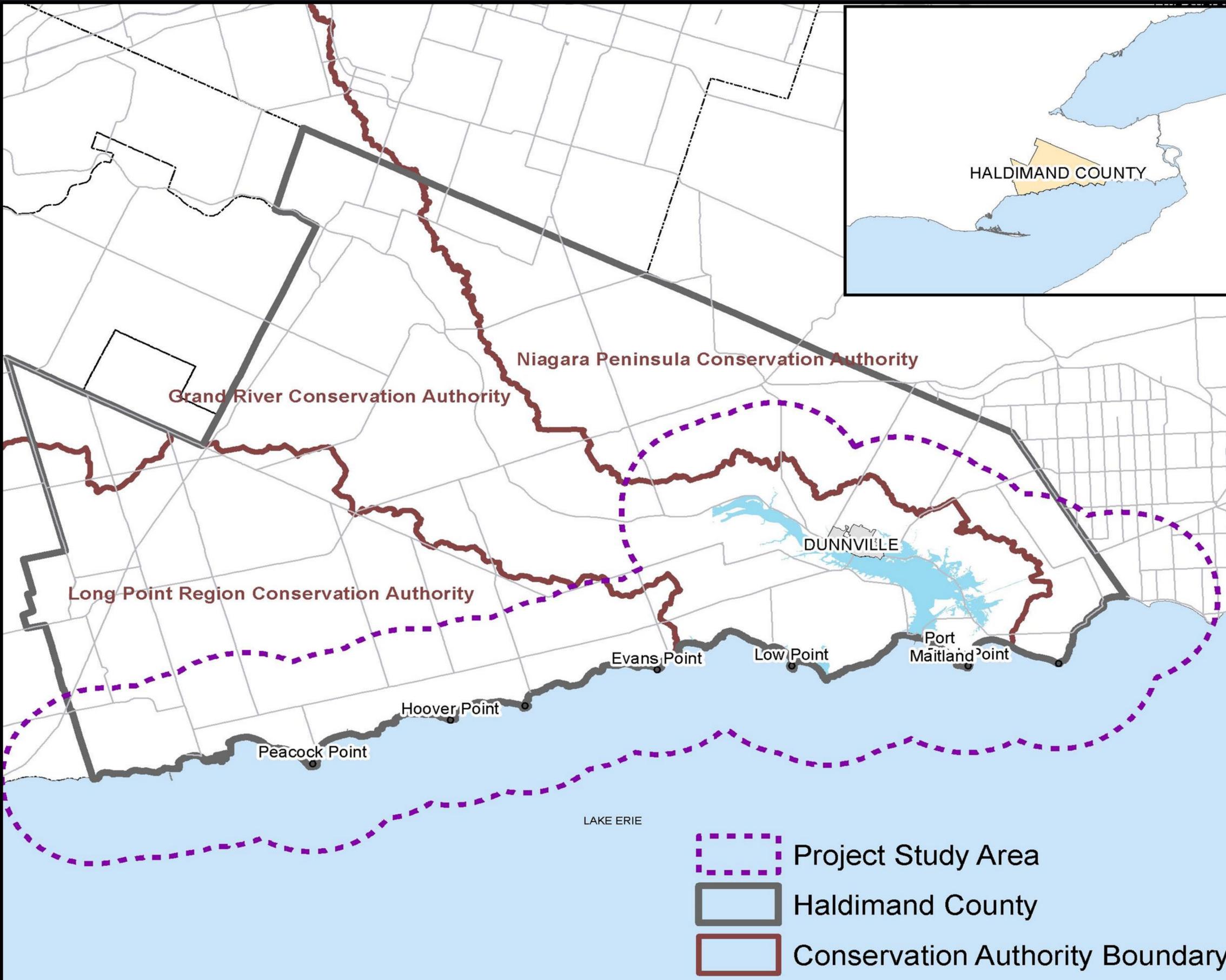


# PROJECT PARTNERS AND STUDY AREA

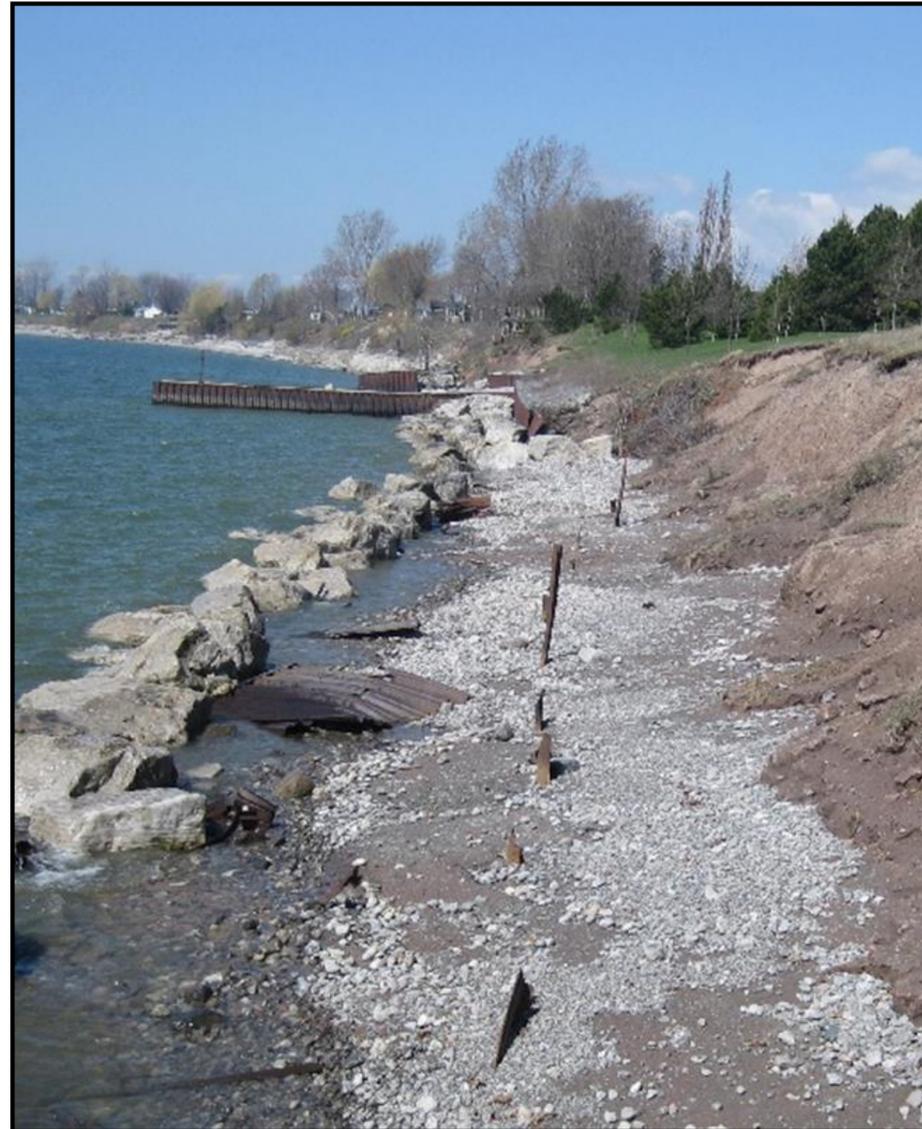


# WHAT ARE THE HAZARDS?

## TYPES OF HAZARDS



Flooding



Erosion



Dynamic Beaches

# WHAT IS HAZARD MAPPING?

## Haldimand County Lake Erie Shoreline Flood and Erosion Hazards



**Haldimand County**  
 Haldimand County  
 Cayuga Administration Building  
 45 Munsee Street North  
 Cayuga, N0A 1E0  
[www.haldimandcounty.on.ca](http://www.haldimandcounty.on.ca)

**Long Point Region C.A.**  
 4 Elm St.  
 Tilsonburg, N4G 0C4  
[www.lprca.on.ca](http://www.lprca.on.ca)

**Grand River Conservation Authority**  
 Grand River C.A.  
 400 Clyde Road, PO Box 729  
 Cambridge, N1R 5W8  
[www.grandriver.ca](http://www.grandriver.ca)

**NIAGARA PENINSULA CONSERVATION AUTHORITY**  
 Niagara Peninsula C.A.  
 250 Thorold Road West, 3rd Floor  
 Welland, L3C 3W2  
[www.npsa.ca](http://www.npsa.ca)

**Legend**

**Hazard Mapping**

- Toe of Bluff
- Stable Slope Allowance
- Erosion Hazard Limit
- 100 Year Flood Level
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

**Basemap Features**

Elevation Contours

**Elevation**  
 Topographic elevation contours are derived from two sources: 2015 Southwestern Ontario Orthophotography Project (SWOOP) Digital Terrain Model (DTM), and the 2017 Lake Erie Watershed LiDAR Digital Terrain Model. The 2017 dataset provides coverage of the Grand River and most of the Haldimand County Lake Erie shoreline, except for about 7.5 km of shoreline East of Erie Heights Line to the eastern County limit, which is covered by the 2015 dataset.

The 2015 SWOOP DTM is a 2 metre raster elevation data product that was generated from a classified LAS, acquired through the Government of Ontario's Imagery Acquisition Strategy. GRCA processed the DTM to create products in the new vertical datum of CGVD2013. GRCA converted the 2 m DTM to points and converted from CGVD28 to CGVD2013 using the Natural Resources Canada GPS-H desktop tool, then converted back to a raster with a 2 m cell size, then generated contours at a 1 m interval. Data was collected between 12 April and 23 May 2015.

The 2017 Lake Erie Watershed LiDAR data was collected as part of the Ontario Government's LiDAR Digital Terrain Model (2015-2018) Land Information Ontario (LIO) Dataset. It was collected in March to May 2017 and October to December 2017. The LiDAR Digital Terrain Model (DTM) is a 50 cm resolution raster representing the bare-earth terrain derived from a classified LiDAR point cloud, which has been hydro-flattened using water body breaklines. Topographic contours are shown at 0.5 metre intervals.

**100 Year Flood Level**  
 The 100 Year Flood Level is defined as the peak instantaneous stillwater level (i.e. mean lake level plus storm surge) having a combined probability of being equaled or exceeded during any year of 1% (i.e. probability, P=0.01). The 100 Year Flood Level elevation varies across Haldimand County as follows.

Reaches	Description	Elevation CGVD2013 (m)
1 to 7	West County Limit to Nanticoke	175.9
8 to 31	Nanticoke to Hoover Point	176.0
32 to 62	Hoover Point to Low Point	176.1
63 to 76	Low Point to Mohawk Point	176.2
77 to 84	Mohawk Point to Lowbanks	176.3

**Flood Hazard Limit**  
 The Flood Hazard Limit is defined as the 100 Year Flood Level plus an allowance for Wave Uprush. The allowance for Wave Uprush was determined on a reach basis using a representative profile for each reach.

**Toe of Bluff**  
 The Toe of Bluff (cliff, bluff or bank) was defined by interpretation of the 2015 airphotos and topographic contours.

**Stable Slope Allowance**  
 The Stable Slope Allowance is defined as a horizontal allowance, measured landward from the toe of the shoreline cliff, bluff, or bank. The Stable Slope allowance was determined on a reach basis using borehole data and a geotechnical analysis.

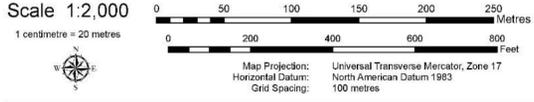
**Erosion Hazard Limit**  
 The landward limit of the Erosion Hazard is the sum of the Stable Slope Allowance plus an Erosion Allowance measured landward from the toe of the shoreline cliff, bluff, or bank. The Erosion Allowance reflects the erosion that would be expected to occur over 100 years, and was assessed for each reach.

**Dynamic Beach Hazard Limit**  
 The Dynamic Beach Hazard Limit is defined as the sum of the Flood Hazard Limit plus 30 metres (measured horizontally), or as determined by a site specific technical study by the Conservation Authority.

**Aerial Photography**  
 The 2015 Southwestern Ontario Orthophotography Project (SWOOP) acquired aerial imagery at 20 cm resolution through the Government of Ontario's Imagery Acquisition Strategy that provides LIO with a mandate to collect and refresh imagery for southern Ontario on a five year cycle. Data was collected between 12 April and 23 May 2015. This dataset is consistent across the entire study area of Haldimand County. Licensed by Haldimand County. INCLUDES MATERIAL, © 2015, OF THE QUEEN'S PRINTER FOR ONTARIO. ALL RIGHTS RESERVED.

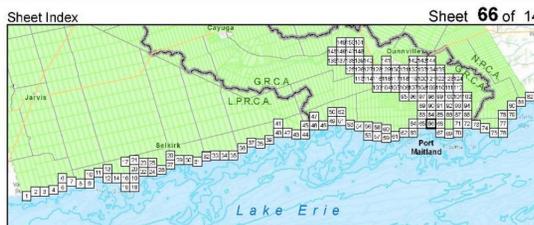
**Lake Erie Water Level**  
 The Lake Erie Chart Datum (Low Water Datum, IGLD1985) elevation is 173.5 metres. Corresponding with the aerial photography shown in this map, the Lake Erie monthly mean water level for April 2015 was 174.22 metres and for May 2015 was 174.31 metres (IGLD1985). Water Level information is provided by Canadian Hydrographic Service, Fisheries and Oceans Canada.

Every reasonable effort has been made to ensure the accuracy of this map. However, neither Haldimand County, LPRCA, GRCA, NPCA or Baird assume any liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.



Mapping Prepared by: **Baird.** W.F. Baird & Associates  
 Coastal Engineers, Ltd.  
 Oakville & Ottawa, Ontario  
[www.baird.com](http://www.baird.com)

Map Publication Date: 28 August 2019



## HAZARD MAPPING:

- 01 Identifies shoreline areas at risk of flooding and erosion, or that meet the criteria for dynamic beaches.
- 02 Supports implementation of County Official Plan policies and Conservation Authority regulation of development in shoreline areas.
- 03 The Ontario Ministry of Natural Resources and Forestry provides the technical guidance on how to identify and map these hazard areas.

# HALDIMAND COUNTY LAKE ERIE SHORELINE HAZARD MAPPING AND RISK ASSESSMENT

## PROJECT SCOPE

### PURPOSE

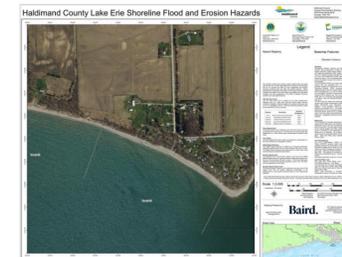
- 01 To update to current mapping and technical standards, the Lake Erie shoreline flooding, erosion and dynamic beach hazard mapping within Haldimand County.
- 02 To develop consistent hazard mapping across conservation authority jurisdictions (LPRCA, GRCA, NPCA), that will support flood and erosion related response and mitigation planning, land use planning and permitting decisions.
- 03 To update flood risk assessment information for shoreline flooding, including estimates of damage potential.

### KEY TASKS



#### Background Data Review and Site Visits

- Site visits by consulting team
- Review background data and reports
- Prepare Technical Memo



#### Prepare Base Maps

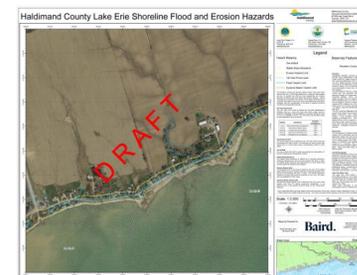
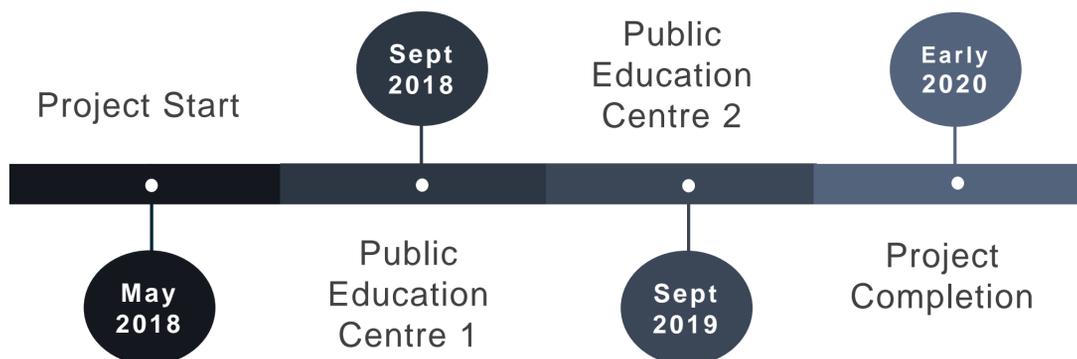
- 1:2000 scale base maps will be prepared for the study area
- The maps will show topographic contours, surface water features, wetlands, buildings, parcel fabric and municipal infrastructure



#### Public Engagement

- Public Education Centres (2)
- Community Liaison Group will attend project meetings, receive updates and provide input

### SCHEDULE



#### Prepare Shoreline Hazard Mapping

- Technical analyses to delineate Flood, Erosion and Dynamic Beach Hazards based on guidance provided in the MNR Technical Guide;
- Identification of flood and erosion related risks and issues;
- Vulnerability assessment of at risk structures
- Recommendations will be made for protection and maintenance of municipal infrastructure
- Slope Stability Risk report is a value added deliverable
- Maps will highlight emergency ingress-egress routes during flooding



#### Update Flood Risk Assessment

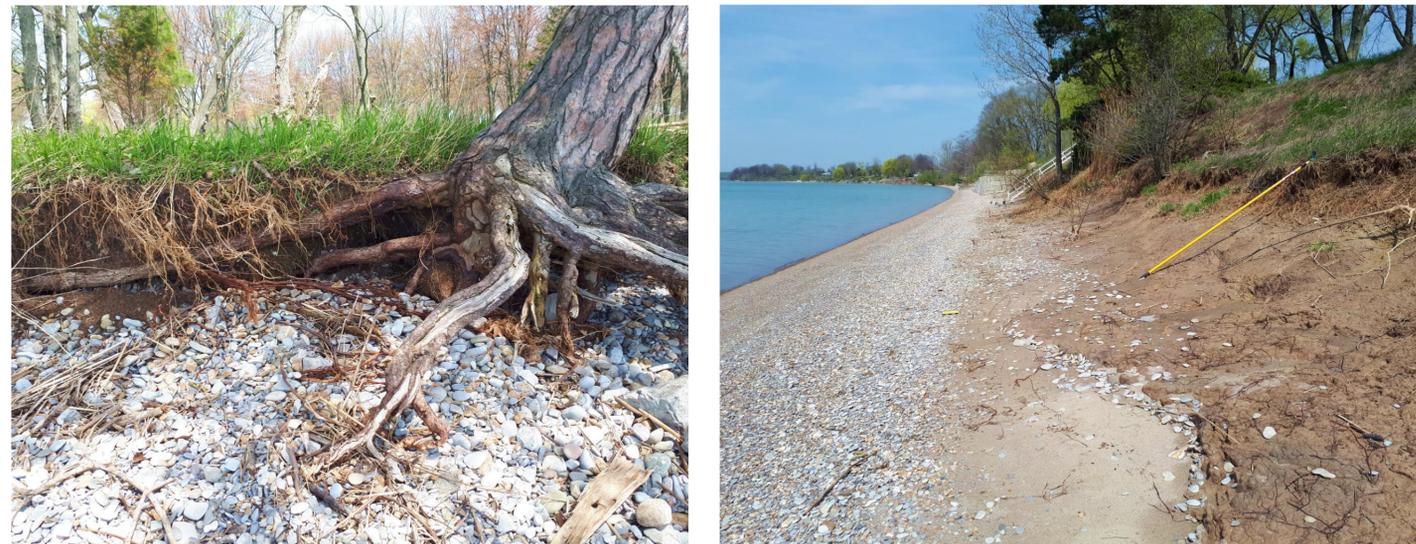
- Inventory of at risk buildings, roads and bridges within flood, erosion and dynamic beach hazards will be identified
- Vulnerability assessment of at risk structures
- Review of existing flood mitigation measures
- Assessment of future risks considering climate change
- Workshop with County and CA staff
- Prepare report

# HALDIMAND COUNTY LAKE ERIE SHORELINE HAZARD MAPPING AND RISK ASSESSMENT

## SITE VISITS & BACKGROUND REVIEW

### SITE VISITS BY CONSULTING TEAM

- Familiarize team with shoreline characteristics and local issues
- Site visits in May 2018 (Baird) and August 2018 (Terraprobe)
- Assess flood, erosion and dynamic beach vulnerabilities
- UAV and ground photos used to document shoreline



### REVIEW BACKGROUND DATA & REPORTS

- Ontario Regulations for the Administration of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (150/06, 178/06, 155/06)
- Shoreline Management Plans
- Haldimand County Official Plan
- Haldimand County Flood Risk Assessment
- Haldimand County Emergency Response Plan
- Source Water Protection Plans
- Great Lakes – St. Lawrence River System: Technical Guide
- Great Lakes System Flood Levels and Water Related Hazards
- Digital Terrain Models
- Regulated Areas Mapping
- Mapping of Haldimand County feature (municipal drains, roads, water/wastewater/stormwater management infrastructure, parks, roads)

### PREPARE TECHNICAL MEMO

- Describe background review
- No significant data gaps identified
- Analytical approach to project confirmed



# HALDIMAND COUNTY LAKE ERIE SHORELINE HAZARD MAPPING AND RISK ASSESSMENT

Base mapping was developed for mapping the natural hazard regulation limits (erosion, flood and dynamic beach).

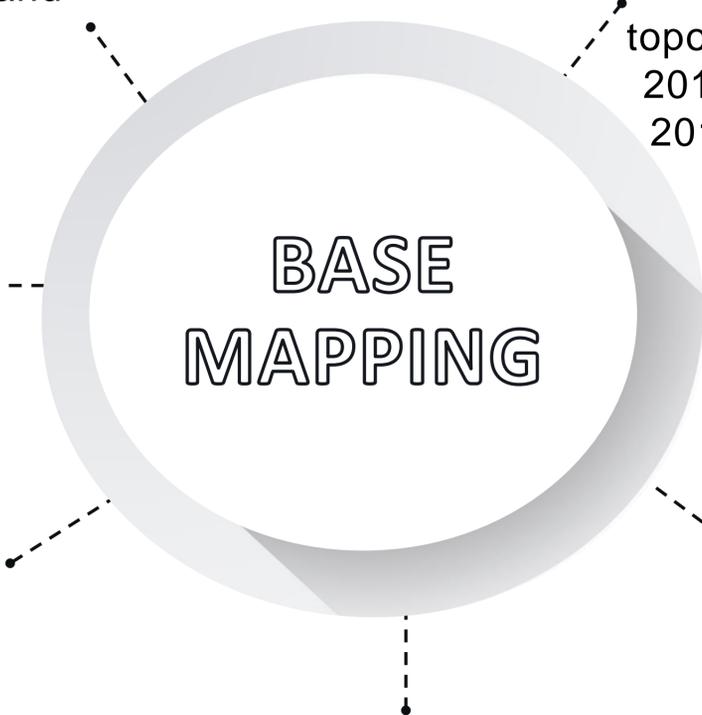
Aerial imagery collected in 2015 for the Southwestern Ontario Orthophotography Project (SWOOP) was used for the base maps. New topographic and bathymetric information collected in 2017 was available for most of the study area. The 2015 SWOOP data was used for the eastern most 7.5 km of the study shoreline.

The base mapping provides a common mapping foundation for Haldimand County.

The mapping is at 1:2,000 scale (1 cm = 20 metres; sufficient detail to differentiate a car from a pick-up truck).

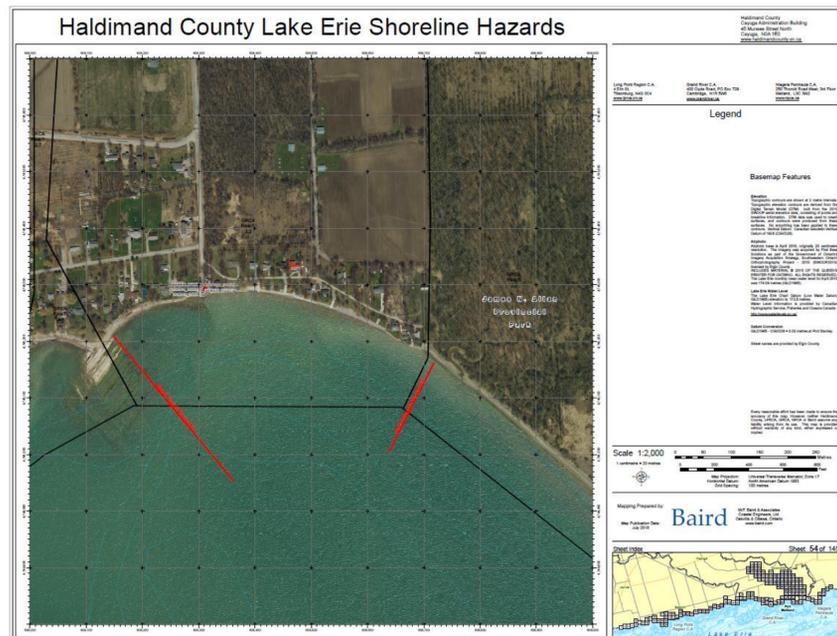
Mapped features include: topographic and structures, infrastructure and aerial imagery.

The shoreline was divided into 84 reaches based on similar shoreline characteristics.

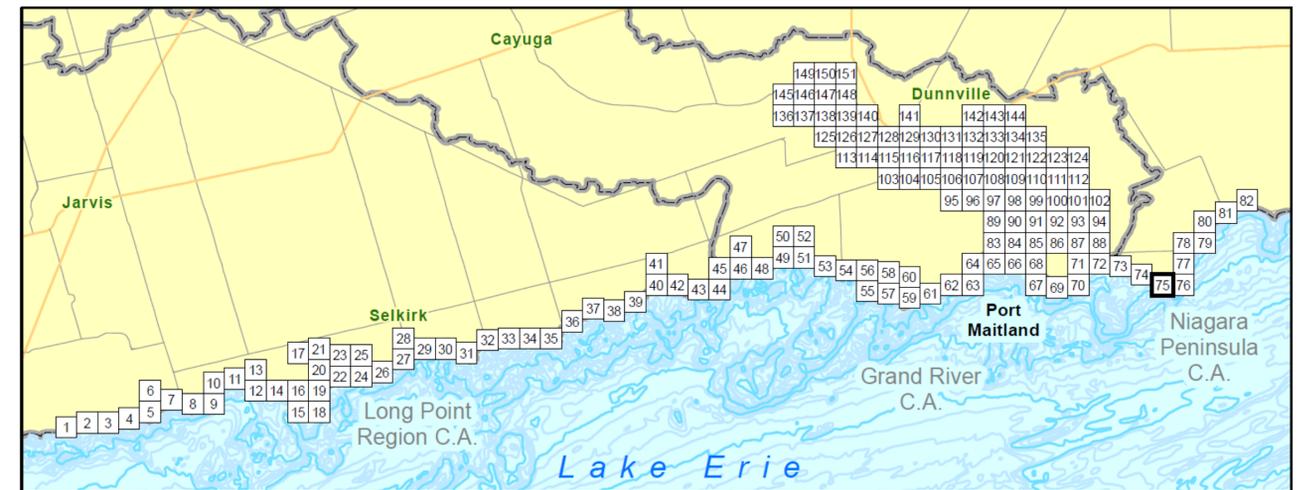


151 map tiles

## MAP TILE EXAMPLE



## MAP TILE SHEET INDEX

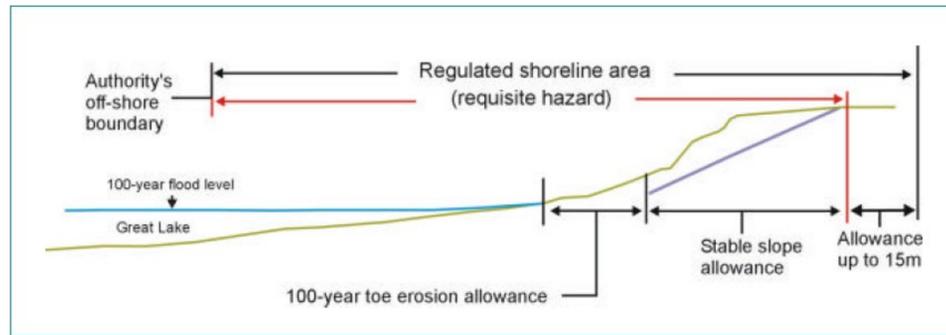


# HALDIMAND COUNTY LAKE ERIE SHORELINE HAZARD MAPPING AND RISK ASSESSMENT

## PROVINCIAL TECHNICAL GUIDELINES

The Area of `Shoreline Regulation' extends from the furthest offshore extent of the Authority's jurisdictional boundary to the furthest landward extent of the aggregate of the following natural hazards and allowances.

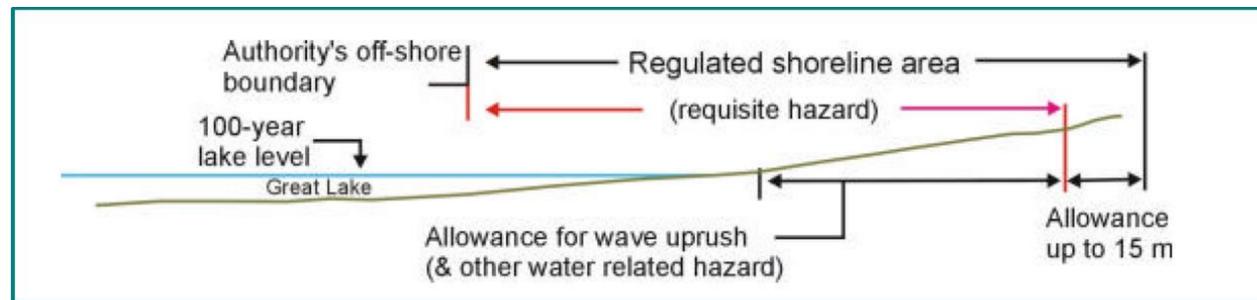
### SHORELINE EROSION HAZARD



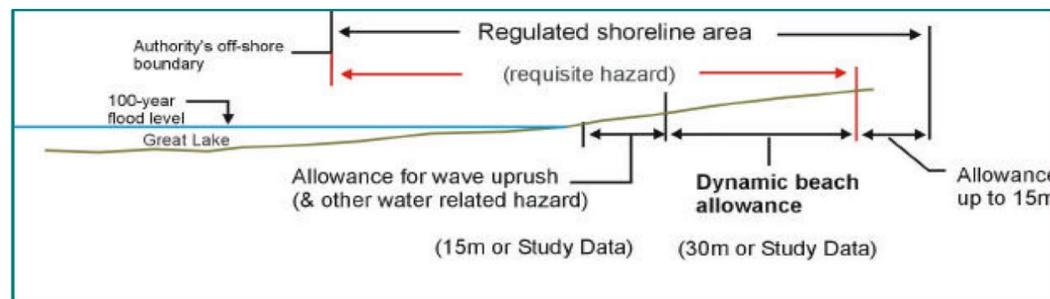
EQUALS  
the stable toe of slope (as may be shifted as a result of erosion over a 100-year period)  
PLUS  
the predicted long-term stable slope projected from the stable toe of slope

### SHORELINE FLOOD HAZARD

EQUALS  
the 100-year flood level  
PLUS  
an allowance for wave uprush



### SHORELINE DYNAMIC BEACH HAZARD



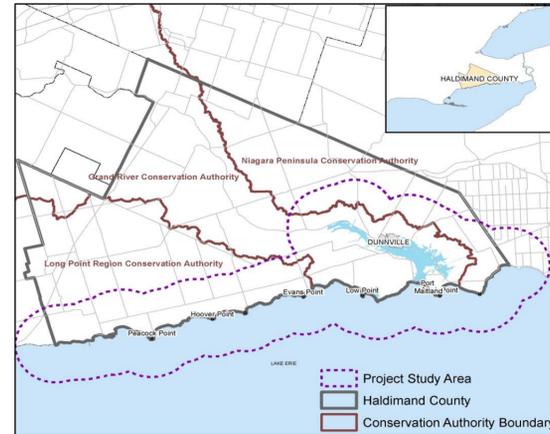
EQUALS  
the 100-year flood level  
PLUS  
an allowance for wave uprush  
PLUS  
an allowance to accommodate dynamic beach movement

# HALDIMAND COUNTY LAKE ERIE SHORELINE HAZARD MAPPING AND RISK ASSESSMENT

## WHAT'S NEW IN THE 2019 HAZARD MAPPING UPDATES?

### CONSISTENCY

- The **previous hazard mapping** was based on **3 separate studies** and the approaches differed for each Conservation Authority within Haldimand County:
- Long Point Region Conservation Authority (1989)
- Grand River Conservation Authority (1994)
- Niagara Peninsula Conservation Authority (2010)
- For the **new hazard mapping**, a **uniform approach** has been used for the entire Haldimand County shoreline.



### NEW DATA

- New **water level data from 1988 to 2019** used to assess the 100-year flood level.
- New and higher resolution **LiDAR topography data (2017)** and **bathymetry data (2018)**.
- New and higher resolution **aerial imagery collected in 2015** used for historical shoreline comparison, to assess erosion rates.
- Ground and UAV photos collected in 2018**, by the project team to assess shoreline conditions.



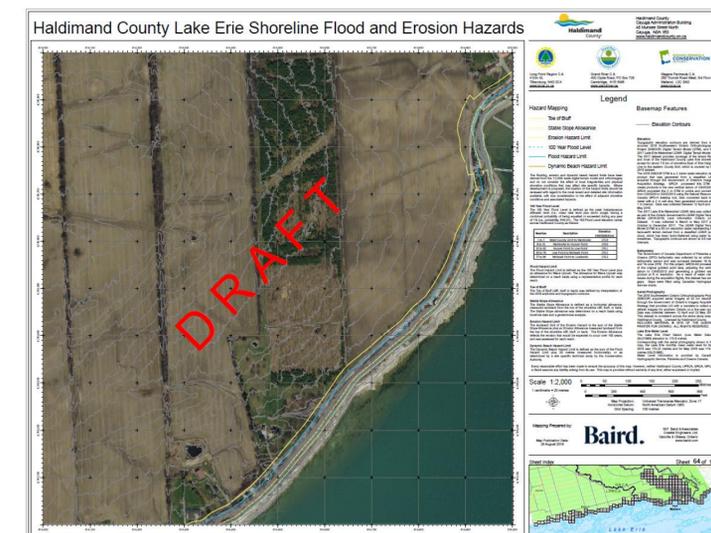
### UPDATED ANALYSES

- Shoreline divided into more detailed reaches for hazard mapping.
- Wave uprush calculated on a reach basis (previously default value used).
- Geotechnical analysis used to assess stable slope allowance on a reach basis (previously a default value used).
- Historical aerial imagery used to assess erosion allowance (previously default values used).



### IMPROVED MAPPING APPROACH

- All data sets incorporated into a single mapping software environment.



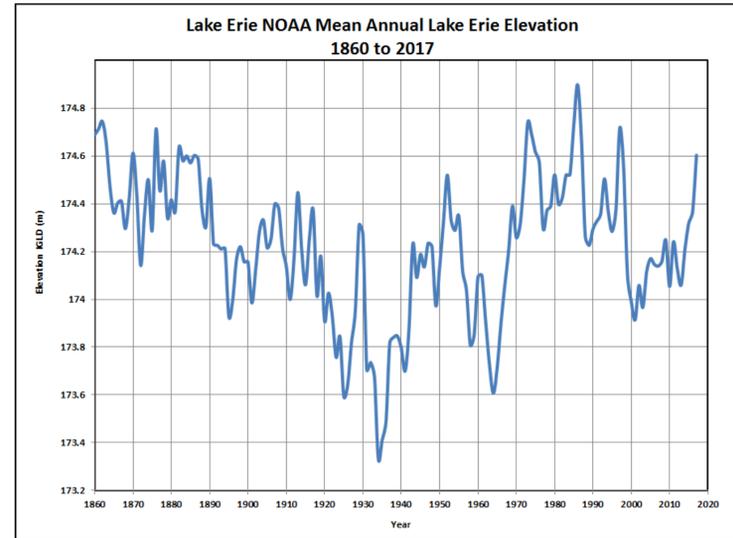
# LAKE ERIE FLOOD RISK

## LAKE LEVELS

Lake levels follow a seasonal pattern, peaking after spring runoff and reaching a low later in the year.

Long term lake levels cycle over decades. Higher levels occurred in the 1970s, 1980s and 1990s. Lake Erie reached record levels in 2019.

“Surge” occurs when air pressure and winds push the water from one side of the lake to the other, and can result in up to 4 m of elevation difference.



## FLOOD INFORMATION

Being aware of risks is an important part of flood preparedness. Always pay attention and listen to the advice of municipal emergency officials. To stay informed about flooding hazards:

- Check HaldimandCounty.ca and the local conservation authority websites for up-to-date flood messages.
- Follow @HaldEmerg and @HaldimandCounty on Twitter or like us on Facebook where we'll share the most up-to-date flood messages from the local conservation authorities.
- Tune in to 92.9 The Grand FM, Haldimand County's official emergency information broadcast partner.

## SHORELINE FLOODING

Flooding can be caused by high lake levels or surge events.

The Critical Level is the lake level at which Conservation Authorities begin issuing flood messages. Critical levels are surpassed more often in the fall and winter months.

