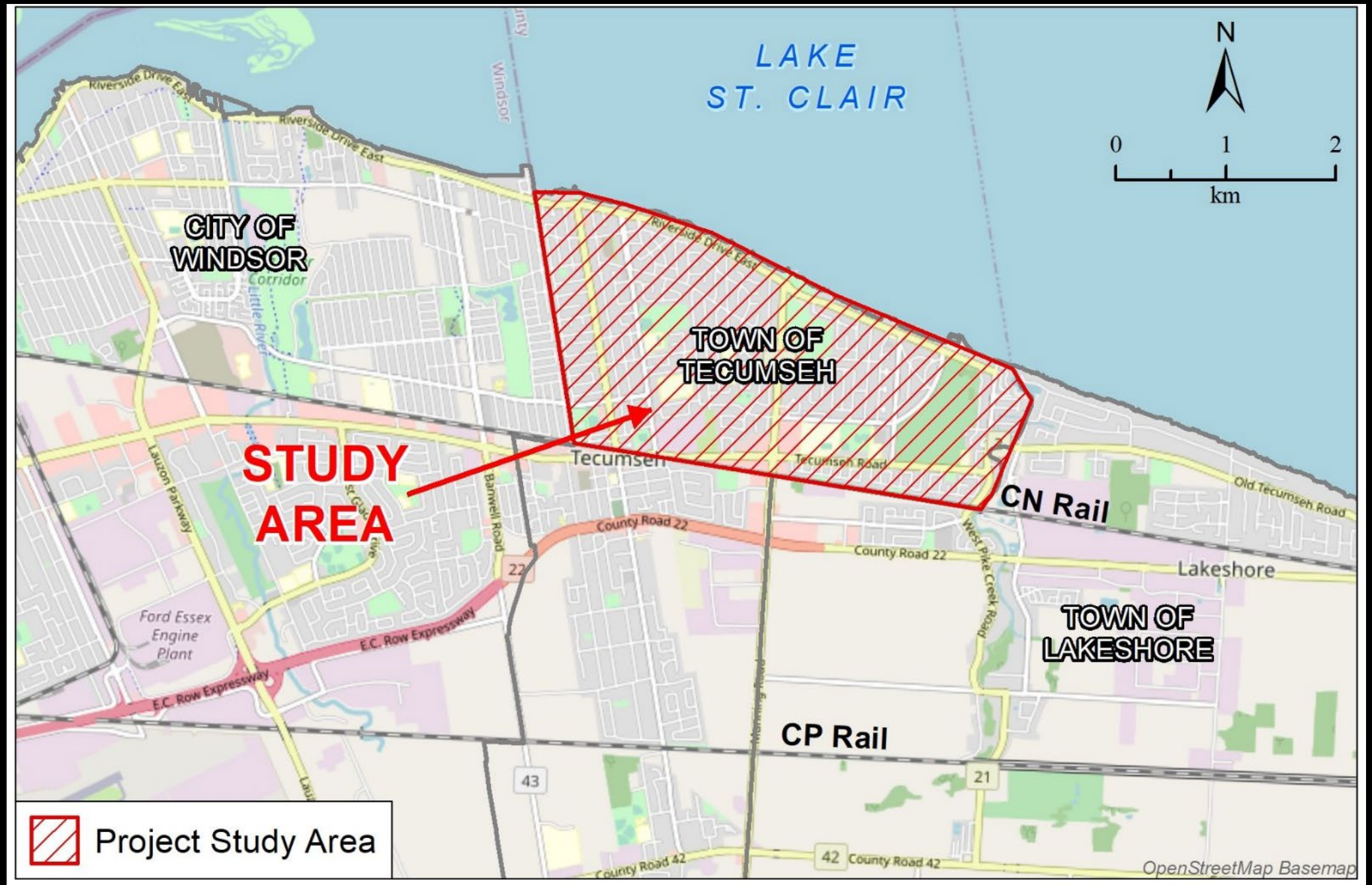
Town of Tecumseh
Shoreline Management Plan Update
Coastal Flood Risk Assessment

Public Information Centre #2

April 20, 2021

Study Area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LAKESHORE
Lakeshore
Tecumseh
Riverside Drive East
Tecumseh Road
County Road 22
E.C. Row Expressway
Ford Essex
Engine
Plant
Lauzon Parkway
Barnwell Road
West Pike Creek Road
Old Tecumseh Road
County Road 42
Project Study Area
OpenStreetMap Basemap

AGENDA FOR PIC#2

- Meeting format, goals, and next steps
- Flood risk factors in Tecumseh
- Flood mapping and potential economic damages
- Options to reduce flood risk and damages
- Question and answer on the presentation
- Interactive discussion with the participants
- Next Steps

Public Information Centre Guidelines

- All participants are muted and off video
- The panelists will present the webinar and have their video on
- During the feedback portion you can use the '**Question and Answer**' button found at the bottom of your screen
  - Open the Question and Answer Window
  - Type your question or comment in the window. Click send
  - Your question will be read to all participants by the facilitator and one of the panelists will respond to the comment or question
- Note: Check **Send Anonymously** if you don't want your name attached

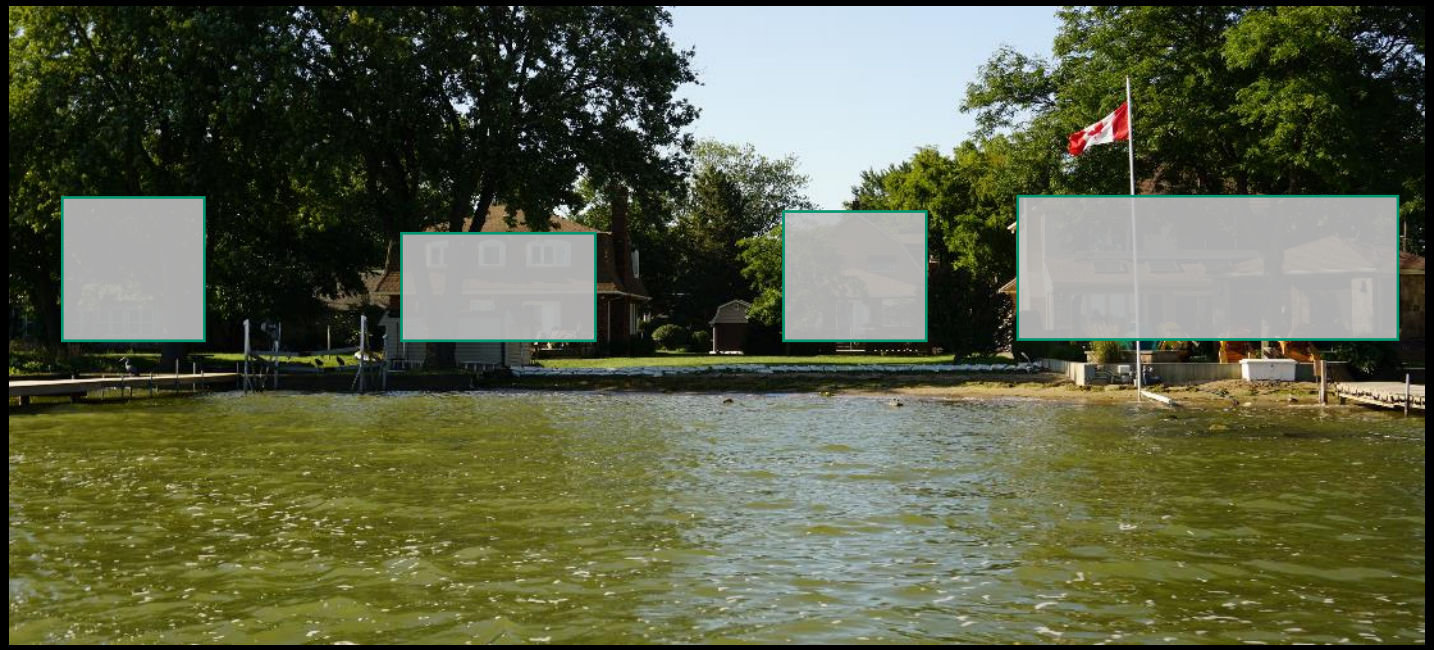
Public Information Centre (PIC) #2 GOALS

- Provide an update on the project and workplan
- Update on climate change impacts and rainfall/wave flooding events
- Share findings of the flood risk assessment and potential economic damages
- Provide preliminary information on flood mitigation strategies
- Gather feedback from the attendees about local conditions and evaluation criteria

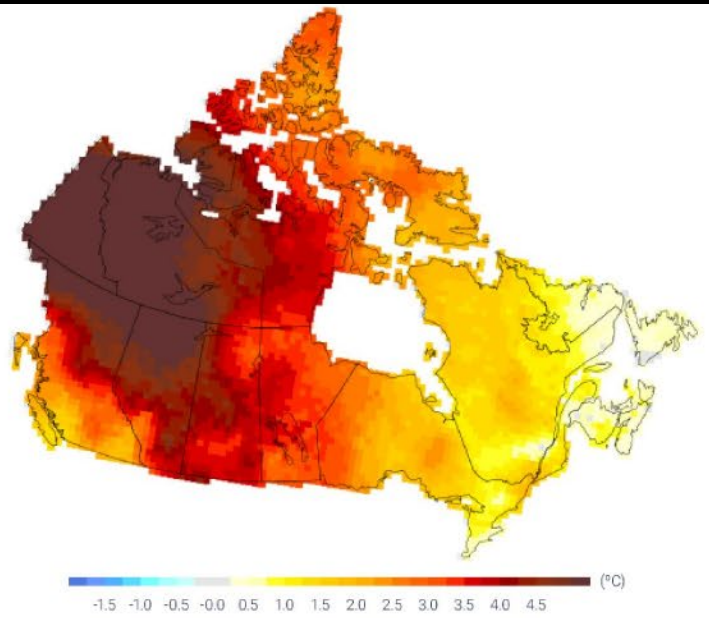
LOOKING AHEAD FOR PIC#3

- PIC#3: June-July 2021 (tbd)
- Afternoon and evening sessions
- Scope of meeting (partially based on feedback today):
  - Re-assess floodplain mapping with hypothetical mitigation projects
  - Review mitigation options to reduce flood risk and improve emergency access
  - Assess reduction in economic damages with mitigation projects
  - Feedback from the attendees
- Draft report July 2021

FLOOD RISK FACTORS IN TECUMSEH

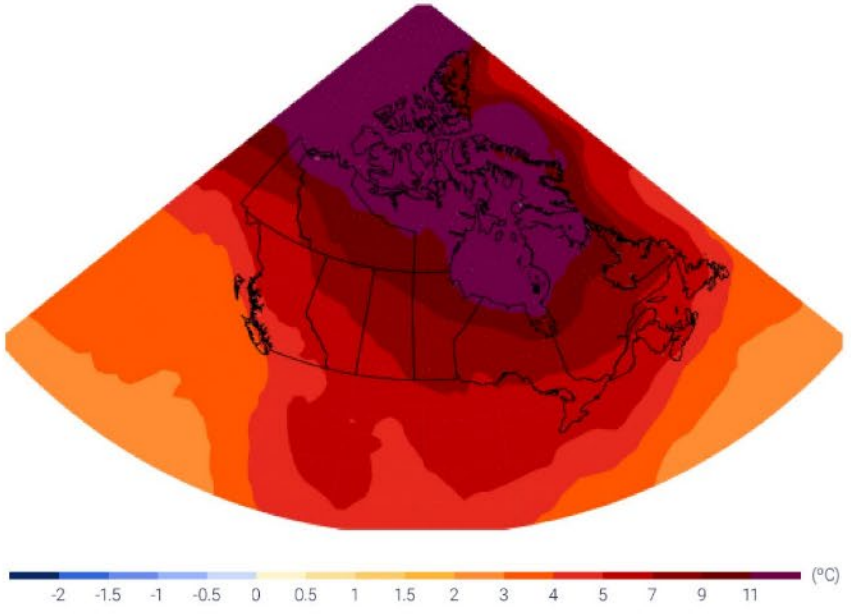


1948 to 2016 Winter Air Temperature Increase

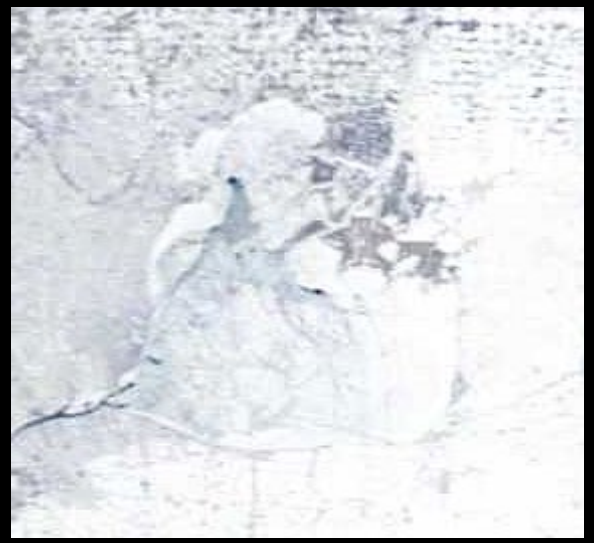


Source: Vincent et al. 2015. In 'Zhang, X., Flato, G., Kirchmeier-Young, M., Vincent, L., Wan, H., Wang, X., Rong, R., Fyfe, J., Li, G., Kharin, V.V. (2019): Changes in Temperature and Precipitation Across Canada; Chapter 4 in Bush, E. and Lemmen, D.S. (Eds.) Canada's Changing Climate Report. Government of Canada, Ottawa, Ontario, pp 112-193'.

2081-2100 Winter Warming Projection for RCP8.5

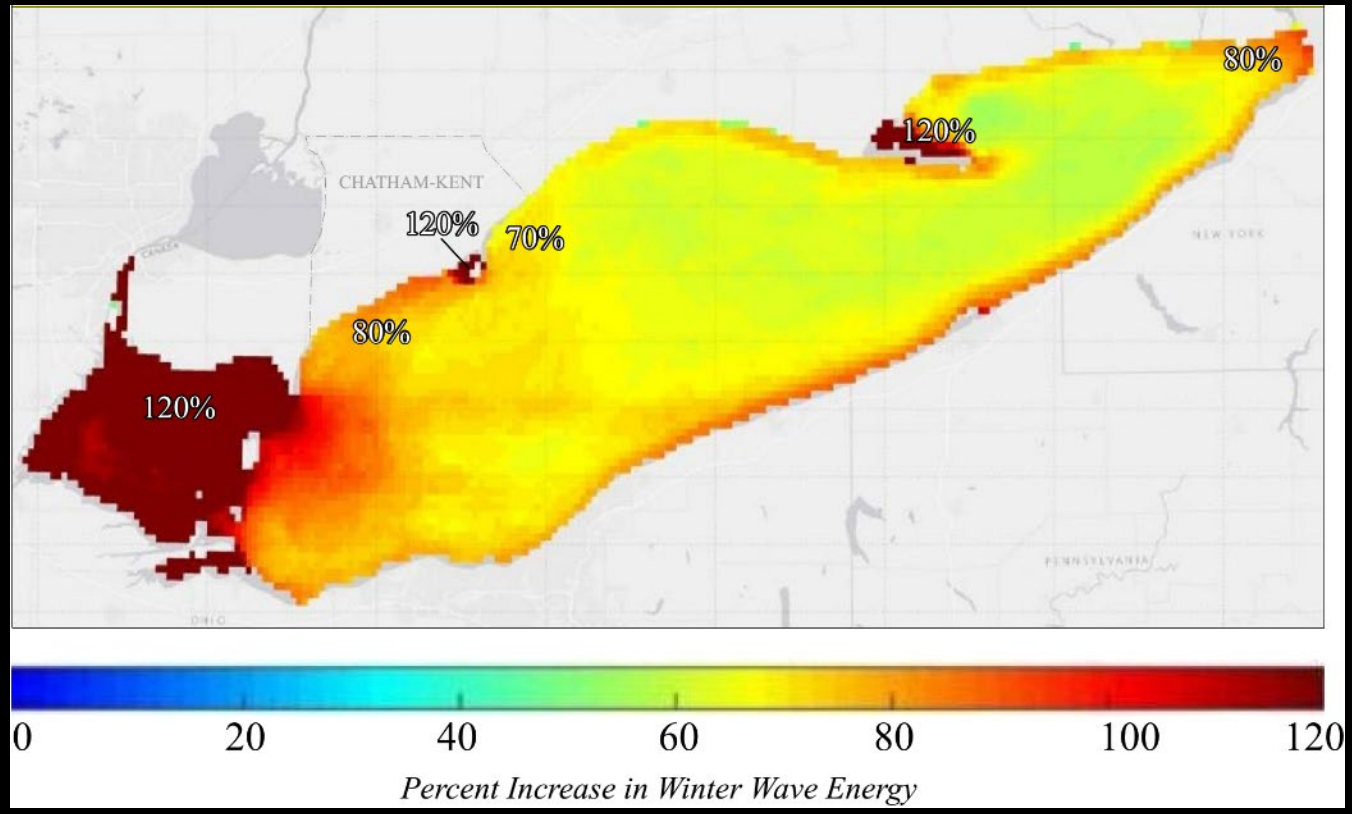


Source: Climate Research Division, Environment and Climate Change Canada. In 'Zhang, X., Flato, G., Kirchmeier-Young, M., Vincent, L., Wan, H., Wang, X., Rong, R., Fyfe, J., Li, G., Kharin, V.V. (2019): Changes in Temperature and Precipitation Across Canada; Chapter 4 in Bush, E. and Lemmen, D.S. (Eds.) Canada's Changing Climate Report. Government of Canada, Ottawa, Ontario, pp 112-193'.

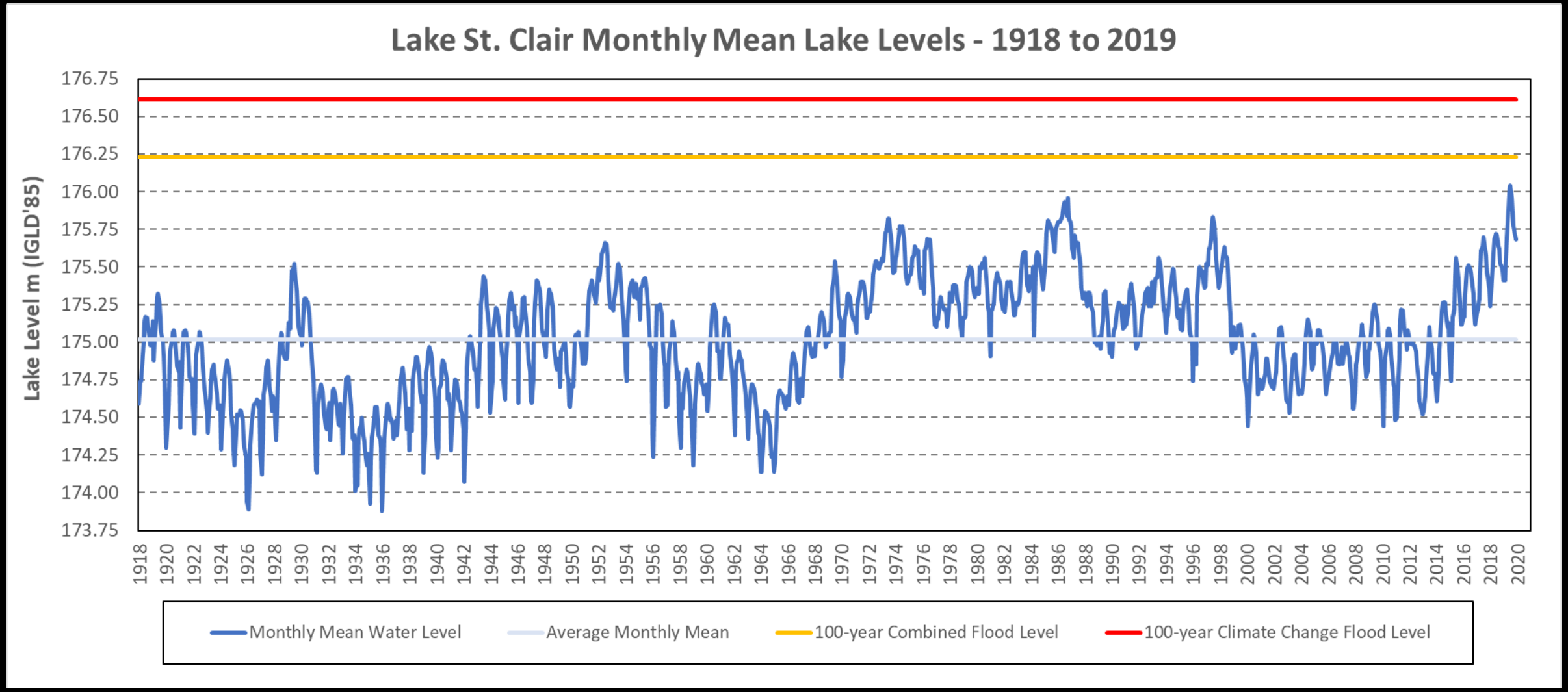


Projected Increase in Wave Energy due to Reduced Ice Cover (Lake Erie example)

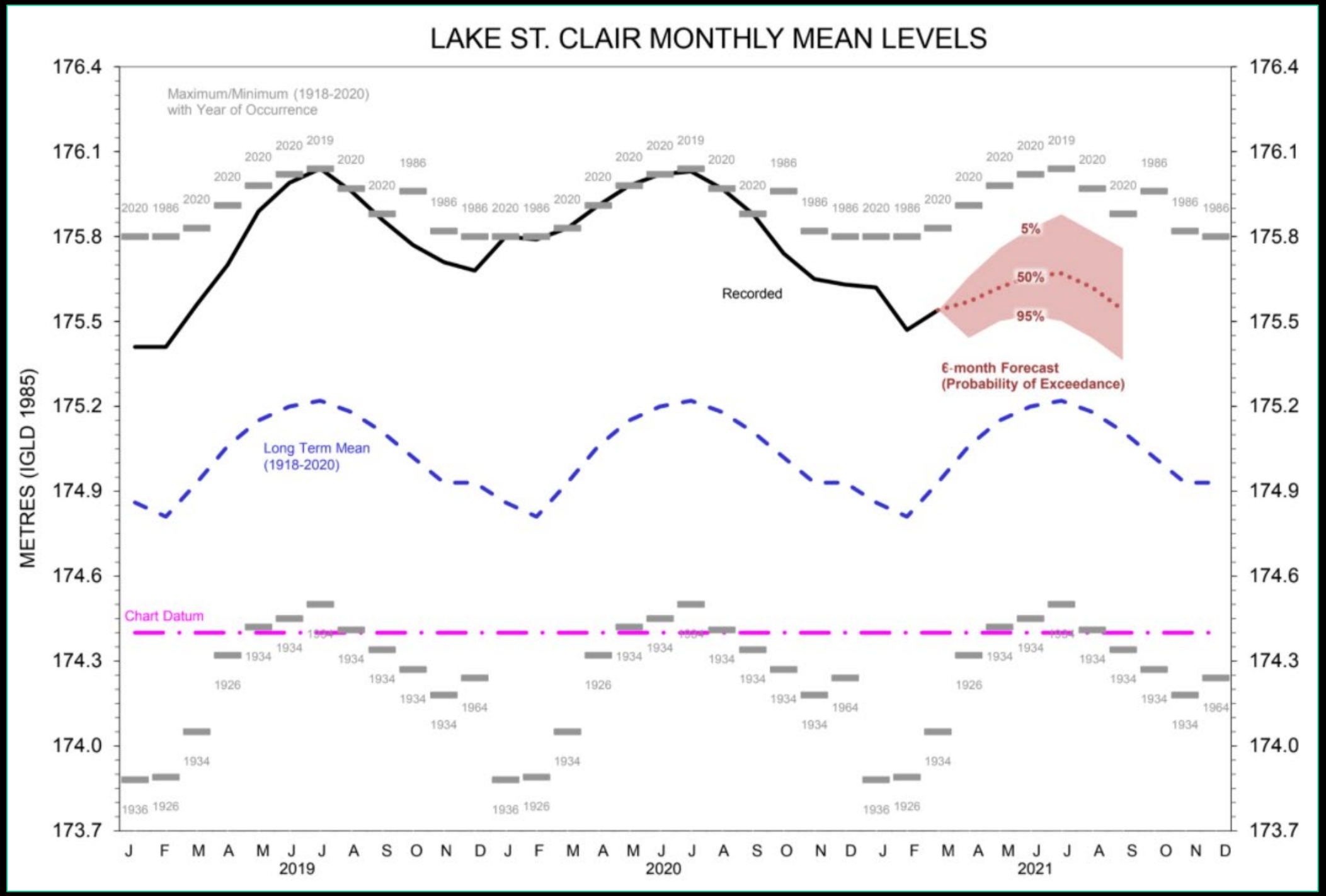
- Climate Change projections suggest lake ice cover might completely disappear, leading to winter wave energy increases of 100% (by late century/2080)
- Flood and erosion risks increase in the winter



Historical Water Levels, 100-year Combined Flood Level, and 100-year Climate Change Flood Level

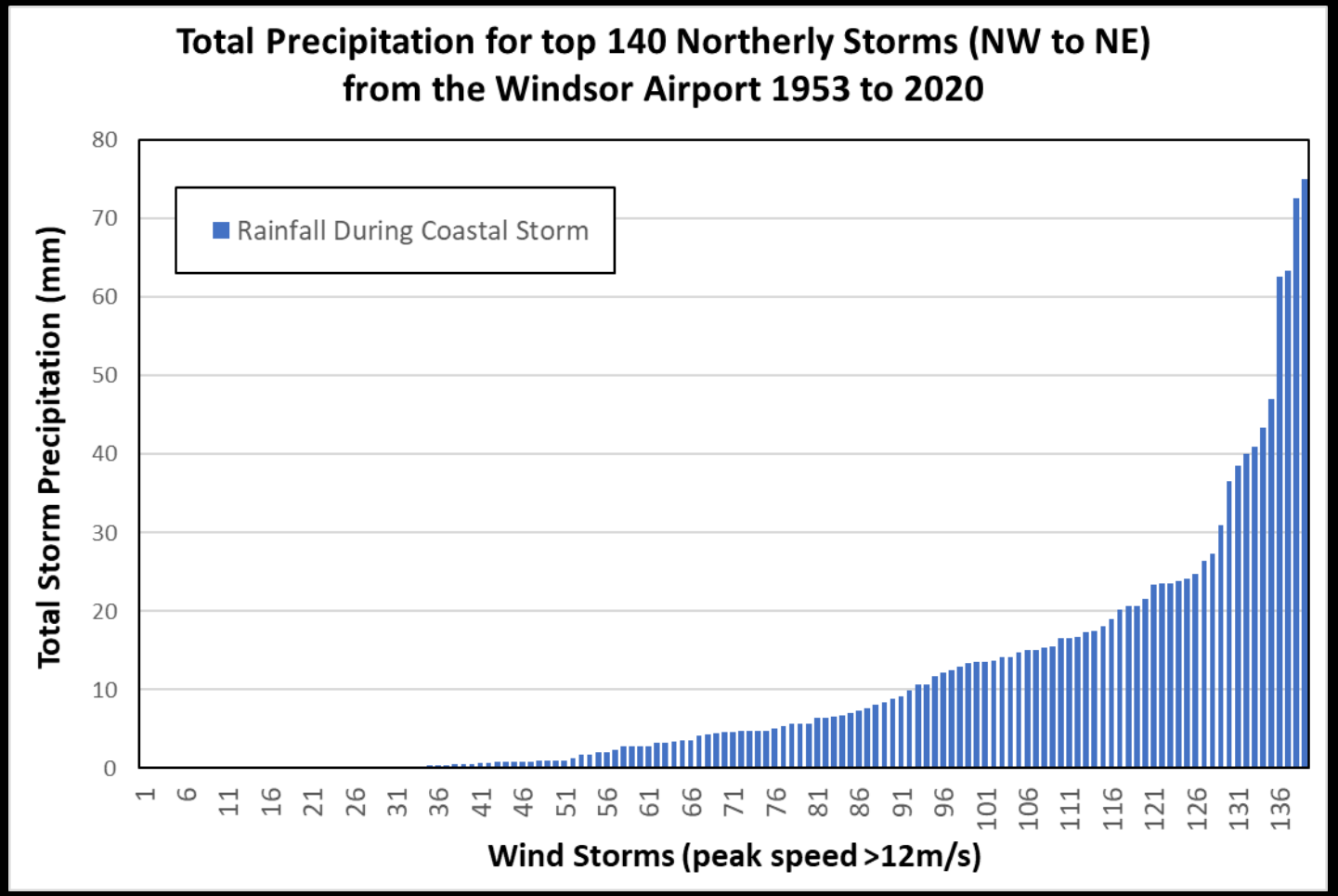


LAKE LEVEL FORECAST



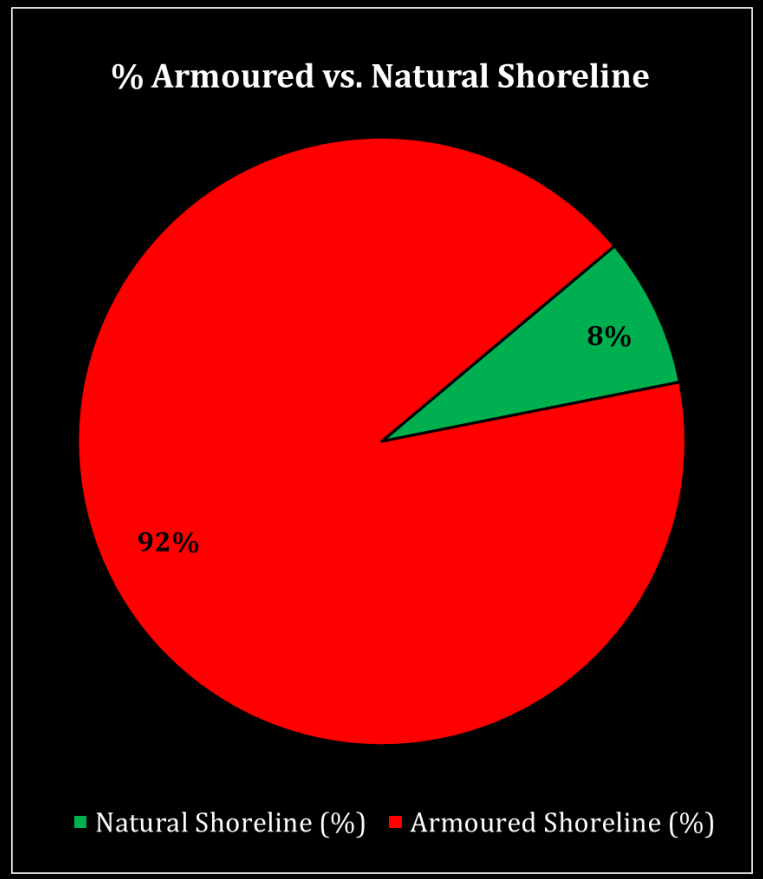
Combined Rainfall and Coastal Flooding Events (wave overtopping)

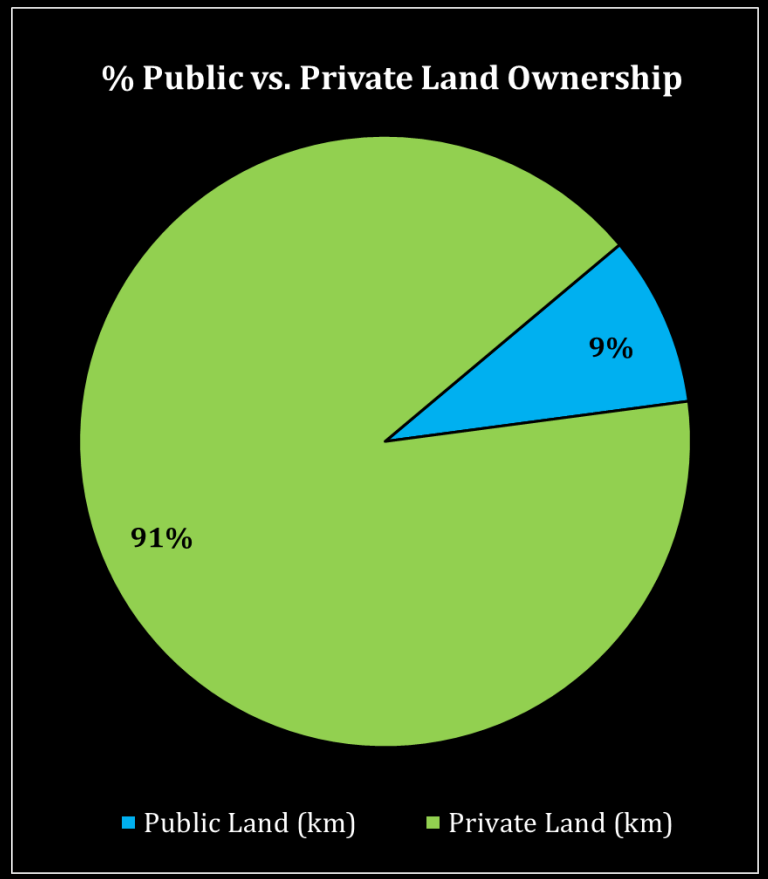
- Leverage results from Dillon (2019) for rainfall flood risk
- Rain and wave events?
- Windsor airport provided the closest long-term record of wind speed and rainfall data
- Roughly 70% of the historical coastal storm events featured some rainfall
- 5-year 4-hour rainfall is 49.5mm
- Storms with coastal flooding and rainfall will be evaluated

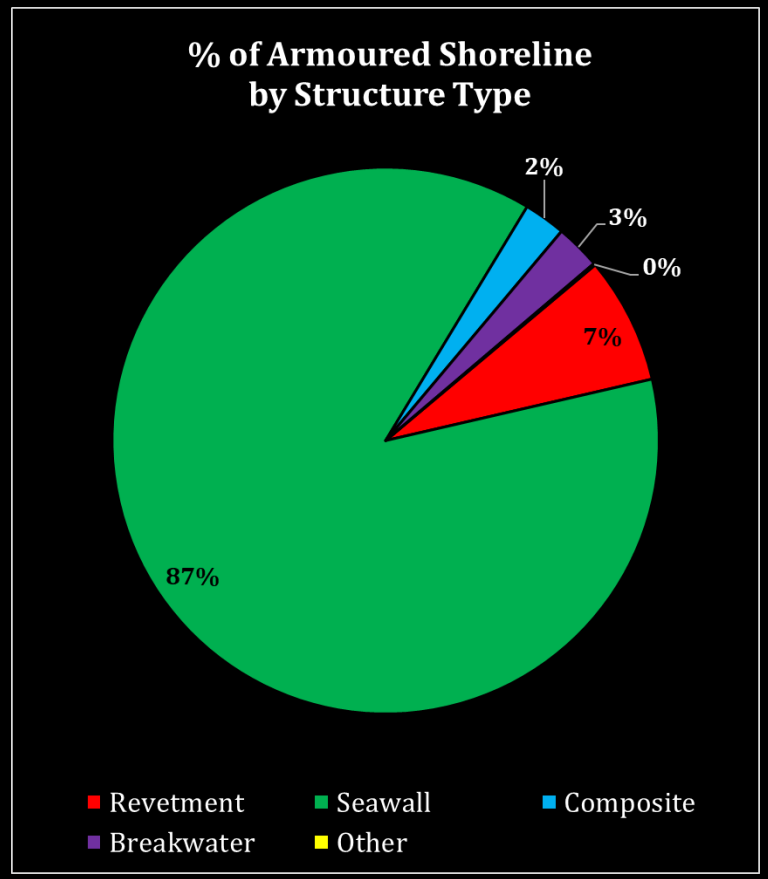


Shore Protection Database

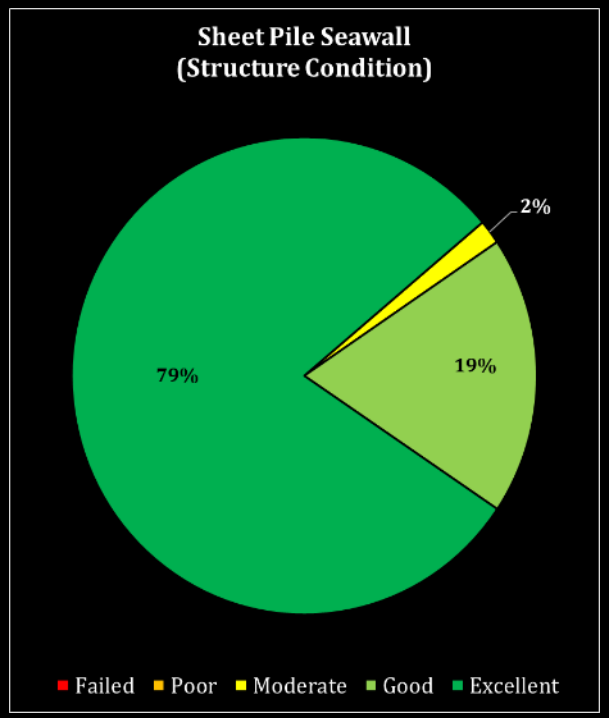
- Shoreline protection database was assembled for the entire study shoreline
- Summary statistics:

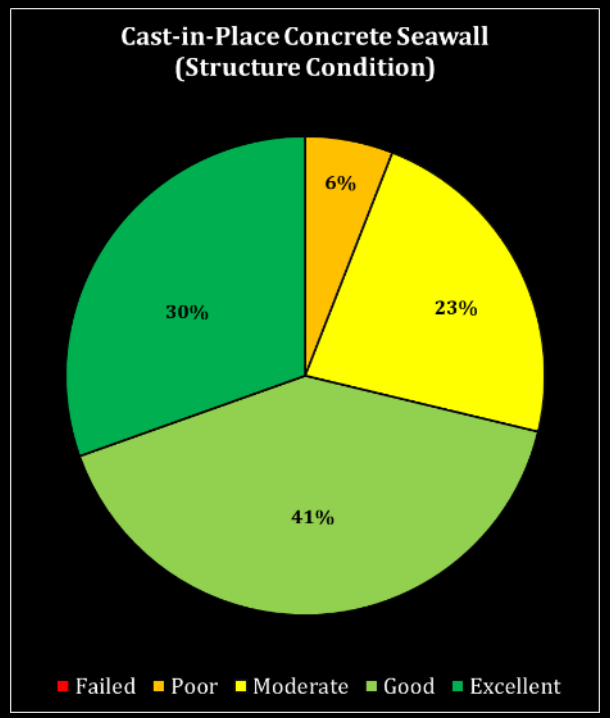


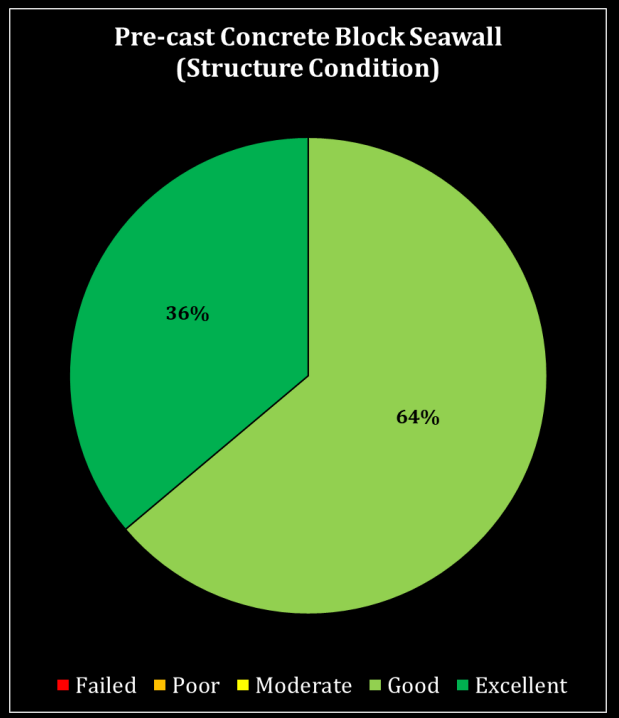


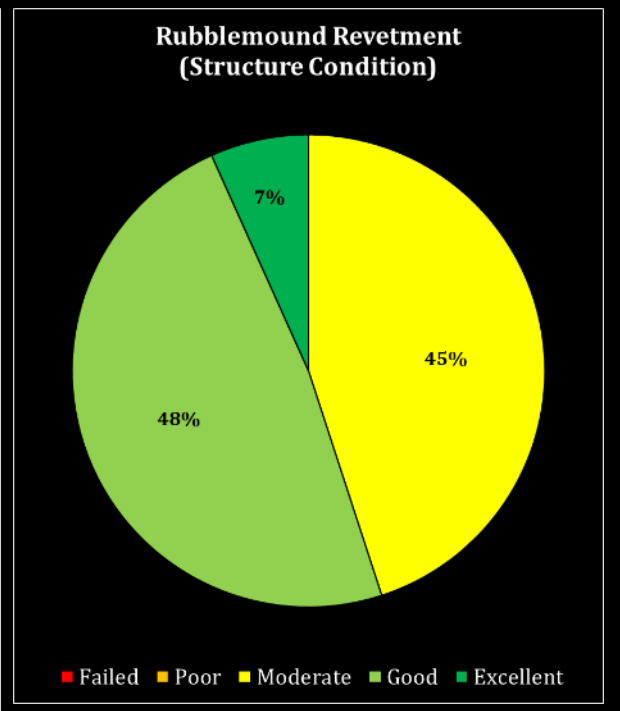


Shore Protection Structure Condition is Good
BUT CREST ELEVATION IS TOO LOW

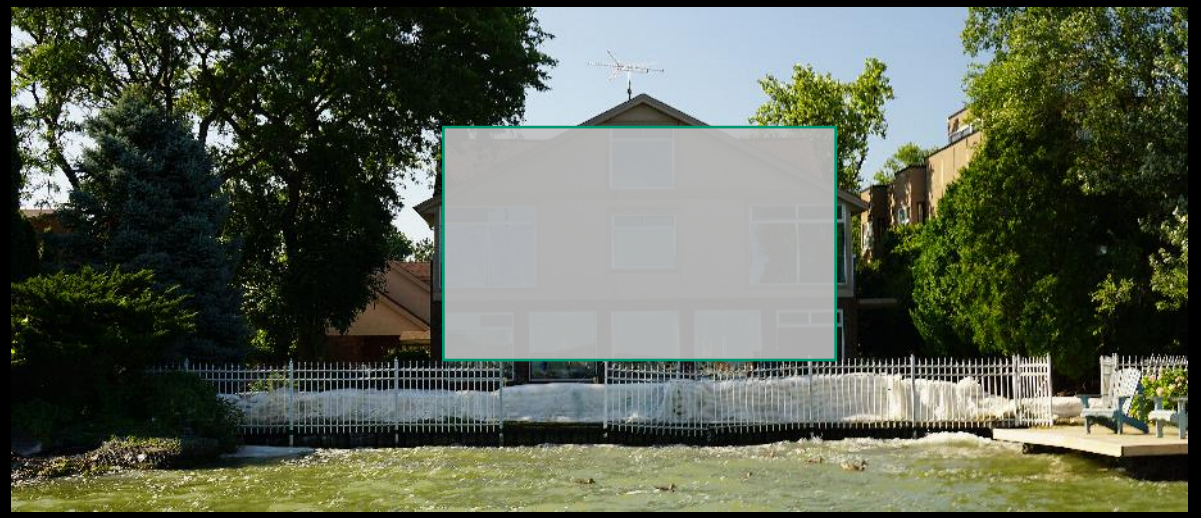




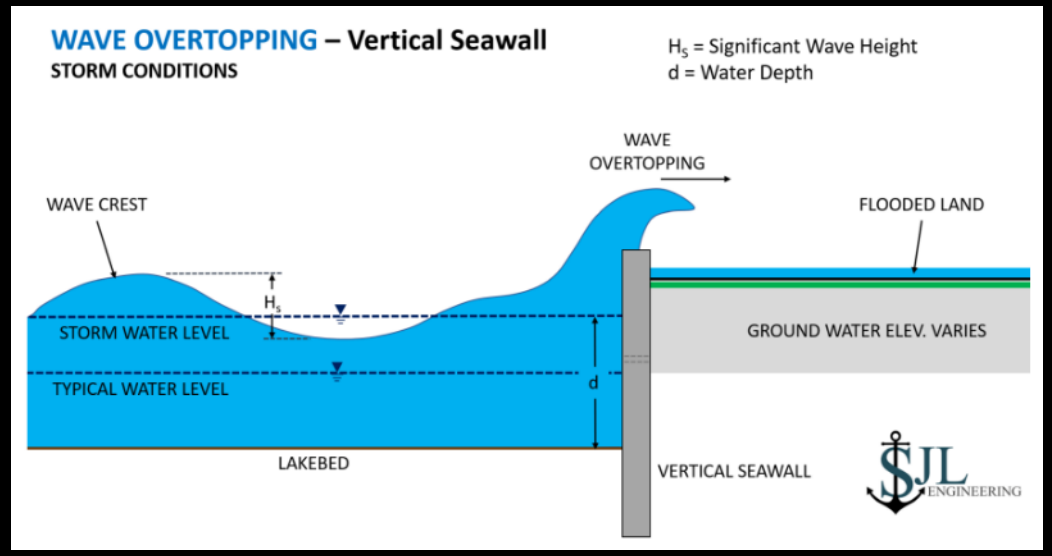


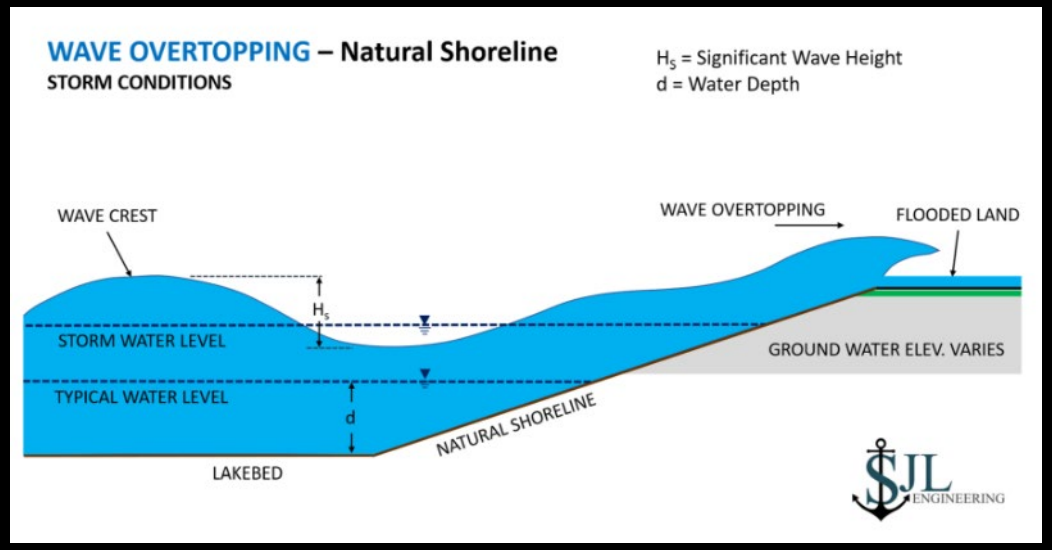


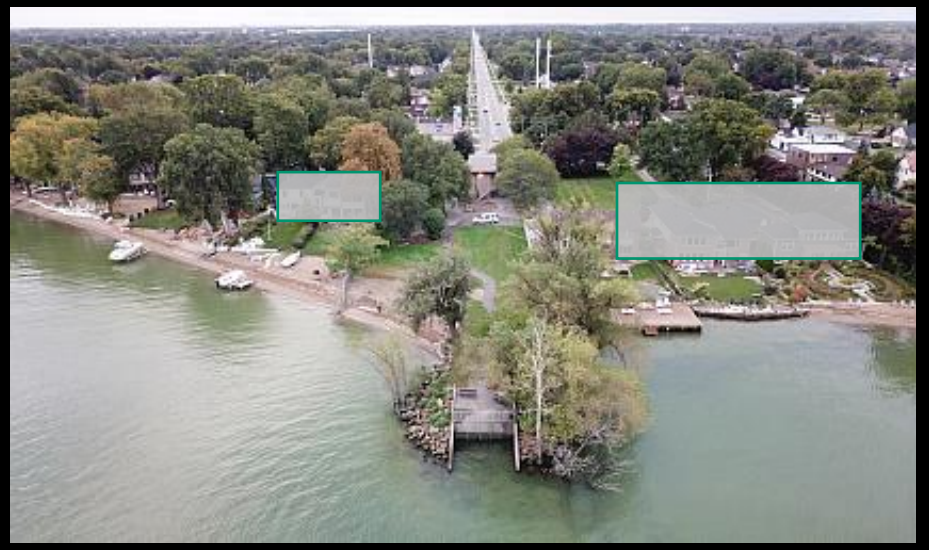
Examples of Low Properties and Low Crest Elevations for Shore Protection (176.04 m wl)



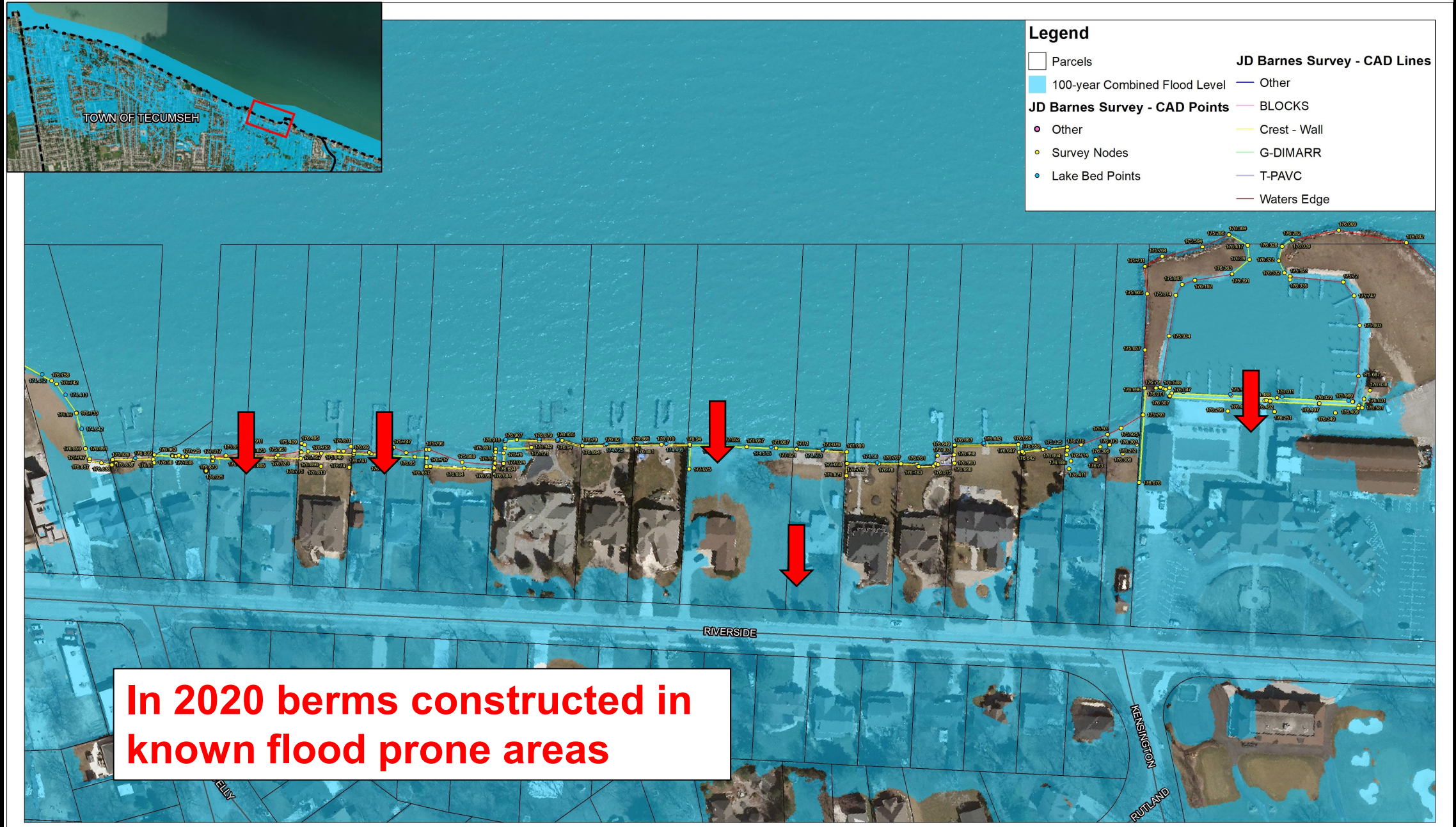
Wave Overtopping Pushes Water over the Shore Protection and onto Riverside Drive







FLOOD PATHWAYS



TOWN OF TECUMSEH
FLOOD RISK STUDY

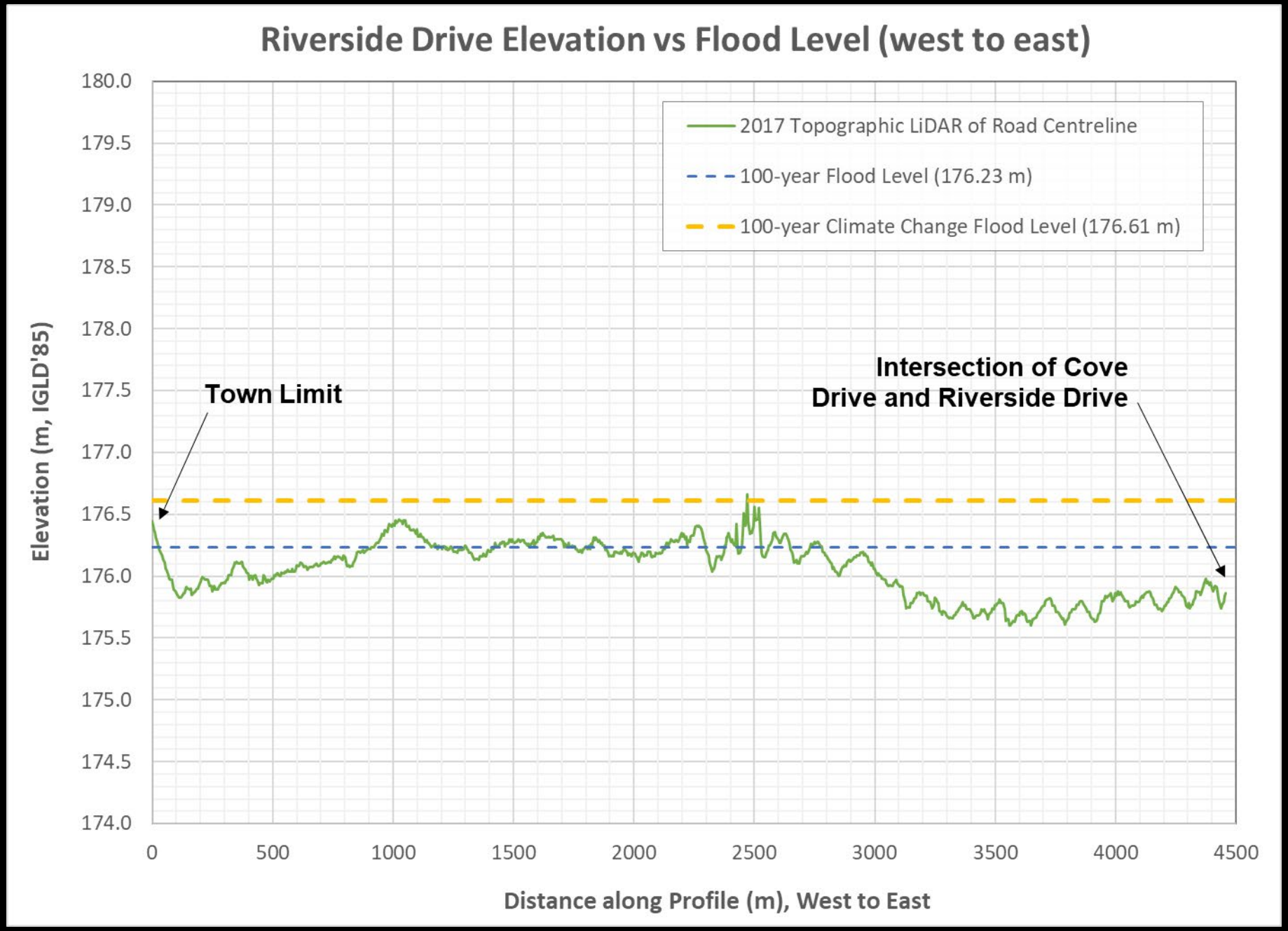
Flood Pathway for 100-year Combined Flood Level

Notes:
JD Barnes survey elevations in CGVD'28, m.
For Tecumseh, IGLD'85 - CGVD'28 = ~0 m.

0 50
m

Zuzek inc.
ONE WORLD

Road Elevation versus Flood Elevation



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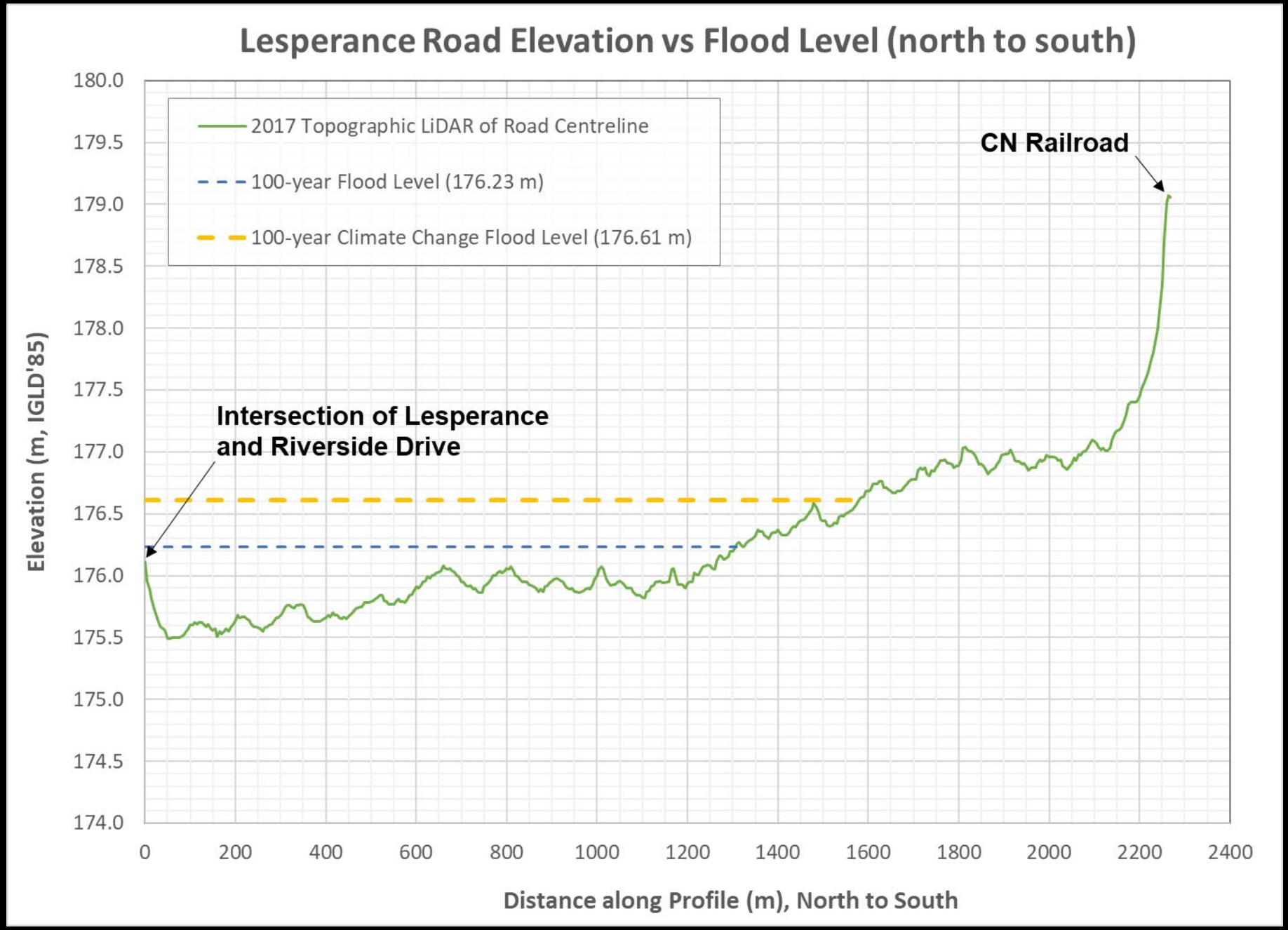

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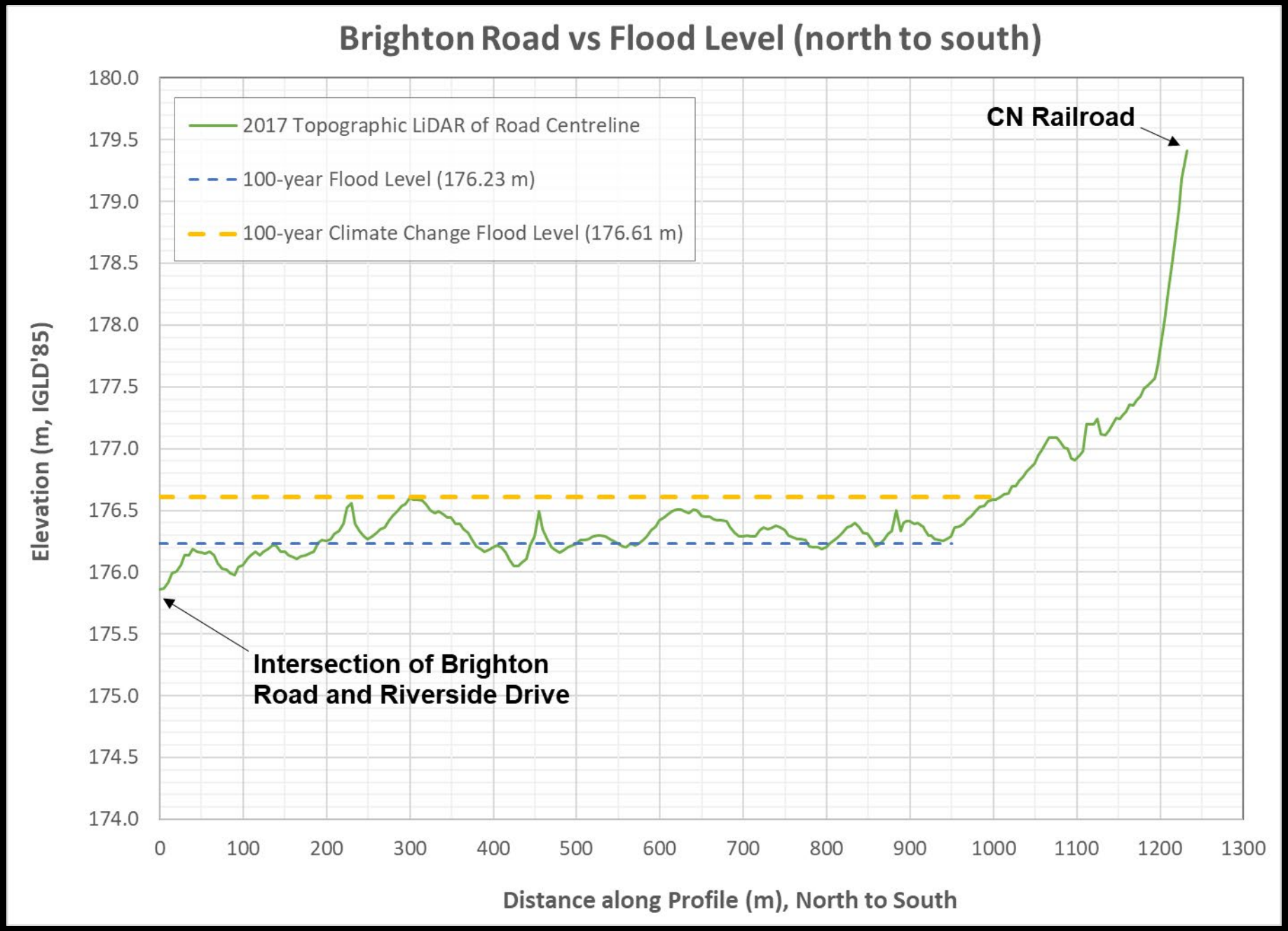


Saint Patrick's Day Storm of 1973

- Major coastal storm on March 17, 1973
- Peak water level at Belle River reached +176.19 m IGLD85'
  - 4 cm below predicted 100-year combined flood level
  - Mean Lake Level = +175.83 (50-year for March)
  - Storm Surge = 0.36 m (25-year)
  - Significant wave height event


St. Clair Beach Police Station


Riverside Drive


Tecumseh Road


Arlington Blvd.

Saint Patrick's Day Storm - 1973

- Water levels in 2019 peaked at +176.17 m IGLD85' (July 20, 2019). Some infrastructure has been updated since 1973
- Only 2 cm less than the March 17, 1973 event
- Why did we not see the same flooding?
  - 2019 water levels were a result of high mean lake levels
  - Did not have a concurrent major storm surge or wave event
  - No significant wave overtopping of the shoreline
  - We were lucky!

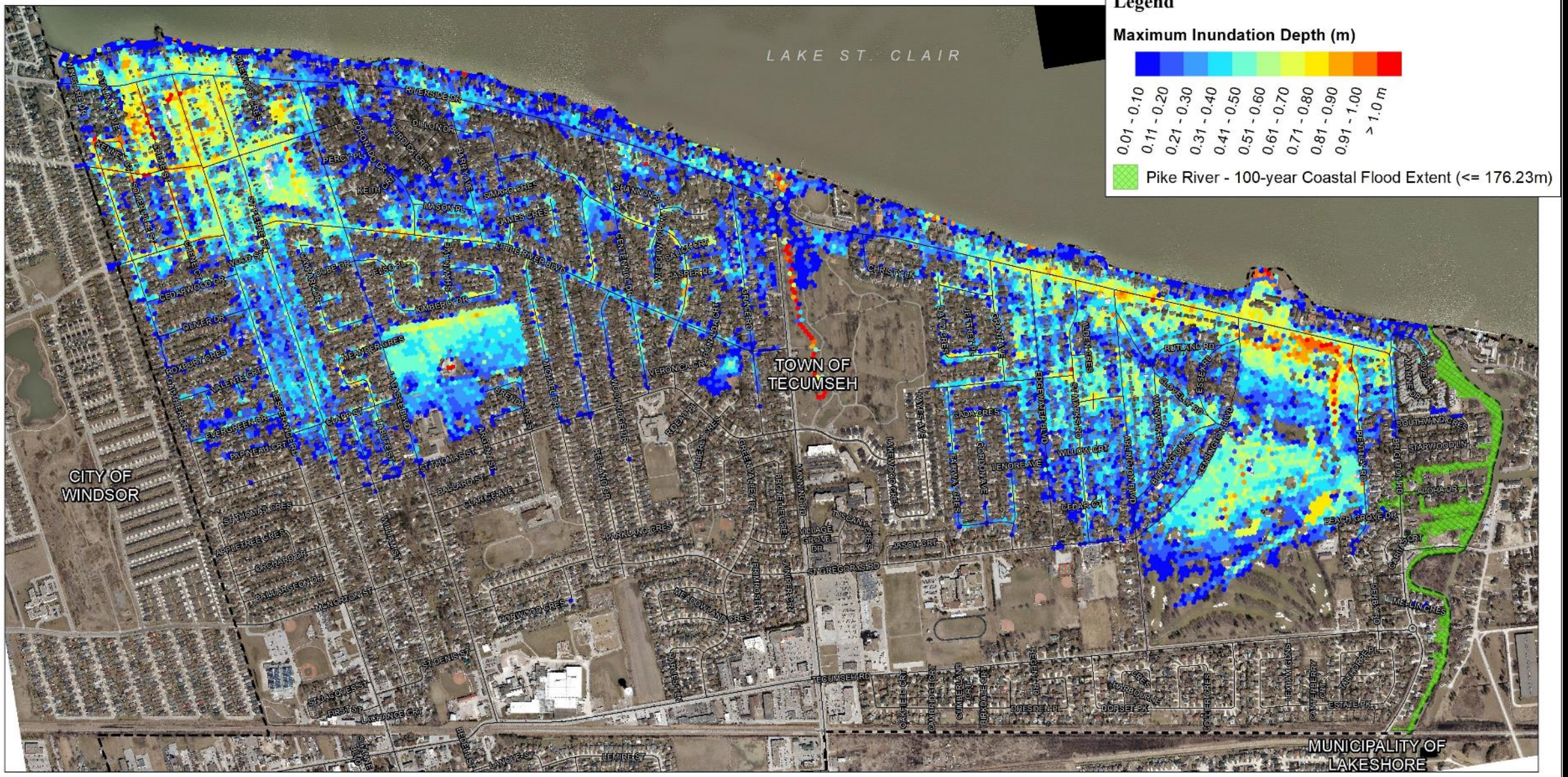
"Over 3,000 residents evacuated from their homes"

Windsor Star

"4 feet of water on Riverside Drive"

Windsor Star

FLOOD MAPPING AND POTENTIAL ECONOMIC DAMAGES



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Scenario A
100-year Coastal Flood with No Rain

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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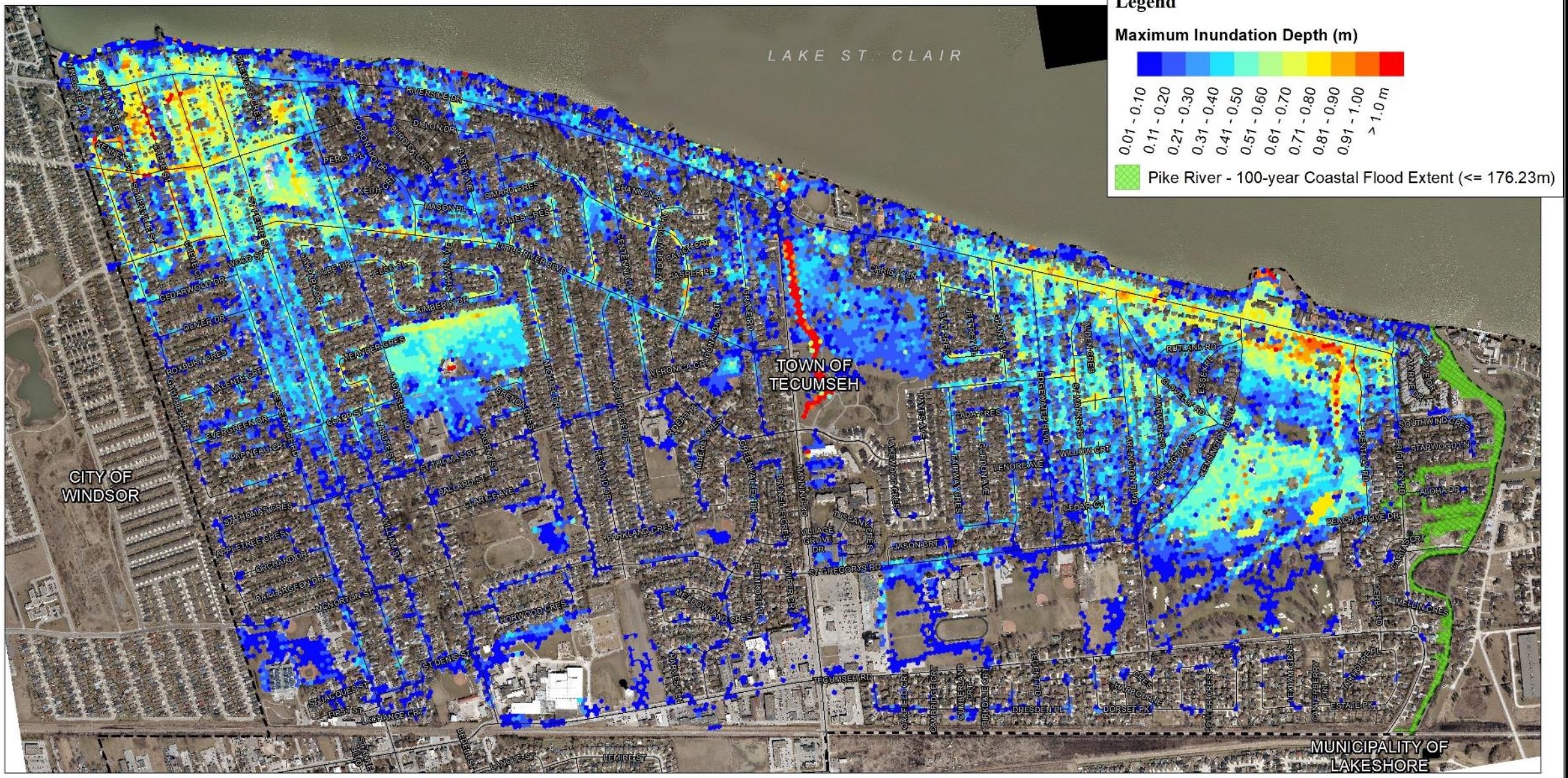

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Scenario B
100-year Coastal Flood with 5-year Rainfall over 4 Hours

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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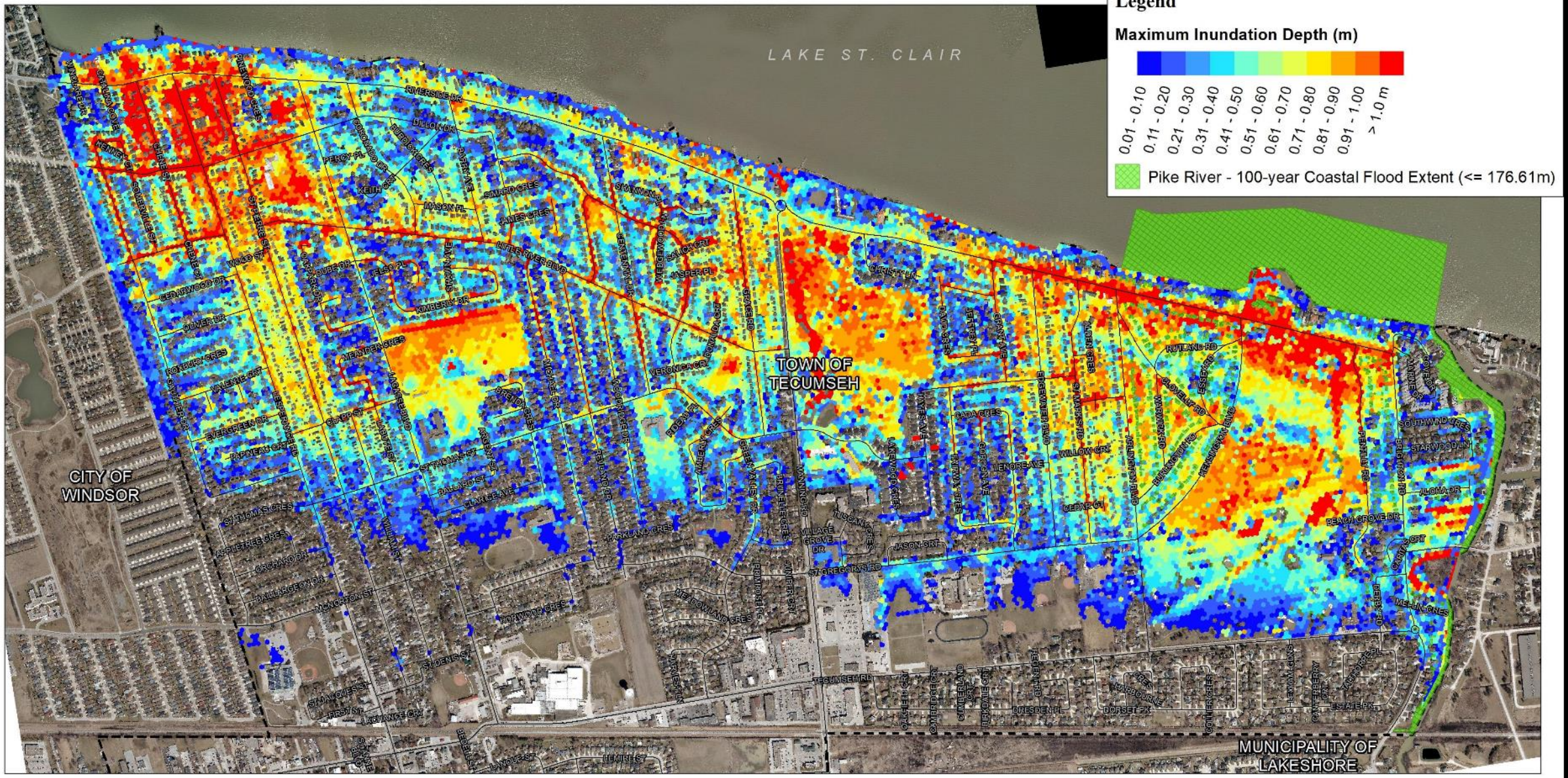

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Scenario C
100-year Climate Change Coastal Flood with No Rain

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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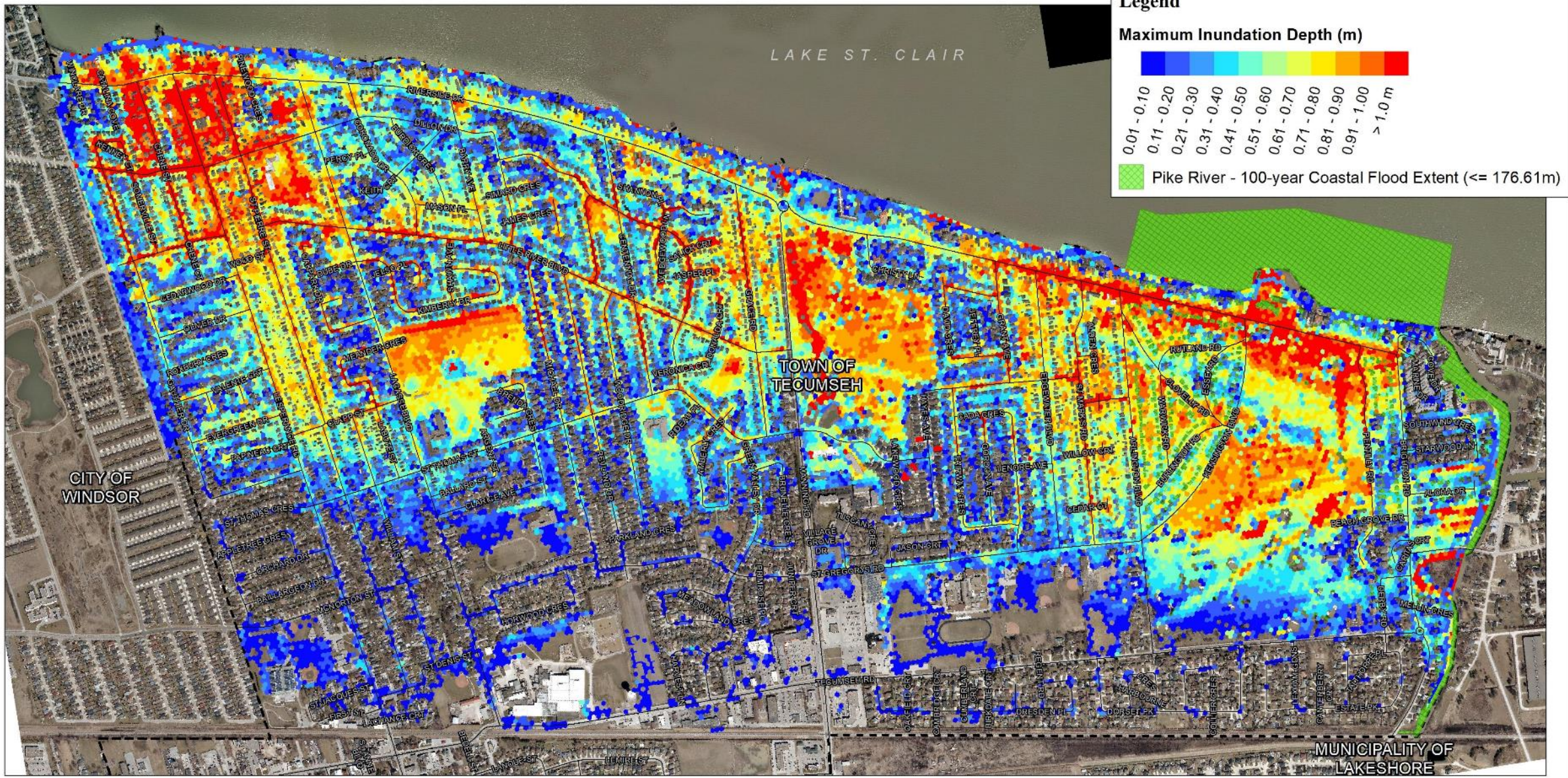

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Scenario D
100-year Climate Change Coastal Flood with 5-year Rainfall over 4 Hours

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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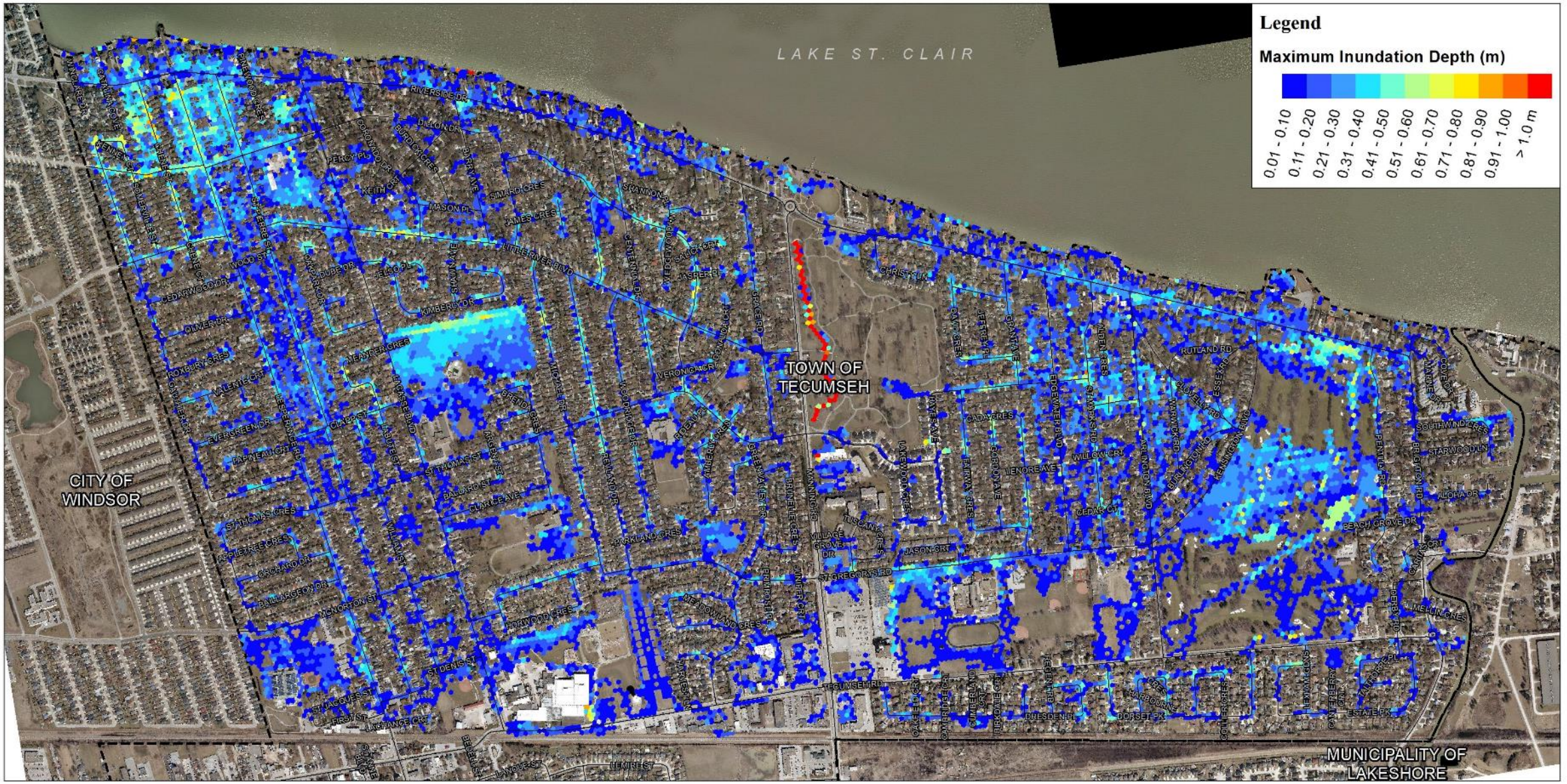

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Scenario E
Urban Stress Test Rainfall (150 mm) and 5-year Coastal Flood

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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PROPERTY PARCEL DATABASE

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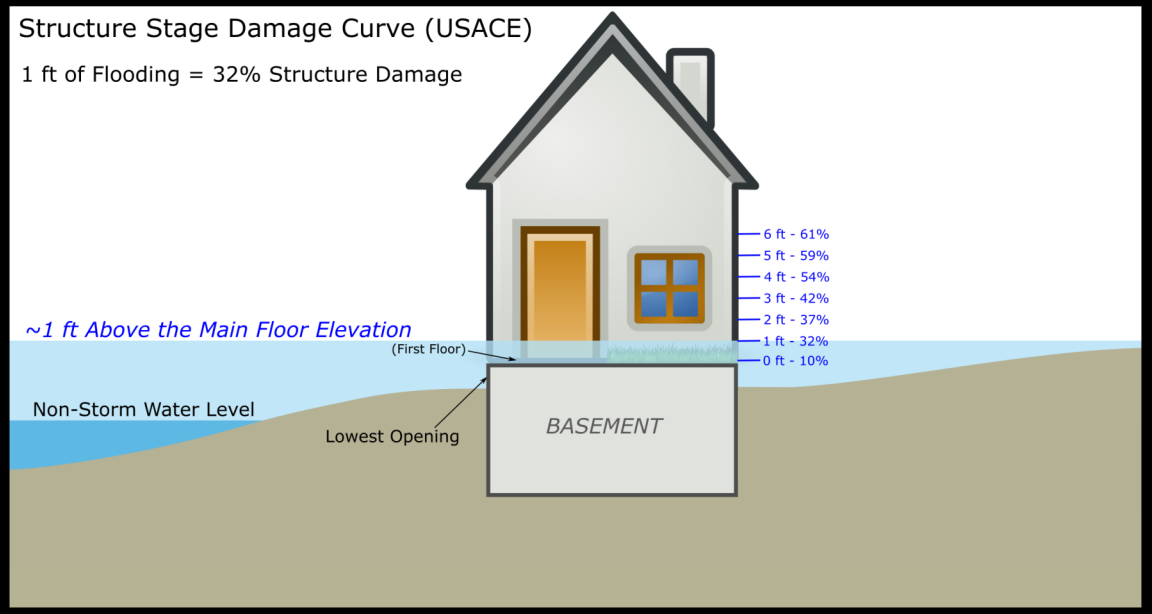
Parcel Database
Collection of Estimated First Floor Elevations

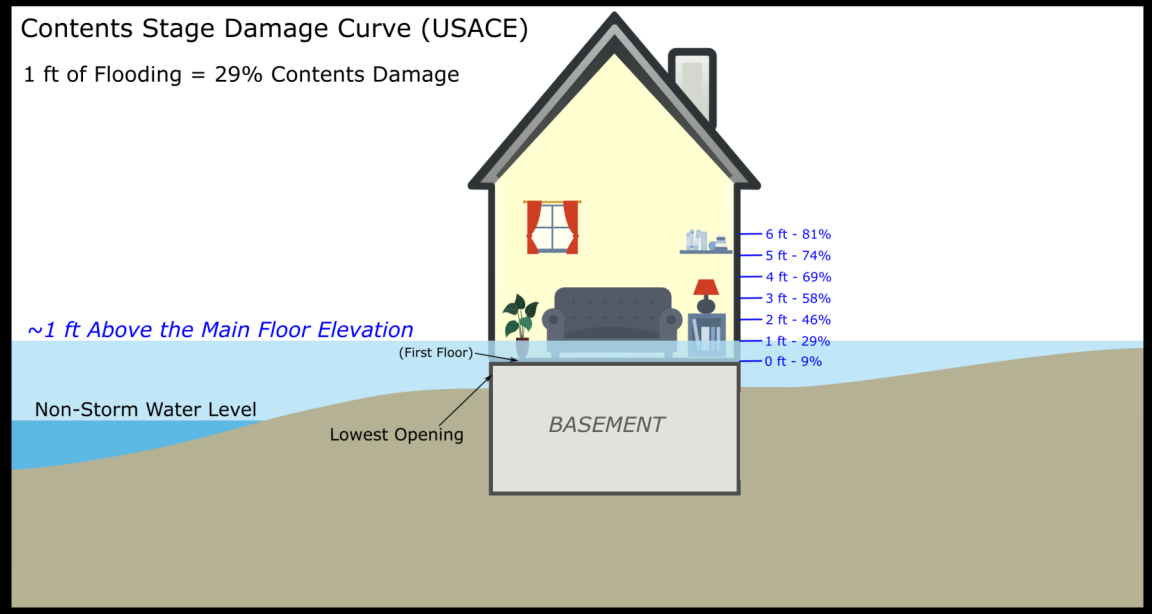
Town of Tecumseh

Data Sources:
1) 2019 ortho provided by the Essex.

Flood Damage Methodology (DRAFT)

- Property value based on current assessment value
- Building and content damages increase with the depth of flooding above the first floor (USACE methodology in graphics below)
- Potential for basement flooding ongoing (no damage estimate yet)



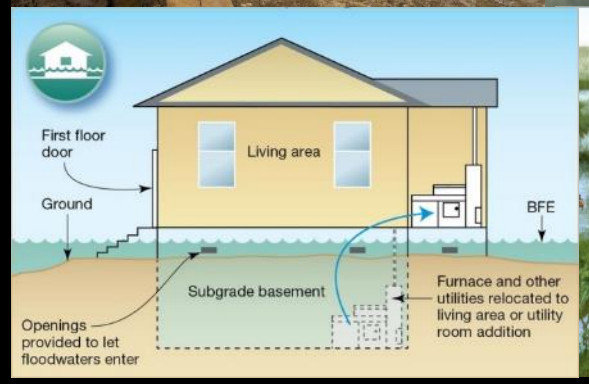


Estimated Economic Damages for Flood Scenarios (DRAFT)

- Damages for Commercial (18), Institutional (1), Industrial (10), and Recreational (1) buildings ongoing but not included in the estimates below
- Basement flooding damage calculations ongoing (*only estimates below*)*

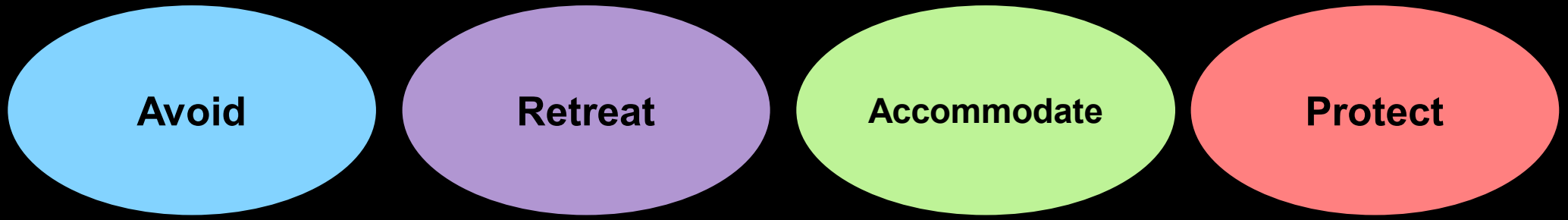
Flood Scenario	Wet Exterior Basement Foundation	*Potential Basement Damage	First Floor Flooded	Residential Structure and Content Damage
A – 100-year Coastal Flood no Rain	~700	Calculation not complete. Could exceed $20M (*high uncertainty*)	95	$12 to $20 million
B – 100-year Coastal Flood with 5-year Rainfall (49.5 mm)	~700		97	$12 to $20 million
C – 100-year Climate Change Coastal Flood no Rain	~2,650	Calculation not complete. Could exceed $60M (*high uncertainty*)	712	$92 to $138 million
D – 100-year Climate Change Coastal Flood with 5-year Rainfall (49.5 mm)	~2,650		715	$93 to $139 million
E – Urban Stress Test Rainfall (150 mm rain) with 5-year Coastal Flood	~300	Calculation not complete. Could exceed $7M	11	$2 to $3 million

ADAPTATION CONCEPTS



Types of Climate Change Adaptation Strategies

- **Avoid**: reduce exposure by ensuring new development doesn't occur on hazardous land (doesn't help with legacy development)
- **Retreat / Re-Align**: a strategic decision to relocate public and private assets exposed to significant coastal hazards, or change existing land uses
- **Accommodate**: an adaptive strategy that allows for continued occupation while changes to human activities or infrastructure are made to reduce risk
- **Protect**: a reactive strategy to protect people, property, and infrastructure. Traditional approach and often the first considered

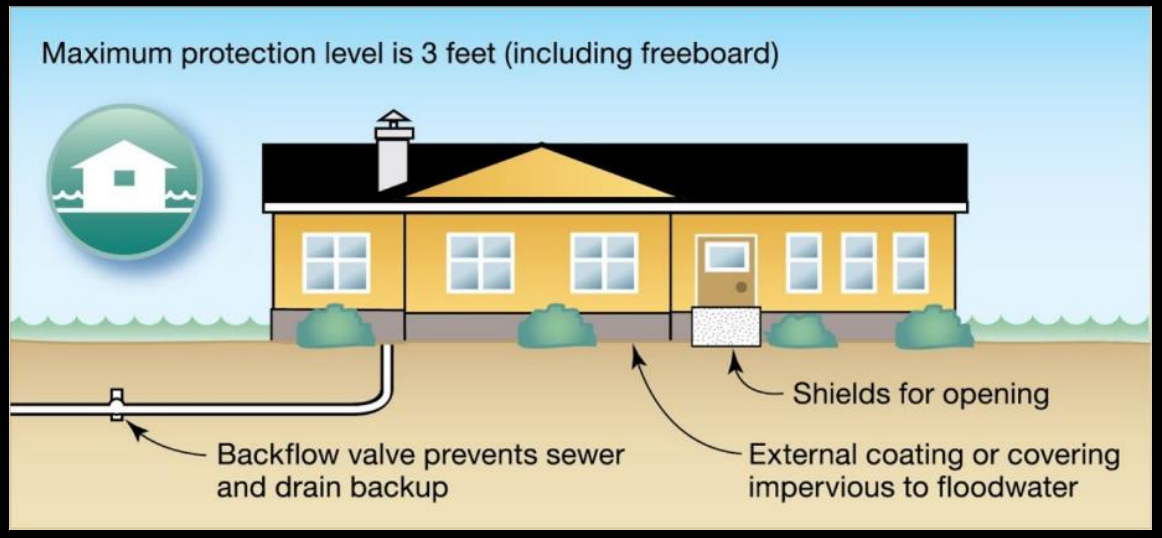


ACCOMMODATE

- Flooding persists, but impacts of flooding are mitigated
  - Mitigated impacts can be economic (property, possessions, infrastructure, loss of employment, etc.)
  - Mitigated impacts can also be related to human safety (emergency access, ability to evacuate, etc.)

ACCOMMODATE: Floodproof

- Floodproofing Homes:
  - Backflow valves
  - Foundation coating / covering
  - Opening shields (doorways, windows)
  - Raise homes

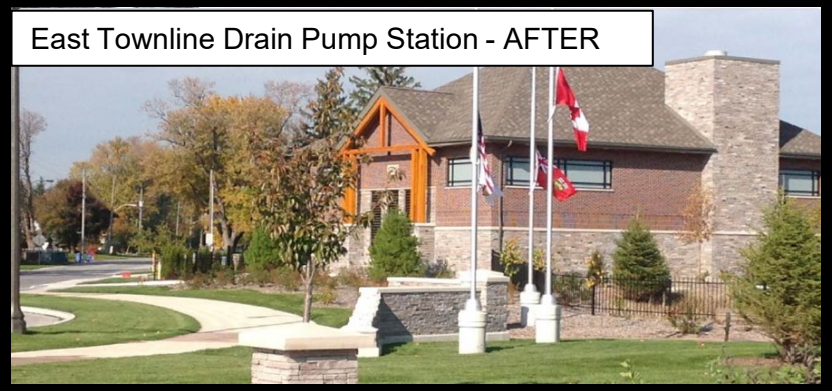


ACCOMMODATE: Stormwater Management

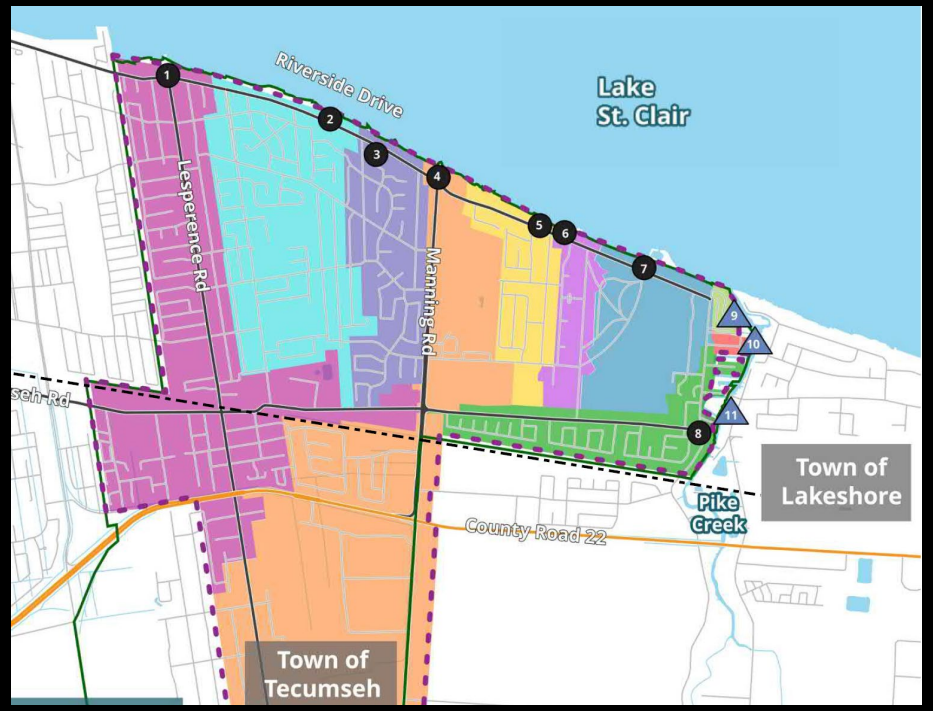
- Upgrade stormwater management capacity

East Townline Drain Pump Station - BEFORE

East Townline Drain Pump Station - AFTER



East Townline Drain Pump Station - AFTER

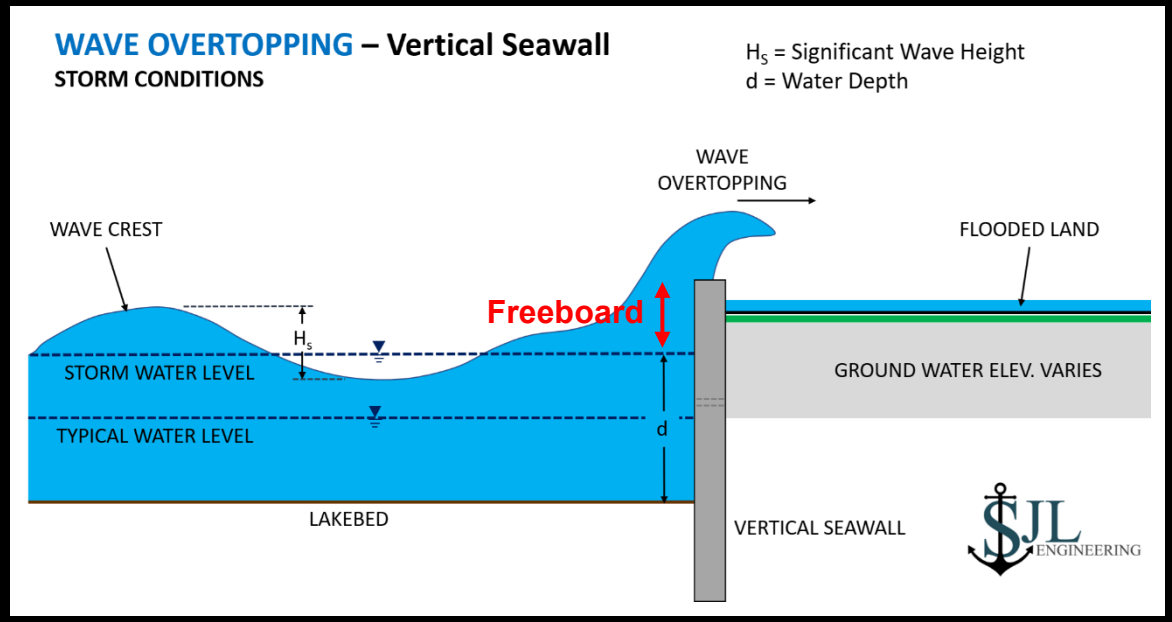


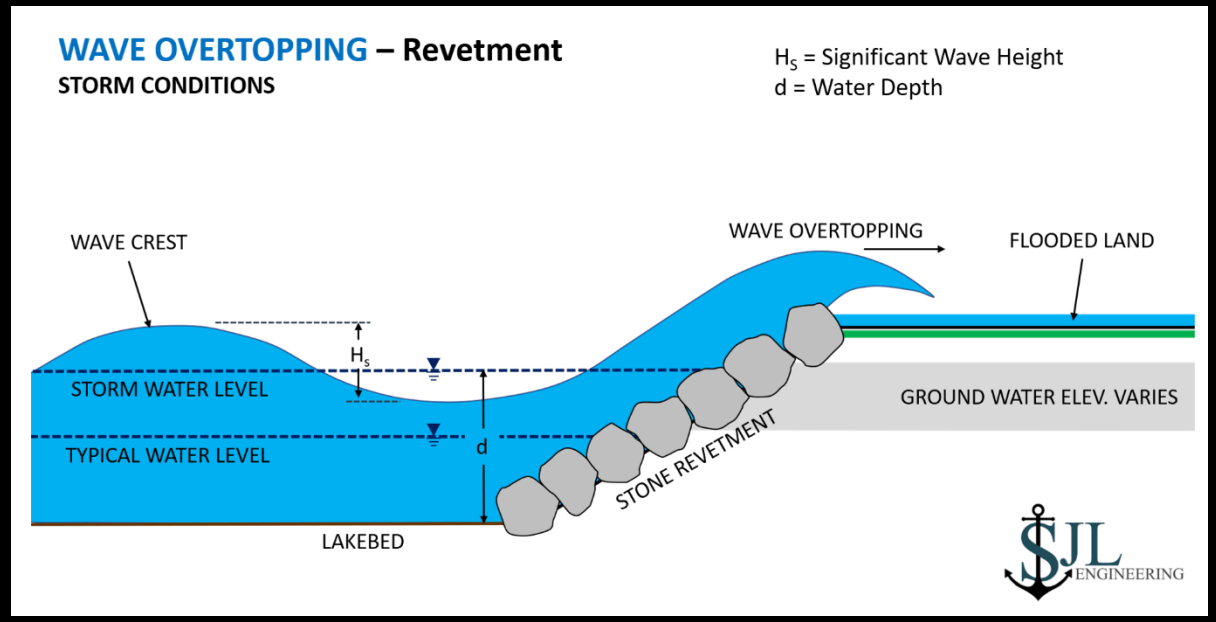
ACCOMMODATE: Emergency Planning

- Specialized emergency vehicles
- Emergency preparedness and planning

PROTECT

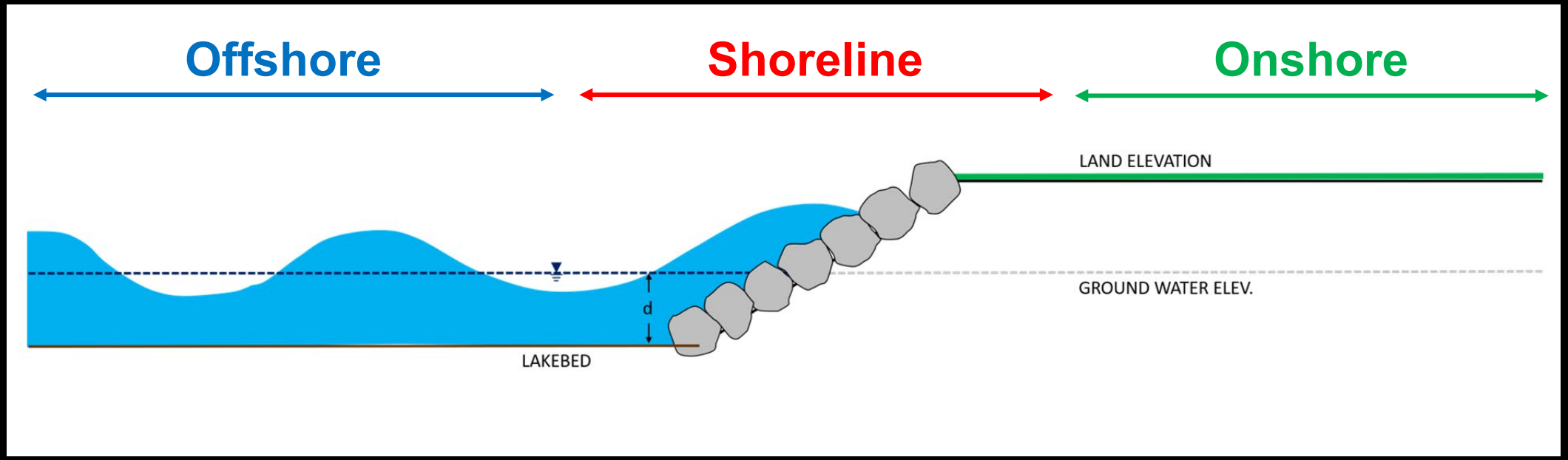
- Wave overtopping will occur for most of Tecumseh Shoreline during 100-year event under existing conditions:
  - 22% of shoreline infrastructure has less than 1 foot of freeboard
  - 67% of shoreline infrastructure has less than 2 feet of freeboard





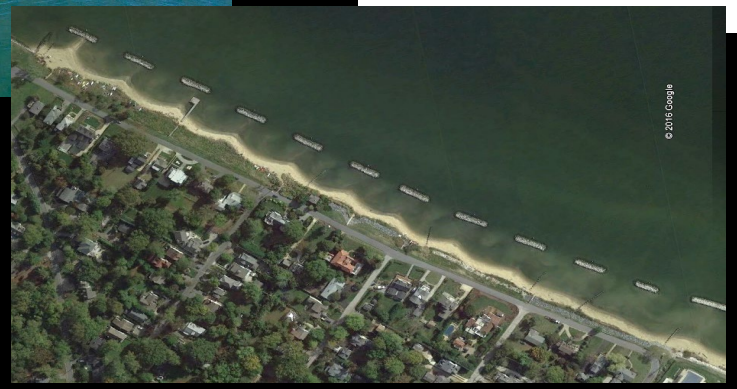
PROTECT: Reduce wave overtopping, mitigate flooding

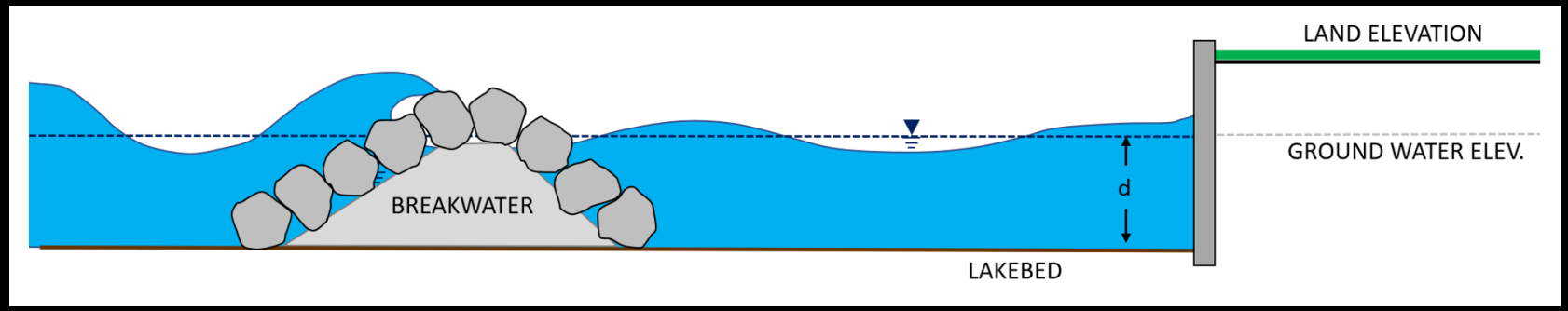
- Flooding can be mitigated through coastal flood protection
  - Coastal flood protection can be located offshore, along the shoreline, or onshore

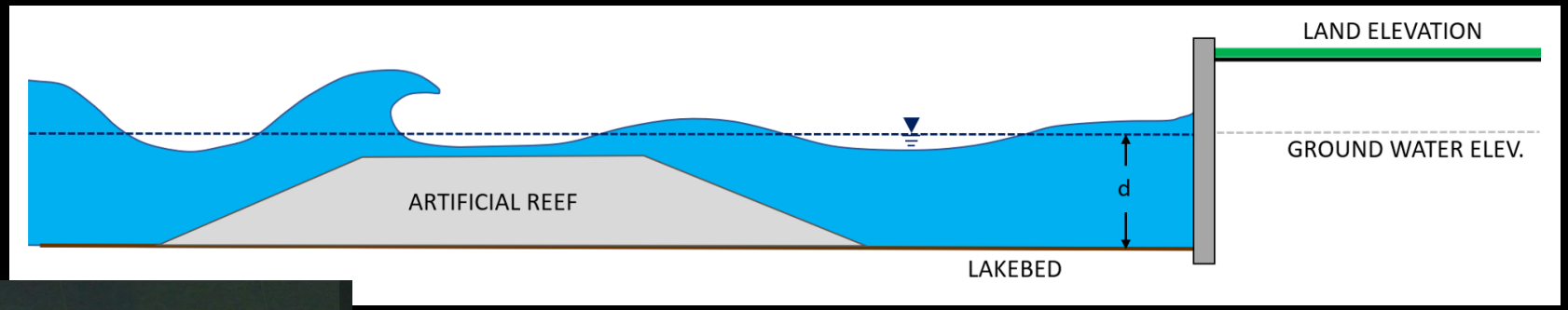


PROTECT: Offshore Flood Protection

- **Offshore** protection:
  - Breakwaters
  - Artificial reefs

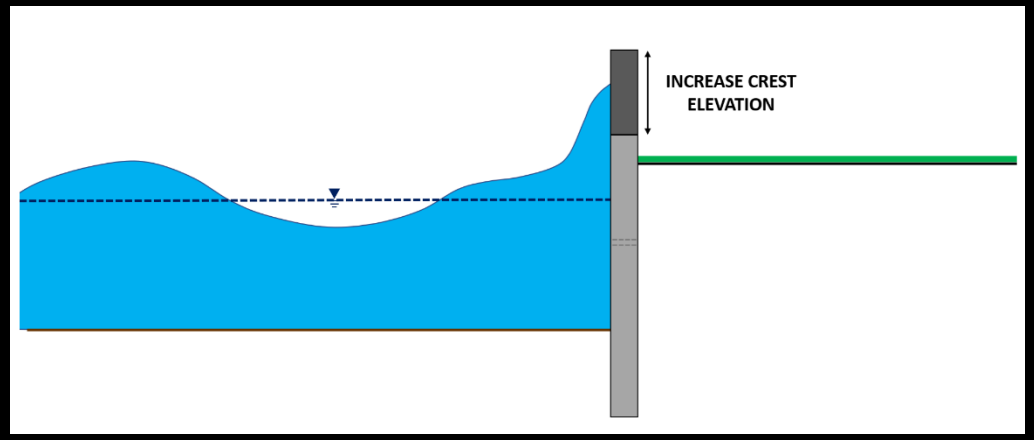




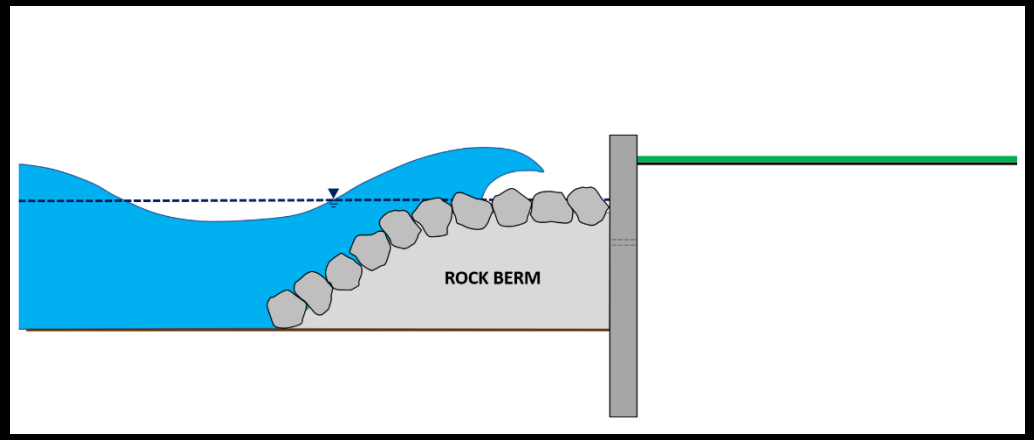


PROTECT: Shoreline Flood Protection

Increase crest elevation

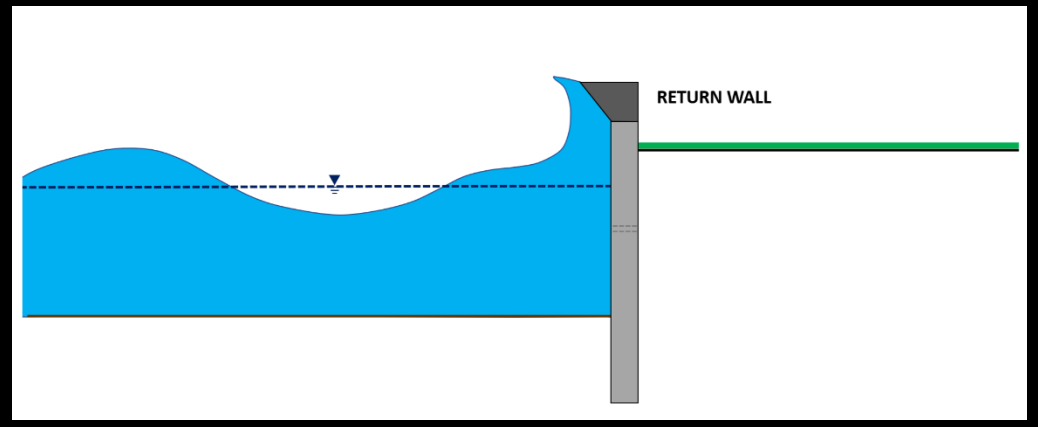


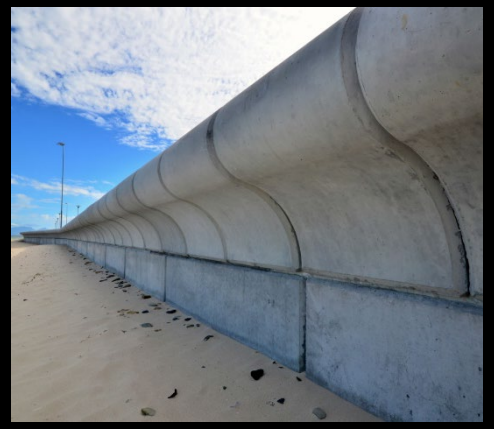
Rock berm / cobble beach



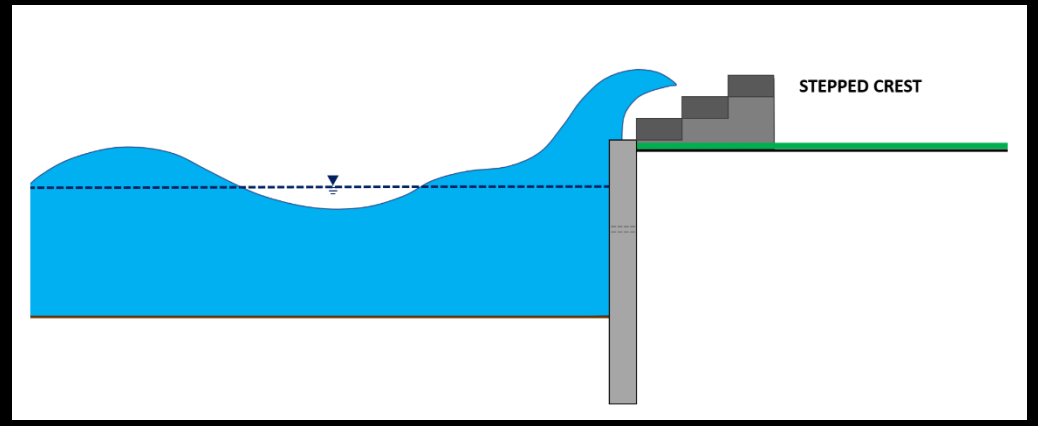
PROTECT: Shoreline Flood Protection

Return / re-curved / parapet walls



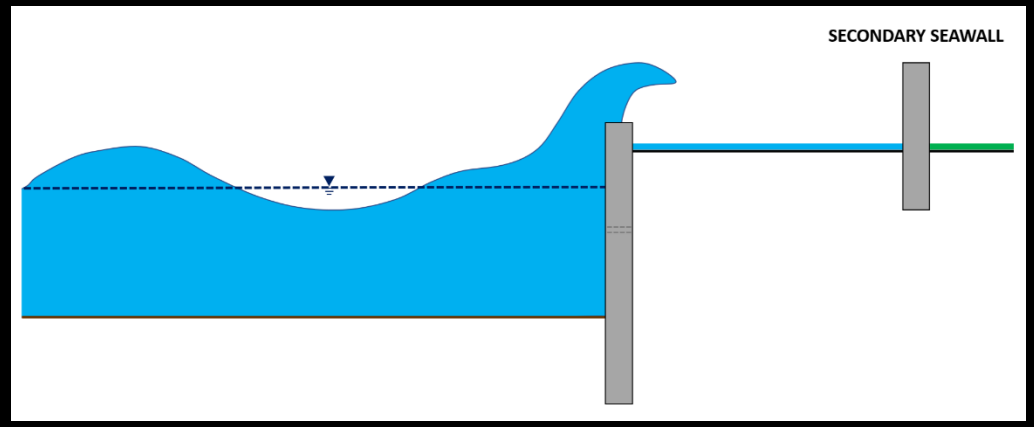


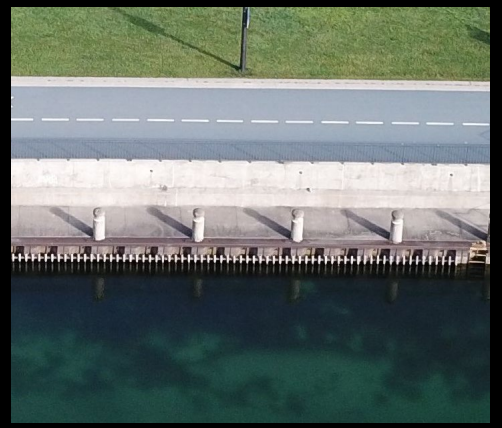
Stepped Wall



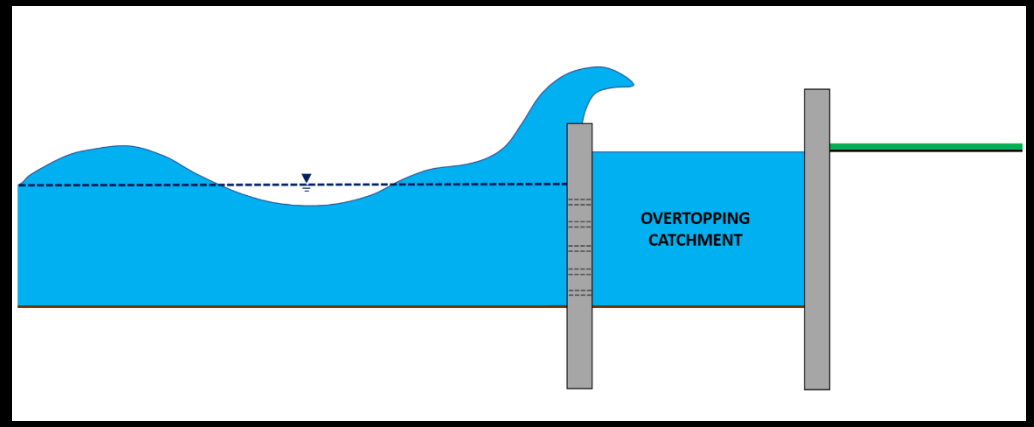
PROTECT: Shoreline Flood Protection

Secondary seawall



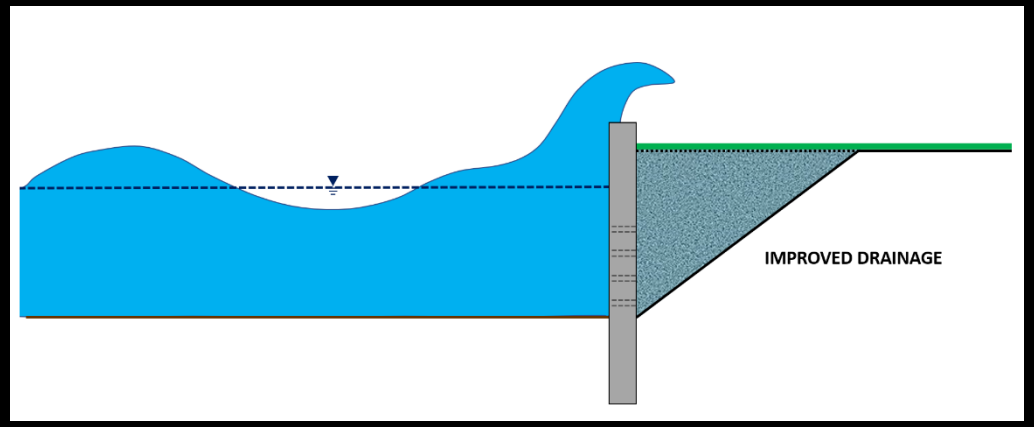


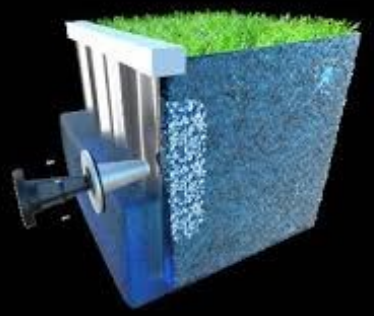
Overtopping catchment



PROTECT: Shoreline Flood Protection

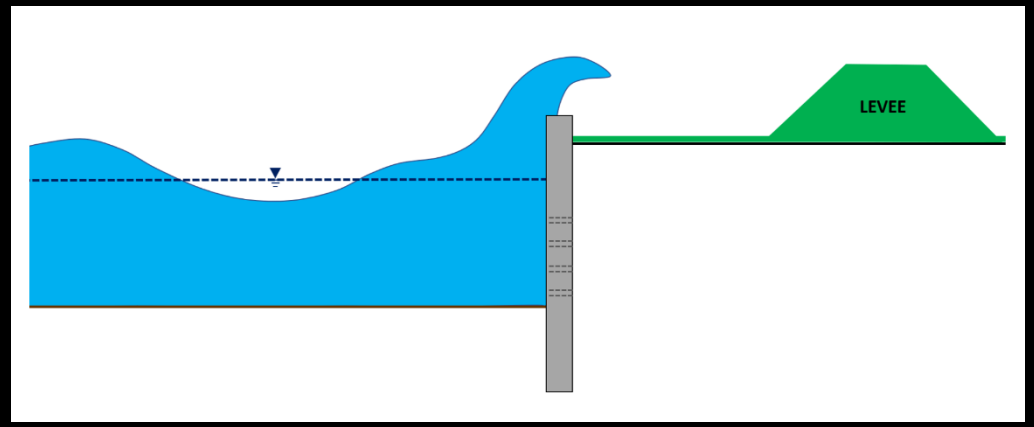
Improved drainage / venting

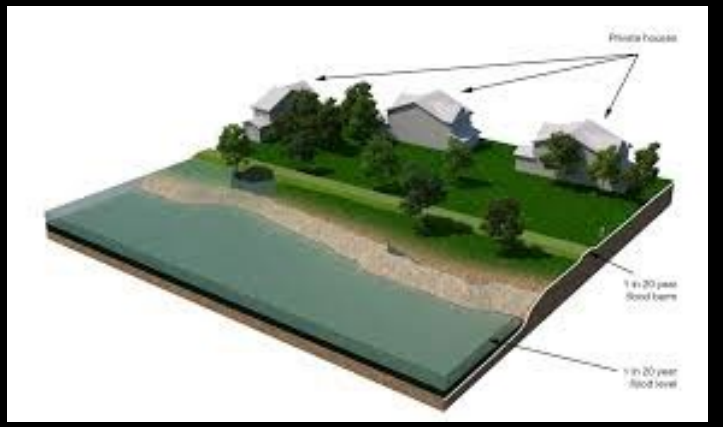




PROTECT: Onshore Flood Protection

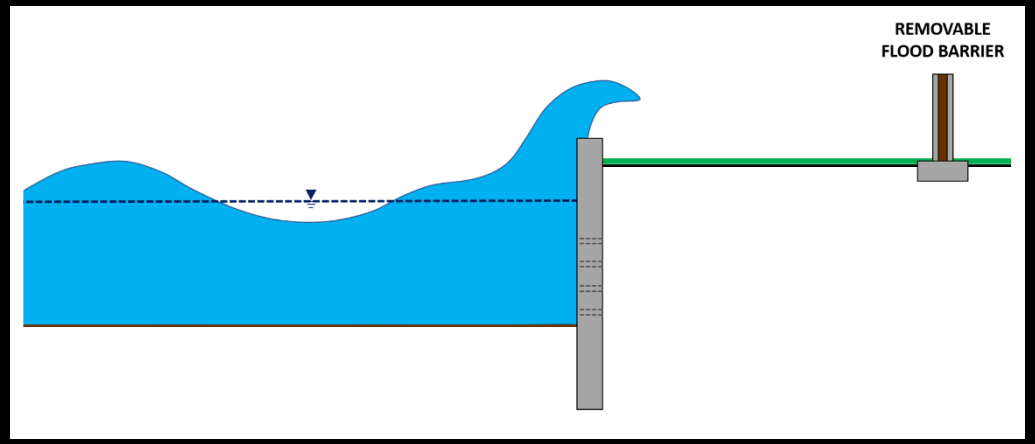
Levees / flood berms



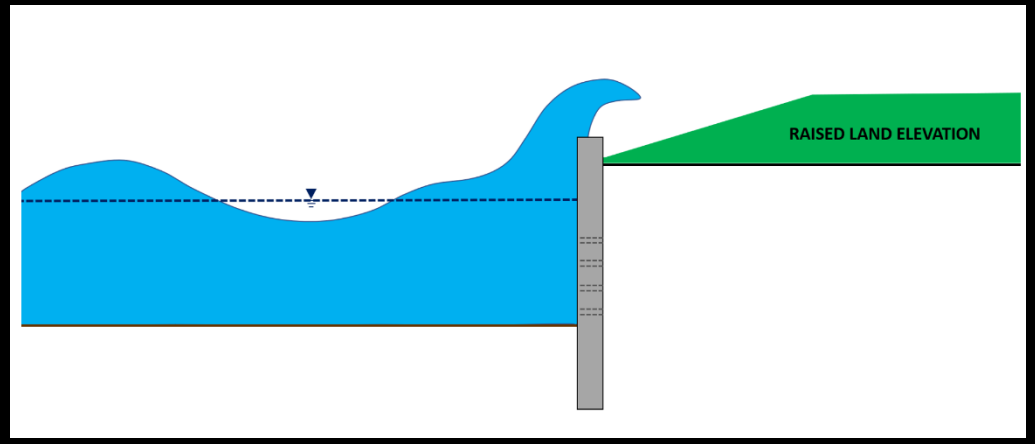


PROTECT: Onshore Flood Protection

Flood barriers

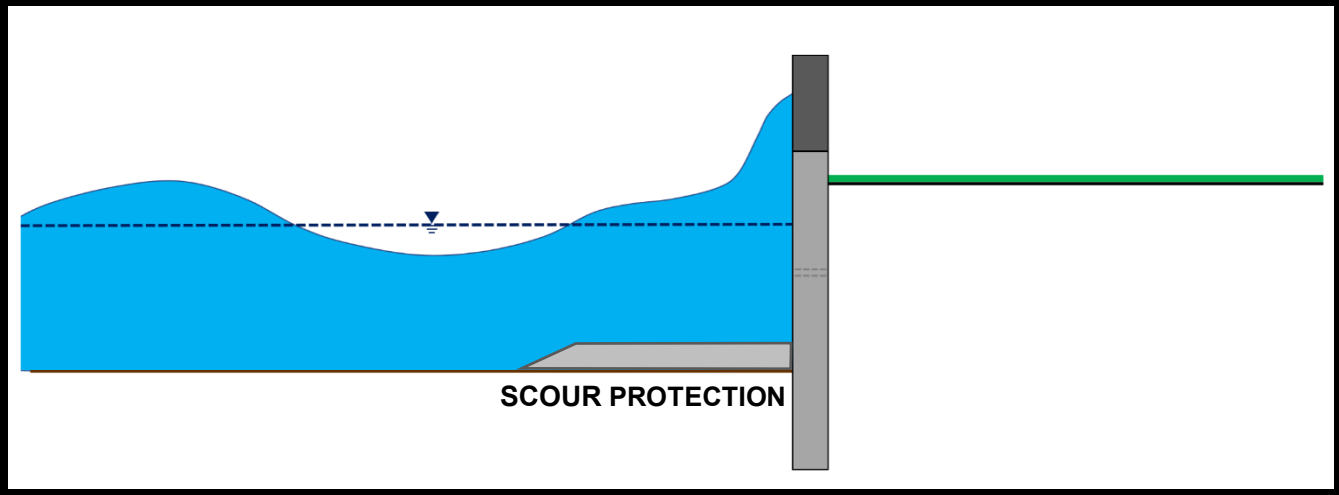


Raise land elevations & Improve overland drainage pathways



PROTECT: Other Considerations

- Scour protection will mitigate erosion of the lakebed, which would result in deeper water and larger waves



- Changes to vertical walls may create additional surcharges
  - Additional structural elements for increase stability may be required (tie-backs, improved drainage, etc.)

PROTECT: Key Takeaways

- Flood protection should be properly engineered based on an analysis of local design conditions and performance objectives
  - Design standards should be implemented to ensure consistency
- Although flood protection can be implemented lot by lot, community scale solutions are preferred
  - Integrated approach
  - Ensure standards are followed to meet performance objectives and protect investments
  - Piecewise (lot by lot) protection can lead to additional vulnerabilities and increased risk for others if impacts are not thoroughly investigated

QUESTION AND ANSWER PERIOD ON THE PRESENTATION

INTERACTIVE DISCUSSION WITH THE PARTICIPANTS

QUESTION #1

From the first PIC, we learned your priorities for developing infrastructure solutions to the flood risk in Tecumseh included:

- Long-term sustainable solutions (77% of respondents)
- Cost to landowners (69% of respondents)
- Cost the Town of Tecumseh (54% of respondents)

1. Based on what you learned today, should other priorities or criteria be considered when developing solutions to mitigate flood risk?

QUESTION #2

2. Please share your ideas for short- and long-term options to reduce coastal and interior flood risk.

QUESTION #3

3. Emergency access for people and first responders may be limited on some roads during flooding events. In addition to the ongoing emergency response planning by the Town of Tecumseh, do you have any other suggestions on how to improve emergency access?

QUESTION #4

4. For the Lakefront landowners, would you be willing to participate in a shoreline protection upgrade program that standardizes criteria and approaches for the Tecumseh lakefront? How should such a program be developed and implemented?

NEXT STEPS

- PIC#2 Comment Sheet
- Finalize technical work on flood mitigation alternatives
- PIC#3 June/July 2021 to include:
  - Final Flood and Erosion Risk Assessment
  - Draft Adaptation Concepts to reduce flood risk
- Final Report

COMMENT SHEET

www.tecumseh.ca\shorelinemanagementplan