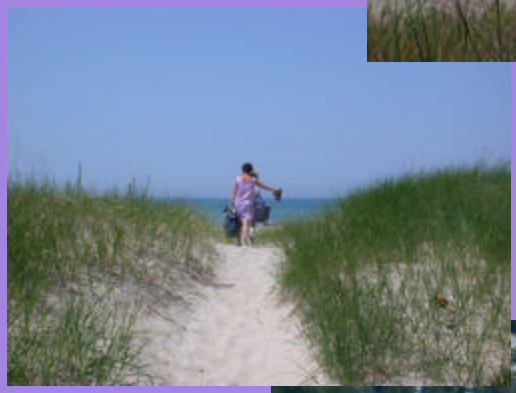
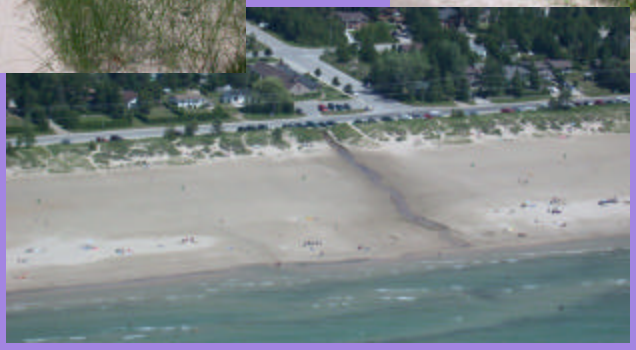
Sauble Beach Management Plan

Conserving a Finite Resource





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This project is made possible by a grant to ***Friends of Sauble Beach*** by

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Introduction

Sauble Beach represents one of the largest beach-dune systems on Lake Huron. It is a closed beach system, contained between two large headlands—Chief's Point to the north and Frenchman's Point to the south. The total length of the beach-dune system between these headlands measures approximately ten kilometers. The beach and dunes are a legacy of geomorphic conditions that are no longer present. They are relic sands that comprise an important non-renewable resource along the coast of Lake Huron.

Dunes are coastal features which are particularly vulnerable to degradation resulting from human disturbances. Human disturbances usually come in the form of vegetation trampling by people making their way to the beach. Disturbances can also come in the form of vehicle transportation across or into the dunes, and deliberate or accidental removal of, or damage to, dune vegetation. The dunes at Sauble Beach have been under increasing pressure in recent years, as more and more visitors come to enjoy the beaches.

Friends of Sauble Beach, a local community group, have recognized the stresses occurring to this ecosystem and have embarked on a vision for Sauble Beach, including the development of a long term

management plan for the waterfront that strives to accommodate the needs of the beach-dune ecosystem while maintaining the use of the beach for tourism and recreation. Friends retained the Lake Huron Centre for Coastal Conservation to prepare this plan. The Centre employed a science-based approach involving an examination of the existing condition of the dunes, identifying areas of concern and recommending measures that conserve the integrity of the beach-dune system.

The study area used for this report includes the approximately 6 kilometers of beach and dunes from Main St., north to the Sauble River. The area south of the study area is under the jurisdiction of Saugeen First Nation. While this report focuses on the study area described above, much of the information and management approaches are relevant to the beaches and dunes within Suageen First Nation. It is recommended that this document be shared with Saugeen First Nation and that a unified approach to dune ecosystem conservation be encouraged.

This plan provides an overview of the ecology of Sauble Beach and the rationale for conservation. This is followed by a description of conservation measures which should be implemented to protect the long-term integrity and dynamic equilibrium of the dunes. In concordance with this report, a set of maps and designs have been prepared by Brian W. Folmer, Environmental Landscape Design. The maps illustrate the current condition of the dunes, the plant communities and present beach access patterns. The design plans and construction details for the boardwalks, fencing and other infrastructural components discussed in this report have been prepared to assist with the implementation of this plan. These resources are provided under separate cover from this report.

Finally, some potential funding sources are suggested to assist Friends of Sauble Beach, the Town of South Bruce Peninsula, and others in implementing this plan.

1.0 Conserving Sauble Beach

1.1 Purpose of this Plan

This Plan has been prepared for the *Friends of Sauble Beach*, a local organization in the community of Sauble Beach dedicated to the stewardship of the waterfront and the protection of the sensitive coastal environment at Sauble Beach. The beach and dunes are the dominant coastal system at Sauble Beach. This beach is a major tourist destination in Ontario during the summer months, attracting thousands of people throughout the summer season. The large number of beach users has had a significant impact on the dunes at Sauble Beach, particularly in the south end (Main Street to Sixth Street). Dune degradation has been the result of these impacts and this has led to the predictable consequence of sand erosion from the dunes and sand accumulations landward of the dunes.

Sand erosion and dune degradation has been an ongoing problem, based on past reports pertaining to the Sauble Beach waterfront (Fanshawe College, 1980; Totten Sims Hubicki, 1974). These past reports were studies commissioned by the former Township of Amabel to look at a range of issues, including dune conservation. Based on the recommendations of these reports, neither consultant appeared to have much coastal experience, particularly as it related to coastal processes. As a result, the municipality and community of Sauble Beach have not had the benefit of comprehensive resource information that specifically deals with the waterfront and the protection of its beach and dune resources.

This Plan is intended as a guidance document to assist the Friends of Sauble Beach, the Town of South Bruce Peninsula and the broader community of Sauble Beach to implement an effective dune conservation, environmental education and restoration program that works with the tourism and recreation needs of the community.

1.2 What are Dunes?

A dune may be simply defined as a mound or ridge formed by the deposition of sand. These geologic landforms develop when an abundance of sand combines with wind, vegetation and geography.

At Sauble Beach, the beach and dunes have formed over the last 3000 to 4000 years, since post-glacial Lake Nipissing began to recede. Since the composition of dunes is fine sand, the dunes are particularly vulnerable to erosion—from stormwaves and from wind. People's indiscriminate use of dunes can damage or destroy thousands of years of geologic processes in a very short time horizon.

1.3 What's the Connection between Beaches and Dunes?

When we talk about dunes, we're really talking about beaches and dunes as a system. Dunes are reliant on the beach for their ongoing sand supply. Likewise, the beach relies on the dune's sand reservoir during periods of high lake levels and storm events to supply sand to the beach to maintain its form and function. Waterfront management needs to respect beaches and dunes as a system. Understanding that system will help managers make decisions that avoid compromising Sauble Beach's beach and dune resources.

Sauble Beach from Main Street looking north towards Chief's Point. The Study Area for this Plan included the beach and dunes from Main St. to Sauble River.

1.4 Dunes in the broader context

Prevailing winds have concentrated dunes along the eastern shores of Lake Huron. There is a lack of dunes on the western shores of Lake Huron. We in Ontario are fortunate, then, to have some of the best beach and dune systems on the lake. However, even on the eastern shores of the lake, dune systems are limited in geographic area.

Pinery/Ipperwash, Point Clark, Inverhuron, Saugeen Shores and Sauble Beach are the main dune systems along Lake Huron. Of these, two large dune complexes - Pinery (2,532 ha) and Inverhuron (288 ha) - are within Provincial Parks, and so their management and conservation are more straightforward. The other dune systems have little formal management or stewardship arrangements.

What starts to become clear is that in the 'big picture', Lake Huron's dune systems represent an extremely small land mass. 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 disturbances (Bowles, 1981). Dunes are vulnerable to wind erosion once the anchoring vegetation is damaged or destroyed. Without effective conservation measures, we stand to lose an already limited resource.

1.5 Why Conserve Dunes?

Aside from the ecological imperative to protect dunes as critical coastal features and habitats, are there any economic reasons to protect dunes? Consider the following: During the high water levels of 1985-86, millions of dollars were spent to protect coastal properties and municipal waterfronts along Lake Huron. The average cost of an armourstone revetment, for example, was $2000 per linear metre.

Sand dunes have long been known by scientists and resource managers to be nature's shore protection. They outperform their structural counterpart by their ability to give and take with the dynamic (wind and wave) processes at work along the shoreline. Using $2000/m as the amount that would be required to replace dunes with conventional shore protection, it becomes apparent that the value of dunes to a community can be great. For example, the Sauble

Historical Photographs of the Dunes at Sauble Beach

Beach's four kilometres of dunes, would have a value of about $8 million simply as shore protection. This does not include the aesthetic value of the dunes, important to tourism, or the ecological value of the dunes, important to naturalists and educators. By conserving its dunes, Sauble Beach is protecting a multi-million dollar asset.

1.6 What makes the Dunes at Sauble Beach so Special?

The bulk of the sand that makes up the beaches and dunes in Sauble Beach is relic material. That means it was deposited by waves and winds in historical times. The Sauble River no longer contributes significant amounts of sand to the coastal system. There is also no sediment contribution from the north or the south into Sauble Beach. These relic sands have been held in place by the unique configuration of the shoreline. Frenchman's Point to the south, and Chief's Point to the north, help to contain the sand deposits within those headlands. The sand at Sauble Beach is an irreplaceable, non-renewable resource.

Some of the plants that have evolved in the dunes of Sauble Beach are rare dune species. For example, Long Leaved Reed Grass which is an endemic plant in Sauble Beach's dunes, is rare in Canada, and confined to the dunes of Lake Huron.

1.7 An Historical Account of Dunes at Sauble Beach

During the early stages of the development of this plan, it was important to look at the history of the dunes, since some claims were made by area residents suggesting that dunes were not existent 50-60 years ago. Based on the geomorphic characteristics of the coast in this area, such claims did not seem plausible. As part of the research phase of this plan, local residents were asked for historical pictures of the beach and dunes at Sauble Beach. The result was a collection of historical photographs confirming that the dunes were extensive at Sauble Beach as far back as the 1930's. The photographs also show that the dunes had a significant biological diversity at that time as well.

1.8 Land Use Policies - Zoning Protection for Dunes

In the mid 1990s the Province of Ontario instituted the Provincial Policy Statement (PPS) under the provincial *Planning Act* which

included restricting development from areas defined along the Great Lakes as “Dynamic Beach”. The PPS recognized that beaches and dunes play important functions, both ecologically and in terms of protecting the shore during high water levels. Dynamic beach policies have been recognized in the Shoreline Management Plan prepared by the Grey Sauble Conservation Authority in 1994.

New development along the shoreline, under these new policies, has been identified in the Shoreline Management Plan as not being permissible west of Lakeshore Boulevard. The PPS restricts ‘new’ development, and is not intended to address dune stewardship, or best management practices. However, it is one more tool in the dune conservation “toolbox” that municipalities have at their disposal. The Town of South Bruce Peninsula will need to incorporate dynamic beach policies into its Official Plan and Zoning By-laws during the plan review process.

2.0 The Ecology of the Dunes

During the summer of 2003, Geoff Peach of the Lake Huron Centre for Coastal Conservation, and Brian Folmer, environmental landscape design consultant, conducted a survey of the dunes at Sauble Beach to document the ecological attributes of the dune system. The approach taken was an “ABC Resource Survey” which looked at the abiotic (physical), biotic and cultural (human impacts) features associated with the dunes. The information was mapped at a scale of 1:2000, identifying major plant communities, physical characteristics of the dunes and areas where people have had an impact on the dune’s structure and function. A preliminary botanical inventory, identifying both dominant species and rare species, accompanied the mapping. The inventory information would be used to help to prioritize approaches for management of the dune system, as well as locate areas where interventions might be necessary to restore highly degraded dunes.

“Health is the capacity of the Dunes for self renewal. Conservation is our effort to understand and preserve this capacity”

Adapted from A. Leopold

2.1 “A” - Abiotic - How Does Sauble Beach “Work?” (beach and dune processes and functions)

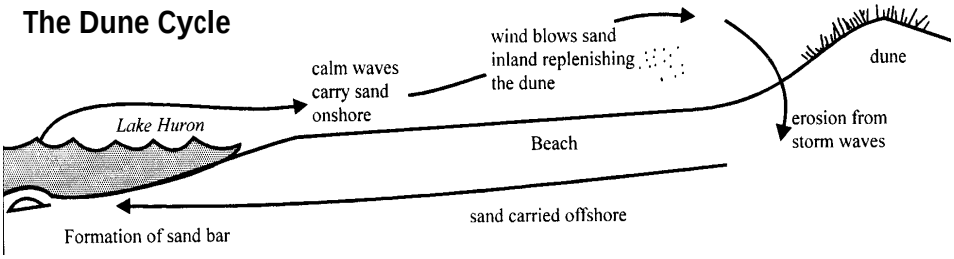
Sauble Beach owes its existence to the topography of the coast. It is a self-contained “pocket beach” which has formed within a large embayment or crenulate (‘U’ shaped) shoreline, bounded by Chief’s

Point and Frenchman's Point.

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-attach it to the beach.

Once onshore, the sand is then prone to movement by wind, and the sand can then be transported to the dunes. This process forms the "dune cycle."

The Dune Cycle



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 dune system.

Significant 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 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 that 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. At Sauble Beach, wet beaches predominate during periods of high lake levels. Less wind movement of sand can be expected during high lake levels.

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. Generally, winds of the greatest intensity occur during the fall (Sept-Dec.) and winter (Jan.-Mar.). Winds during this period, on average, prevail from the south, southwest and west (MacLaren Plansearch, 1991).

As well as wind speeds and duration, the prevailing water level plays

"It is fundamental to understand that sand dunes and beaches must be managed as one system"

The dunes at the north end of Sauble Beach (Sixth St. to the Sauble River) are significantly wider than the dunes to the south. These north dunes possess a greater diversity of dune plants than those to the south. They have also been the least impacted by human interactions.

The dunes to the south end of the study area (Main St. to Sixth St.) are more narrow, have a smaller species diversity and are highly impacted by human interactions.

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.

The physiography of the dunes varies from narrow, steep dunes in the south end of the study area, to wide expanses of more gradually sloping dunes. Where dunes have been impacted by human activity, sand erosion from the dunes is carried leeward of the dunes, across Lakeshore Blvd. An exception are the dunes south of the Sixth St. washrooms. Here, impacts to the foredune have led to erosion, but

The dunes to the south of Sixth St. stand higher than the dunes anywhere else in the Sauble Beach area. The face of the foredune has been de-vegetated and eroded sand has accumulated further back into the dune where vegetation is present to “catch” sand particles as they are blown inland.

the eroding sand has caused the dune to build upward, creating the highest section of dunes at Sauble Beach.

2.2 "B" - Biotic - Role of Dune Vegetation
"Sand dunes need their greens!"

The dunes at Sauble Beach have an impressive biological diversity. This is particularly true in the north portion of the dune system (between Sixth St. and the Sauble River). The diversity of plant species in this area is perhaps only surpassed by the dune diversity found at the Pinery Provincial Park. The dunes to the south (from Sixth St. to Main St.) have a much smaller biodiversity, but this is, in large part, attributed to the impacts and pressures placed upon the dunes by beach users. Uncontrolled access through the dunes has led to serious degradation problems in the south dunes. While a number of globally rare and Provincially rare species can be found in the dunes at Sauble Beach, at least one globally rare plant has been extirpated (eliminated) from these dunes. *Cirsium pitcheri* (Pitcher's Thistle), a rare and threatened dune flower, was once an important part of the dune system at Sauble Beach. There have been no records of this plant here since 1941. Cottaging and human recreation have been attributed to the cause of its demise (MNR, 1999). The fate of

Long-leaved Reed Grass (Calamovilfa longifolia) dominates the dunes at Sauble Beach. This dune species is considered rare in Canada.

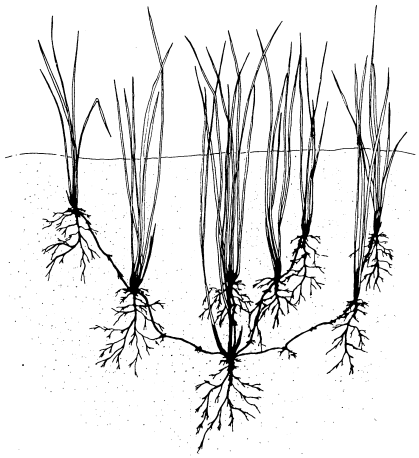
other rare species in these dunes may rest in how successful conservation efforts will be.

If we are looking to this plan for some guidance on preserving the environmental integrity of the dune system at Sauble Beach, it is useful to first understand the critical 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 and stable dune provides an erodible 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 (see Dune Cycle, p. 9).

Coastal vegetation is itself dynamic. Earlier, simpler plant



Graphic showing the growth pattern of American Beachgrass (Ammophila breviligulata). The primary mode of reproduction of this species is through the development of horizontal stems called “rhizomes.” Several new plants will grow from the parent plant. The roots and rhizomes also act to bind the sand, providing substantial stability to the dune.

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. At Sauble Beach, the dunes adjacent to the Lakeshore Road are dominated by *Calamovilfa longifolia*. This is an important stabilizing beach grass at Sauble Beach and perhaps one of the most important plant species and plant communities in terms of the present and future stability of the dunes.

Pioneer plants trap and hold windblown sand in the foredune and help create conditions that 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 to the beach/dune system. Wind erosion of the beach and unvegetated foredunes results in coastline recession. 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
(*Ammophila breveligulata*)

American Beachgrass is the most successful sand-trapping plant colonizing dunes along most of the Lake Huron

coastline. It has the ability to grow through large accumulations of windblown sand. Cycles of sand deposition and plant growth result in dune formation and build-up. At Sauble Beach, this beachgrass is restricted to the foredune portion of the dunes. American Beachgrass communities expand and contract under the influence of lake levels. During high lake levels, the waves will erode the front of the dune, including the Beachgrass, causing the Beachgrass community to contract. During low water periods, Beachgrass migrates shoreward, expanding its cover and enabling it to collect more wind blown sand. This process has been interrupted at Sauble Beach through the practice of mechanical raking of the beach.

The development of vegetative cover on newly formed dunes, if undisturbed, will create conditions that suit 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 act 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.

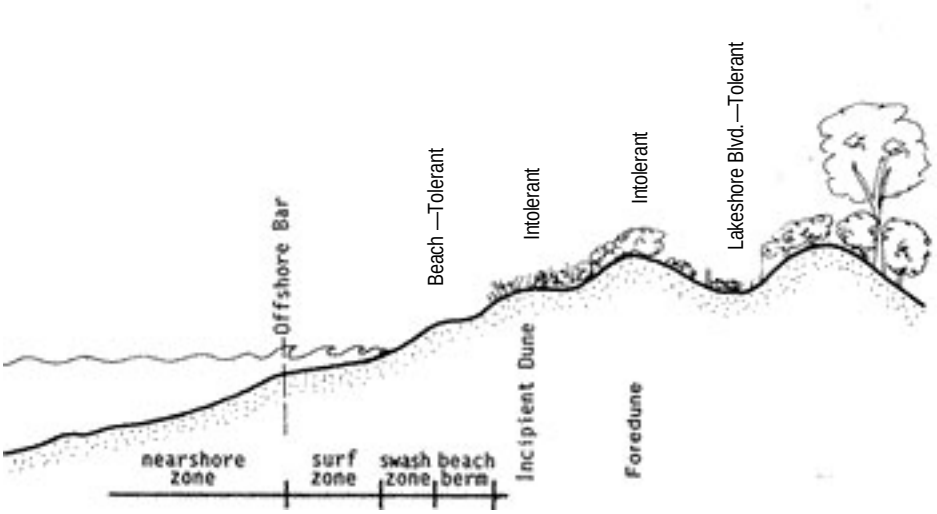
Sand dune grasses are plants which have specifically adapted to the dune environment. The structure of these grasses can resist sand abrasion, wind breakage and water loss. They have adapted to extreme heat (dunes can reach temperatures of 60C in summer) as well as nutrient deficient soil. Confronted 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 at the active lakeward side of the foredune, but Long-leaved Reedgrass (*Calamovilfa longifolia*), is another key dune stabilizer that is much more dominant at Sauble Beach. Where American beachgrass can tolerate substantial burial by aeolian sand deposition, the Reedgrass is less tolerant and therefore tends to develop landward of the crest of the foredune 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. As can be seen in the photograph below, these two beachgrass species have distinct linear, shore-parallel growth patterns. American Beachgrass, being the most tolerant to sand burial, develops along the beach and foredune, while the Reedgrass, which is less tolerant to sand burial, grows behind along the back portion of the dune.

The American Beachgrass expands lakeward during low lake levels, as waves are less likely to interfere with this lakeward expansion. The larger expanse of Beachgrass corresponds with the additional sand migration that occurs as winds travel over the wider beach. The reverse is true during high lake levels, as the Beachgrass community contracts as the waves erode that portion of the foredune.

Dune grass communities showing distinct linear patterns. American Beachgrass develops along the most lakeward side of the dune where sand deposition is most prevalent. Long-leaved Reedgrass, landward of the Beachgrass, develops in a part of the dune that is more sheltered from excessive sand deposition.



Generalized profile of the dunes at Sauble Beach showing the relative resistance of features to human disturbance.

A generalized profile of the dunes at Sauble Beach shows the relationship between plants and landforms, including an assessment of the relative ability of the dune system to withstand human disturbances. The foredune, or most lakeward dune ridge, is the most critical part of the dune system and is the area least able to tolerate any 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 trampling and soil disturbance. Typically these areas are made up of the dominant Beachgrass and Reedgrass communities. Behind the foredune, plant communities which are less tolerant to sand deposition tend to grow. These include communities dominated by Sand Cherry and Willow.

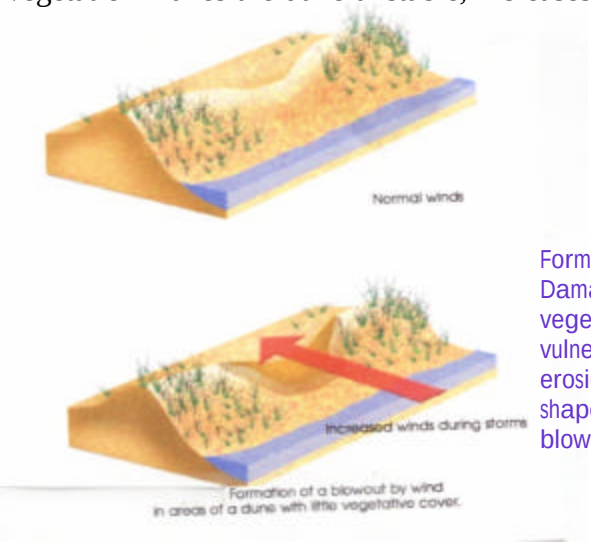
Beach and sand dune vegetation both bind the soil and lower wind velocities causing fine sands to be deposited. This can be observed in beach areas occupied by vegetation and in bare areas caused by human disturbance. Fine sands collect around dune vegetation, while in areas devoid of vegetation, fine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

Many other dune species occur in Sauble's dunes. A preliminary list, prepared as part of the ABC survey, can be found in Appendix A.

2.3 "C" - Cultural- Human Impacts to Dunes
"These Dunes aren't made for Walking"

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 *Calamovilfa longifolia*, the dominant dune plant at Sauble Beach, is fragile to human disturbance and can be damaged by fewer than 50 passes. As few as 200 passes can severely affect its growth pattern and chance for recovery (Bowles and Maun, 1982).

Dunes are fragile systems and trampling by beach goers destroys the vegetation and results in deterioration of the dune. Destruction of vegetation makes the dune unstable, increases wind erosion and



Formation of a "blowout." Damage to the protective vegetation makes the dune vulnerable to wind erosion. Sand erosion can lead to large 'bowl-shaped' depressions known as blowouts.

Trampling Effects on Dune Vegetation

Studies by researchers from the University of Western Ontario have shown that Long-leaved Reedgrass *(Calamovilfa longifolia)* is vulnerable to trampling effects and can be seriously impacted by as few as 50 passes. The plant becomes damaged to the point where recovery is severely impaired. Photograph illustrates how quickly an impact of this nature can happen. Two bus-loads each carrying 50 passengers crossing over to the beach and back again can meet that 200 pass threshold within a matter of minutes. Since this species cannot recover quickly, the pathway becomes vulnerable to wind erosion and the formation of a blowout.

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 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 sediments along the Sauble Beach waterfront are relic materials and cannot be replaced naturally. This inland migration of sand can also result in substantial maintenance costs to the town as it forms drifts on the roads, covers lawns and gardens, and clogs storm drains. A blowout also represents a breach of the dunes shore protection capability. This breach can allow storm waves to erode much larger segments of the shore than would otherwise be the case. In any case, blowouts are usually quite costly.

Parking

Ironically, the Sauble Beach area was not designed well to

Angle parking adjacent to the dunes has led to the development of hundreds of pathways through the dunes. Regardless of how difficult it is to negotiate the dune, the tendency is for people to leave their vehicle and take the shortest route to the beach. Scaling steep dunes can lead to additional damage as downward pressures exerted on the soil causes the slope to collapse. Part of this erosion process is the development of "sand cones" which form on the leeward side of the dune at the foot of the pathway.

accommodate the parking of vehicles. There are no formal parking facilities designed for beachgoers, and so beach parking has evolved into an angle parking system on the leeward side of the dunes. The tendency under this arrangement, is for people to cross the dunes directly in front of their vehicle. This has lead to the development of hundreds of pathways cut into the dunes from people trying to access the beach. The numbers of pathways is significantly greater at the south end of the study area (Main St. to Sixth St.) than in the north.

Even the steepness of the dune does not appear to deter people from scaling the dune to get to the beach. Steep dunes near Second St. N. are regularly traversed by beachgoers. The problem is that the erosion process is accelerated as a result. It was common to observe erosion cones that had developed at the landward base of the pathways. These cones are primarily gravity induced formations. They are continually removed during routine maintenance of the parking shoulder on Lakeshore Boulevard.

While not ideal from the standpoint of dune conservation, there does not appear to be an alternative to the current arrangement of angle parking adjacent to the dune. However, the problem of uncontrolled access through the dunes will need to be addressed. Each dune pathway is susceptible to wind erosion, and each open pathway could potentially develop into a blowout. Every breach in the dune weakens the integrity and internal strength of the dune. This is an important concern when one considers the significance of dunes as a coastal shore defense structure during periods of high lake levels. Such openings in the dunes are points of vulnerability to eroding storm waves.

There are currently no effective mechanisms in place to control or guide people's access through the dunes at Sauble Beach.

Vehicular Impacts and Beach Raking

Vehicular traffic on the dunes can have a profoundly damaging effect on dunes. Recreational vehicles, like ATV's, should be prohibited from operating in dune areas in Sauble Beach. Town maintenance vehicles, however, have historically had access to the waterfront to conduct maintenance activities, like the removal of debris along the beach washed in from the Sauble River during the Spring freshet. It is important that workers are aware of the sensitivities of the dunes

and its vegetation, and take measures to avoid or mitigate damage to the dune.

Beach access roads through the dunes are subject to the same erosive processes and may become channels for wind erosion. At Sauble Beach, specific entry points along the beach have allowed maintenance vehicles to access the beach while minimizing impacts to the dunes. Still, these access points are vulnerable to wind scouring and care must be taken to prevent sand loss through them.

Some conventional beach management practices that include mechanized raking or grading the beach can be destructive and have long-range implications for the sustainability of the beach-dune system. Where the fine-grained, low gradient beach is often high in moisture content (particularly during periods of high lake levels), raking has the effect of aerating the sand and drying it out, thus making the fine sands vulnerable to wind erosion. Raking and

Access routes for maintenance and emergency vehicles can be large enough openings in the dunes to channel substantial amounts of sand. These are points where off-season sand fencing should be installed to prevent mass sand transport out of the beach-dune system.

grading also tend to obliterate sand binding beach vegetation which tend to populate the mid and upper beach. This undermines the critical relationship between lake levels and dune development. During low lake levels, dune vegetation (American Beachgrass in particular) migrates lakeward through its underground rhizome systems and colonize areas of the upper beach. The extent of this colonization is confined by high lake levels and storm events.

Photo "A" shows the raking machine currently used by the Town of South Bruce Peninsula. Raking is done as close to the dunes as possible (photo "B"). Dune vegetation is directly impacted as the rake cuts into the base of the foredune, impacting the vegetation and sometimes severing the rhizomes (photo "C"). This practice seriously reduces the capacity of the *Ammophila* to expand, particularly during low lake levels when the dunes should be in their building phase.

3.0 Beach and Dune Conservation Measures

Best Management Practices

Conserving Lake Huron's beach-dune systems requires using a number of strategies concurrently. No one measure is likely to be fully effective. A number of measures are provided below that have been used successfully by the Lake Huron Centre for Coastal Conservation, and others, in the conservation of beach-dune systems. The key to success is acquiring a sound knowledge of the natural beach and dune processes, and working *with* these processes rather than at odds against them. Dune stewardship is essentially taking care of our beach and dune resources for current and future generations. In the end, our stewardship efforts will not only help to achieve a healthy coastal environment, but help the waterfront-based economy and the community focus of Sauble Beach.

The Town of South Bruce Peninsula has a leading role to play in dune stewardship. It will set the example of how well (or how poorly) dune conservation efforts proceed into the future. Effective control of works activities, implementation of necessary and sufficient dune conservation strategies, and the day-to-day commitment to excellence in dune conservation are all part of the stewardship imperative for Sauble Beach.

The citizens of the community also have a key role. People need to be sensitive to the importance of the beach-dune ecosystem and its value (economically, socially and environmentally) to Sauble Beach and to Lake Huron. Landowners living adjacent to dunes need to realize that the lakeshore is a dynamic system where change is the rule. They may perceive a change in dune height or configuration as a problem if it affects their traditional view of the lake. Dune accumulation is part of a natural process, just as bluff erosion and lakeshore flooding are natural processes in other areas of Lake Huron where people have learned to accommodate these changes.

Friends of Sauble Beach is a group of citizens who have recognized the importance of the natural coastal system, and the need to balance the traditional economic values of the waterfront, with the environmental values. They are a committed group of individuals

who want to pursue a long-term focus and desire to see Sauble Beach flourish as one of the best beaches in the country. Effective, long-term conservation efforts at Sauble Beach will require a group like the Friends of Sauble Beach to champion such efforts and ensure their success. There are many examples worldwide, of how groups like the Friends play an instrumental role in the success of large scale dune conservation efforts. They will, however, need the cooperation and support of the local municipality, and community service and business organizations, to ensure that progress is made.

Managing Sauble Beach's dunes is more about what we should not do to the dunes rather than what we do to them. Sand dune conservation efforts around the world focus on one primary objective—letting the dune vegetation perform its ecological function. That involves keeping people's contact with the dune vegetation to a modest level. To accomplish this, the Coastal Centre has developed a dune conservation model for Lake Huron which is based on four main objectives:

1. Education
2. Managed Access
3. Restoration
4. Management Practices

Each category will be explained in greater detail below. A number of prioritized action items are provided under each category, providing the users of this plan with some guidance towards an effective dune conservation strategy.

3.1 Education

One of the biggest challenges in dune conservation is a general lack of awareness about the important functions that dunes provide, and their value ecologically, economically and socially. There is also a poor understanding about how sensitive these coastal features are to human disturbances, and the consequences of these disturbances. The Coastal Centre has placed a major emphasis on public education in its dune conservation efforts in other communities. Public education is a long term and sustained commitment to provide relevant and appropriate information on protecting Sauble Beach's dunes. It is also a multi-facetted undertaking, requiring different approaches for

different target audiences.

Some key approaches follow that will assist the Sauble Beach community to reach a wide audience in a cost-effective manner.

3.1.1 Signs

The use of signs is important as an educational tool, particularly since this may be the only opportunity that visitors have to learn about the dunes and why their conservation is so important. Signs used for this purpose must not only be attractive and appealing to the reader, but they should also be stylized so that all signs used along the waterfront have a consistent look. Colour, lettering style and size are all considerations in an attractive and functional sign system.

(1) Information signs

Information signs are recommended for use throughout the dune area at Sauble Beach. These are signs that inform beach-goers about the fragile nature of the dunes. Information signs would say something like:

"Sensitive Area" - the dunes at Sauble Beach provide natural shore protection and are habitat for unique and rare plants. Please take special care not to disturb the dunes. Access the beach only at the marked access crossings."

A sample sign is included in Appendix B. The language on the signs should be non-threatening (avoid terms like "Keep Out"), advise people why the dunes are so important, and instruct them on how to access the beach appropriately.

These signs should be placed on the east side of the dunes along Lakeshore Blvd. in conspicuous locations and at regular intervals (e.g. every 20 metres). Signs should also be placed on the west side of the dunes facing the beach and can be done at less frequent intervals (e.g. every 30 metres).

(2) **Interpretive signs**

Interpretive signs are large signs placed at major entrances to the beach. Suggested locations include the main beach near the entrance

sign to Sauble Beach, at Third St., Fourth St. and Sixth St. Additional signs could be placed further north as funding permits.

Interpretive signs provide beach users and other interested people with some more detailed information about the dunes. These types of signs signify to the reader that dune conservation is an important part of the Sauble Beach community. They also list the partnering organizations involved in the conservation efforts here. A sample interpretive sign is provided in Appendix B

(3) Beach Access Signs

Beach Access signs identify the designated access routes through the dunes. They are located at the points of access along Lakeshore Blvd., as well as on the beach side of the access so that beach users can identify there way back to their cars from the beach.

Beach Access signs could also be numbered to help people identify which access pathway they used. A sample is provided in Appendix B.

Sample wording:

"Beach Access—Please stay on the Beach Access path to help protect the dunes at Sauble Beach. When you protect our dunes, you protect our beach."

(4) Water Quality Advisory signs

A number of storm drains empty onto the beach. Storm drains typically have poor water quality and can be a public health risk if people, particularly children, use these water outlets for recreation. Information signs advising people about the risks may help to encourage people to restrict their water recreation to the lake. These signs would provide an initial water quality response until a comprehensive water quality improvement program is developed in the Sauble beach area.

Sample wording:

"Water from these drains may be impaired with bacteria and chemical pollutants. Please keep small children from contact with drain water."

3.1.2 Information and Awareness

(5) Dune Stewardship literature

Literature handouts on dune stewardship should be prepared and widely circulated, and made available to the public on an ongoing basis. This type of information is geared toward those who would like to learn a bit more about the dunes and the dune conservation efforts at Sauble Beach.

Internet access is also very important. The literature prepared as part of this planning study has been posted to the Coastal Centre's web site, and similarly could be posted to the Friends of Sauble Beach web site and the Town of South Bruce Peninsula web site.

(6) Workshop on Dune Ecology

An initial dune conservation workshop would be useful for the community of Sauble Beach and other interested people to learn about the dune conservation objectives of this plan and to provide information on what people can do individually and collectively to make conservation efforts a success.

In addition, opportunities should be made to highlight the efforts at Sauble Beach to others around the Great Lakes basin. Members of Friends of Sauble Beach could make presentations at conferences and workshops and promote Sauble Beach as a community trying to balance both tourism and environmental needs. The Coastal Centre took the opportunity to present the conservation challenges and opportunities in Sauble Beach at the Canadian Coastal Conference held at Queen's University in October 2003.

(7) Interpretive Tours of the Dunes

Promoting both the community of Sauble Beach and the conservation efforts here, could be done by offering interpretive tours. Members of Friends of Sauble Beach, and other interested participants, could be trained in educating visitors to Sauble Beach about the natural attributes of the dunes, their significance locally, regionally and Provincially, and why it has become necessary to conserve the dunes.

Tours could be advertised in tourism brochures as an interesting

activity to do while visiting Sauble Beach. They could be a fundraising activity for the Friends of Sauble Beach that could be put towards additional investments in dune conservation.

(8) Articles into Media and Tourism Brochures

Friends of Sauble Beach should consider regular submissions to local newspapers during the summer season highlighting various aspects of the Sauble Beach waterfront. The objective should be the education and awareness of readers concerning the waterfront.

This could include articles on dune conservation, dune research, water quality, water levels, biodiversity and climate change. It could also include historical accounts, archeological information, maritime history and other topics of interest. Short, regular weekly features would help promote the dunes and their conservation, a better understanding of the waterfront and its inter-connectedness, and provide some profile to the Friends of Sauble Beach.

Similarly, Friends could pursue submitting articles to the various tourism associations in the region, highlighting the conservation work being carried out and asking visitors to share in caring for the dunes. Developing a close working relationship with local tourism associations and promoters of Sauble Beach could help visitors to Sauble Beach to access information about the dunes prior to their arrival.

(9) Education in a Formal Setting

Friends of Sauble Beach obtained copies of the Coastal Centre's educational curriculum resource kits on Beach and Dune Ecosystems and donated them to local elementary schools. These kits were designed to provide resource information to teachers to teach students about local beach and dune ecosystems both in the classroom and in the field.

Friends of Sauble Beach, as well as local service clubs, could help to facilitate area schools to take advantage of the field experience by ensuring that barriers, like bussing costs, are removed.

(10) Interpretive Guide Book to Sauble's Dunes

An interpretive guidebook could be developed to allow people to

conduct self-guided tours to learn more about the dunes at Sauble Beach. Self-guided tours would have to be designed in a way that ensures that users respect the sensitivities of the dunes. Local businesses could be approached to sponsor the development of the guidebook.

3.2 Managed Access

Beaches are a public resource and access to them is very important. However, in beach-dune systems, people need to cross the dune to get to the beach. Where there are no controls or guidelines, people tend to find the shortest route to the beach, often resulting in many pathways cut through the vegetation. At Sauble Beach, over 300 pathways have been cut through the dunes. The consequence is the formation of many blow-outs, damage or loss of dune vegetation (including rare species), loss of sand from the shore system and a loss of dune structure and integrity.

To help minimize this damage, controlling access is essential. This does not mean restricting access. It is a matter of focusing the flow of traffic through the dunes to a few major arteries rather than scores of small ones. To do this, the access points have to be clearly and visibly defined so that people know where they should be walking. For the most part, people will cooperate with using these specific access routes once they understand the reasons for using them.

Dune access routes can take a number of different forms depending upon the local characteristics of the beach-dune system. In the Pinery Provincial Park, for example, elevated boardwalks have been used to keep the thousands of visitors to the park off of the dunes completely. In the community of Southampton, on the other hand, railed pathways keep visitors on the trail, but they are able to walk

Examples of access pathways used in the Town of Saugeen Shores dune conservation program. Post-and-rail pathway (left); Post-and-rope barrier (right).

directly on the sand. Management decisions like this become a function of scale (numbers of people using an area) and cost (expense of boardwalk systems vs. railed pathways). The important aspect is whether the access system being used will meet the dune conservation objectives. At Sauble Beach, some combination of the two might be the most effective. Construction and site details have been prepared separately by Brian Folmer Environmental Design.

As discussed in the previous section, public access routes should be clearly marked if the route is not obvious to people. Some routes may be well known to residents of an area, but not obvious to visitors. Clearly identified routes can minimize incidents of people creating additional trails or continuing to impact existing ones. Posting "Public Beach Access" signs along Lakeshore Blvd. will help identify to people where it is appropriate to access the beach. In addition, signs should also be posted on the beach side of the access to help people who are on the beach to clearly find the access paths.

(1) Development of Elevated Boardwalk Access Routes

As discussed, some of the dunes at the south end of the study area are of such an elevation and steep gradient that a conventional access on grade would not be an effective approach. In this area of the dunes, access from Lakeshore Blvd. should be done through a system of stairs and elevated boardwalks particularly where dune accretion is occurring. The structure would have to be designed to allow for the boardwalk to be re-adjusted as sand accumulations occur. The width of the structure should be such that two adults could pass each other easily at any point along the boardwalk.

(2) Access for Physically Challenged Individuals

Access for physically challenged individuals should, out of

Viewing deck constructed along Kincardine's waterfront. Siting of such structures in a dynamic dune environment is important to ensure that the structure does not promote wind scouring or be prone to sand burial.

practicality, be placed in those areas where access is currently at road level elevation and where the approach to the beach is relatively flat. The access at 4th Street is one example where such access would be feasible. In these access areas, sufficient "handicapped" parking facilities should be reserved. This should include a clearance in front of the access-way for the physically challenged to be able to disembark from their vehicle safely and easily. A boardwalk-on-grade designed for wheelchair use should be considered in these areas. Viewing decks could be incorporated at the beachside terminus of the boardwalk, similar to what has been developed along the waterfront in Kincardine. A practical location for such a deck would be Sixth St., west of the change rooms. A viewing deck would eliminate a barrier for those restricted to wheelchairs from enjoying the waterfront. The design and the limits of its westerly extension should be reviewed by the Grey Sauble Conservation Authority.

(3) Alignment of Boardwalks

A number of wooden boardwalks have been installed at a number of access points. These boardwalks have been constructed at grade, which is quite appropriate given the conditions at these locations. They are, however, of insufficient length. Many are constructed from Lakeshore Blvd. and extend into the dune halfway and then end before the end of the dune is reached. Once off the boardwalk, people tend to deviate from the intended path impacting vegetation which, in turn, leads to a greater potential for wind erosion. Existing pathways

Existing at-grade boardwalk is prone to sand burial as sand laden winds are able to blow unabated up the pathway. The boardwalks only extend halfway through the dunes and the tendency is for people to deviate from the intended pathway, damaging vegetation and leading to greater sand erosion. Extending the pathways and angling them at different angle to the prevailing wind could help to minimize this funneling effect.

need to be extended to the end of the dune.

Public access pathways also need to be designed relative to the prevailing winds on Lake Huron. Aligning pathways perpendicular to the prevailing winds can help to minimize the effects of scouring and blowout conditions from developing. Based on historical wind data for this region, the prevailing winds during the critical seasons when the greatest sand erosion occurs tends to be from the south, southwest and west. Pathway alignment should be, as much as possible, perpendicular to the prevailing winds to minimize the sand scour effect. Generally, pathways can start out from Lakeshore Blvd. in an east-west pattern, and then as the pathway crosses the most active portion of the dune, it should take a northwest alignment.

During pathway development, great care should be taken to preserve existing vegetation. Vegetation on the pathways should be transplanted at the appropriate times (see Restoration) at openings in the dunes. *Ammophila breveligulata* should be planted along each side of the pathway to help mitigate sand deposition and erosion on that portion of the pathway.

(4) Fencing along the East Side of the Dunes

As discussed previously, the current parking arrangement has caused people to cross the dunes directly in front of their vehicles. This practice will continue unless there is some kind of barrier which signifies that it is only appropriate to cross at designated access crossings. The objective is not to erect a physical barrier designed to prohibit access through the dunes, but, rather, a visual barrier which acts as a deterrent.

Two types of fencing which have been used for this purpose in other coastal communities are post-and-rail, and post-and-rope fencing. Used in combination with signs, and other awareness tools, they can function very effectively. The fencing should be tied in to the access pathways. Since this fencing may be costly to establish at one time, it is recommended that a fencing program be established with the installation occurring from south to north.

Vandal resistance should be a consideration in fencing design. Posts should be of sufficient dimensions to withstand intentional and unintentional impacts. If wood posts are used, it is recommended

that cedar posts be used and that chemically treated wood products not be used in this application.

3.3 Restoration

Restoration of dunes at Sauble Beach is only recommended where it is unlikely that natural plant regeneration will occur rapidly enough to mitigate wind erosion of the dunes. Where possible, allowing the dunes to recover by restricting people from the recovery site is a preferable restoration strategy to planting. Where it is not possible to undertake natural regeneration, planting of dune vegetation is very effective at erosion control, but dune vegetation planting must be done with forethought and care. Dune planting is usually done in combination with sand fencing for the best results.

(1) Restoration Planting

Dune vegetation offers a far greater superiority in beach-dune 'stabilization' than strictly using 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, thus reducing 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,

Local students can be involved in learning about beach-dune ecosystems with the assistance of curriculum-based resource materials.

Students involvement in restoration planting has the dual benefit of implementing a conservation restoration project, and providing an educational experience outside of the classroom.

by its massive root structure, gives the developing dune some structure. That is why Sauble Beach's foredunes, for example, can have a near vertical face when high lake levels erode the sand from the dunes. Dune vegetation is also able to regenerate naturally, providing a permanent cover and requiring no ongoing maintenance.

American Beachgrass (*Ammophila breviligulata*) is perhaps the most commonly used dune species in dune restoration, but its applicability is limited to areas where 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.

In restoration projects involving other physiographic areas of the dune, other species would be more applicable. Also, care must be taken in selecting locally derived plants in order to maintain genetic diversity. The Coastal Centre should be consulted in regard to particular species selection.

In all cases, dune restoration planting should occur in late autumn, once the restoration 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.

The Coastal Centre has undertaken a number of restoration projects in a number of municipalities along Lake Huron. In highly degraded sites where this species is absent or limited, the Centre has used imported plants from other areas of the lakeshore. At Sauble Beach this would not be appropriate since a viable native population is present. Imported material could genetically contaminate the native community modifying its resistance to disease. Instead, endemic populations could be transplanted into areas requiring restoration.

Restoration sites should be chosen based on the extent of degradation of the dune, and the practicality of planting and maintaining the site following the planting project. Initially, a limited number of "demonstration sites" would be beneficial as an educational opportunity to familiarize residents with the restoration process and provide them with an example of what can be expected.

Once the planting is complete, the only maintenance is ensuring that people remain off the planted plot as it becomes established. Plots should be fenced off if there is a probability that people will access the site. One possible site for restoration would be the lakeward side of the high dunes at Sixth St. Other possible locations for demonstration plots would be in the area south of Fourth St. where blowouts are prevalent. Site locations should be confirmed by the Coastal Centre.

Involving local students in restoration planting projects provides an excellent opportunity to involve local youth in dune conservation, provides an educational forum for experiencing the world outside the classroom and builds a respect and ethic for caring for Sauble Beach's coastal environment. Friends of Sauble Beach have taken the initiative of acquiring and donating available curriculum resource materials to local schools to help teachers and students understand local ecological processes and functions of dunes as a precursor to active participation in a restoration exercise. The students will often take pride in the work that they have accomplished, and be more inclined to protect this area in the future.

(2) Use of Sand Fencing

The use of sand fencing to control beach and dune erosion has been used in jurisdictions around the world for decades. 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 about eight times the height of the fence (Carter, 1993). For a typical one meter high fence, then, one should expect sand accumulations as far back as eight meters from the fence. Sand

Overlapping fencing with a one metre space between can allow pedestrian access to the beach during the off-season. Pedestrian access is not appropriate where restoration planting has occurred.

fencing also acts as a barrier which keeps people from passing through the restored site.

Fencing with a porousity of 40-50% is ideal, as this is most effective for slowing wind velocities for sand deposition. Typical wood slat snow fencing is preferred by the Coastal Centre in dune restoration projects. Plastic snow fencing has been used, but it tends to be more prone to vandalism.

Sand fencing can be used to control sand accumulations. If the objective is to increase the height of the sand deposit, the fencing can be built on existing deposits as the dune grows taller. To minimize height, fencing is gradually moved shoreward as accumulations develop.

While sand fencing is useful initially at 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

Proper spacing of sand fencing is important to optimal sand capture. Significant sand deposition will occur in an area approximating eight metres from the fence line.

also aids with keeping people off the planted area. Unless it is intended that the fencing is to become completely buried, it is advisable that the fencing be removed before it gets 25% buried. It can then be reinstalled on the new dune profile.

Sand fencing can also be used on its own in areas where planting is not feasible, such as at access points for emergency and maintenance vehicles, and any other access terminus or breech in the dune prone to wind scouring. Where there are large breeches in the dunes, multiple rows of sand fencing may be required. Sand fencing in these circumstances provide a surrogate for dune vegetation, trapping wind-blown sand that dune vegetation would normally have trapped. *Fencing should be established along the beach at the Main St. entrance to Sauble Beach, along the beach in front of the Crowd Inn, at vehicle access points and at all major breaches in the dunes.* Fencing should be installed from the Thanksgiving holiday weekend to the Victoria Day weekend. Loose sand accumulations at these specific locations can be graded back onto the beach once the fencing is removed in the spring.

During periods of low lake levels when the beach is typically wider, additional rows of sand fencing may be required (3-4 rows in areas of extensive sand drifting). During high lake levels when the beach is typically narrower, fewer rows may be needed (1-2 rows), but this will depend on the extent of sand drifting being experienced.

3.4 Management Issues

(1) Beach Raking

As discussed previously, the practice of beach raking can have a profound long-term negative effect on beach erosion and shore ecology. The beach and dunes are considered geologic relics—sand deposits which were deposited centuries ago when the coastal geologic conditions were much different than today. The beach and dunes should be regarded as a non-renewable resource that must be conserved in order to maintain this natural resource. That means understanding the natural coastal processes at work, and ensuring that our interactions with the beach-dune system does not compromise Sauble Beach's quality or quantity.

The process of beach raking, which has been done at Sauble Beach for aesthetic purposes, can exacerbate the erosion process such that sand is lost from the dune system, interrupting the dune cycle. Sand blown leeward of the dunes represents a permanent loss to the system.

Raking has three key negative consequences. ***First***, the typically wet sand is drawn up and aerated, contributing to sand desiccation and making the fine sands more vulnerable to wind erosion. High winds can transport fine sands a considerable distance inland. ***Second***, raking can destroy new seedlings establishing at the leading edge of the dune. Although seedlings in this 'embryo' dune, or pioneer zone, often become buried by wind-blown sand or storm-deposited sand, they will usually grow through the new sand layer and continue to stabilize the area. In addition, these upper beach and foredune vegetation colonies expand lakeward during lower lake levels. Conversely, these colonies contract during high lake levels and storm events as wave erosion removes and redistributes the foredune plants. ***Third***, the beach ecosystem is a habitat and feeding grounds for a mosaic of wildlife, including shorebirds, invertebrates, terrestrial insects and vegetation. Raking with heavy machinery can have a detrimental impact on species and habitat. More subtly, beach raking removes organic debris that washes up on the beach forming a wrack line. This organic detritus typically releases valuable nutrients into the beach substrate. These nutrients, in turn, are used by beach plants like American Beachgrass, Silverweed, etc. Preventing this nutrient cycling from occurring as it should can affect the integrity of the dune system over the long-term. This is not to say that excessive debris

If raking occurs, a minimum 10 metre buffer should be established between the leading edge of dune vegetation and the raked portion of the beach. Guidelines should be established defining the circumstances under which beach raking would be permitted to occur.

cannot be removed from the beach, but the tendency of regular, scheduled raking is to produce a sterile beach environment.

Aside from the ecological effects of raking, there are compelling economic reasons for reconsidering the practice of beach raking. Losses of sand from the beach-dune system represents a loss to the protective capacity of the beach-dune system during high lake levels and storm events. While losses may not appear significant on a *per annum* basis, over the long-term it can amount to substantial quantities of permanent sand loss.

Other local jurisdictions with significant public use and similar beach characteristics, either have not embarked on a raking program (Pinery Park), or have discontinued the practice (Port Elgin). A number of American jurisdictions (e.g. Palm Beach County, Florida) have re-evaluated their raking programs, based on their environmental impacts, and have radically scaled back their programs.

It is recommended that the Town of South Bruce Peninsula consider implementing a beach cleaning program that is more environmentally appropriate. The large raking machine in current use could be replaced by beach clean-up staff walking the beaches and picking up litter manually. Staff are already assigned to clean up litter in the dunes, and so this could be a logical extension. Other alternatives could include working with local groups to develop an "Adopt-a-beach" program where volunteers look after a section of the dunes.

There may be occasions when mechanical raking is considered unavoidable (e.g. Excessive debris washing up on the beach, garbage accumulated after a holiday weekend). It is recommended that the Town define a set of guidelines that stipulate what types of conditions constitute a need for raking. The current scheduled raking is indiscriminate and allows for unnecessary raking to occur. Guidelines that have criteria defining specific conditions for raking, would only allow raking on an as-needed basis. If any raking continues to be undertaken, it is strongly recommended that a minimum 10 metre buffer be established between the leading edge of the dune vegetation and the area being raked.

(2) Sand Disposal

As sand gets transported by wind through the many breeches and

blowouts along the dunes, a large amount typically drifts across Lakeshore Blvd., requiring regular maintenance to clear the sand from the street. Approximately 30 truck loads of sand are typically removed on an annual basis. One issue has been determining where the sand that has been cleared from the roadway can be allowed be placed. Can it be placed back onto the beach, or should it be hauled away and disposed of in the landfill?

The traditional response from the Ministry of the Environment has been that the sand could not be placed back on to the beach as deleterious materials could be picked up from the roadway and these materials could impair water quality if placed on the beach. The Ministry's position continues to discourage the placement of drifted sand if it has made contact with the paved surface of the roadway. Sand which is removed from the paved surface should be removed and disposed of in a landfill.

The Centre agrees with this approach, particularly since Lakeshore Blvd. is scheduled to begin winter maintenance in November 2004. Aside from the typical vehicle pollutants which can end up on roadways, the addition of road salt is another deleterious substance which should not be placed onto the beach.

It should be noted that restoration efforts, and the proper installation of sand fencing during each off-season will help to reduce the amount of sand reaching Lakeshore Blvd.

(3) Dune Vandalism

On occasion, instances occur where individual landowners along the waterfront undertake to remove dune vegetation, or alter the dune itself, to gain a better view of the lake. This can become a serious problem, particularly as it tends to enhance sand mobilization creating (1) a loss of sand from the beach; (2) a greater maintenance requirement to the Town; and (3) a change to the ecology of the dunes, including the potential development of a blowout, and a loss of integrity of the dune. For the most part, the dunes are under the jurisdiction and ownership of the Town of South Bruce Peninsula. Formal approvals have not usually been sought to undertake such activity in the past, but some level of public control would be helpful in protecting the dunes.

Where the dunes are in private hands, education and public

encouragement may be the only recourse. Private dunelands at Sauble Beach are not common and so the issue can generally be addressed by the Town.

Other jurisdictions have experienced similar problems and have addressed the issue in different ways. In the Township of Huron-Kinloss, the municipality recently prosecuted a waterfront landowner in Small Claims Court for removing vegetation along the waterfront on Township property. The landowner was ordered to make repairs at his cost and under the supervision of the Coastal Centre.

The former Town of Southampton took the approach of requiring the landowner to make an application to Council to seek approval to do any work in dune areas. This approach ensured control over public lands, and enabled a preliminary review of the work before it was undertaken. Variations of this approach include notification of neighbours. The key to the success of this approach is ensuring the reviewer is knowledgeable about dune vegetation and the consequences of its modification. A sample application form has been prepared as part of this plan and is presented in Appendix C, for Council's assistance.

The City of Gold Coast in Australia took an unusual approach of posting a public notice sign on the area that had been vandalized. The approach is a last resort if the offending landowner refuses to take responsibility for the damage to the dunes. The sign is removed if the

Vegetation removal from the dunes near Third St. in July, 2003

landowner restores the site, if the person has been fined or charged for the vandalism incident, if there is widespread community support for the removal of the sign, or, if the sign has been in place for 12 months.

The establishment of a consistent approach for dealing with dune vandalism needs to be developed. Some possible examples are noted above. With any vandalism policy, public education will be necessary. Council should work with groups like the Friends of Sauble Beach in promoting its dune protection policies. A Committee composed of representatives from the Town, Friends of Sauble Beach and an organization like the Chamber of Commerce could be developed to implement this initiative.

(4) Climate Change

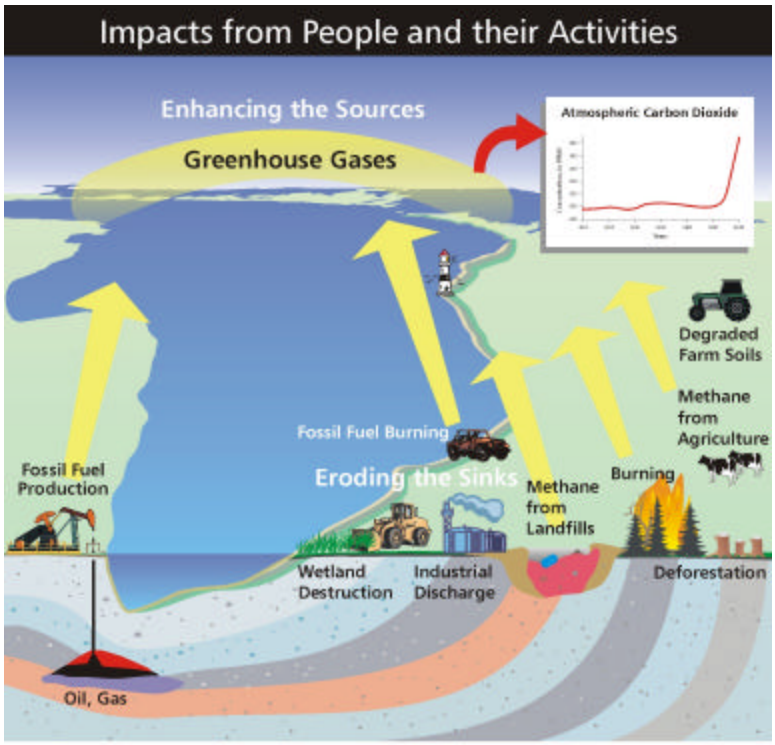
Climate change is emerging as an important issue that will affect coastal municipalities throughout the Great Lakes. Lake levels on Lake Huron are projected to drop by 1-2 metres over the next 50 years. Such a decline will have a dramatic impact on Sauble Beach. As we have seen with the recent low lake levels over the last 4-5

An Australian example of an approach taken to address dune vandalism. This large 2 x 3 metre sign is installed in the area where the dunes have been vandalized.

years, a drop in levels results in a much wider beach. As discussed earlier, wider beaches are prone to greater wind related erosion from the beach and deposition in the dunes. A water levels decline of this magnitude could lead to a significant mobilization of sand.

Protecting dune vegetation, eliminating and preventing breaches in the dunes and allowing the westerly expansion of the dunes will help to minimize sand losses as well as increased maintenance requirements. If the dunes are not allowed to expand westward under this low levels scenario, the existing dunes would be expected to grow vertically, which could pose problems related to reduced lake vistas, the potential for increases in dune vandalism and more nuisance sand deposition on streets, storm drains and properties requiring regular maintenance.

This climate change scenario underscores the importance of dune conservation at Sauble Beach, and the long-term benefits of applying the conservation principles of this plan based on coastal science principles.



The graphic identifies some general climate change impacts in the Lake Huron region caused by people and their activities. Specific impacts, like increased sand mobilization would be anticipated at Sauble Beach as lake levels decline by 1 to 2 metres as projected by current models. Adopting a comprehensive dune conservation strategy now, will help Sauble Beach cope with these climate change impacts.

(5) **Endangered Species Recovery**

As discussed earlier, Sauble Beach's dunes once recorded occurrences of the species Pitcher's Thistle (*Cirsium pitcheri*). This plant, which is considered to be "threatened in Canada" has undergone population declines in many areas of Lake Huron.

Efforts have been underway by researchers at the University of Western Ontario to re-introduce this species along the shores of Lake Huron in areas where it has, or has once had, populations growing in the dunes. The Coastal Centre partnered with Western researchers to undertake the re-introduction of Pitcher's Thistle in the dunes at Southampton. The plant's extirpation from Sauble Beach may make it an attractive site for re-introduction, specifically if conservation measures are being implemented that would increase the likelihood of a successful re-introduction.

There are potential funding sources specifically targeting endangered species re-introduction which could be pursued at Sauble Beach.

Pitcher's Thistle (*Cirsium pitcheri*) is a rare and threatened plant species that has been lost from the Sauble Dunes. It has not been recorded in the dunes since 1941.

Summary of Recommendations

The following summarizes each of the recommendations made in the report, including the identification of the lead implementation organization (FOSB = Friends of Sauble Beach; Town = Town of South Bruce Peninsula; LHCCC = the Coastal Centre)

Education

Signs

(1) Information Signs - “Sensitive Area” signs are recommended throughout the study area. Implementation should be given a high priority. *Town*

(2) Interpretive Signs - interpretive signs are recommended at strategic locations within the study area. They are used to introduce people to the waterfront, providing a bit of detail as to why beach and dune conservation efforts are important at Sauble Beach. *Town*

(3) Beach Access Signs - access signs are critical at all designated access points. Signs are necessary along the road side of the dunes as well as the beach side. *Town*

(4) Water Quality Advisory Signs - water quality advisory signs are recommended at all storm drains emptying onto the beach. *Town*

Information and Awareness Building

(5) Dune Stewardship Literature - production of dune stewardship literature is recommended as one method of making people aware of the conservation efforts at Sauble beach. Posting information to partner websites is also recommended. *FOSB*

(6) Dune Ecology Workshop - opportunities should be sought to highlight the efforts at Sauble Beach to others in the region. Friends of Sauble Beach, and its partners, should make presentations at conferences and workshops. Friends could also host its own local workshop to promote awareness of dune conservation efforts. *FOSB, LHCCC*

(7) Interpretive Tours - it is recommended that interpretive tours of the dunes be offered to help interested residents and tourists learn more about the coastal environment at Sauble beach. *FOSB*

(8) Media articles - it is recommended that regular submissions be made to local newspapers focussing on education and awareness of

the coastal environment at Sauble Beach. *FOSB*

(9) Education in a Formal Setting - area schools should be encouraged to participate in environmental education along the waterfront. Curriculum resources have been provided to local schools. Schools may need assistance in implementing activities outside of the classroom. *FOSB*

(10) Interpretive Guidebook - an interpretive guidebook is another type of educational tool that could be developed to allow for self-guided tours, where people are sufficiently knowledgeable about the sensitivities of the dunes. *FOSB*

Managed Access

(11) Elevated Boardwalks - beach access points through steep gradient dunes should have elevated boardwalks to mitigate dune scouring and blowout development. Designs have been prepared to assist with implementation. *Town*

(12) Access for Physically Challenged - wheelchair access and access for the visually impaired should be developed at appropriate locations. It is suggested that a viewing platform be considered for incorporation at the Sixth St. access. *Town*

(13) Boardwalk Alignment - existing boardwalks need to be upgraded and realigned to minimize wind erosion. *Town*

(14) Fencing along Lakeshore Blvd. - fencing along the east side of the dunes along Lakeshore Blvd. is necessary to deter people from crossing the dunes in places other than the designated access paths. *Town*

Restoration

(15) Restoration Planting - planting is recommended in areas that are severely degraded and not likely to recover naturally. Demonstration sites should be established initially. Local students should be involved in planting projects as part of their coastal education program. *FOSB*

(16) Sand Fencing - it is strongly recommended that sand fencing be installed at vehicle access points, and other large gaps in the dunes, during the off-season. A series of two or more lines of fencing will be necessary during periods of low lake levels. Fence installation would be an ongoing annual program. Sand fencing will also be necessary where

restoration planting has taken place. In these cases, fencing would remain in place until the planted vegetation has become established. *Town*

Management Issues

(17) Beach Raking - it is recommended that the Town of South Bruce Peninsula consider implementing a beach cleaning program that is more environmentally appropriate. The Town, in consultation with the Friends of Sauble Beach, define a set of guidelines stipulating the conditions that would constitute a need for raking. A minimum 10 metre buffer needs to be established between the leading edge of the dune vegetation and the area being raked. *Town*

(18) Sand Disposal - sand drifts onto Lakeshore Blvd. cannot be returned to the beach, but must continue to be hauled away and properly disposed. *Town*

(19) Dune Vandalism - damage to dune vegetation, or to the dunes themselves, can initiate the erosion process that leads to more sand loss and requiring additional maintenance. As the majority of the beach and dunes are under the jurisdiction of the Town, it is recommended that the Town develop dune vandalism policies for dealing with individuals who carry out these acts at the cost of the community. *Town*

(20) Ongoing Research - research is important to our understanding of human f on the waterfront and how the community can respond to environmental challenges. Opportunities to encourage university level research should be sought where it is possible. *LHCCC*

- Climate Change - an important issue that could be costly to the community unless the issue is well understood, and adaptation plans are developed.
- Sand Erosion - erosion modelling could be useful in helping to define priority areas for management measures.
- Water Quality - public health issues research related to pathogens in drain water flowing across the beach, as well as residency of pathogens in beach sand would help beach users make better judgements regarding contact with these areas.

(21) Endangered Species Recovery - it is recommended that an endangered species recovery program be investigated for the dunes at Sauble Beach (particularly the north dunes). FOSB

4.0 Moving Forward

Friends of Sauble Beach have taken an important step for the entire Sauble Beach community by developing a vision for Sauble Beach and preparing this plan. Protecting the natural function of the beach and dunes here is important to the continued enjoyment by the thousands of people who visit Sauble Beach each summer. By protecting these dune attributes, it will serve to support the social and economic aspects of the community.

The challenge will be in implementing this plan. Many of the recommended measures will require funding in order to complete them. Some potential funding sources will target specific measures.

Funding Sources

Implementation of this plan will require that the necessary funding is in place to carry out, and maintain, the work. This is a challenging undertaking, but there are possible funding sources that could help fund portions of the recommended action items. In a dune conservation project in the former Town of Southampton in the 1990s, over $100,000 was secured from various funding sources to carry out an environmental program there. While the Sauble Beach study area is on a much larger scale, it is recommended that some targeted demonstration areas be designated to begin a progressive process that eventually incorporates the whole study area.

In both the Town of Southampton and the Town of Kincardine, volunteers played a key role in implementing their waterfront plans. Provided that there is adequate municipal support, volunteer projects can go a long way to keeping costs down, and are a valuable asset when calculating in-kind support when applying for funding.

A number of potential funding sources have been provided in Appendix D at the back of this report. These sources are geared toward non-profit community groups, although some potential sources require that the organization have charitable status. In those cases, it may be possible to link with an existing charity and carry out the work as a partnership. It may also be possible for the municipality to access funding like the Green Municipal Investment Fund (GMIF)

to fund some aspects of this plan.

Design specifications for the structural components of the plan have been prepared by B.W. Folmer Environmental Landscape Design of Walkerton, and are under separate cover from this report. These design specifications will be important for determining cost estimates for funding applications and in implementing the structural components of the plan.

Maintenance

The maintenance of this waterfront program will be a long-term undertaking. Much of the physical infrastructure (boardwalks, fencing, signs) will be the responsibility of the Town of South Bruce Peninsula. Other measures, like the education and awareness program and restoration program, can be a shared partnership between the Town, and community groups like the Friends of Sauble Beach.

Effective maintenance will require that Town employees responsible for undertaking activities along the waterfront understand the basic concepts of dune ecosystem function. Further, they will need to be aware of how their activities can impact the beach-dune system and how they can minimize these impacts. The Coastal Centre has worked with the Town of Saugeen Shores to develop a manual for employees for specific issues related to the waterfront in that municipality. Specific guidelines could be developed for the Town of South Bruce Peninsula.

Research

Research on Sauble Beach's coastal environment is crucial to understanding how to effectively respond to management challenges. For example, current research by researchers from Wilfred Laurier University are using Digital Elevation Models to measure erosional and depositional patterns experienced at Sauble Beach during the spring, summer tourist season and during the post-tourist fall season.

The three dimensional images were created using Geographic Positioning System (GPS) data gathered by Connor Houston, Dr. Mary-Louise Byrne and Alex McLean for the department of

Geography and Environmental Studies at Wilfrid Laurier University in 2003. These data points were interpolated using ArcMap 8.3. Creating three-dimensional Digital Elevation Models (DEM) before, during and after the tourism season is being investigated to allow the researchers to measure the amount of erosion or deposition that is occurring between time periods. The diagrams below are similar models to the ones created in this study.

Other research should be encouraged at Sauble Beach to help improve our understanding of ecological dynamics and anthropogenic impacts. Examples of needed research could include studies on the sediment budget, climate change impacts and adaptation strategies, human impacts on dune biodiversity and local nearshore water quality impacts.

As fundamental questions about the waterfront system arise, opportunities should be pursued to encourage university students and researchers to help answer those questions. The Sauble Beach system spans the area from Chief's Point to Frenchman's Point. Studies should be encouraged to look at the whole system, where possible, and Saugeen First Nation should be involved in the data and results sharing .

Example of 3 dimensional image of the dunes at Sauble Beach showing the physical structure of the dunes. This research, conducted by researchers from the Department of Geography at Wilfred Laurier University, will help in our understanding of erosion and accretion dynamics at Sauble Beach. (3-D Image provided by C. Houston).

Adopt-a-Dune Program

Friends of Sauble Beach have successfully implemented a beach and dune clean-up program called ‘Dopt-a-Dune. Volunteers from Friends carry out a regularly scheduled clean-up of litter that tends to accumulate in the dunes during the summer season. Volunteers are responsible for their ‘section’ of dune for clean-up purposes.

This program could be expanded to include a monitoring component which includes surveillance of measures implemented from this plan to track and report on the level of success related to restoration and managed access, vandalism and unforeseen problems that need to be addressed. This information could be collected and collated with the results assisting with identifying problems and establishing priorities for dealing with those problems.

Conclusion

The beach-dune ecosystem of Sauble Beach is a key coastal feature of Bruce County. It is a major abiotic feature of the coast with a rich diversity of dune plant communities. The prevalence of some important rare species underscores the importance of this area's biological diversity.

The dunes are under stress. As one of the Province's premier beaches, Sauble Beach attracts thousands of visitors each summer season. It will be imperative to enact measures that seek to minimize the damage to the dunes while, at the same time, promoting access to the beach. This plan is the first step toward achieving a balance between the economic and social needs of the community, and the ecosystem requirements of the beach-dune system.

The *status quo* will mean the continued loss of sand from the system, a loss of shore protection, a loss of the kinds of natural amenities that attract people to Sauble Beach, and ongoing maintenance costs to the Town of South Bruce Peninsula related to clearing away sand drifts as erosion continues unabated. Accepting the status quo would be short-sighted and lead ultimately to the degradation of Sauble Beach as it is known currently. It would represent an economic loss of millions of dollars to the community.

This plan is an attempt to underscore the importance of Sauble Beach from an ecological perspective and to recommend measures that will serve the needs of the community as well as the needs of the coastal environment. The four pillars of this plan— education, managed access, restoration and other management issues— together form a comprehensive program of dune conservation and waterfront management. Everyone in the community must share in the responsibility of implementing this program. The Town of South Bruce Peninsula will play a major role. However, they cannot do it alone. Friends of Sauble Beach have taken a leadership role in getting a program established. Other organizations, individuals, schools and businesses need to become involved too. Experience in other municipalities has shown that where partnerships can be established, projects like this can be successfully carried out.

Effective conservation of the waterfront will mean that changes will be needed in how the waterfront has been managed in the past. Changes will also be needed in how people have traditionally accessed the beach and how they have interacted with the dunes. Education is the fundamental recommendation of this plan. Individuals, organizations, students, municipal employees, and visitors will all need to be targets of an ongoing education program.

The region's tourism industry has capitalized on the catch-phrase "Ontario's Natural Retreat" to describe this region's natural amenities. There is an opportunity to promote Sauble Beach as a community with a long-term vision, where conservation efforts will help to ensure that the natural attributes of the coast will be here to enjoy for generations. However, before promoting this, it will be important for the conservation measures recommended in this plan to be in place.

There is much to be optimistic about. While Sauble's dunes are under stress, there are committed individuals in the community with the foresight and desire to protect this finite resource. The beach and dunes are a multi-million dollar asset to the community. They are also of immeasurable value to the coastal ecosystem.

Glossary

Abiotic: pertaining to the non-living environment. The sand beach and dunes are examples of the abiotic environment at Sauble Beach.

Aeolian: pertaining to wind.

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

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

Biotic: pertaining to living organisms. Beach and dune flora and fauna are examples of the biotic environment at Sauble Beach

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.

Cultural: pertaining to human influences on the beach and dune environment.

Dune: ridges or mounds of loose, wind-blown material, usually sand.

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.

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.

Headland: an erosion resistant point of land, either man-made or natural, extending into the lake; embayments often form between adjacent headlands (e.g. Chief's Point and Frenchman's Point, with Sauble Beach spanning the two headlands).

Invasive plants: species which possess aggressive reproductive qualities that enable

them to displace endemic plant species. Examples: Garlic Mustard, Purple Loosestrife (also see Alien Plants).

Lake Nipissing: post glacial lake which existed about 6,000 years B.P. The remnant beach ridges left by Lake Nipissing are still evident in the Sauble Beach area.

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).

Sand Fencing: fencing used in dune restoration that typically has a porousity of 40-50%. Wood-slat snow fencing is commonly used.

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.

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

Wrack zone: see strandline.

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Appendices

Preliminary List of Plant Species for the Sauble Dunes

NOTE: The following is the result of a preliminary inventory of plant species observed in the dunes at Sauble Beach during the course of the 2003 growing season (May-Sept). This is not an exhaustive list, but is representative of the main species growing in Sauble's dunes.

Deciduous Trees	Common Name	Special Notes
Acer negundo	Manitoba Maple	Invasive (not native to the region)
Betula papyrifera	Paper Birch	
Fraxinus americana	White Ash	
Populus balsamifera	Balsam Poplar	

Conifer Trees	Common Name	Special Notes
Larix laricina	Tamarack	Naturalized (not native to the region)
Picea abies	Norway Spruce	Naturalized (not native to the region)
Pinus sylvestris	Scots Pine	Naturalized (not native to the region)
Thuja occidentalis	White Cedar	

Shrubs	Common Name	Special Notes
Arctostaphyllos uva-ursi	Bearberry	
Cornus sericea	Red-Osier Dogwood	
Hypericum kalmianum	St. John's Wort	
Juniperus communis	Shore Juniper	
Physocarpus opulifolius	Common Ninebark	
Potentilla fruticosa	Shrubby Cinquefoil	
Prunus pumila	Sand Cherry	
Salix spp.	Willow	
Vitis riparia	Wild Grape	

Grasses	Common Name	Special Notes
Ammophila breveligulata	American Beachgrass	Rare in Grey-Bruce
Andropogon gerardii	Big Bluestem	Rare in Ontario
Andropogon scoparius	Little Bluestem	
Calamovilfa longifolia	Long-leaved Reedgrass	Rare in Ontario; Globally rare
Panicum virgatum	Switch grass	Rare in Ontario

Herbaceous	Common Name	Special Notes
Achillea millefolium	Yarrow	Naturalized
Arabis lyrata	Lyre-leaved Rock Cress	
Artemesia campestris	Wormwood	
Asclepias syriaca	Milkweed	
Calopogon pulchellus	Grass Pink	
Campanula uliginosa	Blue Marsh Bellflower	
Castileja coccinea	Indian Paintbrush	
Cypripedium calceolus	Yellow Lady Slipper	
Equisetum hyemale	Field Horsetail	
Eupatorium perfoliatum	Boneset	
Euphorbia spp.	Spurge	Naturalized
Fragaria virginiana	Wild Strawberry	
Hemerocallis fulva	Day lily	Naturalized
Iris lacustris	Dwarf Lake Iris	Rare in Ont.; Globally rare
Juncus spp.	Rush	
Lathyrus japonicus	Beach Pea	Rare in Ontario
Lilium michiganense	Michigan Lily	Rare in Grey-Bruce
Lithospermum caroliniense	Hairy Puccoon	Rare in Ontario
Lobelia puberulu	Downy Lobelia	
Lythrum salicaria	Purple Loosestrife	Invasive exotic
Oenothera biennis	Common Evening Primrose	
Potentilla anserina	Silverweed	
Sisyrinchium montanum	Common Blue Eyed Grass	
Smilacina racemosa	False Soloman's Seal	
Solidago spp.	Goldenrod	
Tradescantia ohiensis	Spiderwort	