Lakehead Coastal Resilience Management Plan

Public Update Meeting
June 10, 2026

KGS GROUP

DHI

Zuzek inc.
ONE WORLD

Agenda

- Project Overview and Status Update
- Preliminary Analyses and Results
  - Field Work
  - 100-Year Flood Line
  - Wave Modelling
  - Erosion Assessment
- Next Steps
- Questions and Discussion

Project Overview and Status Update

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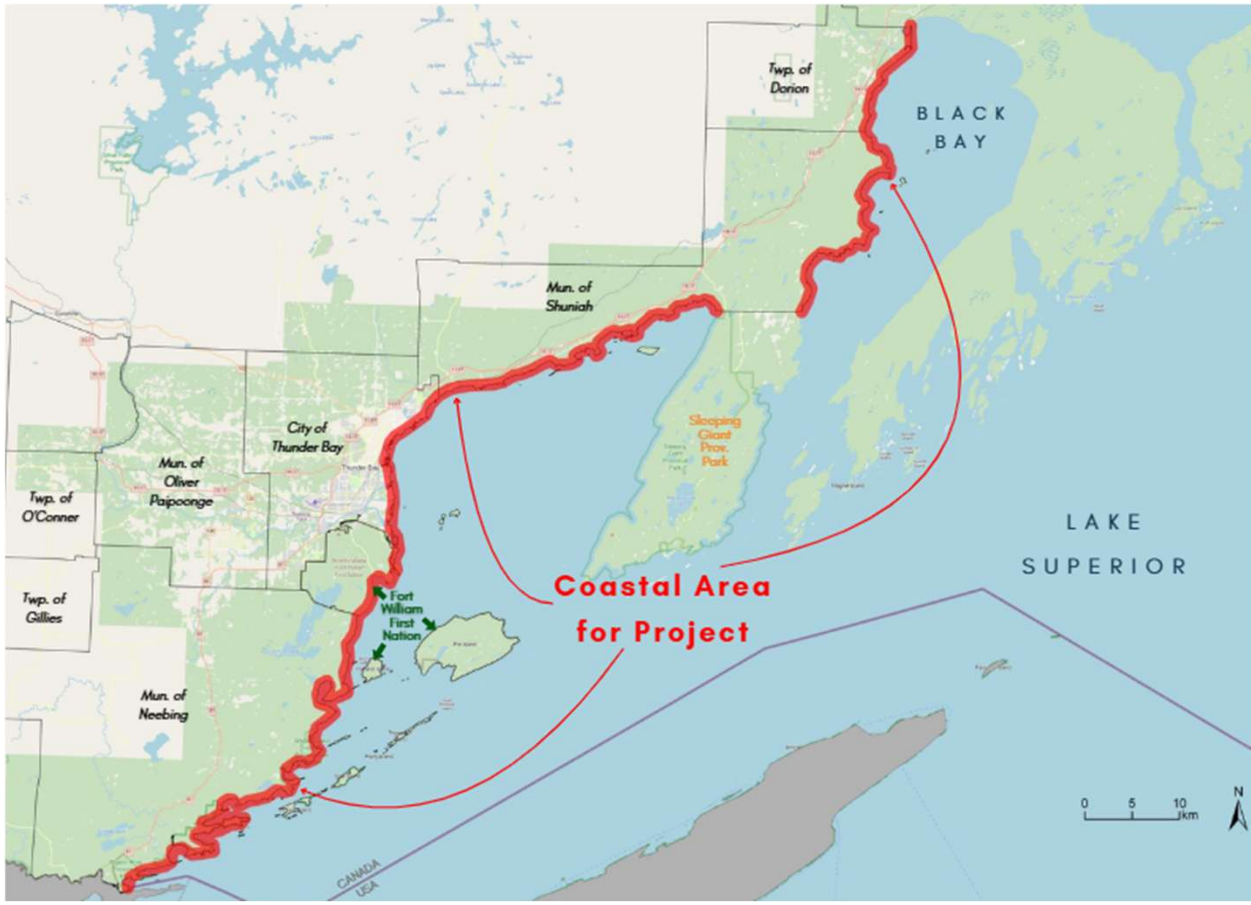
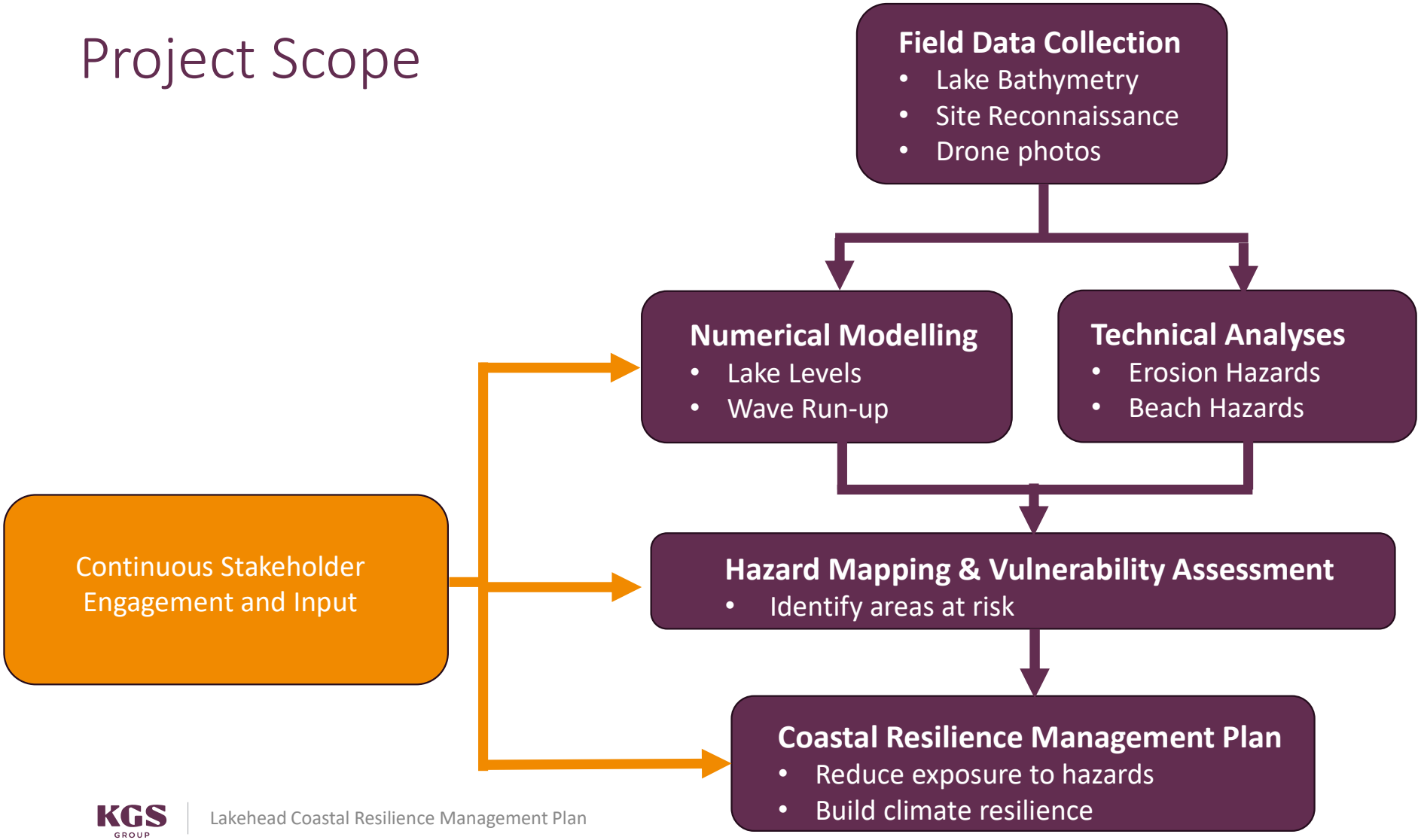
Project Objectives

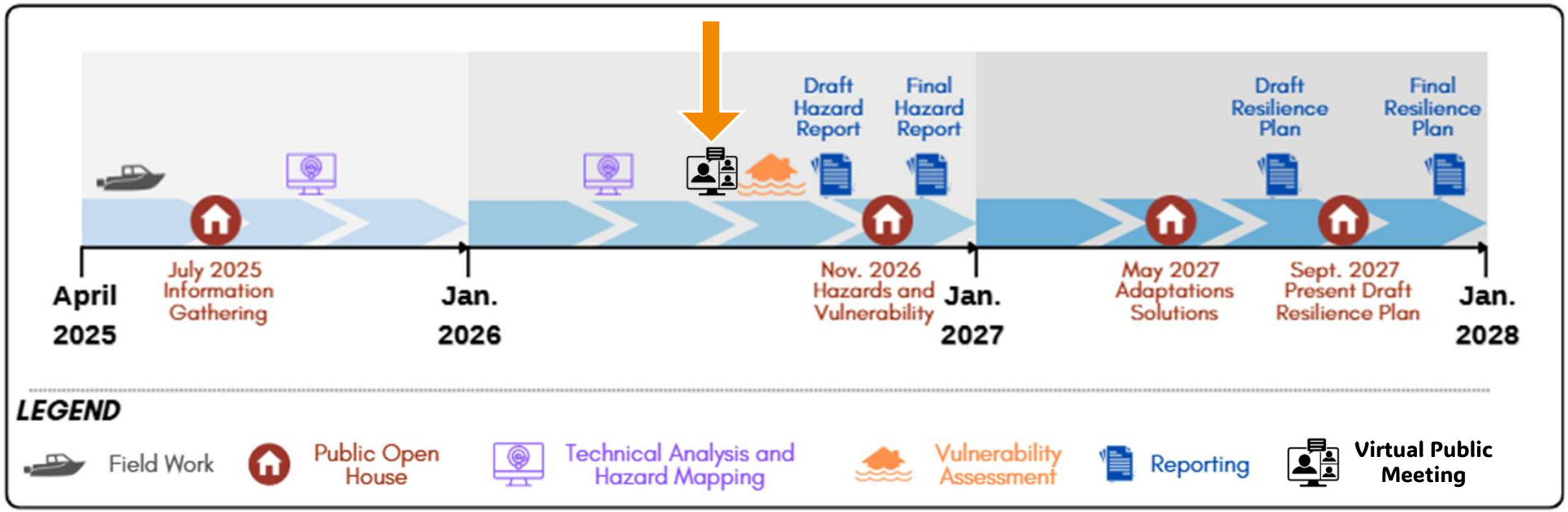
- Assess hazards from flooding and erosion
- Identify vulnerable shoreline, communities, and infrastructure
- Develop a community-informed Coastal Resilience Management Plan to improve long-term climate resilience



Project Scope



Project Status / Schedule



Field Work

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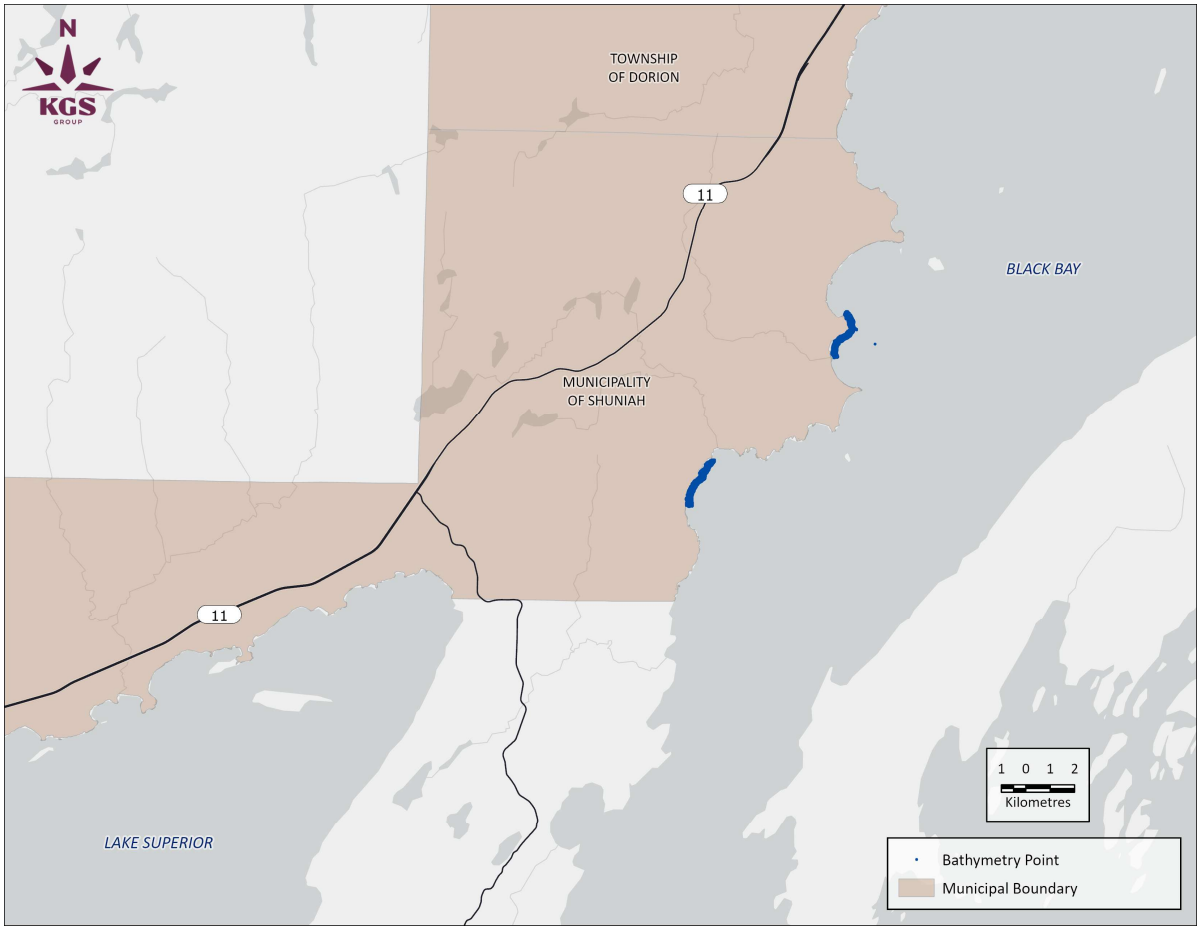
Site Reconnaissance

Drone Photography

Lake Bathymetry



Static 100-Year Water Level

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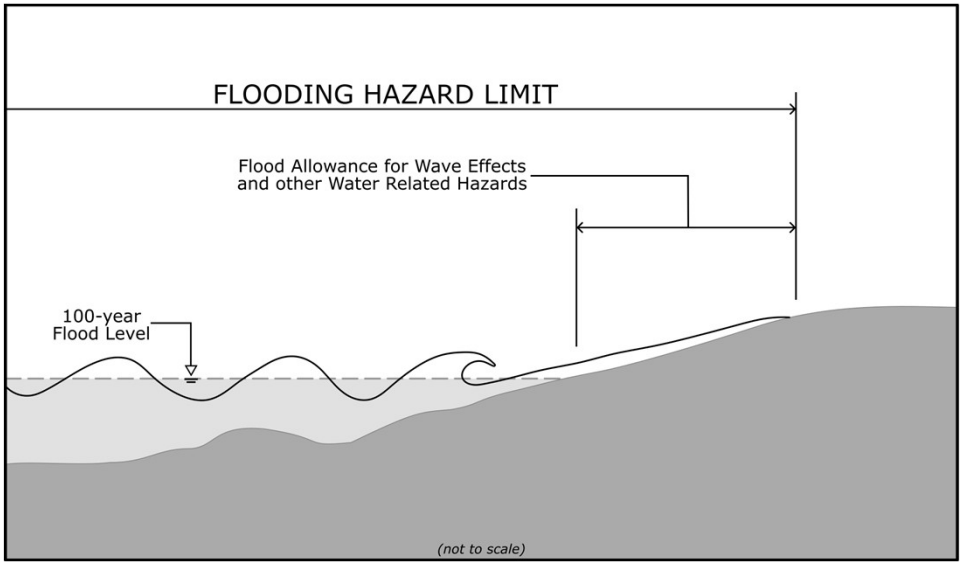
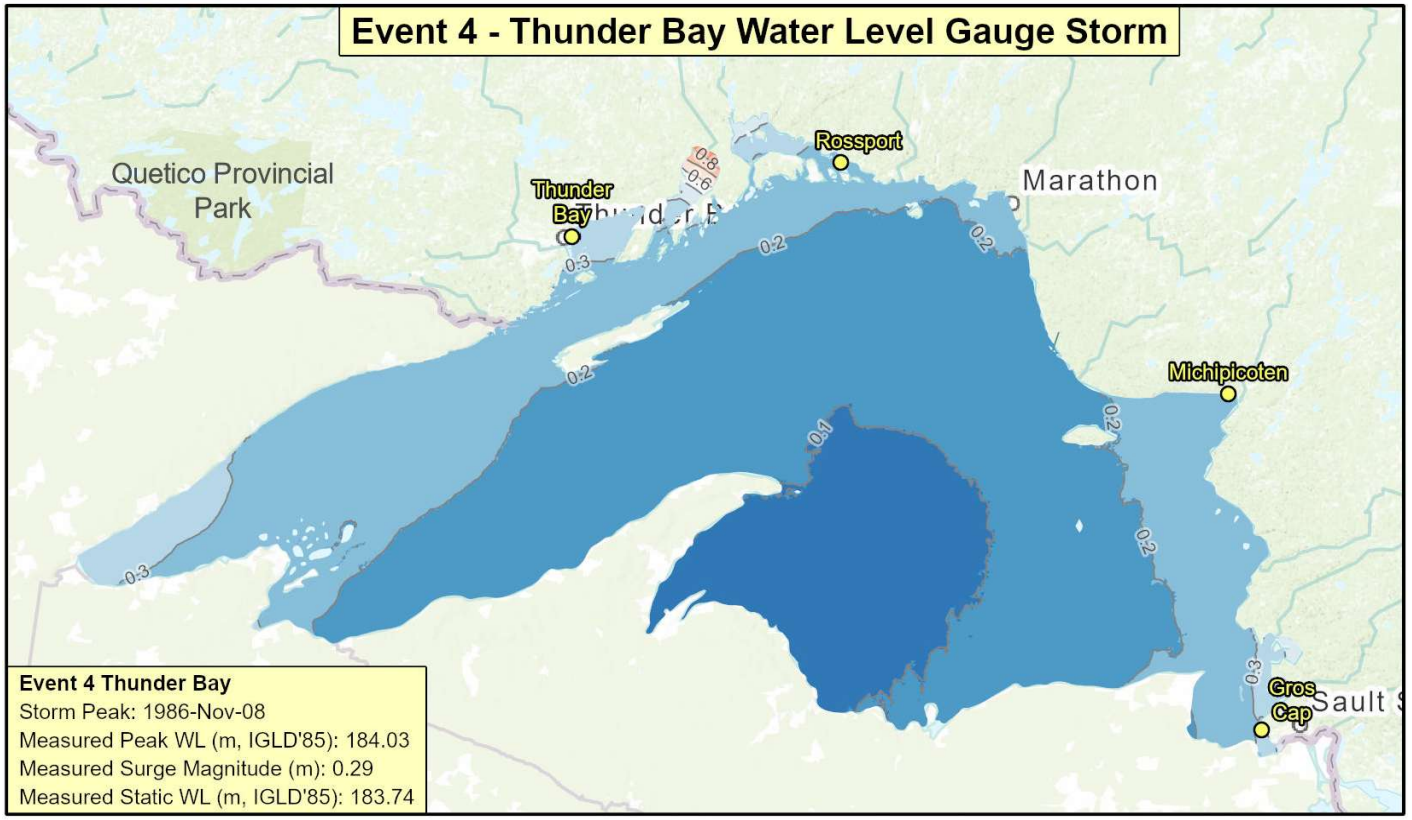
100-Year Flood Level Required for the Flood Hazard

- Statistical Analysis of static lake levels and storm surge
- 100-year flood level at Thunder Bay Gauge is 184.32 m IGLD'85

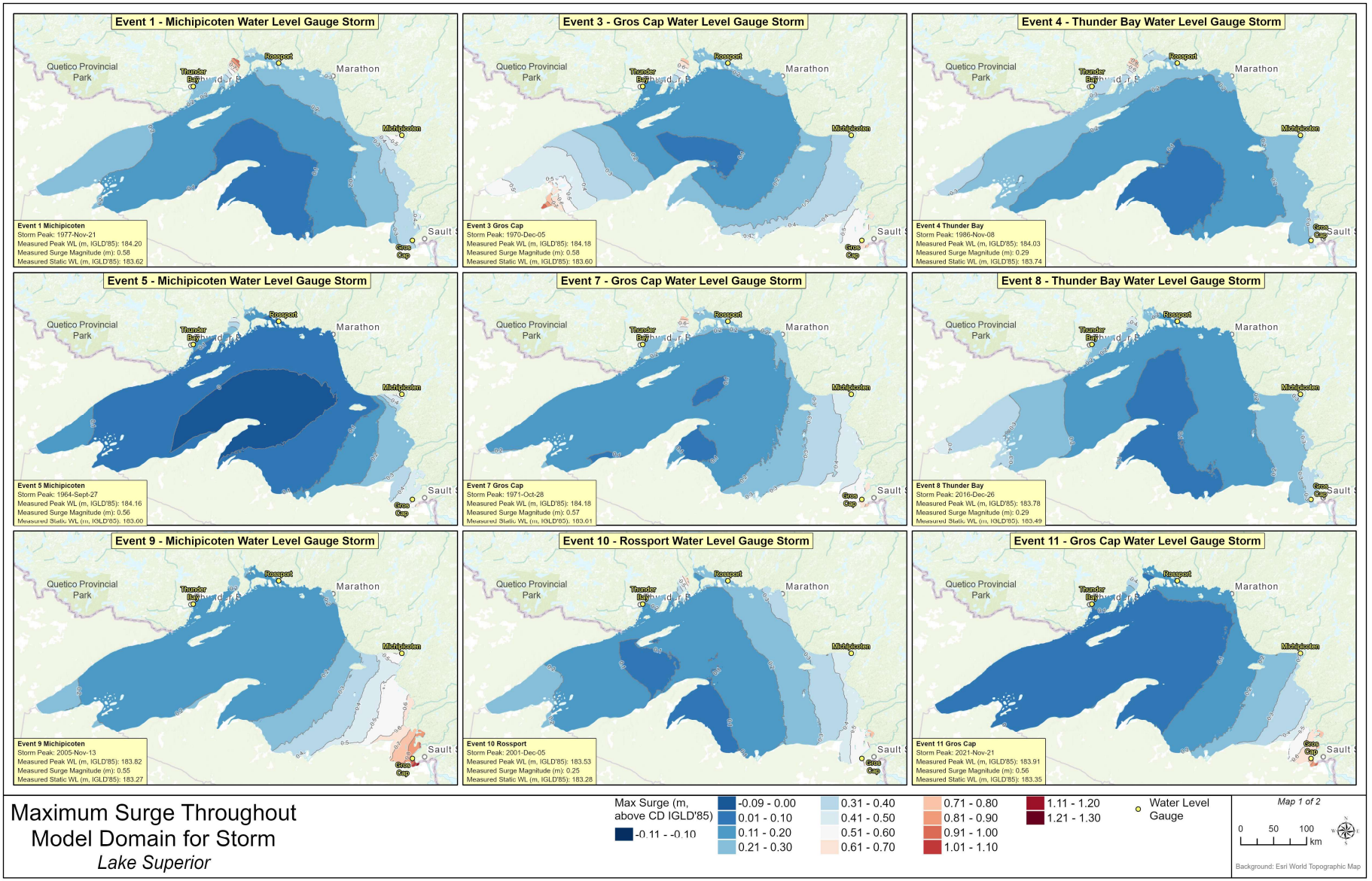


Storm Surge Modelling to Establish Gradients Between Water Level Gauges

- Gauge locations on map
- Simulate top storm surge events at each gauge



Storm Surge Runs



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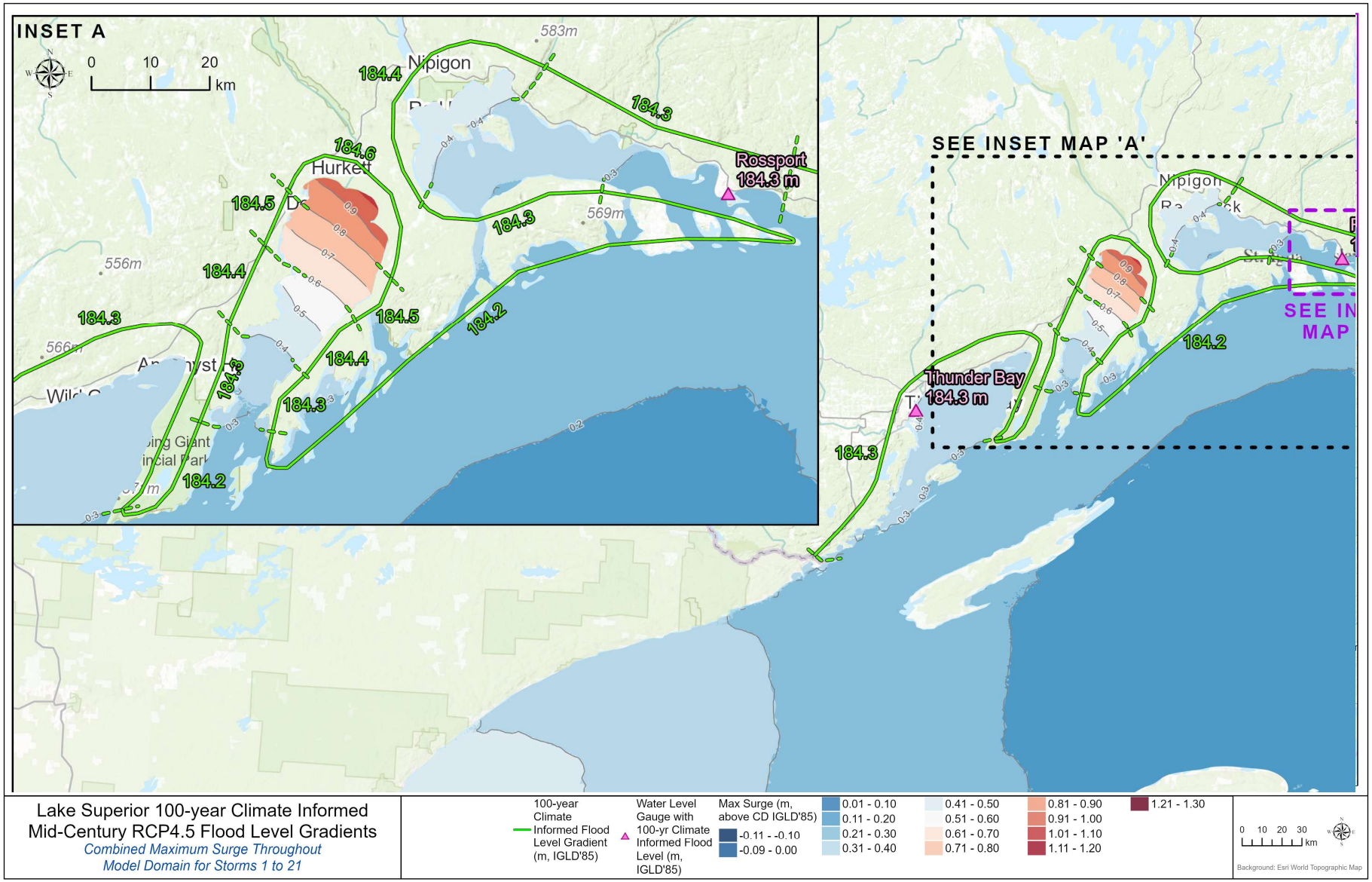
100-Year Flood Level

Mid-Century CC



Wave Modelling

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Estimate Wave Runup and Map Flood Hazards

To determine the wave-driven flood hazard area along the LRCA region

Extreme Metocean Conditions

100-Year Lake Level + Climate Change

25-year Wave Conditions

Wave Uprush Methodology

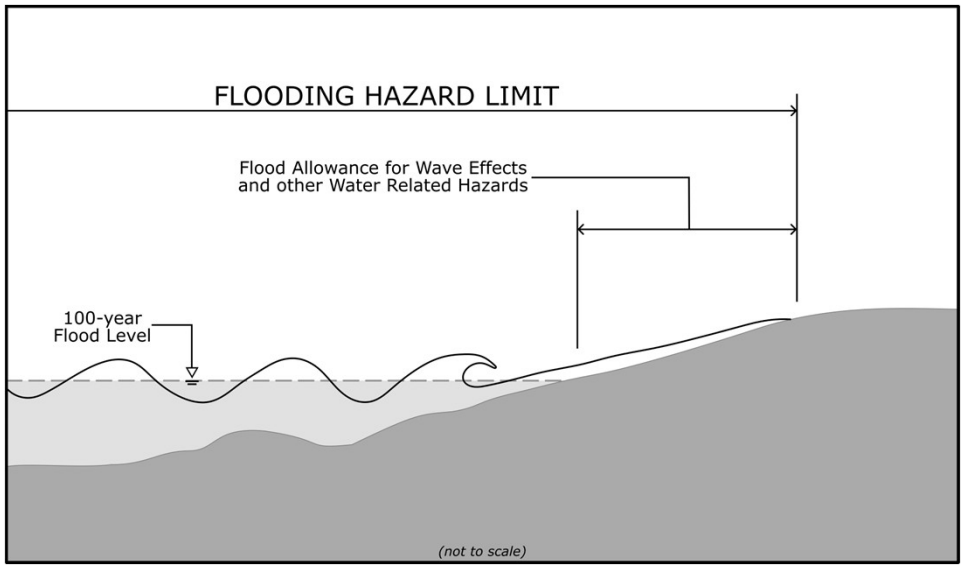
Select Wave Uprush Approach based on shoreline analysis

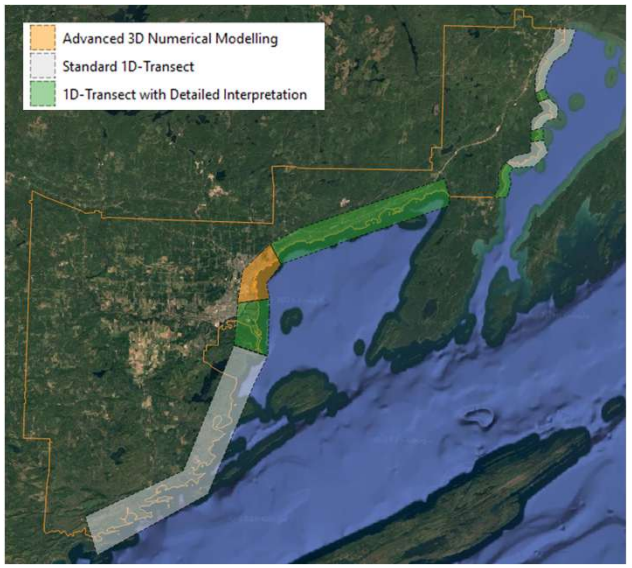
Wave Uprush Modelling

Define Reaches and Transects - Perform Wave Uprush Calculation

Wave-Driven Flooding Hazard Mapping

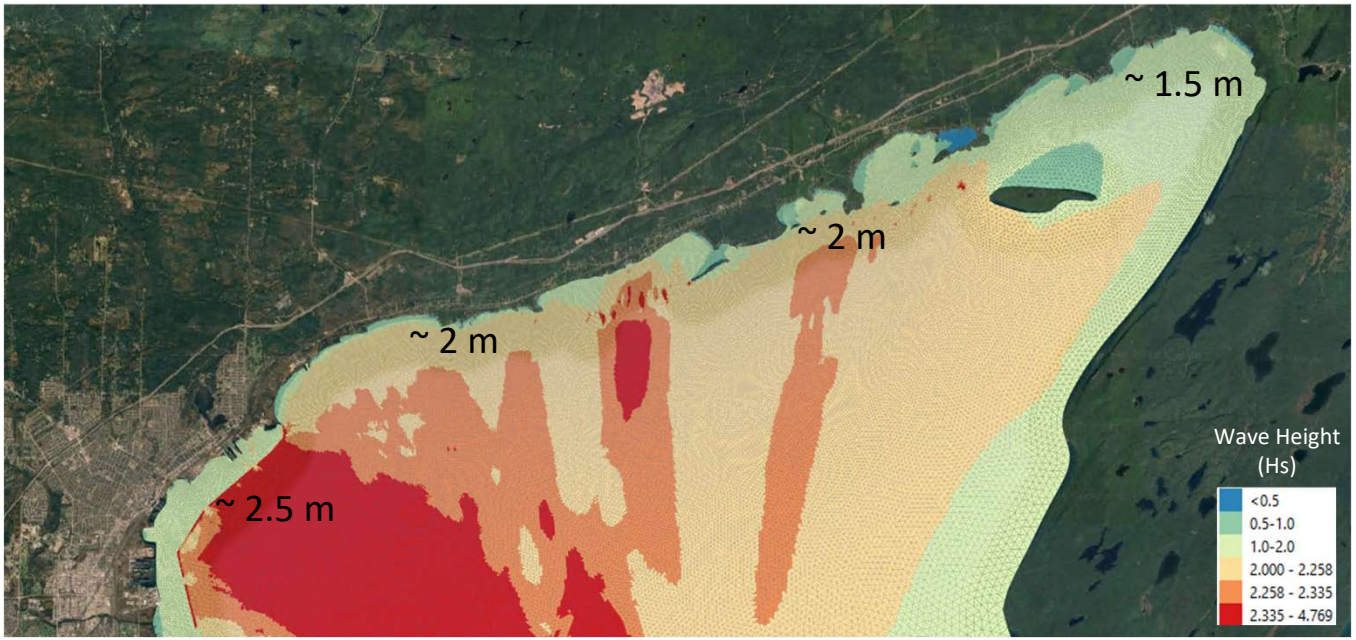
Translate the wave uprush results into 2D maps

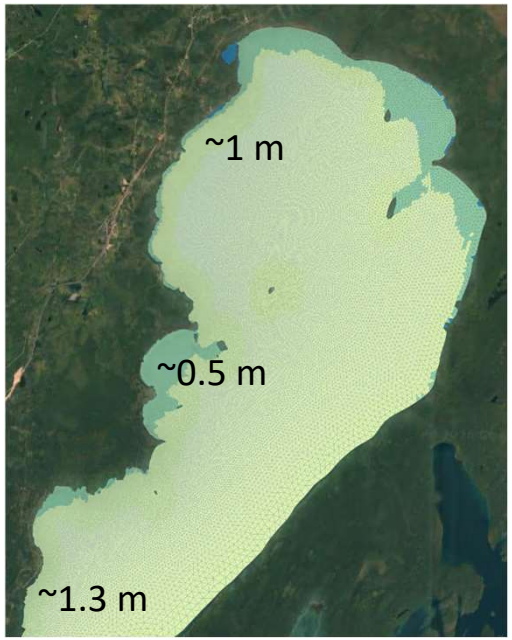




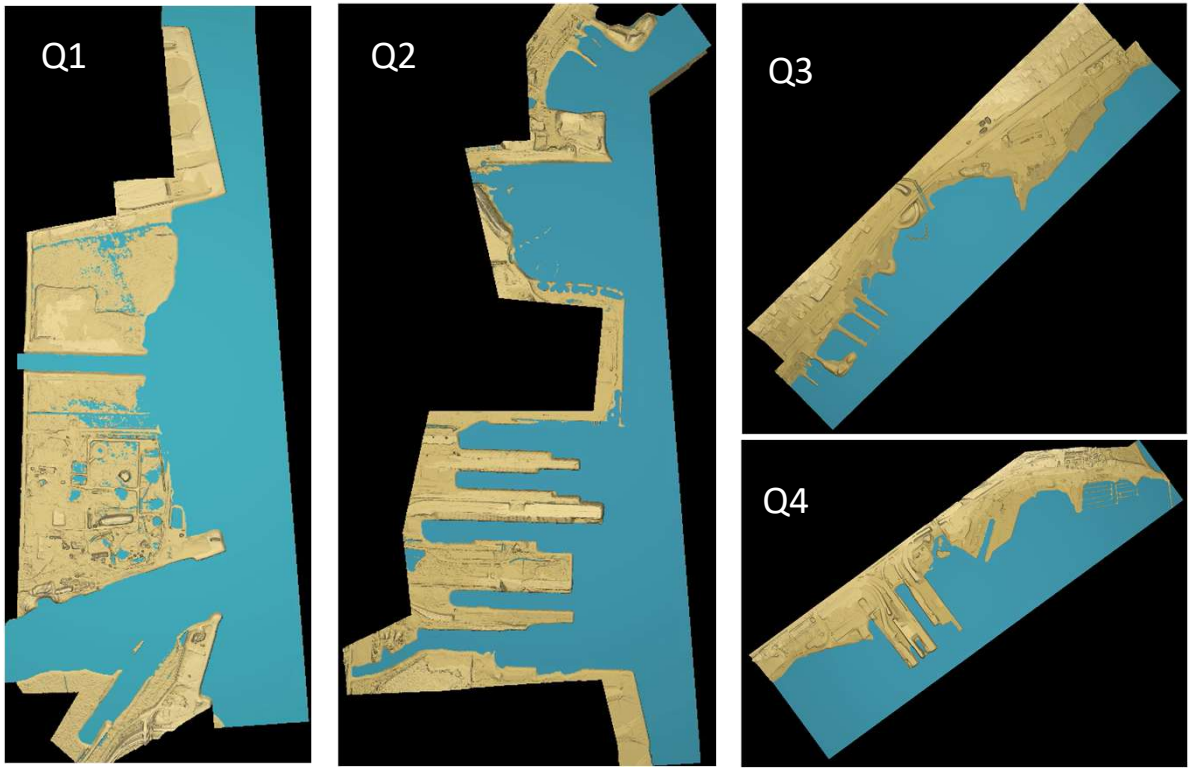
To determine the extreme wave conditions along the entire LRCA nearshore region

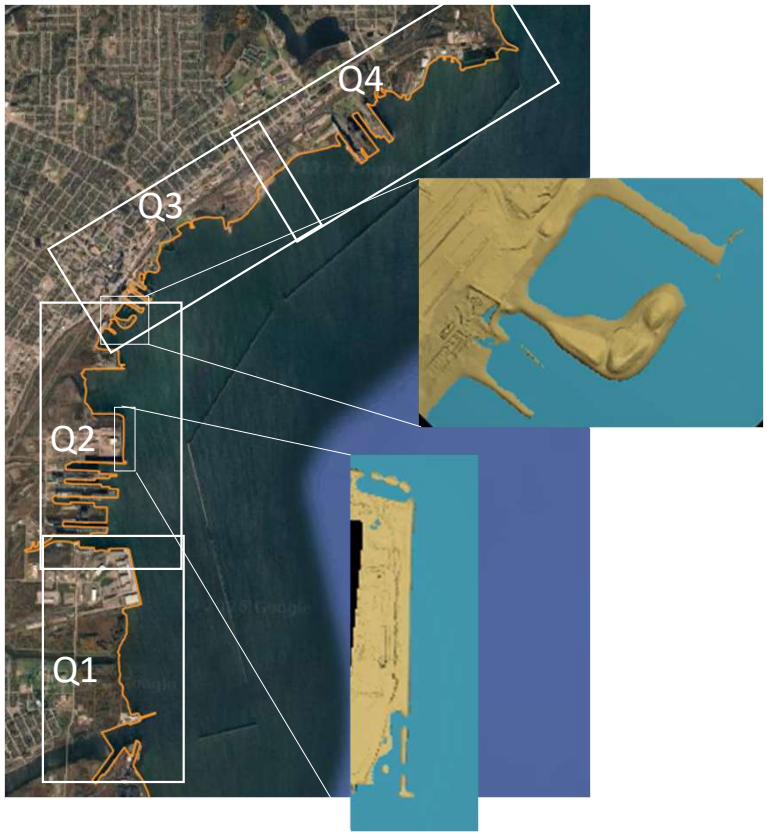
The simulated multi-directional wave conditions were the **25-year return period** wind-wave conditions
The results provide the **wave height, period and direction along the nearshore LRCA region** to drive the wave runup calculations



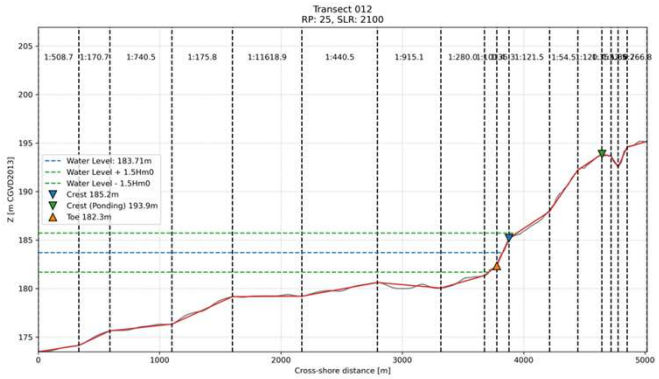


Port of Thunder Bay – Advanced 3D Wave Modelling

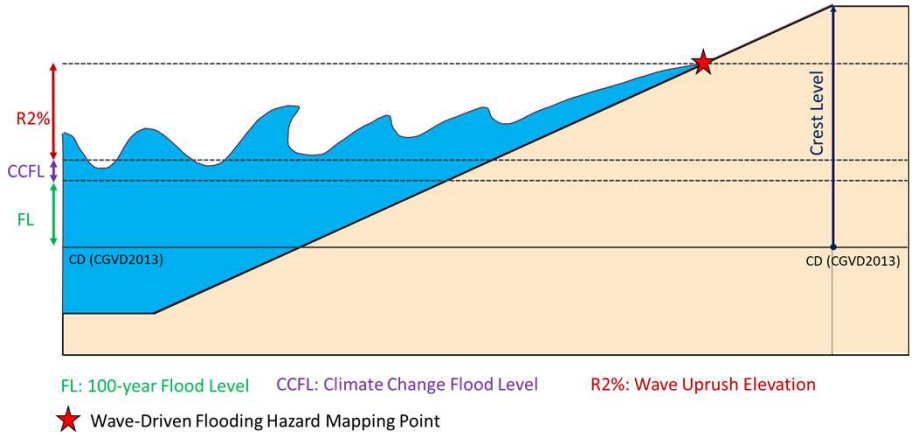




1D-Transects Wave Uprush Calculation: To obtain the runup level at each profile.

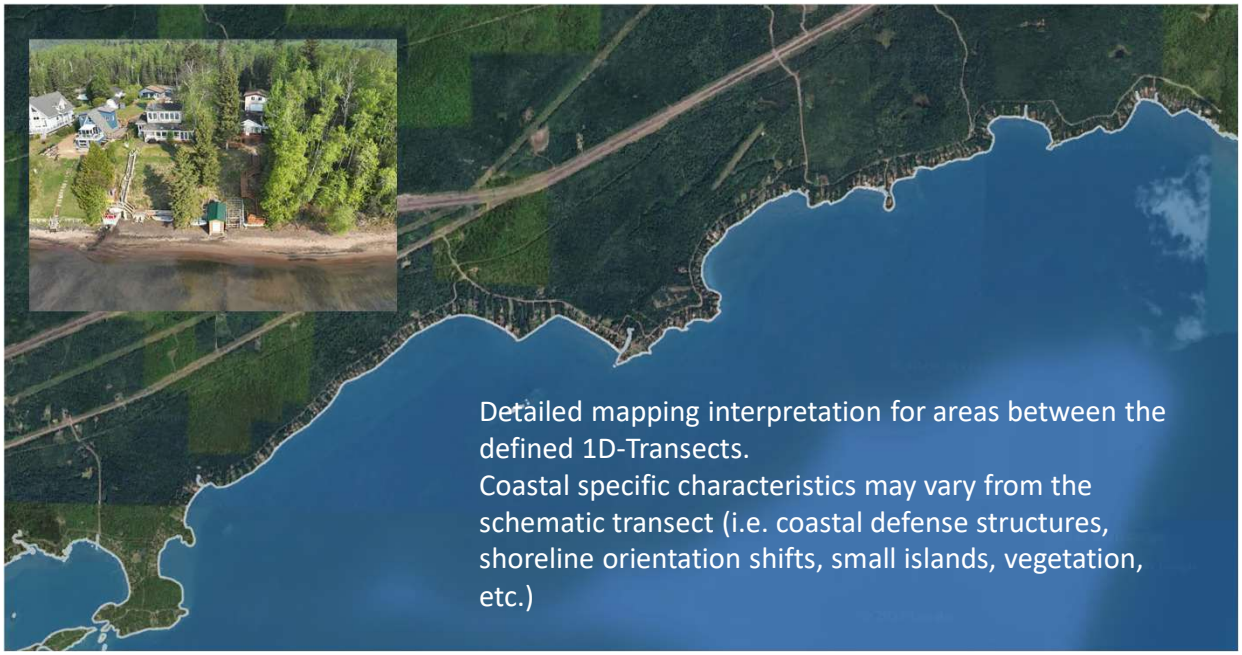


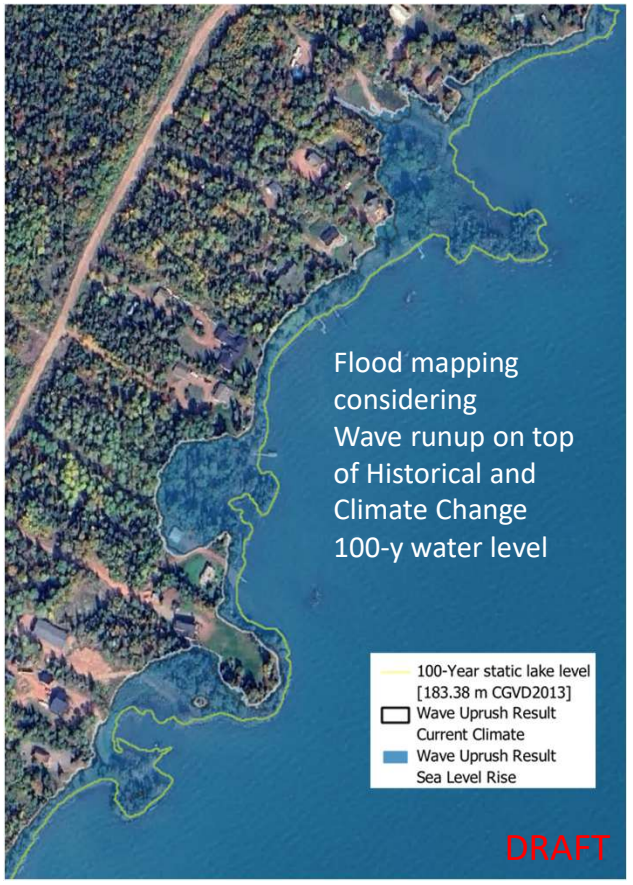
- The coastline is divided into reaches of similar characteristics.
- Schematic representative topographic transects are defined for each reach.
- Wave runup at each profile is estimated using CSHORE model.



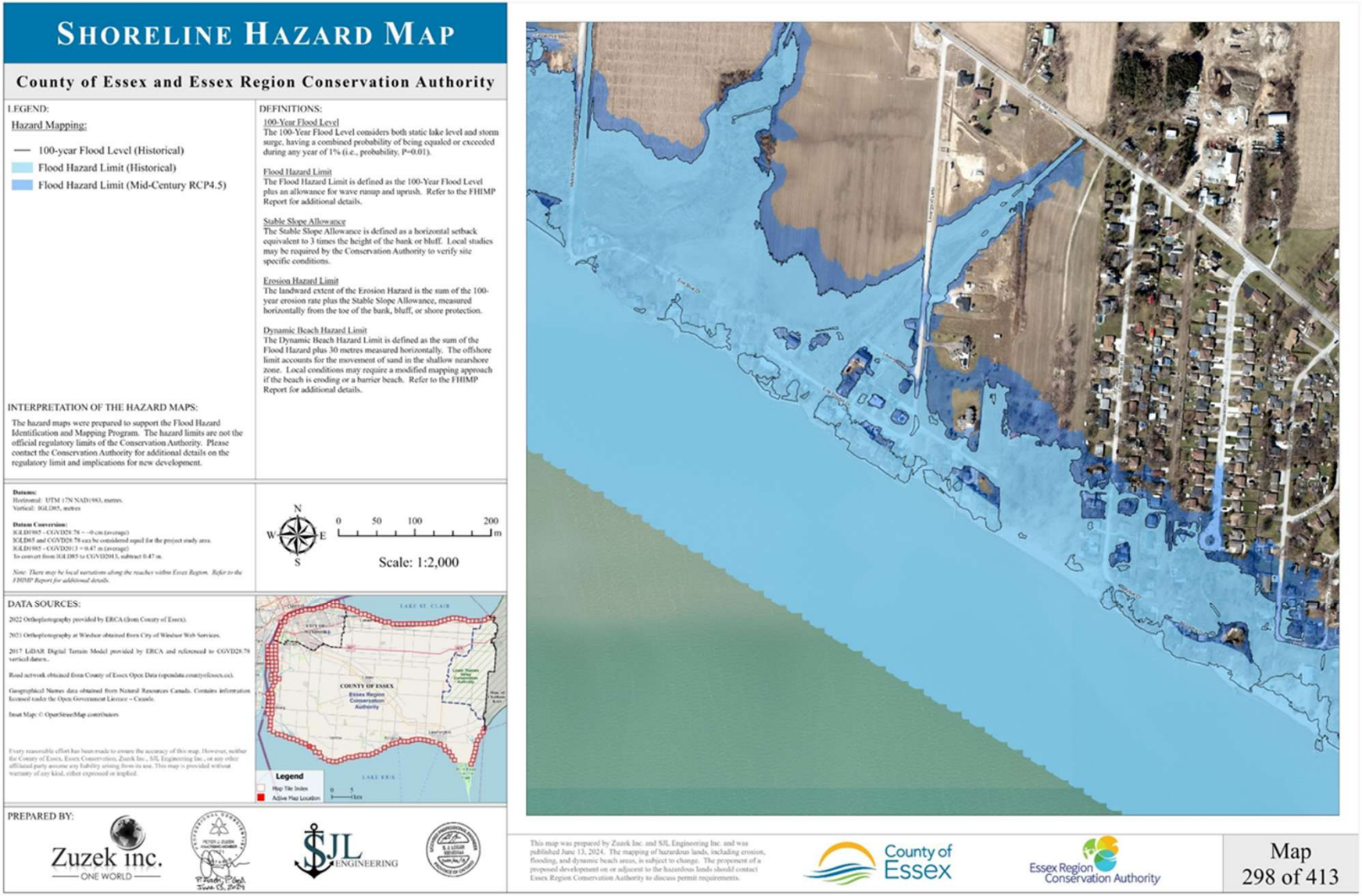
CSHORE is a phase-averaged cross-shore numerical wave model (USACE) used to estimate wave runup for irregular waves.

To determine a continuous wave-driven flooding line associated with the extreme water levels and wave condition





Flood Hazard Map Example



SHORELINE HAZARD MAP

County of Essex and Essex Region Conservation Authority

LEGEND:

Hazard Mapping:

- 100-year Flood Level (Historical)
- Flood Hazard Limit (Historical)
- Flood Hazard Limit (Mid-Century RCP4.5)

DEFINITIONS:

100-Year Flood Level
The 100-Year Flood Level considers both static lake level and storm surge, having a combined probability of being equaled or exceeded during any year of 1% (i.e., probability, P=0.01).

Flood Hazard Limit
The Flood Hazard Limit is defined as the 100-Year Flood Level plus an allowance for wave runup and uprush. Refer to the FHIMP Report for additional details.

Stable Slope Allowance
The Stable Slope Allowance is defined as a horizontal setback equivalent to 3 times the height of the bank or bluff. Local studies may be required by the Conservation Authority to verify site specific conditions.

Erosion Hazard Limit
The landward extent of the Erosion Hazard is the sum of the 100-year erosion rate plus the Stable Slope Allowance, measured horizontally from the toe of the bank, bluff, or shore protection.

Dynamic Beach Hazard Limit
The Dynamic Beach Hazard Limit is defined as the sum of the Flood Hazard plus 30 metres measured horizontally. The offshore limit accounts for the movement of sand in the shallow nearshore zone. Local conditions may require a modified mapping approach if the beach is eroding or a barrier beach. Refer to the FHIMP Report for additional details.

INTERPRETATION OF THE HAZARD MAPS:

The hazard maps were prepared to support the Flood Hazard Identification and Mapping Program. The hazard limits are not the official regulatory limits of the Conservation Authority. Please contact the Conservation Authority for additional details on the regulatory limit and implications for new development.

Datums:
Horizontal: UTM 17N NAD1983, metres.
Vertical: IGLD85, metres

Datum Conversion:
IGLD1985 - CGVD28.78 = ~0 cm (average)
IGLD85 and CGVD28.78 can be considered equal for the project study area.
IGLD1985 - CGVD2013 = 0.47 m (average)
To convert from IGLD85 to CGVD2013, subtract 0.47 m.

Note: There may be local variations along the reaches within Essex Region. Refer to the FHIMP Report for additional details.

N W E S

0 50 100 200 m

Scale: 1:2,000

DATA SOURCES:

2022 Orthophotography provided by ERCA (from County of Essex).

2021 Orthophotography at Windsor obtained from City of Windsor Web Services.

2017 LiDAR Digital Terrain Model provided by ERCA and referenced to CGVD28.78 vertical datum..

Road network obtained from County of Essex Open Data (opendata.countyofessex.ca).

Geographical Names data obtained from Natural Resources Canada. Contains information licensed under the Open Government Licence – Canada.

Inset Map: © OpenStreetMap contributors

Every reasonable effort has been made to ensure the accuracy of this map. However, neither the County of Essex, Essex Conservation, Zuzek Inc., SJL Engineering Inc., or any other affiliated party assume any liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.

PREPARED BY:

Zuzek inc. ONE WORLD

SJL ENGINEERING

This map was prepared by Zuzek Inc. and SJL Engineering Inc. and was published June 13, 2024. The mapping of hazardous lands, including erosion, flooding, and dynamic beach areas, is subject to change. The proponent of a proposed development on or adjacent to the hazardous lands should contact Essex Region Conservation Authority to discuss permit requirements.

County of Essex

Essex Region Conservation Authority

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Erosion Assessment

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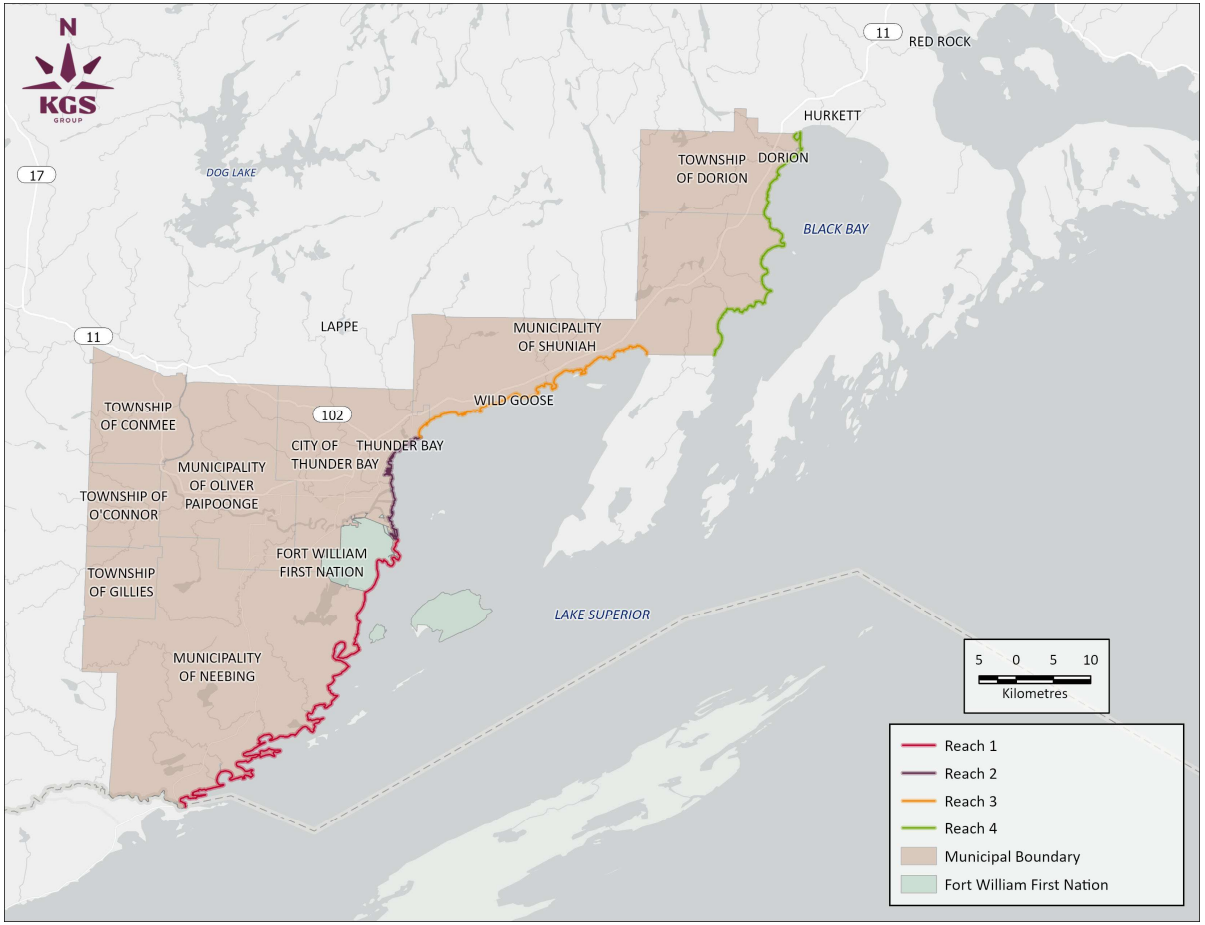
Methodology

1. **Define Erosion Reaches**
   - **Based on morphological features**
2. **Calculate Historical Erosion Rate**
   - **Using Historical Air Photos**
3. **Calculate 100 Year Recession Rate**
   - **Based on historical erosion**
4. **Map Erosion Hazard Limit**
   - **100 Year Recession Rate plus stable slope allowance**

Erosion Reaches

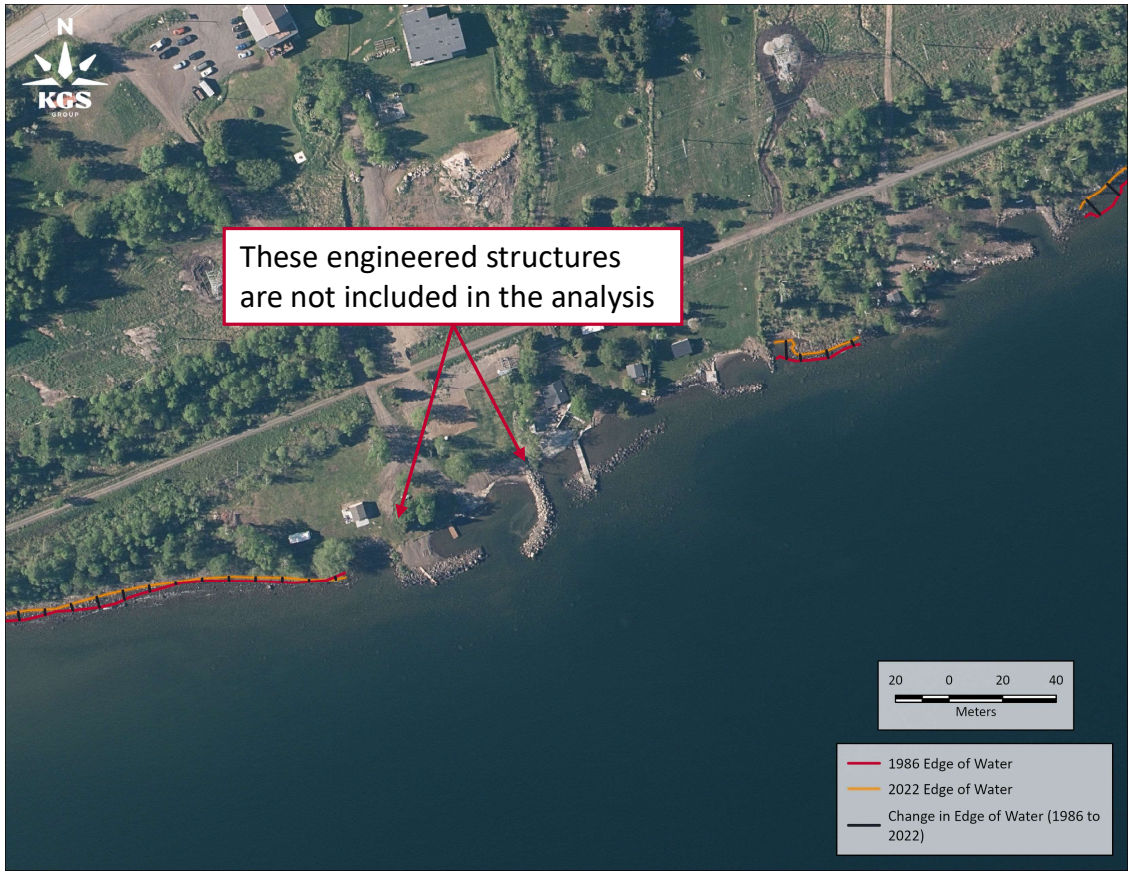
- Rate of erosion varies spatially along Lake Superior
- This is due to:
  - Geology
  - Wave Exposure
  - Shoreline Hardening



Historical Erosion Rate

- Georeference historical air photos
- Digitize the shoreline at that time
  - 1986
- This is an area within the Municipality of Shuniah

Historical Erosion Rate



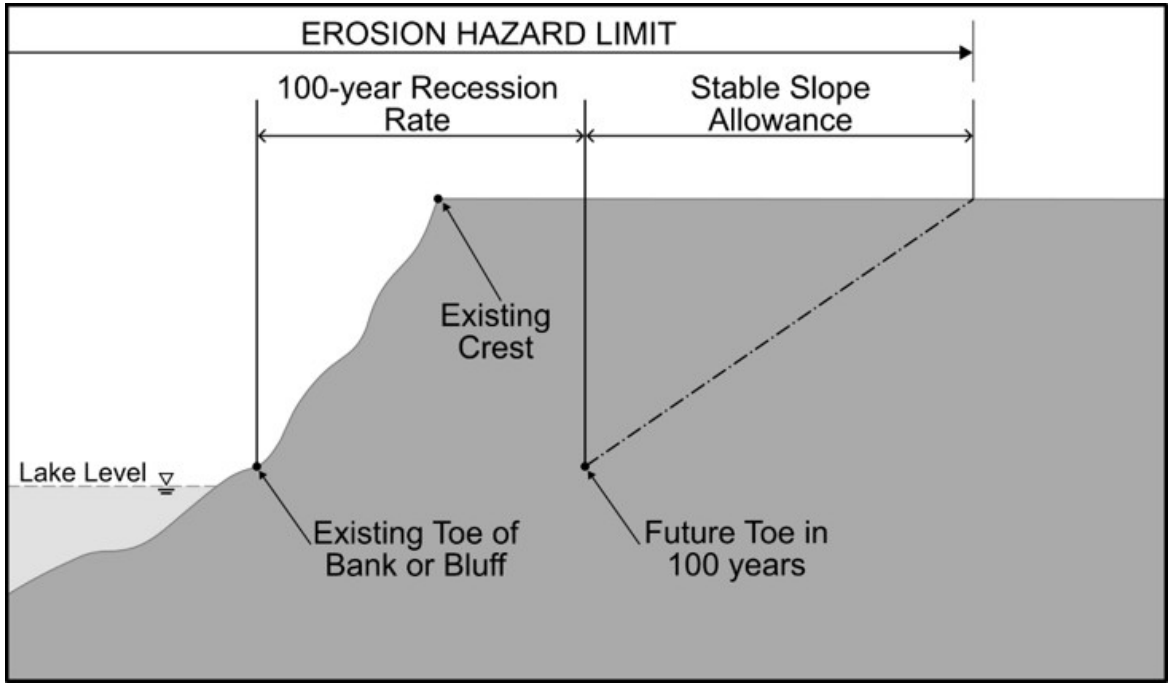
- The historical erosion rate is the difference between the historical shoreline and current shoreline
- For analysis, shoreline protection and engineered structures are omitted
- This area has eroded between 0.5 m and 6 m in 36 years

Historical Erosion Rate

- This is an area north of the Thunder Bay ports
- It has eroded between 0.1 m and 2.0 m which is within the accuracy of the analysis
- We can't draw conclusive rates but from the density of vegetation, it is relatively stable

Erosion Hazard Limit

- The historical recession rate is used to estimate how much erosion is expected to occur in a 100-year period



Example of Erosion Hazard Limit Mapping (Lake Ontario)

Next Steps

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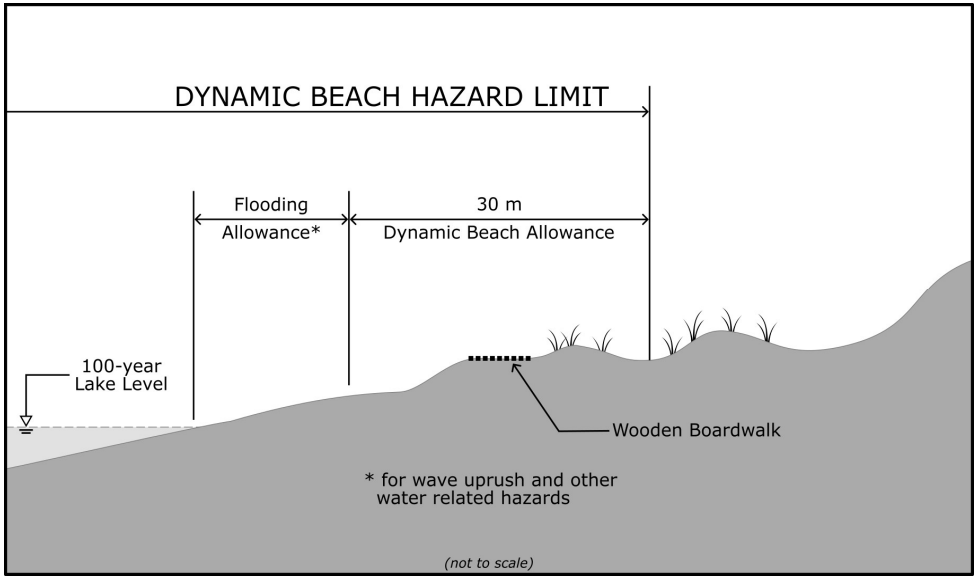
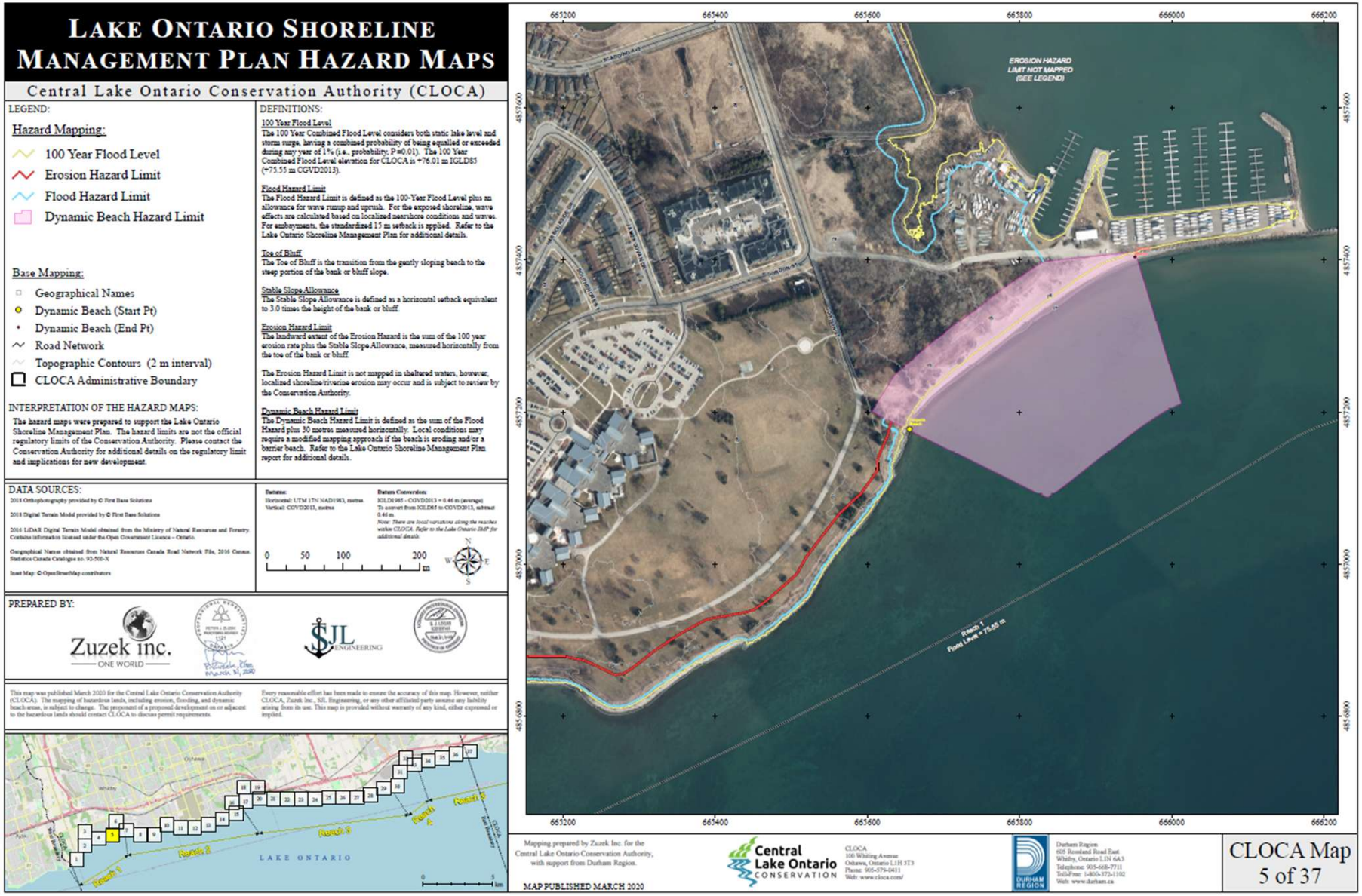
Dynamic Beach Assessment (presence/absence)

- Goal is to protect the dynamic nature of sand beaches
- A beach must have a fetch of at least 5 km, beach length of at least 100 m, width at low water of 10 m, and depth of sand at least 0.3 m
- Uses flood allowance
- Plus, dynamic beach allowance
- 30 m width evaluated



Dynamic Beach Hazard Map Example



LAKE ONTARIO SHORELINE MANAGEMENT PLAN HAZARD MAPS

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
- Dynamic Beach (Start Pt)
- Dynamic Beach (End Pt)
- Road Network
- Topographic Contours (2 m interval)
- CLOCA Administrative Boundary

INTERPRETATION OF THE HAZARD MAPS:

The hazard maps were prepared to support the Lake Ontario Shoreline Management Plan. The hazard limits are not the official regulatory limits of the Conservation Authority. Please contact the Conservation Authority for additional details on the regulatory limit and implications for new development.

DEFINITIONS:

100 Year Flood Level
The 100 Year Combined Flood Level considers both static lake level and storm surge, having a combined probability of being equalled or exceeded during any year of 1% (i.e., probability, P=0.01). The 100 Year Combined Flood Level elevation for CLOCA is +76.01 m IGLD85 (+75.55 m CGVD2013).

Flood Hazard Limit
The Flood Hazard Limit is defined as the 100-Year Flood Level plus an allowance for wave runup and uprush. For the exposed shoreline, wave effects are calculated based on localized nearshore conditions and waves. For embayments, the standardized 15 m setback is applied. Refer to the Lake Ontario Shoreline Management Plan for additional details.

Toe of Bluff
The Toe of Bluff is the transition from the gently sloping beach to the steep portion of the bank or bluff slope.

Stable Slope Allowance
The Stable Slope Allowance is defined as a horizontal setback equivalent to 3.0 times the height of the bank or bluff.

Erosion Hazard Limit
The landward extent of the Erosion Hazard is the sum of the 100 year erosion rate plus the Stable Slope Allowance, measured horizontally from the toe of the bank or bluff.

The Erosion Hazard Limit is not mapped in sheltered waters, however, localized shoreline/riverine erosion may occur and is subject to review by the Conservation Authority.

Dynamic Beach Hazard Limit
The Dynamic Beach Hazard Limit is defined as the sum of the Flood Hazard plus 30 metres measured horizontally. Local conditions may require a modified mapping approach if the beach is eroding and/or a barrier beach. Refer to the Lake Ontario Shoreline Management Plan report for additional details.

DATA SOURCES:

2018 Orthophotography provided by © First Base Solutions

2018 Digital Terrain Model provided by © First Base Solutions

2016 LiDAR Digital Terrain Model obtained from the Ministry of Natural Resources and Forestry. Contains information licensed under the Open Government Licence – Ontario.

Geographical Names obtained from Natural Resources Canada Road Network File, 2016 Census. Statistics Canada Catalogue no. 92-500-X

Inset Map: © OpenStreetMap contributors

Datums:
Horizontal: UTM 17N NAD1983, metres.
Vertical: CGVD2013, metres

Datum Conversion:
IGLD1985 - CGVD2013 = 0.46 m (average)
To convert from IGLD85 to CGVD2013, subtract 0.46 m.
Note: There are local variations along the reaches within CLOCA. Refer to the Lake Ontario SMP for additional details.

0 50 100 200 m

N W E S

PREPARED BY:

Zuzek inc. ONE WORLD

JL ENGINEERING

This map was published March 2020 for the Central Lake Ontario Conservation Authority (CLOCA). The mapping of hazardous lands, including erosion, flooding, and dynamic beach areas, is subject to change. The proponent of a proposed development on or adjacent to the hazardous lands should contact CLOCA to discuss permit requirements.

Every reasonable effort has been made to ensure the accuracy of this map. However, neither CLOCA, Zuzek Inc., JL Engineering, or any other affiliated party assume any liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.

Mapping prepared by Zuzek Inc. for the Central Lake Ontario Conservation Authority, with support from Durham Region.

MAP PUBLISHED MARCH 2020

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CLOCA Map
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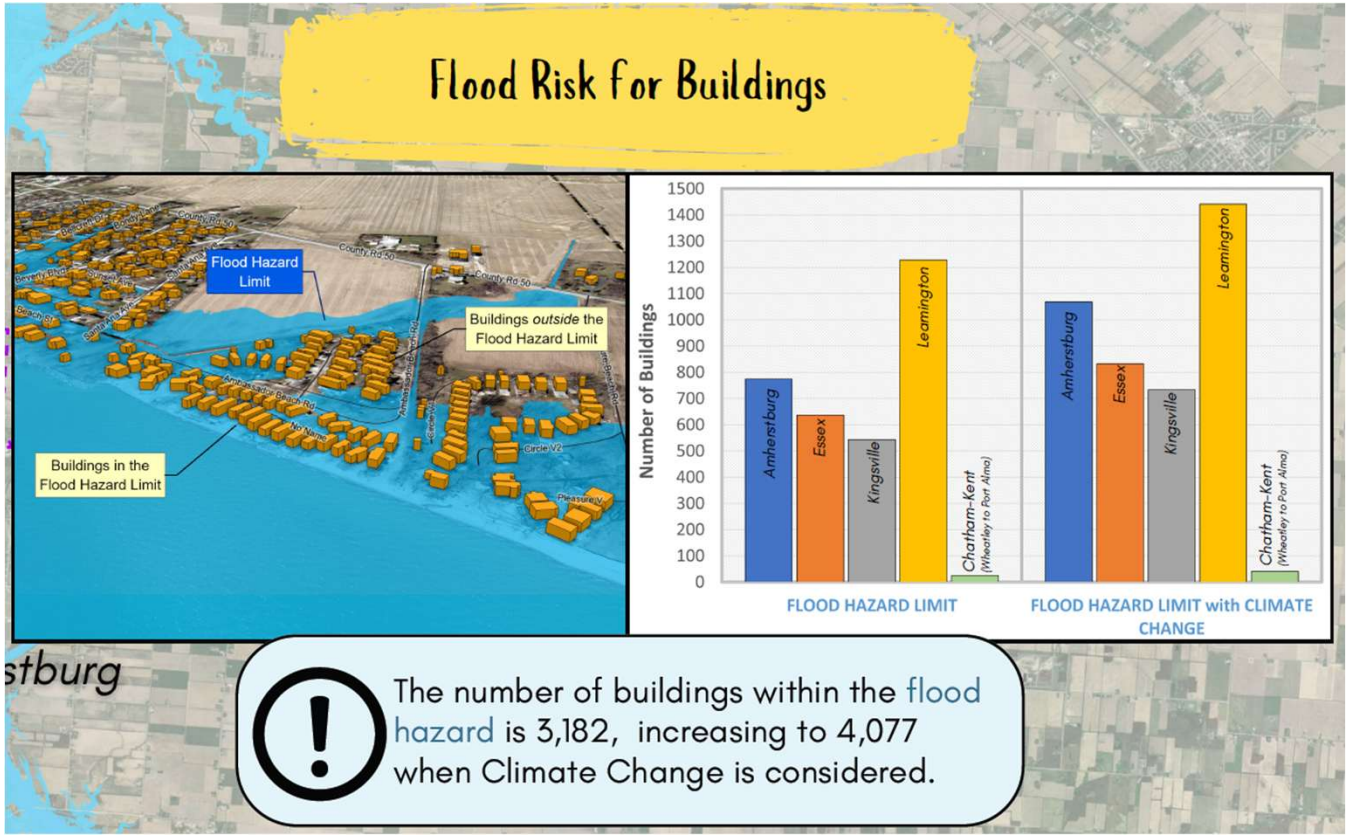
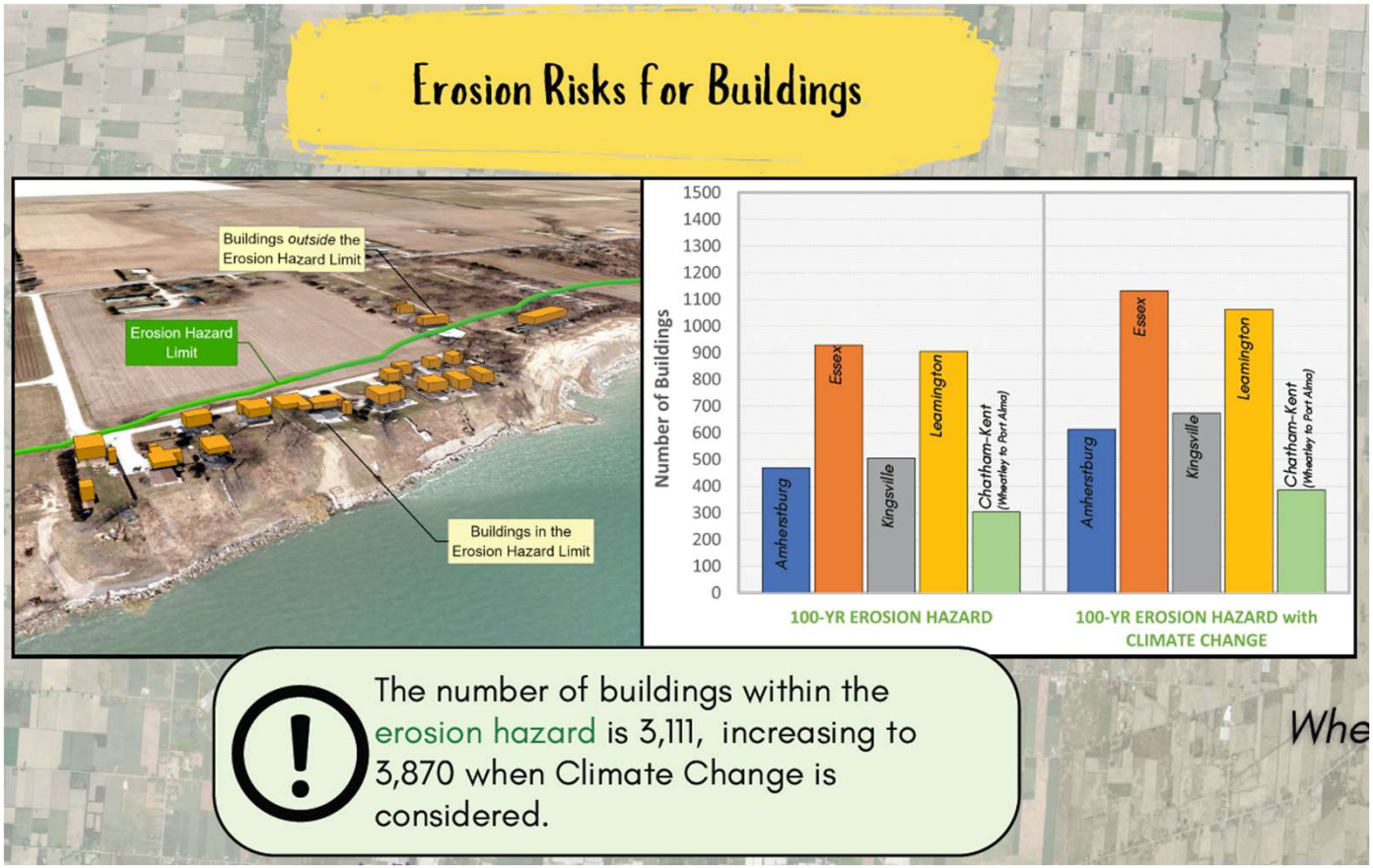
Example of Flood Risk Vulnerability (Lake Erie)



Example of Erosion Risk Vulnerability (Lake Erie)

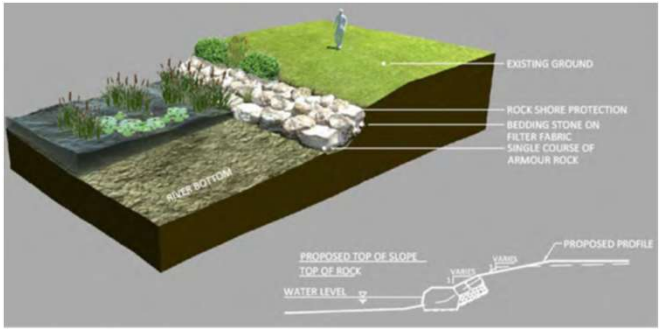


Future Management Plan Will Provide Examples to Increase Resilience to Natural Hazards

Emergency Preparedness

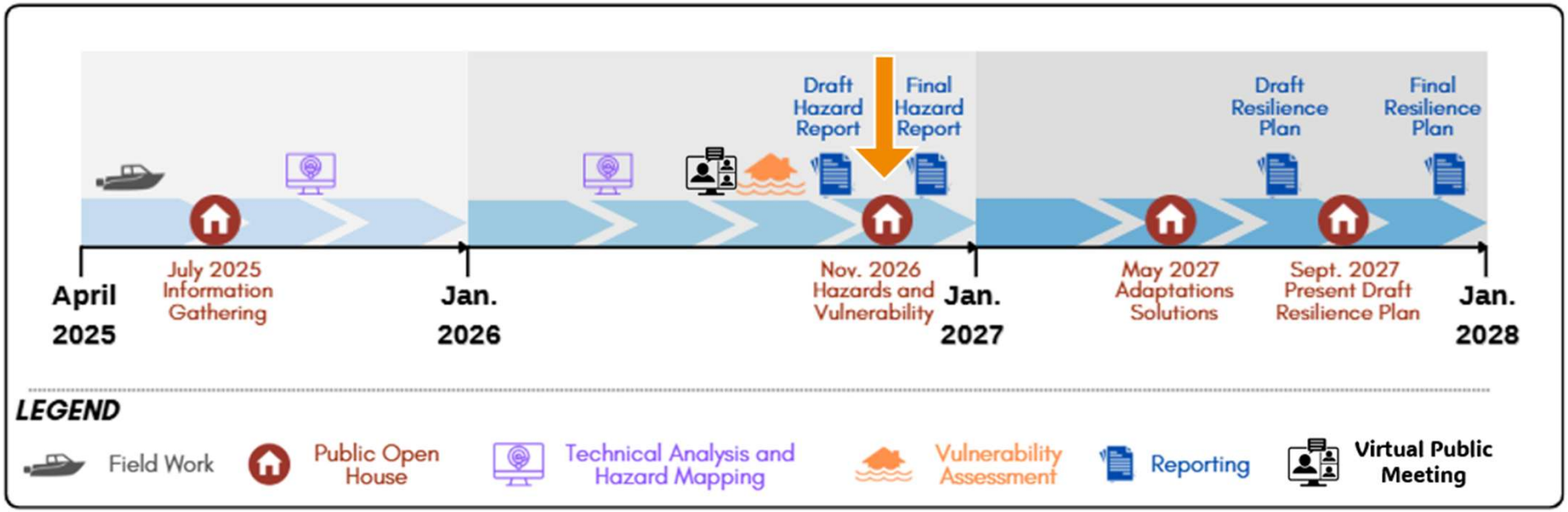
Floodproof

Nature-based, Hybrid, and Engineered Solutions



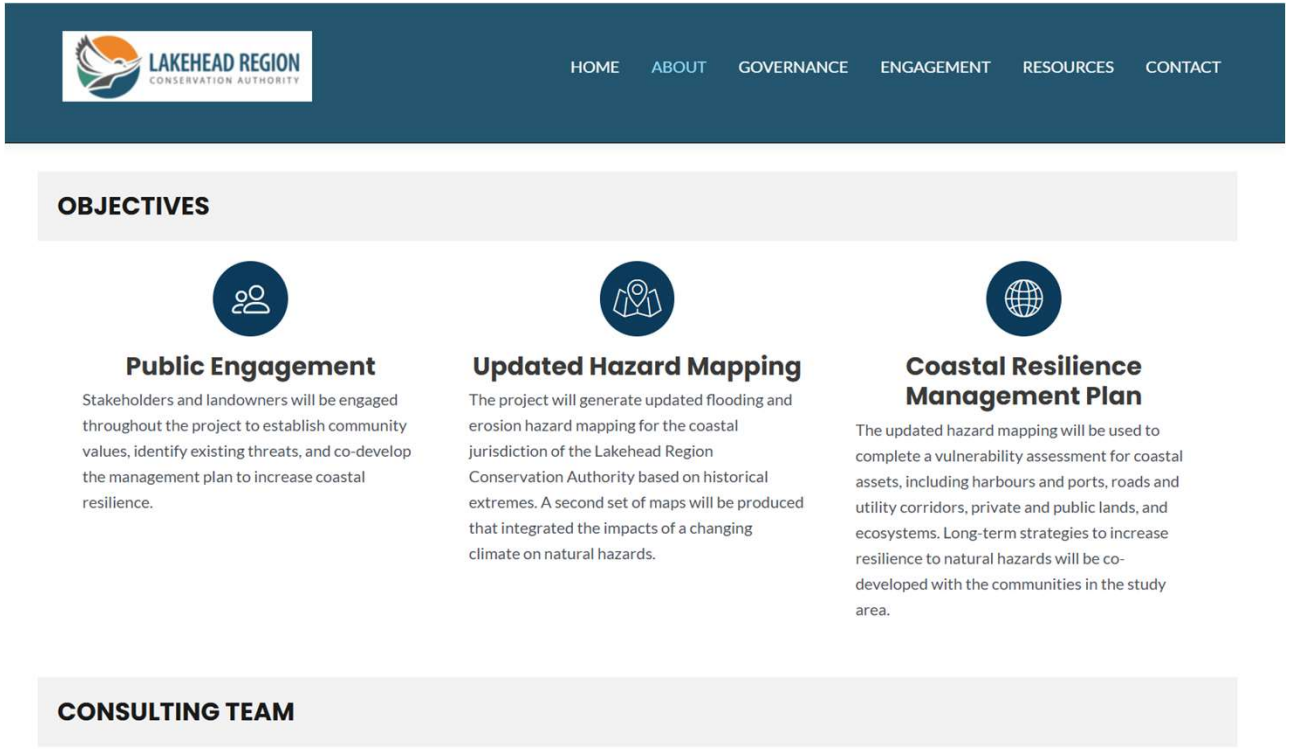
Public Information Centre #2 – Hazards and Vulnerability

- Present draft hazard maps (flooding, erosion, dynamic beach areas)
- Introduce climate change projections and resilience concepts
- Collect input on key risk areas and potential response strategies



More Information

- Visit our website: lakeheadresilience.ca
  - Copy of presentation
  - Ongoing project updates
  - Future engagement opportunities
  - Contact project leaders



Questions and Discussion

KGS GROUP

Thank-you!

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