiltration Trench</td>
<td>70</td>
<td>2</td>
<td>$3,500 per ha. of u/s area (max 2 ha.) $12,500 with OGS</td>
</tr>
<tr>
<td>Infiltration Basin</td>
<td>70</td>
<td>2</td>
<td>$3,500 per ha. of u/s area (max 2 ha.) $12,500 with OGS</td>
</tr>
<tr>
<td>Standard Sand Filter</td>
<td>79</td>
<td>2</td>
<td>$7000 (max 2 ha.) $27,000 to 57,000 with OGS</td>
</tr>
<tr>
<td>Concrete Tank Sand Filter</td>
<td>79</td>
<td>1</td>
<td>$20,000 for all areas up to 5 ha.</td>
</tr>
<tr>
<td>Concrete Tank Sand Filter and OGS</td>
<td>79</td>
<td>1</td>
<td>$40,000 to $70,000 (Max. 5 ha.)</td>
</tr>
<tr>
<td>Standard Sand Filter with ED Wetland</td>
<td>80</td>
<td>5</td>
<td>$85 per m$^3$ of storage</td>
</tr>
<tr>
<td>Grassed swales or ditches</td>
<td>20</td>
<td>2</td>
<td>not applicable</td>
</tr>
</tbody>
</table>
The following is a brief description of each of the above BMPs:

**Wet Pond with Extended Detention**

Wet Ponds consist of a deep (greater than 2 m) permanent pool of water into which storm drainage is directed. The extended detention component refers to providing a layer of active storage above the standing water elevation which would drain down in 24 hours.

![An example of a wet pond](image)

**Wetland with Extended Detention**

Constructed wetlands consist of a shallow (0.3-0.5 m) pool of water with deeper areas at the inlet/outlet to trap sediments.

**Wet Pond**

These are similar to the Wet Pond with Extended Detention described above without extended detention.

**Extended Detention Dry Pond**

These facilities are large open grassed depressions that have been sized to store water from a 25 to 40 mm storm event and slowly drain out in 24 hours.

**Dry Pond**

Dry ponds are designed to control peak flows from development in order to limit impacts from erosion and flooding. They fill with water only after a significant rainfall event and drain down within approximately 24 hours.

![An example of a dry pond](image)
**Oil Grit Separator**
This type of BMP consists of a large underground concrete tank that, through a series of baffles and weirs, separates oils and sediment from the incoming stormwater.

**Infiltration Trench**
These facilities consist of a series of trenches with perforated pipes in them. Stormwater is directed into the pipes and percolates into the ground. The cost for this BMP in the above table assumes that the water will be pre-treated in a forebay and that an Oil Grit Separator is not required.

**Infiltration Basin**
Stormwater infiltration basins generally consist of a depressed area dug in highly pervious soils which allows stormwater to be infiltrated into the groundwater. The costs calculated in the above table assumes that the water will be pre-treated in a sediment forebay and that an Oil Grit Separator is not required.

**Sand Filter**
This BMP treats stormwater by filtering it through a sand layer and collecting it in a perforated pipe. The costs calculated in the table above have been separated into standard type filters (constructed at the surface) and concrete type sand filters (sand in an underground concrete box).

**Grassed Swales or Ditches**
This BMP is constructed as surface depressions to convey stormwater. Ditches are usually deeper with steeper slopes. Ditches are usually naturally vegetated while swales are grass lined.
Bank Stabilization

The removal of vegetation along stream channels and increased flows due to urbanization are but two examples of how human activities can accelerate the natural process of streambank erosion. By establishing buffer zones and controlling urban runoff, streambank erosion can be reduced and in some instances totally prevented. Where streambanks have already experienced a severe erosion problem steps may need to be taken to rehabilitate the bank. In these instances, both conventional and bioengineering (use of “soft materials”) methods of streambank erosion control can be used to address these problems.

Presently, there is a shift away from the older, traditional techniques of employing stone protection to more natural controls like the use of root wads (tree roots to deflect the current of the stream) or bioengineering techniques. Bioengineering is a process whereby bundles of live cut branches are arranged to provide both physical/mechanical stability to the bank while growing to provide cover and become self-sustaining. A variety of different bioengineering projects have been completed within the Lake Simcoe Watershed which have proven to be cost effective. In either instance, fish habitat is a consideration and techniques can usually be incorporated to enhance habitat while protecting the streambank.

Removal of Instream Barriers and/or Alteration of Existing On-Line Ponds

The presence of man-made or natural stream barriers can have a deleterious effect on fish populations by impeding fish migration, increasing streambank erosion, ponding and warming surface waters. In all instances, the best solution would be the total removal of the barrier, however, this is not always possible. Therefore, alternative solutions such as the construction of a fish ladder or an alternate channel around the barrier can help
alleviate the problem. Remedial options to address constructed ponds in order of preference include:

- Complete removal of the barrier and the restoration of a natural channel;
- Taking the pond off line and restoring a natural channel around the facility;
- Installation of a bottom draw and fish pathway/ladder to reduce the severity of downstream warming.

Fish Habitat Enhancement (Instream Cover)

The absence of instream cover can adversely effect fish populations because all species of fish utilize various habitats throughout their life cycle. Therefore, different habitat requirements must be found within the stream system to ensure a healthy and viable population. If these requirements are not present, habitat creation must be considered. Creating habitat can be as simple as adding boulders and logs to the stream channel or establishing a buffer zone. The over hanging vegetation not only provides shade and cover but also food as insects and leaf litter drop from the branches. Man-made structures such as “lunkers” and “rootwads” provide structures similar to natural undercut banks and can also be installed to improve bank stabilization as well. Gravel and cobble spawning beds can be restored by increasing the velocity of the current to move accumulated fine sediment or by mechanically removing the material and addressing the source of the sediment.

Cropland Field Management

A wide variety of techniques are available to reduce runoff, wind and water erosion and nutrient loss from cultivated lands. In addition to reducing contamination of water systems, the adoption of many of these techniques will result in cost savings or improved efficiencies for the operator:

- **Grassed waterways** involve shaping and seeding an overland drainage route to convey runoff away from a field without causing gully erosion.
- **Filter strips** are vegetated buffers located between cultivated areas and agricultural drains, ditches and watercourses.
- **Contour farming** reduces runoff and soil loss by simply plowing and seeding across
the slope following the topography.

! *Low till / no till* farming improves long-term soil viability and reduces soil loss by leaving at least 30% of the previous year’s crop residue on the field.

! *Strip cropping* increases infiltration and reduces runoff by alternating a ground cover crop and a row crop effectively changing the amount of surface cover.

! *Crop rotation* involves alternating crops year to year thereby improving soil structure, infiltration and reducing erosion while improving crop yield.


Aerial view showing windbreak plantings around a homestead

Windbreak made up of poplars and spruce

Cropland soil erosion - before

Grass waterway - after

No-till is an excellent alternative to traditional moldboard plowing reducing the risk of erosion by ensuring that the soil is not exposed.
Naturalization and Reduced Fertilizer and Pesticide Use in Urban Areas

Naturalization refers to the process of encouraging natural growth and the revival of a natural landscape in place of a high maintenance, manicured landscape. This can be accomplished with varying amounts of energy input:

- **Intensive planting** involves mass planting of trees, shrubs or herbaceous vegetation, generally followed by some level of maintenance to ensure establishment.

- **Managed succession** can be likened to natural regeneration with a helping hand. This may involve some planting, the removal of non-native species or other management techniques to aid the process.

- **Natural regeneration** simply involves the cessation of all maintenance activities and allowing nature to take its course.

Benefits of naturalizing appropriate park areas include reduced energy inputs and costs, reduced herbicide and pesticide use and improved wildlife habitat. Additional water quality and aquatic habitat improvements can also be realized if this technique is used to reestablish buffers along watercourses. It should be recognized that all areas cannot be naturalized. Playing fields necessitate a manicured lawn environment, but even so, efforts can still be made to reduce the use of herbicides, pesticides and fertilizers. Soil testing can be used to determine the proper fertilizer application rate based on the nutrient requirements of the turf grass and the existing nutrient levels within the soil. This ensures that over application does not occur and also saves money through reduced fertilizer costs.

**Manure Storage and Handling**

Manure should be stored in an area which is designed to contain runoff and control infiltration in order to reduce ground and/or surface water contamination. Manure handling practices such as season of spreading, application rate and incorporation of the manure into the soil are also essential considerations. Manure storages should therefore be sized...
to contain a minimum of 250 days of manure to ensure that the farmer does not have to spread during winter months. Concentrated barnyard runoff should also be collected in a run-off collection pond. (Agriculture Canada, et al.: 1993 -1998)

Restrict Livestock Access to a Watercourse
Uncontrolled livestock access to streams or other water bodies results in damage to aquatic habitat, increased erosion and phosphorous, bacteria and other contamination. The installation of a fence, alternative water supply and if necessary a livestock crossing is a simple and effective solution.

Establish Buffer Strips
Vegetated areas between watercourses or other water bodies and alternate land uses have a number of benefits including the filtration of runoff, reduced erosion, delayed snowmelt rates and provision of terrestrial and aquatic habitat. Existing naturally, vegetated buffer zones are protected from urban development through legislation. Areas where the vegetation has been removed should be reestablished using a mix of natural species blending grasses, shrubs and trees.

Retirement of Fragile/Marginal Lands
Many forested areas which were originally cleared for agriculture or for the lumber are located on extreme slopes or highly erodible soil types and as such should not have been
disturbed. A number of these areas have already been taken out of production or abandoned while others are still in use. Incentives should be provided to landowners to retire these lands and either reforest them or allow them to naturalize.

Reforestation, Woodland Management and Protection
Forested areas contribute significantly to the health of the Subwatershed, particularly in key locations such as headwater or recharge areas, stream and valley corridors or fragile/marginal lands. Water quality is enhanced through filtering, shading and reducing runoff, maintenance of baseflows, stabilization of soil, provision of aquatic and terrestrial habitat and the improvement of aesthetics and recreational potential.

The protection of existing forested lands has been discussed in the previous section, however, landowners should also be encouraged to complete management plans for these forested properties. In many cases, it is possible to improve the health and structure of a woodlot while generating income at the same time, which can be an excellent incentive to maintain forest cover.

Reforesting priority and wildlife corridor areas which have been denuded of forest cover in the past should be encouraged where possible to restore the above mentioned ecological functions. Revegetating stream corridors where native vegetation has been removed and planting of corridors to connect low lying forested areas with upland forested
areas enables wildlife movement which increases habitat area and quality.

**Recreational Boating Best Management Practices**
Reducing the introduction of grey water, fuel, oil, glycol and other contaminants into the aquatic environment can be accomplished by encouraging the boating community to utilize a variety of BMPs. Local marina operators should ensure that their procedures are as environmentally friendly as possible. Educating the boating public should also be encouraged to further reduce the associated impacts from grey water and other direct contamination.

Artificially altered and hardened shorelines reduce runoff-filtering capacity and increase sediment suspension from wave action. Dock and boathouse construction and the removal of aquatic vegetation for boat access have all played a role in increasing sediment loading and the destruction of fish habitat. New construction should only occur above the high-water mark or minimal contact should occur near shore by building floating structures or using stilts. The removal of aquatic plants should occur only where necessary to avoid the destruction of fish habitat. Boating can also disturb sediment and increase shoreline erosion unless speeds are kept to a minimum. Inappropriate vessel cleaning practices may contribute to algal blooms and low dissolved oxygen levels. The disposal of fish waste in a small area of water can also result in a decrease of dissolved oxygen levels in the water column.

Improvements to the current situation will only be achieved through the education of waterfront residents and other recreational boaters and by ensuring that only appropriate construction activities occur in the future. Comprehensive details of a variety of recreational boating BMPs are available through the Ontario Marina Operators Association at [www.marinasontario.com](http://www.marinasontario.com).

8.1.1 **BMPs to Maintain and Improve Water Quality**
BMPs evaluated to maintain and improve water quality have to be sensitive to existing land management practices and implemented within the context of the existing infrastructure.
In rural areas, BMPs must be cost-effective for the landowner and not result in a loss of productivity or revenue. Within urban areas, existing limitations associated with the available space to retrofit for stormwater management have to be considered. Overall, the ability to improve water quality in relation to the associated cost of the BMP is a final consideration.

Table 8.4 lists the BMPs which were evaluated relative to the management issues and concerns previously identified. The BMPs focus on reducing sediment, nutrient and bacteria loadings to the East Holland River either by decreasing inputs at the source or by preventing nutrient export. They involve a combination of both capital projects and policies and regulations which have been proven effective.

Table 8.4 BMPs to Maintain and Improve Water Quality

<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
</table>
| **Urban Development**                                | Promote Soil Conservation Practices  
- Continue to comment on subdivision proposals and ensure compliance of conditions through enforcement of regulations.  
- Encourage the public to report poor practices.  
- Conduct workshops for the construction industry.  
- Develop a Soil Conservation By-Law under the Topsoil Preservation Act (RSO 1990) including a requirement for a letter of credit to protect lands. |
| Soil Erosion and Sediment from Construction Activities |                                                                                                                                                                                                                        |
| **Urban Runoff from New Development**                | Employ “state of the art” Urban Stormwater Best Management Practices  
- Ensure the construction of state of the art stormwater management practices.  
- Water quality should meet Level 1 Protection criteria anywhere within the East Holland River Subwatershed.  
- Evaluate the feasibility of installing grassed swales and ditches versus utilising curb and gutter systems for stormwater conveyance. |
<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
</table>
| Runoff from Existing Uncontrolled Urban Areas | Retrofit Existing Developed Areas with Best Management Practices  
  • Develop and implement a strategy to retrofit uncontrolled urban areas using best management practices. Employ “state of the art” controls.  
  • Develop a maintenance plan to ensure facilities continue to operate properly.  
  • Increase street sweeping in uncontrolled urban areas.                                                                                                  |
| Private Waste Disposal Systems                | Trace and Correct Problems Associated with Inadequate or Faulty Private Sewage Disposal Systems  
  • Based on the groundwater sensitivity mapping and proximity to surface water identify and address problem systems.  
  • Educate the public regarding the importance of proper system maintenance.  
  • Require a septic system inspection certificate as a precondition of all property sales.                                                                  |
| Road Salt and Dust Suppressant                | Reduce the Use of Road Salts and Dust Suppressants while Protecting Public Safety  
  • Promote environmentally safe sand and salt alternatives to Municipalities and homeowners.  
  • Use as little road salt as possible timing the use for maximum results.                                                                                     |
| Over-Use of Fertilizers and Chemicals in Parks | Reduce the Use of Fertilizers and Chemicals in Parks  
  • Encourage Municipalities to carefully examine their use of fertilizers and chemicals in parks adjacent to rivers and streams to ensure that only the minimum required amount is being applied and to fully consider other options.  
  • Encourage the naturalization of areas that are not used for field sports to buffer streams and reduce the amount of fertilizer and chemicals needed. |
<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
</table>
| Agriculture                              | **Promote Soil Conservation Practices**  
  • Provide technical and financial support to construct soil erosion control structures such as grass waterways, terraces and windbreaks.  
  • Promote conservation tillage practices and the retirement of erodible lands unsuitable for crop production. |
| Application of Fertilizers, Pesticides and Herbicides on Agricultural Lands | **Promote Best Management Practices**  
  • Promote organic farming, soil and manure testing so that fertilizer application rates are calculated based on crop requirements.  
  • Ensure that farmers are well educated regarding spraying practices for pesticide and herbicide use. |
| Agriculture                              | **Restrict Livestock Access**  
  • Provide technical and financial support to fence livestock out of streams, reestablish vegetation and provide alternate watering facilities and crossings where necessary. |
| Milkhouse Washwater Discharge             | **Install Proper Treatment Systems**  
  • Provide technical and financial support to reduce milkhouse washwater discharge by constructing treatment systems. |
| Runoff from Manure Storage, Feedlots and Manure Spread Fields | **Promote Agricultural Best Management Practices**  
  • Provide technical and financial support to construct manure storage, clean water diversions and establish buffer strips.  
  • Promote proper manure management, soil and manure testing and discontinue winter spreading. |

8.1.2 BMPs to Maintain and Improve Water Quantity

BMPs to maintain and enhance water quantity focus on processes associated with the hydrologic cycle such as groundwater recharge and discharge. They address problems related to existing and future development such as the loss of recharge/discharge areas,
flooding and reduced baseflow to the East Holland River. Table 8.5 lists the BMPs considered to address issues and concerns impacting upon water quantity.

Table 8.5  BMPs to Maintain and Improve Water Quantity

<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
</table>
| Flooding Construction in Areas Prone to Flooding    | Prevent or Limit Construction Within Floodplains  
  - Through the permit process, development in these areas can be restricted to areas of minimal impact.                                                                                                          |
| Increase in Stream Flows Due to Upstream Development and Deforestation |  
  - Require all new development to control flows off site to pre-development levels.  
  - Continue to enforce the Regional Municipality of York Tree Cutting By-Law  
  - Limit the amount of trees to be cut down and promote plantings in park areas to help reduce the increases in run off volume.                                                                 |
| Negatively Altered Base Flow |  
  - Promote Infiltration of Stormwater from Urban Areas  
    - Promote the infiltration of stormwater by using lot level controls and BMPs while ensuring that ground water quality is not negatively affected. |
| Loss of Recharge and Discharge |  
  - Ensure No Net Loss of Groundwater Recharge or Discharge  
    - Adopt Oak Ridges Moraine polices relating to recharge/discharge areas.  
    - Use infiltration BMPs.  
    - Eliminate use of curb and gutter systems to convey stormwater runoff in new developments.                                                                                   |
| Erosion Caused by an Increase in Stream Flows Due to Upstream Development |  
  - Require all new development to control flows off-site to pre-development levels and to provide 24 hour extended detention for erosion control.                                                                                     |
8.1.3 BMPs to Maintain and Improve Aquatic Habitat

The BMPs associated with maintaining and improving aquatic habitat involve protecting or enhancing factors essential to the health and survival of aquatic organisms. Many of the BMPs focus on protecting the existing stream buffers and establishing suitable buffers in areas where habitat has been degraded. The other most common BMP is to reestablish a functional natural channel, which will control erosion, restore confined channels, enhance degraded habitat and improve instream temperatures.

It is clear that other resource factors such as; water quality, quantity and the terrestrial environment will effect efforts to improve and maintain aquatic habitat. Therefore, some of the issues identified previously may be repeated within the scope of this discussion as they relate to aquatic habitat. Table 8.6 outlines the BMPs reviewed to maintain and improve aquatic habitat.

Table 8.6 BMPs to Maintain and Improve Aquatic Habitat

<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on Base Flow Due to the Use of Water for Irrigation During Dry Summer Months</td>
<td>Water Taking Permits • Promote the benefits of water conservation. • Ensure that people taking water have the appropriate permits.</td>
</tr>
<tr>
<td>Overland Flow into Stream</td>
<td>Establish Buffer Zones • Ensure that existing buffer zones are protected and that buffers are established where they have been removed. • Encourage Municipalities to undertake naturalization projects around streams in parks to intercept overland flow.</td>
</tr>
<tr>
<td>ISSUE OR CONCERN</td>
<td>BEST MANAGEMENT PRACTICE</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Lack of Cover</strong></td>
<td>Establish Stream Side Vegetation</td>
</tr>
<tr>
<td><strong>Instream Warming</strong></td>
<td>• Plant a diverse variety of native plant species along streambanks to increase cover.</td>
</tr>
<tr>
<td></td>
<td>• Encourage Municipalities to naturalize parks around streams to provide cover.</td>
</tr>
<tr>
<td><strong>Reduced Refuge for Fish</strong></td>
<td>Habitat Creation</td>
</tr>
<tr>
<td></td>
<td>• Instream habitat diversity can be increased by placing logs and boulders in the channel and with stream side plants.</td>
</tr>
<tr>
<td></td>
<td>• Reduce the removal of aquatic vegetation and the hardening of shorelines.</td>
</tr>
<tr>
<td><strong>Bank Erosion/Stabilization</strong></td>
<td>Stabilise Eroding Streambanks</td>
</tr>
<tr>
<td></td>
<td>• Stabilize streambanks using erosion control techniques; reestablish vegetation.</td>
</tr>
<tr>
<td><strong>Sedimentation</strong></td>
<td>Stabilize Eroding Streambanks and Reestablish Vegetation</td>
</tr>
<tr>
<td><strong>Bank and Channel Stabilization</strong></td>
<td>• Maintain natural stream gradients and preserve sinuosity.</td>
</tr>
<tr>
<td></td>
<td>• Promote use of full span bridges and avoid the use of culverts, where possible.</td>
</tr>
<tr>
<td></td>
<td>• Encourage and regulate sediment and erosion controls in construction sites.</td>
</tr>
<tr>
<td><strong>Construction Sites</strong></td>
<td>Restore Degraded Habitat</td>
</tr>
<tr>
<td></td>
<td>• Spawning beds can be restored by physically removing sediments from areas that are known to be spawning beds or by adding gravel substrate in some areas.</td>
</tr>
<tr>
<td><strong>Habitat Restoration</strong></td>
<td>Naturalizing Confined Channels</td>
</tr>
<tr>
<td></td>
<td>• Restore confined channels to reconnect them to their floodplain where possible and increase aquatic habitat using natural channel design.</td>
</tr>
</tbody>
</table>
### ISSUE OR CONCERN | BEST MANAGEMENT PRACTICE
--- | ---
**Instream Barriers**  
Beaver Dams | Remove Dams in Sensitive Habitats  
- Remove beaver dams only when found to be destroying or significantly degrading fish habitat.  
Install Beaver Bafflers  
- Install beaver bafflers where activities are not directly degrading but are a nuisance.

**Private Dams** | Promote Dam Removal  
- Dam removal is the best solution for reducing flooding hazards and restoring natural fish migration.  
- Other options include constructing fish ladders or alternate channels to facilitate fish migration.

**Ponds** | Removal or Alteration of On-Line Ponds  
- Ponds should be removed and a natural channel restored to facilitate fish passage.

**Loss of Baseflow in the East Holland River** | Protect Groundwater Recharge and Discharge Areas  
- See water quantity.

**Introduction of Non-Native or Exotic Species** | Educate the Public Regarding the Implications of Introducing Non-Native or Exotic Species  
- Produce and distribute materials pertaining to the potential dangers of transporting and introducing non-native species into the East Holland River Subwatershed.

---

8.1.4 **BMPs to Maintain and Improve Terrestrial Habitat**

BMPs evaluated to preserve and improve terrestrial habitat within the East Holland River Subwatershed must be sensitive to existing land management practices. In rural areas, BMPs must be cost-effective for the landowner and not result in a loss of productivity or revenue. BMPs that were identified for terrestrial habitat included the protection of existing valuable habitat and the rehabilitation of degraded habitats. Protection of forests and wetlands involves private land stewardship programs and tree cutting by-laws. Rehabilitation of resources includes the regeneration of forest areas, wetland restoration projects and the creation/preservation of corridors linking forested and wetland areas.
Table 8.7 outlines the BMPs reviewed to maintain and improve terrestrial habitat.

Table 8.7  BMPs to Maintain and Improve Terrestrial Habitat

<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
</table>
| Lack of Forest Cover              | Maintain/Improve Forest Cover  
  • Educate the public on the importance of forests.  
  • Designate significant forested lands as Locally Significant Areas (LSA's) in Official Plans. Protect from development by utilising tree cutting by-laws.  
  • Enhance existing forested areas by promoting planting assistance programs and encouraging Municipalities to plant trees in suitable park areas. |
| Lack of Natural Corridors         | Establish Corridors Between Key Natural Areas  
  • Provide technical and financial assistance to landowners to participate in planting assistance programs to establish corridors.  
  • Establish corridors within new developments where possible.  
  • Encourage the use of Municipal park areas for the establishment of corridors. |
| Soil Erosion                      | Identify/Stabilise Eroding Soil  
  • Provide technical and financial assistance to reestablish vegetation where required.  
  • Promote the retirement of land where appropriate.  
  • Educate and involve the community in restoring native vegetation on affected slopes wherever possible. |
| Protect and Rehabilitate Wetlands | Promote the rehabilitation of wetlands  
  • Encourage residents and community groups to become involved in wetland restoration projects.  
  • Utilize constructed wetlands for stormwater control.  
  • Involve school groups. |
8.1.5 **BMPs to Maintain and Improve Recreation and Aesthetic Amenities**

The degraded water quality which currently exists is having a negative impact upon the local tourism industry and the lifestyle of local citizens. Opportunities for boating, fishing, swimming, hiking, bird watching, hunting and other activities are hampered by the excessive nutrient inputs as well as other pollutants in the East Holland. Best Management Practices required to improve upon the current condition include all those previously listed under the other sections. By improving water quality and quantity and terrestrial and aquatic habitat, the recreational and aesthetic amenities associated with the Subwatershed will improve as well.

Table 8.8 outlines the BMPs reviewed to maintain and improve recreation and aesthetic amenities.

**Table 8.8  BMPs to Maintain and Improve Recreation and Aesthetic Amenities**

<table>
<thead>
<tr>
<th>ISSUE OR CONCERN</th>
<th>BEST MANAGEMENT PRACTICE</th>
</tr>
</thead>
</table>
| Parks            | Naturalize Parks and Reduce the Use of Fertilizers and Other Chemicals.  
|                  | • In addition to the other benefits previously mentioned, naturalized parks with reduced fertilizer and chemical use become areas where the community enjoys spending time as well as providing opportunities for education about the improvements that have been made.  
|                  | • Actively discourage littering and abuse of parks. |
| Trails           | Provide a Connected Network of Trails.  
|                  | • Establish a network of trails throughout the Subwatershed using the existing trails as well as establishing new ones.  
|                  | • Actively discourage littering and abuse of trails. |
8.2 Resource Targets

In order to begin the rehabilitation of the East Holland River Subwatershed through restoration projects, achievable resource targets need to be adopted where they exist or developed where they do not. The following is a list of targets that were used to guide the development of a rehabilitation strategy.

**Water Quality**
- Reduce phosphorus loadings by 25% by the year 2010. (LSEMS, 1995)
- Achieve PWQO (MOE, 1994) for all exceeded water quality parameters by 2010.

**Water Quantity**
- Ensure protection of existing recharge and discharge areas. Maintain baseflow at the present level of 0.5 m³/sec (Singer et al., 1999).
- Reduce damage from flooding in the Subwatershed by 2010.

**Terrestrial**
- Achieve 25% forest cover within the East Holland River Subwatershed by 2050. (York Region, 1994, 1999)
- Establish 261 kilometers of buffer strip along the exposed sections of the East Holland River by 2050. (York Region, 1999)

**Aquatic Resources**
- Address all identified erosion problems along the East Holland River by 2010
• Maintain and enhance the existing reaches of coldwater fishery.
• Remove 25 on-line ponds or at minimum, install bottom draw conversions in areas of coldwater by 2050.
• Where feasible, remove, or allow passage past 12 barriers (dams, perched culverts, etc.) to fish and aquatic organisms by 2010.
• Encourage landowners to maintain natural shorelines, and reduce hard structures along stream banks.
• Involve and educate the public.

Recreational Aesthetics
• Establish trails linking the four municipalities of Georgina, East Gwillimbury, Newmarket and Aurora along the East Holland River.
• Ensure garbage along the East Holland River is removed and signs posted “No Dumping”.
• Approach marsh farmers dumping debris along the riverbank to clean up and discontinue dumping.
• Involve and educate the public. Work with community service groups.

Using these targets as a guide, a number of environmental opportunities were identified. The following is a description of each of the opportunities and the benefits associated with them.

8.3 Environmental Opportunities in the East Holland River Subwatershed

8.3.1 Water Quality Improvement Opportunities

Water Quality Modelling of Land Use Scenarios

The previous section outlines a variety of Best Management Practices which can address management issues and concerns. However, how confident can we be that these measures will not only achieve our ecosystem goals, but also be able to maintain them
against the pressure of expanding urban development? To answer this question, two watershed computer models were used to predict the impacts of proposed remedial works relative to water quality based on current trends and land use practices. Phosphorus was examined because of its impacts on Lake Simcoe and the East Holland River. Phosphorus has been identified as the nutrient responsible for problems such as algae and excessive weed growth in Lake Simcoe and the East Holland River.

The main model used was the Lake Simcoe Watershed Model (HSPF) developed by BEAK Consultants Ltd. to predict phosphorus inputs to Lake Simcoe. For a more detailed description of the BEAK model refer to “Development and Implementation of a Phosphorus Loading Watershed Management Model for Lake Simcoe”. (BEAK Consultants, 1994)

Description of Land Use Scenarios
Four modelling scenarios were evaluated and include:

- Scenario “A” - Existing Conditions “Do Nothing”
- Scenario “B” - Existing Conditions Implementing Rural and Urban BMPs
- Scenario “C” - Future Growth (Official Plan Designation) “Do Nothing”
- Scenario “D” - Future Growth (Official Plan Designation) All BMPs

Scenario “A” is a description of conditions within the watershed as they exist now representing the status quo. No future development has been assessed and existing land use has been determined from a combination of air photo analysis, satellite imagery, inventory work, and ground truthing. Scenario “B” involves the implementation of rural and urban BMPs throughout the Subwatershed. This scenario provides information concerning the qualitative and quantitative water quality benefits associated with initiating BMPs. The BMPs which were evaluated and their associated effectiveness are displayed in Table 8.9.

Conservative estimates of the effectiveness of BMPs were used in the modelling analysis since not all of the proposed measures are legislated and therefore in some instances require the cooperation of the landowners. It was also realized that some phosphorus
sources could escape detection. Therefore, the maximum efficiency of BMPs was generally assumed to be 50% with the exception of a wetland and sand filter system (80%) and grassed swales (20%) under stormwater runoff.

Table 8.9 Modelled Effectiveness of Best Management Practices

<table>
<thead>
<tr>
<th>Phosphorus Source</th>
<th>Best Management Practice</th>
<th>Estimated Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Dry Weather Inputs</td>
<td>! Decoupling illegal sanitary connections from storm sewers</td>
<td>50%</td>
</tr>
<tr>
<td>Urban Storm Water Runoff</td>
<td>! Stormwater ponds, sand filters, infiltration devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level 1 sizing</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Level 2 sizing</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>Level 3 sizing</td>
<td>37%</td>
</tr>
<tr>
<td></td>
<td>Level 4 sizing</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>! Decoupling roof drains, street sweeping, grass swales</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>! Wetland with sand filter</td>
<td>80%</td>
</tr>
<tr>
<td>Agricultural Inputs from Livestock</td>
<td>! Restricting livestock access</td>
<td>50%</td>
</tr>
<tr>
<td>Agricultural Cropland Erosion</td>
<td>! Conservation tillage practices</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>! Install buffer strips</td>
<td></td>
</tr>
<tr>
<td></td>
<td>! Erosion control structures</td>
<td></td>
</tr>
<tr>
<td>Private Septic Systems</td>
<td>! Maintenance</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>! Replacement</td>
<td></td>
</tr>
</tbody>
</table>

Scenario “C” involves a description of future land use impacts associated with urban growth based on the Regional Municipality of York official plan designation. Development areas as shown on land use schedules (Aurora, Newmarket, Holland Landing, Sharon, Ballantrae, Keswick South and Queensville) have been implemented in full for the uses specified in the official plans. The “do nothing” scenario implies that there will be no initiation of BMPs thereby providing a “worst case” scenario.

Scenario “D” illustrates the predicted phosphorus loadings associated with future
development as specified in the official plans (similar to Scenario “C”) and includes the proposed reduction associated with the implementation of BMPs. This scenario provides the results required to determine whether the watershed goals can be achieved and maintained in light of future growth.

Phosphorus Modelling Using the BEAK Model

Phosphorus loadings to the East Holland River were estimated using an adaptation of the Lake Simcoe Water Quality Model developed by BEAK Consultants and from monitoring data. These predictions use 1990 meteorological conditions, since that year is considered to best reflect the average climatic norms. The following is a brief description of the modelling methods, a more detailed explanation is provided in “Development and Implementation of a Phosphorus Loading Watershed Management Model for Lake Simcoe”. (LSEMS Implementation Report A.3, 1995)

Septic Systems

Information on the number of septic systems within the subwatershed was estimated using census data because there are still residences known to be serviced by septic systems. Loadings from septic systems were calculated using the BEAK Water Quality Model and are based upon the following assumptions:

- individuals generate 0.8 kg of phosphorus per year (BEAK, 1995),
- 50% of systems have automatic dishwashers which increase individual loads by 0.36 kg/yr,
- septic systems service 3.5 persons each on average,
- 5% of septic tank effluent reaches surface waters.

These assumptions are believed to be reasonable based on experiences elsewhere in Ontario and compared to results from previous modelling efforts conducted during the LSEMS studies (LSEMS Tech. Report A.6, 1985). The estimated loading from septic systems within the subwatershed is approximately 394 kilograms per year.
Urban Stormwater Runoff

Urban stormwater runoff was modelled using hydraulic loadings and unit area phosphorus concentrations derived from the Lake Simcoe Water Quality Management Model. A survey of all existing stormwater outfalls was completed during the summer of 1998 and 1999. In addition, the drainage areas for each of these outfalls was determined through a review of existing subdivision files and discussions with Town of Aurora, Newmarket, and Holland Landing. Existing land uses were determined from zoning maps and aerial photographs. The existence or absence of stormwater quality BMPs was also investigated and the type of BMPs employed within each area identified. Phosphorus loadings from areas which were found to have existing water quality BMPs in place were reduced by the expected efficiency of that specific BMPs to a maximum of 50%. These removal efficiencies are outlined in Table 8.3.

In addition to urban runoff, dry weather inputs of phosphorus have also been estimated to account for infiltration or other inflow sources into the municipal storm drainage system. A constant runoff rate of 0.05 L/s/ha (BEAK and Paul Theil Associates, 1990) was applied to the total area connected to the storm sewer system to determine the hydraulic loading. A typical phosphorus concentration for dry weather discharges (BEAK and Paul Theil Associates, 1990) was then used to predict annual loadings to the East Holland River. To determine the possible increase in phosphorus loadings due to future development, it was assumed the extent of new development would occur only within the confines of the existing urban boundaries (Aurora, Newmarket, Holland Landing, Sharon, Keswick and some smaller urban centres).

Livestock

Phosphorus loadings from livestock sources were calculated using a model developed by the Grand River Conservation Authority called the Phosphorus Source Accounting Methodology for the Rural Water Quality Program (Grand River Model). A survey conducted in 1999 of all the farming operations within the East Holland River subwatershed collected information regarding individual livestock operations and their manure storage...
and management practices. The data provided was then used to estimate phosphorous loadings for each of the sub-catchments.

The Grand River Model was used to determine animal phosphorus factors which weighted the various types of livestock based on their ability to generate phosphorus in their waste. The numbers and types of livestock along with these animal phosphorus factors were used to determine the phosphorus produced in each catchment by livestock on an annual basis.

The model also assumes that livestock loadings are continuous throughout the year, while in fact loadings would peak during storm events. The proportion of this manure phosphorus production which enters the East Holland River is extremely dependent upon management factors. However, the estimated phosphorus loadings from all livestock sources for the entire East Holland Subwatershed is to be 658Kg per year. The breakdown by animal type and the animal phosphorus factors are presented in Table 8.10.

Table 8.10  Phosphorus Loadings from Livestock Operations

<table>
<thead>
<tr>
<th>Livestock Type</th>
<th>Numbers</th>
<th>Animal Phosphorus Factor</th>
<th>Phosphorus Loading (Kg/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Cattle</td>
<td>245</td>
<td>0.043</td>
<td>154</td>
</tr>
<tr>
<td>Dairy Cattle</td>
<td>180</td>
<td>0.028</td>
<td>301*</td>
</tr>
<tr>
<td>Sheep</td>
<td>250</td>
<td>0.002</td>
<td>7</td>
</tr>
<tr>
<td>Poultry</td>
<td>8000**</td>
<td>0.0005</td>
<td>58</td>
</tr>
<tr>
<td>Horses</td>
<td>431</td>
<td>0.022</td>
<td>138</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>9106</td>
<td></td>
<td>658</td>
</tr>
</tbody>
</table>

* This loading includes the untreated milkhouse wash water from a typical dairy operation.
** There was a large poultry operation not included because it has an existing manure storage.

Cropland and Natural Soil Erosion

Phosphorus loadings from cropland and natural erosion were estimated using the BEAK model. The modelling involves three steps:

1. Simulating hydraulic conditions and the generation of runoff over the lands surface,
determining the amount of particle detachment and soil erosion occurring as a result of meteorological conditions,

quantifying the delivery of eroded material to receiving waters,

The model utilizes compiled GIS data which is the perfect tool to display and overlay the various climatic, topographic and soil characteristics as well as cultivation practices on agricultural lands. This information is then entered into the Hydrologic Simulation Program in Fortran (HSPF) where a subroutine called PWATER which simulates hydraulic conditions based on real meteorological data for any given year. PWATER considers infiltration rates, soil moisture, soil storage, lateral groundwater flow, and other external characteristics which generate surface runoff.

The next modelling subroutine activated is SEDMNT which simulates the production and removal of sediment from the land. Removal of sediment by water is simulated as particles are detached by rainfall or scoured by surface runoff and transported by overland flow. It is important to note that the conditions of the lands surface and the amount of vegetation cover are significant factors which influence the amount of sediment eroded. In cultivated areas the farming practices employed directly affect the areas erosion potential. By utilizing the model and changing the type of tillage practices evaluations of improved residue management or conservation tillage practices can be examined. Table 8.11 lists the phosphorus loading that occurs as a result of erosion throughout the subwatershed.

Table 8.11 Phosphorus Loadings from Cropland and Natural Soil Erosion

<table>
<thead>
<tr>
<th>Loading Component</th>
<th>Phosphorus Loadings (Kg/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated Lands</td>
<td>2033</td>
</tr>
<tr>
<td>Pasture/Fallow</td>
<td>602</td>
</tr>
<tr>
<td>Forest</td>
<td>677</td>
</tr>
<tr>
<td>Wetland</td>
<td>234</td>
</tr>
<tr>
<td>Scrubland</td>
<td>226</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3772</strong></td>
</tr>
</tbody>
</table>
Summary of Phosphorus Modelling Results

The total annual phosphorus loading entering the East Holland River from all sources is 16,111 kg/y. Urban sources are the largest contributors accounting for more than 72% (11,681 kg/y) of the total load. Rural sources such as runoff from livestock operations and cropland soil erosion are the next most significant contributors providing roughly 21% (3,293 kg/y) of the total load. Natural sources account for the remaining 7% (1,137 kg/y) of the total phosphorus load.

Comparison of Land Use Scenarios

Phosphorus loadings for the various land use scenarios are summarized in Table 8.12. Scenario “A” is the present day loading which was described in detail in the proceeding sections. Given the present day conditions the total phosphorus load entering the East Holland River from all sources is 16,111 kilograms per year (kg/y). The following is a discussion of the remaining scenarios and their implications to the water quality of the East Holland River.

Table 8.12 Summary of Phosphorus Loadings Based on Modelling Scenarios

<table>
<thead>
<tr>
<th>Loading Component</th>
<th>Modelling Scenario Annual Phosphorus Loads (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Septic Systems</td>
<td>394</td>
</tr>
<tr>
<td>Urban Stormwater Runoff</td>
<td>11287</td>
</tr>
<tr>
<td>Agriculture - Livestock</td>
<td>658</td>
</tr>
<tr>
<td>Agriculture - Cropland Erosion</td>
<td>2033</td>
</tr>
<tr>
<td>Pasture/Fallow</td>
<td>602</td>
</tr>
<tr>
<td>Forest</td>
<td>677</td>
</tr>
<tr>
<td>Wetland</td>
<td>234</td>
</tr>
<tr>
<td>Scrubland</td>
<td>226</td>
</tr>
<tr>
<td>Watercourse Buffering</td>
<td>-1097</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>16111</strong></td>
</tr>
</tbody>
</table>
Scenario “B” Existing Conditions and the Implementation of BMPs

Scenario “B” involves the implementation of a full range of BMPs to address urban stormwater, septic systems, runoff from livestock operations and cropland erosion. Also included in Scenario “B” is watercourse buffering and can be modelled using the Grand River Model (detailed below, page 73). A watercourse buffer will reduce the amount of phosphorus reaching the river by approximately 1,097 kg/yr. Therefore, the total phosphorus load from this scenario is estimated at 12,068 kg/yr. This means that the implementation of BMPs could reduce roughly 4,043 kg/yr of phosphorus entering the East Holland River annually. The largest reductions in loading can be achieved by implementing best management practices associated with urban runoff, rural cropland runoff and erosion and watercourse buffering.

A phosphorus reduction of 329 kg/yr could be realized by improving manure storage and handling practices, restricting livestock access to the East Holland River and its tributaries. Another 1525 kg/yr of phosphorus could be reduced by farmers adopting conservation or no-till cropping practices and reducing fertilizer application rates. The total reduction from urban sources accounts for 793 kg/yr and involves replacement of faulty septic systems and the treatment of stormwater runoff. Constraints due to the lack of land to construct stormwater management facilities is the main reason behind the a poor reduction of only 596 kg/yr from urban stormwater runoff. These opportunities are discussed in greater detail below.

Scenario “C” Future Urban Growth - Do Nothing

Scenario “C” represents the worst case scenario for the East Holland River based on uncontrolled future urban growth and no implementation of BMPs. The total loading to the East Holland River is estimated at 17,605 Kg/yr an increase of 1,494 kg/yr above the existing conditions. The increases in phosphorus loadings are associated with urban runoff from the new development in Aurora and Newmarket (and other urban areas inside the
subwatershed). Additional inputs from agricultural activities are not expected and therefore not predicted. In fact, inputs from agriculture in all likelihood will be reduced as lands presently being farmed are taken out of production for urban development.

Scenario “D” Future Urban Growth and Implementation of All BMPs

Scenario “D” shows the projected phosphorus load from future growth described in scenario “C” and includes the implementation of all BMPs discussed in scenario “B”. The total predicted load for scenario “D” is 13,920 kg/y. This represents a total reduction of 2,191 kg/y from scenario “A” - existing conditions, while accommodating additional growth. As with scenario “B” the major reductions in phosphorus loading are associated with rural BMPs. Any reductions associated with urban BMPs have been more than compensated for by the additional loadings related to future growth.

Consequences

What are the implications of these modelling scenarios relative to the East Holland River and the subwatershed targets for water quality? Under Scenario “A” or present day conditions average water quality exceedances for phosphorus occur more than 80% of the time. The present day conditions are clearly not acceptable to the community, therefore, action must be taken to improve water quality.

Under scenario “B” a reduction in the present day phosphorus load of 4,043 kg/y could be achieved through the aggressive implementation of BMPs. This represents an improvement of slightly more than 25% and would also reduce contamination by other nutrients, bacteria and sediment. It is important to realize that the benefits associated with the implementation of BMPs will not only improve water quality but also enhance the aquatic and terrestrial ecosystems by improving habitat. Improvements in water quality will also enhance recreational opportunities.

The consequences of Scenario “C”, “future growth” and “doing nothing” would have severe
impacts to the local aquatic ecosystem and recreational activities of the East Holland River. Doing nothing would clearly result in increased phosphorus loading, and based on an extrapolated mean flow for the entire subwatershed Scenario “C” would result in a concentration consistently above the PWQOs. It is apparent from these results that future growth should occur only if accompanied by the implementation of BMPs or conditions will be much worse than those that exist.

Scenario “D” evaluates the sustainability of future growth relative to the health of the East Holland River. Implementing all BMP’s while allowing predicted growth in urban centers in the subwatershed would improve environmental conditions slightly. The total projected phosphorus load is estimated at 13,920 kg/y which represents a reduction of 3,685 kg/yr (21%) of the total loading in scenario “C”, or a reduction of 2,191 kg/yr (13.5%) of the total loading in scenario “A”. This, however, does not meet the 25% reduction objective for Lake Simcoe but will begin to affect minor changes within the river.

The guiding principles of the East Holland River Study are clear, “protect what is healthy and rehabilitate what has been degraded”. If urban growth is allowed to continue without the implementation of BMPs further degradation to the ecosystem is certain to occur. Therefore, BMPs must be implemented throughout the watershed to maintain the status quo. In addition, if our goal is to improve overall ecosystem health then water quality impacts associated with future development within the East Holland River Subwatershed have to be further mitigated. This means more stringent guidelines for stormwater management controls than exist today to ensure that phosphorus removal efficiency exceeds 50%. For example, should the phosphorus removal efficiency for stormwater runoff be improved to 80% for new development and proposed retrofits the contribution of phosphorus from stormwater runoff would be reduced by a further 1,587 kg/y. This means that the total load entering the East Holland River and Lake Simcoe would be approximately 12,333 kg/y representing a 30% reduction in total phosphorus under scenario “C”, or a reduction of 23% under scenario “A”. An 80% phosphorus removal rate is probably the best that can be achieved using present day technologies. This will likely involve an additional cost to the development industry to achieve this level of phosphorus
control and will in all likelihood require the installation of a combination of stormwater controls both at the end-of-pipe and at the source.

**Watercourse Buffering**

The establishment of a watercourse buffer can have a direct impact on the water quality of the watercourse. A buffer acts as filter for surface runoff entering the watercourse by removing nutrients, thereby improving the quality of water in the watercourse.

York Region has set a target of achieving 100% watercourse buffering (York Region: 1999). This target would have many ecological benefits, one of those being an improvement in water quality. (A discussion of the cost and time frame of implementing 100% watercourse buffering can be found in section 8.3.4) To quantify the benefit associated with watercourse buffering a formula developed by the Grand River Conservation Authority can be used. It is as follows, *Phosphorus controlled per year by buffer strip = 0.7 kg X hectares buffered.*

In the East Holland River Subwatershed there are approximately 261 km of unbuffered watercourses. At a buffer width of 30m per side the total hectares to be buffered equals 1,567 ha. Therefore, the total amount of phosphorus that could be achieved by buffering all unbuffered watercourses equals 1,097 kg/yr. A breakdown of phosphorus reduction by each catchment and municipality can be seen in table 8.13.
Table 8.13 Phosphorus Reduction via Watercourse Buffering by Municipality and Catchment

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Aurora</th>
<th>WS</th>
<th>EG</th>
<th>Newmarket</th>
<th>King</th>
<th>Georgina</th>
<th>TOTAL</th>
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<tr>
<td>1</td>
<td>140.20</td>
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<td>25.17</td>
<td>289.31</td>
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<td>90.91</td>
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<tr>
<td>3</td>
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<tr>
<td>4</td>
<td>17.77</td>
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<td>17.77</td>
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<tr>
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<td>15.93</td>
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<td>6</td>
<td>13.02</td>
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<td>55.50</td>
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<td>7</td>
<td>20.36</td>
<td>8.56</td>
<td>28.92</td>
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<tr>
<td>8</td>
<td>0.55</td>
<td>51.42</td>
<td>12.04</td>
<td>64.01</td>
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<td>9</td>
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<td>27.30</td>
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<tr>
<td>13</td>
<td>194.09</td>
<td>23.98</td>
<td>218.07</td>
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</tr>
<tr>
<td>TOTAL</td>
<td>231.11</td>
<td>189.71</td>
<td>397.66</td>
<td>197.27</td>
<td>23.98</td>
<td>1097.07</td>
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</tr>
</tbody>
</table>

Stormwater Retrofit Opportunities

As has been discussed previously, stormwater runoff can have a major impact on water quality. As well as reducing phosphorus, stormwater ponds will also reduce the levels of other pollutants that have been identified as impacting the health of the river. In this way stormwater ponds will help in meeting the target of reducing pollutants to the levels specified by the Provincial Water Quality Objectives (MOE, 1994).

Stormwater ponds act to reduce the impact of runoff on the receiving stream depending on the level of control (level 1 through 4). However, much of the urban area in the East Holland River Subwatershed is either uncontrolled or is quantity control only. These areas were examined to find sites in which the existing pond could be retrofitted to improve quality control, or if no pond existed where one could be constructed.

The rationale for selecting candidate sites was based on the following three points:

! Is the sewershed a large source of untreated stormwater runoff?
! Is there a common outfall for the sewershed?
! Is there sufficient municipally owned land (that is open and flat) at the outfall to allow construction of an appropriate stormwater management facility?
Following this rationale, 7 sites were identified in Aurora and 10 in Newmarket. The sites that were identified in Holland Landing were not found to be cost-effective and were therefore rejected. In Holland Landing alternative methods to stormwater management ponds should be adopted, examples of which were discussed in Section 8.1. Effectiveness and approximate cost of stormwater management ponds and alternatives are listed in Table 8.3. In Sharon a level 1 quality facility is planning to be constructed to service proposed development. An additional two sites were identified where level 1 facilities could be installed, however further field work would need to be conducted to determine the area draining to these sites. For the purpose of this study an approximation was used.

Using an adaptation of the Lake Simcoe Water Quality Model developed by BEAK Consultants the area necessary to achieve a level 1 pond and the associated phosphorus reduction could be calculated for each site. Using a standard of $50 per m$^3$, a cost estimate for each site was generated. These details can be seen in Table 8.14, figures 8.1 to 8.6 show the sites of the proposed retrofits.

Table 8.14 Proposed Stormwater Retrofits

<table>
<thead>
<tr>
<th>Location of SWMF / Retrofit (R)</th>
<th>Type and Size of SWMP</th>
<th>Reference Figure</th>
<th>P Reduction (kg/yr)</th>
<th>Sediment Reduction m$^3$/yr</th>
<th>Estimated Cost (per kg P removed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aurora</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A1) SW6 - Quantity Pond on South Side of Henderson Dr.</td>
<td>Excavate existing pond to provide 8617 m$^3$ Level 1 wet pond.</td>
<td>8.1</td>
<td>45.5</td>
<td>86.2</td>
<td>$430,850 ($9,469)</td>
</tr>
<tr>
<td>A2) SE3 - Quantity Pond off Otford Cr.</td>
<td>Excavate existing pond to provide 5140 m$^3$ Level 1 wet pond.</td>
<td>8.2</td>
<td>33.69</td>
<td>7.7</td>
<td>$257,000 ($7,628)</td>
</tr>
<tr>
<td>A3) NW41 - Open area in Matchell Park north of Aurora Heights Dr.</td>
<td>Construct a 4949 m$^3$ Level 1 wet pond at the storm sewer outlet.</td>
<td>8.2</td>
<td>26.14</td>
<td>49.5</td>
<td>$247,450 ($9,466)</td>
</tr>
<tr>
<td>A4) NW28 - Open area in Matchell Park south of Orchard Heights Blvd.</td>
<td>Construct a 6469 m$^3$ Level 1 wet pond at the storm sewer outlet.</td>
<td>8.1</td>
<td>34.16</td>
<td>64.7</td>
<td>$323,450 ($9,467)</td>
</tr>
<tr>
<td>Location of SWMF / Retrofit (R)</td>
<td>Type and Size of SWMP</td>
<td>Reference Figure</td>
<td>P Reduction (kg/yr)</td>
<td>Sediment Reduction m³/yr</td>
<td>Estimated Cost (per kg P removed)</td>
</tr>
<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>A5) NC10 - Quantity Pond north of Twelve Oaks Dr., south of McKenzie Marsh</td>
<td>Retrofit existing quantity pond to 1284 m³ Level 1 wet pond or repair failing pond.</td>
<td>8.2</td>
<td>6.78</td>
<td>12.8</td>
<td>$64,200 ($9,469)</td>
</tr>
<tr>
<td>A6) NC9 - Wet pond south of St. John’s Srd., west of Bayview Ave. Area being developed.</td>
<td>Repair failing structures when development continues.</td>
<td>8.1</td>
<td>No reduction</td>
<td>7.2</td>
<td>$20,000</td>
</tr>
<tr>
<td>A7) NC11 - Wet pond south of St. John’s Srd., west of Bayview Ave. Area being developed.</td>
<td>Repair failing structures when development continues.</td>
<td>8.1</td>
<td>No reduction</td>
<td>14.8</td>
<td>$20,000</td>
</tr>
<tr>
<td><strong>Newmarket</strong></td>
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</tr>
<tr>
<td>N1) CE14 - The East College Manor Pond. Serves CE14</td>
<td>Excavate existing pond to provide 1292 m³ Level 3 wet pond.</td>
<td>8.3</td>
<td>21.09</td>
<td>58.8</td>
<td>$64,600 ($3,063)</td>
</tr>
<tr>
<td>N2) CE18 - The West College Manor Pond. Serves CE18</td>
<td>Excavate existing pond to provide 1405 m³ Level 3 wet pond.</td>
<td>8.3</td>
<td>22.93</td>
<td>63.9</td>
<td>$70,250 ($3,064)</td>
</tr>
<tr>
<td>N3) CE2 - The On-Line Pond south of Gorham, east of Leslie. Serves CE2</td>
<td>Construct wet pond cell on the north side of the creek at the storm sewer outlet to provide 4730 m³ Level 3 wet pond.</td>
<td>8.3</td>
<td>73.68</td>
<td>326.8</td>
<td>$236,500 ($3,210)</td>
</tr>
<tr>
<td>N4) CW21 - The open area east of Cane Parkway, North of Mulock Drive. Serves SW3 &amp; CW17</td>
<td>Construct a 11713 m³ Level 1 wet pond at the storm sewer outlet.</td>
<td>8.3</td>
<td>61.85</td>
<td>117.1</td>
<td>$250,000 ($4,042)</td>
</tr>
<tr>
<td>N5) CW11 - The On-Line Quantity Pond West of Yonge Street, North of Eagle Street Serves CW2, CW3, CW5, CW7</td>
<td>3946 m³ Level 2 wetland.</td>
<td>8.4</td>
<td>105.69</td>
<td>160.5</td>
<td>$197,300 ($1,867)</td>
</tr>
<tr>
<td>Location of SWMF / Retrofit (R)</td>
<td>Type and Size of SWMP</td>
<td>Reference Figure</td>
<td>P Reduction (kg/yr)</td>
<td>Sediment Reduction m³/yr</td>
<td>Estimated Cost (per kg P removed)</td>
</tr>
<tr>
<td>--------------------------------</td>
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<td>----------------------------------</td>
</tr>
<tr>
<td>N6) NE13 - George Richardson Park - West of Mountview Place. Serves NE10</td>
<td>3313 m³ Level 1 wet pond.</td>
<td>8.4</td>
<td>17.49</td>
<td>33.1</td>
<td>$165,650 ($9,471)</td>
</tr>
<tr>
<td>N7) NE13 - George Richardson Park North of Elgin Street Serves NE6 &amp; NE7</td>
<td>3950 m³ Level 3 Wet Pond.</td>
<td>8.4</td>
<td>59.55</td>
<td>165.9</td>
<td>$197,500 ($3,317)</td>
</tr>
<tr>
<td>N8) NE13 - George Richardson Park North of Leslie Valley Drive. Serves NE9</td>
<td>3788 m³ Level 1 Wet Pond.</td>
<td>8.5</td>
<td>20</td>
<td>37.9</td>
<td>$189,400 ($9,470)</td>
</tr>
<tr>
<td>N9) NW5 - North of Dorchester Street. Serves NW5</td>
<td>Expand existing pond to provide a 1546 m³ Level 3 Wetland.</td>
<td>8.5</td>
<td>34.7</td>
<td>96.6</td>
<td>$77,300 ($2,228)</td>
</tr>
<tr>
<td>N10) SE11 - Existing Pond East of Schaeffer Outlook. Serves SE11</td>
<td>Major maintenance and repair of existing pond including new outfall and restoration.</td>
<td>8.5</td>
<td>No reduction Restore to design specifications</td>
<td>41.9</td>
<td>$20,000</td>
</tr>
<tr>
<td>Sharon</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>S1) 3 - Open area west of Leslie St.</td>
<td>Construct 2618 m³ Level 1 wet pond.</td>
<td>8.6</td>
<td>17.28</td>
<td>15.7</td>
<td>$130,900 ($7,575)</td>
</tr>
<tr>
<td>S2) 7 - Quantity pond north of David Wilson Tr., east of Civic Centre Dr.</td>
<td>Retrofit quantity pond to 2296 m³ Level 1 wet pond.</td>
<td>8.6</td>
<td>15.16</td>
<td>13.8</td>
<td>$114,800 ($7,576)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>18 Retrofits</strong></td>
<td><strong>595.69</strong></td>
<td><strong>1374.8</strong></td>
<td></td>
<td><strong>$3,077,150</strong></td>
</tr>
</tbody>
</table>

The retrofit opportunities outlined in this study were chosen because they are cost-effective and represent current accepted stormwater management practices. There are further opportunities that were not examined in detail in this study as they were not found to be cost-effective. However, these opportunities may need to be considered to achieve a 25% reduction in phosphorus. As well there are other new experimental options that could also be considered to achieve greater reductions.
A4 - Proposed Pond Locations to Service Sewershed NW28

- 6,469 m² needed to achieve level 1, or 3,105 m² to achieve level 2
- Phosphorus reduction of 34.16 kg/yr at level 1, 29.38 kg/yr at level 2
- Area serviced = 51.75 ha

A1 - Retrofit of Pond SW6

- ~9,500 m² available
- 8,617.63 m² needed to achieve level 1, 4,136 m² to achieve level 2
- Phosphorus reduction of 45.5 kg/yr at level 1, 39.13 kg/yr at level 2
- Area serviced = 68.94 ha

A6 & A7 - Rehabilitation of Ponds NC9 and NC11

- Upon renewal of development, fix failing structures and address erosion around ponds

The East Holland River Subwatershed Study

Figure 8.1

Aurora Stormwater Retrofit Sites A1, A4, A6 and A7
A5 - Retrofit of Pond NC2 in Sewershed NC10

- ~2,400 m² available
- 1,284 m² required to achieve level 1, 616 m² to achieve level 2
- Phosphorus reduction = 6.78 kg/yr at level 1, 5.83 kg/yr at level 2
- Area serviced = 10.27 ha

A2 - Retrofit of Pond SE1 in Sewershed SE3

- ~15,000 m² available
- 5,104 m² required to achieve level 1, 2,552 m² to achieve level 2
- Phosphorus reduction = 33.69 kg/yr at level 1, 28.97 kg/yr at level 2
- Area serviced = 51.04 ha

A3 - Proposed Pond Location to Service Sewershed NW41

- ~2,800 m² available (if pond is dug to 2 m available space = 5,600 m²)
- 4,949 m² required to achieve level 1, 2,375 m² to achieve level 2
- Area serviced = 39.60 ha
- Phosphorus reduction = 26.14 kg/yr at level 1, 22.48 kg/yr at level 2

The East Holland River Subwatershed Study

Figure 8.2

Aurora Stormwater Retrofit Sites A2, A3 and A5
N1 & N2 - Retrofit for Sewersheds CE14 and CE18

Retrofit the existing east and west ponds to provide level 3 protection. The estimated cost of constructing the west pond is $70,250 and would service 51.1ha. The estimated cost of constructing the east pond is $64,600 and would service 47.0ha. The associated phosphorus reduction would total 44.02 kg/yr.

N3 - Retrofit for Sewershed CE2

Construct 2m deep wet pond parallel to watercourse 4730m

N4 - Retrofit for Sewersheds SW3 and CW17

Excavate 2m deep 11,713m² wet pond, preserve existing trees

Retrofit the existing east and west ponds to provide level 3 protection. The estimated cost of constructing the west pond is $70,250 and would service 51.1ha. The estimated cost of constructing the east pond is $64,600 and would service 47.0ha. The associated phosphorus reduction would total 44.02 kg/yr.

Retrofit existing pond to provide level 3 wet pond at an estimated cost of $236,500. This pond would service 86ha, the associated phosphorus reduction would total 73.68 kg/yr.

The East Holland River Subwatershed Study

Figure 8.3

Newmarket Stormwater Retrofit Sites N1, N2, N3 and N5
N6 - Retrofit for Sewersheds NE10

Install forebay and excavate as required to provide 331.3m³ of storage

Retrofit existing pond to provide level 1 protection at an estimated cost of $165,650. This pond would service an area of 26.5ha, with an associated phosphorus reduction of 17.49 kg/yr.

N7 - Retrofit for Sewersheds NE6 and NE7

Construct 2m deep wet pond - 3950m³

Construct a level 2 wetland at an estimated cost of $197,300. This facility would service 176.2ha, with an associated phosphorus reduction of 105.69 kg/yr.

N5 - Retrofit for Sewersheds CW2, CW3, CW5 and CW17

Construct 0.3m deep wetland with plunge pools and sediment forebay 3946m²

Construct flow splitter

The East Holland River Subwatershed Study

Figure 8.4

Newmarket Stormwater Retrofit Sites N5, N6 and N7
N8 - Retrofit for Sewershed NE9

Construct a level 1 wet pond at an estimated cost of $189,400. This pond would service an area of 30.3 ha, with an associated phosphorus reduction of 20.00 kg/yr.

N9 - Retrofit for Sewershed NW5

Retrofit existing pond to provide a level 3 wetland at an estimated cost of $77,300. This pond would service an area of 77.3 ha, with an associated phosphorus reduction of 34.70 kg/yr.

N10 - Retrofit for Sewershed SE11

Retrofit existing pond at an estimated cost of $20,000.

The East Holland River Subwatershed Study

Figure 8.5

Newmarket Stormwater Retrofit Sites N8, N9 and N10
S1 - Sharon Sewershed 3 Retrofit

- ~5,000 m² available
- 2,618 m³ needed to achieve level 1, 1309 m³ to achieve level 2
- Phosphorus reduction of 17.28 kg\(\text{yr}\) at level 1, 14.86 kg\(\text{yr}\) at level 2
- Area serviced = 26.18 ha

S2 - Sharon Sewershed 7 Retrofit

- ~2,100 m² available
- 2,296 m³ needed to achieve level 1, 1148 m³ to achieve level 2
- Phosphorus reduction of 15.16 kg\(\text{yr}\) at level 1, 13.03 kg\(\text{yr}\) at level 2
- Area serviced = 22.96 ha

The East Holland River Subwatershed Study

Figure 8.6

Sharon Stormwater Retrofit Sites S1 and S2
Agricultural Opportunities

During the summer and fall of 1999, Conservation Authority staff conducted a survey to collect information regarding individual farming operations and practices in the East Holland River Subwatershed (Lake Simcoe Region Conservation Authority, 1999). The purpose of the results of this survey was to develop a better understanding of areas where improvements in farming operations and practices could be made that would benefit both the farming community and the environment. The results of the investigation are as follows: 4 farms in need of manure storage, 7 farms that spread manure in winter, 2 farms where cattle have direct access to a watercourse, 20 farms with tile drained fields, and 32 farms where soil testing has never been conducted. The catchments in which these issues are occurring can be seen in figures 8.10 to 8.22.

Farms needing manure storage facilities were determined by examining farms that spread manure during winter. Those farms that are generating over 30 Equivalent Animal Units (EAU) of manure and are under 200m from a watercourse have been identified as the farms where manure storage facilities need to be constructed. It is recommended that no manure spreading be conducted during winter as the manure can not be fully incorporated into the soil and much of it will runoff in spring. Those farms winter spreading near a watercourse will likely be contributing high levels of phosphorus, nitrogen and bacteria to the watercourse.

Fencing cattle out of watercourses is recommended as this will eliminate the direct deposit of cattle faeces to the watercourse reducing the amount of phosphorus and bacteria entering the stream. This also improves the quality of aquatic habitat as it prevents the cattle from trampling the river banks. Fencing cattle out of watercourses helps to meet three targets, 25% reduction in phosphorus loading, improving water quality to meet PWQO’s and maintaining a natural shoreline to improve aquatic habitat.

Tile drained fields were identified because they act to increase the runoff from the field to the watercourse and therefore increasing the nutrients reaching the watercourse. The recommended solution is to intercept the runoff before it reaches the watercourse with a
detention pond or wetland area. Water from the pond could then be reused on the field and would recycle the nutrients in the runoff. This would help in meeting the target of a 25% reduction in phosphorus loading.

Soil testing is an important component of developing an effective nutrient management program. Accurate knowledge of the nutrient needs of the soil can help prevent over application of fertilizers and save the farmer money and prevent excess nutrients from entering the river. This would assist in meeting the target of a 25% reduction in phosphorus loading.

Conservation tillage techniques and erosion control structures can also be used to decrease runoff to a watercourse. This benefits both water quality and productivity of the land by keeping nutrients from fertilizers and manure and top soil on the land while also helping to reduce phosphorus loading. In the East Holland River Subwatershed there is approximately 5527ha of cultivated land. As was discussed earlier the BEAK model was employed to calculate the phosphorus load coming from these lands (2033 kg/yr) and the approximate reduction associated with adopting conservation tillage practices on these lands (1,525 kg/yr). Conservation tillage practices represent a reduction of approximately 75% of the 38 kg/yr/ha of phosphorous loading from normal farming practices. The cost associated with the implementation of conservation tillage is to educate and train farmers and in some cases upgrade or change equipment. However, conservation tillage is one of the most cost effective means of reducing phosphorus loads of those discussed in this report.

With practices such as conservation tillage, soil testing and winter spreading, farmers are encouraged to address these issues on their own with assistance in the form of education from the Conservation Authority and other agencies. However, for issues such as the construction of a manure storage facility, installation of fencing to restrict livestock from watercourses, or intercepting runoff from tile drained fields there are funding programs that exist that can assist the farmer in addressing these issues. The estimated cost of a manure storage facility is $35,000. Of the four sites that were located, two lie in the
Township of King, one in the Town of East Gwillimbury, and one in the Town of Whitchurch-Stouffville. The two fencing sites lie in the Town of Whitchurch-Stouffville, one costing approximately $2,572 and the other $1,552. Table 8.15 shows the cost of the agricultural opportunities by catchment and municipality.

Table 8.15 Agricultural Projects* by Municipality and Catchment

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Aurora</th>
<th>WS</th>
<th>EG</th>
<th>Newmarket</th>
<th>King</th>
<th>Georgina</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>$70,000.00</td>
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<td>$144,124.00</td>
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* - Approximate cost of a manure storage facility is $35,000
* - Cost of restricting cattle access = length of access (meters) * $6 + $500 (for watering station)

The total phosphorus reduction from these projects equals 277 kg/yr. *E. Coli* levels would also be reduced through the implementation of these projects. High *E. Coli* levels were identified as an issue impairing water quality in the East Holland River. These agricultural projects would assist in meeting the target of reducing *E. Coli* levels to those specified by the Provincial Water Quality Objectives (MOE, 1994).

Two programs that exist to assist landowners in financing projects such as manure storage and fencing cattle access include the Environmental Farm Plan and the Landowner Environmental Assistance Program (LEAP). The Environmental Farm Plan (administered by OMAFRA) requires farmers to prepare a plan that identifies the environmental strengths and weaknesses of their operation which can then qualify them for grants to assist in the implementation of environmental projects. The LEAP program is run by the Lake Simcoe Region Conservation Authority.
Region Conservation Authority. This program provides assistance to eligible landowners, such as farmers, to complete environmental projects. More information on these and other programs designed to assist farm operations in reducing their environmental impacts can be obtained from the Lake Simcoe Region Conservation Authority.

Water Quality Improvement Opportunities Priorities

Table 8.16 outlines the priority of the water quality improvement opportunities that were discussed above. These priorities were developed by prioritizing projects based on cost per kilogram of phosphorus removed. The phosphorus reduction associated with a project is a good measure of the improvement it will make to the environment. Those projects with lower costs per kilogram of phosphorus removed will be those that provide the best return on investment. Therefore, the projects that have lower costs per kilogram of phosphorus removed were given high priority.

Table 8.16  Water Quality Improvement Opportunities Priorities

<table>
<thead>
<tr>
<th>Project</th>
<th>Project Cost</th>
<th>Phosphorus Reduction</th>
<th>Cost per kg Phosphorus Reduction</th>
<th>Municipality</th>
<th>Priority</th>
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<td>Cattle Access</td>
<td>$1,552</td>
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<td>Project</td>
<td>Project Cost</td>
<td>Phosphorus Reduction</td>
<td>Cost per kg Phosphorus Reduction</td>
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<tr>
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<td>6.8 kg/yr</td>
<td>$9,469</td>
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</tr>
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</table>
8.3.2 Water Quantity Improvement Opportunities

Surface Water

The issue of flooding was examined in the State of the Watershed report which identified 21 sites in the Subwatershed that are at risk of flooding (Figure 8.7). Approximately 1,350 people live in these susceptible areas and would be at risk in a flood event. There are also approximately 330 houses, several apartment complexes and commercial buildings in these areas. The damage caused by flooding can be averaged out to a yearly cost of approximately $105,498 (at time of study). (South Lake Simcoe Region Conservation Authority, 1983) To insure the safety of residents and to mitigate the damage associated with flooding it is important that this issue is addressed. Mitigating the damage caused by flooding in these areas is also one of the targets set out in this study.

In the past, attempts were made in Ontario to protect flood susceptible areas by structural methods. This included the construction of dams, dykes, diversion channels and increasing culvert and bridge sizes. The problems with these measures, however, outweigh the potential benefits. The reliance on an artificial structure, such as a dyke, requires extensive on-going maintenance. When these structures fail under severe flow conditions, the resulting flood wave is even more damaging then if the structure wasn’t there. Flood channels and increased bridge / culvert sizes protect adjacent properties but tend to transfer the flood to downstream properties by displacing flood storage and reducing peak flow attenuation.

The flood plain management philosophy in Ontario today is to keep all new development out of the flood plain. For existing homes and businesses that are subject to flood damages, the removal of these from the flood plain is the most desirable and effective means of eliminating the problem. The land could then be converted to passive parkland. This was done in many areas after Hurricane Hazel which occurred in October of 1954. If a property is to be bought there must be a willing seller and buyer and a fair market value assigned to the property. This course of action is recommended for areas that are highly flood prone such as those in the floodway that are subject to high flow velocities (one metre per second or greater) and /or flood depths of greater than or equal to one metre during
The East Holland River Subwatershed Study

Figure 8.7
Flood Susceptible Areas

Legend
- Flood Susceptible Area
- Road
- River
- Town Boundary

Scale

1 0 4 km
a regional storm event.

In other areas where flooding of structures is not as severe, flood proofing techniques can be used to protect existing structures. This includes such options as raising the house using hydraulic jacks, building flood walls or installing window wells. The approximate cost of raising a house is $20,000 (this figure is in 1983 dollars and is expected to be higher today); window wells and flood walls are considerably less expensive to install.

To determine the best solution for the flood hazard areas in the East Holland Subwatershed each site should be examined in detail to determine flood levels and the associated risk to property and persons. This would also assist in identifying priority sites. It is important that residents be included in developing a plan of action to ensure cooperation and efficiency.

In a report produced by the South Lake Simcoe Conservation Authority (1983), the yearly damage from flooding was estimated to be $105,498. This money could be set aside yearly and be applied to the 21 sites in the Subwatershed. This would help reduce the damage and cost incurred during future flood events. In the past the Conservation Authority ran a Floodproofing Assistance Program to help land owners flood proof their home where it was needed. If funding were reinstated, this could be another means of reducing flood damage within the Subwatershed.

**Groundwater**

Groundwater sources in the East Holland River Subwatershed are an important source of drinking water for many of the municipalities in the subwatershed. Therefore, the maintenance of groundwater quantity is an important issue. As part of a study completed for this report (Groundwater Resources of the East Holland Watershed, 2000) two important recommendations were made concerning groundwater quantity.

The first recommendation is for the development and maintenance of a database to track municipal water withdrawals and permits to take water. It would also be useful for this
database to contain information regarding land use, streamflow, environmentally significant areas, water wells, geologic test drilling and groundwater monitoring. A database of this nature would assist in monitoring the state and quantity of groundwater and help protect it from overuse and depletion.

The report also identified areas of groundwater vulnerability (Figure 8.8). These are areas in which changes in land use can impact both the quality and quantity of groundwater. The effect of increased development on groundwater quality and quantity was identified as an issue in the subwatershed. The Lake Simcoe Region Conservation Authority regulates areas of groundwater vulnerability as Hydrogeological ESAs and carefully monitors development that occurs in these areas. However, the areas identified in this new report include areas that are not currently regulated by the Conservation Authority. It is the recommendation of the Conservation Authority that these new areas be adopted as Hydrogeological ESAs and subject to the same regulations. The protection of these areas will help ensure that groundwater quality and quantity is not threatened. This will also aid in meeting the target of protecting recharge areas and maintaining baseflow.

8.3.3 Aquatic Habitat Improvement Opportunities
During the summers of 1998 and 1999 Conservation Authority staff undertook a survey of the majority of the East Holland River and its tributaries (some intermittent tributaries were not surveyed as they were dry at the time) (Lake Simcoe Region Conservation Authority, 2000). The objective was to identify any evident environmental concerns in and along the river and document them. The problems that were encountered included: erosion, log jams, on-line ponds and dams. The locations of these problems can be seen on figures 8.10 to 8.22.

Streambank Erosion Stabilization
The first step in developing a strategy to deal with the problems found along the river is to generate a rough estimate of the cost to address the concerns. This was accomplished for the erosion sites by identifying the severity of the erosion sites (1 being most severe, and 3 being less severe), and simply using the size of the erosion scar to generate a cost.
**The East Holland River Subwatershed Study**

**Figure 8.8**

**Areas of Groundwater Vulnerability**

**Legend**
- **Area of Groundwater Vulnerability**
  (area recommended to be adopted as Hydrogeological ESA)
- **Hydrogeological ESA**

**Scale**

Data Source: MOE, LSRCA
The total cost to stabilize all erosion sites in the Subwatershed was estimated at $1,352,865. The breakdown by municipality and erosion severity is presented below in Table 8.17. Another breakdown by municipality and subcatchment is presented below in Table 8.18.

Table 8.17 Erosion Mitigation Costs by Municipality, and Severity Rating

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<thead>
<tr>
<th>Erosion Level</th>
<th>East Gwillimbury</th>
<th>Newmarket</th>
<th>King</th>
<th>Aurora</th>
<th>Whitchurch - Stouffville</th>
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<td>Level 1</td>
<td>$89,250</td>
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<td>$21,000</td>
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<td>Level 2</td>
<td>$14,250</td>
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<td>$263,635</td>
<td>$41,580</td>
<td>$797,292</td>
<td>$113,658</td>
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</table>

* Erosion cost = length of erosion (metres) X height of erosion (metres) X $200

Table 8.18 Cost for all Erosion Stabilization Projects by Municipality and Catchment

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Aurora</th>
<th>WS*</th>
<th>EG*</th>
<th>Newmarket</th>
<th>King</th>
<th>Georgina</th>
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<td>$62,990</td>
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* WS = Town of Whitchurch-Stouffville, EG = Town of East Gwillimbury

Maintain and enhance the existing reaches of coldwater fishery

To achieve the protection of headwater and cold water stream areas of the East Holland River, all agencies involved in planning and development decisions must work together. Ensuring that all streams are properly identified, in terms of their aquatic resources and fisheries status is the first step in protecting the resource. Secondly, enforcing spacial limits on development, and providing large stream corridor “buffers” or natural vegetation
zones will help to protect the stream resources. The stream buffer requirements currently used by the Lake Simcoe Region Conservation Authority are a 30m undisturbed vegetation area on both sides of a cold water stream, and 15m on both sides of a warm water stream. Stream temperature zones are determined by the Ontario Ministry of Natural Resources.

The protection of some stream corridors can be improved by establishing zones of natural vegetation, where it has been removed in the past through land use practices. The costs for revegetation, and the riparian areas which would benefit from enhanced plantings are identified in the following section (Terrestrial Habitat Improvement Opportunities).

Remove significant on-line ponds, or install bottom draw conversions
Thermal impacts throughout the watershed can be addressed in part through the installation of bottom draw structures in on-line ponds within coldwater sections of the watershed. In this way, the cool, bottom waters will be drawn off the pond, and allowed to flow downstream, where aquatic life would be otherwise stressed by the warmer water from the top of the pond, during the warm months of the year.

An average bottom draw structure would cost between $3,000-$7,000 to construct and install. Creating a bypass channel around a pond is a longer-term solution for ensuring cool water flow past a pond, but it can be more expensive than installing a bottom draw structure. There are 25 ponds noted in the subcatchment areas of the watershed which could be considered for converting to either a bottom draw or be bypassed with a natural channel. Using the higher cost per pond ($7,000) to estimate the works yields a total cost of $175,000.

Prior to any works taking place, a detailed inspection and cost estimate would be required for each pond to determine feasibility. Priority should be given to ponds in the headwater area, which includes almost all ponds identified in this study, and more importantly to ponds on coldwater reaches of the river. The chart below, Table 8.19 outlines the number of ponds in each municipality.
Table 8.19 Number of Ponds by Municipality and Catchment and the Cost to Install Bottom Draws

<table>
<thead>
<tr>
<th>Catchment</th>
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* Installation of bottom draw costs approximately $7000 per pond.

Remove dams or other barriers to fish passage

Dams (both natural and constructed), weirs and improperly installed (or degraded) culverts can present a barrier to fish passage, and movement of other aquatic life along waterways. An inventory of major structures was made during the summers of 1998 and 1999. Bypass channels, fishways, modification or removal of large or permanent structures can take many years to implement, and can be expensive. An estimate of $35,000 to address each of the twelve structures noted in the inventory would result in a cost of $420,000. These projects should be prioritized from the mouth of the river and move to the headwaters to improve the access of lake fish species. Table 8.20 outlines the number of dam sites in each municipality and subcatchment.

Table 8.20 Number of Dams by Municipality and Catchment and Cost of Addressing Fish Passage

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* Addressing each dam costs approximately $35,000.
Smaller structures, such as perched culverts, or small weirs on private properties were not noted during field work. As these structures age, and maintenance work is required, permits or approvals through the municipality, Conservation Authority, OMNR, and/or DFO may be required to complete the work. Through the permitting process, these issues can be addressed. Installation of new structures is regulated through the same agencies, and recommendations for properly sized and installed structures can be made through the approvals process. Costs will vary with the size and complexity of the structures.

**Encourage landowners to maintain natural shorelines**

Individual landowners, especially those who have property that abuts the Holland River or its tributaries should be encouraged to leave their shorelines in a natural state, through educational materials and information programs. It may be possible to take advantage of existing educational programs, such as the Living by Water Program, which was developed in British Columbia, and is currently under modification for use in Ontario. It is difficult to prioritize projects of this nature as they are opportunistic, therefore when they present themselves every effort should be made to complete them.

**Involve and educate the public**

It is possible to involve local community members through hands-on projects aimed at improving habitat, undertaking shoreline stabilization, and aquatic habitat monitoring.

In the past, successful community events have included tree planting along stream and valley corridors, and participation in salvaging shrub materials for use in streambank stabilization projects. For efforts along the East Holland River system, it would be realistic to plan one or two public involvement events each year. These typically can add between $1,000-$5,000 in organizational, and promotional costs to the base cost of tree planting. The expected costs of organizing two public events per year until 2010 would be approximately $100,000.

Monitoring for baseline environmental information, as well as project-related monitoring is an important means of gauging changes in a watershed. In a number of watersheds in Ontario, the public have been involved in monitoring habitat, or aquatic organisms to assist resource management agencies. The benefits of involving the public is multifaceted. The
amount of data which can be collected is much greater than using only staff, and the public gain a greater appreciation for the local environment, and may develop a stronger sense of responsibility for environmental stewardship. The cost of developing a monitoring program for the East Holland River, which involves members of the public must be determined in concert with the choice of monitoring protocols. Conservatively, the involvement of the public with aquatic monitoring programs could cost up to $5,000 per event, each year. Assuming two public involvement sessions a year, until 2010, the cost of involving the public would be $100,000.

8.3.4 Terrestrial Habitat Improvement Opportunities

The Region of York’s long term goal is to achieve a forest cover equal to 25% (York Region, 1994, 1999). The forest cover currently found within the East Holland River Subwatershed is 19%. While the majority of the forested lands are fragmented and small (<20 ha), opportunities do exist to expand and link the existing forest cover. While it is impossible to achieve 25% forest cover in each catchment, overall, this goal can be attained in the Subwatershed by planting in catchments where there is space for greater forest cover.

Little information exists regarding forest composition and flora and fauna inventories which are needed to make appropriate management decisions. Focus should therefore be given to protecting existing forested areas, enlarging existing forested areas, creating linkages and buffering watercourses. Linkages that should be given priority can be seen in figure 8.9. These linkages connect forest patches with good interior habitat optimizing species movement and the majority follow rivers and therefore incorporate river buffering.

There are many opportunities for reforestation projects in the subwatershed. Sites were identified by looking at soil capability of supporting agriculture, creation of forested linkages

Example of forest flora
between forest tracts, buffering of all watercourses and enlarging existing forest tracts.

Class 5 to 7 soils are lands deemed unsuitable for agriculture in the York Region Official Plan (1994) and therefore considered prime potential sites for planting. Linking forest tracts would allow and encourage movement by flora and fauna throughout the watershed. As seen in figure 8.9, the majority of linkages follow watercourses.

With the Region of York’s goal of buffering all watercourses (1999), the watercourses present in each of the catchments would benefit from this increased forest cover (see figures 8.10 to 8.22). This not only provides habitat for flora and fauna, it also improves water quality and aquatic habitat. It has been estimated that buffering all watercourses could lead to a reduction of just over one tonne of phosphorus entering the East Holland River Subwatershed. As every kilometre buffered will reduce phosphorus loading to the river it is difficult to use this criteria to prioritize sites. Therefore, sites that would provide habitat benefits, such as the links shown in figure 8.9, or that would buffer coldwater reaches of the river should be given priority.

Increasing the size of forest tracts would increase the available habitat for forest interior species. Furthermore, it will also increase the available habitat for species that require larger tracts of forest.

The potential planting sites are illustrated in the opportunities maps (Figures 8.10 to 8.22). To achieve the goal of 25% forest cover, 4,336 acres at a cost of $3,252,000.00 would have to be planted (Table 8.21). To achieve the goal of having 100% buffered watercourses, a total of 261 Km would have to be planted at a cost of $2,350,854.00 (Table 8.22).

Future investigations should be directed at updating existing information on what type of forest cover is present, ESAs, flora and fauna inventories. This could be accomplished by partnering with local naturalist clubs and stakeholders and encourage them to collect data on a watershed basis. More accurate and up-to-date information would help in making better management decisions.
Table 8.21 Potential Planting Sites Breakdown by Municipality and Catchment in acres

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COST $949,500.00 $1,131,000.00 $653,250.00 $114,750.00 $403,500.00 $0.00 $3,252,000.00

* - cost of $750 per acre to plant

Table 8.22 Unbuffered Watercourses by Municipality and Catchment in Kilometres

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COST $495,234 $406,521 $852,138 $422,730 $122,850 $51,381 $2,350,854

* - each km costs $9,000

8.3.5 Recreation and Aesthetic Amenities Improvement Opportunities

Recreation and aesthetic amenities will be greatly improved with the implementation of the opportunities listed above. The poor water quality of the East Holland River has a negative impact on both the local tourism industry and the lifestyle of local citizens. Recreational activities such as boating, fishing, swimming, hiking, bird watching, hunting and other activities are all impaired by the excessive nutrients and pollutants in the river. By improving water quality and quantity and terrestrial and aquatic habitat, the recreational and aesthetic amenities associated with the Subwatershed will improve as well.
One of the management issues identified by this study was the need for a trail along the East Holland River linking Aurora, Newmarket, East Gwillimbury and Georgina. During the course of this study efforts to address this issue have already begun by a group called Nokiidaa. This not for profit group consists of representatives from each municipality, the Conservation Authority and members of the public. The goal of Nokiidaa is to create a trail that links the four municipalities to Lake Simcoe via the East Holland River. Such a trail would greatly improve the recreation opportunities of the East Holland River Subwatershed.

Other issues identified as impairing recreational opportunities in the subwatershed include the overuse of pesticides and the highly manicured state of parklands as well as littering and dumping in these natural areas. These issues should be addressed through education and enforcement.

Over use of pesticides can impair water quality. Education about application rates and alternatives to pesticides would help alleviate this issue. Highly manicured parks can also impair water quality as well as limiting aquatic and terrestrial habitat. Increasing the natural area of these parks can address this issue as well as increasing the aesthetic value of these areas.

The issue of littering and dumping in natural areas should be addressed through enforcement as well as through education. No littering signs should be posted in parks and fines imposed on those caught littering. Education should also be used to inform the public of the impact litter has not only on the aesthetic value of an area but the impact on wildlife and the ecology of an area. Education should encompass river edge residents as to the impacts caused by dumping things such as grass clippings along the river and also to farmers that may be dumping along the river.

8.3.6 Summary
The value of implementing BMPs to reduce phosphorus loading was made apparent through the water quality modelling exercise. Present conditions are resulting in 16,111 kg/yr of phosphorus entering Lake Simcoe from the East Holland River Subwatershed. The implementation of the suggested BMPs will reduce this load to 12,068 kg/yr, a reduction of 25%. Under present day conditions it is possible to meet the LSEMS target
of 25% reduction. However, with the future development proposed in the Subwatershed these BMPs will only achieve a 21% reduction. To achieve the LSEMS target an increase in stormwater facility effectiveness to that of 80% would result in a reduction of 30%.

The opportunities that were discussed here would serve to improve water quality through the reduction of 4 tonnes of phosphorus under present day conditions as well as protecting groundwater quantity, improving aquatic and terrestrial habitat and improving and increasing recreational opportunities in the Subwatershed. These improvements do not come without a significant price tag of $10,762,869, however, through the cooperation of municipal partners, related agencies and the public it is possible to implement the suggested opportunities over a reasonable time frame. Table 8.23 shows the total cost of the suggested opportunities by municipality and catchment.

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8.4 **Opportunities Maps by Subcatchment**

A variety of environmental improvement opportunities exist throughout the Subwatershed as was discussed in the section above. To view the locations of the opportunities a series of 13 maps were created, one per catchment. These maps show the exact location of erosion sites, log jams, on-line ponds, dams and stormwater retrofits. The estimated cost of stormwater retrofits broken down by municipality can be seen in table 8.11 above and the estimated cost of fixing erosion sites by municipality can be seen in table 8.12. Potential planting areas are also shown in this map series. These areas were determined
through the creation of 15 - 30 metre buffers along all watercourses where they do not already exist. All land that has a rating of 5 - 7 (excluding muck soil) on the Canadian Land Inventory (land unsuitable for agriculture) and is not already forested was also considered as potential planting area. The maps also give the number of agricultural improvement projects that exist in each catchment but not the exact location. The environmental opportunities maps are figures 8.7 through 8.19. Table 8.21 provides a summary of the number of improvement opportunities and costs for each of the catchments.
<table>
<thead>
<tr>
<th>Catchment</th>
<th>Stormwater (Cost)</th>
<th>Agricultural (Cost)</th>
<th>Erosion (Cost)</th>
<th>Ponds (Cost)</th>
<th>Instream Obstruction (Cost)</th>
<th>River Buffer (Cost)</th>
<th>Forest (Cost)</th>
<th>($ Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 ($317,000)</td>
<td>0 ($0)</td>
<td>67 ($746,615)</td>
<td>6 ($42,000)</td>
<td>1 ($35,000)</td>
<td>69km ($619,947)</td>
<td>1678 ac</td>
<td>($3,019,062)</td>
</tr>
<tr>
<td>2</td>
<td>4 ($1,065,950)</td>
<td>2 ($70,000)</td>
<td>49 ($268,962)</td>
<td>3 ($21,000)</td>
<td>2 ($70,000)</td>
<td>41km ($366,435)</td>
<td>1396 ac</td>
<td>($2,909,347)</td>
</tr>
<tr>
<td>3</td>
<td>2 ($371,350)</td>
<td>3 ($39,124)</td>
<td>28 ($157,858)</td>
<td>9 ($63,000)</td>
<td>5 ($175,000)</td>
<td>28km ($252,135)</td>
<td>350 ac</td>
<td>($1,320,967)</td>
</tr>
<tr>
<td>4</td>
<td>1 ($250,000)</td>
<td>0 ($0)</td>
<td>3 ($16,240)</td>
<td>3 ($21,000)</td>
<td>1 ($35,000)</td>
<td>4km ($38,070)</td>
<td>0 ($0)</td>
<td>($360,310)</td>
</tr>
<tr>
<td>5</td>
<td>1 ($197,300)</td>
<td>0 ($0)</td>
<td>3 ($6,200)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>4km ($34,398)</td>
<td>0 ($0)</td>
<td>($237,898)</td>
</tr>
<tr>
<td>6</td>
<td>3 ($552,550)</td>
<td>0 ($0)</td>
<td>5 ($24,290)</td>
<td>4 ($28,000)</td>
<td>1 ($35,000)</td>
<td>13km ($118,926)</td>
<td>79 ac</td>
<td>($818,016)</td>
</tr>
<tr>
<td>7</td>
<td>1 ($77,300)</td>
<td>1 ($35,000)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>7km ($61,965)</td>
<td>12 ac</td>
<td>($183,265)</td>
</tr>
<tr>
<td>8</td>
<td>2 ($245,700)</td>
<td>0 ($0)</td>
<td>1 ($11,000)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>15km ($137,169)</td>
<td>58 ac</td>
<td>($437,369)</td>
</tr>
<tr>
<td>9</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>8 ($105,300)</td>
<td>0 ($0)</td>
<td>2 ($70,000)</td>
<td>7km ($59,355)</td>
<td>212 ac</td>
<td>($393,655)</td>
</tr>
<tr>
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<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>8km ($75,906)</td>
<td>62 ac</td>
<td>($122,406)</td>
</tr>
<tr>
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<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>7km ($60,759)</td>
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</tr>
<tr>
<td>12</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>5 ($27,400)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>6km ($58,491)</td>
<td>284 ac</td>
<td>($298,891)</td>
</tr>
<tr>
<td>13</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>0 ($0)</td>
<td>52km ($467,298)</td>
<td>205 ac</td>
<td>($621,048)</td>
</tr>
<tr>
<td>Total</td>
<td>18 ($3,077,150)</td>
<td>6 ($144,124)</td>
<td>168 ($1,363,865)</td>
<td>25 ($175,000)</td>
<td>12 ($420,000)</td>
<td>261km ($2,350,854)</td>
<td>4336 ac</td>
<td>($10,782,993)</td>
</tr>
</tbody>
</table>
Figure 8.10
Environmental Opportunities Map: Catchment 01

Mitigation Costs
- Total Erosion Cost = $746,615
- Total Stormwater Cost = $317,000
- Total Farm Cost = $0
- Total Pond Cost = $42,000
- Total Stream Obstruction Cost = $35,000
- Total River Buffer Cost = $619,947
- Total Reforestation Cost = $1,258,500
Total = $3,019,062

Legend
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

The opportunities shown here are priority sites. Other sites may exist.
Figure 8.11
Environmental Opportunities Map: Catchment 02

The opportunities shown here are priority sites. Other sites may exist.

Mitigation Costs
- Total Erosion Cost = $268,962
- Total Stormwater Cost = $1,065,950
- Total Farm Cost = $70,000
- Total Pond Cost = $21,000
- Total Stream Obstruction Cost = $70,000
- Total River Buffer Cost = $366,435
- Total Reforestation Cost = $1,047,000
Total = $2,909,347

Farm Information
- Winter Spreading = 3
- Manure Storage Needed = 2
Figure 8.12
Environmental Opportunities Map: Catchment 03

Farm Information
- Cattle Access = 2
- Winter Spreading = 3
- Manure Storage Needed = 1

Legend
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3

Key
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

Mitigation Costs
- Total Erosion Cost = $371,350
- Total Stormwater Cost = $157,858
- Total Farm Cost = $39,124
- Total Pond Cost = $63,000
- Total Stream Obstruction Cost = $175,000
- Total River Buffer Cost = $252,135
- Total Reforestation Cost = $262,500
Total Cost = $1,320,967

The opportunities shown here are priority sites. Other sites may exist.
Figure 8.13
Environmental Opportunities Map: Catchment 04

Legend
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

Mitigation Costs
- Total Erosion Cost = $16,240
- Total Stormwater Cost = $250,000
- Total Farm Cost = $0
- Total Pond Cost = $21,000
- Total Stream Obstruction Cost = $35,000
- Total River Buffer Cost = $38,070
- Total Reforestation Cost = $0
Total Cost = $360,310

The opportunities shown here are priority sites. Other sites may exist.
Figure 8.14
Environmental Opportunities Map: Catchment 05

Legend
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

Mitigation Costs
- Total Erosion Cost = $6,200
- Total Stormwater Cost = $197,300
- Total Farm Cost = $0
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $0
- Total River Buffer Cost = $34,398
- Total Reforestation Cost = $0

Total Cost = $1,320,967

The opportunities shown here are priority sites. Other sites may exist.
Figure 8.15
Environmental Opportunities Map: Catchment 06

The opportunities shown here are priority sites. Other sites may exist.

Mitigation Costs
- Total Erosion Cost = $24,290
- Total Stormwater Cost = $552,550
- Total Farm Cost = $0
- Total Pond Cost = $28,000
- Total Stream Obstruction Cost = $35,000
- Total River Buffer Cost = $118,926
- Total Reforestation Cost = $0
Total Cost = $818,016
Figure 8.16
Environmental Opportunities Map: Catchment 07

The opportunities shown here are priority sites. Other sites may exist.

**Legend**
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

**Mitigation Costs**
- Total Erosion Cost = $0
- Total Stormwater Cost = $77,300
- Total Farm Cost = $35,000
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $0
- Total River Buffer Cost = $61,965
- Total Reforestation Cost = $9,000
**Total Cost = $183,265**
Figure 8.17
Environmental Opportunities Map: Catchment 08

Mitigation Costs
- Total Erosion Cost = $ 11,000
- Total Stormwater Cost = $ 245,700
- Total Farm Cost = $ 0
- Total Pond Cost = $ 0
- Total Stream Obstruction Cost = $ 0
- Total River Buffer Cost = $ 137,169
- Total Reforestation Cost = $ 43,500
Total Cost = $ 437,369

The opportunities shown here are priority sites. Other sites may exist.
Figure 8.18
Environmental Opportunities Map: Catchment 09

The opportunities shown here are priority sites. Other sites may exist.

Mitigation Costs
- Total Erosion Cost = $105,300
- Total Stormwater Cost = $0
- Total Farm Cost = $0
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $70,000
- Total River Buffer Cost = $59,355
- Total Reforestation Cost = $159,000

Total Cost = $393,655

Legend
- Green: Forest
- Yellow: Potential Planting Area
- Red: Erosion Site-Level 1
- Orange: Erosion Site-Level 2
- Purple: Erosion Site-Level 3
- Triangle: Log Jam
- Dam: Potential
- Stormwater Retrofit: Surveyed Pond
- Circle: Pond

Key
- Ace: Surveyed Pond
- Square: Forest Log Jam
- Triangle: Dam
- Cross: Potential
- Gear: Stormwater Retrofit
- Circle:Surveyed Pond
Figure 8.19
Environmental Opportunities Map: Catchment 10

Mitigation Costs
- Total Erosion Cost = $0
- Total Stormwater Cost = $0
- Total Farm Cost = $0
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $0
- Total River Buffer Cost = $75,906
- Total Reforestation Cost = $46,500
Total Cost = $122,406

Legend
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

The opportunities shown here are priority sites. Other sites may exist.
Figure 8.20
Environmental Opportunities Map: Catchment 11

The opportunities shown here are priority sites. Other sites may exist.

Legend:
- Forest
- Potential Planting Area
- Erosion Site-Level 1
- Erosion Site-Level 2
- Erosion Site-Level 3
- Log Jam
- Dam
- Potential Stormwater Retrofit
- Surveyed Pond

Key:

Mitigation Costs:
- Total Erosion Cost = $0
- Total Stormwater Cost = $0
- Total Farm Cost = $0
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $0
- Total River Buffer Cost = $60,759
- Total Reforestation Cost = $0

Total Cost = $60,759
The opportunities shown here are priority sites. Other sites may exist.

Mitigation Costs
- Total Erosion Cost = $27,400
- Total Stormwater Cost = $0
- Total Farm Cost = $0
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $0
- Total River Buffer Cost = $58,491
- Total Reforestation Cost = $213,000

Total Cost = $298,891
Figure 8.22
Environmental Opportunities Map: Catchment 13

Mitigation Costs
- Total Erosion Cost = $0
- Total Stormwater Cost = $0
- Total Farm Cost = $0
- Total Pond Cost = $0
- Total Stream Obstruction Cost = $0
- Total River Buffer Cost = $467,298
- Total Reforestation Cost = $153,750
Total Cost = $621,048

The opportunities shown here are priority sites. Other sites may exist.
PART III  DIRECTIONS FOR IMPLEMENTATION

9.0 IMPLEMENTATION

It is clear from the investigation carried out for this study that the East Holland River Subwatershed is a dynamic and complex ecosystem. Therefore, as land use activities continue to change, so does the landscape, natural features and processes within the Subwatershed. To ensure that the goals of the Subwatershed management strategy are achieved, the recommended policies, rehabilitation strategies and control options similarly must be adaptive and flexible. Most importantly, the financial and staffing resources necessary to fund the implementation efforts will need to be obtained. The challenge to resource managers, planners, politicians, businesses, special interest groups, farmers, and the community alike will be to affect positive change within the Subwatershed to improve watershed health while balancing social and economic considerations. This will require an on-going effort on the part of all stakeholders and the community to work together.

In addition, a monitoring program will need to be established. The results from the monitoring activities will provide the stakeholders with the necessary information on which to evaluate the effectiveness of policies and rehabilitation measures and to identify and respond to any new subwatershed issues which arise. The State of the Watershed Report has identified the ecological basis from which further degradation or improvement within the subwatershed can be measured. As such, it is the base case against which future enhancements to the subwatershed ecosystem can be compared and evaluated. The following section deals with implementation of the plan and summarizes some of the next steps required to take the plan from paper to the public.

9.1 Municipal Policies and By-Law’s

Official Plans are the key documents for the municipalities within the East Holland River Subwatershed which provide direction for suitable land use and guide urban growth. It is important therefore that any new information produced as part of the subwatershed plan be incorporated into this planning framework. Municipal by-law’s are also an important tool which
can be employed to ensure that the municipality's goals and objectives are achieved. The following table summarizes recommendations for the creation of policies, and adoption of By-law's resulting from the development of the subwatershed plan. The development of these policies or By-law's where none presently exist should ideally be undertaken in cooperation with all the municipalities within the subwatershed to ensure a consistent approach to addressing a specific management issue. The creation of policies and adoption of By-law's can be an extremely costly and time consuming exercise and it is recommended that the East Holland River Steering Committee meet with the planning departments of the various municipalities to develop a schedule for implementation immediately upon formal approval of this document by the individual councils.

Table 9.1 Proposed Policies and By-Laws

<table>
<thead>
<tr>
<th>Recommended Action</th>
<th>Municipalities Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adopt a <strong>Top Soil Conservation By-Law</strong> to control the stripping and removal of topsoil during development.</td>
<td>Towns of E. Gwillimbury, Georgina, Whitchurch-Stouffville, Newmarket, and the Township of King</td>
</tr>
<tr>
<td>Adopt a <strong>Fill Control By-Law</strong> to regulate or control filling.</td>
<td>Town of East Gwillimbury</td>
</tr>
<tr>
<td>Develop and adopt a <strong>Groundwater Protection Policy</strong> to protect vulnerable recharge and discharge areas as identified within the study.</td>
<td>York Region</td>
</tr>
<tr>
<td>Develop and adopt a <strong>Wetland Protection Policy</strong> to protect locally significant wetlands as identified within the study.</td>
<td>York Region</td>
</tr>
<tr>
<td>Develop and adopt a <strong>Riparian Zone Protection Policy</strong> to protect existing watercourse buffers identified within the study.</td>
<td>York Region</td>
</tr>
</tbody>
</table>

9.2 Other Legislation and Regulatory Control Options

There are several other existing pieces of legislation or regulatory policies under the administrative control of other agencies that can assist in the implementation of the
management strategy. These include the following:

- Drainage Act, (Provincial Ministry of Agriculture, Food and Rural Affairs)
- Lakes & Rivers Improvement Act, (Provincial Ministry of Natural Resources)
- Fisheries Act (Federal Department of Fisheries and Oceans),
- Conservation Authorities Act,
- Environmental Assessment Act, (Provincial Ministry of the Environment)
- Ontario Water Resources Act,  (Provincial Ministry of the Environment)
- Environmental Protection Act, (Provincial Ministry of the Environment).

It has been suggested throughout the course of this study that some of the existing federal and provincial policies need to be revised and updated. It was universally accepted that this task is beyond the scope of this report, however, a number of other recommended actions were suggested to improve the existing operational efficiency for the purposes of implementation. The recommended actions dealt with two main issues. The first was the development of a one window approach to water resource management or failing that, enhanced communications between the various agencies responsible for environmental approvals within the subwatershed.

For example, three levels of government are presently required to obtain approval to undertake work along the banks of the East Holland River. If the works are within the water, permit approval will be required from the Federal Department of Fisheries and Oceans, Ministry of Natural Resources, and Lake Simcoe Region Conservation Authority. This level of bureaucracy is unacceptable to many of the watershed residents and could be alleviated with the restructuring of the regulations under one agency. In addition, there can sometimes be confusion amongst the agencies with respect to their individual requirements resulting in resource management issues being missed or duplicated. Therefore, it is recommended that the agencies responsible for the delivery of the legislation and policies meet to develop a streamlined protocol to improve inter-agency communication and service delivery while reducing wherever possible duplication of services.
The second major issue identified concerned the lack of active monitoring and enforcement of the existing legislation and/or policies within the subwatershed. For example, the Conservation Authority is responsible for ensuring that sediment and erosion control works are installed and maintained during construction. While the Authority requires and reviews proposed erosion and sediment control plans, there is no active monitoring or enforcement of the contractors’ activities once the plan is approved. This means that if the works are not constructed as plan approved or if the works fail there is no way to ensure repairs or corrections are made and as a result the environmental health of the subwatershed can suffer. While most of the development community can be trusted to ensure the sediment and erosion control measures are maintained and constructed to specifications, some problems within the watershed have been documented.

Another example of poor enforcement deals with the issuance of water taking permits by the Ministry of the Environment. Water taking in the East Holland River Subwatershed involves the pumping of surface waters from the river primarily for the purpose of irrigation. During the course of this and previous watershed studies, it has been revealed that many individuals who were found to be taking surface water did not have the appropriate permits and in some instances were unaware of the legislation.

These examples stress that enforcement throughout the watershed is essential and as with the previous issue the various agencies need to meet to discuss how water resource policies can be enforced in an efficient and effective manner. This discussion should lead to the development of a protocol amongst the agencies outlining roles and responsibilities.

9.3 Project Implementation

The previous sections reviewed the best management practices recommended to improve water quality, quantity, aquatic habitat, terrestrial habitat and recreational opportunities within the East Holland River Subwatershed. It also provided an estimate of the cost, associated benefits, priorities, the lead agency which should be responsible and a time frame for implementation. To ensure that these projects are completed an appropriate implementation
framework needs to be developed. A few of the obstacles that have plagued or prevented the implementation of other remedial strategies include:

- a lack of coordination amongst the partner agencies,
- a refusal of some of the partners to cooperate,
- poor community involvement
- insufficient financial resources, and,
- limited human resources.

Subsequently, these obstacles have been avoided in the past by:

- assigning a lead agency to administer/co-ordinate implementation activities,
- clearly defining the roles and responsibilities of each of the stakeholders,
- involving all of the stakeholders in decision making (consensus building),
- developing funding partnerships and ensuring that adequate resources are available for staffing needs,
- promoting public awareness of the management issues and providing opportunities for the community to get involved, and,
- implement rehabilitation projects and policies and monitor them to determine their effectiveness and to provide information to adapt to new challenges.

The following sections discuss the next steps necessary to ensure that the East Holland River Subwatershed Plan is implemented effectively.

9.3.1 Assigning a Lead Agency

It is recommended that the Conservation Authority adopt the role of lead agency for implementation of the East Holland River Subwatershed Plan. The implementation of the plan should be similar to its development and conducted on a watershed basis. The Conservation Authority is the only agency presently operating based on watershed boundaries. The Authority has also demonstrated experience in the implementation of rehabilitation projects, reforestation and monitoring activities all of which will be required to implement the management strategy. Lastly, the Conservation Authority is already involved extensively in funding partnerships and is successfully implementing similar strategies within the Uxbridge Brook and Maskinonge River Subwatersheds. It is also recommended that a Watershed
Coordinator be hired to ensure the effective implementation of the plan.

9.3.2 Defining Roles and Responsibilities
The roles and responsibilities of each of the partners has been already identified within chapters seven and eight which dealt with the development of policies, by-laws and the recommendation of remedial measure and control options. One of the first tasks of the stakeholders as part of implementation will be reviewing the resource targets, proposed remediation schedule, and developing a work plan and budget to begin achieving the goals of the management strategy. Three year work planning and budgeting is recommended since this time period follows terms of municipal councils. Once the work plan is established then stakeholders can refine their individual roles and responsibilities.

9.3.3 Developing a Governance Model and Involving all Stakeholders in the Decision Making Process
To assist in the implementation of the recommendations outlined in the Management Strategy a Remedial Action Committee (RAC) will be formed. The responsibility of the RAC will be to review and approve annual work plans, budgets, and communication materials. The RAC should include all of the stakeholders including the original members of the Steering Committee along with representation from community interest groups, naturalists clubs, business, agriculture and the general public. A chairperson and other committee officials can be elected during the start-up meetings to direct the meetings. The Authority would provide a recording secretary and administer the committee as part of their coordination duties. Decisions should be made by consensus wherever possible.

9.3.4 Obtaining Funding
One of the first tasks of the Remedial Action Committee will be to review and approve a work plan and budget. Once completed, Authority staff can begin to work with the other stakeholders to request funding from the various partners. For example, the Ministry of Natural Resources is responsible for programs such as CFWIP (Community Fish and Wildlife Improvement Program) to promote and improve fishery and wildlife habitat. The Ontario Ministry of Agriculture, Food, and Rural Affairs, recently launched The Healthy Futures for
Ontario Farmers program which contains a rural water quality component with some 30 million dollars. The Federal EcoAction 2000 program, Trillium Foundation, and Canada Trust “Friends of the Environment” may also be potential partners and provide funding to implement some of the recommendations of the report.

Although programs such as the CURB (Clean Up Rural Beaches) program have been terminated, the Lake Simcoe Region Conservation Authority continues to provide funding through its Landowner Environmental Assistance Program (LEAP). This multifaceted program continues to provide funding assistance for both urban and rural BMPs. A list of the types of projects which are eligible for technical and financial assistance are listed below.

- Livestock Access Restrictions
- Milkhouse Washwater Disposal Systems
- Manure Storage & Handling Systems
- Cropland Erosion
- Streambank and Shoreline Erosion
- Storm Water Management Retrofits
- Retirement Planting of Fragile Priority Lands
- Park Naturalization

The Authority also provides landowner assistance on a comprehensive forestry planting program aimed at priority planting areas. The rural and urban best management practices (BMPs) discussed in this plan must continue to be applied and implemented to all existing and new development in the Subwatershed. The municipalities of the East Holland Subwatershed and the Conservation Authority should continue to apply BMP’s at the plan of subdivision level and should also ensure that appropriate controls or remedial measures are applied at the site plan stage.

9.3.5 Promoting Public Awareness and Community Involvement

Efforts to increase public awareness of the management issues, educate the public regarding activities that they can undertake to improve the environment, and involve the community in the implementation of remedial measures to restore ecosystem health are essential. It is recommended that funding be budgeted to hire a staff individual to deliver a comprehensive
communication program. This would involve working with schools, special interest groups and the provincial and municipal agencies to develop and deliver a comprehensive education program and organising special events and clean up activities. This effort would be linked into the RAC activities and the individual would report to the Watershed Coordinator.

9.4 Monitoring

A comprehensive subwatershed health monitoring program should be developed and approved by the RAC. The rationale for developing the plan with the RAC is to ensure that the stakeholders interests are being addressed. Certainly, monitoring to determine whether the resource targets are being achieved is necessary.

It should be acknowledged, that the water quality modelling methods used in this report were an extremely useful tool to predict the environmental impacts associated with changes in land use. However, the accuracy of any computer model is dependant upon assumptions and data which may not always reflect current environmental conditions. The most reliable method to gauge ecosystem health remains the collection of real data through field observations and measurements made within the subwatershed.

It is recommended that a monitoring program be established and that future urban growth be contingent on the results. This is significant because it will ensure that ecosystem health does not deteriorate at the expense of further urban development or any unpredicted land use changes. Monitoring efforts should encompass a wide range of activities to reflect the diversity of the ecosystem. These activities should include the regular collection of:

- water quality data including temperature,
- fish and other aquatic organisms (macroinvertebrates, algae,...),
- information on changing land use practices (urban and rural),
- the number and location of capital BMP projects completed within the subwatershed.

Monitoring efforts are an excellent activity in which to involve schools, interest groups and the general public. For example, school groups could collect, and identify fish and
macroinvertebrates and naturalists could report any observed flora and fauna. These are just a few examples of activities which could directly involve the community while providing the necessary information to evaluate the health of the East Holland River ecosystem.
GLOSSARY

Aggregate: Sand, gravel and/or broken stone which is the primary ingredient in construction materials such as concrete, roads and fill.

Aquifer: A geologic formation that transmits water, usually through saturated sands, gravels and cavernous rock.

Area of Natural and Scientific Interest (ANSI): Areas of land and water containing natural landscapes or features that have been identified by the Ministry of Natural Resources as having life science or earth science values related to protection, scientific study or education.

Base Flow: The year-round discharge of groundwater into a stream.

Best Management Practices (BMP): Practical solutions used to deal with soil and water conservation concerns including techniques used to manage agricultural and urban runoff to modify agriculture waste management.

Bioengineering: An applied science that combines engineering, biological and ecological concepts to construct living structures for erosion and sediment control.

Buffer Zone: A planted or preserved area next to a waterway, forest or wetland intended to reduce negative impacts from adjacent land uses.

Catchment Area: An area from which rain or snowmelt drains to a lake or river.

Corridor: The naturally vegetated or revegetate areas that link or border natural areas and provide ecological functions such as habitat, passage, hydrological flow or buffering from adjacent impacts.

Development: The creation of a new lot, a change in land use or the construction of buildings and structures.

Discharge Zone: An area where groundwater comes to the surface in streams, rivers and wetlands.

Ecosystem: An interacting system of plants, animals, the land and the climate conditions that are linked by the flow of energy and the cycling of nutrients.

Endangered Species: Any native species, as listen in the Regulations under the Endangered Species Act, that is at risk of extinction throughout all or a significant portion of its Ontario range if the limiting factors are not reversed.
**Environmentally Significant Area (ESA):** A natural area identified by a municipality or Conservation Authority as fulfilling certain criteria for ecological significance or sensitivity.

**Erosion:** The wearing away or removal of soil and rock by running water, wind, ice and gravity.

**Eutrophic:** The state of a lake or pond rich in dissolved nutrients such as phosphates resulting in seasonal deficiencies of oxygen.

**Evapotranspiration:** The process where water vapour enters the atmosphere through evaporation from the land and through escaping from living plants (transpiration).

**Flood Plain:** The area, usually low lands adjoining a watercourse, which has been or may be subject to flooding hazards.

**Geographic Information System (GIS):** A computer tool that can be used to integrate several types or ‘layers’ of information about an area and perform analytical or predictive functions.

**Groundwater:** Water that has infiltrated below the earth’s surface and moves in response to gravity, but may be restricted by impermeable rock or clay layers.

**Habitat:** The local environment that supplies the food, water and shelter needed by a plant or animal species to carry out its life cycle requirements.

**Hazardous Lands:** Property or lands that could be unsafe for development due to naturally occurring processes including flooding and erosion.

**Hazardous Sites:** Property or lands that could be unsafe for development or site alteration due to naturally occurring hazards such as unstable soils or bedrock.

**Headwaters:** Areas of a watershed where water courses originate.

**Hydrogeology:** The study of the presence, movement and chemistry of water beneath the surface of the earth and the factors that influence this water including interactions with surface water.

**Hydrologic Cycle:** The circulation of water from the atmosphere to the earth and back to the atmosphere through precipitation, runoff, infiltration, transpiration and evaporation.

**Infiltration:** The movement of water from the land surface into the soil and the water table.
**Infrastructure**: Physical structures that form the foundation for development including sewage and water works, waste management systems, electric power, communications, transit and transportation corridors and facilities and oil and gas pipelines and associated facilities.

**LSRCA**: Lake Simcoe Region Conservation Authority

**Mitigation**: The prevention, modification or alleviation of impact on the natural environment due to development.

**MMAH**: Ministry of Municipal Affairs and Housing

**MNR**: Ministry of Natural Resources

**MOE**: Ministry of the Environment

**Non-Point Source Pollution**: Pollution whose source cannot be linked to a specific location.

**OMAFRA**: Ontario Ministry of Agriculture, Food and Rural Affairs

**Point Source Pollution**: Pollution from a single source such as an industrial smoke stack.

**Provincially Significant Wetland**: Class 1, 2 and 3 wetlands in that part of the Great Lakes - St. Lawrence Region below the line approximating the south edge of the Canadian Shield, defined in “An Evaluation System for Wetlands of Ontario South of the Precambrian Shield. Second Edition, 1984”.

**PWQO**: Provincial Water Quality Objectives

**Recharge Zone**: An area where the soil conditions allow rain and snowmelt to seep into the ground to replenish the groundwater system.

**Rehabilitation**: The process of restoring, recreating or repairing a damaged area to a healthy dynamic state.

**Remediation**: The rehabilitation of a site for valuable land uses but not necessarily restoring the site to its original natural state.

**Retrofit**: Works undertaken to improve a facility or bring it up to current standards.

**Riparian**: Relating to, living or located on the bank of a watercourse or a body of water.

**Runoff**: Water that moves over the land surface to run directly into rivers and streams.
Sewershed: A specific area such as city block or subdivision that drains to a common outlet by means of a subsurface system or surface topography.

Stormwater Management (SWM): The management and control of water flowing from the land to rivers or streams during storm events.

SWMF: Stormwater Management Facility

SWMP: Stormwater Management Pond

Subwatershed: The land drained by a tributary to a main watercourse.

Threatened Species: Any native species that is at risk of becoming endangered through all or a portion of its Ontario range if conditions are not changed.

Vulnerable Species: Any indigenous species that is represented in Ontario by small but relatively stable populations, and/or that occurs sporadically, or in a very restricted area or at the edge of its range as defined by MNR, the Committee on the Status of Species-At-Risk in Ontario (COSSARO) or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Watershed: The area of land that drains into a river or other body of water.

Watershed Planning: A form of holistic planning that integrates watershed ecosystem resource management and land use planning.

Wetlands: Low lying wet areas supporting marsh, bog, swamp or fen plant communities where soil is saturated for most of the year.
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