Conserving a Delicate Balance

Management Plan for North Sauble Beach, Ontario, Canada

Prepared By
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Preface

This management plan follows a similar plan undertaken for the south Sauble Beach (Main St. to Sixth St.) in 2004. Both plans were commissioned by the Friends of Sauble Beach, a local non-profit organization dedicated to conserving the environmental health of the beach and dune system at Sauble Beach.

This plan was prepared by Geoff Peach, Coastal Resources Manager with the Lake Huron Centre for Coastal Conservation. It focuses on the area from Sixth St., north to the Sauble River. Components of this plan were completed by experts contracted by the Coastal Centre. Dr. Jane Bowles provided a vegetation inventory and assessment. Mr. Larry Porter, OALA, assisted with the determination of access points which he identified on a map of the project area. He also provided cost estimates for the implementation of the access trails.

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Introduction

Coastal Dune systems are considered to be among the most fragile ecological features in North America. Great Lakes dune systems in Ontario, due to their rarity and ecological fragility, are of national and global significance. Lake Huron's dunes are found along a small fraction (about 2 to 3%) of the lake's 6,000 kilometre shoreline. Lake Huron's dune systems represent an extremely small land mass. They are narrow linear features restricted to localized areas along major shorelines, and their total area is spatially limited. Yet these are the areas of the lakeshore that attract thousands of people each summer.

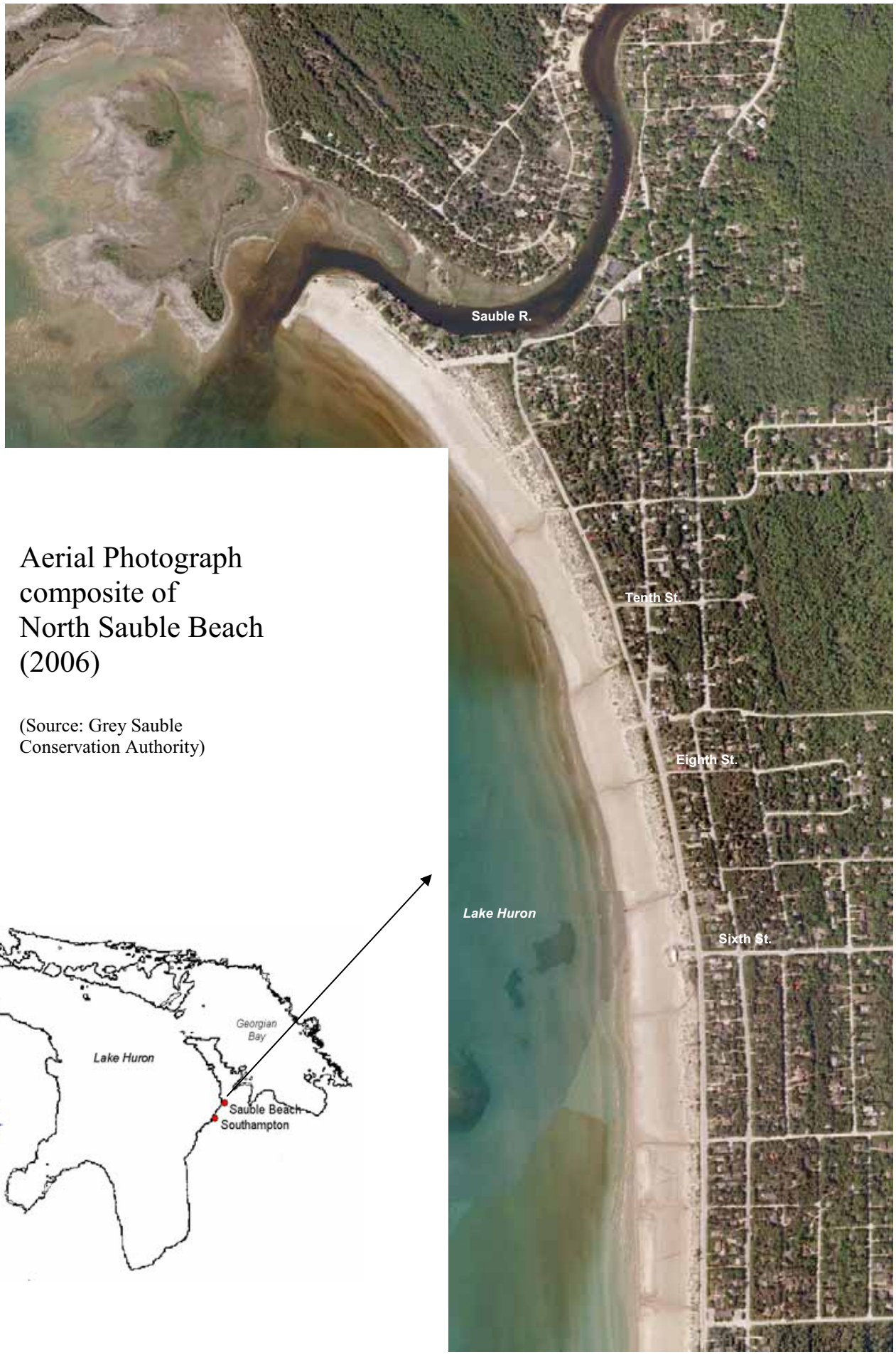
All ecosystems have a certain threshold for being able to absorb human impacts. Dunes, in particular, have a very low threshold. Research has demonstrated that dune vegetation is sensitive to damage by human disturbance (Trowell, 1987). Dunes are vulnerable to wind erosion once the anchoring vegetation on them is damaged or destroyed. Without effective conservation measures, we stand to lose an already limited resource.

Dunes are enormously rich in biological diversity, and usually contain plant communities and species that are rare. As habitat, dunes are unlike any other ecological feature in Ontario, and so they are special places, to plants, animals and people.

Current research on Lake Huron has concluded that degraded dune areas can actually create the conditions that lead to elevated bacterial pollution in the groundwater below beaches. Removal of beach sand, dunes and beach grass, leads to a shallow depth to the water table, which in turn promotes wet or damp sand on the beach, the invasion and growth of non-native beach plants and a higher exposure risk to *E. coli* (Crowe, personal communication, 2007).

North Sauble Beach

The study area includes the lakeshore system of beach and dunes west of Lakeshore Blvd. and from 6th Street to the Sauble River in Sauble Beach, Bruce County, Ontario. The northern limit of the study area at 44^{o} 39.67' N 81^{o} 16.85' W is marked by an artificial rock breakwater at the mouth of the Sauble River. The south end is marked by a pavilion at the west end of 6th Street at 44^{o} 37.6'N 81^{o} 16.23' W. The beach and dune system is narrowest at the southern end, (about 90 m from lake to road) and gradually widens to the north to about 220 m before narrowing abruptly about 320 m south of the breakwater. The dune system is about 70 metres wide at the northern end, where the dunes are highest (4-5 m) and narrowest at the southern end where it is about 20 m wide and 2-3 m high. To the east, between the dune and the road is a stabilized system of wet meadows. These occur as small pockets at



Aerial Photograph composite of North Sauble Beach (2006)

(Source: Grey Sauble Conservation Authority)

various points, but are best developed in the north. They are usually associated with about seven storm drain outlets that form small intermittent or permanent streams that cross the beach and form small wetland areas.

A few structures are present on the dunes. These include the 6th St. washroom facility, a second smaller washroom, a tennis court and swing sets. Several "official" well marked and trails with post-and-rail barriers cross the dunes, but there is also a network of smaller trails and access points for individual housed on the east side of Lakeshore Blvd. Parking facilities are provided along the edge of part of the road, so that access across the dunes to the beach is well directed to certain points, but not completely controlled.

Beach Processes

Sand is continually being eroded and deposited on the shore by waves. Storm waves will erode the beach, taking the sand offshore, and forming a sand bar. The sand bar acts as a temporary protective berm, absorbing wave energy that would otherwise reach the shore causing even more erosion. Once the storm subsides, gentle waves will gradually bring the sand from the sand bar back to the shore and re-deposit it on the beach.

Once onshore, the sand is then prone to movement by wind.

Dunes form when sand is carried by the wind from the beach towards the land. The wind transports the sand in three ways: in ***suspension***, by lifting the smaller, lighter fractions into the airstream and carrying them for long distances; by ***saltation***, as heavier grains are moved in a series of 'hops' and 'jumps' along the beach surface; and as ***surface creep***, in which sand particles are rolled along the surface as a result of wind forces or the impact of descending saltating particles. Although most sand particles are moved by saltation, surface creep may account for 20-25% of the moved sand (Bagnold, 1954). Most of the sand is carried within 0.15 m (6 inches) of the ground surface. The very fine sands light enough to be carried by suspension are usually carried well outside of the active dune system.

A significant amount of sand movement will take place when the wind speed, measured at a height of 1 m (3 ft) above ground level, exceeds 12 knots (6 m per sec). Initiation of sand movement occurs at wind speeds of 5m per second. Onshore winds will dry the sand and selectively pick up the smaller grains of sand (0.08 - 0.5 mm) and move them towards the land. Sand grain sizes in dunes are therefore finer than those on beaches. This is important because fine sand deposits have greater water retention capacity than coarse sands and are therefore more suitable for vegetation growth. Moist sand is moved less easily by the wind than dry sand since

moisture promotes surface adhesion. The threshold shear velocity (the wind strength needed to initiate movement) is higher for moist sand.

While wind strength is important, the quantity of sand moved is also influenced by how long the wind is blowing from a particular direction. Wind duration is an important consideration, and knowing the prevailing wind directions at certain times of the year can help with determining management strategies for dune conservation and restoration efforts. Winds from the west and southwest are perhaps the most influential in the movement of sand at Sauble Beach.

As well as wind speeds and duration, water levels play a significant role in how much sand transportation will take place. During high water levels, more of the beach is submerged and the width of dry beach is less. As a result, less beach is exposed to wind erosion. Conversely, during lower water levels, more beach is exposed and greater wind erosion of the beach is possible. Therefore, periods of dune building tend to occur during lower water levels. Periods of natural dune erosion tend to occur during high lake levels when storm waves erode the base of the dune and carry that sand to offshore bars. What is fundamental to understand is that sand dunes and beaches must be managed as one system. Dunes depend on beach sand for their formation, particularly during low water level periods, and beaches need the sand reserve held in the dunes during high lake levels and storm events.

Role of Dune Vegetation

When the wind encounters an obstacle such as a clump of vegetation, the wind speed is reduced and the sand grains fall out under gravity, resulting in sand deposition. As the sand accumulation continues, a dune is formed. Dunes form when there is an adequate sand supply and onshore winds of sufficient velocity to move the sand. As the dune builds, it becomes a major obstacle to the landward movement of windblown sand. Thus, the dune serves to conserve sand in close proximity to the beach system.

Dune vegetation promotes the large scale trapping of sand. The stems of dune grasses reduce the wind velocity near the surface, causing the deposition of sand. Plant roots also serve to bind and consolidate the sand. Dune grasses thrive on incoming sand and accelerate their growth to keep up with the increasing height of the dune (Broome *et al,* 1982). The vegetation cover represents the difference between a mobile pile of sand and a stabilized dune (Salmon *et al*, 1982).

A vegetated dune provides an important reservoir of sand that circulates between the first dune (foredune), the beach, the surf zone and the lake bed, according to lake and wind conditions.

Coastal vegetation is itself dynamic. Earlier, simpler plant communities pave the way for a series of future, more complex communities. This process is known as succession and is reflected in the formation of distinct plant communities over time. These communities are usually quite visible to the observer, yet the transition between plant communities can sometimes be difficult to distinguish.

Pioneer plants trap and hold windblown sand in the foredune and help create conditions which encourage the establishment and growth of other plant communities. All plants, whether they are herbs, shrubs or trees, growing either singly or in groups, have a role in the development of vegetative cover and together they bring about dune stabilization. Windblown sand trapped in the foredune by vegetation serves as a reservoir of sand for the beach during periods of wave erosion. In the absence of sand-trapping dune vegetation, windblown sand from the beach moves inland and is lost from the beach/dune system. Wind erosion of the beach and unvegetated foredunes results in coastline recession. Over the long term, a receding shoreline (gradually moving landward) could impact residences (stationary structures) along the lakefront.

The importance of dune vegetation to dunes is straightforward. The above-ground parts of dune plants act as obstructions, increase surface roughness and reduce the surface speed of sand-carrying wind. The reduction in wind movement results in the deposition of sand on and around the plant. There is actually a boundary layer where wind velocity equals zero and it is in this zone that sand is deposited. Bare sand has a small boundary layer, whereas research has shown that when an area is planted with American Beachgrass *(Ammophila breviligulata)* this boundary layer is 30 times higher than the bare surface.

American Beachgrass (also known as Marram grass) is the most successful sand-trapping plant colonizing dunes along most of the Lake Huron coastline. It has the ability to grow through substantial accumulations of windblown sand. Cycles of sand deposition and plant growth result in dune formation and build-up.

The development of vegetative cover on newly formed dunes, if not disturbed or trampled, will create conditions which support the colonization and growth of a wider range of plant species. The shade produced by plants keeps surface temperatures lower than on bare sand and, together with reduced wind movement, helps to lower the evaporation rate from the sand surface. Increasing vegetative cover further reduces wind movement, which results in a lower rate of water loss from plant leaves. Dead plants and leaf litter add humus to the sand and acts as mulch. The accumulation of humus results in improved moisture and nutrient-holding capacity of developing dune soils. With lower surface temperatures and increased moisture and nutrient content, the sand can support a greater variety of plants. Thus, the vegetative cover on the dune increases and movement of sand by wind is further

decreased.

Pioneer plants make up the initial dune vegetation. They are found on the dune nearest the lake, where their survival depends on their ability to establish, grow and reproduce. They must also tolerate strong winds, sandblasting, temperature extremes and occasional inundation by water. Plants with these characteristics are ideally suited as agents for initial stabilization of dunes.

Sand dune grasses are plants which have specifically adapted to the dune environment. The structure of these grasses can resist sand abrasion, wind breakage and water loss. They have adapted to extreme heat (dunes can reach temperatures of 60C in summer!) as well as nutrient deficient soil. Confronted by high winds capable of blowing seeds many kilometres away, these plants have evolved a dual system of reproduction. In addition to the conventional seed production, they send out horizontal stems called 'rhizomes' under the surface to push up new growth short distances away. The massive underground root systems that develop provide the dune with structure, making them far more durable than they would be otherwise.

American Beachgrass is a common pioneer plant at Sauble Beach but the Lake Huron endemic Long Leaved Reed Grass (*Calamovilfa longifolia*) is another key dune stabilizer. Where American Beachgrass can tolerate substantial burial by wind generated sand deposition, Long-leaved Reedgrass is less tolerant and therefore tends to develop in areas where sand deposition is less. Many dune plants require specific conditions to thrive, and so they tend to grow in more or less predictable, shore-parallel zones within the dunes.

(Note to Reader: Long-leaved Reedgrass, which is an important endemic dune species, should not be confused with Common Reed, which is an alien, invasive plant species. The names Reedgrass and Reed may sound similar, but the two are very different plants).

The foredune is the most critical part of the dune system, as far as coastal processes are concerned, and is the area least able to tolerate any human disturbance or development. Vegetation on the foredune builds up the dunes by trapping wind-blown sand, preventing it from being blown inland and lost from the beach system. The sand-binding plants that grow on the foredune and perform this vital function are highly susceptible to damage through human disturbance, like trampling.

Beach and sand dune vegetation both bind the soil and lower wind velocities causing fine sands to be deposited. This can be observed in beach areas occupied by vegetation and in bare areas caused by human disturbance. Fine sands collect around dune vegetation, while in areas devoid of vegetation, fine sands are eroded away, leaving coarse sands behind.

VEGETATION AND FLORISTICS

(Dr. Jane Bowles)

Vegetation Communities

The vegetation community structure of the site is characterized mainly by distance from the lake and the height above the water. According to the Ecological Land Classification (ELC) for Southern Ontario (Lee et al.1998), five Ecosites in three Community Classes, Beach/Bar, Sand Dune and Marsh can be recognized.

Mineral Open Beach/Bar (BBO1)

The beach forms a broad level area between the lake shore and the base of the sand dunes. The width of this community is dictated by water levels in the lake. Current low levels mean that this stretch is wider than normal at present – about 50 m. Under natural conditions this community would be characterized by strand lines of debris deposited by the lake and a plant community of annuals and opportunistic perennials. Because of beach management activities (clearing of debris, scraping and raking) and a great deal of human trampling traffic this area is almost devoid of vegetation. Almost the only plants established form an ephemeral mixture of mainly weedy species close to the lake at the north end where the beach was cordoned off while piping plovers bred, and some scattered plants near the base of the dunes. The appearance of this community in an undisturbed area provides a hint of what the beach community might be during periods of low water if the beach was not managed (Figure 1). The most common plant in the upper beach zone is Dog Mustard (*Erucastrum gallicum*), an introduced weedy species. Two other plants, Sea Rocket (*Cakile edentula*) and Wormwood (*Artemesia campestris*) are typical native plants of the Great Lakes Shoreline. Wormwood is found near the base of the dunes and is much more common on the dunes themselves. Sea Rocket is a strand line species with its main distribution on the beaches of the Atlantic Coast Plain. It is surprisingly rare at Sauble Beach, probably because its habitat is usually destroyed by current beach raking practices.

Figure 1—Vegetation community developing on the beach in an unmanaged area at the north end of Sauble Beach. (Bowles).

Open Sand Dune SDO1

The sand dunes at Sauble Beach fall into three Ecosites depending on the form of the dominant vegetation. Dune grasses characterize open sand dunes. Open sand dune communities are intermixed with Shrub Sand Dunes, but tend to occupy the lakeward faces of slopes and the more active dunes. Typical dune grasses are Sand Reed (*Calamovilfa longifolia*), Indian Grass (*Sorgastrum nutans*), American Beach Grass (*Ammophila breviligulata*), Little Bluestem (*Schizachyrium scoparium*), Switch Grass (*Panicum virgatum*) and Canada Wild Rye (*Elymus canadensis*). These are found mixed together and different proportions throughout the dunes. Beach Grass tends to occupy the active frontal dunes closest to the beach (Figure 2). Little Bluestem is found on the back faces of more stable dunes with less sand movement. Indian Grass and Sand Reed are on the steeper rolling dunes and Canada Wild Rye is most common near the north end of the site in low dunes. Canada Blue Grass (*Poa compressa*), which is not a dune specialist is also common on the open dunes. Prominent non-grass species include Wormwood, Starry-flowered False Solomon's Seal (*Mianthemum stellatum*) and Balsam Ragwort (*Senecio paupercaulis*). The substrate in the Open Dune Ecosite is almost always pure sand, with little organic litter cover. Sand movement is a normal part of community processes.

Figure 2—Pure stand of American Beach Grass on the lakeward side of the dunes at Sauble Beach. (Bowles).

Shrub Sand Dune SDS1

Shrub Sand Dunes intermingle with the open sand dune and occupy a range of sites from areas where bare sand is the substrate to more stable sites with a partial ground cover of organic material. The dune grasses and other species are present, but the dominant species are low shrubs. The most abundant species are Heart-leaved Willow (*Salix cordata*), Sand Cherry (*Prunus pumila*) Shrubby Cinquefoil (*Potentila fruticosa*) and Kalm's Saint John's-wort (*Hypericum kalmianum*) (Figure 3). Red Osier Dogwood (*Cornus stolonifera*) is also present and there are some large shrubs of it, partially buried by sand at the north end of the beach. Balsam Poplar (*Populus balsamifera*) is also present as a shrub, but not as the tree form it reaches on some dunes. Ninebark (*Physocarpus opulifolius*) and Bearberry (*Arctostaphylos va-ursi*) are found on more stable slopes.

Figure 3—Sand dunes at Sauble Beach occupied by low shrubs. (Bowles).

Heart-leaved Willow is quite rare in southwestern Ontario and is more abundant on the Sauble Beach dunes than anywhere else to the south. Sand Cherry was once abundant along dunes of the Great Lakes shorelines, but in the last two decades has been decimated at many places because of the over-abundance of White-tailed Deer. The abundance of the shrub at Sauble Beach may be partly due to the urban setting with few deer. Kalm's Saint John's-wort (Figure 4), named in honour of Pehr Kalm (1716-1779) a pupil of Linnaeus, is a Great Lakes endemic, found along the shores of the Great Lakes, particularly northern Lake Huron, but occurring nowhere else in the world.

Figure 4—Kalm's Saint John's-wort (*Hypericum kalmianum*). (Bowles).

Gravel pile:
At one place close to a swing set a load of gravel and coarse sand has been dumped. The purpose for this is unclear, but the results are very evident in the increase in non-native weedy species at this location. The non-dune contaminants include White Sweet-clover (*Melilotus alba*), Bladder Campion (*Silene vulgaris*), Wall Rocket (*Diplotaxus muralis*), Black Medic (*Lupulina medicago*), Bugleweed (*Echium vulgare*), Russian Thistle (*Salsola kali*) and Knotweed (*Polygonum aviculare*), none of which are native, but all of which have the potential to spread and become weedy in dune systems. A similar set of weeds is found along roadsides in the area.

Treed Sand Dune SDT1
Treed Sand Dunes have developed in small pockets along the road behind the dune ridge. Many of the trees are planted, or are volunteer recruits from planted trees. Scots Pine (*Pinus sylvestris*) is abundant as is European White Birch (*Betula pendula*). White Spruce (*Picea glauca*) and Tamarack (*Larix laricina*) are native trees, but would not normally be found in natural treed dunes in this area (Figure 5). Eastern White Cedar (*Thuja occidentalis*) is present as small trees as well as shrubs of all sizes. The species of the open and shrub dunes are present in the treed areas, but are augmented with additional species that are not commonly found in the open dunes. They include Soapberry (Shepherdia canadensis), Tall goldenrod (*Solidago altissima*), Ohio Goldenrod (*S. ohioensis*) and Wild Strawberry (*Fragaria virginiana*). The ground cover is much greater, with little open sand between the plants.

Figure 5—A small patch of Treed Sand Dune at Sauble Beach. Most trees are planted, but young Scots Pine are beginning to invade the adjacent dune. (Bowles).

Rocky breakwater

Next to the river at the northern boundary of the site is an artificial berm built of rocks and boulders. This supports it own suit of plant species that generally do not extend onto the beach or adjacent dunes. Most spectacular of these is Plumeless Thistle (Carduus acanthoides) an unusual European weed (Figure 6). Common Saint John's-wort, (*Hypericum perforatum*), White Sweet Clover and Horseweed (*Conyzia canadensis*) are also prominent, as is Spotted Knapweed (*Centaurea maculosa*).

Figure 6— Plumeless Thistle (*Carduus acanthoides*) (Bowles).

Great Coastal Meadow Marsh (MAM4)
Great Lakes Coastal Meadow Marshes are distinctive wetlands that are restricted to near shore areas of the Great Lakes. Because they have a restricted distribution and many have been destroyed by lakeshore development, and are considered globally imperiled. They are characterized by calcareous, course textured substrates of sand, gravel and cobbles and have low nutrient levels. There is also a high incidence of rare and uncommon species. Sauble Beach contains two kinds of Great Lakes Coastal Meadow Marsh Community Types.

Graminoid Coastal Meadow Marsh (MAM4-1)
Graminoid Coastal Meadow Marsh Ecosites occur in wet seepage areas at the mouth of drains where they enter the beach. The vegetation is typically low and sparse, consisting of graminoid species such as rushes (*Junus nodosus, J. articulatus, J. alpinus J. bufonius*) and sedges (*Scirpus pungens, Eleocharis erythropoda, E. pauciflora, Cladium marisicoides*) as well as Slender bog Arrow-grass (*Triglochin palustris*).

Shrubby Cinquefoil Coastal Meadow Marsh (MAM4-2)
These Coastal Meadow Marsh communities have formed in low wet pockets at the

backs of the dune, close to the road. They are older communities, with stabilized sand and a better developed soil horizon and often some accumulation of organic matter. These communities are very sensitive to moisture levels. They expand and develop during years of high lake levels and are threatened by lowering of the water levels. With the current trend of lowered lake levels and projections of future drought these small remnant communities are probably the most threatened at Sauble Beach. These communities are characterized by low shrubs of Shrubby Cinqfoil and Kalm's Saint-John's-wort, but they contain other species that are very specialized by habitat and that are found nowhere else at Sauble Beach. These include Upland White Goldenrod (*Solidago ptarmicoides*), Harebell (*Campanula rotundifolia*, Small Yellow Flax (*Linum medium*), Grass of Parnassus (*Parnasia glauca*), Round-leaved sundew (*Drosera rotundifolia*), Sticky Tofieldia (*Tofieldia glutinosa*) and Dwarf Canadian Primrose (*Primula mistassinica*) and Bullush Sedge (*Carex sciroidea*). Some of these species, for example the last two, are rare in southwestern Ontario and seldom found except on the Bruce Peninsula.

Floristics

A total of 134 vascular plant species in 47 families were recorded from the study site. Of these 39 (29%) were non-native (adventive) species, mainly weeds of Eurasian origin. This is similar to the average of 31% for southern Ontario (Oldham, 1993). An annotated list of plant species and an indication of the vegetation types in which they were found is given in *Appendix 1*. Table 1 summarizes some of the floristic statistics for the site. The percentage of non-native species varies from 10% in the globally rare Shrubby Cinquefoil Coastal Meadow Marsh to 86% on the imported pile of gravel. Non-native species in southern Ontario have been assigned a score from –1 (slightly weedy) to –3 (highly invasive). The total weediness score for a site gives an indication of how invaded a site is. The total weediness for vegetation types at Sauble Beach ranges from –6 (Beach) to –26 (Treed Sand Dunes). The weediness scores of individual species is given in *Appendix 1*. The total weediness will depend partly on how species rich a site is and how many species are recorded. The imported gravel piles with 86% adventive species have the highest average weediness. This emphasizes the danger of bringing imported material on to the beach.

Another way of assessing site quality is using the Mean Conservative Coefficient (CC). Each native species has assigned a conservative coefficient that reflects how sensitive the plant is to habitat types and disturbance. Highly specialized plants that are only found in specific habitats are given a high score (8-10). Generalist species that will grow almost anywhere are given a low score (0-2). The mean conservatism score for any site provides an indication of site quality. Most natural vegetation communities will have a Mean CC of about 4-5. Highly disturbed habitats usually range below 3. At Sauble Beach the high score of 6.9 in the Shrubby Cinquefoil

Coastal Meadow Marsh reflects the high number of sensitive and highly specialized plants in this site (Table 1). The Graminoid Coastal Meadow Marsh and the Sand Dune habitat also have high Mean CC because of the number of specialized sand dune species. Note that the Gravel pile has a Mean CC of 0. The only native species recorded is a generalist.

Table 1: Summary of floristic quality statistics for vegetation communities at Sauble Beach.

	VEGETATION COMMUNITY TYPE		
	BEACH	**SAND DUNES**	**TREED DUNES**
Count of native species	14	34	45
Count of adventive species	5	9	15
Total plant species	19	43	60
Percent adventive species	26	21	25
Total weediness	-6	-16	-26
Mean weediness	-0.3	-0.7	-1.1
Mean CC	4.4	5.7	5.6
Count of conservative species	4	14	17
Wetness	-1.6	0.8	0.4

Table 2 gives a list of species at Sauble Beach with high conservatism coefficients and the vegetation community types in which they occur.

Table 2: List of vascular plant species with high Conservatism Co-efficients (CC) of 8-10 and the vegetation types at Sauble Beach in which they are found.

SCIENTIFIC NAME	COMMON NAME	CC	BEACH	SAND DUNE	TREED SAND DUNE	ROCKY BERM	GRAM. MEAD. MARSH	SHRUB MEAD.MARSH
Arctostaphylos uva-ursi	BEARBERRY	8		X				
Artemisia campestris	WORMWOOD	8		X				
Elymus canadensis	CANADA WILD-RYE	8		X	X			
Parnassia glauca	GRASS-OF-PARNASSUS	8	X	X	X		X	
Sorghastrum nutans	INDIAN GRASS	8	X					
Cakile edentula	SEA ROCKET	9		X				
Calopogon tuberosus	GRASS-PINK;CALOPOGON	9						X
Cladium mariscoides	TWIG-RUSH	9						X
Hypericum kalmianum	KALM'S ST. JOHN'S-WORT	9						X
Lathyrus japonicus	BEACH PEA	9	X				X	
Lobelia kalmii	BOG LOBELIA	9		X	X	X	X	
Potentilla fruticosa	SHRUBBY CINQUEFOIL	9		X				X
Salix cordata	SAND-DUNE WILLOW	9		X				
Solidago ptarmicoides	UPLAND WHITE GOLDENROD	9		X				
Solidago uliginosa	BOG GOLDENROD	9						X
Ammophila breviligulata	MARRAM GRASS;BEACH GRASS	10		X				
Anemone multifida	RED ANEMONE	10						X
Calamovilfa longifolia	SAND REED;DUNE REED	10						X
Carex scirpoidea	BULRUSH SEDGE	10		X				
Eleocharis pauciflora	SPIKE-RUSH	10						X
Juniperus horizontalis	CREEPING JUNIPER	10		X				
Linum medium var. medium	SMALL YELLOW FLAX	10		X				
Lithospermum canescens	HOARY PUCCOON	10					X	
Primula mistassinica	DWARF CANADIAN PRIMROSE	10						X
Prunus pumila var. pumila	SAND CHERRY	10						X
Solidago ohioensis	OHIO GOLDENROD	10		X	X		X	
Tofieldia glutinosa	FALSE ASPHODEL	10						X
Triglochin palustris	SLENDER BOG ARROW-GRASS	10	X				X	
Zigadenus elegans	WHITE CAMAS	10						X

Species at Risk
Piping Plover

The piping plover (*Charadrius melodus)*, named for its melodic mating call, is a small, pale-coloured North American shorebird. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has identified the piping plover as an endangered species in Canada.

The bird's light sand-coloured plumage blends in with the sandy beaches and shorelines that are its primary habitat. It weighs about 43-63 grams (1-2 ounces) and is 17-18 centimetres (6-6 2 inches) long. During the breeding season the legs are bright orange and the short stout bill is orange with a black tip. There are two single dark bands, one around the neck and one across the forehead between the eyes. Plumage and leg colour help distinguish this bird from other plovers. The female's neck band is often incomplete and is usually thinner than the male's neck band. In winter, the bill turns black, the legs remain orange, but pale, and the black plumage bands on the head and neck are lost. Chicks have speckled grey, buff, and brown down, black beaks, orange legs, and a white collar around the neck. Juveniles resemble wintering adults and obtain their adult plumage the spring after they fledge.

Generally, piping plovers favour open sand, gravel, or cobble beaches for breeding. Breeding sites are generally found on islands, lakeshores, and coastal shorelines. Piping plovers were extirpated from Great Lakes beaches in Illinois, Indiana, New York, Ohio, Pennsylvania and Ontario by the late 1970s. Until the successful breeding at Sauble Beach in 2007, the Great Lakes population of plovers has been restricted to Michigan's coastline.

Figure 7 - Piping plover

Piping plovers feed along beaches and sand flats. They feed primarily on exposed beach substrates by pecking for invertebrates one centimeter (0.4 in) or less below the surface. Primary prey for piping plovers includes worms, crustaceans, insects, and occasionally bivalve molluscs. Most foraging is diurnal. The time adults devote to foraging may increase during the incubation period and after chicks fledge; adults incubating or caring for chicks may spend less time foraging than birds that have lost their broods. Foraging habitat (beach) and food resources ultimately affect piping plover survival (US FWS, 2003).

Any activities at Sauble Beach that disturb the beach (e.g. mechanical raking, vehicle use, etc.) could destroy the feeding grounds for the birds.

Threats

Loss or degradation of habitat resulting from the recreational use of beaches is a serious threat throughout the plover's range. In addition, high water levels have resulted in the reduction of beach habitat on the Great Lakes and elsewhere. Increases in predators such as the red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*) and ring-billed gull (*Larus delawarensis*) have contributed to the poor breeding success of this beach nesting bird. Their nests accidentally get stepped on or crushed by people and vehicles. The presence of people also may cause the birds to desert the nest, exposing eggs or chicks to the hot sun and predators. Interruption of feeding may stress juvenile birds during critical periods in their life cycle. Pets, especially dogs, may harass or kill the birds. Many of the coastal beaches traditionally used by piping plovers for nesting, feeding, and roosting have been lost to commercial, residential, and recreational developments. Also, developments near beaches provide food that attracts increased numbers of predators such as racoons, skunks, and foxes.

Some activities could have an adverse effect on piping plover habitat. Such activities might include:

- Dredging and dredge spoil placement; dumping of fill material.
- Construction of dwellings, roads, marinas, and other structures and associated impacts such as staging of equipment and materials.
- Beach nourishment, stabilization and cleaning.
- Certain types and levels of recreational activities such as all-terrain vehicle or snowmobile activity.
- Stormwater and wastewater discharge from communities.

Features needed for life and successful reproduction of the piping plover include:

- space for individual and population growth and for normal behaviour;
- food, water, air, light, minerals, or other nutritional or physiological requirements;
- cover or shelter;
- sites for breeding and rearing of offspring; and
- habitats that are protected from disturbance.

(*U.S. Fish and Wildlife Service, 2003*)

Human Impacts to Dunes

Vegetation is absolutely critical to the stability of the dune. Without it the dune is vulnerable to erosion by either wind or waves, or both. Research has demonstrated that dune vegetation is fragile to human disturbance and can be killed by fewer than 200 dune crossings (Bowles and Maun, 1982). Pioneer vegetation may be killed by far fewer passages.

Dunes are fragile systems and trampling by beach goers destroys the vegetation and results in deterioration of the dune. Destruction of vegetation makes the dunes unstable, increases wind erosion and causes the coastline to recede. As trails are established along frequently used routes through the dunes, the vegetation is destroyed and the wind begins to carry sand from the exposed area. The continual loss of sand deepens the trail. Sloughing away of sand from the trail's sides widens it. As a greater area is exposed to wind erosion, a blowout or washout may develop. As blowouts develop, sand blows inland, often outside of the active beach-dune system. When it does this, it represents a loss to the system. This is of great concern because, as discussed earlier, the beach and dune sands along the waterfront are mainly relic materials and geomorphic conditions that created the large dune deposits at Sauble Beach are no longer present, and therefore unable to be replaced naturally. This inland migration of sand can also result in substantial maintenance costs to the municipality as it forms drifts along roads and beach accessways. A blowout can also represent a reduction of the dune's shore protection capability. This gap in the dunes can allow storm waves to erode much larger segments of the shore than would otherwise be the case.

Beach Vegetation

In recent years we have experienced a period of lower than average water levels on

Figure 8—Photo illustrates the growth of Marram grass Lakeward of the dune during periods of lower lake levels. This vegetation expansion corresponds with the wider beach and increased wind transport of sand. If the expanded dune grass is damaged as a result of human impacts, sand will deposit further inland, and backdunes will grow vertically, or sand will be lost onto Lakeshore Blvd. or beyond.

Lake Huron. This has resulted in much wider beaches, particularly in areas with a shallow nearshore profile, like Sauble Beach. This period of low lake levels has given rise to the migration of dune vegetation (particularly Marram grass) toward the lake. This is a natural process which should not be disturbed. This plant migration allows the dune to develop outward and build the sand reserve. When plants are removed or damaged, the dune tends to build upwards, often obstructing views of the lake.

The lakeward expansion of dune vegetation during low lake levels helps the beach to retain sand (reducing wind erosion), and slows the dune building process, effectively allowing certain rare dune species to establish populations.

The return of higher lake levels will again alter the plant communities found on the leading edge of the dunes.

Beach and dune systems are best managed by not interfering with the natural processes, but instead accepting that wave induced erosion will occur during periods of high lake levels, and wind induced sand deposition will be more prevalent during low lake levels. Working with natural lake processes, rather than at odds with them, provides a wide range of benefits, including a healthy beach from ecological, economic and public health standpoints. It must be understood that beaches and dunes are dynamic environments and physical change occurs normally and with regularity.

Climate Change

How might climate change affect our beaches? Researchers project a decline in Great Lakes water levels by as much as one to two metres lower than present. This is not to say that we will not experience higher water and erosion of dunes under climate change scenarios. It means the current range of lake levels (from the record high of 1985 to the record low of 1964), will shift downward. So lake levels will still fluctuate, but within a different range than to what we have been accustomed.

Increases in wind strength and duration would increase the likelihood of damage to vegetation, development of blowouts where susceptible, and enhanced migration of sand into the interior.

In general, lower lake levels will expose more sand along beaches, widening their expanse. Wider sand beaches will lead to more wind transported sand. If the necessary dune vegetation is not present to intercept this blown sand, both the quantity and quality of beaches will deteriorate as the fine sands migrate outside of the active beach system.

Changes in total precipitation and seasonal distribution may have a great influence on sand transport rates, since moisture content of near surface sand will influence not only the threshold wind velocity needed to begin the process of sand transport by wind, but also the vigour of the beach and dune vegetation. Sauble Beach has typically had a high groundwater table which has resulted in a generally wet sand beach. Lowering of groundwater table could have a major effect on the stability/ instability of the dune system, since in active dune systems, the base level of deflation is controlled by the position of the water table (Houston, et al., 2001). This has important management implications and means that adaptations will have to be made to dune conservation strategies as conditions change.

Average temperatures in the Great Lakes region are projected to increase by as much as 2 to 4 degrees Celsius. An increase in average temperature may enhance rates of sand transport on bare sand surfaces as the higher temperatures increase the rate at which sand dries out after a rainfall.

Lower lake levels may influence the quality of nearshore waters. As experienced already in the early part of this century, lower levels created a shallower nearshore. Current issues related to nutrient loading to the lake, and pathogenic pollution have been worsened by lower lake levels, creating conditions for the accelerated production of algae, and increased incidences of beach postings for unsafe swimming in some areas.

Lower levels may also make it easier for invasive plant species to take advantage of disturbed or unpopulated parts of the beach. More efforts may be necessary to identify invasive plants and establish control programs. Plants like Common Reed, Spotted Knapweed and Sweet White Clover (and others identified earlier) are some of the invasive plants currently taking an aggressive hold on some beach and dune areas. Management of these plants has been costly in both time and resources. Invasive plants may be an issue that will require ongoing monitoring, and appropriate control measures, in the future.

Management Recommendations

Beach Cleaning

Small amounts of organic material usually forms a "strand line" on the beach, particularly after a storm. The material in the strand line is important to the ecology of the beach, providing habitat for various invertebrates, and nutrients for shorebirds and beach and dune plants. The strand line should **not** be disturbed.

Vehicle Access

The use of vehicles, including heavy equipment, all-terrain vehicles and snowmobiles, can have a profound negative impact on both beaches and dunes.

Impacts to Beaches

Research has identified that vehicle traffic on beaches tended to compact beach sand at depth, but loosened the surface of the beach, thus making it more susceptible to wind and/or swash activity. The shearing and compressional effects of vehicle passage extended to a depth of approximately 20 cm. The shear stresses of turning wheels loosened the sand and broke underground rhizomes as well as crushing seedlings of annuals and young plants of perennials such as American Beachgrass. Vehicle impact also decreased the rate of decay of organic material. The normal bacterial content associated with the organic drift were normally very high, but were markedly reduced when vehicles pulverized the deposits (Stephenson, 1999).

Impacts to Dunes

The fragile nature of dunes and the destructiveness of vehicles and even pedestrian traffic on dunes is well documented. Since the dunes at Sauble Beach are a finite resource, it is critical to manage people's interaction with these features so that negative impacts are kept to a minimum. Beaches are inextricably linked to dunes and so management of dunes must necessarily include the proper management of beaches (Peach, 2004). Vehicle impacts to dunes can cause structural alterations that lead to increased erosion by wind. These alterations disrupt the delicate balance of physical conditions found in the beach – dune region. In addition, sand compaction by vehicles in the backshore area can

Figure 9—Strand line left from storm waves. Strand lines contain organic material, plant and animal life important to coastal species.

negatively impact dune plants that would otherwise reduce wind erosion of the beach.

Recreational vehicles, like ATVs and snowmobiles, should be prohibited from operating along the dunes at Sauble Beach. Community education about the use of ATV equipment only within designated areas of the Town should be considered. In addition, the municipality may wish to consider posting notices throughout the lakeshore area about the prohibition of ATVs and snowmobiles and work in cooperation with the Ontario Provincial Police to enforce their restricted operation within the municipality.

Garbage/recycling

Beach garbage is an important management issue from the standpoint of debris that is not only aesthetically offensive, but could choke, poison or entangle wildlife. The community has invested a great deal of energy and time providing adequate garbage facilities, and cleaning up after visitors leave. Large amounts of this refuse are often recyclable (pop cans, plastic water bottles, etc.). Recycling stations along Lakeshore Blvd. would help to divert a great deal of material from entering the municipal landfill. Blue recycling facilities are becoming very well known in Ontario. Food retailers like Tim Horton's are offering recycling facilities at their outlets.

Figure 10—Example of recycling containers used on the water-front at Kincardine, and at Providence Bay on Manitoulin Island.

In waterfront areas, some municipalities have recycling stations established. The Township of Central Manitoulin, for example, has recycling stations along its waterfront boardwalk at Providence Bay. It is recommended that recycling facilities be investigated for use at Sauble Beach.

Beach Access

In the Management Plan for the south beach prepared in 2004 (Main St. to 6th St.), beach access focused on taking a more aggressive approach to controlling beach access. The purpose was to minimize impacts related to the number of trails being cut through the dunes to allow for recovery of the dunes, while providing more user friendly and visible access pathways to the beach.

In the North Beach, the state of the dunes is relatively good. A more passive

approach to access control is recommended. The number of beach access locations should be restricted to the primary locations where the greatest number of beach users typically cross. Based on an evaluation of current beach access trails and observing how people currently access the beach, it is recommended that beach access be focused to those pathways where local streets terminate onto Lakeshore Blvd.

In most instances, it is recommended that beach access treatments be limited to the east (Lakeshore Blvd.) and west (beach) ends of the access trails. Acess from Lakeshore Blvd. should generally be restricted to guide rail fencing to help people identify the appropriate beach access to use. This is especially important for visitors to Sauble Beach who would not be as familiar with dune conservation measures.

On the beach side, it is recommended that year round sand fencing be established. They would have the dual effect of directing people to the designated access trail from the beach, and help with sand management and dune restoration. Beach access signs are recommended to be consistent with access identification on the south beach.

Beach access trails should remain as sand pathways. They are well defined and provide a distinguishable path to the beach. Structural treatments (e.g. boardwalks) are not necessary, and would create more impact to the dune than the existing trails. The exception is 11th St. where the construction of a boardwalk structure was considered to be important to provide a hard surface access within the north beach area for wheelchairs and other special needs purposes.

At the north end of the project area, there is an opportunity for a viewing facility (e.g. deck or patio) for the benefit of physically challenged persons, and others. This is close to the location where the piping plovers nested. There is an opportunity to incorporate sufficient access control features that would promote beach access without direct access to piping plover habitat. In addition, this would be a good location for educational signs related to dune grasslands conservation and piping plover protection.

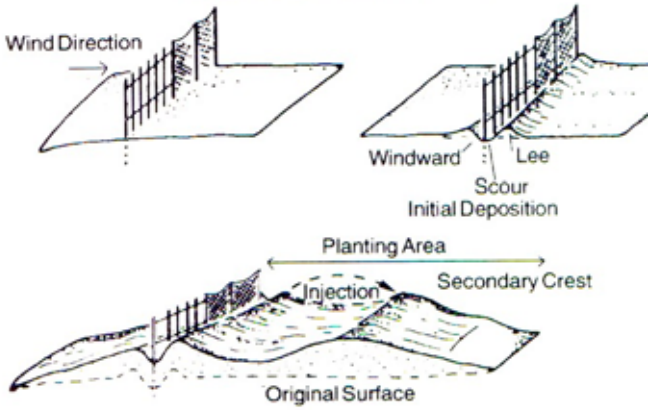
Recreation Equipment

A number of swing sets are recessed into the dunes at a number of locations. Situating recreation equipment in the dunes encourages damage to anchoring vegetation which has the effect of forming large blowout areas.

It is recommended that swing sets and other recreation equipment be re-located onto the beach, away from the leading edge of the dune. It is noted that this equipment will be subject to water level fluctuation on the beach. However this equipment has the ability to be moved depending on conditions.

Dune Stabilization or Restoration Measures

Figure 10



Use of Sand Fencing

Sand fences are used worldwide in beach and dune erosion control efforts. The fencing ideally requires 40% to 50% porosity for optimum sand accumulation. Typically, wood slat snow fencing is used. Plastic snow fencing has also been used, but it tends to be more prone to vandalism, and decays more readily due to ultraviolet radiation, wind and wave damage.

The basic premise behind the use of sand fencing is that it slows onshore wind velocities, thus allowing sand to collect behind the fence. The general "rule of thumb" is that all significant sand deposition will occur in an area behind the fence measuring about eight times the height of the fence (Carter, 1993—Figure 10). For a typical one metre high fence, then, one should expect sand accumulations as far back as eight metres behind (or leeward of) the fence.

Figure 11

Seasonal Sand Fencing

For seasonal use, the wood slat fence should be installed with 7 foot long "T" rails, or similar post, driven approximately one metre into the sand. The posts should stand about the same height as the fencing. The fence is fastened to the windward side of the posts with galvanized wire. Posts are spaced in 3 metre spacings.

If sand fencing is used, it should be installed no later than the Thanksgiving Day weekend in mid-October, prior to the fall storm season. It should not be removed prior to the Victoria weekend as lake winds in April and early May can be quite strong and move a lot of sand.

Figure 12

Year Round Sand Fencing

Seasonal fencing requires a substantial investment in time and energy to install and remove each year. Friends of Sauble Beach has successfully demonstrated

the use of sand fencing that can be left up throughout the year. During the summer of 2007, a substantial amount of sand was collected behind the fencing. This suggests that year round fencing may have a benefit of capturing sand that would otherwise end up on interior roadways and lawns, or contribute to the vertical growth of dunes where sufficient new growth dune vegetation has been impacted at the leading edge of the dunes.

The year round fencing approach uses the same wood slat fencing, but fastens then to wood 4x4 anchoring posts. The wood posts remain in place over several seasons, while the wood slat fencing can be re-positioned on the posts depending on the amount of sand burial occurring. The wood posts can be re-positioned Lakeward as sand accumulations develop.

Year round fencing is recommended to be used on the beach side of each access pathway. The fencing will have a two-fold purpose: (1) act to help control pedestrian access into the dunes, and (2) help build sand deposits and promote dune growth on either side of pedestrian pathways.

Care will need to be taken in areas of piping plover habitat that fences do not pose a constriction to the movement of these birds.

Sand fencing can be quite effective at controlling sand accumulations and keeping sand on the beach. To minimize the depth of accumulations at one location, fencing can be gradually moved shoreward as accumulations develop. In doing this, one must be cognizant of the fact that lake level fluctuations like storm surge will occur and the location and placement of fencing must anticipate how far wave action will advance up the beach (towards the dunes), dictating where the fencing should be placed.

While sand fencing is useful initially for accumulating sand, the accumulations are loose sand particles still vulnerable to wind erosion. In most cases of beach and dune restoration and erosion control, sand fencing is used in combination with planting dune vegetation. Fencing acts as a temporary barrier for accumulating sand, but it is the dune vegetation that provides the structure and stability of the dune over time. Generally, sand fencing is used in the first two to three years of a restoration project, until the dune vegetation has become well enough established to function as the primary sand trapping mechanism. In a planting program, the fence also aids with keeping people off the planted area.

Beachgrass Planting

Dune vegetation offers longer term beach-dune ‘stabilization’ than sand fencing. It functions in the same capacity as sand fencing in slowing wind velocities and allowing wind borne sand particles to collect. Their growth produces a surface

roughness which decreases the wind velocity near the ground, and reduces wind erosion at the sand surface. The plant stems and leaves above the sand surface greatly interfere with sand movement by saltation and surface creep (Woodhouse, 1978). It also, by its massive root structure, gives the developing dune some structure. Dune vegetation is also able to regenerate naturally, providing a permanent cover and requiring no ongoing maintenance.


Figure 13

American Beachgrass (Marram grass) is perhaps the most commonly used dune species in dune restoration in North America, but its applicability is limited to areas where relatively large amounts of sand accumulation are expected (e.g. beach and foredune). The Beachgrass cover will continue to trap sand even as it gets buried with sand, as the plants are stimulated to grow by the deposition of sand around them.

Restoration planting is recommended where year round fencing is proposed. Planting should occur landward to the fencing where the area might lack natural dune vegetation. Plants used for dune restoration should be harvested locally from existing dunes and transplanted to the area being restored. Harvesting and planting should be done during fall. Harvesting along the foredune of adjacent dunes should be targeted to obtain source material needed for site restoration. Plant harvesting should be done with care. Plants should be harvested randomly and sporadically through the source population, so that the issue of over-harvesting leading to a wind erosion situation is avoided.

Plants should be dug up, separated and placed in garbage bags. The plants should be kept in a cool, dark location until they are required for transplanting. Dug plants should be stored no longer than 5 days.

When planting, spacing should be 30 centimetres apart.

Dune restoration planting is typically recommended for late autumn, once the plants are in their dormant state. Fall planting increases the survival of these plants dramatically because they are planted into cool, moist sand, have the following moisture-rich spring to begin establishing roots, and are in a much better state to withstand the rigours of the hot, dry summer ahead. Spring planting is possible, but the success rate drops by 25% or more.

It typically takes a species like Marram grass about three to four years to become fully established and begin to fill in the planted area.

Invasive Species

Open beaches and dunes can be affected by alien invasive plant species that can pose a real problem for local ecosystems and overall beach health. Invasive species tend to intrude into natural areas and overtake native plant populations. Invasive species are opportunistic and usually move in when an opening has been made available. Often a human disturbance, like the removal of large amounts of native vegetation (e.g. dumping of sand piles scraped from roadways, landscape alteration), can provide the opening necessary for an invasive plant to take hold. One of the characteristics that make these species such a problem is their high capacity to reproduce. This helps the plant to overtake native populations and eventually form a monoculture of the invasive plant.

While most of the non-native species identified at Sauble Beach may not be cause for management concern, several are considered highly invasive. If they become established in suitable habitat they can out-compete the native species, alter ecosystems and become major management concerns.

Two of these, White Sweet Clover (*Melilotus alba*) and Bouncing Bet (*Saponaria officinalis*) are well established, but are probably restricted by the sand dune habitat and may not become more of a threat. Removal at this stage may be more disruptive than their presence. Management recommendations include monitoring these populations so that dramatic increases in the populations can be recognized early. Spotted Knapweed (*Centaurea maculata*) is also in this category. It is mostly confined to the breakwater area at the north end of the beach, but elsewhere in Bruce County it is a serious roadside weed.
Purple loosestrife (*Lythrum salicaria*) is well known as a serious pest of wetlands. It is very limited at Sauble Beach at present, but it occurs in the Great Lakes Coastal Meadow Marshes and any spread of the species could be highly disruptive to these rare and fragile habitats.

Two trees are potential threats to the dune habitat. White Poplar (*Populus alba*) can spread rapidly once it becomes established in dunes. Only one plant was found at Sauble Beach, but a systematic search and removal of all plants in recommended. Since it spreads by root sprouting, cutting standing stems merely encourages the spread. Herbicides are usually needed for effective treatment.

Scots Pine (*Pinus sylvestiris*) has been planted and is well established in the treed dune areas. In several locations it is spreading and self-seeding into the adjacent dunes. A gradual program of Scots Pine removal is recommended. Some trees have already been felled, apparently by adjacent landowners, where the trees may have been blocking the view of the lake.

The biggest potential threat to Sauble Beach by invasive species is from Common

Reed (*Phragmites australis*). This species has been spreading aggressively in southern Ontario over the last few years. If it becomes well established in beach habitats and wetlands it can form dense, impenetrable stands. There are several places where *Phragmites* is present at Sauble Beach – most of them on the beach at the mouth of drains. At present these infestations are small and contained. It is recommended that these plants are immediately removed and burned at a suitable location off-site. Digging by hand or by small machinery is needed to remove all of the root system and rhizomes. Even small sections of rhizome will re-sprout if left in place. Annual monitoring and removal is needed to ensure that the species does not take hold at Sauble Beach.

Control of invasive plants can be difficult, but the effort usually pays off. Taking no action could jeopardize the very environment we enjoy. Since coastal dune plant communities are often high in diversity, and contain a number of rare plant species, keeping vigilance over invasive species is important. Control measures are often different for different invasive plants. It is important to use tested and proven techniques to ensure that control efforts are successful and not made worse by poor information, or a lack of understanding of the plant's ecology.

Figure 14—Common Reed

The recent invasion of Common Reed on beaches along Lake Huron has posed concerns. The reed, which can grow up to three metres or more in height, first appeared on beaches in the Township of Huron-Kinloss between 2003-2005. It began growing in wet beach swales between the foredune and the lake. Below average lake levels helped produce the conditions that made this environment open and attractive for this plant to invade.

The decaying plant material from previous year's growth, as well as roots, will reduce the pore structure of the sand and reduce the ability of beach sand to transmit groundwater. As a result the flow of shallow groundwater below the beach will be impeded and the water table will rise. As the water table moves closer to the ground surface, the beach becomes wetter, and enables other invasive species to take root.

Contaminants from septic systems will flow towards the shoreline. The reduced permeability of the sand and corresponding rising water table will increase the risk of contaminants discharging onto the beach. The wet beaches can be affected by pollution from geese, gulls or nearby septic systems. So, expansive invasions by alien plants like Common Reed are not only a concern to local ecology, but their potential to contribute to beach impairment by pathogens.

Rapid response is important and the knowledge of how to deal with invasive species is crucial. Each plant has its own ecological characteristics which need to be understood before a control program is undertaken.

Dumping

The dumping of a single pile of gravelly sand in the beach area has introduced a number of alien, not dune species. Dumping of fill or gravel material from elsewhere, even from nearby roadsides and parking area should be avoided since this has the potential to open sites for invasion by weedy species.

Water levels

The water level in Lake Huron determines not only the width of the beach, but also the water table level in the meadow marshes behind the dune ridges. Moisture levels in the latter and in the meadow marshes at storm drain outlets are also determined by the amount of water flowing in the drains that feed these outlets, which are in part determined by rain events. Water levels are critical to maintaining the fragile and unusual communities in the meadow marshes. More study is needed to determine the sources of water and predict how the hydrology may be affected by climate change and anthropogenic activities upstream in the community of Sauble Beach. Development east of these features could alter the hydrology of the local area and damage these coastal wetlands, unless suitable precautions are taken to preserve the local hydrology of this area.

Beach grading

As discussed in the first management plan for Sauble Beach, grading, clearing and raking the beach is done to provide an aesthetic appearance for recreation purposes. However, as discussed in the last Plan in some detail, such activities can interfere with natural beach and dune processes. When lake levels are low and the beach very wide, there is enormous potential for sand movement during wind storms. In a natural, undisturbed beach environment vegetation would quickly establish above the strand line. Such vegetation would help trap the moving sand and lead to the formation of a new dune ridge. If the dune vegetation is not permitted to expand Lakeward due to mechanical intervention, the blowing sand will either be captured in the existing dunes causing the dunes to grow vertically or it will be carried out of the dunes and onto adjacent roads and properties.

Mechanical raking of the beach is destructive ecologically, and contributes to increased sand erosion from the face of the beach. As recommended in the south beach plan, mechanical beach raking should not occur any closer than 10 metres from the leading edge of dune vegetation. The municipality is urged to consider further restrictions to the practice of beach raking, expanding the buffer from the dunes.

Since the last Plan, Sauble Beach has attracted a breeding pair of piping plovers, an endangered species in Canada. The birds developed a nest in the north beach area and successfully raised a family. During this time beach raking was stopped in this area. Plovers, a shore bird, use the wet beach near the shoreline as its feeding grounds. Often regarded by many as barren, sterile environments, beaches can contain a wide variety of life on which shorebirds rely for food. Beach raking has the effect of damaging the habitat of this food source. It is recommended that raking be eliminated in the area from 11th St. to the River for the benefit of piping plover and other shorebirds.

Mechanical beach raking should not occur any closer than 10 metres from the edge of the lake, between 6th Street and 11th Street. The Strand line should not be disturbed, so this distance may become greater than 10 m at times, depending on the wave runup distance on the beach. This would leave the wet beach undisturbed, preserving the feeding grounds for shorebirds. It would also enhance multiple use of the beach. According to some beach users, mechanical beach raking makes it difficult to use the beach for recreation activities. If the area adjacent to the waters edge was not mechanically raked it would provide a natural path, and relatively hard surface, for walkers, runners/joggers and cyclists to use.

Structures and facilities

Existing structures along the dunes at Sauble Beach are all being affected by sand movement. With continued low lake levels, this is likely to continue particularly in areas where breaches in the dunes provide no protection. Sand encroachment onto the tennis court is a continuing problem and sand on the road is likely to increase as the beach widens and the supply increases.

Figure 15—Tennis court, with encroaching sand, behind the dune ridge at Sauble Beach. (Bowles).

Management Considerations for the Piping Plover

This Plan promotes the conservation of the north beach in as natural a state as possible, for the benefit of the quality and health of the beach-dune ecosystem, and to promote attractive habitat conditions for returning piping plovers. The plovers not only benefit from undisturbed beach flats for their feeding, but benefit from healthy dunes adjacent to where they nest.

Predation is a threat to plovers and their nests. Wild animals (e.g. fox, gulls) pose a risk throughout the nesting and rearing period. Domestic animals (e.g. dogs at large) can pose a risk, or disturb the birds to the point where they abandon the nest. Enforcement of local leashed-dog or no dog bylaws are critically important (Dingledine, 2007).

Curious people also pose a risk and have been known to cause mortality by careless behaviour, or stress to the birds. The use of psychological fencing during periods when the birds are present substantially increases the success of the birds. The Canadian Wildlife Service, and Ontario Ministry of Natural Resources, should be consulted whenever there is an occurrence of nesting plovers.

Garbage management is a key management concern. Garbage can attract predators or be lethal to wildlife due to entanglement. Regular garbage pick up, and 'no trash on the beach' policies should be strictly administered. Fireworks should be prohibited when plovers are present.

Invasive plant species in beach and dune areas can have a major impact on piping plover by displacing native plants important to the plover (Dingledine, 2007). Invasive species like the Common Reed, Spotted Knapweed and others identified in this plan should be controlled as soon as possible. Friends of Sauble Beach should also monitor for new invasions and respond rapidly before the plants become established.

Several designated access pathways have been identified in this plan. Should piping plovers nest close to the beach access, it may be necessary to temporarily close that particular access path until the birds have left the area.

Education programs are important to inform the public about the needs of the plovers and the risks posed by human disturbance. Brochures, fact sheets and media releases are useful for community education. Permanent educational signs at strategic locations in the north Sauble Beach area help to educate visitors. It is recommended that educations signs be placed at key beach access points at the north end of the north beach. A recommended sign design has been included as Appendix D. It provides a dune conservation message as its main point, but includes information about piping ploversas a part of Sauble Beach's ecosystem.

Education

In the 2004 Management Plan for Sauble Beach, it was recommended that efforts focus on informing and educating the public about how the beach-dune ecosystem functions at Sauble Beach, and how people should minimize their impacts to this vulnerable environment. For the north beach, similar and consistent messaging is important, but efforts should be expanded to incorporate the higher quality beach-dune ecosites identified in this Plan.

The Marsh Meadow complexes, situated adjacent to Lakeshore Blvd., are geographically located in a high visibility area that provides a unique opportunity to educate people about these diverse and sensitive features. Other valued ecosites identified in this plan offer similar opportunities to educate the public about dune ecology, biodiversity and coastal processes. Educational possibilities could include:

- Interpretive signs, which identifies the feature and some of the species within;
- A numbered way marker tied to an annotated tour guide of the dune complex;
- Summer guided tours;
- Educational literature;
- Community workshops;
- Education with school groups.

No single approach is effective. Rather a sustained, multi-faceted approach to community education is needed to help foster informed attitudes and behaviour toward the coastal environment.

Figure 16—Visitors using the dunes for a day camp at Sauble Beach. (Bowles)

Efforts should be made to assist municipal Council and staff by enhancing their understanding of Sauble Beach's ecology through regular updates and presentations.

Education about the piping plover should also be sustained and multi-faceted. Educational resources are available through the Canadian Wildlife Service, as well as online. A sample education sign is included as an appendix to this plan.

Education about dune conservation and vulnerability is a difficult process, particularly at Sauble Beach where so many beach users are transient visitors. Interpretive signs can be effective and should be incorporated into the north Beach implementation. Physical barriers, like fencing or railed barriers, are also important in guiding visitors to using the appropriate pathways. Signs and physical barriers will not completely resolve the issue of impacts related to inappropriate activities in dunes. Creative approaches to visitor education should be considered. For example:

- Hire summer students, or recruit volunteers as "dune Defenders" who can walk around promoting good dune stewardship;
- Have guided beach tours for visitors;
- Consider offering the Coastal Centre's summer 'Coastal Camp for Kids' program for youth;
- Consider a Summer Beach Event to attract visitors, while providing opportunities to educate and engage people about conservation (including garbage and recycling management).

Activities and approaches targeted to visitors are a long term undertaking. The use of brochures and flyers for this group can have mixed and sometimes unintended results. Handouts of this type might produce more of a littering problem than it is worth.

Youth Education

Friends of Sauble Beach have been successful in engaging local school children in dune education and restoration projects. Friends are encouraged to continue with this program as a way to promote active learning outside the classroom.

There are also opportunities to engage youth outside of the school season. In 2007, the Coastal Centre piloted a 'Coastal Camp for Kids' program. This day, or half day, summer camp was developed to provide a fun learning opportunity for youth age 9 to 12. The aim was to teach students about beach science in a fun and interesting way through various activities and games lead by an outdoor education specialist. The program is intended as an option for municipalities and organizations to consider,

particularly those involved with the Blue Flag program needing to satisfy its environmental education criteria.

Blue Flag

The international Blue Flag program was adopted at Sauble Beach in 2006 along the south beach (Main St. to 6th St.). The Blue Flag symbolizes a beach of high quality for recreation purposes, and can be a tourism draw for localities involved in this program. Including the north beach as a 'Blue Flag beach' may have the unintended consequence of attracting more people to this area than if it were not identified as a Blue Flag beach. Great care must be taken to ensure that adequate access control and education facilities are in place to accommodate people and help them to understand the significance of this area. Blue Flag tends to attract non-resident users who may be less familiar with the ecological attributes of the north beach.

It will also be important to carefully monitor this area for use and apply strategies as they become necessary. For example, if beach goers wander off the designated pathways leading to dune degradation, barrier fencing may be needed to provide a more permanent psychological barrier for people accessing the beach.

The piping plover nesting has provided a new dimension to beach management at Sauble Beach. If more people are attracted by Blue Flag to the north beach area, effective measures will need to be taken to ensure that returning plovers are not impacted. As people are a key threat to piping plover nesting success, the emphasis of the blue Flag in this area should be more toward beach and dune preservation, for the purposes of protecting high quality dune grasslands, as well as endangered species habitat.

Costing Analysis

(Larry Porter, OALA)

ACCESS ONE – northern parking lot

The northern extreme of the beach at Sauble Falls Rd. has a parking lot area. The access point in this location is ideal for viewing the expanse of the beach to the south. It is also ideal for accessibility to the beach for people with disabilities. However, currently the area does not have a hard surface access to the beach.

It is suggested that this area be considered for a viewing platform which may further be considered for a roofed in area architecturally designed to fit into its surroundings. It is also suggested that this area have a boardwalk ramp constructed to allow accessibility to the beach for people with disabilities. An area at access one should also be designated for a flag pole to fly the Blue Flag.

1) -new flag pole and base			$1,500.00
2) -platform area 6 x 8 metres			$5,000.00
-new base preparation & relocation of rocks			$1,000.00
3) -access ramp- 20 m (65') x 1.86 m (6')			
- 143'-2" x 6" x 6' planking	$1,000.00		
- 8 – 6" x 6" x 8' posts	$ 200.00		
- 8 - 6" x 6" x 12' posts	$ 280.00		
- 200' of 2" x 8" under-carriage	$ 275.00		
- 260' of guide-rails	$ 260.00		
- 130' of 4"x 4" platform edge restraints	$ 163.00		
- hardware		$ 300.00	
	Sub Total	$2,478.00	
	10% markup on products	$ 250.00	
	Machine time	$1,000.00	
	Delivery & Labour	$3,500.00	
		Total boardwalk ramp	$7,228.00
Total estimated cost for Access One			**$14,728.00**

ACCESS TWO

Access two is an existing access beside the tennis courts at #1119 Lakeshore Rd. It is proposed that 40 m (131') of sand fencing be installed along the lakeward edge of the dunes.

- sand fencing - 131 x $3.00/ft	$392.00

- 18- 4" x 4" posts	$180.00	
- hardware	$ 50.00	
	$622.00	
10% markup on products	$ 63.00	
machine time	$150.00	
Sub-total	$835.00	
Delivery & Labour	$850.00	
Total		$1,685.00
-re-paint gate a sand colour		$ 50.00
Total estimated cost for Access Two		**$1,735.00**

ACCESS THREE

Access three is located at the end of 11th St. Considerable pedestrian traffic is realized due to the number of residence in this area. It is proposed that a boardwalk be constructed along this access with a 7.62 entry guard-rail to block a nearby entry point. Due to there being a swale outfall at the beach only the north side of the beach area can have a 20m sand fence installed.

- 47.3 (155') long x 1.8 (6') wide boardwalk

-465'- 4" x 4" sleepers at $1.25/ft	$ 582.00	
-337'- 2" x 6" x 6' planking at $6.00 ea	$2,022.00	
- 25'- 2" x 6" guard rail	$ 25.00	
-4- 4" x 4" posts	$ 40.00	
-hardware	$ 100.00	
	$2,769.00	
10% markup on products	$ 277.00	
machine time	$ 600.00	
Sub Total	$3,646.00	
Delivery & Labour	$4,000.00	
	Total	$7,646.00
-7.62 (25') entry guard-rail -25'- 2" x 6"	$ 25.00	
-4- 6" x 6" posts	$ 100.00	
-chamfering & notching of posts	$ 80.00	
	$ 205.00	
10% markup on products	$ 20.50	
machine time	$ 150.00	
Sub Total	$ 375.50	
Delivery & Labour	$ 400.00	
	Total	$ 775.50

-20 m (66') of sand fence @ $3.00/ft.	$ 200.00	
-hardware	$ 50.00	
	$ 250.00	
10% markup on products	$ 25.00	
machine time	$ 150.00	
Sub Total	$ 425.00	
Delivery & Labour		$ 500.00
Total		$ 925.00
-relocate swing set 12 metres closer to water		$1,000.00
Total estimated costs for Access Three		**$10,346.50**

ACCESS FOUR

Access four is located between 7th and 8th Sts. It is used extensively but is a narrow path with a culvert and swale running along the south side. It is proposed to developed this access further by installing a bollard post at the entry with a sign posted on it to indicate that it is a beach access. The access path should have a guide-rail installed along the south side for a length of 7-8 m and the path surface should be leveled wider. Sand fencing is also proposed along the lakeward edge of the dunes for a length of two15m sections.

-8" x 8" bollard x 8'		$ 48.00
Installation		$ 50.00
Total		$ 98.00
-7.62 (25') guide-rail -25'- 2" x 6"	$ 25.00	
-4- 4" x 4" posts	$ 40.00	
-chamfering & notching of posts	$ 80.00	
	$ 145.00	
10% markup on products	$ 15.00	
machine time	$ 150.00	
Sub Total	$ 310.00	
Delivery & Labour	$ 400.00	
Total		$ 710.00
-sand fence		
-30 m (100') of sand fence @ $3.00/ft.	$ 300.00	
-hardware	$ 50.00	
	$ 350.00	
10% markup on products	$ 35.00	
machine time	$ 150.00	
Sub Total	$ 535.00	
Delivery & Labour	$ 550.00	
Total		$1,085.00
Total estimated cost for Access Four		**$1,893.00**

ACCESS FIVE

Access five is located at the end of Tenth St. It is proposed to construct entry guard-rails at this location. A 3.7 m guard-rail at the north side of the entry and a 11 m guard-rail at the south side. It is also proposed that sand fencing be installed along the lakeward edge of the dunes.

-14.7 (48') entry guard-rail -48'- 2" x 6"	$ 50.00		
-8- 6" x 6" posts	$ 200.00		
-chamfering & notching of posts	$ 100.00		
	$ 350.00		
10% markup on products		$ 35.00	
machine time		$ 200.00	
Sub Total			$ 585.00
Delivery & Labour			$ 600.00
Total			$1,185.00

-30 m (100') of sand fence @ $3.00/ft.	$ 300.00		
-hardware	$ 50.00		
	$ 350.00		
10% markup on products		$ 35.00	
machine time		$ 150.00	
Sub Total			$ 535.00
Delivery & Labour			$ 550.00
Total			$1,085.00

Total estimated cost for Access Five **$2,270.00**

ACCESS SIX

Access six is at #905 Lakeshore Blvd. The entry to this access is framed by a mixture of poplar and spruce. The entry is not ideal due to a large culvert grate at the path. The entry should be constructed around this grate with a 1m guard-rail installed in front of the gate. The existing directional sign should be removed with a new beach access sign installed. A 30m sand fence is also proposed along the lakeward edge of the dunes.

-1m (4') entry guard-rail		
-4'- 2" x 6"	$ 4.00	
-2- 6" x 6" posts	$ 50.00	
-chamfering & notching of posts	$ 30.00	
	$ 84.00	
10% markup on products		$ 10.00
machine time		$ 50.00

Sub Total	$ 144.00	
Delivery & Labour	$ 150.00	
Total		$ 294.00

-30 m (100') of sand fence @ $3.00/ft.	$ 300.00	
-hardware	$ 50.00	
	$ 350.00	
10% markup on products	$ 35.00	
machine time	$ 150.00	
Sub Total	$ 535.00	
Delivery & Labour	$ 550.00	
Total	$1,085.00	

Total estimated cost for Access Six **$1,379.00**

ACCESS SEVEN

Access seven is a very well developed access at Lakeside Village and is also used for emergency vehicle access. The yellow gate entry could be painted a sand colour to blend more into the backdrop.

-30 m (100') of sand fence @ $3.00/ft.	$ 300.00	
-hardware	$ 50.00	
	$ 350.00	
10% markup on products	$ 35.00	
machine time	$ 150.00	
Sub Total	$ 535.00	
Delivery & Labour	$ 550.00	
Total	$1,085.00	
-re-paint gate a sand colour	$ 50.00	

Total estimated cost for Access Seven **$1,135.00**

ACCESS EIGHT

Access eight is located at the end of Eighth St. There is currently a no parking sign with arrows pointing to the left and right and says beach access. This sign should be removed. It is also proposed to install sand fencing along the lakeward edge of the dunes for a length of 30m.

-30 m (100') of sand fence @ $3.00/ft.	$ 300.00	
-hardware	$ 50.00	
	$ 350.00	
10% markup on products	$ 35.00	
machine time	$ 150.00	
Sub Total	$ 535.00	

Delivery & Labour	$ 550.00	
Total		$1,085.00

Total estimated cost for Access Eight **$1,085.00**

ACCESS NINE

Access nine is a recognized access point due to the demand in this area. It is proposed to recognize its use and formally establish it as an access with signage and trash receptacle.
Also, it is proposed that sand fencing be installed along the lakeward edge of the dunes for a length of 30m.

- 30 m of sand fence at $2.37/ft.	$ 240.00	
Sub Total	$ 240.00	
Delivery & Labour	$ 300.00	
Total	$ 540.00	
10% markup	$ 54.00	

Total estimated cost for Access Nine **$ 594.00**

ACCESS TEN

Access ten is located at #615 Lakeshore Blvd. It is proposed to install 30m of sand fence along the lakeward edge of the dunes.

-30 m (100') of sand fence @ $3.00/ft.	$ 300.00	
-hardware	$ 50.00	
	$ 350.00	
10% markup on products	$ 35.00	
machine time	$ 150.00	
Sub Total		$ 535.00
Delivery & Labour		$ 550.00
Total		$1,085.00

Total estimated cost for Access Ten **$1,085.00**

ACCESS ELEVEN

Access eleven is at the Sixth St. washroom location. It is proposed to move the swing set 12m (40') closer to the water to allow and encourage the dunes to regenerate in this area. It is recommended that new swings be re-located on the beach, lakeward of the dunes.

-moving of swing set	$ 1,000.00	
Total estimated cost for Access Eleven is		**$ 1,000.00**
Total estimated cost projection is		$37,741.50
10% contingency		$ 3,774.15
	Total	$41,515.65
	Gst	$ 2,490.94
	Pst	$ 3,321.25
Project Estimated Costs		**$47,327.84**
Tender Preparation		$ 2,400.00
Contract supervision		$ 3,700.00
Signage		$ 9,300.00
Architecturally designed roof structure		$20,000.00
Sub Total		$35,400.00
Total projected costs	**$ 82,727.84**	

* A unit price for supply and installation of sand fencing for future phases (ie: along Lakeshore Blvd.) could be estimated at a price of: **$43.00/linear metre**

Conclusion

This plan is to provide guidance to Friends of Sauble Beach and the Town of South Bruce Peninsula in managing the north beach with the intent of protecting the natural integrity, and special attributes of this section of Sauble Beach. As Sauble Beach has become a highly popular beach destination, there is risk to vulnerable environments like dune grasslands to intensive use by beach goers. There is also an opportunity to proactively manage people's access to the beach in a way that minimizes impacts and informs the user that this is a sensitive and highly valued coastal environment.

The recommendations set out in this plan are intended to accomplish the goal of accommodating people's need to access the beach, with the need to conserve the beach and dune ecosystem for future generations. Friends of Sauble Beach will be key to this plan's success as local champions to the cause of beach and dune conservation. The cooperation and coordination between Friends of Sauble Beach and the Town of South Bruce Peninsula has been inspiring. This relationship has been instrumental in the success of conservation work accomplished to date.

The future health of Sauble Beach will depend on its care and stewardship. Several challenges are ahead:

Increased Use: As Ontario's population increases, demand for quality beaches is anticipated to increase as well. More beach goers to Sauble Beach will place greater stress on the dune system. Work implemented through this plan should help to provide the necessary measures antecedent to greater increases in beach use.

Climate Change: Projected lowering of lake levels, higher mean temperatures and changes in precipitation patterns are anticipated to combine to increase sand migration. Unaltered dune systems should be able to assimilate this sand. However, degraded dune, and large breeches in the dunes will be pathways for snad to erode inland, out of the beach-dune system. Recommendations identified in this plan are intended to promote the natural integrity of the dune system, which, if effectively adopted, should anable the dunes to adapt to changing conditions. Under current circumstances, the dunes along the north beach will be better able to adapt to changes than the south beach.

Invasive Species: Invasive non-native plant species could pose a threat to native dune species at Sauble Beach. Careful monitoring, and rapid response control measures will help to minimize impacts from invasive species. Removal should be done with care, keeping in mind that removal of large infestations may require the temporary use of sand fencing, as well as restoration planting with native dune grasses, to prevent wind erosion.

The foregoing challenges can be met through the implementation of this plan, careful monitoring, and adapting to changes as they arise. Fundamentally, by maintaining the dune system in as natural a state as possible, the beach-dune ecosystem at Sauble Beach will have a positive future, and the health of the beach will be preserved. It will mean a change in attitude and behaviour from how Sauble Beach has been treated and managed in the past. With perseverance and education efforts, Friends of Sauble Beach and the Town of South Bruce Peninsula will make Sauble Beach a conservation model for protecting one of Canada's rarest coastal ecosystems.

Glossary

Adventive: in botany terminology, describes a plant which has been introduced to an area recently, in particular since colonisation by humans.

Aeolian: pertaining to wind.

Alien plants: Exotic plants which are not endemic to the local ecosystem.

Beach Health: term used to describe the ecological condition of a beach and dune system. A 'healthy beach' is one that retains its bio-physical form and function, allowing the beach to respond to changing wind and wave conditions.

Biodiversity: an array of different animals, fish, waterfowl and plants in nature.

Blow-out: a term used to describe that portion of a dune which has become mobile, or active, due to the absence of vegetation to stabilize it. It can be induced by natural processes, but commonly is a result of human impacts.

Climax community: the community of plants which is the last stage in a succession of plant communities from pioneer stage through a number of intermediate stages. The climax community may be a woodland or herbaceous (grassland) community depending upon available water.

Coastal Ecosystem: an ecosystem which is found specifically within the coast or shoreline region.

Coastal Processes: Natural processes (e.g. Littoral drift, dune accretion, erosion) which occur within the coastal environment.

Dune: ridges or mounds of loose, wind-blown material, usually sand held together by specially adapted vegetation.

Dune Stranding: refers to the ongoing process of aeolian sand migration outside of the natural shore system. Sand becomes stranded outside of the shore system such that waves are no longer able to reclaim the material. Stranding can occur in areas of relic beach and dune deposits where there is no sufficient source of sand to replace what is lost.

Dynamic beach: that portion of a shoreline where accumulated unconsolidated sediment (eg. sand, gravel, cobbles) continuously moves as a result of naturally occurring processes associated with wind and waves and changes in the rate of sediment supply. Dynamic beaches are associated with dune systems which, if left unaltered, provide habitat for unique and rare species, provide a protective function

from storm waves, and are linked to improving local water quality. Dunes are considered to be one of the Great Lakes most vulnerable ecosystems.

Endangered: a wildlife species that is facing imminent extirpation or extinction.

Endemic species: a species native and confined to a certain region; having comparatively restricted distribution.

Foredune: the first dune feature landward of the beach, which exhibits some stabilization due to vegetation growth. Storm wave action may reach inland far enough to erode some, or all, of this feature.

Graminoid: grasses (family *Gramineae* or *Poaceae*) and grass-like plants such as sedges (family *Cyperaceae*) and rushes (family *Juncaceae*).

Headland: an erosion resistant point of land, either man-made or natural, extending into the lake; Sand deposits often form on the updrift side of the headland (e.g. Point Clark, Kettle Point).

Invasive plants: species which possess aggressive reproductive qualities that enable them to displace endemic plant species. Examples: Garlic Mustard, Purple Loosestrife, Common Reed (also see Alien Plants).

Lake Algonquin: post glacial lake which existed about 11,000 years ago. The remnant bluff of Lake Algonquin is a prominent feature from Point Clark to Saugeen Shores.

Lake Nipissing: post glacial lake which existed about 6,000 years ago. The remnant beach ridges left by Lake Nipissing are still evident landward of the Algonquin bluff. A large portion of the cottage development in Huron-Kinloss has been built on the Nipissing sand deposits.

Littoral zone: of or pertaining to the bio-geographic region between the nearshore zone (generally to 4 metre depth on the Great Lakes) and the high-water line and sometimes including the supralittoral zone above the high-water line.

Nearshore: an indefinite zone extending from the shoreline to just beyond the breaker zone. This is the area where wave energy has a profound influence on the lakebed. This is in contrast to the Offshore, where waves do not impact the lakebed.

Reach: a length of shoreline with fairly uniform onshore and offshore physical features and subject to the same level of wave energy.

Relic deposit: sand deposits which are remnants of a post-glacial lake (e.g.

Nipissing or Algoma).

Rhizome: a horizontal stem, either on or just below ground, especially one that forms roots at the nodes to produce new plants. Many plants spread with rhizomes, since they can send up new stems and leaves as they grow. This way, a colony of plants may start with many of the same species in an area.

Secondary dune: the dune landward of the foredune. It has, through succession, developed a more diverse plant community, more advanced soil structure and generally has a more sheltered climate than the foredune.

Shoals: offshore areas which are more shallow than the surrounding depths.

Species at Risk: According to the Committee on the Status of Endangered Wildlife in Canada, there are currently 487 plant and animal species at risk in Canada. Species at Risk are wild species that are in some danger of disappearing from Canada. The dune species Pitcher's Thistle is a Species at Risk in Canada.

Stewardship: care of the heritage of our natural spaces and species in such a way that it can be passed on to future Canadians intact.

Strandline: the line of organic matter that is deposited by wave action along the upper part of the beach. (Also called the 'debris line').

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Appendix A

Plant Inventory
(J. Bowles)

APPENDIX A

Annotated Checklist of Vascular Plant Species recorded at Sauble Beach

The following list includes species recorded from Sauble Beach during the preliminary inventory in June 2007. 152 species are listed in alphabetical order according to their Scientific Names. Names mostly follow Oldham et al. (1995). The following is an explanation of the annotations.

CW: Wetness coefficients. Plants that are obligate wetland species have a **CW** score of –5. Plants that are obligate upland species have a score of +5. Wetness scores of native species can be used to assess the moisture regime of a site.

CC: Conservatism Coefficient. Native species have been assigned a CC from 0-10 according to their fidelity to particular site conditions. Species with a CC of 0 are generalists with no predictability as to where they will grow. Plants with a score of 10 are highly conservative and will only grow in a particular type of habitat.

WEED: Weediness coefficient. Non-native species have been assigned a score from –1 to –3 according to their invasiveness. Species with a score of –1 survive in the wild but are not highly invasive. Species with a score of –3 spread rapidly and can disrupt native ecosystems by competing with native species.

FORM: The form or physiognomy of the plant.

N/A: An indication of whether the plant is native (N) or adventive (A). Non-native (adventive) species Scientific Names are also given in UPPER CASE letters.

Vegetation Community Types: Ann indication of where each plant is found as follows: BEACH = beach; SD = Open and Shrub Sand Dunes; SDT1 = Treed Sand Dune; Gravel = gravel dump on dunes; BERM = rocky breakwater; MAM4-1 = Graminoid Great Lakes Meadow Marsh; MAM4-2 = Shrub Great lakes Meadow Marsh.

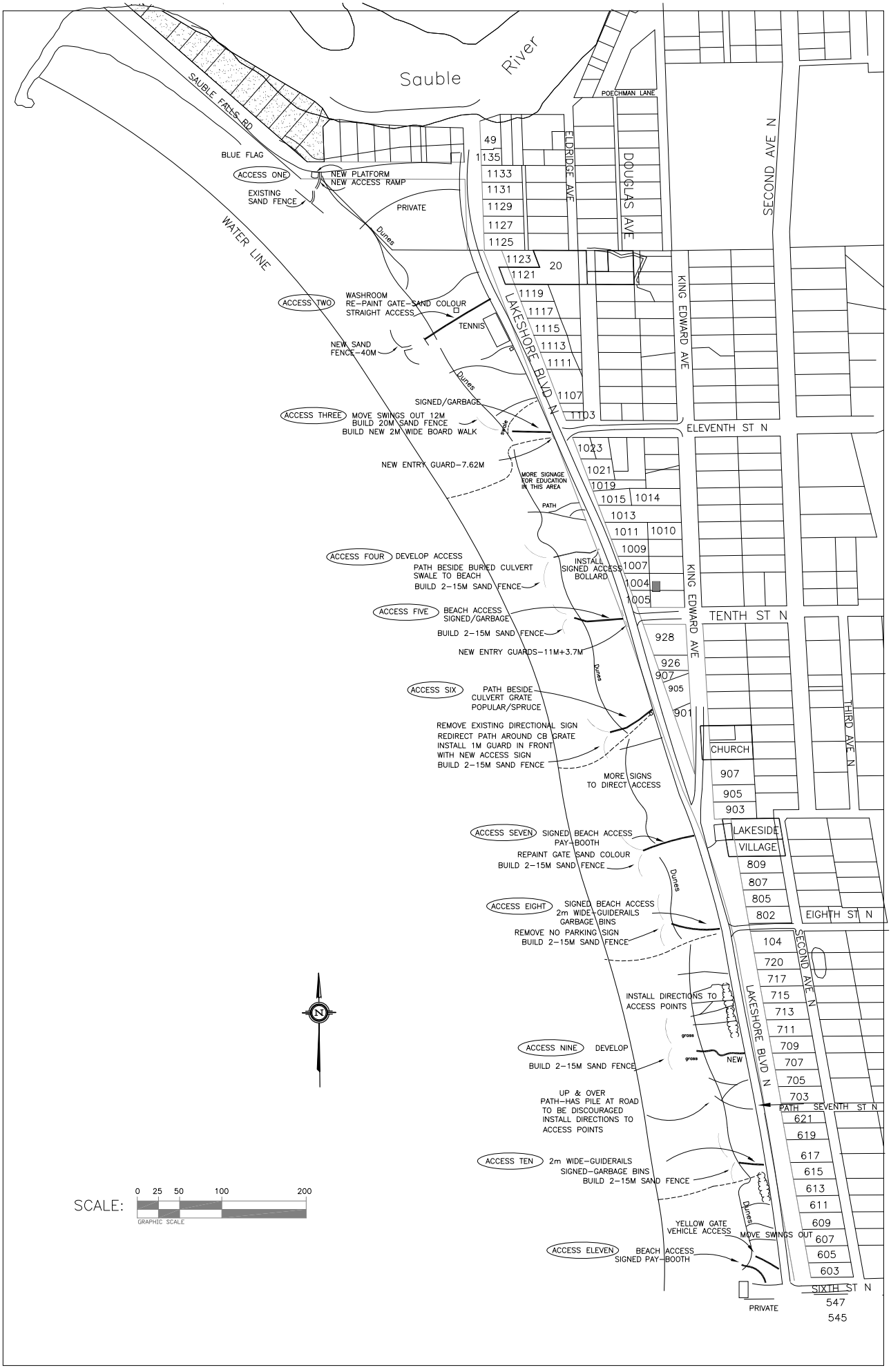
SCIENTIFIC NAME	CW	CC	WEED	FORM	COMMON NAME	FAMILY	N/A	BEACH	SD	
Acer negundo	-2	0		Tree	BOX ELDER	Aceraceae	N	X	X	X
ACHILLEA MILLEFOLIUM	3		-1	Forb	YARROW	Asteraceae	A			
AGROSTIS GIGANTEA	0		-2	Grass	REDTOP	Poaceae	A			
Agrostis stolonifera	-3	0		Grass	CREEPING BENT	Poaceae	N		X	X
Alnus incana	-5	6		Shrub	SPECKLED ALDER	Betulaceae	N			
Ammophila breviligulata	5	10		Grass	BEACH GRASS	Poaceae	N		X	X
Andropogon gerardii	1	7		Grass	BIG BLUESTEM GRASS	Poaceae	N			X
Anemone multifida	5	10		Forb	RED ANEMONE	Ranunculaceae	N		X	X
Arctostaphylos uva-ursi	5	8		Shrub	BEARBERRY	Ericaceae	N		X	X
Artemisia campestris	0	8		Forb	WORMWOOD	Asteraceae	N	X	X	X
ARTEMISIA VULGARIS	5		-1	Forb	MUGWORT	Asteraceae	A			
Asclepias incarnata	-5	6		Forb	SWAMP MILKWEED	Asclepiadaceae	N			
Asclepias syriaca	5	0		Forb	COMMON MILKWEED	Asclepiadaceae	N	X	X	X
Aster lateriflorus	-2	3		Forb	SIDE-FLOWERING ASTER	Asteraceae	N			
BETULA PENDULA	-4		-3	Tree	EUROPEAN WHITE BIRCH	Betulaceae	A			X
Bidens frondosa	-3	3		Forb	COMMON BEGGAR-TICKS	Asteraceae	N	X		
Bromus pubescens	3	7		Grass	CANADA BROME	Poaceae	N		X	X
Cakile edentula	3	9		Forb	SEA ROCKET	Brassicaceae	N	X		
Calamovilfa longifolia	5	10		Grass	SAND REED;DUNE REED	Poaceae	N		X	X
Calopogon tuberosus	-5	9		Forb	GRASS-PINK	Orchidaceae	N			
Calystegia sepium	0	2		Forb	HEDGE BINDWEED	Convolvulaceae	N	X		
Campanula rotundifolia	1	7		Forb	HAREBELL	Campanulaceae	N			
CARDUUS ACANTHOIDES	5		-1	Forb	PLUMELESS THISTLE	Asteraceae	A			
Carex hystericina	-5	5		Sedge	SEDGE	Cyperaceae	N			
Carex scirpoidea	3	10		Sedge	BULRUSH SEDGE	Cyperaceae	N			
CENTAUREA MACULOSA	5		-3	Forb	SPOTTED KNAPWEED	Asteraceae	A		X	X
CHENOPODIUM ALBUM	1		-1	Forb	LAMB'S QUARTERS	Chenopodiaceae	A		X	X
CHRYSANTHEMUM LEUCANTHEMUM	5		-1	Forb	OX-EYE DAISY	Asteraceae	A			
CICHORIUM INTYBUS	5		-1	Forb	CHICORY	Asteraceae	A		X	X
Cladium mariscoides	-5	9		Sedge	TWIG-RUSH	Cyperaceae	N			
Comandra umbellata	3	6		Forb	BASTARD-TOADFLAX	Santalaceae	N		X	X
Conyza canadensis	1	0		Forb	HORSEWEED	Asteraceae	N			
Cornus stolonifera	-3	2		Shrub	RED-OSIER DOGWOOD	Cornaceae	N		X	X
Danthonia spicata	5	5		Grass	POVERTY GRASS	Poaceae	N			
DAUCUS CAROTA	5		-2	Forb	QUEEN-ANNE'S-LACE	Apiaceae	A			
DIPLOTAXIS MURALIS	5		-1	Forb	WALL ROCKET	Brassicaceae	A	X		
Drosera rotundifolia	-5	7		Forb	ROUND-LEAVED SUNDEW	Droseraceae	N			
ECHIUM VULGARE	5		-2	Forb	VIPER'S BUGLOSS	Boraginaceae	A			
Eleocharis erythropoda	-5	4		Sedge	SPIKE-RUSH	Cyperaceae	N	X		
Eleocharis pauciflora	-5	10		Sedge	SPIKE-RUSH	Cyperaceae	N	X		
Elymus canadensis	1	8		Grass	CANADA WILD-RYE	Poaceae	N		X	X
EPIPACTIS HELLEBORINE	5		-2	Forb	HELLEBORINE	Orchidaceae	A			X
Equisetum arvense	0	0		Fern	FIELD HORSETAIL	Equisetaceae	N			X
Equisetum variegatum	-3	5		Fern	VARIEGATED SCOURING RUSH	Equisetaceae	N			
ERUCASTRUM GALLICUM	5		-1	Forb	DOG MUSTARD	Brassicaceae	A	X		
Eupatorium maculatum	-5	3		Forb	JOE-PYE WEED	Asteraceae	N			
Eupatorium perfoliatum	-4	2		Forb	COMMON BONESET	Asteraceae	N			

SCIENTIFIC NAME	CW	CC	WEED	FORM	COMMON NAME	FAMILY	N/A	BEACH	SD	
Euthamia graminifolia	-2	2		Forb	GRASS-LEAVED GOLDENROD	Asteraceae	N			
Fragaria virginiana	1	2		Forb	WILD STRAWBERRY	Rosaceae	N			X
Fraxinus pennsylvanica	-3	3		Tree	RED ASH	Oleaceae	N			
HIERACIUM AURANTIACUM	5		-2	Forb	ORANGE HAWKWEED	Asteraceae	A			
Hypericum kalmianum	-2	9		Shrub	KALM'S ST. JOHN'S-WORT	Guttiferae	N		X	X
HYPERICUM PERFORATUM	5		-3	Forb	COMMON ST. JOHN'S-WORT	Guttiferae	A			
Impatiens capensis	-3	4		Forb	SPOTTED TOUCH-ME-NOT	Balsaminaceae	N	X		
Juncus alpinoarticulatus	-5	5		Forb	RUSH	Juncaceae	N			
Juncus articulatus	-5	5		Forb	JOINTED RUSH	Juncaceae	N			
Juncus balticus	-5	5		Forb	RUSH	Juncaceae	N		X	X
Juncus bufonius	-4	1		Forb	TOAD RUSH	Juncaceae	N			
Juncus nodosus	-5	5		Forb	JOINT RUSH	Juncaceae	N			
Juniperus communis	3	4		Shrub	COMMON JUNIPER	Cupressaceae	N		X	X
Juniperus horizontalis	1	10		Shrub	CREEPING JUNIPER	Cupressaceae	N		X	X
Larix laricina	-3	7		Tree	TAMARACK	Pinaceae	N			X
Lathyrus japonicus	4	9		Forb	BEACH PEA	Fabaceae	N		X	X
Leersia virginica	-3	6		Grass	WHITE GRASS	Poaceae	N			
Linum medium var. medium	3	10		Forb	SMALL YELLOW FLAX	Linaceae	N			
Lithospermum canescens	5	10		Forb	HOARY PUCCOON	Boraginaceae	N		X	X
Lobelia kalmii	-5	9		Forb	BOG LOBELIA	Campanulaceae	N			
Lycopus americanus	-5	4		Forb	COMMON WATER HOREHOUND	Lamiaceae	N			
LYTHRUM SALICARIA	-5		-3	Forb	PURPLE LOOSESTRIFE	Lythraceae	A			
Maianthemum stellatum	1	6		Forb	STARRY FALSE SOLOMON-SEAL	Liliaceae	N		X	X
MEDICAGO LUPULINA	1		-1	Forb	BLACK MEDICK	Fabaceae	A			
MELILOTUS ALBA	3		-3	Forb	WHITE SWEET-CLOVER	Fabaceae	A			
MENTHA SP.	-3		-1	Forb	MINT (UNSPECIFIED)	Lamiaceae	N			
Mimulus ringens	-5	6		Forb	MONKEY-FLOWER	Scrophulariaceae	N	X		
MYOSOTIS SCORPIOIDES	-5		-1	Forb	COMMON FORGET-ME-NOT	Boraginaceae	A			
NASTURTIUM OFFICINALE	-5		-1	Forb	WATERCRESS	Brassicaceae	A			
Oenothera biennis	3	0		Forb	COMMON EVENING-PRIMROSE	Onagraceae	N	X	X	X
Onoclea sensibilis	-3	4		Fern	SENSITIVE FERN	Dryopteridaceae	N			
Panicum implicatum	0	2		Grass	PANIC GRASS	Poaceae	N			
Panicum virgatum	-1	6		Grass	SWITCH GRASS	Poaceae	N			
Parnassia glauca	-5	8		Forb	GRASS-OF-PARNASSUS	Saxifragaceae	N			
Phalaris arundinacea	-4	0		Grass	REED CANARY GRASS	Poaceae	N		X	X
Phragmites australis	-4	0		Grass	REED;GIANT BULRUSH	Poaceae	N			
Physocarpus opulifolius	-2	5		Shrub	NINEBARK	Rosaceae	N		X	X
PICEA GLAUCA	3		-1	Tree	WHITE SPRUCE (PLANTED)	Pinaceae	A			X
PINUS SYLVESTRIS	5		-3	Tree	SCOTSPINE	Pinaceae	A			X
PLANTAGO LANCEOLATA	0		-1	Forb	ENGLISH PLANTAIN	Plantaginaceae	A	X	X	X
Poa compressa	2	0		Grass	CANADA BLUEGRASS	Poaceae	N		X	X
POLYGONUM AVICULARE	1		-1	Forb	KNOTWEED	Polygonaceae	A			
POPULUS ALBA	5	4	-3	Tree	WHITE POPLAR	Salicaceae	A		X	X
Populus balsamifera	-3	5		Tree	BALSAM POPLAR	Salicaceae	N		X	X
Potentilla anserina	-4	9		Forb	SILVERWEED	Rosaceae	N			
Potentilla fruticosa	-3			Shrub	SHRUBBY CINQUEFOIL	Rosaceae	N		X	X
POTENTILLA RECTA	5		-2	Forb	ROUGH-FRUITED CINQUEFOIL	Rosaceae	A			
Primula mistassinica	-3	10		Forb	DWARF CANADIAN PRIMROSE	Primulaceae	N			

SCIENTIFIC NAME	CW	CC	WEED	FORM	COMMON NAME	FAMILY	N/A	BEACH	SD	
PRUNELLA VULGARIS SSP. VULGARIS	0		-1	Forb	LAWN PRUNELLA	Lamiaceae	A			
Prunus pumila var. pumila	5	10		Shrub	SAND CHERRY	Rosaceae	N		X	X
Prunus virginiana	1	2		Shrub	CHOKE CHERRY	Rosaceae	N			X
Sagittaria latifolia	-5	4		Forb	COMMON ARROWHEAD	Alismataceae	N			
Salix cordata	-1	9		Shrub	SAND-DUNE WILLOW	Salicaceae	N		X	X
Salix eriocephala	-3	4		Shrub	WILLOW	Salicaceae	N		X	X
Salix exigua	-5	3		Shrub	SANDBAR WILLOW	Salicaceae	N	X	X	X
Salix lucida	-4	5		Shrub	SHINING WILLOW	Salicaceae	N			
SALIX SP.			-1	Shrub	WILLOW (UNSPECIFIED)	Salicaceae	A		X	X
SALSOLA KALI	3		-1	Forb	RUSSIAN THISTLE	Chenopodiaceae	A		X	X
SAPONARIA OFFICINALIS	3		-3	Forb	BOUNCING BET	Caryophyllaceae	A		X	X
Schizachyrium scoparium	3	7		Grass	LITTLE BLUESTEM GRASS	Poaceae	N		X	X
Scirpus pungens	-5	6		Sedge	THREE-SQUARE;BULRUSH	Cyperaceae	N			
Senecio pauperculus	-1	7		Forb	BALSAM RAGWORT	Asteraceae	N		X	X
Shepherdia canadensis	5	7		Shrub	SOAPBERRY	Elaeagnaceae	N		X	X
SILENE VULGARIS	5		-1	Forb	BLADDER CAMPION	Caryophyllaceae	A			X
Sisyrinchium montanum	-1	4		Forb	MOUNTAIN BLUE-EYED-GRASS	Iridaceae	N			
Solidago altissima	3	1		Forb	TALL GOLDENROD	Asteraceae	N			X
Solidago hispida	5	7		Forb	WHITE GOLDENROD	Asteraceae	N			X
Solidago ohioensis	-5	10		Forb	OHIO GOLDENROD	Asteraceae	N			X
Solidago ptarmicoides	5	9		Forb	UPLAND WHITE GOLDENROD	Asteraceae	N			
Solidago uliginosa	-5	9		Forb	BOG GOLDENROD	Asteraceae	N			X
SONCHUS ARVENSIS	1		-1	Forb	PERENNIAL SOW THISTLE	Asteraceae	A	X		
Sorghastrum nutans	2	8		Grass	INDIAN GRASS	Poaceae	N		X	X
TARAXACUM OFFICINALE	3		-2	Forb	COMMON DANDELION	Asteraceae	A			
Thelypteris palustris	-4	5		Fern	MARSH FERN	Thelypteridaceae	N			
Thuja occidentalis	-3	4		Tree	ARBOR VITAE	Cupressaceae	N			X
Tofieldia glutinosa	-5	10		Forb	FALSE ASPHODEL	Liliaceae	N			
Triglochin palustris	-5	10		Forb	SLENDER BOG ARROW-GRASS	Juncaginaceae	N	X		
TRIFOLIUM REPENS	2		-1	Forb	WHITE CLOVER	Fabaceae	A			
TUSSILAGO FARFARA	3		-2	Forb	COLTSFOOT	Asteraceae	A	X	X	X
Typha latifolia	-5	3		Forb	BROAD-LEAVED CAT-TAIL	Typhaceae	N			
Veronica americana	-5	6		Forb	AMERICAN BROOKLIME	Scrophulariaceae	N			
VERONICA ANAGALLIS-AQUATICA	-5		-1	Forb	WATER SPEEDWELL	Scrophulariaceae	A			
VICIA CRACCA	5		-1	Forb	BIRD VETCH	Fabaceae	A			
Vitis riparia	-2	0		Vine	RIVERBANK GRAPE	Vitaceae	N		X	X
Xanthium strumarium	0	2		Forb	COMMON COCKLEBUR	Asteraceae	N	X		
Zigadenus elegans	-3	10		Forb	WHITE CAMAS	Liliaceae	N			X

Appendix B

Plan Showing
Recommended Access Points
(L. Porter)


Sauble River
SAUBLE FALLS RD
POECHMAN LANE
BLUE FLAG
ACCESS ONE
NEW PLATFORM
NEW ACCESS RAMP
EXISTING SAND FENCE
PRIVATE
Dunes
WATER LINE
ELDRIDGE AVE
DOUGLAS AVE
SECOND AVE N
KING EDWARD AVE
LAKESHORE BLVD N
ACCESS TWO
WASHROOM
RE-PAINT GATE-SAND COLOUR
STRAIGHT ACCESS
TENNIS
NEW SAND FENCE-40M
SIGNED/GARBAGE
ACCESS THREE
MOVE SWINGS OUT 12M
BUILD 20M SAND FENCE
BUILD NEW 2M WIDE BOARD WALK
NEW ENTRY GUARD-7.62M
MORE SIGNAGE FOR EDUCATION IN THIS AREA
PATH
ELEVENTH ST N
TENTH ST N
ACCESS FOUR
DEVELOP ACCESS
PATH BESIDE BURIED CULVERT
SWALE TO BEACH
BUILD 2-15M SAND FENCE
INSTALL SIGNED ACCESS BOLLARD
ACCESS FIVE
BEACH ACCESS
SIGNED/GARBAGE
BUILD 2-15M SAND FENCE
NEW ENTRY GUARDS-11M+3.7M
ACCESS SIX
PATH BESIDE
CULVERT GRATE
POPULAR/SPRUCE
REMOVE EXISTING DIRECTIONAL SIGN
REDIRECT PATH AROUND CB GRATE
INSTALL 1M GUARD IN FRONT
WITH NEW ACCESS SIGN
BUILD 2-15M SAND FENCE
MORE SIGNS TO DIRECT ACCESS
CHURCH
THIRD AVE N
LAKESIDE VILLAGE
ACCESS SEVEN
SIGNED BEACH ACCESS
PAY-BOOTH
REPAINT GATE SAND COLOUR
BUILD 2-15M SAND FENCE
ACCESS EIGHT
SIGNED BEACH ACCESS
2m WIDE GUIDERAILS
GARBAGE BINS
REMOVE NO PARKING SIGN
BUILD 2-15M SAND FENCE
EIGHTH ST N
INSTALL DIRECTIONS TO ACCESS POINTS
ACCESS NINE
DEVELOP
BUILD 2-15M SAND FENCE
NEW
UP & OVER
PATH-HAS PILE AT ROAD
TO BE DISCOURAGED
INSTALL DIRECTIONS TO
ACCESS POINTS
PATH SEVENTH ST N
ACCESS TEN
2m WIDE-GUIDERAILS
SIGNED-GARBAGE BINS
BUILD 2-15M SAND FENCE
YELLOW GATE
VEHICLE ACCESS
MOVE SWINGS OUT
ACCESS ELEVEN
BEACH ACCESS
SIGNED PAY-BOOTH
SIXTH ST N
PRIVATE
SCALE:
0 25 50 100 200
GRAPHIC SCALE

Appendix C

Invasive Species Control Methods

Appendix C

Control of Selected Invasive Plant Species In Coastal Dunes of Lake Huron

BEST MANAGEMENT PRACTICES

Applicability

The following document contains acceptable practices for control of the following terrestrial invasive species: Common Reed *(Phragmites australis* ssp*. australis)*, Garlic Mustard *(Alliaria petiolata) and Spotted Knapweed (Centaurea maculosa).*

The following management options, should be selected with consideration for the location and size of the infestations, the age of the plants, past control methods used at the site, time of year, weather conditions and adjoining and nearby land uses.

Other management approaches not identified here may be appropriate, but should be carefully researched before implementation.

GENERAL PRACTICES

1. **Erosion Control** - Some of the methods described below require actual digging or pulling of plants from the sand/soil. In all cases they require removal of vegetation whether or not there is actual soil disturbance. Each situation must be studied to determine if the proposed control method and extent of the action will destabilize sand/soils to the point where erosion is threatened. Generally in beach and dune areas, sand fencing is recommended to prevent wind erosion of open sand. Fencing should be installed no later than mid-October, and should remain up through fall, winter and spring. It may be removed during summer, but until native plants stabilize the area, sand fencing should be replaced each fall.

2. **Revegetation** - Although not a specific condition, replanting with native species is highly desired. All of the control methods below are aimed at reducing or eliminating invasive species so that natives are encouraged to grow and re-establish stable conditions that are not conducive to invasive colonization. In most cases removal or reduction of invasive populations will be enough to release native species and re-establish their dominance on a site.

3. **Equipment Sanitation** - All equipment used for invasive species control, whether it be hand or power driven, must be cleaned prior to entering onto a control site and prior to leaving the site. This is an effort to reduce transport of

invasive plant seeds or plant propagules and reduce the potential for new invasive introductions. Use steam or hot water to clean equipment.

4. **Material Collection and Transportation** – While on the control site place all cut plant material in heavy duty, 3 mil or thicker, black contractor quality plastic clean-up bags. Securely tie the bags and transport from the site in a covered vehicle in order to prevent spread or loss of the plant material during transport from the control work site to the appropriate staging or disposal location. The main root structure, root fragments and/or horizontal rhizomes from harvested controlled infestation should be bagged only to facilitate transport to an appropriate staging area.

5. **Composting** - Because of the extremely robust nature of invasive species, composting in a typical backyard compost pile or composting bin is not appropriate. However, methods can be used whereby sun-generated heat can be used to destroy the harvested plant materials. For instance, storage in a sealed 3 mil thickness (minimum) black plastic garbage bags on blacktop in the sun until the plant materials liquefy is effective. If a larger section of blacktop is available, make a black plastic (4 mil thickness minimum) envelope sealed on the edges with sand bags. The plant material left exposed to the sun will liquefy in the sealed envelope without danger of dispersal by wind. The bags or envelopes must be monitored to make sure the plants do not escape through rips, tears or seams in the plastic. **When composting is suggested later in the text it is understood that liquefying the plant material in or under plastic is the desired action; not disposal in backyard composters or open landfill composting piles.**

CONTROL METHODS FOR COMMON REED (Phragmites australis ssp. *australis)*

PLANT DESCRIPTION

Phragmites is a perennial grass that can grow to 4 metres in height. Flowering and seed set occur between July and September, resulting in a large feathery inflorescence, purple-hued turning to tan. Phragmites is capable of vigorous vegetative reproduction and often forms dense, virtually monospecific stands. It is unclear what proportion of the many seeds that Phragmites produces are viable. **Please note that identification of Phragmites should be done by a professional botanist prior to treatment to distinguish the invasive non-native race from the non-invasive native.**

MANAGEMENT OPTIONS

1. Cutting / Mulching

Effectiveness:
Need to repeat annually for several years to reduce spread of plants. Hand-pulling, though labour intensive, is an effective technique for controlling Common Reed in small areas with sandy soils.
Can be effective in small stands i.e.<100 plants, low-med density (1-75%area) & <1 hectare

Methods:
The best time to cut Common Reed is when most of the food reserves are in aerial portion of plant when close to tassel stage, e.g.: at end of July/early August to decrease plant's vigour. Some patches may be too large to cut by hand, but repeated cutting of the perimeter of a stand can prevent vegetative expansion. Common reed stems should be cut below the lowest leaf, leaving a 10 cm or shorter stump.
Hand-held cutters and gas-powered hedge trimmers work well.
Repeat in second year and then every subsequent year until the plant is under control.

Cautions:
Since Common Reed is a grass, cutting several times during a season, at the wrong times, may increase stand density. However, if cut in late July/early August, most of the food reserves produced that season are removed with the aerial portion of the plant, reducing the plant's vigour. This cutting regime may eliminate smaller colonies if carried out annually for several years. Manual or mechanical cuttings of larger, high density, monospecific Common Reed stands can be difficult from a control standpoint.

Disposal:
Cut material should be removed from the site and composted or allowed to decay in an area inland to prevent sprouting and formation of rhizomes. Do not attempt to compost rhizomes.

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

2. Black Plastic

Effectiveness:
Can be effective in small stands i.e.:<100 plants, low-med density(1-75%area). Plants die off w/in 3-10 days, depending on sun exposure.

Methods:
Cut plants first to less than 10 cm. Gas powered hedge trimmers are very effective for cutting After cutting a stand of Common Reed, anchor a sheet of black plastic, geotextile or dark tarp over the cut area using sand bags, logs or rocks. High temperatures under the plastic will eventually kill off the plants. This

technique works best when the treated area is in direct sunlight. Plastic should be at least 6 millimeters thick. Hold plastic in place with sandbags, rocks, biodegradable stakes, etc. Can treat runners along the plastic edges with a spot application of Rodeo®. The plastic can be removed the following year when the covered plants have been killed. A few common reed shoots may return. These can be cut or hand-pulled.

Cautions:
Must monitor to determine if shoots are extending out from under the plastic.

Disposal:
Can leave cut material under plastic or bag all plant parts & remove from site (compost at municipal facility, dispose of in approved landfill or incinerate with appropriate municipal permits.

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

3. Pulling

Effectiveness:
Can be effective in small stands i.e. <100 plants. Very labour intensive control method, best results when infestation occurs in sandy soils.

Methods:
Hand-pull plants <2 years old. Use shovel for plants >2 years old-dig up plant, then replace sand.

Disposal:
Bag all plant parts and remove from site (compost at municipal facility, dispose of in approved landfill or incinerate with appropriate municipal permits).

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

CONTROL METHODS FOR GARLIC MUSTARD (Alliaria petiolata)

PLANT DESCRIPTION

Garlic mustard is a naturalized European biennial herb that typically invades partially shaded forested and roadside areas. It is capable of dominating the ground layer and excluding other herbaceous species. Its roots also emit a toxin which inhibits the growth of trees, ultimately limiting the capacity of a woodland to regenerate. Its seeds germinate in early spring and develop a basal rosette of

leaves during the first year. Garlic mustard produces white, cross-shaped flowers between late April and June of the following spring. Plants die after producing seeds, which typically mature and disperse in August. Normally its seeds are dormant for 20 months and germinate the second spring after being formed. Seeds remain viable for up to 7 years.

MANAGEMENT OPTIONS

1. Pulling.

Effectiveness:
Hand pulling is an effective method for removing small populations of Garlic Mustard, since plants pull up easily in most forested habitats. It is best to pull plants when seed pods are not yet mature, but they can be pulled during most of the year.

Methods:
Soil should be tamped down firmly after removing the plant. Soil disturbance can bring existing Garlic Mustard seed bank to the surface, thus creating a favourable environment for additional germination within the control site.

Cautions:
Care should be taken to minimize soil disturbance but to remove all root tissues. Re-sprouting may occur from mature plants root systems if not entirely removed. Cutting is preferred to pulling when Garlic Mustard infestations are interspersed amongst native grasses/forbs or other sensitive or rare flora.

Disposal:
Bag all plant parts and remove from site (compost at municipal facility, dispose of in approved landfill or incinerate with appropriate municipal permits).

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

2. Cutting

Effectiveness:
Cutting is effective for medium-to large-sized populations depending on available time and labour resources. Dormant seeds in the soil seed bank are unaffected by this technique due to minimal disturbance of the soil.

Methods:
Cut stems when in flower (late spring/early summer) at ground level either manually (with clippers or a scythe) or with a motorized string trimmer. This technique will result in almost total mortality of existing plants and will minimize re-sprouting.

Cautions:
Cuttings should be conducted annually for 5 to 7 years or until the seed bank is depleted.

Disposal:
Cut stems should be removed from the site since they may produce viable seed even when cut. Bag all plant parts and remove from site (compost at municipal facility, dispose in approved landfill or incinerate with appropriate municipal permits).

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

3. Herbicide

Effectiveness:
Roundup will not affect subsequent seedling emergence of garlic mustard or other plants. Herbicide is only used as a last resort.

Methods:
Use glyphosate formulations only. Should be applied after seedlings have emerged, but prior to flowering of second-year plants. Application should be by spot spray bottle or wick applicator for individual spot treatments.

Cautions:
This herbicide is not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act. Should not be used in areas of standing water or along the shoreline or a watercourse or the lake.

*CONTROL METHODS FOR Spotted Knapweed (*Centaurea maculosa*)*

PLANT DESCRIPTION

Appearance: Biennial or short-lived perennial herbaceous plant, 2 - 3' high. Basal leaves form a rosette the first year from which grow 1- 20 wiry, hoary, branched stems during the second year.

Leaves: Alternate, grayish, hoary, and divided into lance-shaped lobes decreasing in size at the top.

Flowers: Thistle-like pink to purple flowers sit at the tips of terminal and axillary stems, bloom from July through September.

Seeds: Brownish, 1/4" long with small tuft of bristles, dispersed by rodents, livestock and commercial hay. Seed viable in the soil for 7 years.

Roots: Stout taproot. Lateral shoots form new rosettes near the parent plant.

Caution: Wear long sleeves and gloves, can be a skin irritant to some people.

Ecological Threat:

- Especially threatens dry prairie, oak and pine barrens, dunes and sandy ridges.
- Spotted knapweed is poisonous to other plants (phytotoxic).
- Spreads rapidly in artificial corridors (roadways, laneways or disturbed paths)..
- A native of Europe and Asia it has become a serious problem in natural dune areas

MANAGEMENT OPTIONS

1. Early Detection and Prevention
Survey for flowering and pre-flowering knapweed from **May to July** along roadsides,streambanks and dunes. Isolated small populations can be dug up but the site should be monitored for several years to look for plants growing from root fragments and from the seed bank.

2. Pulling.

Effectiveness:
Pulling is most appropriate in dune areas. Pull or dig up small infestations including the entire root if possible. Plants in sandy soil pull easily but those in hard-packed soil will require a shovel or stout trowel. Plants are most susceptible to hand pulling if the soil is still moist and uncompacted. Roots still tend to break off 10 to 15 cm beneath the ground. A small percentage of these root fragments will re-sprout. Sites where weeds are pulled need to be watched closely for new rosettes and re-sprouts throughout the
growing season. The disturbed soil from pulling and digging aids in germination of any seeds present. Soil should be tamped down firmly after removing the plant. Soil disturbance can bring existing Spotted Knapweed seed bank to the surface, thus creating a favourable environment for additional germination within the control site.

Cautions:

Prevent plants from spreading from existing populations by washing vehicles, boots and animals that have been in infested areas. Seeds are small and are easily carried in mud and in animal fur.

Disposal:
Bag all plant parts and remove from site (compost at municipal facility, dispose of in approved landfill or incinerate with appropriate municipal permits).

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

2. Cutting

Effectiveness:
Cutting is effective for medium-to large-sized populations in non-dune areas depending on available time and labour resources. In non-dune areas, plants that are periodically mowed will generally continue to flower and produce seed on shorter plants below the mower blade height. Cultivation can bury seeds and plant parts under the soil surface and repeated cultivation can be effective if combined with monitoring for and controlling re-sprouts.

Re-establish a cover of dune vegetation to help prevent knapweed from re-establishing in dune areas.

Methods:
Cut stems when in flower (late spring/early summer) at ground level either manually (with clippers or a scythe) or with a motorized string trimmer. This technique will result in almost total mortality of existing plants and will minimize re-sprouting.

Cautions:
Cuttings should be conducted annually for 5 to 7 years or until the seed bank is depleted.

Disposal:
Cut stems should be removed from the site since they may produce viable seed even when cut. Bag all plant parts and remove from site (compost at municipal facility, dispose in approved landfill or incinerate with appropriate municipal permits).

Sanitation:
Clean all clothing, boots, & equipment to prevent spread of seed.

Sources:

The Nature Conservancy, Element Stewardship Abstracts for Common Reed, Garlic Mustard and Spotted Knapweed, 2005. (see http://tncweeds.ucdavis.edu/esadocs.html)

Minnesota Department of Natural Resources, 2007.
http://www.dnr.state.mn.us/invasives/terrestrialplants/herbaceous/spottedknapweed.html

Appendix D

Sample Interpretive Sign

Protecting the Dune Grasslands of Sauble Beach

Long-leaved Reedgrass is a signature dune grass native to Sauble Beach.

The endangered Piping Plover is vulnerable to human disturbance. Please stay on designated pathways.

Freshwater dune systems are among the most fragile ecological systems in North America. Great Lakes dune systems in Ontario are rare and vitally important to the health of our beaches.

Plants found on coastal dunes have adapted to a harsh environment. They are able to withstand periodic burial, low levels of moisture and nutrients and temperature extremes. Dune grasses also slow wind speed near the ground and ultimately protect dunes against wind erosion.

Dunes in Sauble Beach are:

- Reservoirs of sand that the beach 'borrows' during high lake levels and storms to protect the shoreline.
- Important features that can help improve local nearshore water quality.
- Habitat for many rare species of plants, like Long-Leaved Reed Grass and American Beachgrass (Marram grass).
- The endangered Piping Plover has successfully nested on more remote parts of Sauble Beach.
- Help protect our dunes. Please take special care not to disturb the dunes or their stabilizing vegetation. Dune conservation helps protect the health and quality of our beaches.

Ontario

Friends of Sauble Beach

THE LAKE HURON CENTRE FOR COASTAL CONSERVATION