Shore Naturalization Plan Along Hague Boulevard

Includes:
Final Report

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Lakefield Millennium Trail Committee
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Prepared for: The Lakefield Trail Committee

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1.0 Introduction

1.1 Shoreline along Hague Boulevard Site History

This shoreline site, along the Otonabee River, is located in the township of Smith-Ennismore-Lakefield, in Ontario, Canada. The shoreline is approximately 0.5km long and extends along the east side of Hague Boulevard. In November 2002, close to 30 docks were removed from this shoreline. Some of these docks were built in the 1940s; others were built more recently. These privately owned docks were removed from the shoreline because they had been built on public property. After removal, there was concern for the appearance and soil erosion of the remaining shoreline.

1.2 Purpose and Goal

The purpose of this project was to plan and budget for the naturalization of the shoreline along Hague Boulevard in an environmentally sound and aesthetically pleasing manner. The goal of this project was to help reduce damage to the river from soil erosion and from contaminant runoff. The planting of vegetation will also help stabilize the bank, create habitats for favourable species, and provide a natural and welcoming atmosphere along the riverfront for pedestrians on the Lakefield Trail. The two islands in the Otonabee River just adjacent to the subject site, along with other naturalized shorelines along the river were used as an approximate model for this shoreline naturalization. Issues such as river visibility and aesthetics were also taken into consideration.

1.3 Important Note

This university project is intended to be a starting point for the naturalization of the shoreline along Hague Boulevard. Because the Otonabee River is a large, strong and regulated river, it is important to realize that this project is particularly complicated. High spring flows have the capability to wash away newly planted species and destroy naturalization efforts if not implemented properly. Changes in water levels can negatively affect newly planted species. Erosion control measures chosen for this site are based on advice from knowledgeable individuals. These individuals have not studied this specific site. In order for proper and successful implementation of this naturalization plan, it is imperative to consult with an engineer or a landscape architect prior to and during the planning and execution of this project.

2.0 Research on the Benefits of a Naturalized Shoreline

A naturalized shoreline can provide abundant benefits to both nature and the community around it. It is important to realize the abundance of life supported by a river. As much as 90% of all the species living in a lake, reside or use the littoral zone (Ford, 2003; LandOwner Resource Centre, 2000). The littoral zone is defined as the area in the water that extends out from the shoreline to the location where "well-mixed warm surface waters still reach the lake bed in the summer" (Horne and Goldman, 1994). Abundant populations of plant and animal species are contained in the shallow littoral zone (Horne and Goldman, 1994; Daigle and Havinga, 1996). Because this area supports the majority of life in the river, it should be protected from human activities that will disturb this zone. The littoral zone may be protected in two ways: a dock protects the littoral zone by providing shelter and shade, while also providing access to the water. Naturalization of the shoreline is an alternative method of protection.

2.1 Protection from Shoreline Erosion

Shoreline erosion can change fish habitats, and can cause poor water quality by decreasing the ability for aquatic plants to photosynthesize (Daigle and Havinga, 1996). The best safeguard against shoreline erosion is to revert the shoreline to its natural state. Erosion can occur from fast moving water flowing in the river, from fast moving water to the river as runoff, or from ice movement that pushes up against the shoreline and dislodges the soil particles. In an experimental study of bank erosion in a wave tank, there were reductions in wave damage over vegetated slopes in relation to unplanted slopes (Coops et. al., 1996). This demonstrated the transmission of wave action by the presence of vegetation. Even waves 10 cm in height were capable of causing extensive alterations to the slopes in the experiment, while vegetated slopes experienced little effects. The establishment of vegetation can also be affected by waves and soil erosion (Coops et al., 1996). In a study of erosion caused by boat-generated waves (Nanson et al., 1994), the unvegetated riverbanks experienced severe erosion by waves exceeding 30 cm in height, which are caused by the mere passing of recreational boats.

The roots and foliage of trees, shrubs and plants near a shoreline act as a net that reinforces the soil structure (Coops et al., 1996). These plants also help to slow the

movement of water, which in turn reduces its ability to erode the shoreline (Nichol, 2003; Coops et al., 1996). The vegetation will also help shield the land from rainstorms that can loosen shoreline soil. High stem densities retain waterborne sand particles, and reduce the amount of sand discharged to the water body (Coops et al., 1996). When the larger vegetation around water is removed, there are no more roots to hold the soil in place. Dogwood, a native shrub species, is an ideal shrub for erosion control as it develops roots that extend 0.5 meters down from the ground surface. Grass roots extend a mere 8 cm below surface (LandOwner Resource Center, 2000)(photo 17& 18). Building a concrete barrier to keep the soil in place creates an artificial habitat, which is not a hospitable environment for wildlife. These concrete barriers can also wear away with time, without providing nutrients to the water. Conversely, when trees or even their leaves fall into the water, they provide nutrients to the river water. Fallen tree trunks can also provide fish habitat (Ford, 2003).

2.1.1 Advantages over other erosion control methods

Naturalization	**vs.**	**Hard Armoring**
Provides immediate bank stabilization that strengthens over time		Provides immediate stabilization that will weaken over time
Economical		Expensive
Provides habitat for wildlife		Does not provide habitat for wildlife
Decreases water velocities then decreases erosion. Does not deflect waves that can stir up toxic sediments.		Increases water velocities, which can increase downstream erosion. Deflects waves that can stir up toxic sediments (LandOwner Resource Centre, 2000)
Decreases water temperature by providing shade. The water can then support more life because oxygen is more soluble in cold water (Wetzel, 2001)		Increases water temperature by eliminating shade. Warmer water can support less oxygen (Wetzel, 2001)
Works with natural forces		Works against natural forces
Aesthetically pleasing		NOT aesthetically pleasing

(Riggs, 2002)

In a study by Hellsten et al. (1996), on the re-vegetation of a regulated lake in northern Finland, the high water levels in the summer contributed to shore erosion and consequently vegetation loss. It was found that tall willow cuttings had the best survival rate due to their resistance against flooding and quick rooting capabilities

2.2 Protection From Surface Runoff

Vegetation in the riparian zone (river bank) not only provides protection to the littoral zone from soil erosion, but it also helps to filter out contaminants that can enter a waterway through overland runoff. The location of the riparian zone can be seen in figure 1a.

A typical contaminant from cottages is phosphorus. Phosphorus is beneficial to plant growth, and is used in detergents and fertilizers. However, when added to surface water unintentionally, it causes algal blooms (Daigle and Havinga, 1996). The rapid decay of algae and other small aquatic plants can lead to premature eutrophication. Eutrophication occurs as a water body ages, and promotes low oxygen levels, warm water and overall poor water quality (Daigle and Havinga, 1996). In cottage areas where there are septic systems, the nutrients from the septic systems may eventually lead to eutrophication of surface water (Nichol, 1998). In order to avoid this fate, vegetation along the riparian zone forms a "buffer" between the water and the land. Any runoff running towards the river can be slowed by the vegetation, and can then instead be absorbed by the soil and the plant roots. Any phosphorus in the runoff will then be used by the plants and will not enter the waterway. According to Terrestrial Biologist, James Kamstra, with a 15m vegetated buffer along the shoreline, 95% of Nitrogen and Phosphors can be attenuated.

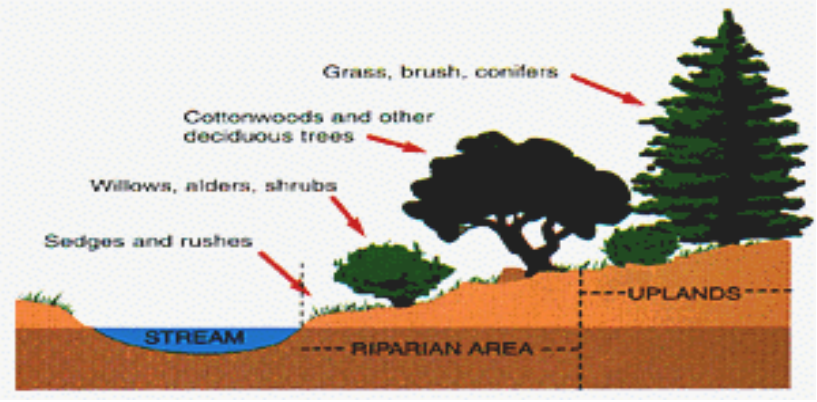

Figure 1a: Location of riparian Zone (Agriculture and Agri-Food Canada, 2003)

2.3 Wildlife Benefits

Vegetation along water also provides habitat for many shoreline and water species. A naturalized shoreline can even be seen as a wildlife corridor that provides a connection between natural areas among urban or rural landscapes. It can alleviate some of the effects of habitat fragmentation (Daigle and Havinga, 1996). These corridors are also important because they can assist in maintaining genetic variability among small isolated populations that would otherwise not persist (Daigle and Havinga, 1996). Overhanging branches provide shade that cools the littoral zone, and falling insects to feed fish. Tall grasses provide nesting areas for water birds and other favourable species. Native grasses provide the best diversity of structure, height and density for ground nesting birds (Melinchuk, 1995). Comoss et al. (2002) found that native plantings of live saplings had not only provided bank stability, but also food sources and habitats for several hundred bird species found at the Presque Isle State Park.

Rodway (1998) conducted a study on Harlequin Duck breeding in Hebron Fiord, Labrador. He found that nest sites were located in dense vegetation cover along the water's edge for concealment. Shorelines used by Harlequin ducks had greater vegetation cover than unused shorelines.

In a study by Peterson et al. (2000), early life-history stages of fish and crustaceans were collected from natural vegetated marsh habitats, sandy beaches, and altered marsh habitats including long stretches of rubble and bulkheads. Low species diversity was found in the altered landscape as opposed to the natural landscapes. This suggested that the habitats adjacent to altered habitats are less frequently used as nursery habitats, and natural areas are therefore important in life-history stages of aquatic species.

Lakeshore development was related to green frog abundance in a study conducted by Woodford, (2003). Adult green frog abundance was significantly lower on lakeshores with varying degrees of house or cottage development, than on lakeshores with little or no development. It was found that the amount of suitable habitat, and not the density of development significantly affected green frog abundance. According to this study, even though there was development along a waterfront, it was the direct damage to the riparian

and littoral zone that negatively affected green frog populations. The highest densities of green frogs were observed in riparian zones dominated by vegetation.

A naturalized shoreline deters the Canada goose, a common nuisance to shorelines in Ontario. The Canada goose enjoys feeding on shorelines where the grass is cut and there are few obstacles in its line of view. On naturalized shorelines, there are too many places for predators of the Canada goose to hide. Therefore, the Canada goose will view the shoreline as an unsafe place and will avoid feeding at that location (McCabe, 2003; Carter, 2003).

2.4 Aesthetic Quality of Vegetated Shorelines

The visual aesthetic quality of northern Ontario's forested shorelines was assessed in a studied by Haider and Hunt (2002). The purpose of this study was to expand the scientific understanding of the relationship between offshore (in-water) shoreline perception and biophysical forest characteristics. People who enjoy outdoor activities such as boating, fishing and canoeing feel that the landscape is an integral part of the whole experience. Biophysical characteristics such as tree species, mortality, tree height, tree diameter at breast height (DBH), and photographic data were collected from all the study sites. Slide photographs were taken from 140m offshore. The slides were categorized into undisturbed shorelines, shorelines with anthropogenic disturbances and shorelines with natural disturbances. Results showed that people enjoyed scenes with large amounts of vegetation. A certain amount of depth and tree density was also found to be an important factor for scenic beauty. White and Red Pine stands received the highest scenic beauty evaluation, followed by Eastern White Cedar and Jack Pine stands

Donald Fraser wrote in the Peterborough Examiner that while he was canoeing on the Otonabee River one weekend, he saw many natural shorelines that appeared to be in "pristine ecological condition". Even though many of these vegetated shorelines were buffers between farm fields and the shoreline, it made him feel as if he were paddling through a "much more pristine, northern route". He also paddled through areas that were more populated, with altered shorelines of mown lawns right down the water's edge. While the natural areas supported sightings of blue herons, muskrats, beavers and

ospreys, the developed shoreline's water quality was noticeably poorer and supported only sightings of dead fish. There was one bird, however, seen uniformly around the cottage's mown lawns: the Canada goose. Fraser did not see one Canada goose during his weekend trip on the natural, vegetated shorelines.

3.0 The Subject Site

3.1 Existing Site Conditions

The subject shoreline is located on the Otonabee River, approximately 50 meters east of Hague Boulevard in the Township of Smith-Ennismore-Lakefield, Ontario, Canada. The Otonabee River is part of the Trent Severn Waterway that flows south approximately 45 km to Rice Lake. Katchewanooka Lake is situated approx. 400 m from the subject shoreline and flow into the Otonabee River just on the west side of Hague point. The shoreline is approximately 0.5 km long, starting from the beach at the most northern tip, to the gate at the southernmost tip. A copy of the subject site on a 1:50,000 National Topographic System (NTS) map of Peterborough, 31 D/8, can be located in appendix A. Universal Transverse Mercator (UTM) coordinates for this site are 4922800mN and 717050mE. There is one drainage ditch leading into the Otonabee River on the north end of the shoreline, and a drainage culvert at the south end near the gate. A drainpipe is located near the edge of the beach, leading into the river. After speaking with Ed Barber, parks, recreation and community centers manager with the Township of Smith-Ennismore-Lakefield, the origins of this drainpipe remain unknown. Ed Barber also stated that there is a water testing station located on the shoreline near the beach. Runoff from the gravel parking lot on the east side of Hague Boulevard, adjacent to the beach, has recently been diverted to the drainage ditch. I have not seen any water in this ditch when visiting the shoreline.

Located on Hague Point, there are residential houses, a campground, a trailer park, the Marshland Center, a restored marsh named "Imagine the Marsh", and other recreational lands. The shoreline terrain is mainly flat, with slightly lower lying lands near the docks at the south end of the shoreline. This lower lying area is prone to flooding in early spring (photo16). The Otonabee River is a dammed river, and its water level is kept at its

full level of 232.02 meters above sea level (masl) in the summer, and at 231.92 masl in the winter (Trent Severn Waterway, 2003). The deepest point in the river was found to be 19ft (5.79 m), located between locks 24 and 23 just below Lakefield. The deepest point in the river in Lakefield was found to be 10ft (3.05 m), just above the Lakefield lock station. The total number of boats passing through the Lakefield lock station in 2002 was 2,749. In 2001 there were 2,944 boats, in 2000 there were 2,292 boats, and in 1999 there were 3,531 (Jameson, M., 2003).

Southern Ontario prevalent summer winds are from the south or southwest, and winter winds are predominantly from the west or northwest (Daigle & Havinga, 1996). The shoreline is facing south to southeast. South facing slopes receive the most sunlight and shelter from prevalent winds (Daigle & Havinga, 1996). There are several houses along Hague Boulevard that look out onto the water. The Lakefield Trail is situated between the houses and the riverfront. The distance between the trail and the water varies from 2 m to about 20 m (Figures 1-12).

The shoreline soil was described using the field guide to describing soil in Ontario. It was found to be dark brown, organic with an earthy smell, moist with fibrous materials present, silty sand to sandy loam with a trace of gravel. After lab analysis, the pH of the soil was found to be 7.39. The location where the soil sample was taken is located on figure 2. The river bottom is mainly sandy with a few cobbles. Where there used to be docks, rock and cobble beds remain in the water and on the water's edge. In several places between the trail and the water, the grass is mown continuously to the water's edge. The grass is also kept mown in most places from the residences to the trail. Canada geese can access the shoreline because of the cut grass. They like to walk and defecate along the shoreline and this has become a concern for the residences and the users of the Lakefield Trail.

Typical game fish species in the Otonabee River include carp, small and largemouth bass, bluegill, walleye, pumpkinseed, and muskellunge (Fox, 2004). There are also several minnow species that reside in the river.

Lakefield is located in the 5a plant hardiness zone. The hardiness zones are based on minimum winter temperatures, length of the frost-free period, summer rainfall, maximum temperatures, snow cover, January rainfall and maximum wind speed (plant hardiness zones, Agriculture and Agri-food Canada, 2000). There are many areas where shoreline vegetated is well established. There are patches of dogwood, Choke Cherry and Honeysuckle shrubs. There are also patches of Joe-Pye-Weed, tall grasses, Asters, Goldenrods and other various wildflowers that are beginning to establish (photos 1, 2, 4, 6, 11 & 12). Many of these species are already located close to the water's edge. These areas are thriving and do not need to be altered. Even though some of these areas include exotic species, they appear to be doing well, and are not invading the entire site. This may change in the future, therefore regular management of the site to prevent the invasion of exotic species is recommended. There are also numerous large trees including willows, maples, and a red cedar. Several smaller trees are also established, including eastern white cedars, ashes, oaks and poplars.

Because this shoreline area was treated in the past as if it were private property, some minor alterations have been made. In one area, there was and still remains a temporary fire pit. In other areas, plants such as lilies have been deliberately planted (photo 3). Because many of the houses along the shoreline used to have docks extending out into the water close to their houses, some individuals are still tying up small recreational boats and skidoos to trees or man-made anchors in the water (photo 7). Presently, there are 10 public docks that have been installed this spring and summer. These docks are located at the north and south ends of this subject site (figures 2 & 11).

Currently, there is only one sitting area, located at the south end of the shoreline. There is only one bench under a large willow tree, and no garbage cans anywhere on the pathway.

3.1.1 Areas of Immediate Concern

There are two areas that are of concern to me at the subject site. First, located in one of the areas planted with lilies situated under a large Willow tree (photo 3), a plant called Dog Strangling Vine (*Vincetoxicum nigrum* L.), or called Black swallow-wort

(Cynanchum louiseae) was observed. This plant can be seen in photos 13-15. This is an exotic and highly invasive plant (Minnesota Department of Agriculture, 2002) that has been recently making its way into this region. The plant is native to central and southern Europe and Asia, and it was introduced to North America as a horticultural plant, but escaped cultivation. It is found commonly in Wisconsin, Iowa and South Dakota (Minnesota Department of Agriculture, 2002). This plant can grow up to 2 m tall, and wraps around surrounding plants. It is very difficult to control, and it can eventually take over several acres of land (Minnesota Department of Agriculture, 2002). It spreads by releasing seeds with long, white, silky parachutes that are carried by the wind (Ontario Ministry of Agriculture and Food, 2003). The Dog Strangling Vine should be located and removed from the roots before it spreads. Leslie Huffman, weed management specialist at the Ontario Ministry of Agriculture and Food suggested via email that a Roundup type treatment should give good results, used with a spot sprayer to reduce damage to neighboring vegetation. I do not suggest using chemicals to control this pest because it is located so close to surface water. Removing the plant from the roots before it spreads its seeds appears to be the best method of control for this plant.

The second area of concern is the area where the shoreline is lacking bank-stabilizing vegetation. This area of immediate concern is located in figure 11. The grass around docks 6, 7 and 8 has been mown right to the water's edge. The land seems to be actively eroding around the new docks (photos 7-10). It appears that almost 0.3 m (1 ft) of soil has eroded from this area during the 4 months (May to August, 2003) I studied this shoreline. It is important that erosion control measures be conducted as soon as possible on this area. After speaking with Brian Basterfield, Landscape Architect, Cathy Dueck, and Beth Cockburn from the Trent Severn Waterway, it appears that the best solution for the problem is to place washed cobbles and rock to immediately stabilize the bank. Washed cobbles do well at stabilizing low slope shorelines (Basterfield, 2003). The turf will need to be removed, and then filter cloth placed down. The washed cobbles should be between 5"-10" in diameter, extending about 4ft (1.2m) up the bank (figure 11a). Live willow cuttings can then be planted within the washed cobbles, and shrubs can be planted behind the cobbles. This appears to be the best solution. It is economical and easy to implement, with a higher success rate than brush bundles or coconut rolls (Basterfield,

2003). Coconut rolls are flexible logs made from coconut hull fibres (Tennessee Valley Authority, 2003). They have been used in bioengineering projects to assist the growth of new plants by anchoring the soil, especially at the base "toe" of the shoreline (Tennessee Valley Authority, 2003). Brush bundles are collections of live branches tied together and placed on the shoreline to stabilize the soil (Dueck, 2003). Since these brush bundles consist of live branches, they have the ability to grow and further anchor the soil. Excessive soil erosion in this area due to spring flooding (photo 16) and boat wakes may prevent roots from establishing on shrubs planted directly at the water's edge. The erosion could continue in the winter with ice buildup. See figure 11 details for more information.

3.2 Plant and Wildlife Species Observed at the Site

(Newcomb, 1977; Farrar, 1995; Newmaster, 1997)

Native Plant Species:

Common Name	**Latin Name**
Red Osier Dogwood	*Cornus stolonifera*
Balsam Poplar	*Populus balsamifera* L.
Poplar sp.	*Populus spp.**
Basswood	*Tilia Americana* L.
Hemlock	*Tsuga Canadensis* L.
Violet	*Viola sp.*
Ash	*Fraxinus spp.*
Common Cattail	*Typha latifolia*
Eastern White Cedar	*Thuja occidentalis*
Joe Pye-weed	*Eupatorium maculatum*
Tall Goldenrod	*Solidago altissima*
Canada Goldenrod	*Solidago canadensis*
Blackeyed Susan	*Rudbeckia hirta*
Jewelweed	*Impatiens capensis*
Silver Maple	*Acer saccharinum*
Common Milkweed	*Asclepias syriaca*
Virginia Creeper	*Parthenocissus quinquefolia*
Canada Anemone	*Anemone canadensis*
Common Ragweed	*Ambrosia artemisiifolia*
Wild Strawberry	*Fragaria virginiana*
New-England Aster	*Aster nova-angliae*
Choke Cherry	*Prunus virginiana*
Nannyberry	*Virburnum lentago*
Wild Grape	*Vitis riparia*
Red Oak	*Quercus rubra*

St. John's wort	*Hypericum kalmianum*
Selfheal	*Prunella vulgaris*
Spike rush	*Eleocharis spp.*
Black Bulrush	*Scirpus atrovirens*
Eastern Red Cedar	*Juniperus virginiana* L.
Orchard Grass	*Dactylis glomerata* L.
Common Yarrow	*Achillea millefolium* L.,
Meadow Horsetail	*Equisetum pratense*
Canada Bluegrass	*Poa compressa*

*** May not be native**

Introduced Plant Species:

Tartarian Honeysuckle	*Lonicera tatarica*
Birdsfoot Trefoil	*Lotus corniculatus*
Sweet Clover	*Melilotus alba*
Red Clover	*Trifolium pratense*
Black Medic	*Medicago lupulina*
Queen Anne's Lace	*Daucus carota*
Hybrid White Willow	*Salix alba* X S. *fragilis* L.
Norway Maple	*Acer platanoides* L.
Oxeye Daisy	*Chrysanthemum leucanthemum*
Mossy Stonecrop	*Sedum acre*
Dog Strangling Vine	*Vincetoxicum nigrum* L
Manitoba Maple	*Acer negundo* L.
Ground ivy	*Glechoma hederacea* L.
Common Dandelion	*Taraxacum officinale*
Purple Loosestrife	*Lythrum salicaria*
Wild Rose shrub	*Rosa spp.*
Day Lily	*Hemorocallis spp.*
Cow Vetch	*Vicia cracca*
Field Hawkweed	*Hieracium pratense*
Bladder Campion	*Silene cucubalus*
Common Plantain	*Plantago major*
Quack grass	*Agropyron repens* (B.)
Common Mullein	*Verbascum thapsus*

Wildlife Species Observed

American Robin	*Turdus migratorius*
Song Sparrow	*Melospiza melodia*

4.0 High-End Naturalization Plans for the Entire Shoreline

4.1 Figures 1-12

4.2 Figure details

All native plant species and locations were chosen in for their light and moisture requirements, as well as their overall suitability for the site. According to landscape architect Brian Basterfield (contact info in references), a 20% attrition rate of the planted species can be expected after the first winter.

Legend

Curvy line	- shrub planting
Dashed line	- wildflower planting
Solid line	- good present vegetation areas
Dots	- trees
Wavy line	- moist, low-lying soils begin
Many small circles	- washed cobbles
Rectangles	- park benches
Cylinders	- garbage cans
SS	- soil sample location

Plant species legend is located in the plant list seen in Table 2.

Figure 1: Area 1 (0-40m), Scale 1:167

Red Osier Dogwood and Silky Dogwood will be planted along both sides of the ditch, all the way up to the parking lot (parking lot not on diagram). Standard spacing of shrubs is 2 meters apart (1m centers). These two bushes are excellent for erosion control and will do well in moist soils (see section 4.3.3 for shrub details). The combination of Silky and Red-Osier Dogwood is particularly desirable for wildlife because they have a 3-week difference in fruiting time (Dueck, 2003). The placement of shrubs along the beach will prevent Canada geese from walking onto the beach, and then having access to the grassed areas of this shoreline. These shrubs can also be planted along the ditch on the north side of the beach for the same reason. Swamp rose and high-bush cranberry will be planted on the south side of the sitting area. One Swamp rose bush will be planted in the middle of the sitting area. High-bush cranberry is also beneficial for wildlife, and both are aesthetically pleasing and valued for erosion control and naturalization (Soper & Heimburger, 1982). Mulch and filter cloth should be placed down around the shrubs to

assist in their establishment and to prevent invasion by weeds. Two planks of wood will be placed over the ditch so that people can access or view the beach while sitting in area #1. The sitting area will also be accessible via the path. Woodchips will be placed in all the sitting areas, as well as on the pathways leading up to the sitting areas to reduce grass cutting around obstacles. The turf will be removed, and filter cloth will need to be placed under the woodchips to prevent the growth of weeds through the woodchips. All sitting areas will be constructed similarly. Sitting area #1 will have two park benches, one picnic table and one garbage can. Prairie Cordgrass will be planted along the shoreline in this sitting area. A buffer of about 1.5m will be kept as it is on the south side of this sitting area. The area close to the ditch will be planted with Red Osier Dogwood.

Two islands of wildflower vegetation will be located on each side of the woodchip pathway (see section 4.3.2 for wildflower details). Standard spacing of wildflowers is 1 meter apart (0.5m centers). The turf will need to be removed, then filter cloth and mulch should be placed down to assist in their establishment and prevent invasion by weeds. Interpretative signage is planned for this area.

General notes: When doing any shoreline work, it is imperative to place silt fences in the river to prevent soils from washing away downstream. Silt fences placed in the water are required for project approval by the Trent Severn Waterway. To prevent excess soil erosion when planting, only the minimum amount of turf and other vegetation should be removed.
Planting should take place in late spring (May), or early fall (Sept., Oct.) to prevent being swept away by fast-moving river water in early spring. (Daigle & Havinga, 1996).

Interpretive signage at both ends of this piece of shoreline will help the public understand the purpose of this project and promote community cooperation. The area will not be fully established for another 2 or 3 years after planting. People in the area may be tempted to mow or trample the vegetation. Visits from Canada geese can be expected until the vegetation is fully established or if the vegetation becomes trampled (Howard, 2003). Signage will help in educating about the importance of naturalization, and will help to keep people from affecting the land where the plants are establishing. Access to

the water should be kept to the sitting areas, the docks, and the one small area close to the drainage ditch.

Regular grass cutting by the Lakefield municipality should be confined to the meandering line close to the path. The grass around the wildflower islands can be mowed 2-3 times per year until the wildflowers have matured. This could take between 2-3 years (Howard, 2003). After this time, the grass will be taller, and the wildflowers will create a colourful, aesthetically pleasing, wildlife-attracting environment.

Figure 2: Area 2 (40-80m), Scale 1:167

The docking area will have mown grass so people can access the docks. Red-Osier Dogwood will be placed around the docks for erosion control. There is already good vegetative cover in between docks 2 and 3, and between docks 4 and 5. Cedar posts will be laid along the ground and anchored with large spikes. The wood will help delineate the docking area, and will prevent the vegetation around the docking area from being trampled. One garbage can will be placed just outside of the docking area, near the path. The Lakefield municipality will empty the garbage cans as needed.

A soil sample was taken from the area at the foot of dock 2. It was analysed for pH at Trent University.

Figure 3: Area 3 (80-120m), Scale 1:167

Nannyberry and Swamp Rose will be planted along the shoreline (see section 4.3.3 for shrub details). Then there will be a break in height, and there will be a wildflower island for river visibility. Plantings of Common Elderberry and then one White Pine are planned to the south of the large willow already present at the site. White Pine is a self-pruning tree that frames water landscapes (Basterfield, 2003). It is also found on the islands just adjacent to the site. Standard spacing of trees is 4 meters apart (2m centers). Jewelweed will be planted just adjacent to the White Pine, which should also do well in the shade, once the Pine grows larger.

Figure 4: Area 4 (120-160m), Scale 1:167

Area 4 can be fully planted with shrubs to stabilize the soil. It is already very narrow, and the view across the water is of the marina. Common Elderberry, Meadowsweet, Highbush Cranberry, Nannyberry and Swamp Rose are to be planted in this area.

Figure 5: Area 5 (160-200m), Scale 1:167

Area 5 includes plantings of Red-Osier and Silky Dogwood near the shore. Some plantings of water tolerant wildflowers will be placed around the Cedar already present at the site. Two small islands of showy upland wildflowers are to be planted, situated nearer to the path. To the south of the Cedar is an area that is already established with Dogwood, Wild Grape, Goldenrods, sedges and other species (photo 1). Highbush Cranberry will be planted just to the south of this patch.

Figure 6: Area 6 (200-240m), Scale 1:167

Plantings of Highbush Cranberry will continue south until sitting area #2. It should not be planted too close to where the land juts out because it may be subject to unprotected conditions. This shrub is well suited for this site because it likes the water and will do well in the shade of the large willow already present. An island of wildflowers is located just west of the Highbush Cranberry. Sitting area #2 is located near to this large willow. There will be two benches and one garbage can. Canada Anemone will be placed near the water's edge. Shrub willow, Turtlehead and Joe-Pye-weed will help to hide the concrete slab on the shore just adjacent to the sitting area. Jewelweed and Showy Tick-trefoil will be planted in the partial shade of the shrubs that are already present at the site. Photo 2 is located in this area, just adjacent to the concrete slab. The area in the photo is already well vegetated and does not need more planting.

Figure 7: Area 7 (240-280m), Scale 1:167

Shrubs and wildflowers will also be planted along the shoreline in this area. An island of wildflowers is planned for the area where a large patch of ragweed was observed. It is located just west of the concrete slab on the shoreline. Shrub Willow will be placed just behind the concrete slab to minimize its appearance. The Dog Strangling vine (photo 13, 14 &15) mentioned earlier in this report is located amongst the lilies, under the large

willow already present at the site (photo 3). Some Red-Osier and Silky Dogwood will be planted on the south side of the willow tree.

Figure 8: Area 8 (280-320m), Scale 1:167
Two shoreline islands of water tolerant wildflowers and grasses will be planted on either side of Red-Osier and Silky Dogwood plantings. There are two large patches of day lilies, likely planted by the residences. An island of wildflowers surrounding a chokecherry shrub will be planted next to the day lilies. The wildflowers closest the water will be water tolerant, and the others will be more showy upland species.

Figure 9: Area 9 (320-360m), Scale 1:167
Jewelweed, and New England and Flat-topped Aster will be planted in and near to the shade of the Cedar tree already present at the site. More plantings of water tolerant wildflowers will continue. An island of showy upland wildflowers will be located closer to the path. Nannyberry will be planted just adjacent to the north of sitting area #3. Sitting areas #3 will have Canada Anemone planted along the shoreline. Sitting area #4 will have Prairie Cordgrass, Canada Anemone, and New-England Aster planted along the shoreline. Two large sitting boulders will be placed in sitting area #3, and two benches, one boulder and one garbage can will be placed in sitting area #4. Dogwood shrubs will be planted along the water's edge in between the two sitting areas, and there will also be a showy wildflower island in between the pathways of the two sitting areas. Highbush Cranberry will be placed just south of sitting area #4, along the shoreline. Approximately 12-14m south of the large willow, the land slopes downward, and the soil becomes very moist.

Figure 10: Area 10 (360-400m), Scale 1:167
Dogwoods will be planted on the water's edge. There is a patch of vegetation already established just north of the rocks in the water (photo 5). It will be substituted with water tolerant wildflowers because the invasive purple loosestrife is present in this area. An island of showy wildflowers surrounding a common elderberry shrub is located near to the path. Dogwood plantings are planned for the area south of the wildflowers, and will

continue until the fully vegetated area seen in photos 4 and 6. Photos 4 and 6 are ideal examples of a naturalized shoreline.

Figure 11: Area 11 (400-455m), Scale 1:204

The area around docks 6, 7 and 8 is of immediate concern. As mentioned earlier, there is severe erosion taking place due to the lack of strong root stabilization. This is because the grass has been mown to the water's edge, the area is subject to flooding in the spring (photo 16), and from the wake of the boats coming into and leaving the docks. Washed cobbles appear to be the best method of erosion control for this low-slope area. They should be approximately 5"-10"in diameter and placed from the water's edge to about 4 ft (1.2m) onto the land. The total thickness should be about 0.5m (see figure 11a).

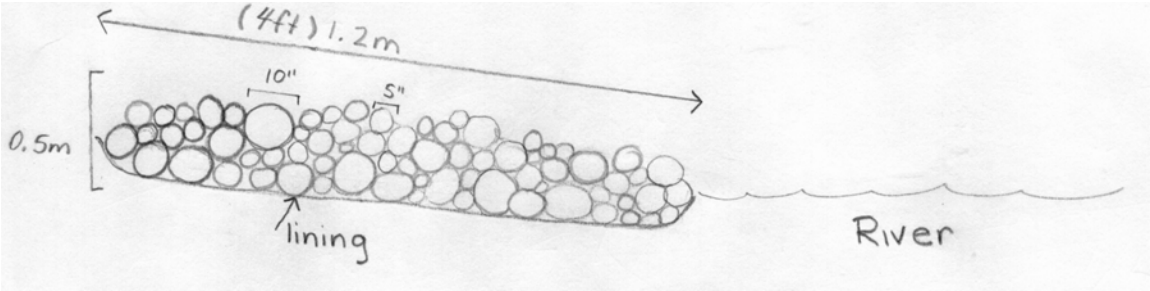

Figure 11a. Cross-section view of the washed cobble placement along the Otonabee River.

Consultation is required for proper slope and placement criteria to ensure permit approval from the Trent Severn Waterway. The grass will be removed, and filter cloth will be place under the cobbles to stabilize the soil. Some excavation may be required. Shrub willow cuttings can be placed within the cobbles. Shrub willow will also be planted behind the cobbles, along the shoreline. The shrubs in this area will have to be maintained so that the docks are accessible. Cedar posts will be placed along the docking area, to delineate where the grass should be mown and where the docks should be accessed. The docking area will be separated into two docking areas to prevent excessive grass cutting. Red-Osier Dogwood will be planted between the docks where there is currently no vegetation. One garbage can will be placed close to the path, in between the two docking areas.

Figure 12: Area 12 (455-495m), Scale 1:167

There is already an area fully established with dogwoods, lilies and wild grape just at the start of this area, as seen in photo 11. South of this area, plantings of Red-Osier Dogwood are required for erosion control. Sitting area #5 is located just under the large willow tree already present at the site. There is one bench already present near the willow. A new bench will be placed at the appropriate angle to the existing one to promote conversation (Basterfield, 2003). Prairie Cordgrass, New-England Aster, and Canada Anemone will be planted along the shoreline in the sitting area. The entire area to the south of sitting area #5 should be left to grow (photo 12). It is already well vegetated and established. There is one culvert draining into the river just adjacent to the gate. It appears that this culvert receives runoff from the adjacent road.

The budget for this high-end naturalization plan can be seen in table 1.

-End-

4.4 Sources for Materials

Plants, shrubs and bare root cuttings:

Peterborough Ecology Park
Cathy Dueck
Ashburnham Drive, Peterborough
Tel: (705) 745-3238

Wild Ginger Native Plant Nursery
Emony Nicholls
6752 Perrytown Rd.
Port Hope, ON
L1A 3V5
Tel: (705) 740-2276
905-797-2662

Richardson Pineneedle Farms
Hwy 35, Pontypool, ON
Tel: (705) 277-9993

Uxbridge Nurseries
P.O. Box 400
Uxbridge, Ontario
(905) 655-3379 or 1-877-655-3379
Landscape Materials: (mulch, landscape fabric, silt fences and metal spikes)

Home Depot
500 Lansdowne West
Tel: (705) 876-4560

White Rose
1550 Lansdowne West
Tel: (705) 743-2666

Peterborough Landscape Design
2200 Keene, Peterborough
Tel: (705) 743-1428

Rehill Building Supplies
921 High St., Peterborough
Tel: (705) 742-5428

Rock and cobbles:

Drain Brothers Quarry
Off county Rd. #6
Tel: (705) 639-2301

CBD Excavating
Tel: (705) 652-8713
John cell (705) 749-8617
Lakefield

South Fork Aggregates
Doug Wright, Sales Representative
Cell: (613) 813-9183
Tel: (613) 966-2022
Belleville

Signs:

John's Signs
470 Robinson Rd, Ennismore
Tel: (705) 292-5445

Shaun Milne Signs
RR 1, Peterborough
Tel: (705) 292-8091

Park benches, picnic tables, garbage cans and cedar posts:

Ed Barber, township of Smith-Ennismore-Lakefield.

5.0 Low-End Naturalization Plans for the Entire Shoreline

5.1 Details for Low-end Plan

The key component of this low-end naturalization plan will be to let the grass grow. With the grass allowed to grow, sight lines will be reduced and this will prevent visits by Canada geese (Carter,M.; McCabe, K, 2003). Wildflowers and woody species will colonize the previously mowed areas by themselves (Nichol, 1998). The plan for the sitting areas will remain the same as in the high-end plan, however sitting area #3 will be removed, and the second park bench in sitting area #5 will be removed. Instead of planting full bushes, bare-root cuttings, or regular cuttings of willow, dogwood and other desired species will be placed along the entire shoreline and along both drainage ditches. Bare-root cuttings are cuttings that have been placed in water and have been given time to grow roots (Daigle & Havinga, 1996). These cuttings must be placed in the soil promptly after purchase (Dueck, 2003). Regular cuttings are cuttings taken directly from the source and planted (Carter, 2003). They can be taken from almost anywhere, however some properties will require permission. The Otonabee Conservation should be contacted if unsure whether permission is required. Cuttings should be approximately 0.5m long, no larger than 2cm in diameter, and should include at least one vigorous bud (Daigle & Havinga, 1996). They should be placed 2/3 of the way into the soil, with the end that was closest to the plant underground (Dueck, 2003). They are best taken and planted in early spring, prior to breaking spring dormancy. They should be stored overnight in wet to moist sand and planted in saturated soils (Daigle & Havinga, 1996). The shrub cuttings will take longer to stabilize the soil, but will have the same effect as planting full shrubs once established. To reduce costs even further, Cathy Dueck suggested that newspaper with holes for the vegetation should be placed under the mulch. The newspaper would be used instead of the filter cloth placed around the wildflowers and shrubs to prevent the growth of weeds near the new plantings. Landscape fabric will still need to be placed under the cedar mulch in the sitting areas and the pathways.

Visits from Canada geese can be expected until the shrubs become well established. This could take several seasons. The turf will need to be removed, and cuttings should be planted every 1.2 meters instead of the 2 meters normally allowed for full shrubs

(Basterfield, 2003). This is because the success rate of cuttings is lower than that of full shrubs. Newspaper and cedar mulch will also be needed for the establishment of the cuttings.

The only grass that should be mown is the meandering strip along the path and at the docking areas. The grass around the newly planted cuttings will require maintenance. This may mean some cutting or weed whacking until the shrubs become established.

The dock areas with severe erosion will still require the washed cobbles and shrub cuttings to prevent further loss of the soil to the water.

Paul Nichol has started his own Lindsay Ontario based business called *Ecosystems*. *Ecosystems* is an information management and environmental services company that has been providing environmental consulting services since 1996. Paul Nichol prefers this "do nothing" approach of naturalizing shorelines. He feels that as long as the grass is not cut, the shoreline can become "natural" on its own. Woody and herbaceous plants will eventually colonize the shoreline.

The budget for this low-end naturalization plan can be seen in table 3.

-End-

7.0 Permits

7.1 Trent Severn Waterway Permit Requirements

On May 6, 2003, I spoke with Beth Cockburn in the Realty Services Department at the Trent-Severn Waterway. An application to perform all in-water and shoreline works has been given to the Lakefield Trail Committee. Further copies of this application form can be picked up at the Trent-Severn Waterway address listed below. There is no fee for the work proposed along the subject because it is for the benefit of the public (Cockburn, 2003). As noted on the application form, a detailed sketch of the proposed work, including locations and measurements, and summer photographs of the subject site need to be attached to the application form upon submission. A land survey and a copy of the deed are not necessary for this work, because it is not commercial property. Instead, a letter of permission from the municipality, printed on letterhead, needs to be attached to the application. The entire application should be sent to the address listed below. The application must be submitted well in advance as the approval process can take up to 2-3 months. Approval must be granted prior to starting the project. The Trent-Severn Waterway can grant a 1-year extension of the approval if needed. In order the preserve water quality and habitat for spawning fish, all in-water work is normally permitted between July 1 and March 31. Once approval is granted, a letter of permissions will be issued. This letter must stay on the subject property when the work is taking place. It should be noted that an inspection by the Trent-Severn Waterway should be expected during and after the completion of the project to ensure proper compliance with the submitted plan. Because the washed cobbles planned for the active erosion site may need to be placed in the water, approval from the Department of Fisheries and Oceans (DFO) may be needed. If approval from the DFO is needed, the Trent-Severn Waterway will inform the applicant of this.

The application package and any further questions can be addressed directly to:

Trent-Severn Waterway
Attention: Realty Services
P.O.Box 567, Ashburnham Drive
Peterborough, ON
K9J 6Z6
Tel: (705) 750-4900
Fax: (705) 742-9644

7.2 The Otonabee Region Conservation Authority (ORCA)

The subject project does not need a permit from the Otonabee Region Conservation Authority if planting is the only naturalization technique. If erosion control materials such as the washed cobbles are needed there is a fill placement fee. If less or equal to 21 m^3 is placed on the shoreline above the high-water mark, there is a minimum fill placement fee of $125. If more than 21 m^3 of material is placed on the shoreline, there is a fill placement fee of $250. A copy of this fill placement permit application is located in appendix B. Requirements for the permit are located on the application. If no fill is placed on the shoreline, a permit is not required. If a permit is not required, Meredith Carter, Manager of Watershed Health at the Otonabee Conservation Authority has requested that the conservation authority be contacted before any work is started. The details of the project, as well as when it will be completed should be conveyed so that the conservation authority is aware of the project if any concerns are directed to them.

Any further questions can be addressed directly to:

The Otonabee Region Conservation Authority
250 Milroy Drive
Peterborough, ON
K9H 7M9
Tel: (705) 745-5791
Fax: (705)745-7488

7.3 The Ministry of Natural Resources (MNR)

Because this is a federal operated watercourse, provincial permits from the MNR are not required.

Further inquiries can be directed to:

The Ministry of Natural Resources
Attention: Colin Higgins, Resource Management Technician
1st Floor, South Tower
300 Water Street
Peterborough, ON
K9J 8M5
Tel: (705) 755-3301
Fax: (705) 755-3125

9.0 Recommendations for the Lakefield Trail Committee

9.1 Professional Consultation

It is important to reiterate the need for an engineer or landscape architect to assist in the planning and implementation of this project. Because of the size and strength of the Otonabee River, it is difficult to know whether this plan will be entirely successful during peak flows. An engineer or a landscape architect would be better able to study the river, and is likely to have related experience. Brian Basterfield, Landscape Architect at Basterfields & Associates has mentioned to me that he would be able to assist in the planning of this project free of charge. His contact information is located in the list of references.

9.2 Maintenance

As requested by Ed Barber, there is a section of grass along the edge of the path that should be cut on a regular basis. This meandering line, approximately the width of a lawnmower blade, prevents the area from looking untidy. The shape of the line is critical, and a consultation with a landscape architect is essential to discover appropriate angles for the edge of this naturalized shoreline. For the high-end naturalization plan, the grass along the shoreline and surrounding the wildflower islands can be cut approximately twice each year during the first 2-3 years after planting. This is to allow the establishment of the wildflowers and shrubs. Once the wildflowers are established, grass cutting should be kept to the line along the trail and the docking areas. The grass around the cuttings in the low-end naturalization plan should be maintained to allow the establishment of the shrubs. Wood chips will be used for the sitting areas to avoid cutting grass around benches and garbage cans.

Short-term aftercare for newly planted species is needed for the first year or two. This is a critical stage for root development due to their sensitivity to desiccation and flooding, and for seedling and sapling establishment due to herbivory and predation (Daigle & Havinga, 1996). Maintenance during the first year or two can include weed control, protection from herbivory and predation, watering and mulching, removal of exotic invading species, and removal and replacement of dead or vandalized plants. Fertilizers, pesticides or herbicides should not be used on or near the shoreline. These elements can

enter the waterway and contaminate the river. Approximately 20% of the plantings will not survive after the first winter (Basterfield, 2003). Self established woody saplings can be controlled as needed by manual removal.

The garbage cans, benches and rocks can be periodically monitored for vandalism and untidiness. The garbage cans will need to be emptied.

Some of the bushes used in this naturalization plan have the potential to grow very tall. The residence along the shoreline may have concerns about river visibility. Periodically, these bushes may need to be trimmed.

9.3 Community Communication

Public communication is essential for the success of projects such as this. This situation is particularly delicate. The people living in the residences along this shoreline feel very strongly and it is imperative that they be contacted during the planning process. If there are misunderstandings about the purpose, goal or outcome of this project, many complications could arise, and the entire plan could fail. I recommend that public consultation meetings be held during the planning process. These meetings are an opportunity to educate the public on the benefits of a naturalized shoreline. The community needs to be aware of the threats of poor water and habitat quality and what causes them. The meetings are also an opportunity to discuss different plant species as well as their planting locations. This plan is intended for best erosion control, habitat quality and aesthetic results including river visibility. The residences of the shoreline may have different needs that must be addressed so as to have full community understanding and cooperation with this project.

9.4 Signage

Strategically placed signs along the shoreline can be used to educate the public about naturalized shorelines. The signs can describe the plant species used and their benefits for wildlife, and can even publicize any donations made. The sign could also include contact information for volunteers willing to help in future projects.

In the short-term, signage along the project site can help people understand why the shoreline may look less “tidy” than other urban shorelines. In the long-term, the information gained by these signs can be passed on; creating an environmentally aware public that understands natural processes. These people can then go forward and make wise decisions about preserving water quality and wildlife habitat on other waterfront properties.

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11.0 Appendices