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**SUSTAINABLE MANAGEMENT STRATEGY FOR
SOUTHEAST LEAMINGTON – PHASE 2 REPORT**

FULL SECTION 6.0

Prepared for:

ESSEX REGION CONSERVATION AUTHORITY

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Sustainable Management Strategy for Southeast Leamington Phase 2 Report

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6.0 SUSTAINABLE MANAGEMENT STRATEGIES

Section 6.0 of the report is dedicated to solutions, evaluation and developing a path forward. The objectives for the strategies are discussed, along with the screening and evaluation criteria that were developed for this study. Existing provincial documents that provide direction for land use planning are reviewed. The draft sustainable management strategies are described and evaluated for expected benefits and implementation costs. Design criteria is presented for shoreline protection structures. Section 6.0 concludes with a discussion of future steps and working towards a consensus for the future.

6.1 Evaluation of Sustainable Management Strategies

The objectives for the sustainable management strategies are described below. Screening criteria are introduced and all strategies must pass this initial test. The evaluation method is described and will consider expected benefits and costs of implementation. Additional information is provided on future steps.

6.1.1 Background

The terms of reference for the study indicate that screening criteria should be used as a defensible approach to evaluate preliminary concepts or elements/components of the full strategies to ensure they meet the overall objectives of the study (i.e. sustainability). Once a series of sustainable alternatives has been developed, evaluation criteria will be applied to determine the extent to which the alternative concepts for sustainable management accomplish the study objectives. Refer to Task 4.3 in the Phase 1 report for additional details (Baird, 2005).

The definition of sustainable, in generalized terms, is ‘the use of resources today such that it does not compromise the ability of future generations to use these resources.’ In terms of land use in the study area, this means that current practices and proposed future changes in land use must be evaluated in a holistic context over long temporal periods, such as 50 years. For example, along the coastline if the shoreline protection of one riparian land owner has a negative impact on the adjacent or downdrift land owners, then the shore protection is not a sustainable design. For natural heritage, if biodiversity continues to decline due to current land uses, then the current practices are not sustainable, as additional species extirpations should be expected.

6.1.2 Strategy Objectives

Prior to establishing the screening and evaluation criteria, it was necessary to define the strategy objectives. Since the three pillars of sustainable development are the natural environmental factors, economic considerations and social factors, the strategy objectives

are based on these three elements. In addition, feedback from area stakeholders gathered during the mail-out survey and the public workshop were also used in formulating the objectives, as follows:

Resource and Environmental Objectives:

- Protect existing development from shoreline erosion, flooding and lakebed downcutting;
- Enhance natural beach building (by managing sand and gravel deposits);
- Sustain or enhance current levels of biodiversity;
- Enhance habitat for species at risk and endangered species;
- Improve connections and corridors between existing natural areas; and
- Contribute to other local / regional resource management plans and initiatives for natural areas.

Economic Objectives:

- Protect existing and future public/private investments in the study area that contribute to sustainable development;
- Increase opportunities for economic activity and new business development within the study area and adjacent communities;
- Increase property values (if possible);
- Maintain, and wherever possible, enhance the tax base for the municipality; and
- Concept components and/or attributes enhance the potential for funding.

Social Objectives:

- Improve the safety of community residents from flooding and erosion hazards;
- Maintain existing sustainable development and infrastructure;
- Ensure safe ingress/egress during storm events; and

- Allow current sustainable activities, lifestyles and land uses to continue.

These objectives were used to develop the screening and evaluation criteria. These evaluation criteria provide a means for assessing the expected beneficial outcomes from the proposed strategy. Benefit categories have been developed for each objective. In addition, implementation cost is also an evaluation criteria. A system to rank the strategies for expected benefits and costs was developed to determine the extent to which the study objectives are satisfied.

6.1.3 Screening Criteria

Screening criteria provide an initial check on the viability or suitability of an idea or element of a strategy for the sustainable management of Southeast Leamington. To adopt an idea or alternative in a sustainable management strategy, it must:

- Comply with all existing local, provincial and federal legislation, and associated land use regulations;
- Have no negative impacts on physical processes of the natural environment; and
- Have a reasonable expectation of being accepted by a majority of stakeholders.

6.1.4 Evaluation Method

In general, the strategies should provide a rationale and defensible basis for the long-term and sustainable planning, management and regulation of the study area lands. In addition, the strategies should contribute to other applicable resource management plans (to the extent they exist). Based on these principles and the study objectives described above, the following benefit categories have been developed to assess the extent to which each of the alternatives contribute to them.

The alternative concepts for long-term sustainable management of Southeast Leamington will be compared and ranked against the expected benefits and the anticipated cost of the strategy. A third important area of concept evaluation concerns implementation; however, this area requires a more fully developed plan before being applied and will fall within later stages of strategy implementation. The expected benefits and costs are described in more detail below.

Expected Benefits

The expected benefits are directly related to the strategy objectives and are organized into the following categories: resource/environmental, economic and social. The types of expected benefits that were considered are described below:

a) Resource/Environmental Benefits

- i. Mitigates or reduces shoreline and lakebed erosion threats to buildings and infrastructure
- ii. Natural beach building processes enhanced
- iii. Buildings and infrastructure protected from a 1% chance flood
- iv. Biodiversity is enhanced following implementation
- v. New habitat is created in the study area
- vi. Human access/connections between natural areas improved
- vii. Natural/physical connections between natural areas improved
- viii. Supports other local/regional resource management plans

b) Economic Criteria

- i. Protects sustainable public infrastructure and utility assets
- ii. Protects sustainable private property, buildings and fixed assets
- iii. Strategy reduces future cost liability for landowners and government
- iv. Creates more commercial opportunities for current businesses
- v. Creates new business opportunities not currently in existence
- vi. Property values should rise due to strategy implementation in the long-term.
- vii. Municipal tax base is maintained or improved
- viii. Potential funding for strategy is enhanced due to concept components.

c) Social Criteria

- i. Personal safety from flooding/erosion hazards improved
- ii. Unsustainable land uses curtailed

- iii. Sustainable development and land uses remain
- iv. Native biodiversity is maintained for present and future generations
- v. Improved accessibility to and safety of existing road system
- vi. Ingress/egress safety assured during major storm events
- vii. Plan does not displace current landowners
- viii. Hazards reduced/eliminated allowing current lifestyles to continue

Costs

The costs that will be considered to implement the strategy include soft costs, such as planning, design, approvals, administration, and construction management. Plus, hard capital costs such as dyke repairs, road upgrades, erosion and flood proofing and habitat creation will be evaluated. At this phase of the strategy development, it will not be possible to comment on future operating and maintenance costs for each concept. The costs are grouped according to:

- a. Private Shoreline;
- b. Public Shoreline;
- c. Drainage and Roads;
- d. Habitat Restoration; and
- e. Soft Costs (design, approvals, administration and construction management).

At the concept level, only ‘order-of-magnitude’ costs can be produced and assessed for each strategy. More detailed costing can be undertaken when the detailed planning and implementation for the strategy is initiated. Implementation of a strategy would likely involve function from all levels of government (local to federal) and contributions from the affected area landowners. The degree of cost sharing may depend on the distribution of benefits but has yet to be determined.

6.1.5 Evaluation System

An evaluation system was developed to quantify benefits and costs for the draft strategies in a systematic and defensible manor. Each strategy is rated for the individual benefits categories from 0 to 10, with 0 representing no support and 10 representing major support. Refer to Table 6.1 for a blank form. Refer to Section 6.5 for additional details and the results.

Table 6.1 Blank Benefits Table for Evaluating Draft Strategies

Southeast Leamington Sustainable Management Strategy Concepts					
Evaluation of Benefits - For those Concepts that Support the Criteria – Rate the Extent to which it Supports the Criteria Using a Scale of 0 – 10					
Note: 0 is No support; 1 is minimal support and 10 is major support.					
	Concept				
	Do Nothing	A - Status Quo	B - Community Based Prot.	C - Prov. Standards	D - Multi-Use Strategy
a) Resource/Environmental Benefits					
Mitigates/reduces shoreline erosion threats to buildings and infrastructure					
Natural beach building processes enhanced					
Buildings and infrastructure protected from 1% chance flood					
Biodiversity enhanced following implementation					
New habitat created in the detailed study area					
Human access/connections between natural areas improved					
Natural/physical connections between natural areas improved					
Supports other local/regional sustainable management plans					
b) Economic Benefits					
Protects sustainable public infrastructure and utility assets					
Protects sustainable private property, buildings and fixed assets					
Strategy reduces future cost liability for landowners and government					
Creates more business opportunities for current businesses					
Creates new business opportunities not currently in existence					
Municipal tax base maintained or improved					
Funding for strategy is enhanced due to concept components					
Property values should rise due to strategy implementation					
c) Social Benefits					
Personal safety from flooding/erosion hazards improved					
Unsustainable land uses curtailed					
Sustainable development and land uses remain					
Native biodiversity is preserved for present and future generations					
Improve accessibility and safety to existing road system					
Ingress/egress safety assured during major storm events					
Plan does not displace current landowners					
Hazards reduce/eliminated allowing current lifestyles to continue					
Total Benefits Ratings					

For each strategy, a preliminary opinion of costs will be calculated for each of the sub-categories outlined above. It is important to mention that at this point in the strategy development, only order-of-magnitude costs are possible. The benefits and costs will be compared for the various draft strategies. It will be important to compare the relative magnitude of the benefits with the overall costs. The low cost strategy may not be the preferred alternative, since the amount of benefits may be very low. Also, the ability of the strategy to attract funding may be an important consideration.

6.1.6 Future Phases of Strategy Initiation

As indicated above, issues associated with strategy implementation are also important. These are briefly described here but will not be addressed at the strategy concept level.

Implementation Issues and Criteria

It is not only the benefits and costs of the strategy that are important; the ability to implement the strategy is a significant factor. The types of issues that need to be considered by the community, stakeholders and all levels of government when a preferred alternative is selected and a path forward is established include:

- a. Strategy implementation issues that could impede progress;

- b. Acceptance of strategy by area landowners;
- c. Extent of land acquisition (if required);
- d. Type of administrative solution proposed, including extent of area landowner participation/representation;
- e. Extent of an equitable distribution of benefits and costs to area land owners.

Since the draft concepts for the sustainable management strategy of Southeast Leamington have not been developed to the point where these issues can be fully addressed, they are not considered at this stage of the assessment.

6.2 Planning and Policy Direction for Plan Formulation

As outlined in Section 6.1, the results from the mail-out survey and public workshop were used to develop the evaluation criteria. These same results were also used when developing components for the concepts. Section 6.2 of this report will describe several policy documents published by the Ontario government that provided guidance for the development of the long-term sustainable management plans. These documents and their application for strategy development are explained in the following sections.

6.2.1 Provincial Policy Statement

The Provincial Policy Statement (2005) provides policy direction for land use planning and development in Ontario (MAH, 2005). For example, as stated in the policy, it provides guidance for appropriate land uses and development activities, while protecting the resources of the province, the quality of the natural environment and ensuring public health and safety.

The Provincial Policy Statement (PPS) encourages the development of healthy communities by incorporating publicly accessible natural areas for recreation, improving access to shorelines and considering the impacts of planning decisions on parks and conservation areas. It recommends future development be directed to areas outside of hazardous lands adjacent to Great Lakes shorelines and river systems that are impacted by flooding and erosion.

Long-term economic prosperity is encouraged by optimizing land uses, providing opportunities for sustainable tourism and protecting sustainable agricultural resources. For example, prime agricultural areas should be protected in the long-term, particularly areas producing specialty crops.

Regarding natural heritage, the PPS states the diversity and connectivity of natural features should be maintained, improved, and restored. In addition, the ecological

function and biodiversity of these natural areas must be recognized and if possible linkages should be restored.

Guidelines for interpretation and implementation of the PPS are provided in Section 3 of the Planning Act, as amended by the Strong Communities Act (Planning Amendment), 2004. Decisions by the council of a municipality and a minister of the Crown with respect to planning matters “shall be consistent with” the Provincial Policy Statement. Land use applications in Ontario are also subject to a wide range of federal, provincial and municipal legislation/bylaws in addition to the guidelines in the PPS. Consideration must also be given to these other regulations.

6.2.2 *Understanding Natural Hazards*

Understanding Natural Hazards (2001) is a companion document to Section 3.1 (Natural Hazards Section) of the Provincial Policy Statement. For the purpose of this study, flooding and erosion are relevant hazards for existing development. Although there are dynamic beaches within the detailed study area (e.g. east shoreline of Point Pelee National Park) they do not feature development and thus this aspect of the policy is not reviewed.

Flooding Hazard Standard

The flood setback for the shorelines of the Great Lakes is defined by the elevation of the 1% chance flood or 100 year peak instantaneous water level (176.0 m for the purpose of this study, refer to Section 2.1.3) plus a 15 m allowance for wave uprush and other water related hazards, such as wave spray and ice piling. Figure 6.1 provides a schematic diagram that explains the flood setback.

If the land elevations around existing development are lower than the 1% chance flood elevation, the development does not conform to the setback policy. Similarly, if the building is located less than 15 m from the intersection of the 1% chance flood elevation with the shoreline, measure horizontally, then the building does not conform to the setback policy. It should be noted that under special circumstances, such as a sheltered area where there is no wave uprush or other water related hazards, the 15 m horizontal setback distance can be reduced if a calculation is provided, using standard engineering techniques, that indicates the hazard from wave uprush is less than 15 m.

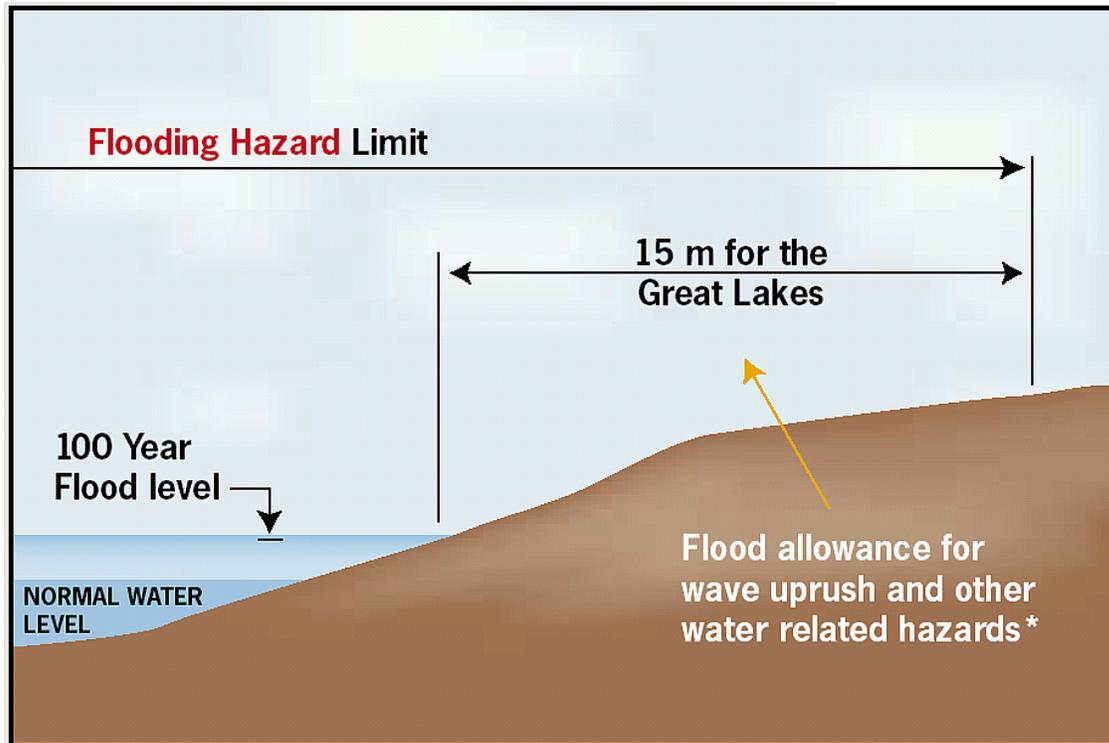


Figure 6.1 Typical Flood Hazard Setback for Great Lakes (graphic courtesy of Understanding Natural Hazards, 2001)

Erosion Hazard Standard

Many of the lake and river shorelines in Ontario feature a long-term erosion rate. Over time, the natural trend for these shorelines is to migrate inland. To protect proposed development and infrastructure from the hazards associated with a receding shoreline, the erosion standard was developed. Figure 6.2 provides a schematic sketch of the standard, which includes two key components: 1) an allowance for a stable slope, which is generally in the 3:1 (H:V) range, and 2) a horizontal distance equal to 100 years of future recession. In other words, the long-term recession rate is multiplied by the planning horizon of 100 years. This total setback distance is measured horizontally from the toe of the bank or bluff and defines the erosion hazard zone. The landward limit of this zone defines the lakeward limit of future development.

Table 6.2 summarizes measured recession rates south of Wheatley Harbour at five locations that feature unprotected and relatively natural segments of the shoreline in proximity to the developed shoreline. Long-term recession rates for setback planning cannot be calculated in areas where either the historical or modern shoreline features erosion protection, such as a seawall or revetment (Technical Guide, OMNR and Zuzek et al., 2003). Of the four locations where a natural shoreline recession rate could be

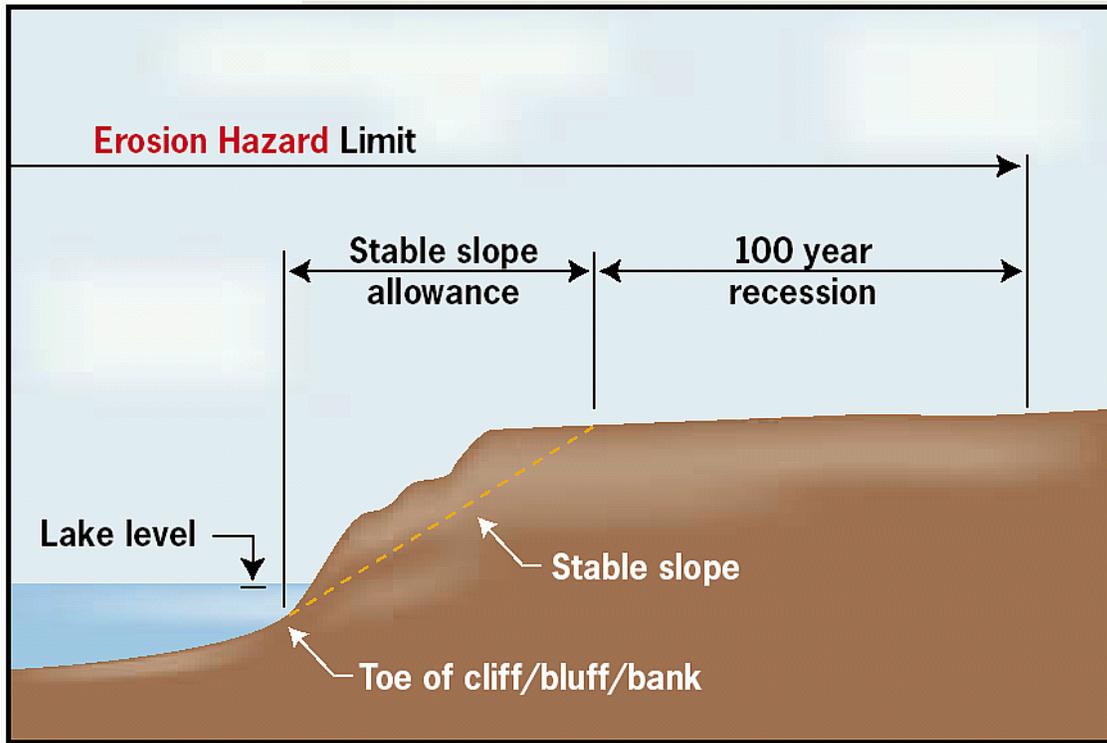


Figure 6.2 Typical Erosion Hazard Setback for Great Lakes (graphic courtesy of Understanding Natural Hazards, 2001)

calculated, the average is 1.25 m/yr. When the landward migration or retreat of the 2 m depth contour is measured at Line 18 (Pulley Road), the annualized recession rate is 3.87 m/yr. It is not recommended this rate be used for development setback applications, however, it does provide an indication of the magnitude of the lakebed downcutting rates within the study area.

Table 6.2 Long-term Recession Rates for the Detailed Study Area

Zone	Location	Period for Recession Calculation	Annualized Recession (m/yr)	100 Years of Recession for Development Setback (m)
4	Retreat of 2 m Depth Contour at Line 18	1974 to 2005	3.87	387
4	Pulley - Lakeshore Boundary	1954 to 2004	0.62	62
4	Cotterie Elmdale Boundary	1954 to 2004	1.44	144
5	Northern Half of the Hillman Marsh Barrier Beach	1954 to 2004	1.28	128
12	Northern Third of Point Pelee National Park	1954 to 2004	1.68	168

Consider this hypothetical example for a new building permit on a waterfront lot. Based on the information in Table 6.2, the recommended long-term recession rate for the study area is 1.25 m/yr. Using this rate, the portion of the erosion setback dealing with future recession is 125 m (1.25 m/yr * 100 years). In other words, the distance from the proposed building foundation to the top of stable bank would be 125 m. This calculation does not include an allowance for stable slope, however, since much of the study area is low lying, the stable slope allowance would not be significant (less than 10 m in most cases).

In this example, if the proposed building footprint is 10 m square (for new building) and a 5 m front yard allowance is proposed, the lot must be approximately 140 m deep from the top of the stable slope. Table 6.3 below summarizes the minimum, average and maximum lot dimensions for the Pulley Road and Lakeshore/Cotterie Road segments of Zone 4 south of Wheatley Harbour. For all parcels, the existing lot depths are less than 115 m. Therefore, none of these lots could conform to the Erosion Hazards setback of the provincial policy statement, which is necessary for new development to occur. It should be noted that many of these homes were constructed before the provincial policy statement and natural hazards policy were developed. Also, there are situations when shoreline protection can be used to reduce the horizontal distance of the setback and this is described further in the next section.

Table 6.3 Summary of Lot Dimensions for Shoreline Community

Zone	Name	No. Developed Lots Parcels	Lot Depth for All Waterfront Parcels (m)			Avg. House Setback (m)	No. Vacant Lots		
			Homes	Other Blds	Min. Depth (m)			Avg. Depth (m)	Max. Depth (m)
4a	Pulley Waterfront Lots	38	31	2	21.11	31.09	43.69	10.39	6
4a	Pulley Second Row Lots (west of road)	49	38	5					12
4b	Lakeshore/Cotterie Waterfront Lots	60	36	7	15.55	45.90	88.47	17.28	22
4b	Lakeshore/Cotterie Second Row Lots	74	50	12					24
4c	Elmdale Subdivision	34	20	4					9
6	East Beach	70	58	10	29.26	44.09	61.77	14.33	14
7	Marentette Beach	94	51	5	19.89	50.34	57.70	11.91	45

- Notes:** 1) Out buildings less than 200 ft² (e.g. small sheds), are not counted
 2) Other buildings includes single car garage, barns, etc.
 3) Lot depth is measured from road to top of bank or shore protection
 4) House Setback - distance from house to top of bank/shore protection
 5) Parcels with less than 5m from shoreline protection to road were omitted from Lot Depth and Vacant Lot calculations
 6) Parcels with no top of bank and/or only sand beach omitted from Lot Depth calculations

Protection Works Standard

This standard is the combination of structural works and allowances for slope stability, flooding and erosion to reduce the damages caused by flooding, erosion and other water related hazards. In other words, when applying the erosion hazard setback of 100 years,

existing or proposed shoreline protection can be used to mitigate a portion of the 100 year planning horizon. For example, if a qualified engineer determines that an existing structure or a new proposed structure will have a design life of 25 years, then the erosion hazard setback would only apply for the remaining 75 years.

Appendix A7-1 of the Technical Guide provides guidance on the appropriate amount of planning horizon that can be mitigated with shoreline protection based on local recession rates. For example, if an area features a low recession rate (i.e. < 0.3 m/yr), it would be appropriate to assign a design life of 25 to 40 years to a well engineered shoreline protection structure. However, in areas with high (0.7 to 1.2 m/yr) to severe (> 1.2 m/yr) recession, lakebed downcutting is recognized as a severe design constraint and the policy recommends only assigning a life span of approximately 10 to 15 years for new well engineered shoreline protection structure.

Considering the long-term recession rate for the study area (1.25 m/yr), the maximum amount of design life assigned to a proposed shoreline protection structure to mitigate erosion is 15 years. Therefore, the site would still have to mitigate 85 years of recession naturally. Using the example from the previous section, 85 year recession limit would be 106.25 m (85 years * 1.25 m/yr). If the 10 m building footprint was considered and a 5 m front yard setback, the minimum lot depth would be 121.25 m.

Therefore, based on the information in Table 6.3, it appears none of the existing waterfront parcels could conform to the Erosion Hazard Setback, since they are all less than required setback. However, it should be noted that this is just a general application of the Provincial Policy Statement and not necessarily applicable on a site by site basis within the study area.

Access Standard

A method or procedure is required to ensure safe vehicular and pedestrian movement to and from a development during times of flooding, erosion and other water related hazards. In addition, access for construction equipment must be available for the maintenance and repair of protection works. The Technical Guide provides guidelines for water depths on a road that will still allow for safe pedestrian traffic. The depth is related to the presence or absence of flowing water. In other words, if there is no flowing water or wave action, a water depth of 0.3 m (1 ft) may be considered safe. However, if the road is susceptible to flowing water, strong currents or wave action, a 0.3 m depth may not be safe for pedestrian traffic.

Given the information in Table 6.3 on average and maximum lot depth along the beach communities, it may be possible to meet the provincial standards in some locations along the shoreline.

Redevelopment and Existing Vacant Lots

Appendix A7-2 of the Technical Guide for Great Lakes – St. Lawrence River Shorelines discusses the provincial policy for redevelopment and infilling within the hazardous lands. Recognizing there may be local constraints to development, there is a provision to consider a reduced planning horizon of 60 years. Therefore, provide the application meets the access and flooding standards, it may be possible to reduce the temporal period for the erosion hazard setback to 60 years. Using the earlier example, if a 15 year credit is assigned to a new well engineered shoreline protection structure, then only 45 years of natural erosion is considered. Using the recommended recession rate of 1.25 m/yr, the required setback from the shore protection to the house would be 56.25 m (45 years * 1.25 m/yr).

It should be noted that this is just a general application of the Provincial Policy Statement and not necessarily applicable on a site by site basis within the study area.

6.2.3 *Great Lakes – St. Lawrence River Shorelines and Large Inland Lakes*

This technical guide is a companion to the Provincial Policy Statement and the Natural Hazards publication. It provides detailed engineering, geotechnical and scientific principles, practices and procedures for hazardous lands identification, planning and management. This publication is available through The Watershed Science Centre at Trent University.

6.2.4 *The Drainage Act*

Profitable returns from the farmlands in the study area as well as the rest of Ontario depend on the effective drainage of the land. Drainage includes the collection and removal of surplus surface and sub-surface water from the farmlands and the discharge of those waters to an outlet. Common Law does not permit non-riparian owners (those owners that do not abut a natural watercourse) from draining their lands onto neighbouring lands. The Provincial Government has enacted laws to provide much needed assistance to meet the problems of obtaining a legal drainage outlet, engineering a solution and financing the works. The Drainage Act is one such provincial statute that provides non-riparian owners with a method of obtaining a legal outlet for water. It also provides a democratic procedure for the construction, improvement and maintenance of a drainage works. The Drainage Act has been in place for over 100 years.

The lands within the four agricultural drainage areas included in the study area (East Marsh, West Marsh, Lloyd and Marentette Drainage Schemes) are all served by drainage works constructed under the Drainage Act. The drainage works within each scheme include the following components:

- An extensive system of open outlet drains;
- A mechanical pump facility;
- A perimeter dyke to protect the lands from flooding; and
- Erosion protection works to maintain and protect the dykes.

The various components of the schemes have been constructed, repaired and improved on numerous occasions under numerous reports under the Drainage Act from the early 1920s to present. All costs related to each work were levied against the lands and roads within the particular drainage scheme impacted by the particular works. Costs levied against private properties were recovered as a direct tax on the property. The Municipality paid costs are levied against roads from the Road Budget or the General Levy. Typically, grants were provided to the Municipality from the provincial and federal governments to offset a portion of the cost of each work under a new report.

The Municipality is responsible for the maintenance of any drainage works constructed under the Drainage Act to the extent of the work and structures specified in the current by-law. The Municipality is obliged to act on any notice of non-repair. Should the Municipality fail in this duty, they are liable for all damages that may arise from their failure to maintain the drainage works.

On the other hand, the property owners are obliged to pay for all maintenance works carried out on the drainage works to the standards identified in the governing bylaw. They may also request that improvements be carried out under a new report on any component of the drainage works but must also bear the cost of those works in the manner identified in the report.

Unless and until the drainage works are officially abandoned under the Drainage Act, any works of repair, improvement or maintenance must be carried out by the Municipality under the provisions of the Act.

Assessments against agricultural lands, for works of maintenance or repair, levied under the Drainage Act may be eligible for grants from the provincial government. The provincial grants are offered through the Agricultural Drainage Infrastructure Program. The funding for this program is limited and is subject to certain conditions. No non-agricultural or municipal lands are eligible for grants under this program. The federal government no longer provides any grants for works of this nature.

6.2.5 Ontario's Biodiversity Strategy

Ontario's biodiversity strategy is entitled "Protecting What Sustains Us, 2005". This report is not about the conflicts between nature and people, but rather about adopting sustainable land uses that respect the ecological functions of a region, social and cultural

values and sound economic principles to ensure prosperous communities. The strategy outlines a plan that can be embraced by all residents of Ontario and collectively will require everyone's cooperation to achieve.

The strategy outlines two conservation principles to ensure we maintain biodiversity in Ontario: 1) protect the genetic, species and ecosystem diversity of Ontario, and 2) use and develop the biological assets of Ontario in a sustainable manner to generate benefits for the residents of Ontario. Adopting these principles and utilizing them for land use planning will not be easy and will not result in immediate successes. The plan requires a long-term vision for success.

One of the key principles of the strategy is the consideration of ecological, economic, social and cultural values when making land use planning decisions and evaluation development applications. Since these considerations are the basic elements of sustainability, by design this study has a solid framework to develop long-term plans for the study area that will embrace biodiversity and ensure it is sustained in the future.

The strategy outlines the following strategic directions to achieve the biodiversity conservation goals outlined above: 1) engage Ontarians to build public understanding, 2) promote stewardship at the local level, 3) work together and form partnerships, 4) integrate biodiversity conservation into land use planning, 5) prevent biodiversity decline by reducing threats, and 6) improve understanding by using scientific knowledge and traditional knowledge from communities.

Refer to the strategy document for additional details.

6.3 Draft Sustainable Management Strategies

A series of draft sustainable management strategies for the detailed study area are described in Section 6.3. Some options strive to enhance existing land uses by reducing natural hazards, while others make changes to the current landscape to address sustainability issues. Although this study is not required to follow the guidelines for a provincial or federal environmental assessment, a wide range of options were explored to determine which strategy generates the most benefits, is economically viable, socially acceptable and environmentally responsible in the long-term. Maps for the draft strategies are provided in Appendix 6.

The screening criteria summarized in Section 6.1.3 were applied to several initial strategies and they failed one or more of the criteria. Therefore, refinements to these strategies were not pursued. These are briefly described in Section 6.4. The maps will be available in Appendix 7 at a later date.

This investigation has been an important step forward in planning for the sustainable management of the resources within the detailed study area. However, it is only the first step towards planning for the future, completing local improvements and possibly

implementing land use changes. Local stakeholders and government must continue to work together to ensure the study moves forward. Failure to communicate and work collaboratively in selecting a preferred alternative will impede progress and ultimately could be the demise of the entire initiative.

6.3.1 Do Nothing

The “Do Nothing” scenario is not a viable strategy, as it does not satisfy any of the objectives summarized in Section 6.1.2. There are serious infrastructure problems within the boundaries of the study area, safety concerns, access problems, and land use activities that are not sustainable. All study participants, including stakeholders and all levels of government must understand that the “Do Nothing” scenario is not sustainable and therefore should not be the ultimate outcome of this initiative.

For the purpose of comparing the relative merits and benefits of the draft strategies to the current situation, Do Nothing will be ranked in Section 6.5. A blank map of the study area is provided in Appendix 6 as a reference for Do Nothing.

Four draft concepts are described below based on the following sub-categories: a) key features, b) dykes, drains and roads, c) shoreline and nearshore, d) natural heritage, e) economic development, recreation and tourism opportunities, f) pros and cons of the strategy, and g) implementation issues.

6.3.2 Concept A – Status Quo Strategy

Generally, the only type of local improvements within the detailed study area that are legislatively enforceable are upgrades to the drainage schemes, as outlined in the Drainage Act. Refer to the discussion in Section 6.2.4. The Municipality is responsible for the maintenance and distribution of the costs through local tax levies to those in the drain benefiting from the improvements. Therefore, the drainage scheme is updated for Concept A as outlined below.

Concept A assumes no other changes inside the detailed study area. No improvements to the current sediment management practices at the Wheatley Harbour, no upgrades to flood and erosion protection, no habitat improvements, nothing to strengthen native biodiversity, or development of new economic opportunities within the detailed study area.

Dykes, Drains and Roads

The following upgrades are implemented for the dykes, drains and roads in Concept A:

- The dyke along Mersea Road 1 adjacent to the Hillman Marsh is upgraded to provide flood and erosion protection that satisfies provincial standards for natural hazards, as outlined in the 2006 Todgham & Case report. It should be noted that the study relied on the MNR peak instantaneous level of 175.5 m, which is lower than the standard recommended in this study. The road is repaired, re-surfaced and re-opened for access. Mersea Road 1 and Road C are both potential emergency ingress and egress routes for the shoreline communities of East Beach and Marentette Beach. If Concept A is selected as the preferred alternative, additional planning would be required to designate either Mersea Road 1 or C as the primary emergency access route during flood situations;
- Mersea Road C between East Beach Road and Mersea Road 12 are also potential ingress/egress routes and will be repaired. If Road C was selected as the primary emergency route, it would have to be upgraded to provincial standards. It is also worth noting that following the recommended upgrades, all roads will provide emergency access for fire and ambulance if there is no flooding;
- The perimeter dykes of the Lloyd, Marentette and East Marsh provide flood protection to the interior from Lake Erie storms. For Concept A, these structures must be upgraded to provide erosion protection that meets provincial standards for protection from natural hazards. Along East Beach field observations of the armour stone berm protecting the lakeshore dyke of the East Marsh indicated select locations require maintenance. It should be noted that this berm is part of the East Marsh drainage scheme and will require repairs. The maintenance for the perimeter dykes for the Marentette and Lloyd drainage schemes, as outlined in the Todgham & Case reports (2004), only restores these structures to the conditions previous to the May 2004 rainfall event. When evaluated against the provincial standards, the cost for repairs may increase;
- Since there are no shoreline improvements for Concept A, an additional cost is included to address the beach erosion problem at the northeast corner of Point Pelee National Park, adjacent to the southeast corner of the Marentette Drain. Without a remedial solution, this beach will continue to migrate inland and the threat of wave attack against the earth dyke will increase;
- Mersea Road C west of Mersea Road 19 is repaired as outlined in the Todgham & Case reports (2004), which is below the provincial standard. The lower design standard is acceptable for this interior dyke, since it is not exposed to lake storms and the perimeter dykes provide the initial line of defence from flooding
- Mersea Road C west of Mersea Road 19, Road B and D were not evaluated. These interior dykes and roads must be evaluated in a future engineering

- investigation, along with the remaining aspects of the West Marsh drainage scheme;
- Recommended upgrades to the pump houses of the four drainage schemes are implemented based on the findings of the current evaluation (Stantec, 2006). Presently, this cost information is not available and thus not included in the assessment;
 - Buffer strips along all drainage ditches are constructed in conjunction with maintenance of the ditches (i.e. excavation), since the lack of a vegetated buffer contributes directly to sedimentation and reduced flow capacity in these ditches;
 - Additional wind breaks are recommended (but not mandatory) for the remaining muck soils to prevent further soil degradation. A cost item is not included in the estimate; and
 - A study is completed to review the current conditions and capacity of the West Marsh Drainage Scheme. An estimated cost for the study and upgrades is included in the cost estimate based on existing information.

Shoreline and Nearshore

No upgrades to the existing flood and erosion protection for the shoreline properties are proposed. These communities will continue to be exposed to flood and erosion hazards. Continuation of the current dredging and sediment management practices at the Wheatley Harbour are assumed. A series of armour stone headlands is constructed along the northeast shoreline of Point Pelee National Park to stabilize the beach and protect the Marentette dyke from exposure to storm surges and waves. Refer to Section 6.3.3 for additional details of this design aspect.

Natural Heritage

Current management activities to maintain and enhance natural heritage continue at the Hillman Marsh Conservation Area and Point Pelee National Park. There are no plans to address the ongoing shoreline erosion rates for the two natural areas with the exception of the northeast corner of PPNP. Hillman Marsh and Point Pelee National Park will continue to lose marsh and Carolinian Forest habitat every year. No new habitat is created.

New Economic Development, Recreation and Tourism Opportunities

The Status Quo strategy does not include any components that will increase economic activity or support additional tourism opportunities in the area.

Pros and Cons of the Strategy (benefits, disadvantages and costs)

Concept A addresses the interior flood problems within the four drainage schemes and restores access to local roads. The anticipated socio-economic benefits, disadvantages and costs of adopting this strategy include:

- Area residents inside the four drains (East Marsh, Marentette, Lloyd and West Marsh) are protected from the flooding hazards. Current agricultural activities and the rural lifestyle continue;
- However, these costs are levied against the current property owners in the drains and the Municipality of Leamington. These individuals have identified serious concerns about the affordability of the maintenance;
- Private property is more secure inside the four drains, which protects and possibly enhances its capital value;
- The drainage infrastructure and roads are more secure in the four drains and planning for future capital costs, such as maintenance, can be projected;
- The municipal property tax base is maintained in the drains and possibly enhanced. However, without any improvements and upgrades to the erosion/flood protection for the shoreline communities, the tax base from these parcels may actually decrease in the future. The anticipated net change is a decrease in municipal property taxes;
- Strategy A does not address the ongoing concerns for flooding and erosion hazards along the shoreline communities and natural areas within the study area. Each future development application would be assessed based on treatment of the flood, erosion and access standards in the provincial policy statement, plus other municipal requirements;
- Existing dredging and disposal practices continue at the Wheatley Harbour. A study is not available to determine if this is the most economical solution. Also, the benefits or disadvantages of the current disposal area (i.e. Pulley Road south of the harbour) are unknown;
- Habitat losses continue for both natural areas due to ongoing shoreline erosion; and
- The strategy does not address the ongoing slow decline of biodiversity within the detailed study area and no new habitat is created.

Implementation Issues

The primary implementation issue for the Status Quo strategy is the cost associated with the drain maintenance, as outlined in the series of Todgham & Case reports. Plus, this study has identified additional maintenance requirements to address concerns with the armour stone berm protecting the lakeshore dyke of the East Marsh and existing threats to the southeast corner of the Marentette dyke from shoreline erosion.

6.3.3 Concept B – Community Based Flood and Erosion Protection

Key Features of the Strategy

The strategy for Concept B is the maintenance of all current land uses in the future and the promotion of a safe, healthy and prosperous community. To ensure the safety of all residents from natural hazards, maintain capital investments, and promote a healthy local economy, upgrades are required to the existing protection and infrastructure. For example, flood and erosion hazards must be mitigated and access to critical road infrastructure must be restored within the community. Extensive maintenance is required for the drainage schemes, including dyke repairs, ditch maintenance and possibly upgrades to the pump houses (pending further study).

Concept B proposes the adoption of a community based approach to implement the flood and erosion protection along the shoreline. For example, a collaborative approach is adopted to ensure all shoreline property is protected to a minimum standard for erosion and flood risks. With a unified and collective voice, the shoreline communities can work together with ERCA and local government to design cost effective solutions that will extend the design life of existing protection. The amount of design life achieved by the upgrades will be directly proportional to the investment in the protection.

As an example, the Drainage Act already provides a framework for a community or drain based approach to local improvements that could be adopted for the shoreline protection upgrades.

Dykes, Drains and Roads

The upgrades and repairs to the drains and roads summarized for Concept A are also included for Concept B.

Shoreline and Nearshore

Concept B includes the following changes and modifications for the shoreline communities and nearshore environment:

- A regional sediment management strategy is developed with the cooperation of all relevant federal and provincial agencies, ERCA, local officials and all stakeholders, including the private landowners. The same community groups that evolve to formulate plans for shore protection can interact with this group. Once implemented, the plan will improve sand management at the Wheatley Harbour to ensure the full sediment supply from the north is bypassed, naturally or

mechanically. It is recommended that a framework be developed for the regional sediment management plan following the completion of this study;

- A policy is adopted to place an annual beach nourishment volume of 4,600 m³ on the beaches of the east shore. This volume is equivalent to the amount of sand that historically was transported in a northerly direction from the southeast shoal. Since the beaches of the National Park were most affected by the historical sand mining, the feeder beach may be located in close proximity to the northeast corner of the National Park. However, a future engineering investigation would be required to design the specifics of this beach nourishment. For the purpose of generating a conceptual cost estimate, it is only necessary to assume 4,600 m³ of sand and gravel is placed annually;
- Much of the existing residential development south of Wheatley Harbour already features shoreline protection. However, field observations collected over the duration of the study indicate many of these structures are in a deteriorated state and likely would not provide adequate erosion and flood protection during extreme storm events. In other words, these structures do not conform to provincial standards.

Section 7.4.5 of the Technical Guide provides guidelines for improvements and maintenance of existing protection works and thus provides relevant information. For example, the guide recommends that upgrades to existing protection may be considered if the works are done in accordance with accepted coastal engineering practice, are undertaken in an environmentally sound manner and do not create hazards off-site. It recommends the protection works standard of 100 years be fulfilled so that the existing development (e.g. residential home) is protected from erosion and flood hazards for 100 years. If it is not possible to conform to the 100 year protection standard for erosion, either due to financial or site constraints, a reduced standard may be considered.

Since much of the shoreline features mature communities, in many cases there would not be a sufficient horizontal setback distance to apply the 100 erosion hazard standard. The reduced standard of 60 years for infilling and redevelopment could be applied, as outlined in Appendix A7-2. For the purpose of developing a cost estimate, it is assumed that the desired objective of the community based groups for the Marentette Beach, East Beach and Pulley to Elmdale Subdivisions is to upgrade existing shore parallel protection, such as walls and revetments. This approach will not stop lakebed downcutting or prevent further shoreline erosion, however, the objective is to extend the design life one or two more decades.

Unlike erosion processes, which occur continuously over time, flooding and the associated hazards are event-based. In other words, flooding hazards will occur randomly in the future and are only sustained for short periods. However, since we are not able to predict future storm chronology or intensity, it is necessary to mitigate flood hazards to the provincial standard, as outlined in the Flood Hazard Setback. There are two general methods to mitigate flood hazards for existing development that is too low: a) raise the buildings above the flood level

associated with the 1% chance flood, and/or locate the building outside the zone of influence for wave runup and overtopping. If neither of these options is viable, then the existing risks could be reduced by upgrading perimeter flood protection.

The shoreline community groups, in consultation with design professionals and the various regulatory agencies, would determine the preferred approach to mitigating erosion and flooding hazards. For the purpose of the cost estimate, a fixed cost for each waterfront parcel is included;

- There is a critical erosion problem along the northern half of the Hillman Marsh barrier beach, as outlined in Section 3.1.5. Without human intervention, the barrier beach will continue to migrate landward. If the historical rates of recession continue, in approximately 50 years (or less) the water level control cell in the northeast corner of the marsh will be threatened by erosion. However, shoreline recession is rarely linear and a series of severe storms during an average or high lake level period could breach the barrier and expose the marsh to lake storm surges and waves in much less than 50 years. This scenario has significant negative impacts for the habitat in the Hillman Marsh and could threaten the stability and access functions of Mersea Road 1. In addition, high water levels in the marsh contributed to the flooding problems in Elmdale and Cotterie in 1998. Refer to Section 5.3 of the report for additional details. Therefore, Concept B includes a 1.5 km zone where engineering structures would be constructed to reduce lakebed downcutting and the landward retreat of the barrier beach. In the draft sketch for the concept (Appendix 6), the barrier beach is protected with a series of large low crested offshore breakwaters and beach nourishment. Design details of these structures (such as size, location, spacing and crest height) or other viable approaches would be refined in an engineering design investigation;
- Beach recession along the northeast shoreline of the National Park, immediately south of the Marentette Drainage Scheme, has been severe since the 1970s. The annualized rate of retreat since 1954 for a 5 km stretch of the park is 1.68 m/yr (refer to Figure 3.20 in Section 3.1.8). Locally, immediately south of the Marentette Drainage Scheme, the recession rates are much higher, creating a vulnerable situation for the southeast corner of the Marentette drain. The lakeward side of this dyke is surrounded by a canal that was excavated during dyke construction. With further retreat of the barrier beach, the dyke will be exposed to the lake waves and this earth dyke was not designed to withstand wave forces during a Lake Erie storm. If lake waves breach this earth dyke, extensive interior flooding would follow, as outlined in Section 5.3.

The existing armour stone berm constructed on the southern third of Marentette Beach partly addresses this hazard, however, given the retreat of the National Park beach in the last 30 years, the dyke remains extremely vulnerable to wave attack south of the terminus of the berm during high lake levels. Therefore, a zone approximately 1 km in length has been identified for the construction of engineering structures to reduce lakebed downcutting and shoreline recession, and protect the Marentette Dyke from exposure to storm surges and lake waves. For the conceptual sketch of Concept B in Appendix 6, a series of armour stone

headlands are proposed, decreasing in length from north to south. Beach nourishment is also included to pre-fill the beaches between these structures. If Concept B was the preferred alternative, the specifics of the protection (type, size, location, etc.) would be determined in an engineering design investigation;

- A series of natural background erosion rates for the detailed study area south of the Wheatley Harbour were presented in Table 6.2. Based on the magnitude of the required horizontal erosion setback, it is very unlikely future applications could meet the provincial standards for erosion hazards following the community based approach for upgrades. However, each application would be reviewed on a site by site basis; and
- The Provincial Policy Statement indicates that development is not permitted in areas inaccessible to people and vehicles during flooding and erosion events and other emergencies. The 1% chance flood elevation for the study area is 176.0 m. Therefore, all roads along the shoreline, public or private, must ensure safe vehicular and pedestrian movement and access for maintenance during a flood at 176.0 m. Presently, there are concerns about safe vehicle or pedestrian access on some of the roads in the beach communities. To comply with the PPS, access roads must provide for safe ingress/egress and maintenance of shoreline protection structures. If existing access roads do not provide safe ingress and egress, then future development applications would not conform to the provincial standards for development adjacent to hazardous lands. It should be noted that updating the elevation of access roads may not be possible due to local site constraints.

It is recommended that this issue be investigated by the community groups organized for the three beach communities. Additional surveying would be required to obtain existing road centreline elevations. Then, the access standard of the provincial policy statement could be applied to investigate existing conformance.

Natural Heritage

There is no new large-scale habitat creation for Concept B, however, several recommendations are provided to enhance the existing natural areas:

- Upgrades to the riparian corridors throughout the Muddy, Hillman and Sturgeon Creek watersheds are recommended. The improvements are outlined in the Biodiversity Conservation Strategy for Essex Region (ERCA, 2002);
- Point Pelee National Park has been separated from its pre-settlement watershed and thus does not receive adequate supplies of new fresh water for the marsh. In order to improve water quality and circulation in Point Pelee National Park, it is recommended two options (and possibly more) be considered in a future study: a) Lake Erie water is pumped artificially into the marsh, and b) the East Beach of the

National Park is breached artificially to restore the inlet that existed in the 1800s (according to the old maps);

- Shoreline recession rates are significantly reduced for two of the natural areas experiencing rapid shoreline retreat: the Hillman Marsh barrier beach and the northeast corner of Point Pelee National Park. The proposed engineering structures at Hillman and PPNP will stabilize the eroding barrier beach. Dune rebuilding may result from the combined affect of the regional sediment management program for Wheatley and the annual beach nourishment for the concept. Collectively, new beach and dune habitat may be created for Concept B; and
- Existing management strategies continue for PPNP and Hillman Marsh.

New Economic Development, Recreation and Tourism Opportunities

Assuming community based flood and erosion protection plans are implemented along the shoreline and a regional sediment management plan is developed for the Wheatley Harbour, Concept B will improve public safety and protect private / public sector investments along the shoreline in the short term. These approaches will not permanently eliminate the hazards, they will just improve conditions locally for several decades. However, landowners will be more secure in the knowledge that basic issues of safety, access, and the preservation of capital are addressed in the short term.

The upgrades for the drainage schemes will eliminate the existing flood risks and restore access along all local roads. These improvements will maintain the capital investments inside the drainage schemes and allow existing land use activities, such as agriculture and rural residential, to continue.

The degree to which Concept B attracts new economic development or permits additional infilling in the residential communities is thought to be marginal for this strategy. Shoreline development permits would be assessed on a site by site basis, but it is unlikely they could meet the provincial requirements for erosion hazards.

There are no new recreation and tourism opportunities in Concept B.

Pros and Cons of the Strategy (benefits, disadvantages and costs)

The pros and cons of the Strategy B, which utilize a community based approach to design and implement improvements for flooding and erosion, are discussed below:

- The development and adoption of a regional sediment management strategy for the Wheatley Harbour ensures the full sediment supply from the north is transported south of the harbour. This will enhance natural beach building along the beach communities and natural areas;

- The annual beach nourishment volume of 4,600 m³ will help to restore the volume of sand and gravel transported in a northerly direction prior to sand mining activities in the 1900s. This additional material may promote beach growth and dune regeneration;
- Concept B addresses the hazards associated with lake and interior flooding within the detailed study area. A community approach is adopted for erosion and flood protection, standards are developed for the protection of and upgrades are completed for sub-standard lots along the waterfront. All buildings must be safe from the 1% chance flood and accessible for emergency response (vehicles and pedestrian).

Area residents will be safer and their capital investments will have a higher degree of protection.

It is not known whether there will be any funding partners or grant opportunities for Concept B;

- Although current land uses will remain, future development applications will be assessed on site by site basis. Based on the known lot dimensions (e.g. depth) for the shoreline communities and the long-term recession rates presented in Section 6.2, it is unlikely future infilling could meet provincial standards for development adjacent to hazardous lands;
- The reduction in flood and erosion hazards for the shoreline community should maintain the capital investment in waterfront properties for the short term;
- Flood and erosion risks for public infrastructure are significantly reduced, allowing for the development of a long-term maintenance plan to ensure repairs are completed and capital re-investment occurs as required;
- The municipal property tax base is maintained for the next several decades;
- Rural land uses are maintained inside the drainage schemes and the current levels of agricultural production continue in the future. However, the landowners in the drains have expressed concern over the magnitude of the repairs and the associated costs;
- Engineered shoreline protection is constructed for two areas of critical erosion: the Hillman Marsh barrier beach and the northeast corner of Point Pelee National Park. These structures will stabilize the shoreline, enhance beach conditions and possibly encourage dune regeneration. Some habitat improvements will be achieved with these projects;
- There is no new marsh habitat created within the detailed study area and the Hillman Marsh and Point Pelee National Park remain habitat fragments. A future study to investigate methods to improve circulation in the marsh may enhance existing habitat in the future. The economic benefits of park visitors will continue in the future, although the resource is in slow decline due to existing stresses on native biodiversity; and

- Concept B does not include any substantial components that would enhance the existing economy of the region or attract new business development opportunities.

Implementation Issues

There are several implementation issues with Concept B, including: developing functioning and successful community groups, the cost associated with upgrades to the beach communities, interior drainage schemes, road re-construction, and shoreline protection for the natural areas. The residents inside the drains have stated that they cannot afford the maintenance without government funding. The desire and ability of the shoreline communities to re-invest in flood and erosion protection is unknown. This issue could be addressed by the three local community groups: Marentette Beach (which already has an association), East Beach and the Pulley to Elmdale Subdivisions. The community upgrades for erosion and flood protection are the minimum to protect the dyke and road infrastructure that separates the waterfront development from the interior areas. For example, the shoreline protection along East Beach and Marentette Beach protects the lakeshore dykes for the East Marsh and Marentette Drain.

The recommended engineering structures to protect the Hillman Marsh barrier beach and the beaches in the northeast corner of Point Pelee National Park will require significant funding and they are integrated with the proposed drainage scheme upgrades. In both cases, these shoreline works are required to ensure lake waves do not erode the perimeter lakeshore dykes. If these works are not completed, then additional protection will be required for the dyke upgrades (i.e. to protect from the threat of breach).

6.3.4 Concept C – Flood and Erosion Protection Upgraded to Provincial Standards

Key Features

Similar to Concepts A and B, all land uses and existing development remain inside the detailed study area. The interior drainage schemes and road infrastructure are upgraded as outlined in Concept A. Another key feature of Concept C is a substantial investment in the flood and erosion protection for the shoreline communities and natural areas. For the residential areas, all aspects of flood proofing and road access are upgraded to meet the full provincial standards. An attempt is made to upgrade the shore protection to provincial standards. The details of these upgrades are described below. A map of Concept C is provided in Appendix 6.

In order to maintain the existing habitat within the detailed study area, shoreline protection is included for all of the beaches fronting the natural areas, including the Hillman Marsh and Point Pelee National Park. Consequently, improved shoreline habitat

is created in the nearshore zone, beach and dune environments. Details of these improvements are provided below.

Dykes, Drains and Roads

The same upgrades for the drainage schemes described in Concept A are included in this concept.

Shoreline and Nearshore

The improvements for the shoreline and nearshore environment for Concept C are extensive and they are described from north to south:

- The Wheatley Harbour is upgraded to address the current and ongoing channel sedimentation problem. In addition, a bypassing program is developed with the cooperation of the harbour management, all levels of government and local stakeholders. The objective of the plan, once implemented, is to ensure 100% of the sediment supply from the north is transported in a southerly direction to the detailed study area;
- The existing erosion protection for the Pulley Road community is significantly upgraded in an attempt to meet provincial standards for erosion protection. However, given the close proximity of the Wheatley Harbour and uncertainties about the ultimate plan to mitigate the ongoing channel sedimentation problems (being studied by others), it is not possible to provide details for conceptual design alternatives at this time. For example, if the upgrades to the shoreline along Pulley Road included beach nourishment, the imported sand may actually exasperate the current sedimentation problems Wheatley Harbour (for the current situation). All existing buildings are protected from water related hazards associated with the 1% chance flooding event, regardless of the mitigation required;
- The Lakeshore / Cotterie / Elmdale Subdivisions are protected from shoreline erosion by a series of large headlands constructed of quarried armour stone. For this conceptual design, the structures are approximately 100 m in length and spaced 300 m apart. The beaches are pre-nourished and collectively the headland – beach system provides long-term protection from lakebed downcutting and shoreline erosion. All existing buildings are protected from the 1% chance flood regardless of the obstacles involved;
- Section 2.1.2 of the Provincial Policy Statement recommends that natural features should be maintained or restored to ensure that ecological function and biodiversity is maintained. With this general principle in mind, the ongoing shoreline recession and the associated loss of habitat is not sustainable for the Hillman Marsh or Point Pelee National Park. Therefore, the conceptual

engineering sketch for Concept C includes a series of four low crested offshore breakwaters and beach nourishment. These structures will reduce incoming wave energy during storms, encourage deposition and protect the lake bottom from further lakebed downcutting. The beaches are initially pre-filled with sand and gravel from upland sources or a borrow deposit in the lake. In the future, the reduction of incoming wave energy and the renewed supply of beach sand will help to promote dune regeneration along the barrier beach ridge;

- The East Beach and Marentette Beach communities are protected with a series of 100 m long headlands constructed of quarried armour stone. The tip of the structures will extend to approximately the 3.0 m depth contour (below Chart Datum, 173.5 m IGLD'85). The beaches are pre-nourished with sand and gravel from upland sources or a borrow deposit in the lake. All of the homes are protected from flooding hazards associated with the 1% chance flood and safe access is assured on all local roads by upgrading grades as required;
- In keeping with Section 2.1.2 of the Provincial Policy Statement, which recommends natural features be maintained or restored to protect biodiversity, the entire 8 km of barrier beach along the east side of Point Pelee National Park is protected. The conceptual sketch for Concept C (Appendix 6) includes a variety of low crested headlands (200 m in length) and low crested offshore breakwaters (also 200 m in length). The southern tip of the east shore is protected with a new "East Shoal", which is a submerged structure designed to stabilize the beach and lake bottom by covering the underlying clay material with sand and gravel. Also, the structure will not be connected to the shoreline, since it is desirable to allow some sediment to pass the shoal and re-nourish the sand spit at the southern limit of mainland Canada.

It must be stressed that the size, location and placement of the structures shown on the Concept C map in Appendix 6 are conceptual and for information purposes only. Although the objectives of the protection is clear, to reduce lakebed downcutting and stabilize the barrier beaches, the actual details of the structures are not known. They are more widely spaced and larger than the structures protecting the beach community since there is a higher threshold for beach and dune erosion during storms, followed by recovery periods during average and low lake levels. In fact, recent research on dune plant communities indicates that occasional disturbances, such as erosion during a high lake level period, actually promotes healthier dune communities in the long-term (Arens and Geelan, 2006). Also, there is a desire for some of the natural sediment supply from the north to migrate south along the shoreline and re-nourish the sand spit, which has been almost completely absent in recent years; and

- As discussed in Section 3.6 of the report, there are some outstanding questions about the sediment dynamics on the western side of the Point Pelee landform and the possible exchange of sediment between the beaches on the east and west side. If Concept C is the preferred alternative, some of these questions must be answered during the design phase of the coastal protection for Concept C. For example, if sediment transported in a southerly direction along the east coast

ultimately supplies the beaches along the western shores of the Point Pelee landform, as suggested by previous researches (Shaw, 1986), then is important to pre-fill the beaches between the proposed structures to their full capacity and ensure sediment will still bypass these structures naturally.

Natural Heritage

The new beaches re-built during the extensive beach nourishment project are one type of habitat creation for Concept C. This new habitat includes a sandy substrate in the shallow nearshore zone, a sand beach and in some of the unprotected areas, such as the barrier beaches at Hillman Marsh and PPNP, enhanced dune building through aeolian sediment transport (wind blown sand). In addition, the engineering structures, such as the proposed East Shoal and other headland/offshore structures will diversify the nearshore substrate by introducing sloping quarried armour stone structures, which provide habitat and cover in the form of interstitial spaces for small fish. Adjacent to the structures, the clay lakebed is replaced by sand and gravel deposits.

Currently, the detailed study area loses approximately 1.0 hectare (2.5 acres) of marsh and Carolinian Forest habitat every year. This loss will be eliminated with the proposed engineering structures and beach nourishment in Concept C.

The other enhancements described in Concept B (upgraded riparian corridors and a study to investigate ways to improve water quality in the National Park) are also included in Concept C.

New Economic Development, Recreation and Tourism Opportunities

Beach improvements along the barrier beaches at Hillman Marsh and Point Pelee National Park may expand recreational opportunities at these locations. They will certainly improve access and may even facilitate the creation of shoreline trails. Presently, much of the eastern side of the National Park is inaccessible to pedestrians.

Beach condition will be dramatically improved along the beach communities by providing safe access to the water's edge and a sand beach for recreation. With erosion, flooding and access addressed to levels that satisfy provincial standards, it may be possible for infilling and re-development of existing properties. This would be evaluated on a site by site basis. Improved conditions in the beach communities may attract additional service industries. Municipal tax revenues may follow this large investment in the shoreline.

Pros and Cons of the Strategy (benefits, disadvantages and costs)

The benefits and disadvantages of Concept C are described below:

- The degree of protection for the waterfront lots and second row development from erosion and flood hazards will be significantly improved. All ingress and egress roads will be accessible during flood conditions and other water-related hazards. The capital investment in these properties will be maintained and may increase in the future;
- Since the entire shoreline is significantly upgraded in Concept C, infilling and re-development may be possible. This would still be a site specific evaluation;
- In the long-term, the municipal property tax base may increase due to higher real estate values and/or additional infilling in locations that meet the requirements for development adjacent to hazardous lands;
- All existing land uses continue for Concept C;
- A stable shore on the east side of Point Pelee National Park and Hillman Marsh will reduce the current rate of habitat loss and improve opportunities for recreation and nature appreciation. These improvements could lead to increased visitation and the associated economic spin-offs for the local economy;
- One potential drawback of the shoreline protection and beach nourishment for Hillman Marsh and PPNP is the loss of the natural shoreline. In other words, shoreline recession is mitigated with engineering structures and beach nourishment, which will alter the character of the shoreline. It should be noted that the engineering structures would be designed to be as unobtrusive as possible for the natural areas;
- The cost of implementing the shoreline improvements of Concept C will be very large, as outlined in Section 6.5.2. This will be a significant disadvantage of this strategy;
- Obtaining the necessary regulatory approvals for the shoreline protection works in Concept C will be a significant undertaking and require federal and provincial environmental assessments; and
- As discussed for Concept A and B, the required drain maintenance and road upgrades will protect the private and public capital investments inside the drainage schemes and allow existing land uses to continue. The disadvantage of this component of Concept C is the cost, since it has been clearly stated the costs are not affordable for the existing landowners.

Implementation Issues

There are several significant implementation issues for Concept C. First, the farming community within the study area has indicated it cannot afford the dyke maintenance recommended in the Todgham & Case reports (2004 and 2006) without significant financial assistance from the government. Second, a significant provincial and federal environmental assessment would be required to obtain the necessary approvals for this large beach nourishment project and the engineering structures. There are only a few examples of other projects in the Great Lakes Basin of similar scope and size. And finally, significant funding assistance would be required to make this concept realistic and attainable, including contributions from landowners.

6.3.5 Concept D – Multi-Use Strategy

Key Features

There is presently a wide diversity of land uses within the study area. Concept D focuses on maintaining those land uses that are sustainable, while developing alternatives for the others that are not. For example, the Marentette Drain generates 73 % of the net returns for the four drains combined, features the highest net return per acre and yet has the lowest per acre cost to restore the dykes and drains to the conditions prior to the May 2004 rainfall event. In other words, it appears agriculture is profitable and viable in the long-term for the Marentette Drain (based on the economic assessment in Appendix 5). Assuming these profits are available, the land owners may be able to afford their portion of the dyke maintenance to reduce the flooding risks inside the drain. In the Lloyd and East Marsh Drains, the economic assessment completed for this study indicates these farms are only marginally profitable producing cash crops. Plus, the landowners have stated the recommended maintenance to repair these drainage systems following the May 2004 storm, as outlined by Todgham & Case (2004 and 2006), is not affordable. The Marentette drain landowners have also expressed this concern. Therefore, without significant financial contributions from government, agriculture in the East Marsh and Lloyd Drains is not sustainable in the future. And the risk of flooding damage and associated liability increases with time if the maintenance is not completed for the drainage system.

Therefore, for the interior drainage schemes, the Marentette Drain is upgraded for Concept D to protect the farms from flood hazards in the future and sustain vegetable production in the long-term. The long-term goal for the lands inside the East Marsh and Lloyd Drains is restoration back to natural habitat (the pre-settlement condition). Once restored, these two new natural areas compliment existing habitat in Point Pelee National Park and the Hillman Marsh Conservation Area.

For the flood-prone lands in the West Marsh and the adjacent Sturgeon Creek watershed, status quo land uses continue, however, complimentary land uses are encouraged to enhance the restoration initiative. The one exception to this general recommendation is the southeast corner of the West Marsh drain, bounded by Mersea Road D in the south and Mersea Road 19 in the east. The long-term objective for these lands is also restoration back to natural conditions, with the ultimate objective of re-establishing an environmental corridor between Hillman Marsh and Point Pelee National Park.

The restoration of the interior lands and the development of an environmental corridor between the two natural areas is a long-term goal of Strategy D and will require two distinct phases. Phase 1 is projected to last approximately 20 to 25 years and will still require upgrades to the drainage schemes. During this period, interior properties in the designated restoration area will be purchased when there is a willing seller. Phase 2 commences when all the properties have been acquired in the designated restoration area, the design is complete and all approvals are secured to convert the former farmland to a natural area. Refer to Appendix 6 for the Phase 1 and 2 maps for the Multi-Use strategy.

A variety of strategies was selected for the shoreline communities and natural areas south of Wheatley Harbour for Concept D. These strategies are also based on a long-term implementation period and follow the two proposed phases. They are described in the following sections.

Upgrades to the Wheatley Harbour are assumed to mitigate the ongoing channel sedimentation problems. Plus, a bypassing strategy is implemented to ensure the downdrift shoreline receives the full natural supply of sand and gravel.

Dykes, Drains and Roads – Phase 1

Since it is anticipated that Phase 1 will last 20 to 25 years, maintenance to the existing drainage schemes will still be required and all roads will be restored. The details are summarized below by drain:

- *East Marsh Drain:* The dyke along Mersea Road 1 adjacent to the Hillman Marsh is upgraded to provide flood and erosion protection that satisfies provincial standards for erosion and flood protection, as outlined in the 2006 Todgham & Case report. As noted earlier, this studied has identified a higher flood standard than the MNR report used in the Todgham & Case report. The road is repaired, re-surfaced and re-opened for access since it is a critical emergency ingress and egress route for the shoreline communities of East Beach and Marentette Beach during Phase 1 and possibly in Phase 2.

A detailed site inspection is required for the armour stone berm protecting the lakeshore dyke of the East Marsh. Following the inspection, which will identify locations of deficiencies in the protection, upgrades will be completed. This will

require re-working existing armour stone to ensure the stability of the structure and adding additional armour stone to ensure a consistent crest elevation;

- *Marentette Drain*: The long-term strategy for the Marentette Drain is the preservation of this unique and valued agricultural land. Road C is upgraded as outlined in the Todgham & Case report (2004) to provide flood protection. The southern dyke (Mersea Road E) must meet or exceed the 1% chance flood elevation (176.0 m, IGLD'85).

The southeast corner of the dyke protecting the Marentette Drain is extremely susceptible to erosion and breaches due to the rapid retreat of the northeast corner of the National Park barrier beach system. The risk of storm waves propagating over the beach and attacking the dyke is addressed with the shoreline protection structures discussed in the next section.

The shoreline protection structures maintained by the residents of the Marentette Beach community provide indirect protection to the north-south earth dyke that forms the eastern boundary of the drain. Therefore, a detailed site inspection is recommended to ensure there are no susceptible locations where storm erosion could break through the beach ridge and expose the earth dyke;

- *Lloyd Drain*: During Phase 1, it will be necessary to upgrade the Lloyd Drain as outlined by Todgham & Case (2004). Some maintenance was done during the summer of 2006 and this work would have to be evaluated in the context of the overall recommendations in the report. The southern dyke, which is south of Mersea Road E, must meet or exceed the 1% chance flood elevation;
- Mersea Road C between East Beach Road and Mersea Road 12 is designated as an ingress/egress route. As discussed for Concept A, additional study is required to determine the primary access road during flood conditions;
- Recommended upgrades to the pump houses of the four drainage schemes are implemented based on the ongoing evaluation (Stantec, 2006);
- Buffer strips along all drainage ditches are constructed in conjunction with any maintenance of the ditches, since the lack of a vegetated buffer contributes directly to sedimentation and reduced flow capacity in these canals;
- Additional wind breaks are recommended for the remaining muck soils to prevent further soil degradation but are not mandatory; and
- *West Marsh*: A Drainage Act study is completed to review the current conditions of the dykes and drainage capacity of the West Marsh Drainage Scheme. This would include the dykes along Mersea Road D, C, B, and 19.

Dykes, Drains and Roads – Phase 2

In Phase 2, the interior restoration is implemented for Concept D. The following points summarize the treatment of the existing dykes, drains and roads:

- *East Marsh Drain:* Mersea Road 1 continues to be an important access road for the beach community. Maintenance of this dyke is required in the future, however a dollar value is not included in this conceptual cost estimate.

Since the ultimate objective for the interior restoration in Concept D is the establishment of a viable environmental corridor between the two existing natural areas, a wildlife corridor will be required under the existing road.

The armour stone berm protecting the lakeshore dyke along East Beach Road must be monitored and maintained.

Mersea Road 19 between Mersea Road 1 and Mersea Road B is maintained. The dyke and existing road are protected from flood waters in the newly restored natural area by a large and wide earth dyke east of Mersea Road 19. It is anticipated that this dyke would be vegetated to create a native upland forest. This earth dyke may also facilitate the development of trails for horseback riding, biking and hiking.

A similar perimeter earth dyke would also be constructed north of Mersea Road C and possibly west of East Beach Road. The segment of Mersea Road 19 between Road B and C is removed to facilitate the development of the environmental corridor;

- *Marentette Drain:* The strategy for the Marentette Drain in Phase 2 remains unchanged. Agriculture continues and the drainage scheme is monitored and upgraded as required. This includes monitoring of the shoreline improvements to prevent storm waves from reaching the southeast corner of the drain.

A forested earth dyke is also used west of Mersea Road 19 to protect the Marentette Drain from potential flood waters in the restored natural area

- *Lloyd Drain:* In Phase 2, the southern dyke protecting the Lloyd drain is removed (all or segments) allowing for a natural connection between Point Pelee National Park and the newly restored areas to the north and northeast.

An earth dyke is used to protect Point Pelee Drive and Mersea Road D from the newly restored natural area. Mersea Road D is terminated at the boundary to the natural area and could be used as an access point to trails and interpretive centres. It is recognized that it may be necessary to construct a connecting road between Mersea Road D and C; and

- *West Marsh:* The West Marsh scheme continues to service the drainage requirements of agriculture in Phase 2. Monitoring and maintenance is completed as required. The southeast corner of the scheme is protected from the new environmental corridor by a north-south earth dyke between Mersea Roads B and D. Refer to the Phase 2 map for Concept D for additional details (Appendix 6).

Shoreline and Nearshore – Phase 1

A variety of treatments are proposed for Phase 1 between the Wheatley Harbour and the tip of the National Park. They are described below:

- Improvements are assumed for the Wheatley Harbour navigation channel and a bypassing program is developed and implemented, as with Concept B and C. The full natural supply of sand and gravel from the north is transported south of the harbour;
- *Pulley Road*: There are a total of 37 waterfront lots along Pulley Road (east of the road). A total of 6 are vacant. The average lot depth is 31 m and the average house setback from the top of the shore protection is 10 m. There are a total of 50 lots on the west side of Pulley Road and 12 are vacant.

The provincial policy for erosion hazard setbacks was discussed earlier in Section 6.0 and a generic calculation determined that a proposed building would require a 56 m setback from well engineered shoreline protection. Based on the lot dimensions in the above paragraph, none of the Pulley Road lots can meet the protection works and erosion setbacks.

Therefore, since future development will not be possible, it is recommended that the lakefront lots along Pulley Road (east of road) be purchased when they become available in Phase 1. Ultimately, this stretch of shoreline would be converted into a green space or park for the local community. The homes would be removed and the existing shoreline protection re-worked to provide adequate protection to the road, which must continue to service the properties on the west side.

- *Lakeshore / Cotterie Road*: There are approximately 58 waterfront lots along Lakeshore / Cotterie. Approximately 12 are vacant. The average lot depth is 46 m and the average house setback from the top of the shore protection is 17 m. There are a total of 74 lots on the west side of Lakeshore / Cotterie and 24 are vacant.

Although the average lot depth is greater than the conditions along Pulley Road, it is still very unlikely any of these lots would satisfy the provincial erosion standard for re-development. Therefore, it is recommended the waterfront lots along Lakeshore and Cotterie be purchased in Phase 1 when they become available. Ultimately, these lands would be converted into a park or green space. The homes would be removed

- *Elmdale Subdivision*: There are a total of 29 parcels in the Elmdale Subdivision. Elevation data along the road (supplied by ERCA) indicates some sections of this subdivision are located below the 1% chance flood elevation of 176.0 m, IGLD'85. Shoreline erosion is severe. Based on these facts, it is recommended

these parcels be purchased when they become available in Phase 1. Ultimately, once all the residential parcels are purchased, the lands are restored to either a natural area or public green space.

- *Hillman Marsh Barrier Beach:* The Hillman Marsh barrier beach is protected with a series of offshore breakwaters and beach nourishment, as described in Concept B and C;
- *East Beach:* There are a total of 72 parcels along east beach and approximately 58 homes. The existing East Beach armour stone berm protects the lakeshore dyke from erosion and overtopping during severe storm events on Lake Erie. It is part of the East Marsh drainage works. However, Section 3.0 of this report has shown that the lakebed continues to erode and eventually this erosion will undermine the armour stone dyke. Recognizing that the lakeshore dyke is an integral part of Phase 1 and 2 for Concept D, a series of short headlands (30 m in length) are constructed between the Hillman Marsh and Marentette Beach and nourished with sand and gravel from upland sources or a borrow deposition in Lake Erie.

The benefits of this protection are twofold. First, the protection will enhance the existing beach conditions in the area and improve access to the waters edge for landowners. Second, the small headlands and beach nourishment will provide partial protection from future lakebed downcutting and will reduce future threats to the lakeshore dyke and existing berm. This dyke is important for the long-term restoration of the East Marsh, since without the dyke the entire interior would be flooded and not represent valuable wetland habitat.

- *Marentette Beach:* There are a total of 96 parcels along Marentette Beach and approximately 51 homes or dwellings. The long-term trend for the shoreline is erosion and the lake bottom is eroding. In the short term, the shore parallel protection is capable of mitigating shoreline erosion hazards. However, in the long-term, lakebed downcutting will continue and eventually undermine the shore protection, leading to a failure.

Although the Marentette Beach community is not located on top of the east dyke for the Marentette Drain, the existing shoreline protection structures along the shore do provide some degree of protection for this dyke and drainage system. In other words, without the beach community and the ongoing maintenance of the existing shoreline protection, the beach would be extremely susceptible to a breach during storm conditions, which could threaten the easterly earth dyke of the Marentette drain.

Therefore, given the existing threats to the beach community and the desire to sustain agricultural production in the Marentette Drain, Concept D proposes to build a continuous series of short armour stone headlands nourished with sand and gravel. This protection will serve the dual purpose of enhancing beach

conditions for the shoreline residents and protecting the shoreline from further lakebed downcutting and erosion. This investment in the shoreline protection will help protect the existing capital in the residential community and provide a first line of defence for the easterly dyke of the Marentette Drain.

- *Northeast Corner of PPNP*: It is critical to address the erosion problem in the northeast corner of the Point Pelee National Park for Concept D. The same treatment described in Concept B is utilized for this strategy.
- *Central and Southern PPNP*: Since Concept D will restore approximately 916 hectares of former marsh in the Lloyd, East Marsh and a portion of the West Marsh drainage schemes, a significant capital investment will not be made in engineering structures to stop shoreline erosion along the central shore of the National Park. Plus, improvements in sediment management at Wheatley Harbour combined with the 4,600 m³ of annual beach nourishment should reduce the long-term recession rate along the park.
- *Southern Carolinian Zone of PPNP*: The southern three kilometres along the east shore of Point Pelee National Park feature Carolinian Forest and it is eroding at approximately 1.0 m per year. To protect this critical habitat, a series of four low crested headlands or shoals are constructed perpendicular to the shoreline. The structures will extend approximately 200 m into the lake.

Natural Heritage

In Phase 1, three vulnerable shoreline erosion locations, namely Hillman Marsh barrier beach, the northeast corner of Point Pelee National Park and the southeast Carolinian Forest are protected with low crested offshore and shore perpendicular structures. These engineering structures will maintain existing marsh habitat and help maintain the native biodiversity of the natural areas.

During Phase 1, property is purchased in the restoration zone, which features approximately 916 hectares of existing agricultural land and rural residential development. In Phase 2, which may not commence for 20 to 25 years, the former agricultural lands are restored to wetlands that feature a diversity of habitat, including deep open water, shallow zones of emergent vegetation, meadows, savannahs, swamps, wet forests and upland forests.

In addition, this restoration will create an environmental corridor between Point Pelee National Park and Hillman Marsh to connect the two large habitat fragments. A wildlife corridor will be required under Dyke Road and Mersea Road C.

New Economic Development, Recreation and Tourism Opportunities

The Multi-Use strategy will develop numerous opportunities for future economic development in support of the new natural area between PPNP and Hillman Marsh. For example, expanded visitation to this newly created natural area may ultimately require additional services, such as food and lodgings. The western portion of the Lloyd Drain has been designated as an economic development zone but in reality, this type of zoning may be applicable in multiple areas for Concept D.

Expanded uses in the new natural area could include horseback riding, walking trails and bike trails, nature interpretation, birding, canoeing, kayaking, hunting, fishing, along with an excellent opportunity to study and document the wetland habitat succession for the newly restored lands. The green space between Wheatley Harbour and the Hillman Marsh will provide a public window to the lake for the entire community. Trails (walking, biking, skating) would be ideally suited to this long narrow green space.

Pros and Cons of the Strategy (benefits, disadvantages and costs)

The Multi-use strategy has numerous short term and long-term benefits for the detailed study area. There are also disadvantages and costs associated with the many elements. The pros and cons of Concept D are summarized below:

- Wheatley Harbour is upgraded and a bypassing program is implemented;
- A long-term strategy of land acquisition is implemented for the waterfront lots between Wheatley Harbour and the Hillman Marsh. The resultant lands will be converted to green space for the entire community to enjoy. Plus, the shoreline protection can be managed to ensure the road and existing services to the second row parcels are protected. Some land owners may look at this as an opportunity to liquidate the capital invested in their properties, while others will not want to leave. The properties will be purchased when there is a willing seller;
- Three vulnerable areas of shoreline erosion, Hillman Marsh barrier beach, and the northeast and southeast segments of the National Park will be protected with low crested engineering structures and beach fill;
- The communities of East Beach and Marentette Beach will be protected with a series of consecutive 30 m headlands (in length) and beach nourishment. These structures will provide additional protection from lakebed downcutting and shoreline erosion. The beach communities will be enhanced and they will

continue to be the first line of defence against erosion threats to the lakeshore dykes of these two drains.

Although these structures and beach nourishment represent a significant investment in shoreline protection, given the very shallow lot depths, it is not anticipated the protection will be sufficient to satisfy the requirements of the erosion hazard setback in the provincial policy. Therefore, additional infilling and re-development will likely not be permitted along the shoreline for Concept D. However, this would be a site by site evaluation, as the information provided in this report is for general planning purposes.

There will however, be a significant reduction in existing erosion and flooding threats to buildings and infrastructure. Improved access to the waters edge will be provided by the beach nourishment and the overall enjoyment from these lakeshore properties should increase.

If flooding and erosion hazards reach a point where the development along the lake is no longer safe or affordable, these properties could be purchased from willing sellers. Ultimately, the beach between the Hillman Marsh and Point Pelee National Park could be naturalized with sand dunes and pioneer species such as poplars, dogwoods and other native shrubs. The time frame for such naturalization is unknown.

- The dykes and ditches protecting the Marentette Drain are upgraded to facilitate the continuation of vegetable production in the future, both in Phase 1 and 2. Presently, the drain produces 73% of the net profits for all of the four drains combined and this valuable economic input to the local economy will continue;
- Agriculture is not sustainable without government subsidies in the Lloyd and East Marsh drains. Therefore, over multiple decades these lands are purchased from willing sellers to support the restoration of wetland habitat. Phase 1 is anticipated to take 20 to 25 years. For those landowners interested in liquidating their property, it could be done in the short term and they may even avoid their share of the required drainage maintenance. Conversely, those land owners who want to continue farming or maintaining their rural properties, can continue to live in the drain for several decades;
- Naturalizing the Lloyd and East Marsh will break the cycle of capital investments in unsustainable agriculture. It will also absolve the Municipality of Leamington of it's commitment to a portion of the drainage maintenance;
- Concept D provides a long-term strategy for the restoration of approximately 916 hectares of wetland habitat and the connection of two critically important habitat fragments. This is an enormous opportunity to protect and enhance existing native biodiversity in the detailed study area with the creation of an environmental corridor;

- The restoration of interior agricultural lands, and to a lesser degree, the stabilization of the shoreline communities in East Beach and Marentette Beach will generate additional economic development opportunities in the future. There is also great potential for human uses in this future natural area, including trails, nature interpretation, water sports, angling, and hunting. Zoning for future economic development would be part of developing the master plan for the restoration; and
- Obtaining the necessary regulatory approvals for the shoreline protection works in Concept C will be a significant undertaking and require federal and provincial environmental assessments.

Implementation Issues

Although Concept D has an enormous potential to generate short and long-term benefits for the community and region, there are also many implementation issues, including:

- Cost. This will be an expensive concept, however, many of the costs are phased in over a two decade period. Significant funding partners will be required;
- Concept D will require land purchases from willing sellers. The phased approach to Concept D gives existing land owners several decades of continued use, if they choose;
- A management structure is required for the newly created natural area between Hillman and PPNP;
- Upgrades to the drainage schemes are still required in the short term and many landowners have expressed concern over the magnitude of the costs;
- Shoreline improvements to the residential communities along the lake may require cost sharing between the owners and government; and
- Funding and a management structure are required for the properties along the waterfront between Wheatley Harbour and the Hillman Marsh (east side of the road only).

6.4 Previously Considered Management Strategies

In order to consider the full range of possibilities for future management strategies in the detailed study area, several other concepts were initially developed and evaluated for benefits and costs. These concepts are named E through H, and described briefly below. Maps of these concepts will be provided at a later date. All of these draft concepts failed one or more of the initial screening alternatives and thus were not pursued for additional development.

6.4.1 Concept E – Beach Nourishment Strategy

Key Features of Strategy

The focus of Concept E is the shoreline communities between Wheatley Harbour and Point Pelee National Park. The concept involves one very large beach nourishment project. Improvements in sand management at the Wheatley Harbour are implemented. Upgrades are completed on the dykes, drains, pumps and roads, and provision is made for their future maintenance. All existing land uses continue. There is no new wetland habitat created, however, enhancements to existing habitat is achieved through continued management of the natural areas.

6.4.2 Concept F – Naturalization Strategy

Key Features

In Concept F all flood prone lands south of Wheatley Harbour are restored to their pre-settlement condition (i.e. flooded and returned to a natural state). This includes the beach communities and the agricultural lands within the East Marsh, West Marsh, Marentette Drain and Lloyd Drain.

This is a very large project. First a collaborative management structure must be developed and funds secured to purchase all of the property. Then, the majority of the existing infrastructure, such as buildings, roads, and utilities must be removed. The habitat restoration must be planned, designed and all necessary approvals secured. This would require a very large environmental assessment.

6.4.3 Concept G – Interior Restoration Strategy

Key Features

Concept G is a variation of F. The principal difference is the plan for the shoreline communities between Wheatley Harbour and Point Pelee National Park. In G, these communities remain as part of the restoration plan for Southeast Leamington. Socially, these communities have a long settlement history and are valued by their residents. Economically, the properties generate tax revenue for the Municipality of Leamington and the riparian shore protection also protects the lakeshore dyke.

The interior lands of the four drainage schemes are naturalized and two routes are maintained (Mersea Road 1 and Mersea Road C) to facilitate access between the beach communities and Leamington. The restored lands in the present drains are connected to the existing habitat at Point Pelee and Hillman Marsh.

6.4.4 Concept H – Phased Interior Restoration Strategy

Key Features

Concept H is also a hybrid of F. The ultimate goal is the full restoration of the interior flood prone lands between Hillman Marsh and Point Pelee National Park. However, recognizing the complexities of such a project and the many obstacles, this concept adopts a phased approach. Initially, the restoration would target one or both of the East Marsh and Lloyd Drains. The shoreline communities are maintained and accessed via Mersea Road 1 and Mersea Road C.

6.5 Evaluation of Draft Sustainable Management Strategies

The four draft sustainable management strategies are evaluated in Section 6.5. ‘Do Nothing’ is also evaluated to establish a baseline for the benefits generated by each concept. The concepts that failed the initial screening criteria were not evaluated (Section 6.4).

6.5.1 Expected Benefits

Table 6.4 summarizes the results of the benefits analysis. For each draft strategy and the Do Nothing scenario, the individual criteria are ranked from 0 to 10. If the strategy provides no support for the objective, it receives 0. Conversely, if the strategy provides major support for the benefit category, it receives a 10.

Consider the first Resource/Environmental benefit: “Mitigates/reduces shoreline erosion threats to buildings and infrastructure”. The Do Nothing scenario provides no support for this objective, since nothing is done to reduce existing hazards and thus it receives a score of 0. Concept C upgrades all the flood and erosion protection in the detailed study area in an attempt to meet the full provincial standard and thus receives a score of 10 for this objective.

Since there are 24 benefit categories, the maximum score is 240. The Do Nothing scenario received a score of 15. Concept A Status Quo received a score of 58. Community Based Flood and Erosion Protection for Concept C received 104. Concept C Provincial Standards and Concept D Multi-use Strategy featured the two highest scores, 146 and 181 respectively. The total scores are summarized in Table 6.4 and presented graphically in Figure 6.3 for reference.

The results are further analyzed in Figure 6.4, where the scores are aggregated for the three benefit categories, resource/environmental, economic and social. Focusing on Concepts C and D, some interesting trends emerge. Both Concepts score similar ratings for economic and social benefits, with the combined score of 109 for Concept C and 111 for Concept D. However, when the results for resource/environmental benefits are assessed, the rating for Concept D is almost twice as high as Concept C (70 versus 37). When the individual scores in Table 6.4 are re-assessed, it can be seen that Concept C scores very low on the benefits associated with biodiversity, new habitat, natural connections and support for other resource management plans.

In summary, Concepts C and D score very similar ratings for economic and social benefits, however, Concept D Multi-use scores significantly higher in the resource/environmental benefits. Concept D also has the highest combined score of 181 versus 146 for Concept C. Overall, Concept D will generate the most benefits and is well balanced in all aspects of sustainable management.

Table 6.4 Evaluation of Expected Benefits for Sustainable Management Strategies

Southeast Leamington Sustainable Management Strategy Concepts Evaluation of Benefits - For those Concepts that Support the Criteria – Rate the Extent to which it Supports the Criteria Using a Scale of 0 – 10 Note: 0 is No support; 1 is minimal support and 10 is major support.					
	Concept				
	Do Nothing	A - Status Quo	B - Community Based Prot.	C - Prov. Standards	D - Multi-Use Strategy
a) Resource/Environmental Benefits					
Mitigates/reduces shoreline erosion threats to buildings and infrastructure	0	0	6	10	8
Natural beach building processes enhanced	0	0	6	10	8
Buildings and infrastructure protected from 1% chance flood	0	0	10	10	10
Biodiversity enhanced following implementation	0	0	1	2	8
New habitat created in the detailed study area	0	0	1	3	8
Human access/connections between natural areas improved	0	0	1	2	10
Natural/physical connections between natural areas improved	0	0	0	0	10
Supports other local/regional sustainable management plans	0	0	0	0	8
b) Economic Benefits					
Protects sustainable public infrastructure and utility assets	0	5	7	10	8
Protects sustainable private property, buildings and fixed assets	0	5	7	10	8
Strategy reduces future cost liability for landowners and government	0	2	4	6	8
Creates more business opportunities for current businesses	0	0	1	5	6
Creates new business opportunities not currently in existence	0	0	0	3	6
Municipal tax base maintained or improved	5	5	6	7	4
Funding for strategy is enhanced due to concept components	0	0	0	2	8
Property values should rise due to strategy implementation	0	2	3	6	5
c) Social Benefits					
Personal safety from flooding/erosion hazards improved	0	5	7	10	8
Unsustainable land uses curtailed	0	0	1	1	8
Sustainable development and land uses remain		5	8	8	8
Native biodiversity is preserved for present and future generations	0	0	1	2	10
Improve accessibility and safety to existing road system	0	8	8	10	5
Ingress/egress safety assured during major storm events	0	6	8	10	8
Plan does not displace current landowners	10	10	10	10	5
Hazards reduced/eliminated allowing current lifestyles to continue	0	5	8	9	6
Total Benefits Ratings	15	58	104	146	181

Total Rating of Benefits for Draft Strategies

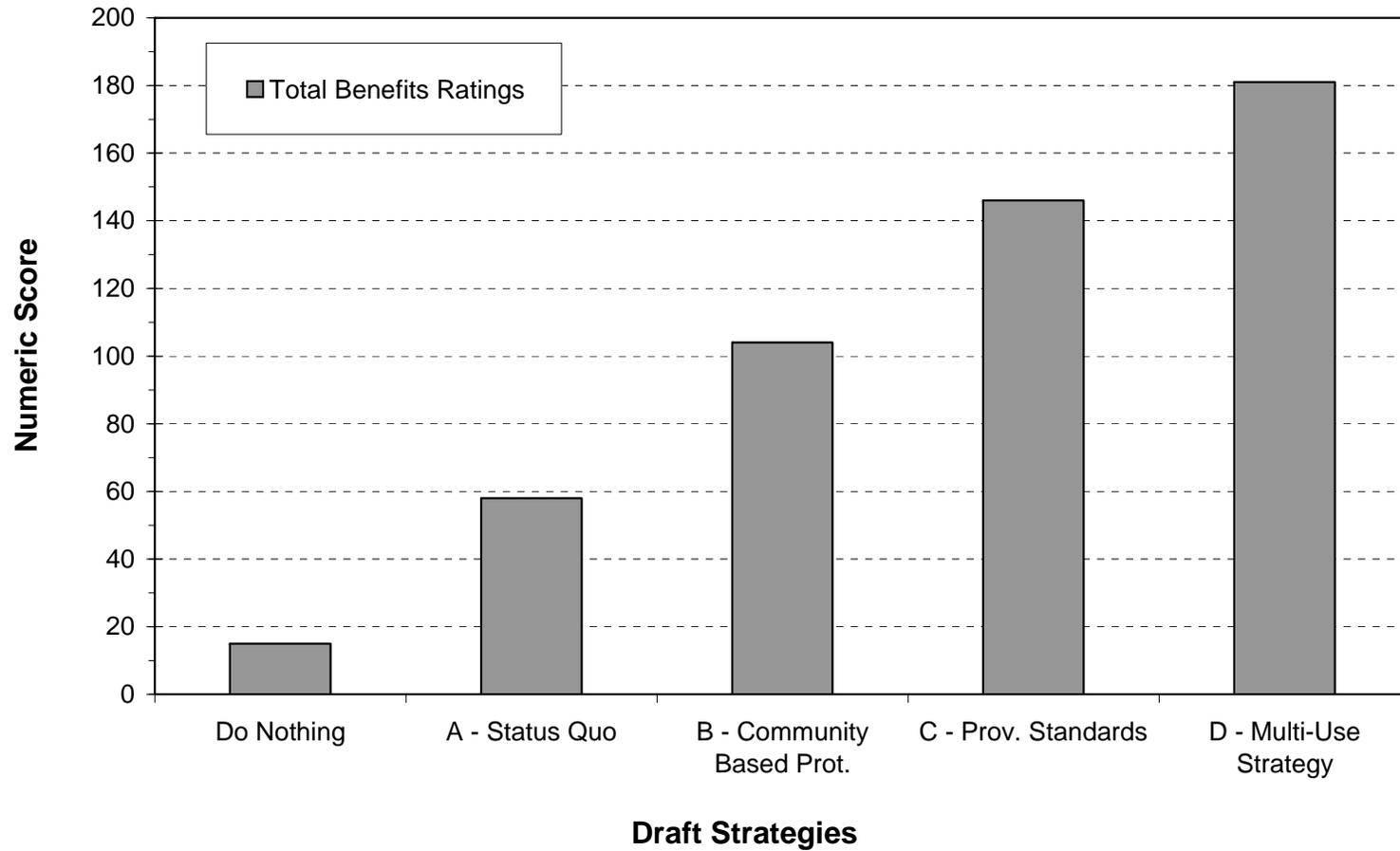


Figure 6.3 Evaluation of Expected Benefits for Sustainable Management Strategies

Expected Benefits by Category for Draft Strategies

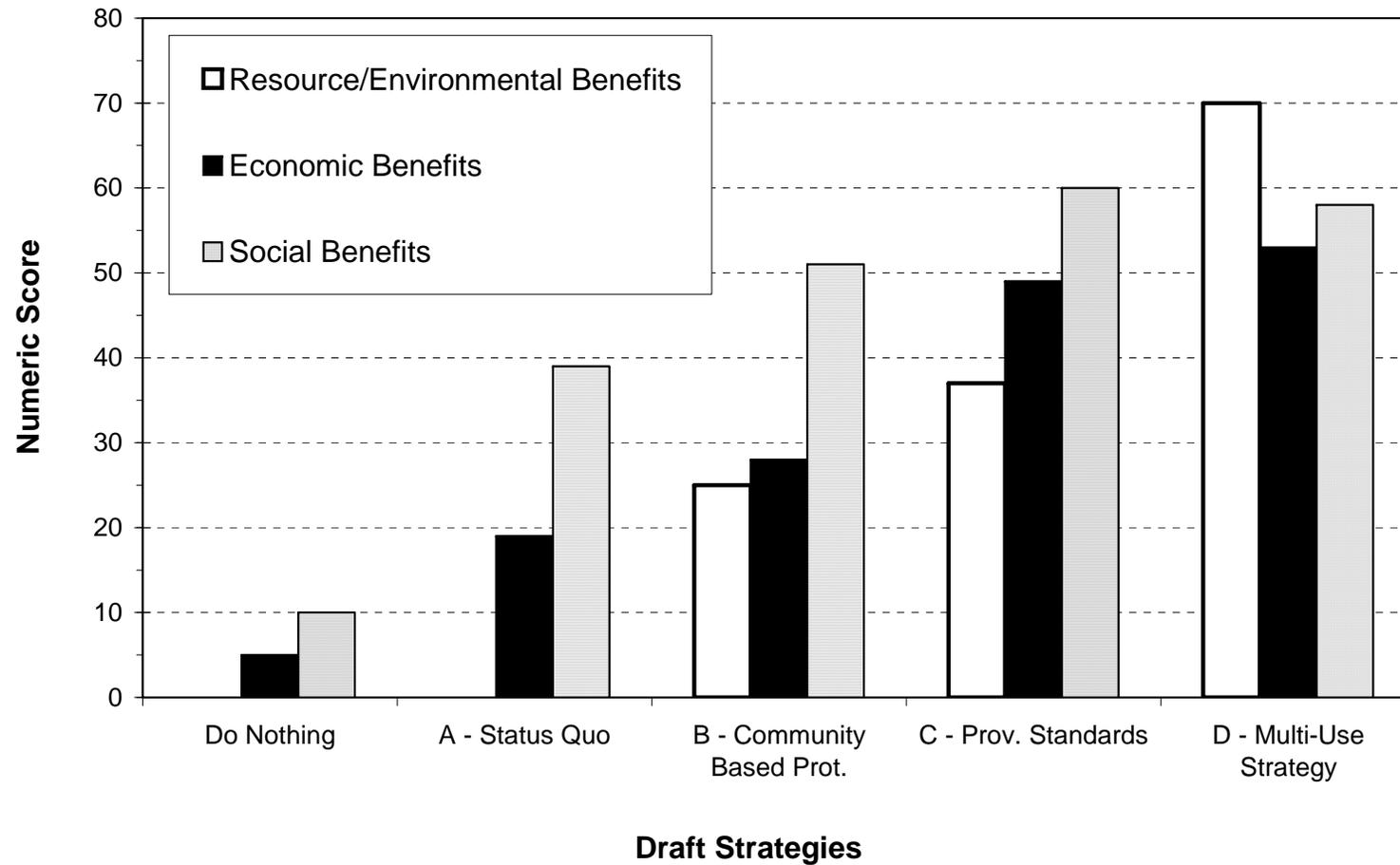


Figure 6.4 Expected Benefits by Category for Draft Sustainable Management Strategies

6.5.2 Order of Magnitude Costs for Draft Strategies

Order of magnitude costs have been prepared for the four draft scenarios. The cost estimate plus a 25% contingency is presented graphically in Figure 6.5. The contingency provides an allowance for items not yet considered. Future costs, such as construction works that will occur in the future (20+ years in the future) are discounted to present value using the Bank of Canada target interest rate as of December 1, 2006 (4.25%).

The total cost for Concept D, which ranked the highest in the benefits analysis, is \$118 million. Concept C, which ranked second in the benefits analysis, is \$183 million.

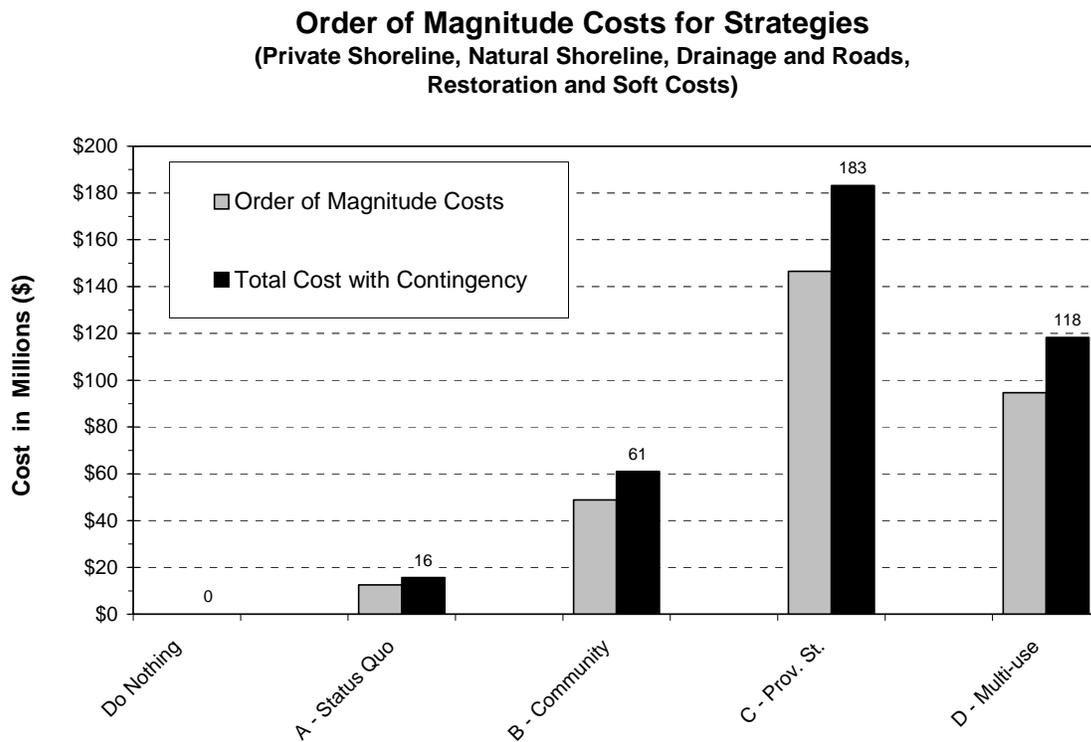


Figure 6.5 Order of Magnitude Costs for Draft Strategies (future costs discounted to PV)

These order of magnitude costs were sub-divided into five categories: private shoreline protection, natural shoreline protection, drainage works and roads, habitat restoration and soft costs (design, approvals, administration and construction management). The results are presented in Figure 6.6. The 25% contingency was added to each category. Concept D has a balance of expenditures, while Concept C is focused heavily on shoreline protection for the private and natural shoreline.

Order of Magnitude Costs for Strategies (Breakdown by Category)

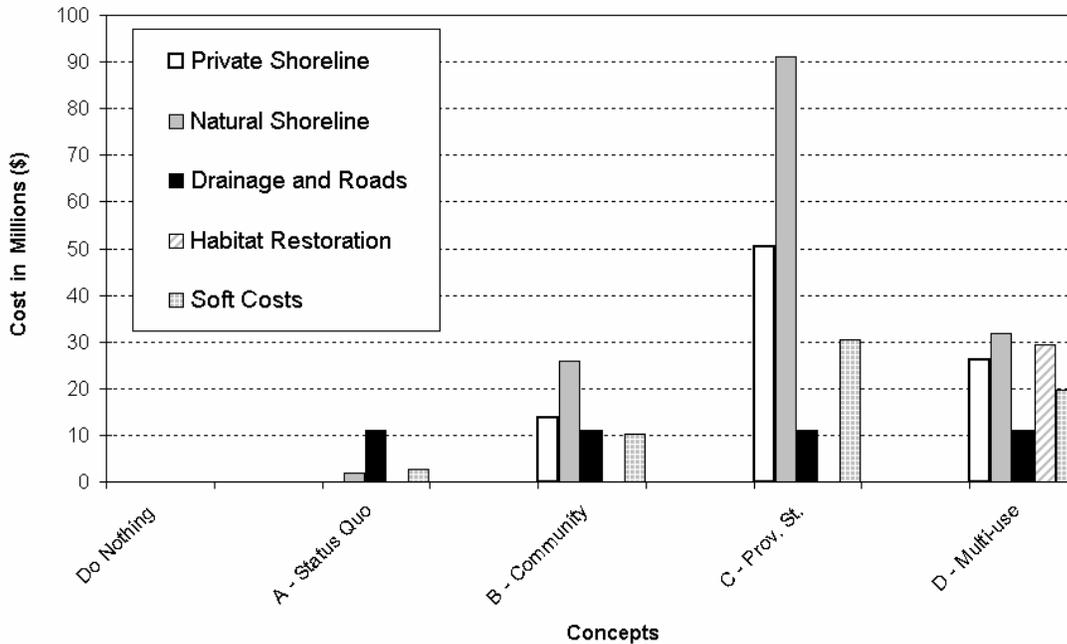


Figure 6.6 Preliminary Opinion of Cost by Category (categories in legend are listed in bar chart from left to right)

The following list includes items not included in the order of magnitude cost estimate:

- Operation and maintenance;
- Management of new natural areas and green spaces;
- Monitoring during and after construction;
- Future maintenance of shore protection, flood proofing, drainage scheme components and roads;
- Pump house maintenance if required for drainage schemes; and
- Vegetation for restoration in Concept D. Presently, only grading is included.

6.6 Guidelines for Shoreline Protection

Some initial guidelines for the design of shoreline protection structures in the detailed study area are provided below. These guidelines do not replace professional engineering experience. All shoreline owners are encouraged to retain the service of an experienced professional engineer to design shoreline protection upgrades and new structures.

6.6.1 Design Water Levels

The 100 year peak instantaneous water level or 1% chance flood level is 176.0 m.

6.6.2 Design Wave Height

A peak over threshold extreme value analysis was completed for point 12837, which was located offshore of the Hillman March at the 14.0 m contour depth (below Chart Datum). The application, which was developed by Baird, estimates extreme wave heights by return period. Refer to Table 6.5. Point 12837 corresponds to a location on the WAVAD model grid. Time series wave information at 12837 was generated from 1986 to 2005. Refer to Section 2.1.5 of this report for additional details.

The application was recently applied to the non-direction wave height data from 1980 to 2006 collected by the National Data Buoy Center for a location offshore of Point Pelee. The return period wave heights were found to be very similar (Baird, 2005) to the results in Table 6.5. It should be noted that 20 years of input data were utilized to complete the analysis, therefore, the predictions for years 50 and 100 should be used with caution since the data record was considerably shorter than these temporal periods.

Table 6.5 Offshore Wave Heights by Return Period (14.2 m depth below chart datum)

2 Year	5 Year	10 Year	20 Year	25 Year	50 Year	100 Year
3.05	3.27	3.42	3.58	3.63	3.78	3.93

6.6.3 Design Criteria for a Typical Revetment

Armour stone revetments are used extensively along the eroding shorelines of the Great Lakes. The sloping nature of the structure helps to dissipate incoming wave energy and generally results in less toe scour than a vertical structure, such as a seawall. A typical sketch of a two layer quarried stone revetment is presented in Figure 6.7. A series of design parameters are listed below for consideration when completing a site specific engineering investigation. It must be stressed that these are not design parameters for the

detailed study area, rather a guide to the type of considerations for a site specific investigation by a qualified engineer.

Design Water Level (DWL): Site specific; for example 176.0 m

Toe Depth: Site specific and depends on actual conditions; for example 173.5 m

Design Water Depth: Sum of Toe Depth and DWL; for example 2.5 m

Return Period for Wave Height: Varies; assume 25 year return period

Design Wave Height (m): Based on return period; for example 3.63 m

Crest Height (m): DWL plus lesser of $(0.78 * DWD = 1.95)$ or $(DWH = 3.63)$. In this example, 1.95 m would be selected; example crest is 177.95 m

Size of Armour Stone: Based on Hudson's Equation (Shore Protection Manual)

Size of Filter Stone: Based on armour stone size

Toe Scour Protection: Equal to two times the breaking wave height. In this example, $2(0.78 * 3.63 \text{ m}) = 5.66 \text{ m}$ in width from the toe of the structure

Slope of Structure: 2:1 or 1.5:1 (V:H), design detail

Geotextile Filter Fabric: Required, details site specific. Must be puncture resistant for filter stone

Crest Terminal Details: Site specific but sufficient to mitigate wave overtopping forces for the proposed structure and integrate with the adjacent grades

Termination Details: Site specific but must address flanking erosion at property boundaries and adjacent conditions

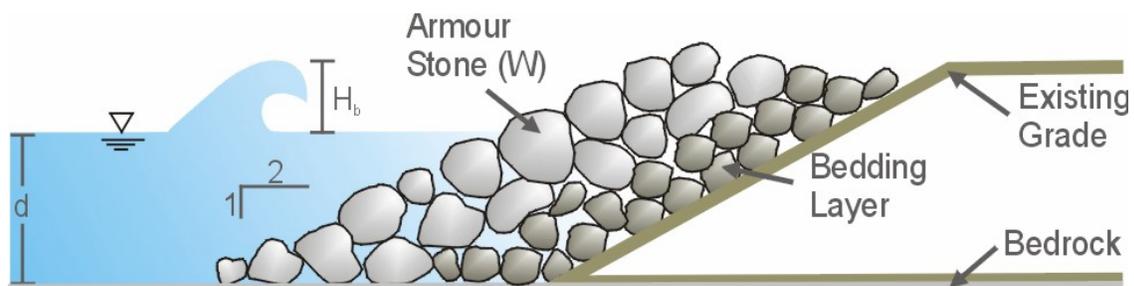


Figure 6.7 Typical Revetment

6.6.4 Other Types of Shore Protection

Other types of shore protection are described in Section 6.6.4, including examples identified by residents of the shoreline community.

Vertical Walls

Vertical walls can be constructed of a variety of materials, including concrete and sheet steel. The structures generally feature a vertical face and flat crest, as seen in the typical example in Figure 6.8. The vertical face results in strong wave reflections and undertow which accelerates toe scour. Given the severe downcutting rates identified along the entire detailed study area, this type of shore protection is not recommended.

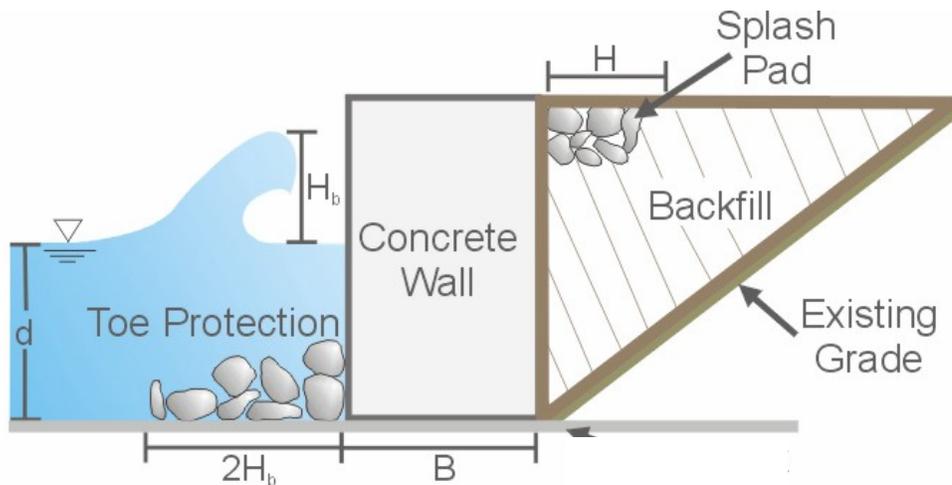


Figure 6.8 Vertical Concrete Wall

WhisprWave Modules – Wave Dispersion Technologies

These structures will not function in the energetic Lake Erie environment. They are only suited to sheltered environments. The design wave heights summarized in Table 6.5 would exceed the capacity of this system. Plus, they would not trap sediment.

Undercurrent Stabilizers – Holmberg Technologies

We do not consider this system a legitimate design option for Lake Erie and the local site conditions.

ADDITIONAL REFERENCES

- Arens, S.M. and Geelen, L.H.W.T., 2006. Dune Landscape Rejuvenation by Intended Destabilisation is the Amsterdam Water Supply Dunes. *Journal of Coastal Research*, 22-5, p.1094-1107.
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