



Shoreline Management Plan 2019

Ausable Bayfield Conservation Authority

February 28, 2019

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12646.201

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
Rev A	2018 10 26	Working Draft	To ABCA	FJLD		FJLD
Rev B	2018 11 08	Draft	To ABCA	FJLD	MOK	FJLD
Rev C	2018 11 14	Draft	To ABCA	FJLD	MOK	FJLD
Rev 0	2018 11 27	Draft	For Public Review	FJLD	MOK	FJLD
Rev 1	2019 02 27	Final		FJLD	MOK	FJLD
Rev 2	2019 02 28	Final		FJLD	MOK	FJLD

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Executive Summary

This report updates the Ausable Bayfield Conservation Authority *Shoreline Management Plan*, last updated in 2000. It builds upon and references previous technical studies prepared for the Ausable Bayfield Conservation Authority (ABCA). The report was prepared jointly by the ABCA and Baird & Associates; the *Development Guidelines 2019* (included in Appendix F) were developed by the ABCA and the Planning Group.

Why has the Shoreline Management Plan been updated?

Since the *Shoreline Management Plan* was last updated in 2000, there have been changes to the *Provincial Policy Statement (PPS)*, last updated in 2014 and to the regulations that stipulate how the hazardous lands are defined. The *Technical Guide for Great Lakes – St. Lawrence River System* (MNR, 2001a), which provides the technical basis and procedures for establishing the hazard limits for flooding, erosion, and dynamic beaches in Ontario as well as options for addressing the hazards was issued after the last *Shoreline Management Plan* was developed.

In addition, land use along the shore has changed substantially since the last *Shoreline Management Plan* was developed. Many residences that were previously used seasonally, are now occupied full time. Housing has also changed substantially. While the option to move houses away from the hazard may have been reasonable at that time, newer houses are often larger and much more difficult to move.

Mandate and Objectives

In implementing its duties as the lead provincial agency with respect to shoreline erosion, flooding and dynamic beach hazards the ABCA is guided by Cabinet approved provincial policy and objectives and by the provincial *Technical Guide* (MNR, 2001a). Provincial and ABCA goals are to minimize risks to life, property damage and social disruption and to encourage an integrated approach to shoreline management.

In promoting responsible management of the shoreline, the ABCA will be guided in all of its actions to ensure that:

- No new hazards are created.
- Existing hazards are not aggravated.
- No adverse environmental impacts result.

These three requirements are mandated by the Province and the policies in this *Shoreline Management Plan 2019* are premised on the need to ensure these three conditions are met.

ABCA Shoreline

The ABCA shoreline is located on the southeast shore of Lake Huron in the Province of Ontario. The ABCA's jurisdiction extends from Lot 30, Concession 1, in the former Goderich Township, in the Municipality of Central Huron at the northern limit, throughout the Municipality of Bluewater and the Municipality of South Huron, to the southerly limit within the Municipality of Lambton Shores at the community of Port Franks.

The ABCA shoreline is divided into a northern section, north of Maple Gove subdivision, characterized by cohesive till bluffs, up to 18 m in height, fronted by narrow beaches of mixed sand and gravel. The shoreline

south of Maple Grove subdivision is characterized by sandy beaches and dune systems. The northern section is largely erosional and supplies sediment to the southern shoreline which is largely depositional. The shoreline hazards along these two stretches of shoreline differ, as do the concerns of property owners and users of the shoreline.

Approach to Shoreline Management

The shoreline management approach presented, addresses both existing and future development along the ABCA shoreline. The management approach reflects the changing nature of the Provincial Policy since the shoreline was first developed and since the ABCA's first iteration of the *Shoreline Management Plan*. The overall philosophy and approach is premised on a philosophy and practice of balanced management.

The shoreline management approach recognizes existing structures located in the erosion, flooding and dynamic beach hazard limits, and advocates for responsible management along the entire ABCA shoreline. This requires a strategic approach that looks to eliminate the risk to human life and property damage over time by ensuring that buildings and structures are located outside of the hazard. This approach is one that is upheld by existing Provincial Policy, supported by legislation and the mandate assigned to conservation authorities and confirmed in existing municipal planning documents.

The approach and overall philosophy support:

1. A clear science-based approach and commitment to ongoing monitoring and identification of hazards.
2. A prevention-first philosophy that will, over time, reduce the risk to natural hazards by encouraging the location of proposed development outside of areas subject to erosion, flooding and dynamic beach hazards.
3. A move, over a period of time, towards clearer consistency with the Provincial Policy.

The management approach focuses on the importance of engaging landowners and working with municipal partners to ensure that there is clarity, consistency, certainty and collaboration moving forward. It is premised on the need to recognize the changing nature of the shoreline and the need to advance a responsible management approach that ensures the shoreline remains accessible, ecologically intact, enjoyable and safe for all.

Updated Development Guidelines 2019

A Planning Group was formed with representatives from the lakeshore counties and municipalities and neighbouring conservation authorities to update the *Development Guidelines* (ABCA, 2000) as part of the *Shoreline Management Plan* update (see Appendix F). The *Development Guidelines 2019* are based on direction provided in the *Technical Guide* (MNR, 2001a) and are consistent with direction provided in the *Provincial Policy Statement* (MMAH, 2014), with the exception of guidelines allowing some development in the less hazardous portion of the Dynamic Beach Hazard. This approach recognizes existing development and provides a strategic approach that looks to eliminate the risk to human life and property damage over time. The *Development Guidelines 2019* provide minimum setback requirements. Property owners are reminded that the preferred approach is to setback as far as possible from the hazards and observing setbacks inland of the hazard limit is the recommended approach in all cases.

Public Process

The ABCA has undertaken the process of updating the *Shoreline Management Plan* with input from the community, stakeholders, municipal staff and technical experts. The process for public consultation was

initiated in 2015 including the formation of a multi-stakeholder community Steering Committee that attended multiple meetings between July 2015 and October 2016. A web page dedicated to the shoreline management plan update was developed, media reports were released, a public survey was conducted, a newsletter was provided with updates at regular intervals and there were a number of meetings and presentations.

Two public open houses were held in 2017, in Zurich and Thedford, and two additional public meetings were held in 9at these locations, to explain shoreline management issues and policies, and to obtain public input. Information from each of these meetings is posted on the ABCA website.

ABCA intends to implement this updated *Shoreline Management Plan 2019* with the support of its municipal and provincial partners, and the public. The public had the opportunity to review and provide comment during the review period, which was posted on the ABCA website at <http://www.abca.ca/page.php?page=shoreline-management>.

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1. Introduction

1.1 Purpose and Background

The Ausable Bayfield Conservation Authority (ABCA) shoreline is located along the east shore of Lake Huron and stretches for 60 kilometres (km) from approximately Towerline Road, north of the village of Bayfield, to Seth Lane in Port Franks. This report updates the previous *Shoreline Management Plan*, updated in 2000. The delineation of the shoreline hazards and the recommended shoreline management approaches are also summarized. The report draws from, and references, previous technical studies prepared for ABCA as outlined in the following section. The report was prepared jointly by the ABCA and Baird & Associates; the *Development Guidelines 2019* (included in Appendix F) were developed by the ABCA and the Planning Group.

1.2 ABCA and Shoreline Management Planning

In 1988 the ABCA was delegated by the Province of Ontario as the lead commenting agency, for land use planning as it relates to flooding, erosion and dynamic beach hazards along the Lake Huron shoreline within its jurisdiction. To fulfil this responsibility the Conservation Authority was directed to prepare a shoreline management plan. Several supporting documents were also developed including: *Lake Huron Shoreline Processes Study* (F.J. Reinders & Associates, 1989); *Inventory of Coastal Structures on Lake Huron* (ABCA, 1990); *Considerations for Shore Protection Structures* (Baird, 1994); and detailed 1:2000 scale base mapping of the shoreline prepared by the federal government. In 1994 the Board of Directors approved the first ABCA *Shoreline Management Plan*. That plan was subsequently updated in 2000 (ABCA, 2000).

In 2015, the ABCA initiated a review and update of the *2000 Shoreline Management Plan* (2000 SMP). The update was required to reflect changes in policy and regulations, as described in Section 2. In addition, new information has become available to more accurately determine recession rates, there is improved understanding of coastal processes, and current patterns of land use and shoreline development have changed, resulting in the construction of more permanent and larger residences along the shoreline.

The *Draft 2016 Consultant Recommendation Report* and regulatory mapping with updated shoreline recession rates (Aqua Solutions 5 Inc. et al., 2016) was completed in 2016. Due to a strong negative response from the public, the Board passed a resolution on November 3, 2016, stating that it would not implement the recommended Shoreline Development Guidelines of Section 7.8 in the report (pages 113 to 117), did not endorse the underlying principle of “managed retreat” and the outright prohibition of all shoreline protection works, and further, that the Board would continue to endorse the use of policies in the 2000 SMP. The Board further directed staff to provide options to re-engage the public to continue to update the 2000 SMP.

On February 16, 2017, staff presented the ABCA Board with a proposed method for re-engaging the public to move forward with updating the 2000 SMP. The ABCA retained Baird & Associates in 2017 to update *Considerations for Shoreline Protection Structures* (Baird, 1994); the updated report (Baird, 2017) is included in Appendix B. Public meetings were held in 2017 and 2018.

A Planning Group was formed with the lakeshore municipalities to review and update the *Development Guidelines 2000*, which provide direction for development in the hazard lands; the *Development Guidelines 2019* are presented in Appendix F. A review of the methodologies used to assess the Average Annual Recession Rate (AARR) was also undertaken (Baird, 2018) and recommendations have been adopted by ABCA.

The updated *Shoreline Management Plan 2019*, presented herein, builds on these previous studies. While the Board did not endorse the *Draft 2016 Consultant Recommendation Report*, and, the report's recommendations for updating the Development Guidelines, it includes good information on shoreline processes and shoreline management planning in general. Some technical sections of this updated *Shoreline Management Plan 2019* are taken directly from the *Draft 2016 Consultant Recommendation Report* with recognition of the original source. A full copy of the *Draft 2016 Consultant Recommendation Report* is provided in Appendix A.

1.3 Study Limits and Approach

The Ausable Bayfield Conservation Authority shoreline is located on the southeast shore of Lake Huron in the Province of Ontario. The ABCA's jurisdiction extends from Lot 30, Concession 1, in the former Goderich Township, in the Municipality of Central Huron at the northern limit, throughout the Municipality of Bluewater and the Municipality of South Huron, to the southerly limit within the Municipality of Lambton Shores at the community of Port Franks. Refer to Figure 1.1 for a map of the jurisdictional boundaries.

The ABCA shoreline is in a littoral cell that extends from Goderich Harbour to Kettle Point. There are two other Conservation Authorities (CAs) with shorelines in the littoral cell; Maitland Valley (MVCA) to the north and St. Clair Region (SCRCA) to the south. Coastal processes within a littoral cell may affect the other shorelines within the same cell.

The ABCA shoreline is divided into a northern section, north of Maple Gove subdivision, characterized by cohesive till bluffs, up to 18 m in height, fronted by narrow beaches of mixed sand and gravel. The shoreline south of Maple Grove subdivision is characterized by sandy beaches and dune systems. The northern section is largely erosional and supplies sediment to the southern shoreline which is largely depositional. The shoreline hazards along these two stretches of shoreline differ, as do the concerns of property owners and users of the shoreline. Consideration of the physical processes within the littoral cell is an important aspect of shoreline management planning.

Recognizing the inter-connected nature of the shoreline, a group made of representatives of MVCA, ABCA and the lakeshore municipalities and counties was established to review and update the development guidelines as part of this project.



Figure 1.1: Ausable Bayfield Conservation Authority showing municipal boundaries

1.4 Principles, Vision and Objectives of the SMP

In implementing its duties as the lead provincial agency with respect to shoreline erosion, flooding and dynamic beach hazards the ABCA is guided by Cabinet approved provincial policy and objectives and by provincial *Technical Guidelines* (MNR, 2001a). Provincial and ABCA goals are to minimize risks to life, property damage and social disruption and to encourage an integrated approach to shoreline management.

To achieve this the ABCA will be guided by the need to manage the shoreline responsibly. The ABCA's vision is to direct new and intensified development away from the identified hazard area, but also recognizes that much of the shoreline development took place well before the adoption of provincial hazard guidelines. To strike this balance the ABCA will:

- Provide clear policy direction to those who are most directly affected as well as to those who will be responsible for implementation.
- Work collaboratively with landowners and municipal partners.
- Interpret and apply policies in a clear, consistent and predictable manner across the entire ABCA shoreline.
- Work in collaboration with municipal watershed partners and landowners to limit or eliminate risks associated with natural hazards.

In promoting responsible management of the shoreline, the ABCA will be guided in all of its actions to ensure that:

- No new hazards are created.
- Existing hazards are not aggravated.
- No adverse environmental impacts result.

These three requirements are mandated by the Province and the policies in this *Shoreline Management Plan 2019* are premised on the need to ensure these three conditions are met.

In carrying out its mandated responsibilities, the ABCA will focus on achieving the following key objectives:

- Minimizing the potential for loss of life or property damage along the shoreline.
- Directing development away from natural shoreline hazards.
- Enhancing awareness by members of the public of the natural hazards associated with the Lake Huron shoreline.
- Minimizing public expenditures resulting from damage and emergency operations associated with flooding, erosion and dynamic beach hazards.

The ABCA is committed to ensuring human life and property is protected to the extent possible from the negative impacts of naturally occurring physical processes along the shoreline and further that public access to the shoreline for recreational purposes is encouraged.

In the *Development Guidelines 2019 (DG2019)*, the ABCA in partnership with the Planning Group has developed its position on shoreline development and shoreline protection works based on science-based evidence and moving forward will be diligent in taking the position that prevention and non-structural protection is preferable to structural protection measures. Non-structural bluff stabilization measures may include planting vegetation on the slope, controlling drainage, runoff and groundwater flow, regrading the slope and beach nourishment.

2. Legislative Authority, Policy and Technical Direction for Shoreline Management Planning

The legislative and policy framework for shoreline management across Ontario in general and, as it applies to the ABCA specifically, is briefly reviewed to provide the context for this study. Technical direction from the Province is also reviewed.

2.1 Legislative Authority

2.1.1 Conservation Authorities Act

The *Conservation Authorities Act* was created in 1946 and provides the legal basis for the creation of Conservation Authorities. Section 20(1) of the *Act* defines the objects of a Conservation Authority, including “to establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources.”

The *Act* provides further direction with respect to completing technical investigations within its watershed boundaries, including the shoreline, to support the development of a program to ensure the natural resources under its jurisdiction are conserved, restored, developed and managed.

The Conservation Authorities are also permitted, as outlined in subsection 28(1), to make regulations prohibiting, regulating, or requiring proponents to secure permission from the Authority for development, if in the opinion of the Authority the control of flooding, erosion, dynamic beaches, pollution or the conservation of land may be affected by the proposed development. Such lands are referred to as hazardous lands and occur adjacent to or in close proximity of the shoreline of Lake Huron, and river and stream valleys. Hazard lands are unsafe for development because of naturally occurring processes associated with flooding, erosion, dynamic beaches, or unstable soil (Section 28(25)).

In 1998, the *Conservation Authorities Act* was amended as part of the *Red Tape Reduction Act* (Bill 25), to ensure that Regulations under the *Act* were consistent across the Province and complementary to provincial policies. Significant changes were made to Section 28, which led to the replacement of the *Fill, Construction and Alteration to Waterways Regulations* with the current *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation* (MNR/CO, 2008).

2.1.2 Ontario Regulation 97/04 (2011)

Ontario Regulation 97/04 was made under the *Conservation Authorities Act* described above and outlines the requirements and content for a regulation pertaining to hazardous lands (updated in 2011) for each individual CA. For the shorelines of the Great Lakes, the limit of hazardous lands is defined as the furthest landward extent of the following:

- **Shoreline Flooding:** the 100-year flood level plus an allowance determined by the Conservation Authority for wave uprush and other water related hazards.
- **Erosion:** the predicted long-term stable slope measured from the existing toe of slope or from the predicted location of the toe of slope as the location may have shifted as a result of shoreline erosion over a 100-year period.
- **Dynamic Beach:** an allowance to accommodate dynamic beach movements over time, as determined by the Conservation Authority.

- Other Areas: an additional allowance determined by the Conservation Authority, not to exceed 15 metres (m), can be added to the flooding, erosion and dynamic beach regulations.

2.1.3 Guidelines for Development Schedules of Regulated Areas

Additional technical information for establishing the boundaries of hazardous lands adjacent to the shorelines of the Great Lakes is provided in *Guidelines for Developing Schedules of Regulated Areas* (Conservation Ontario and Ontario Ministry of Natural Resources, 2005). This information supplements the information in *Ontario Regulation 97/04*:

- **Shoreline Flooding:** In the absence of detailed technical information, the wave uprush limit is 15 metres (m) measured horizontally from the 100-year flood level.
- **Erosion:** The 100-year erosion allowance must be determined with a minimum of 35 years of data and in the absence of detailed site-specific data, the stable slope angle is 3:1 (H:V).
- **Dynamic Beach:** In the absence of detailed technical information, a dynamic beach is the sum of the 100-year flood level, 15 metres (m) wave uprush limit and an additional 30 m allowance for the dynamic nature of beach movements.

2.1.4 Ontario Regulation 147/06

Ontario Regulation 97/04 (discussed in Section 2.1.2), stipulates the criteria by which each conservation authority must establish its updated regulated area or 'Regulation Limit'. The Province of Ontario subsequently enacted *Ontario Regulation 147/06*, in May 2006, which required the ABCA to regulate:

- River and stream systems affected by erosion hazards;
- Shorelines (up to the furthest landward extent of the aggregate of the flooding, erosion and dynamic beach hazards plus an allowance of up to 15 metres, and;
- Lands adjacent to:
 - wetlands (up to 120 metres)
 - valleys (up to 15 metres from stable top of bank)
 - flood plains (up to 15 metres beyond the flooding hazard limit).

2.2 Policy

2.2.1 Ontario Provincial Policy Statement (Ministry of Municipal Affairs and Housing, 2014)

The *Provincial Policy Statement* (PPS) (MMAH, 2014) recognizes that Ontario's long-term prosperity requires resilient communities supported by long-term strategic development plans, protection of natural resources, and sustainable economic growth. To ensure healthy and resilient communities, the PPS recommends: 1) avoid development patterns that cause negative environmental impacts or safety concerns (such as developing on hazardous lands); 2) promote development in existing settlement areas to avoid unnecessary land conversions (e.g., avoid conversion of agricultural land to urban land); and 3) promote development that conserves native biodiversity.

To promote healthy active communities, the PPS outlines that public access to our shorelines should be provided. Existing provincial parks, conservation areas and other natural areas must be protected from negative impacts associated with new development.

The importance of protecting Ontario residents and communities from shoreline hazards is outlined in detail in Section 3.0 of the 2014 PPS, which states:

- Development shall generally be directed to areas outside of hazardous areas adjacent to the shorelines of the Great Lakes – St. Lawrence River System and large inland lakes which are impacted by flooding hazards, erosion hazards and/or dynamic beach hazards (3.1.1-a).
- Development and site alteration shall not be permitted within...the dynamic beach hazard (3.1.2-a).
- Planning authorities shall consider the potential impacts of climate change that may increase the risk associated with natural hazards (3.1.3).

Under the *Planning Act*, the Shoreline Management Plan “shall be consistent with” the PPS (MMAH, 2014). The ABCA requires new development subject to approvals under the *Planning Act* to be in conformity with the PPS (MMAH, 2014). ABCA provides some flexibility for existing development in the hazard lands, while recognizing the need to limit development to the less hazardous portions of the hazard lands.

2.2.2 Official Plans

The *Planning Act* requires all counties and municipalities in Ontario to adopt an official plan that is consistent with the *Provincial Policy Statement, 2014*. The Official Plans for Huron County (2013) and Lambton County (2018) recognize the importance of planning for and with the natural environment. These documents provide a strategic vision for managing growth and future land use decisions in the two counties. They are also linked to the Official Plans and Zoning Bylaws of the lower-tier Municipalities and Townships, where the mapping depicting the hazardous lands as determined in this SMP is presented.

The Official Plans also provide important background information on goals for the protection of natural heritage features (wetlands, wildlife habitat and fish habitat), restoration of habitat (not degradation) in conjunction with new development and locating future growth into existing settlement areas and away from hazardous lands, which is pertinent to this shoreline management plan. Further information is provided in Aqua Solutions 5 et al. (2016).

2.3 Technical Direction

2.3.1 Technical Guide for Great Lakes - St. Lawrence River System

In 2001, the Ministry of Natural Resources (now the Ontario Ministry of Natural Resources and Forestry (MNRF)) released the *Technical Guide for the Great Lakes – St. Lawrence River System and Large Inland Lakes* (MNR, 2001a). This guide provides the technical basis and procedures for establishing the hazard limits for flooding, erosion, and dynamic beaches in Ontario as well as options for addressing the hazards.

2.3.2 Understanding Natural Hazards

The Ontario Ministry of Natural Resources (now the Ontario Ministry of Natural Resources and Forestry) also prepared *Understanding Natural Hazards* (MNR, 2001b) to assist the public and planning authorities with explanation of the Natural Hazard Policies (3.1) of the *Provincial Policy Statement* of the *Planning Act*. This publication updates and replaces the older *Natural Hazards Training Manual* (from 1997). This document is also referenced when addressing natural hazard concerns.

3. Technical Analysis and Description

This section describes technical information used to develop this shoreline management plan and delineate the erosion, flooding and dynamic beach hazards including geology, shoreline characteristics, littoral cells, recession rate analysis, lake levels and climate change.

3.1 Geology

As a result of the glacial history of this area, the entire region is covered by deep glacial deposits. The eastern shoreline of Lake Huron is comprised of bedrock overlain by Rannoch Till, which in places is overlain by St. Joseph Till. The response of the shoreline to wave action depends on the composition of the soil at the shoreline and on the nearshore lakebed. The presence of exposed Rannoch Till on the nearshore lakebed and at the base of the bluff results in a relatively stable (erosion resistant) shoreline, while the presence of St. Joseph Till on the nearshore lakebed and at the base of the bluff results in an eroding shoreline (and nearshore lakebed).

The tills contain differing proportions of sand and gravel in the soil matrix. The Rannoch Till is more resistant to wave action as a result of its relatively high gravel content, and has significantly affected the evolution of the Lake Huron shoreline. Lag deposits of coarse gravel armour the exposed surface of the lakebed. These more resistant shallow shelves, cause waves to break and dissipate their wave energy offshore, reducing the exposure of the shoreline to wave induced erosion. It is likely that the two small headlands at Rocky Point and Dewey Point occur because of Rannoch Till outcrops in the nearshore, which are more resistant to erosion than the adjacent shorelines. The St. Joseph Till, also present along this shoreline, contains a smaller proportion of gravel than the Rannoch Till, and is thus, less erosion resistant. Most of the exposed bluffs along the ABCA shoreline and nearshore lakebed consist of St. Joseph Till.

Erosion of the bluffs and nearshore lakebed supplies sediment (clay, silt, sand and gravel) to the shore zone. These materials are transported by wave action and currents. The finer sediments (clay and silt particles) are carried in suspension, and tend to deposit offshore in deep water, while the coarser sediments (sand and gravel) are transported along the shoreline and form beaches, dunes and nearshore bars. Near Grand Bend, the till has become buried by the sand deposits and the shoreline is dominated by dynamic sand beaches and dunes. The stability of these beaches is dependent on the supply of sand from bluff and nearshore lakebed erosion, gully erosion and rivers in the northern bluff section of the ABCA shoreline.

3.2 Shoreline Characteristics

The ABCA shoreline is divided into a northern section, north of Maple Grove subdivision, characterized by cohesive till bluffs fronted by narrow beaches of mixed sand and gravel and a section south of Maple Grove subdivision which is characterized by sandy beaches and dune systems (see Figure 3.1). The northern section is largely erosional and supplies sediment to the southern shoreline which is largely depositional.

North of Maple Grove subdivision, the shoreline has a north-south orientation. The bluff height tends to decrease from approximately 18 m at the northern limit of the ABCA's jurisdiction to approximately 6 m at Highway 83. Numerous gullies exist along this section of shoreline; these gullies have developed as a result of surface runoff and may be stable or actively eroding. The bluffs have historically been eroding as a result of nearshore lakebed erosion and wave action undercutting the toe of the bluffs, which eventually leads to bluff instability and slumping. The slumped material, or talus, is then removed by wave action and the process continues.

As discussed above, the erosion of the bluffs is preceded by, and controlled by, a slow but continuing downward erosion of the nearshore lakebed. Although most of the visible erosion (i.e., bluff recession above the water line) occurs during periods of high water levels, the controlling process of nearshore erosion continues at all water levels, including during low water periods, however the distribution of erosion across the nearshore zone varies with fluctuating water levels.

The erosion of the bluffs and nearshore lakebed along this section of shoreline, as well as erosion of gullies and sediment transported by creeks, provide sediment to the nearshore area. Of particular interest is the coarser material, specifically sands and gravels, which can form beaches and bars along the shoreline and thus provide some protection to the shoreline, as well as recreational benefits. Along the ABCA shoreline north of Maple Grove subdivision, it has been estimated (Reinders, 1989) that approximately 72% of the supply of sand and gravel to the nearshore area comes from bluff erosion, 10% from gully erosion, 17% from lakebed erosion, and 1% from creeks and rivers. This material is transported alongshore by wave-induced currents. The magnitude of this transport is a function of the wave conditions (principally wave height and direction), water depth close to the shoreline and availability of sediments. Due to the wave climate and shoreline orientation in this area, the net transport is from north to south, although reversals do occur in response to individual storms.

To the south of Maple Grove subdivision, the shoreline orientation changes from north-south to northeast-southwest, and the shoreline characteristics change from cohesive till bluffs to sand dunes. As a result of the change in shoreline orientation, the sediment transport rate decreases significantly, with erosion rates becoming lower moving further south. The shoreline south of Maple Grove has historically been a deposition zone. Over thousands of years this deposition has resulted in the development of an extensive beach-dune system along the Grand Bend/Pinery/Ipperwash shoreline. The deposition of sand along this section of shoreline is offset to some extent by wind-blown (aeolian) losses from the beach to the dune and offshore loses. The stability of this beach-dune system is dependent on the supply of sand provided by updrift erosion processes, in particular bluff erosion between Grand Bend and Goderich. This is an important consideration for shoreline management planning.

3.3 Littoral Cells

A littoral cell is a conceptual shoreline compartment, boundary or zone defined by the supply, transport, and deposition of sand and gravel (littoral material). Within a littoral cell, there is an updrift supply area, a net direction of longshore sediment transport (LST), a downdrift depositional area, and no (or only minimal) leakage of sediment at the cell boundaries. A littoral cell is a self-contained coastal system, where the ongoing shoreline processes are not affected by the processes of the neighbouring cells. As such, shoreline management of one cell can proceed independently of any other cell. In particular, sand is not transported between cells.

The littoral cell boundaries for the east shore of Lake Huron including the ABCA shoreline were defined in Reinders (1989). The ABCA shoreline lies entirely within a littoral cell that extends from Goderich Harbour to Kettle Point; there is no (or only minimal) sediment transport bypassing Goderich Harbour; and similarly, there is no sediment transport bypassing Kettle Point (Reinders, 1989). A detailed description of shoreline processes is provided in Reinders (1989).

The littoral cell is divided into four littoral sub-cells as shown in Figure 3.1. There is some transport between sub-cells, although limited. Sub-cell 1 and a portion of sub-cell 2 are within the Maitland Valley Conservation Authority jurisdiction, and the southern part of sub-cell 4 is within the St. Clair Region Conservation Authority jurisdiction. The remainder is within ABCA jurisdiction, except for First Nation lands located in the Ipperwash area. The four littoral sub-cells are discussed below.

3.3.1 Sub-cell 1 - Goderich Harbour to St. Christopher's Beach

Between Goderich Harbour and the Goderich water treatment plant (this sub-cell is outside the jurisdiction of the ABCA), the shoreline and bluffs are protected by a combination of exposed bedrock in the nearshore zone, beaches and shoreline protection structures, resulting in no significant bluff erosion. Limited erosion of the lakebed supplies approximately 1,000 m³/yr of sand to the nearshore area (Reinders, 1989). Sediment transport is negligible in this area due to the very limited supply and the sheltering effect of the Goderich Harbour structures, which are a barrier to longshore transport.

3.3.2 Sub-cell 2 – St. Christopher's Beach to Bayfield Harbour

Between the Goderich water treatment plant and Bayfield Harbour, the shoreline consists of cohesive bluffs fronted by narrow sand beaches. Within the ABCA's jurisdiction (i.e., south of Towerline Road), approximately 48% (calculated from the 2007 imagery) of the shoreline has been protected to some extent, generally using groynes and/or seawalls. Bluff recession ranges from less than 0.3 to 0.85 m/yr, with the highest recession in the Melena Heights and Birchcliff areas. Reinders (1989) estimated that bluff erosion supplies an average of 13,100 m³/yr of sand to the nearshore zone, and that gully and lakebed erosion supply approximately 4,100 and 2,800 m³/yr respectively.

A feature along this section of shoreline is the wide fillet beach which has accreted to the north of the Bayfield harbour structures (constructed in the late 1880s) and extends to the Jowett's Grove area. While the shoreline is considered generally stable, the bluff in this area was subject to a slump event in 2008. This beach area has now achieved an equilibrium condition, and sand bypasses Bayfield Harbour and is transported south into the next sub-cell.

3.3.3 Sub-cell 3 – Bayfield Harbour to Maple Grove Subdivision

Between Bayfield Harbour and Maple Grove subdivision, the shoreline consists of cohesive bluffs fronted by narrow sand beaches. Approximately 43% (calculated from the 2007 imagery) of this reach of shoreline has been protected to some extent, with groynes and/or seawalls being the predominant structures. Bluff recession ranges from less than 0.3 to 1.1 m/yr, with the highest recession rates in the Lakewood Gardens/Sunny Ridge/Poplar Beach area. Bluff erosion supplies an average of approximately 32,600 m³/yr of sand to the nearshore zone, while gully and lakebed erosion supply approximately 4,200 and 7,400 m³/yr respectively (Reinders, 1989).

Features along this section of shoreline include Rocky Point and Dewey Point; both are headlands projecting into the lake relative to the adjacent shorelines. As noted in Section 3.1, the long-term stability of these points relative to the adjacent shoreline is likely due to the presence of hard Rannoch Till on the nearshore lakebed. Of particular interest to shoreline management is the development of cottages on a beach terrace at the base of the bluff (see for example Drysdale Beach), in addition to the more typical development on tableland at the top of the bluff.

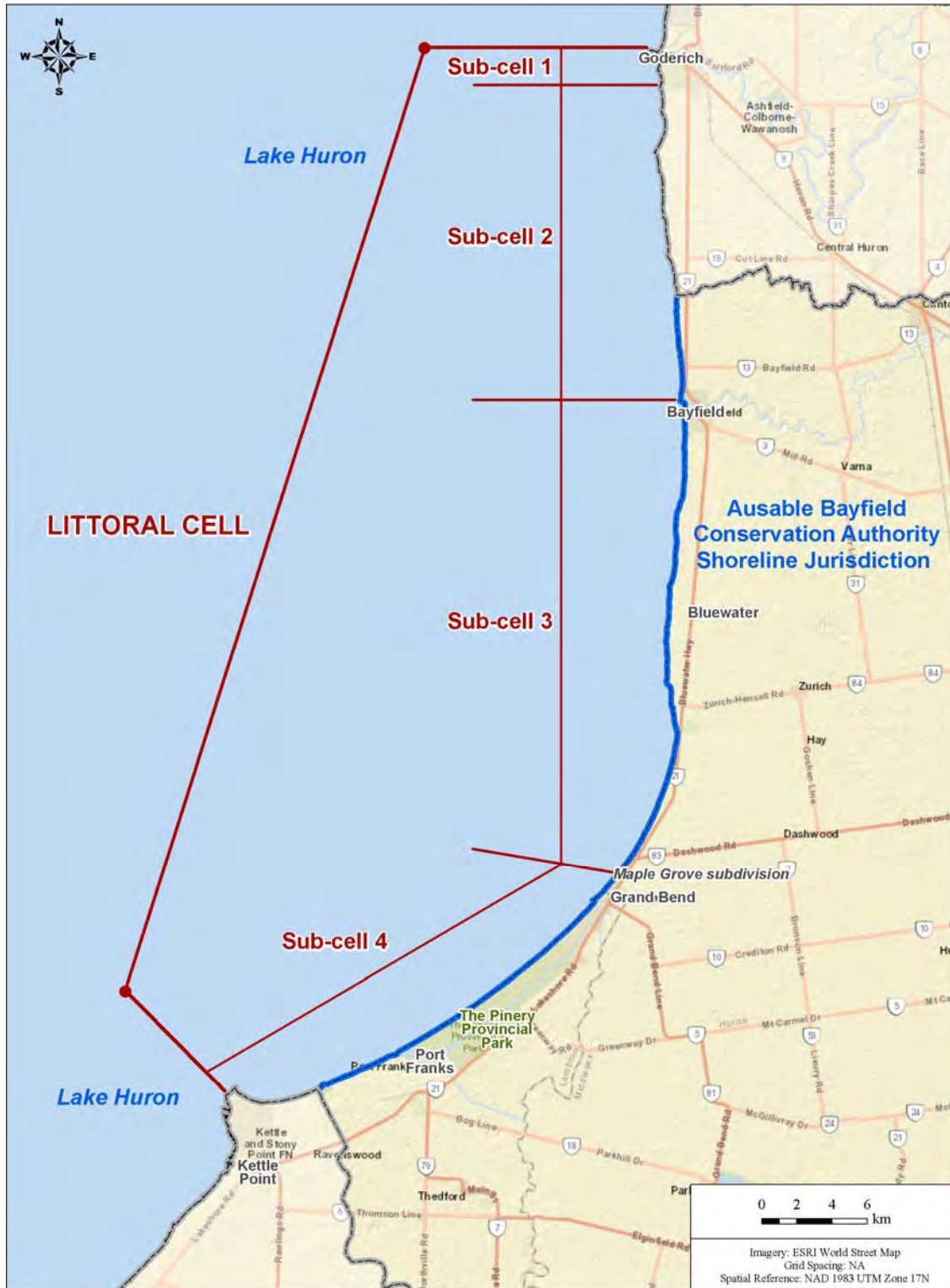


Figure 3.1: ABCA Shoreline showing littoral cell and sub-cells

3.3.4 Sub-cell 4 - Maple Grove Subdivision to Kettle Point

Between Maple Grove subdivision and Kettle Point, the shoreline consists of a relatively wide beach fronting sand dunes. This reach of shoreline represents the deposition zone for the material which has been eroded from the bluffs, gullies and lake bed along the updrift shoreline to the north.

Over thousands of years, the deposition of sand along this reach of shoreline has resulted in the present-day, fully-developed beach-dune system. However, a comparison of shoreline conditions in 1935 and 1988 indicates that although the dune face has been relatively stable, the beach width has decreased substantially over this 53-year period. This change may be in part due to beach response to different water level and wave conditions in periods preceding the two surveys: the 1935 survey was completed following several years of very low lake levels, while the 1988 survey was completed shortly after the record high lake levels of 1985-86. In addition, the 1935 survey was completed in August following the generally expected calmer summer months, while the 1988 survey was completed in April following the fall/winter season which is typically more stormy. Both factors would lead to a narrower beach in 1988, as indicated by the survey results. It is possible however, that a net loss of sediment from the Pinery/Upperwash beach system has occurred since 1935 due to an increasingly negative sediment budget (sand losses exceeding sand supply). Construction of the Goderich Harbour in 1916 would have reduced the supply of sand to this area, as well as possible losses to deep water caused by the harbour structures at Bayfield and Grand Bend, and protection of updrift shorelines. Additional studies including historical aerial imagery comparisons with more recent imagery, including adjustment for water level, is recommended to update recession rates.

A fillet beach has developed to the north of the Grand Bend Harbour structures (built in 1904). This beach extends to the Maple Grove area and appears to have reached an equilibrium condition such that sand is now bypassing the harbour structures to be diverted offshore and deposited further downdrift.

3.4 Recession Rate Analyses

This section describes the methodology used by the ABCA to estimate recession rates along the shoreline. The Average Annual Recession Rate (AARR) is used to determine the Erosion Hazard Limit as described in Section 4.2. The AARR is updated by the ABCA on a regular basis, when new data becomes available.

3.4.1 Best Practice

In establishing shoreline recession rates, the general best practice is to select the most suitable datasets in terms of quality, accurate feature definition, spatial resolution and scale that provide the longest possible temporal period for comparison. A longer temporal period provides a more representative measurement of the long-term bluff recession (MNR, 2001a). Data may include comparison of historical aerial imagery and/or land surveys.

Compared to the toe of bluff, the top of bluff feature is generally preferred for measuring recession rates because it is less susceptible to short-term fluctuations in the lake water level and is generally more distinctive in historic black and white air photos. As prescribed by the provincial *Technical Guide*, recession rate data must be for an unprotected shoreline, as recession rate values are required to represent the erosion potential without any structures (MNR, 2001a).

3.4.2 Methodology

Recession rates were estimated for the SMP 2000 (ABCA, 2000) based on a comparison of the surveyed toe of bluff from the 1935 *Shoreline Traverse Survey* to the 1988 1:2,000-scale mapping derived from 1988 stereo pairs. To verify recession rates, localized top of bluff and mid-slope comparisons as well as historical shoreline locations from various sources were used. This represented change over 53 years and was considered to be

the best available data at the time. There were limitations with the 1935 data including challenges delineating the toe of bluff, use of the High Water Mark (HWM) to identify toe of bluff and the spacing of the transect data.

In 2016, proposed updated recession rates were provided in the *Draft 2016 Consultant Recommendation Report*. That approach involved the comparison of bluff toe position using copies of the 1973 air photo mosaics taken from the *Canada-Ontario Great Lakes Shore Damage Survey Coastal Zone Atlas* (Environment Canada and Ontario Ministry of Natural Resources, 1973) and 2007 ortho- imagery and vector datasets.

In 2016, the ABCA undertook a review of methodologies used to estimate recession rates as described in “*ABCA Historic Photo Pilot, Assessment of Techniques Using Historic Imagery to Locate the Toe and Top of the Slope in a Section Along Lake Huron*” prepared by ABCA dated June 2016. The ABCA concluded that the reproduction of the 1973 air photo imagery taken from the 1973 Atlas resulted in distortions and introduced inaccuracies when estimating the AARR. They concluded that using the 1973 Geo-referenced National Air Photo Library print image scans instead of the copies from the 1973 Atlas produced much more accurate results.

In 2018 ABCA retained Baird to undertake a further review of the methodologies used to calculate the AARR. The recommendations outlined in *Shoreline Management Plan Update 2018: Review of Recession Rate Analyses* (Baird, 2018) and adopted as a result of this review include: improvements to photos selection to obtain the lowest distortion; and use of the top of bluff feature which can be more accurately delineated than toe of bluff.

Where the shoreline is protected, the rate is either estimated from adjacent unprotected shorelines with similar characteristics, or where this is not possible due to extended areas of protection, the 1935-1988 recession rates are used.

A smoothing function is used in developing the recession values for each transect, based on recommendations in Aqua Solutions 5 et al., (2016). The smoothing function is intended to address errors arising from the methodology and spatial and temporal variability in recession rates. The smoothing function considers data to 100 m on either side of a given transect.

As discussed in Section 3.4.1, it is best practice to use the earliest available historic air photos, considering scale and quality, to provide the longest possible temporal period of comparison. Photos from 1955, 1964 and 1966 are available and could extend the period of comparison on unprotected areas of the shoreline by up to 18 additional years if and when funding becomes available. The 2007 ortho-imagery and datasets represent the best-available most recent base mapping because the more recent 2015 ortho-imagery has trees with leaf-on, is a coarser resolution of 20 cm, and has a lot of high contrast and shadows that obscure ground features such as bank features. The comparison on the unprotected sections of the shoreline can also be updated in future if new, high quality imagery becomes available.

3.4.3 Summary of Recession Rates

The calculated AARR along the ABCA shoreline range from low (0.1 to 0.3 m/yr), to moderate (0.31 to 0.7 m/yr) and, in a few specific locations to high (0.71 to 1.2 m/yr), based on the classification scheme presented in MNR (2001a).

Table 3.1: Summary of Recession Rates for ABCA Shoreline

Average Annual Recession Rate (m/yr)	MNR Classification	% of ABCA Cohesive Bluff Shoreline
>1.2	Very High	0
0.71-1.2	High	6.5
0.31-0.7	Moderate	13.3
0.01-0.3	Low	67.1
0	Stable	13.1

The bluff will generally be stable where sufficient sediment has accumulated to produce wide beaches that protect the bluff toe and the nearshore till lakebed from erosion. Examples of this can be found along the 1 km stretch of shoreline where a fillet beach has developed north of Bayfield Harbour (see Figure 3.2) and just north of Grand Bend Harbour.



Figure 3.2: Stable shoreline at fillet beach north of Bayfield Harbour

The majority, 80.2 % (see Table 3.1), of the cohesive bluff shoreline has a low recession rate or is stable (see Figure 3.3, northern and Figure 3.4 southern recession rate maps). Shorelines with low recession rates are usually associated with beaches which offer some protection against erosion of the bluff toe and reduced rates of nearshore erosion. Low recession rates are also found at Stoney Point and Dewey Point, where there are outcrops of the stony Rannoch Till, which also acts to reduce nearshore erosion.

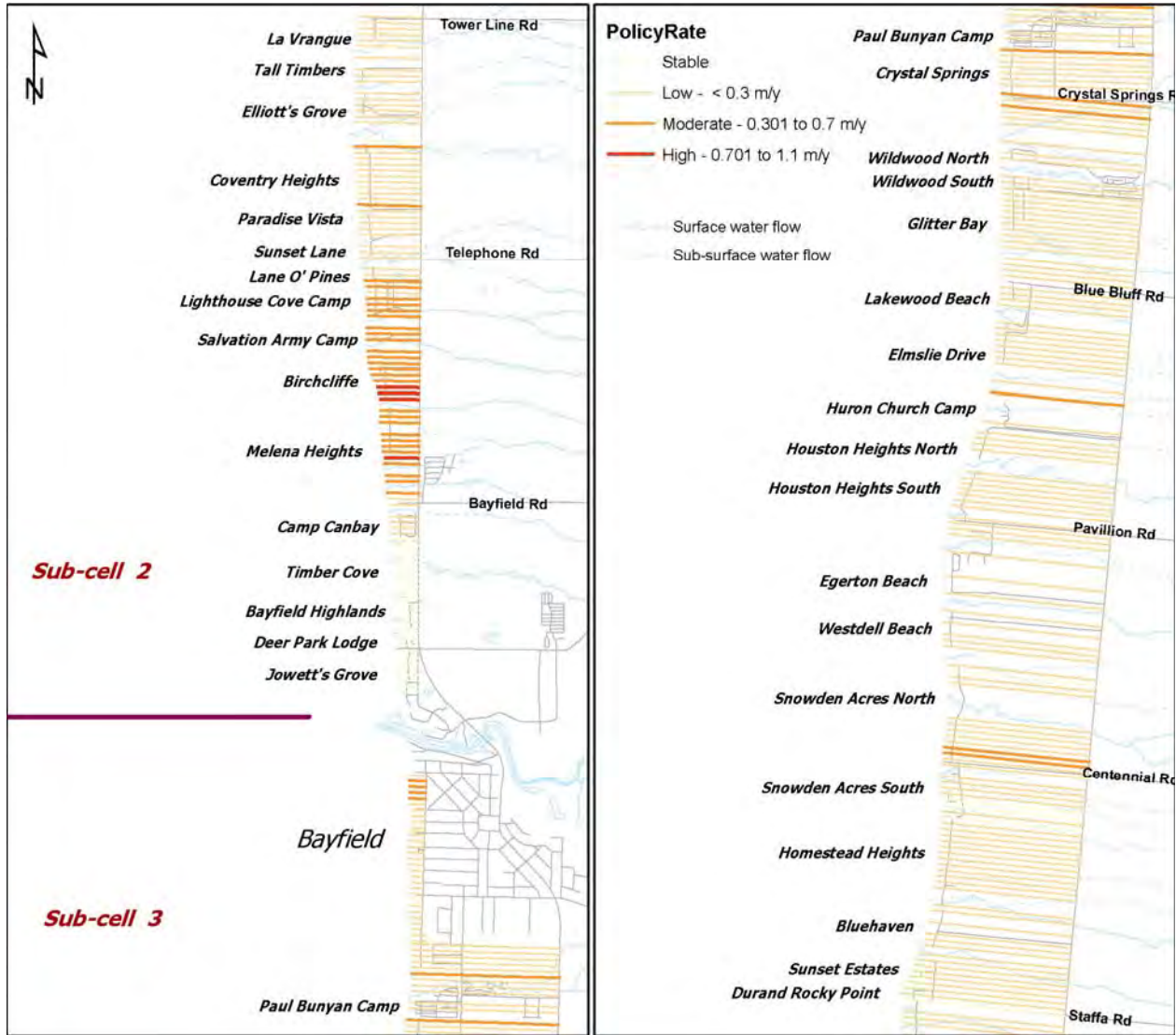


Figure 3.3: Northern recession rate map – average annual recession rates 1973 – 2007

Small sections of shoreline with moderate recession rates combining for 13.3% of the shoreline (see Table 3.1) are found from Lane O'Pines south to Bayfield Rd, north of Bayfield; and south of the Bayfield River, Crystal Springs, Pavillion Road, notably around Huron Church Camp (see Figure 3.3). South of Staffa Road (see Figure 3.4), moderate recession occurs in the Crest Beach, Vista Beach, Antoinettes's Lane, south end of Bayview, Sararas Rd, north portion of Lakewood Gardens North and Poplar Beach.

Two stretches of the shoreline have high recession rates: north of Bayfield in the Birchcliffe/Melena Heights area (see Figure 3.3), and Lakewood Gardens North/South, Sunnyridge, and north of Poplar Beach Road. (see Figure 3.4).

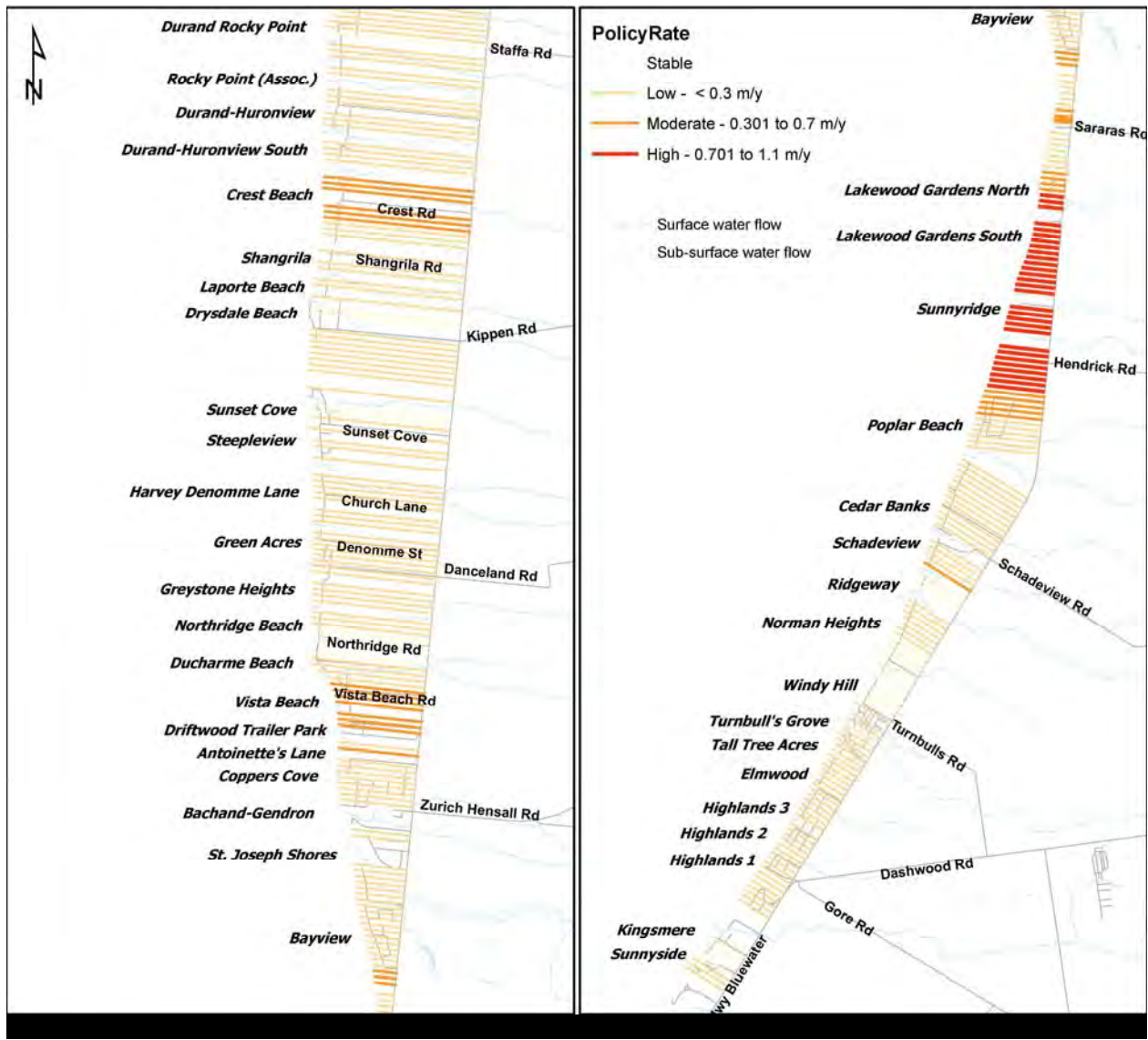


Figure 3.4: Southern recession rate map – average annual recession rates 1973-2007

3.4.4 Requirements for Site Specific Assessments of AARR

The ABCA has spent considerable effort estimating recession rates and the accuracy of these estimates has improved with ongoing technical advances in geomatics. The 588 transects used to calculate the 1973-2007 bluff recession rates provide good regional-scale coverage. For a particular site, the nearest bluff recession rate transects provide a representative value that takes into account the temporal and spatial variability of shoreline erosion. When delineating the Erosion Hazard Limit, the ABCA uses a smoothing function that recognizes temporal and spatial variations in shoreline recession along the shoreline. For example, along a stretch of eroding bluff with similar characteristics, a failure may occur at one property in a given year, and at another several years later. In general, over time, a shoreline with similar features will retreat at a consistent rate. The smoothing function allows this variability to be taken into consideration.

If a property owner chooses to conduct an independent assessment of the recession rate for their property, the assessment must meet the following requirements for site-specific recession rate estimates by property owners:

1. The analysis must provide additional data that extends the temporal range (time over which shoreline position is compared). The analysis must also meet or exceed the level of accuracy of the ABCA analysis.
2. Data must be for an unprotected shoreline, as recession rate values are required to represent the erosion potential without any structures (MNR, 2001a).
3. Imagery or data must be georegistered and analysis undertaken by a geomatics professional; and surveys must be completed by an Ontario Land Surveyor (OLS). A report outlining QA/QC procedures is to be provided.
4. The scale of aerial photography used should be 1:20,000 or better; the scale of a survey should be 1:1,000 or better.
5. While this site-specific set of measurements may be more accurate in a localized sense, it must still be considered within the regional context of adjacent properties to provide context of trends of shoreline erosion.

3.5 Lake Levels

Lake Huron water levels fluctuate over short-term (hours to days), seasonal and long-term (multi-annual) time horizons. These fluctuations in water level are the result of inflows from Lake Superior through the St. Mary's River, climatic conditions such as precipitation, evaporation, wind, pressure variation, runoff from the basin, and outflow through the St. Clair River. The outflow from Lake Superior is regulated at the locks at Sault Ste. Marie but there is no regulation at the outflow to the St. Clair River. On average, Lake Superior supplies approximately 28% of the inflow into Lake Huron, approximately 41% comes from precipitation (rain and snow) over the lake, and an estimated 31% comes from runoff. Nearly 70% of the output is flow down the St. Clair River and an estimated 30% is lost through evaporation (Aqua Solutions 5 et al., 2016).

Monthly mean lake levels for the period 1918 to 2017 are shown in Figure 3.5. The most recent period of high lake levels was 1985-86, and the highest monthly mean water level was 177.50 m International Great Lakes Datum (IGLD) 1985, in October 1986. The lowest monthly mean water level was 175.58 m IGLD 1985, recorded in March 1964, giving a total water level range of close to 2 m. There was a sustained period of low water levels from 2000 to 2012, however the lowest monthly mean in this period was marginally higher than the lowest value recorded in 1964.

Due to the size of the Great Lakes and the limited discharge capacities of their outflow rivers, extreme high or low lake levels will generally persist for a period of years, however lake levels can change relatively quickly as was observed when water levels dropped from record highs to 'normal' conditions following the 1985-86 period of high water levels; and in 2014 to 2017 when water levels rose from the low levels that occurred between 2000 and 2012.



Figure 3.5: Lake Huron monthly mean lake levels (1918 to 2017)

Seasonal fluctuations in the lake level are associated with the annual weather patterns and extent and duration of ice cover, which limits evaporation. The highest lake levels typically occur in the early summer following spring runoff, then levels start to drop as evaporation and precipitation patterns change and lowest levels typically occur in the winter when most precipitation is snow and ice. On Lake Huron, the average seasonal water level fluctuation is approximately 0.3 m but does vary from year to year. Figure 3.6 shows the average seasonal fluctuations and the maximum and minimum monthly mean water levels on Lake Huron. The highest and lowest monthly means are indicated in red and blue respectively, with the year of occurrence. The long-term average monthly mean is indicated in grey and the recorded monthly mean for 2017 and 2018 to date is shown in black, with the forecast range for the next several months in dashed lines. Water levels in this report are referenced to IGLD 1985. Chart Datum is 176.0 m IGLD 1985.

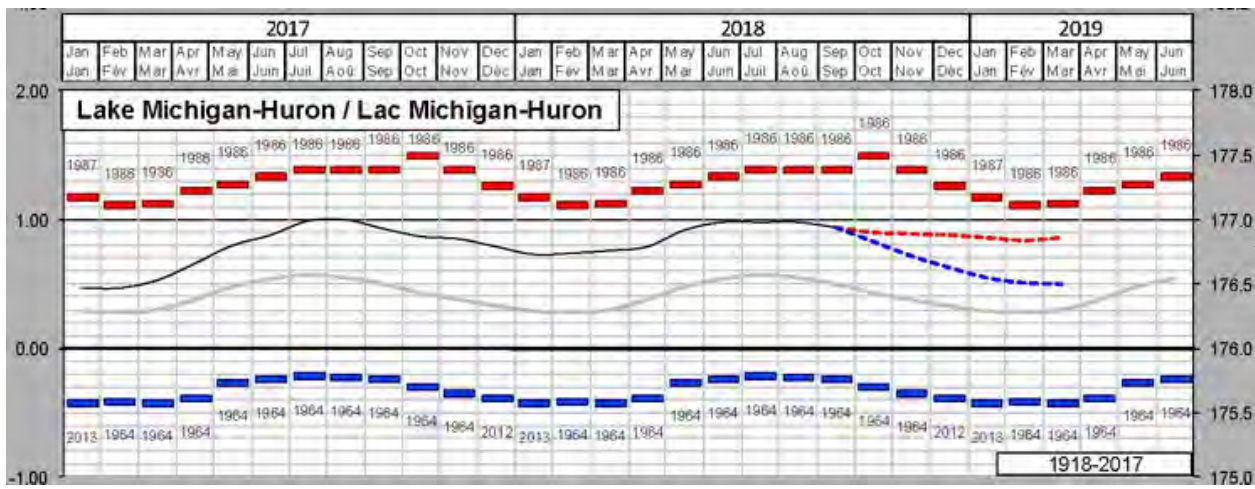


Figure 3.6: Seasonal water level fluctuations on Lake Huron (from the Canadian Hydrographic Service Monthly Water Level Bulletin)

Short-term (hours or days) fluctuations in the water level occur due to the passage of weather systems, with wind stress on the water surface and atmospheric pressure changes causing localized setups referred to as storm surge. Storm surge along the ABCA shoreline varies with the severity of the storm, wind direction and location along the shoreline.

A summary of the 100-year flood levels (combined monthly mean plus storm surge) from MNR (1989) is presented in Table 3.2. The water levels for Kettle Point to Dewey Point are based on values for Kettle Point; water levels for Dewey Point to Goderich are based on values for Goderich. For reference, the difference between IGLD 1985 and Canadian Geodetic Vertical Datum of 1928 (CGVD'28) is 0.00 m at Goderich, meaning there is no correction required.

Table 3.2: 100-Year Flood Levels for the ABCA Shoreline

Location	100-Year Flood Level (m IGLD 1985)
Goderich to Dewey Point	177.80
Dewey Point to Kettle Point	177.91

The 100-year flood level is the water level with a 1% probability of occurring in any given year or on average, once every 100 years. It is used to delineate the Flood Hazard Limit and the Dynamic Beach Hazard Limit as discussed in Sections 4.3 and 4.4 respectively.

There is a high level of uncertainty in predictions for water level change on the Great Lakes in response to climate change. Davidson-Arnott (Aqua Solutions 5 et. al., 2016) discusses climate change impacts on the Great Lakes and notes that recent projections are for mean lake level to remain relatively stable over the next 80 to 100 years, with higher evaporation in the basin being compensated for by increased winter precipitation. Further discussion on climate change is provided in Section 3.6.

3.6 Climate Change

The PPS (Section 3.1.3), (MMAH, 2014) mandates conservation authorities to consider the potential impacts of climate change that may increase the risk associated with natural hazards. The potential implications of climate change should also be considered in the design of shoreline protection works. A detailed review of the present understanding of potential climate change in the Great Lakes Basin and an assessment of the potential impact on processes and shoreline hazards within the ABCA shoreline is provided in the *Draft 2016 Consultant Recommendation Report*, and an extract summarizing the key points from that report is provided below:

“There is general agreement that average temperatures over the next century will increase by 2 to 7 °C, with winter temperatures increasing more than summer temperatures. This will increase the average temperature of Lake Huron and the number of days with severe heat. It will also lead to a decrease in the proportion of precipitation occurring as snow. In terms of coastal processes, the most important change will be a continued decrease in the extent and duration of winter ice cover. As a result, winter storms that in the past did not generate waves because of the presence of ice will now be able to do so and this will lead to an increase in the order of 10-30% on the potential rate of erosion on the cohesive coast both underwater and of the bluff toe. Longshore sediment transport rates will also increase and so the protection provided to the bluffs by beaches may also decrease, though this effect may be partially offset by increased supply.

Agreement on the effects on precipitation is not as good as for temperature, but most recent modelling suggests that precipitation in the northern half of the basin – mainly Lake Huron/Michigan and Lake Superior – will increase by up to 20%. The most significant effect of this is that the mean lake level is now forecast to remain similar to the past 100 years, with increased evaporation being offset by the increased precipitation. There will likely be an increase in the frequency of intense rainfall events which may lead to more rapid erosion of the bluff face and may also have implications for water quality. Increased winter

storm events may also lead to more frequent erosion of coastal dunes and the potential for the maximum limit of wave erosion inland to increase.

In summary, climate change impacts on temperature and precipitation have the potential to increase the severity of flooding and dynamic beach hazards and to increase the rate at which bluff recession takes place along the ABCA shoreline and this will require both continued updating of data on coastal processes and bluff recession and caution in assessing the risks to people and property.” (Aqua Solutions 5 et al., 2016)

In terms of shore protection design, increased uncertainty in design parameters (wave height, water level and ice), should be considered in design. Monitoring structures is an accepted practice; it is important to be aware of the potential impacts of climate change discussed in this section and their implications for shore protection structures.”

4. Shoreline Hazards

Section 4 provides an overview of the erosion, flooding and dynamic beach standards and the procedures followed to map these regulated lands defined by the inland limit of each hazard. Additional information is provided in Aqua Solutions 5 et. al. (2016).

4.1 Overview of Shoreline Hazards

Hazardous lands are defined in the PPS (MMAH, 2014) as “property or lands that could be unsafe for development due to naturally occurring processes.” Along shorelines of the Great Lakes – St. Lawrence River System, this means the land, including that covered by water, between the international boundary, where applicable, and the furthest landward extent of the flooding hazard, erosion hazard or dynamic beach hazard limits.

The technical basis and methodologies for defining and applying the hazard limits for flooding, erosion and dynamic beaches are provided by the *Technical Guide for Flooding, Erosion and Dynamic Beaches, Great Lakes – St. Lawrence River System and Large Inland Lakes* (MNR, 2001a). The basic procedures outlined in the *Technical Guide* (MNR, 2001a) with some modifications have been included in subsequent documents, such as *Ontario Regulation 97/04* (“Generic Regulation”) and *Guidelines for Developing Schedules of Regulated Areas* (MNR/CO, 2005). These methodologies have been applied in this study and are described in the following subsections.

It is important to note, as outlined in the *Technical Guide* (MNR, 2001a), that the regulated hazard limits are generally to be mapped based on the assumption of no shoreline protection works in place. The clearly stated intent is that the mapped flooding, erosion, and dynamic beach hazard limits are to represent the underlying, ambient nature of the natural shoreline hazard and should not be modified by the presence of existing or proposed shoreline protection. The maximum limit of the hazards is utilized in determining the regulated area along the ABCA shoreline.

The PPS (2014) states that development and site alteration shall not be permitted within the dynamic beach hazard (3.1.2a) and areas rendered inaccessible during times of flooding, erosion and/or dynamic beach hazards (3.1.2c). Development in hazardous areas shall not be permitted where the use is institutional, essential emergency services, or hazardous substances (3.1.5).

4.2 Erosion Hazard

As defined in Section 3.4.3, recession rates along the ABCA shoreline vary from low (<0.3 m/yr) to moderate (0.3 to 0.7 m/yr) and in a few specific locations recession rates are high (0.7 to 1.2 m/yr). Therefore, defining and mapping the shoreline hazard setback for the SMP is a critical activity to ensure future development is safe throughout the planning horizon.

When development is located on the tablelands of an eroding bluff, eventually the structural stability of the buildings will be compromised due to slope instability issues. If not relocated, the building will eventually be destroyed. Figure 4.1 shows a home located within the erosion hazard limit, where the bluff is actively eroding.



Figure 4.1: Residence located within the Erosion Hazard Limit on an actively eroding bluff on the ABCA shoreline

4.2.1 Definition of Erosion Hazard

The erosion hazard limit is calculated as the sum of the stable slope allowance, plus the 100-year erosion allowance. Figure 4.2 shows the erosion hazard limit as defined in the *Technical Guide* (MNR, 2001a) and *Understanding Natural Hazards* (MNR, 2001b).

The approach used in *Ontario Regulation 97/04* (see Section 2.1.2) is similar but the recession allowance is applied first and then the stable slope allowance is applied. The stable slope allowance was applied first for this SMP because the stable slope line was used to identify lands and infrastructure in an imminent high risk zone (refer to Section 5.7 for further details). Development should not be permitted within the stable slope allowance.

The stable slope allowance is a horizontal allowance measured landward from the toe of the bluff or bank. It is dependent on soil characteristics and groundwater conditions. The stable slope allowance is determined by a detailed site analysis using boreholes and a geotechnical analysis of slope stability. In the absence of a site-specific study, a stable slope allowance of three times the bluff height may be used. The bluff heights are calculated as the vertical change in elevation from the toe of bluff to the top of bluff.

The erosion allowance is the distance the shoreline would erode in 100 years from present. It is calculated as 100 times the average annual recession rate (AARR). In the absence of a minimum 35 years of reliable data, a

30 metre erosion allowance is used (as shown in Figure 4.3). This may also apply in areas where the shoreline has been protected and an erosion allowance cannot be determined.

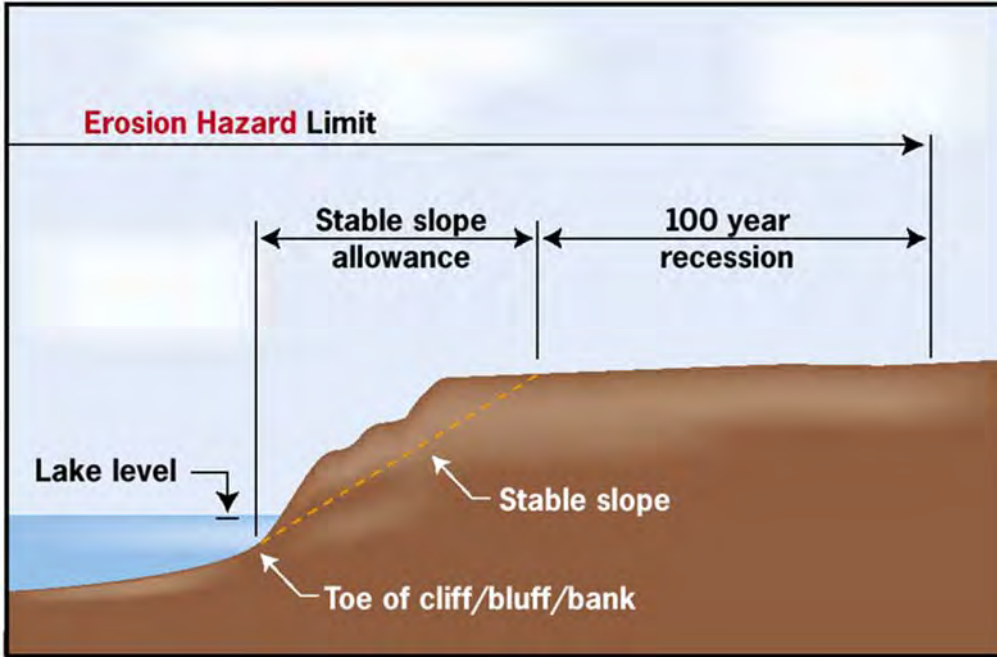


Figure 4.2: Erosion Hazard Limit defined with reliable recession data (from MNR, 2001b)

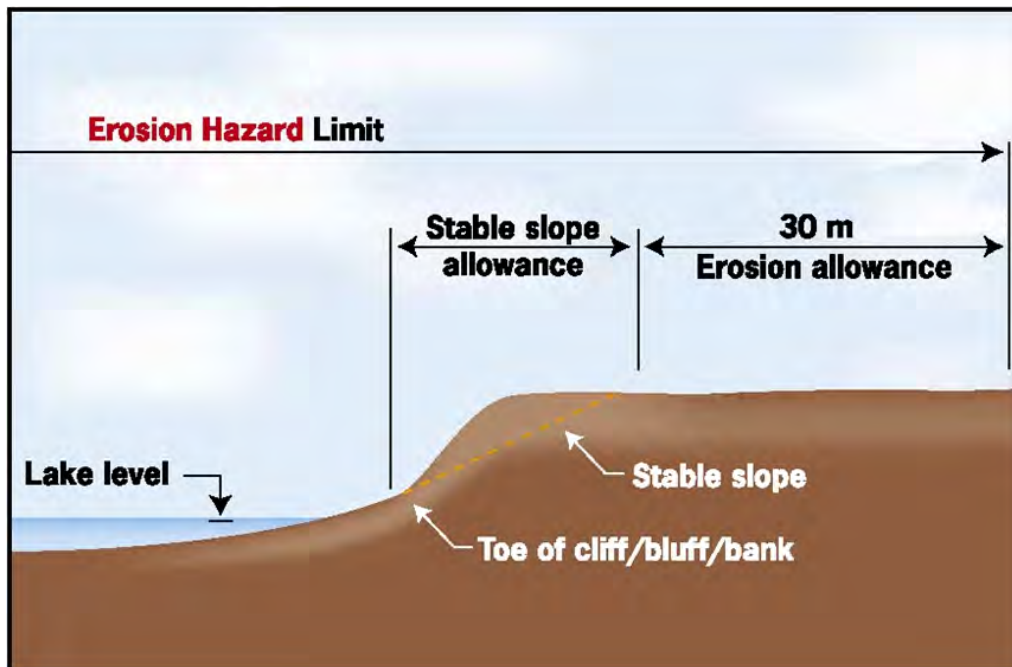


Figure 4.3: Erosion Hazard Limit defined where reliable recession data not available (from MNR, 2001b)

4.2.2 Mapping the Erosion Hazard

The *Technical Guide* (MNR, 2001a) recommends using a stable slope allowance of 3:1 (i.e., three times the bluff height, measured horizontally from the toe of slope) unless a geotechnical engineer provides a detailed site-specific study. A slope stability allowance of 3:1 was used for the entire study area. A bluff crest and toe line were derived from a 2007 Digital Elevation Model (DEM). The elevation difference between the toe and crest was calculated to establish the bluff height. The stable slope allowance was then projected landward from the toe.

The erosion allowance was calculated by multiplying the AARR by 100 years and then adding it, to the stable slope allowance to define the Erosion Hazard Limit. The recession rates for this study are summarized in Appendix C. In areas where the AARR was less than 0.3 m, 30 m was added to the stable slope as recommended in the *Technical Guidelines* (MNR, 2001a).

In locations where shoreline protection was evident, the AARR calculated using the earlier 1935 to 1988 shoreline comparison was used.

The ABCA classified the shoreline into Lakeshore Area 1 and Lakeshore Area 2 to assist in the implementation of the Development Guidelines as discussed in Section 5.7.2.

4.3 Flooding Hazard

Flooding along the ABCA shoreline is primarily focused on the low-lying areas around Bayfield and Port Franks, as well as neighbourhoods located at the toe of bluff such as Drysdale Beach Road. Refer to Figure 4.4 for an example of shoreline flooding. The definition and mapping procedures to delineate the flooding hazards are described in the following sections.



Figure 4.4: Example of shoreline flooding Port Franks 1987 (photo courtesy of ABCA)

4.3.1 Definition of Flooding Hazard

The flooding hazard limit is defined as the 100-year flood level plus an allowance for wave uprush and other water-related hazards, as depicted graphically in Figure 4.5.

The 100-year flood level is the sum of the mean lake level and storm surge with a combined probability of the 100-year return period. This means that on average it has a one per cent probability of occurring in any given year. The 100-year flood levels as defined by MNR (1989) and listed in Table 3.2 were used to map the flood hazard for the SMP.

When shorelines are exposed to wave action, wave uprush and overtopping occur, driving water above the 100-year water level. Other water-related hazards may include ship generated waves and ice. Site specific studies may be used to assess the allowance for wave uprush and water related hazards. The *Technical Guide* (MNR, 2001a) requires a flooding allowance of 15 m, measured horizontally from the location of the 100-year flood level, as shown in Figure 4.5, if a study using accepted engineering and scientific principles is not undertaken. The standard 15 m setback was adopted for the ABCA shoreline.

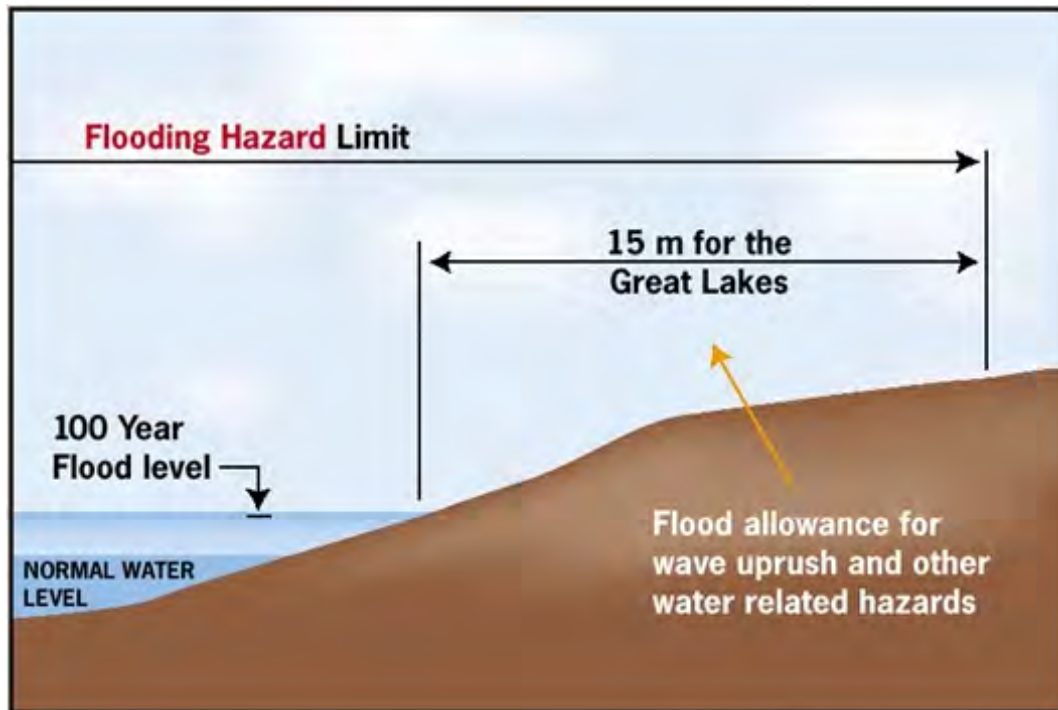


Figure 4.5: Flooding Hazard Limit for the Great Lakes (from MNR, 2001b)

4.3.2 Mapping the Flooding Hazards

The location of the 100-year flood levels from MNR (1989), listed in Table 3.2, were used by ABCA to map the flood hazard. The location of the 100-year flood level was mapped in 1988 (high lake level period) and in 2007 (low lake level period). The 1988 flood mapping was used as the base for mapping the flood and dynamic beach hazards since the lake was in a high level period in 1988. Sand had accumulated in the 2007 low lake period which meant elevation levels of the 100-year flood were lakeward of the 1988 mapping at some locations within the dynamic beach.

Once the 100-year flood level was mapped, a 15 m allowance for wave uprush and other water related hazards was applied in a landward direction to establish the Flood Hazard Limit. The limit of the regulatory line was mapped along the entire ABCA shoreline; however, in locations with a high bluff, the erosion hazard limit will be the governing setback.

4.4 Dynamic Beach Hazard

The southern section of the ABCA shoreline has historically been a deposition zone. Over thousands of years this deposition has resulted in an extensive beach-dune system along the Grand Bend/Pinery/Ipperwash shoreline. These beaches are important economic, cultural, recreational and ecological features that require careful management and protection.

The dynamic beach hazard recognizes that the land-water interface is a very dynamic environment in the Great Lakes due to wave erosion during storms, the wave and wind processes that lead to rebuilding of the beach and fluctuating lake levels. The Pinery Provincial Park dynamic beach is shown in Figure 4.6. The dynamic beach hazard includes an allowance for flooding, the dynamic nature of beach and dune environments, and long-term erosion. Although the dynamic beach area may possibly be receding (see

Section 3.3.4), additional studies would be required to assess this and the erosion component has therefore not been included in the dynamic beach hazard setback for this SMP.



Figure 4.6: Dynamic Beach with Developed Dune at Pinery Provincial Park (photo courtesy of ABCA)

4.4.1 Definition of Dynamic Beach Hazard

Assessment of the dynamic beach hazard involves the calculation of the cumulative impacts of the flooding hazard, an erosion allowance and a dynamic beach allowance.

The dynamic beach hazard is only applied where: a beach or dune deposit exists landward of the water line; the beach or dune deposits overlying bedrock or cohesive material are equal to or greater than 0.3 m in thickness, 10 m in width and 100 m in length along shoreline; and the fetch is more than 5 km (MNR, 2001a).

The dynamic beach hazard limit is defined as the landward limit of the flooding hazard (100-year flood level plus a flood allowance for wave uprush and other water related hazards) plus a 30 m dynamic beach allowance or a distance determined by an accepted coastal study, plus 100-year erosion allowance if the shoreline is eroding (see Figure 4.7).

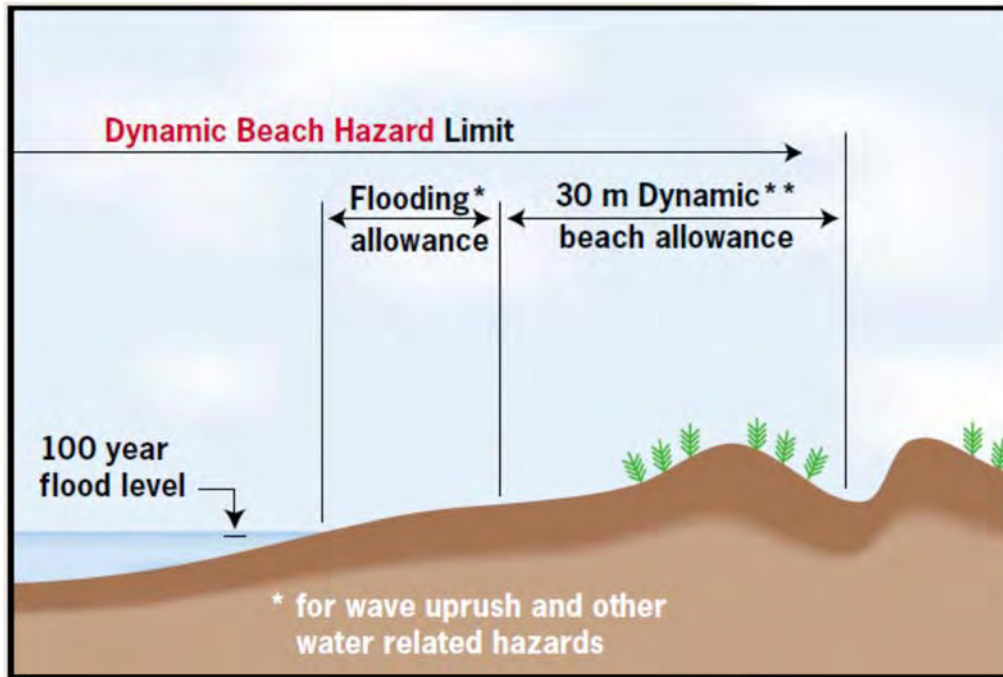


Figure 4.7: Dynamic Beach Hazard Limit (from MNR, 2001b)

The dynamic beach allowance is intended to permit the natural erosion and accretion of the beach/dune system in response to variable lake levels and storm events. As discussed previously, an erosion allowance has not been applied for beaches along the ABCA shoreline.

Where a dynamic beach exists lakeward of an eroding cohesive bluff, then the dynamic beach hazard and regulations apply to the area lakeward of the bluff toe; and the erosion hazard, consisting of stable slope allowance and an erosion allowance applies to the area landward of the bluff toe. This is discussed further in Aqua Solutions 5 et al. (2016).

4.4.2 Mapping the Dynamic Beach Hazard

Dynamic beaches within the study area were identified from Maple Grove subdivision southward and include Grand Bend, Pinery Provincial Park, and Ipperwash. An additional 30 m was added to the flooding hazard (described in Section 4.3.2), to map the dynamic beach hazard along these shorelines.

For shorelines with a dynamic beach backed by a cohesive bluff, the dynamic beach limit extends to the toe of bluff as described in Section 4.4.1. The bluff erosion hazard limit was also mapped at these locations.

The ABCA classified the shoreline into Lakeshore Area 1 and Lakeshore Area 2 to assist in the implementation of the Development Guidelines as discussed in Section 5.7.2.

5. Shoreline Management

5.1 Overall Management Approach

This section outlines the management approach to address both existing and future shoreline development along the ABCA shoreline. The management approach is consistent with the vision, guiding principles and key objectives of the *Shoreline Management Plan*. It also reflects the changing nature of the *Provincial Policy* since the shoreline was first developed and since the ABCA's first iteration of the SMP.

As has been established at the outset, the overall philosophy and approach is premised on a philosophy and practice of balanced management.

Provincial Policy direction is clear: no new hazards are to be created; existing hazards are not to be aggravated and adverse environmental impacts are not to result. Given the number of existing structures located in the erosion, flooding and dynamic beach hazard limits, the approach that is recommended is one that advocates for responsible management along the entire ABCA shoreline. This requires a strategic approach that looks to eliminate the risk to human life and property damage over time by ensuring that buildings and structures are located outside of the hazard. This approach is one that is upheld by existing *Provincial Policy*, supported by legislation and the mandate assigned to conservation authorities and confirmed in existing municipal planning documents.

The approach and overall philosophy support:

1. A clear science-based approach and commitment to ongoing monitoring and identification of hazards.
2. A prevention-first philosophy that will, over time, reduce the risk to natural hazards by encouraging the location of proposed development outside of areas subject to erosion, flooding and dynamic beach hazards.
3. A move, over a period of time, towards clearer consistency with the *Provincial Policy*.

The recommended management approach focuses on the importance of engaging landowners and working collaboratively with municipal partners to ensure that there is clarity, consistency, certainty and collaboration moving forward. It is premised on the need to recognize the changing nature of the shoreline and the need to advance a responsible management approach to ensure that the shoreline remains accessible, ecologically intact, enjoyable and safe for all.

Prior to the development of the *Shoreline Management Plan 2019*, the ABCA did not permit new development (as defined in the *Development Guidelines 2000*, henceforth referred to as DG 2000), in areas susceptible to flooding, erosion or dynamic beach hazards. Alterations to existing structures however have been permitted in the Lakeshore Area 1 and 2 and permits have, over time, been assessed on an individual case-by-case basis. Moving forward, the ABCA will continue to not issue permits for all new development in the hazard limits, except shore protection works in compliance with the *Development Guidelines 2019* (henceforth referred to as DG 2019), in areas that are subject to flooding, erosion and dynamic beach hazards. The ABCA will limit development for existing structures as described in the *Guidelines* described in Section 5.7.3.

5.2 Managing the Erosion Hazard

The ABCA shoreline includes eroding bluffs with different geological characteristics and recession rates as discussed in Section 3.4. The bluffs erode as a result of nearshore lakebed erosion and wave action undercutting the toe of the bluffs, which eventually leads to bluff instability and slumping. The slumped material

or talus is then removed by wave action and the process continues. The erosion of the bluffs and nearshore lakebed, as well as gully erosion and creeks, provide materials to the nearshore area. Of particular interest is the coarser material, specifically sands and gravels, which can form beaches and bars along the shoreline and thus provide some protection to the shoreline, as well as recreational benefits. Erosion of the bluffs along the northern portion of the ABCA shoreline provides the sand and gravel that nourishes the beaches at Grand Bend, Pinery Provincial Park, and Ipperwash. An objective of the SMP is to balance the desire to protect property with the requirement to ensure that protection does not negatively impact surrounding properties and the desire to maintain the existing sand beaches to the south. Wherever possible along the ABCA shoreline, the use of development setbacks, the relocation of existing buildings, and the acquisition of shoreline property by public organizations (i.e., municipalities and ABCA) should be utilized rather than the construction of shore protection structures. For new development, the application of this concept is relatively simple, and the DG2019, as prepared by the Planning Group, seeks to follow in that vein. The DG2000 stipulates that new development is not permitted within the Erosion Hazard. The DG2019 continues to prohibit new development in the Erosion Hazard.

For existing development, the application of this concept is more complicated (refer to Section 5.7). As with the DG2000, the DG2019 continues to strike a balance between, directing new development away from these hazardous areas, and recognizing that in most of the ABCA's shoreline jurisdiction development pre-existed. The DG2019 also recognizes the changing nature of development along the shore and seeks to pragmatically direct increased development further from the most hazardous areas of the shoreline than did the DG2000.

The PPS (2014) directs the ABCA to ensure that no new hazards are created; existing hazards are not aggravated; and adverse environmental impacts do not result. Construction of shore protection invariably has impacts, including a reduction in the supply of sediment to downdrift shorelines.

Where shore protection is considered, there are various approaches that may be used. The characteristics of the shoreline, the erosion mechanisms and coastal processes are important considerations. The ABCA shoreline includes eroding bluffs with different geological characteristics and recession rates as discussed in Sections 3.1 and 3.4. Baird (2017), included as Appendix B describes alternative methods of shore protection including groynes, revetments, seawalls, beach nourishment and offshore breakwaters.

Along bluff shorelines, shore protection must be the furthest landward of the 100-year lake level, a line connecting the toe of bluff or protection on adjacent properties; or the toe of existing bluff. For new protection a review by a coastal engineer is required; a review may also be required for replacement structures.

The ABCA does not support the construction of new groynes.

Bluff stabilization measures such as planting vegetation on the slope, controlling drainage, runoff and groundwater flow, and regrading the slope may also reduce erosion. Aqua Solutions 5 et al (2016) provides a summary of bluff stabilization methods. Additional information on slope stability risks and hazards is provided in the *Shoreline Slope Stability Risks and Hazards Fact Sheet for Property Owners prepared by Terraprobe Inc. for ABCA* (Appendix E).

5.3 Managing the Flood Hazard

There are a number of locations along the shoreline where dwellings have been constructed at the base of the cohesive bluff on what would once have been a beach; examples include Drysdale beach Road and Sandy Beach Road (see Figure 5.1). The 2015-2016 consulting team (Aqua Solutions 5 Inc. et al., 2016) found that these dwellings “may be subject to flooding due to wave uprush during periods of high lake level.”



Figure 5.1: Drysdale Beach Road with development located along the toe of the bluff

These dwellings are located on a dynamic beach and are exposed to erosion and flooding during periods of high lake level where the shoreline is unprotected; many of these properties have constructed shore protection. All three hazards: erosion, flooding and dynamic beach are applicable at these sites and the most landward hazard limit is applicable.

The area around the mouths of the Ausable River (Figure 5.2) and Mud Creek at Port Franks is highly dynamic as a result of shifting of the river channel (Figure 5.3) and the interaction of the discharge of the Ausable River with sand transport along the shoreline. Flooding from the river can impact development close to the shoreline. Heavy onshore winds at times of high lake levels can lead to water backup that can add to that flooding impact. Dredging of the Ausable River mouth may also contribute to movement of the shoreline. The situation is complex and in some areas a site-specific study may be required to determine the best approach to hazard management (Aqua Solutions 5 Inc. et al., 2016).

The DG2000 stipulates that new development is not permitted within the Flooding Hazard. The DG2019 continues to prohibit new development in the Flooding Hazard.

For existing development, limited alteration to properties is permitted (refer to Section 5.7).



Figure 5.2: Development around the mouth of the Ausable River



Figure 5.3: Development around mouth of Mud Creek

5.4 Managing the Dynamic Beach Hazard

The *Provincial Policy Statement* (2014) does not permit development within the Dynamic Beach Hazard. The ABCA currently allows some development in the dynamic beach but limitations are outlined in Section 5.7. New development must be set back landward of the dynamic beach hazard limit.

Development has historically been set back, landward of the dynamic beach hazard limit, in many areas along the dynamic beach shoreline of the ABCA watershed area. This has resulted in a well-vegetated dune zone in front of dwellings in areas such as Oakwood, north of Grand Bend, and south of the Grand Bend harbour to the border of Pinery Provincial Park. This is also present along sections of the Port Franks shoreline (Figure 5.4).



Figure 5.4: Development setback inland from the Dynamic Beach Hazard at Port Franks

In the Dynamic Beach, shore protection is permitted for protecting primary buildings, but must be landward of the 100-year flood level plus a 15 m allowance for wave uprush and other water related hazards. Protection in the dynamic beach is not permitted for non-essential structures. Shore protection works in the dynamic beach must be reviewed by a qualified coastal engineer and show no negative impacts.

ABCA (2015) has guidelines for:

- Maximum size of, and limit of locations for, structures such as decks, gazebos, and boat storage.
- Areas where vegetation can be cleared and where it cannot.
- Beach access trails – what's permitted and what is not.

Beach access paths should be no more than 2 m wide. These paths can be left as bare sand or covered with plastic mesh, bark chips, or like material. Instead of path, a wooden boardwalk may be considered where appropriate, but it should not be raised more than 0.5 m above the sand bed.

In terms of seasonal storage for canoes, sailboards, kayaks, and other small watercraft – larger structures such as roofed storage and decks must be located at least 15 m landward of the line of vegetation and they should not exceed 16 square metres in area. Simple rail platforms for seasonal storage would be permitted at least 5 m landward of the edge of vegetation.

Shoreline property owners can play a positive role in maintaining the protective benefits of dunes through good stewardship. There are excellent stewardship guides for landowners on the ABCA's sandy beach and dune shoreline, for example, the *Port Franks Beach and Dune Stewardship Guide* (Lake Huron Centre for Coastal Conservation, 2008, posted at (<https://www.lakehuron.ca/stewardship-plans-and-guides>)).

5.5 Managing the Shoreline Where More than One Hazard Applies

The ABCA has created hazard mapping for the entire ABCA jurisdiction and has assessed the three hazards: Flooding; Erosion; and Dynamic Beach. The ABCA has assessed, evaluated and mapped all of the hazards of systems in those areas. Where more than one hazard exists, the governing hazard is the furthest landward limit of all the applicable hazards.

5.6 Best Management Practices

Best management practices for bluff type shorelines are described in *Shoreline Slope Stability Risks and Hazard Fact Sheet* (Terraprobe Inc.), included in Appendix E.

Best management practices for dunes and dynamic beaches are provided in <http://theguide.huronstewardship.ca/a-stewardship-guide-for-the-lake-huron-coastline/>

5.7 Development Guidelines

The *Development Guidelines* provide direction to planners and the public, about development proposals within the shoreline hazard areas. They have been updated in parallel with *Shoreline Management Plan 2019* and are discussed in this section.

5.7.1 Process for Updating

As part of the SMP update, ABCA undertook a process to review and update the *Development Guidelines* (DG 2000). A Planning Group was formed with representatives from the lakeshore counties and municipalities and neighbouring conservation authorities:

- Central Huron, Bluewater, South Huron and Lambton Shores, Counties of Lambton and Huron.
- Maitland Valley Conservation Authority.
- Ausable Bayfield Conservation Authority.

The following challenges were identified for discussion and resolution:

- The DG2000 pre-date the *Technical Guide* (MNR, 2001), and therefore do not fully reflect the technical guidance from 2001.
- The *Development Guidelines* were updated for the 2000 SMP to address the amended 1997 *Provincial Policy Statement* (PPS). The PPS has been updated twice since then, most recently in 2014.

- Land use along the shore has changed substantially since the SMP 2000 was developed. Many residences that were previously used seasonally, are now occupied full time.
- Housing has changed substantially since the 2000 SMP. While the option to move houses away from the hazard may have been reasonable at that time, newer houses are often larger and much more difficult to move.

The Planning Group discussed the *Development Guidelines* in detail, including each of the development categories. The discussions were expanded to include redevelopment, shore protection and septic systems. The new *Development Guidelines* presented in Section 5.7.3 recognize the shoreline classifications: Lakeshore Area 1; and Lakeshore Area 2, described in Section 5.7.2.

5.7.2 Defining Lakeshore Area 1 and Area 2

The ABCA recognizes that incorporating the *Provincial Policy* which reflect the shoreline's hazardous nature can be a complex task. In the SMP 2000 (ABCA, 2000), the ABCA classified the shoreline into Lakeshore Area 1 and Lakeshore Area 2 to assist in the implementation of the hazard mapping and development guidelines.

To provide consistency with the previous SMP 2000 and mapping, the nomenclature and partitions were maintained but the definitions were updated to reflect more current provincial policies and the ABCA *Regulation for Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* (Ontario Regulation 147/06).

The definitions of Lakeshore Area 1 and Lakeshore Area 2, for the three hazards (erosion, flooding and dynamic beach) are summarized in the table below and a more detailed description follows.

Table 5.1: Definitions of Lakeshore Area 1 and Lakeshore Area 2 for the Erosion, Flooding and Dynamic Beach Hazards

Lakeshore Area 1			Lakeshore Area 2		
Flood		Dynamic Beach	Erosion	Dynamic Beach	Erosion
100-year Flood Level	15 m (Wave Uprush + OWRH)	100-year Flood Level + 15 m (Wave Uprush + OWRH) + 15 m	Stable Slope Allowance 3:1	Defined Portion of DBH – 30 m	Erosion Allowance = 100 x AARR
Other Water Related Hazards (OWRH)					

The following definitions have been used:

Flooding Hazard

Lakeshore Area 1: That area of the shoreline landward (or inland) from the water’s edge, including the 100-year flood level plus an allowance for wave uprush and other water related hazards (which is 15 m in the absence of a site-specific study). This is also known as the Flood Hazard Limit. The entire flooding hazard is considered to be in Lakeshore Area 1 (Lakeshore Area 2 is not applicable for the flooding hazard). Figure 5.5 depicts the Lakeshore Area 1 Flood Hazard Limit.

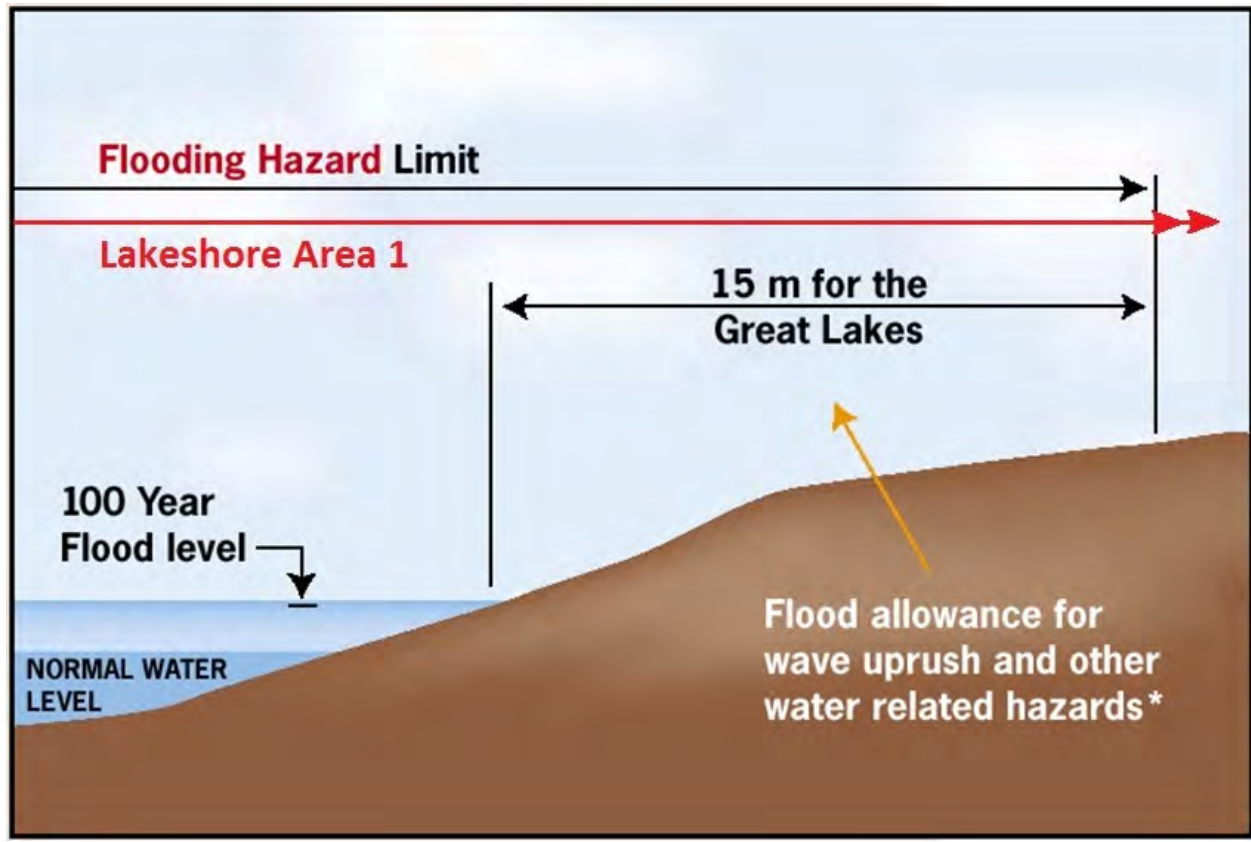


Figure 5.5: Lakeshore Area 1 for the Flooding Hazard

Erosion Hazard

Lakeshore Area 1: That area of the shoreline landward (or inland) from the water’s edge, including the stable slope allowance (3H:1V), from the toe of the bank, unless defined by a site-specific study undertaken by a geotechnical engineer. The Erosion Hazard for Lakeshore Area 1 is shown in Figure 5.6.

Lakeshore Area 2: That area of the shoreline located landward (or inland) from Lakeshore Area 1 extending landward to the greater of; a 100-year erosion setback (based on the 100 years times AARR) or 30 m. The Erosion Hazard for Lakeshore Area 2 is shown in Figure 5.6.

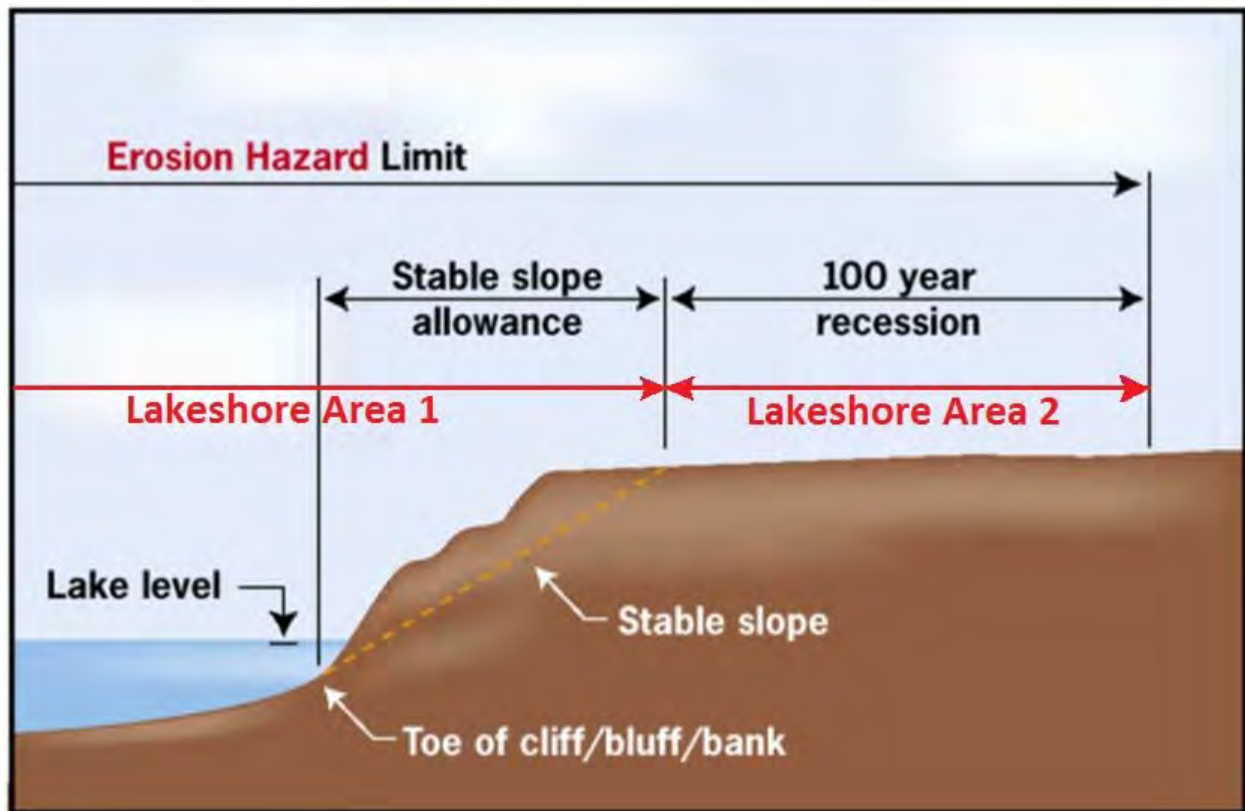


Figure 5.6: Lakeshore Areas 1 and 2 for the Erosion Hazard

Dynamic Beach Hazard

Lakeshore Area 1: That area landward (or inland) from the water's edge including the 100-year flood level plus a distance of 30 m measured horizontally. This 30 m includes the 15 m allowance for wave uprush and other water related hazards plus an additional ABCA 15 m allowance (equal to one half (15 m) of the dynamic beach allowance) as shown in Figure 5.7. This is part of the active beach zone and portion of the dune complex that would be affected by wave action during extreme events including the 100-year event.

Lakeshore Area 2: That area landward (or inland) from Lakeshore Area 1 to the inshore limit of the dynamic beach (further 15 m landward from the inshore limit of Lakeshore Area 1). This area is also part of the active beach zone and dune complex that would be affected by wave action during extreme events including the 100-year event. The Dynamic Beach Hazard for Lakeshore Area 2 is shown in Figure 5.7.

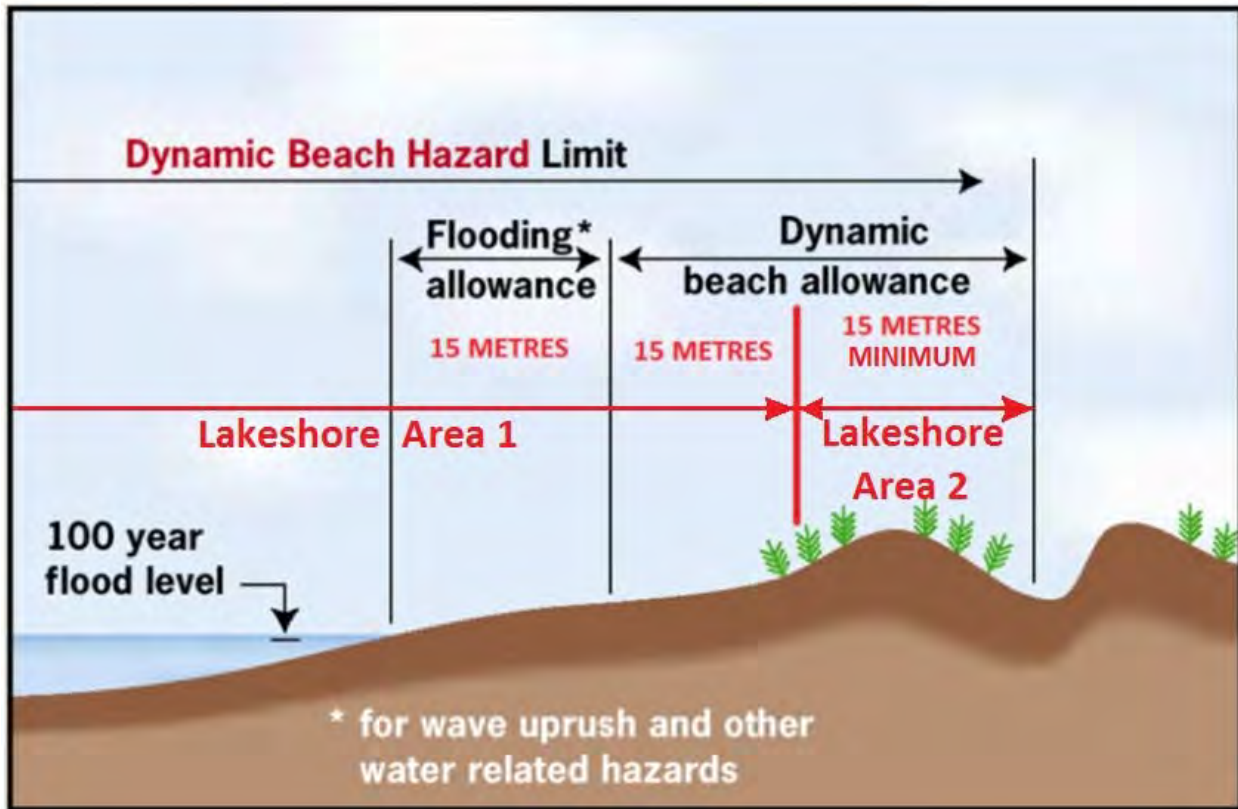


Figure 5.7: Lakeshore Areas 1 and 2 for the Dynamic Beach Hazard

5.7.3 Updated Development Guidelines 2019

The updated *Development Guidelines 2019 (DG2019)* for existing and new development along the ABCA shoreline are presented in Appendix F. The *DG2019* are based on direction provided in the *MNR Technical Guide* (MNR, 2001a) and are consistent with direction provided in the *Provincial Policy Statement 2014* (MMAH, 2014), with the exception of guidelines allowing some development in the less hazardous portion of the Dynamic Beach Hazard. This approach recognizes existing development and provides a strategic approach that looks to eliminate the risk to human life and property damage over time. The *DG2019* provide minimum setback requirements. Property owners are reminded that the preferred approach is to setback as far as possible from the hazards and observing setbacks inland of the hazard limit is the recommended approach in all cases.

The *Development Guidelines (2019)* allow some development within portions of the Erosion Hazard. No development is permitted within the Stable Slope Allowance; however some development is permitted within the 100-year erosion allowance, specifically within the 25-year and 50-year erosion planning horizons.

6. Engagement for SMP Development

This section summarizes the stakeholder engagement process for the development of the Shoreline Management Plan 2019, which took place between 2015 and 2018 and the Planning Group responsible for updating the Development Guidelines. A detailed summary is provided in Appendix G.

6.1 Public Process (2015 to 2016)

ABCA initiated the process for public consultation in 2015 including the formation of a Multi-stakeholder community Steering Committee that attended multiple meetings between July 2015 and October 2016. A web page dedicated to content about the shoreline management plan update was developed abca.ca (<https://www.abca.ca/page.php?page=shoreline-management>), media reports were released, a public survey was conducted, a newsletter was provided with updates at regular intervals and there were a number of meetings and presentations.

6.2 Public Open Houses (2017)

Two Public Open Houses were held during the summer of 2017:

- June 3, 2017 in Zurich.
- June 17, 2017 in Thedford.

The format included information stations with Conservation Authority personnel to explain shoreline management issues and policies. Formal presentations were made by Dr. Robin Davidson-Arnott, and Fiona Duckett (Baird). An open forum for questions and answers followed. The presentations were recorded on video and posted on the ABCA website at <https://www.abca.ca>

6.3 Public Open Houses (2018)

Two Public Open Houses were held during the summer of 2018:

- August 11, 2018 in Thedford.
- August 18, 2018 in Zurich.

The format included information stations with Conservation Authority personnel to explain shoreline management issues and policies. Formal presentation was Fiona Duckett (Baird) and Geoff Cade (ABCA). An open forum for questions and answers followed. The presentations were recorded on video and posted on the ABCA website at <https://www.abca.ca>

6.4 Planning Group for Updating Development Guidelines

As part of the SMP update, ABCA undertook a process to review and update the Development Guidelines. A Planning Group was formed with representatives from the counties and neighbouring conservation authorities:

- Central Huron, Bluewater, South Huron and Lambton Shores, Counties of Lambton and Huron.
- Maitland Valley Conservation Authority.
- Ausable Bayfield Conservation Authority (St. Clair Region Conservation Authority was also invited to participate but was unable to, due to staffing changes).

The Planning Group discussed the Development Guidelines in detail, including each of the development categories. The discussions were expanded to include redevelopment, shore protection and septic systems.

7. References

Aqua Solutions 5 Inc., Dr. Robin Davidson-Arnott, Dr. Ryan Mulligan, Planning Solutions Inc. and Terraprobe Inc., 2016. Shoreline Management Plan 2016 Consultant Recommendation Report.

Ausable-Bayfield Conservation Authority (ABCA), 1990. "Inventory of Erosion Control Structures on Lake Huron". October 1990.

Ausable-Bayfield Conservation Authority (ABCA), 1994. "Shoreline Management Plan".

Ausable-Bayfield Conservation Authority (ABCA), 2000. Shoreline Management Plan, Second Edition.

Ausable-Bayfield Conservation Authority (ABCA), 2016. ABCA Historic Photo Pilot, Assessment of Techniques Using Historic Imagery to Locate the Toe and Top of the Slope in a Section Along Lake Huron
Baird, 1994. Considerations for Shoreline Protection Structures. A report prepared for Ausable Bayfield Conservation Authority.

Ausable Bayfield Conservation Authority (ABCA), 2015. Policies and Procedures Manual for the Administration of Ontario Regulation 147/06 (2007). 2015 Guidelines for Creating Beach Access and Sitting Area.

Baird, 1994. Shoreline Management Plan - Considerations for Shoreline Protection Structures. A report prepared for Ausable Bayfield Conservation Authority.

Baird, 2017. Considerations for Shoreline Protection Structures. A report prepared for Ausable Bayfield Conservation Authority.

Baird, 2018. Shoreline Management Plan Update 2018. Review of Recession Rate Analyses. A report prepared for Ausable Bayfield Conservation Authority.

Environment Canada and Ontario Ministry of Natural Resources, 1973. Canada-Ontario Great Lakes Shore Damage Survey Coastal Zone Atlas.

Ministry of Municipal Affairs and Housing, 2014. Provincial Policy Statement, 2014.

Ministry of Natural Resources (MNR), 2001a. Technical Guide for Flooding, Erosion and Dynamic Beaches, Great Lakes – St. Lawrence River System and Large Inland Lakes. CD-ROM Published by the Watershed Science Centre, Trent University, Peterborough, Ontario for the Ontario Ministry of Natural Resources.

Ministry of Natural Resources (MNR), 2001b. Understanding Natural Hazards – An Introductory Guide for Public Health and Safety Policies 3.1, Provincial Policy Statement.

Ministry of Natural Resources (MNR), 1989. Great Lakes System Flood Levels and Other Water Related Hazards. February, 1989.

Ontario Ministry of Natural Resources / Conservation Ontario (MNR/CO), 2005. Guidelines for Developing Schedules for Regulated Areas.

Reinders, F.J. and Associates, 1989. Lake Huron Shoreline Processes Study for: Ausable Bayfield Conservation Authority, Maitland Valley Conservation Authority, St. Clair Region Conservation Authority, Saugeen Valley Conservation Authority.



Appendix A

Draft 2016 Consultant Recommendation Report

Note to the Reader:

On November 03, 2016 the Board of Directors of the Ausable Bayfield Conservation Authority resolved to reject the concept of *Managed Retreat* as presented in the *Draft 2016 Consultant Recommendation Report*. The Board did recognize however, that the report contained very important technical information. As a result, the *Draft 2016 Consultant Recommendation Report* is provided in its entirety in Appendix A as background information only.



Appendix B

Considerations for Shoreline Protection Structures



Appendix C

ABCA Recession Rate Data



Appendix D

ABCA Hazard Mapping



Appendix E

Shoreline Slope Stability Risks and Hazards Fact Sheet

(Terraprobe Inc.)



Appendix F

Development Guidelines 2019



Appendix G

Public Engagement Process