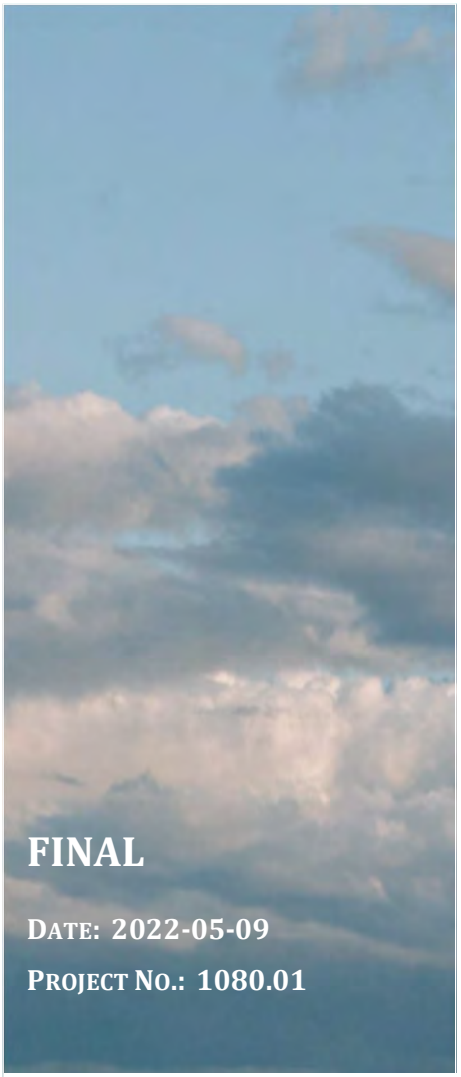
LAKE ONTARIO SHORELINE HAZARD SUMMARY, RISK ASSESSMENT AND MANAGEMENT PLAN

TECHNICAL REPORT



FINAL

DATE: 2022-05-09

PROJECT NO.: 1080.01

SJL ENGINEERING

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EXECUTIVE SUMMARY

SJL Engineering Inc. was retained by the Central Lake Ontario Conservation Authority (CLOCA) to develop a Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan for seven (7) at risk communities within the CLOCA watershed, referred to herein as Shoreline Damage Centres (SDCs). SDCs were identified based on shoreline hazard mapping developed as a component of the recently completed Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a). Shoreline hazard mapping was produced following provincial policy and technical guidance, as outlined in Section 2.0 of this report. Identified SDCs are listed below and represent communities where one or more residential or commercial buildings were found to be located within the regulatory shoreline hazards for Lake Ontario:

- SDC #1 – Ontoro Boulevard (Ajax):
- SDC #2 – Crystal Beach (Whitby):
- SDC #3 – Stone Street (Oshawa):
- SDC #4 – Muskoka Avenue (Oshawa):
- SDC #5 – Port Darlington (Clarington):
- SDC #6 – East Beach Road (Clarington):
- SDC #7 – Wilmot Creek (Clarington):

The principal objectives of the study were to complete a shoreline hazard summary and risk assessment for each of the 7 SDCs listed above, and to develop risk mitigation recommendations to address the hazards. Specifically, the following three principal tasks were completed:

1. Shoreline hazards determined and mapped as a component of the 2020 Shoreline Management Plan (Zuzek Inc., 2020) were reviewed and reassessed at a higher spatial resolution within each of the 7 SDCs. Minor revisions to the hazard mapping were made in two locations, namely within SDC #2 and SDC #4 (refer to Section 2.0 and Appendix A).
2. A detailed, qualitative risk assessment was completed for residential buildings within the 7 SDCs with exposure to one or more of the shoreline hazards. Risk maps were produced for each SDC using the results of the risk assessment to highlight buildings of greater relative risk (refer to Section 3.0 and Appendix C).
3. A variety of risk mitigation strategies were evaluated for each SDC under four broad categories; *Avoid, Accommodate, Protect,* and *Retreat/Re-align*. Where appropriate, *Protect* and *Retreat/Re-align* strategies were recommended as "Primary Risk Mitigation Strategies", while *Accommodate* and *Avoid* strategies were provided as "Other Risk Mitigation Considerations". *Retreat/Re-align* strategies were only considered for SDCs where one or more buildings were evaluated as having *high* to *very high* relative risk. High-level concept drawings and opinions of probable cost were also provided for *Protect* strategies (refer to Section 4.0).

The project included public engagement through the circulation of an online survey and a virtual, Public Information Centre (PIC) held at the mid-point of the study. Public engagement activities including responses to public feedback are presented in Section 1.2. Study conclusions and recommended next steps are presented in Section 5.0, while shoreline hazard mapping and risk maps for each SDC are provided in Appendix A and C, respectively.

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1.0 INTRODUCTION

The legal responsibility for Conservation Authorities to regulate development on hazardous lands is outlined in the Conservation Authorities Act and Ontario Regulation 97/04. Regulations specific to the Central Lake Ontario Conservation Authority (CLOCA) are outlined in Ontario Regulation 42/06 (*Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*), with supporting technical information provided in the Lake Ontario Shoreline Management Plan (the SMP), a study completed by Zuzek Inc. and SJL Engineering Inc. and published in November 2020 (Zuzek Inc., 2020a).

As a component of the 2020 SMP, natural shoreline hazards were assessed, and hazardous lands delineated and mapped for the entire CLOCA Lake Ontario shoreline based on provincial policy and the procedures outlined in the Technical Guide for Great Lakes – St. Lawrence River Shorelines (MNR, 2001), herein referred to as the Technical Guide. Specifically, the erosion, flood and dynamic beach hazards were assessed, as per provincial policy, which stipulates that the hazards be based on events with a 1% probability of occurrence in any given year (commensurate with a 100-year planning horizon). Based on the hazard mapping produced with the SMP, seven (7) separate Shoreline Damage Centres (SDCs) were identified by CLOCA where one or more residential buildings fall within the lands susceptible to natural hazards. These areas are presented and discussed in Section 1.1.

To better understand and evaluate the relative risks associated with these hazards and to identify and prioritize potential mitigation solutions to eliminate or reduce the risks, SJL Engineering Inc. was retained to complete a Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan for each SDC. The major components of this study are summarized as follows:

1. Review shoreline hazards assessed and mapped as a component of the 2020 SMP, confirm their accuracy at a higher spatial resolution within each of the 7 SDCs, and propose revisions where it is deemed that the accuracy can be improved.
2. Complete a qualitative risk assessment for all residential buildings within the 7 SDCs and provide risk mapping for each SDC highlighting buildings of greater relative risk due to natural shoreline hazards.
3. Evaluate a variety of risk mitigation strategies for each SDC under four broad categories; Avoid, Accommodate, Protect, and Retreat/Re-align. Recommend preferred and alternative risk mitigation strategies including high-level concepts and costs for each SDC to address the risk highlighted through steps 1 and 2.

It is noted that only item 2 above was completed for SDC #5 (Port Darlington), as per the study scope. This area has been the subject of several technical studies in recent years by other consultants. Shoreline hazards and risk mitigation recommendations are well documented for this area, and are therefore not re-evaluated herein (refer to Section 4.2).

A critical component of the project was the solicitation of feedback from landowners within each SDC, and public engagement through a Public Information Centre (PIC) that was held virtually on December 8th, 2021. The public engagement aspects of the project are discussed in Section 1.2 below. Each SDC was also visited by SJL Engineering Inc. staff at the outset of the project in September 2021. Existing shoreline conditions were documented both through visual observations and oblique, aerial photographs captured using an unmanned aerial vehicle (UAV). Collected photos were compared to those captured in 2018 and 2019 as a component of the SMP, and major

changes to shoreline conditions between the various sets of photos including areas featuring evidence of recent erosion or flooding were identified and documented.

The summary of shoreline hazards completed for each SDC is discussed in Section 2.0 of this report, with final shoreline hazard maps for each SDC provided in Appendix A. The qualitative risk assessment methodology and results are presented in Section 3.0 with supporting risk mapping provided in Appendix B. The evaluation of risk mitigation strategies and recommendations including high-level concepts and municipal zoning considerations are provided in Section 4.0. Finally, the study conclusions and recommended next steps are presented in Section 5.0.

1.1 SHORELINE DAMAGE CENTRES

Seven shoreline damage centres were identified by CLOCA based on the shoreline hazard mapping produced as a component of the 2020 SMP (Zuzek Inc., 2020). The location and name of each SDC is shown in Figure 1 below. Each SDC features several primary residential buildings potentially affected by the erosion, flooding, or dynamic beach hazard, which were delineated following provincial guidelines and are based on a 100-year planning horizon. The SDCs are defined as follows, ordered from west to east:

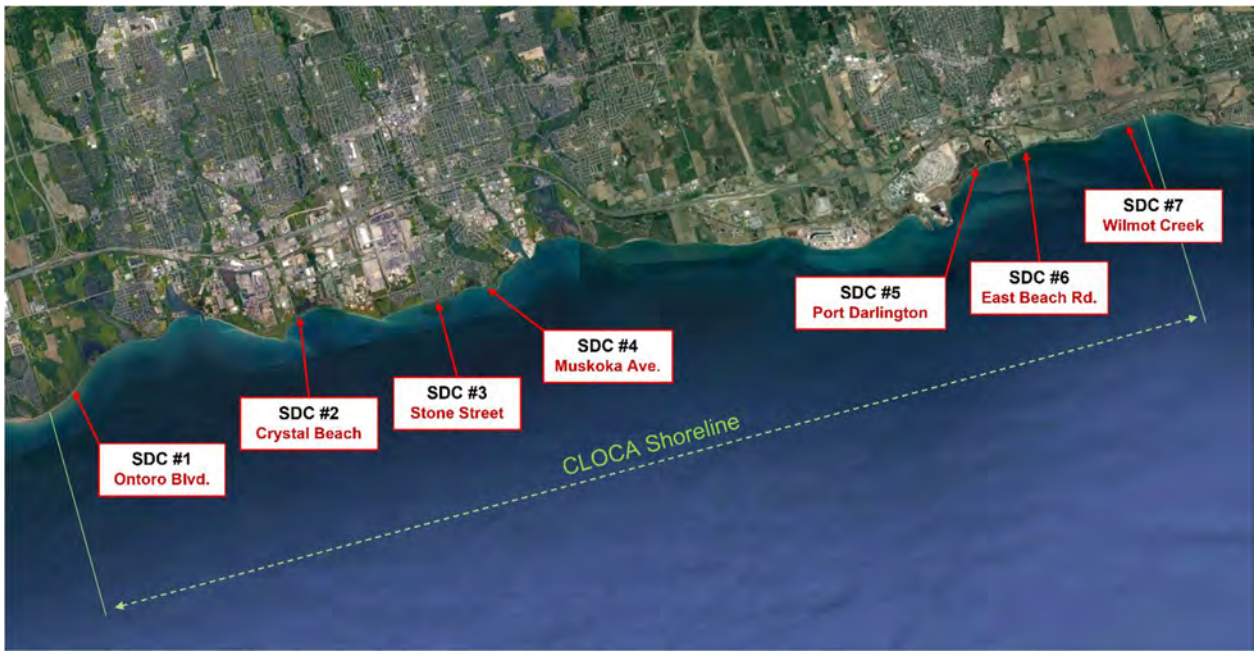


Figure 1 - CLOCA portion of the Lake Ontario shoreline showing the location and name of all 7 Shoreline Damage Centres

SDC #1 – Ontoro Boulevard (Ajax): At the west end of the CLOCA jurisdiction, Ontoro Boulevard is a small residential development that includes 13 homes located on the south side of the road atop an actively eroding low-bluff shoreline. Most properties feature some form of shoreline protection, many of which were implemented in recent years. The type and condition of shoreline protection structures is highly variable.

SDC #2 – Crystal Beach (Whitby): Crystal Beach Boulevard is a private road in Whitby featuring 19 individual properties with residential buildings affected by the shoreline hazards. The western portion of the road sits on a medium-high, actively eroding cohesive bluff, while the eastern portion of the road sits on a low-lying barrier beach that separates the Corbett Creek wetland from Lake

Ontario. All three shoreline hazards including erosion, flooding, and the dynamic beach hazard are relevant in this area, particularly at the east end of the SDC where the low-lying lands, proximity of buildings to the lake and presence of highly erodible dynamic beach material result in significant combined risks to homeowners, particularly during periods of elevated lake levels. Properties at the east end of the SDC are also subject to riverine flood and erosion risks associated with Corbett Creek. Both flooding and erosion was experienced at Crystal Beach during the high lake level periods in the late spring and early summer of 2017 and 2019.

SDC #3 – Stone Street (Oshawa): Stone Street was densely developed several decades ago, with 53 properties presently located on the south (lake) side of the road. These properties sit atop a naturally eroding, medium-high cohesive bluff. Several landowners had erosion protection structures built in recent years, however, much of this SDC remains unprotected with more than half of the properties on the south side of the road featuring primary residential buildings within the Lake Ontario erosion hazard.

SDC#4 – Muskoka Avenue (Oshawa): Muskoka Avenue is fronted by a prominent headland that can be described as high glacial till bluff. A single residential property sits atop the geological feature. The headland is naturally armoured due to its high content of boulder-sized material which has accumulated on the beach and in the nearshore, reducing its erosion rate when compared to neighbouring shorelines. Land elevations immediately west of the headland drop rapidly down to a low-bank shoreline, with five homes located in very close proximity to the seasonal high water line in this transitional area. The shoreline features both erosion and flood risks.

SDC #5 – Port Darlington (Clarington): The Port Darlington region is exposed to significant risk associated with natural hazards due to the presence and severity of all three shoreline hazard types (erosion, flooding and dynamic beach), in conjunction with riverine flood and erosion hazards. The western portion of the SDC features 40 lakefront properties on Cedar Crest Beach Road, a development that was constructed decades ago on a dynamic barrier beach and former inlet. The eastern portion of the SDC features 22 properties on West Beach Road which was also constructed on a low-lying barrier beach that separates Lake Ontario from Bowmanville Marsh and Harbour. West Beach is also a filet beach, meaning its stability is partially reliant on the presence and integrity of a man-made structure (the west jetty at Port Darlington). The two low-lying dynamic beaches are separated by an area of higher elevation which features a further 20 lakefront properties on the south side of Cove Road.

Cedar Crest Beach Road and West Beach Road were both subjected to flooding during the high lake level periods in 2017 and 2019. This is despite the fact that neither period coincided with a major storm surge event. The largest storm surge measured at the Cobourg water level gauge during these periods was 13 cm, occurring on July 4th, 2017, corresponding to a 1 – 2 year return period. Coastal flooding from both the south and north side of these barrier beach systems would have been much worse had a major storm surge event occurred during the late spring and early summer of 2017 or 2019. Emergency access is an important consideration for these communities as both Cedar Crest Beach Road and West Beach Road feature a single access route with road elevations similar to or lower than the 100-year flood elevation for this portion of Lake Ontario shoreline.

Cedar Crest Beach Road was also subjected to coastal flooding and subsequent impacts to properties due to wave uprush and overtopping of coastal structures during the high water level periods in 2017 and 2019. Even during minor storm events wave overtopping on this shoreline can be severe when lake levels are high, due to the greater nearshore depths associated with high lake levels (less wave dissipation through wave breaking), the relatively low elevations of the properties and coastal structures, and the proximity of several buildings to the shoreline.

It is noted that SDC #5 is treated differently than the other six SDCs in this study, commensurate with the original study scope, due to the fact that it has been extensively studied by others in recent years. Shoreline hazards presented for this SDC are the same as those shown in the 2020 SMP (Zuzek Inc., 2020). Recent technical studies providing risk mitigation recommendations are listed in Section 4.2 below. Risk mitigation strategies have not been re-evaluated for SDC #5 as a component of this study. Only the risk assessment component of this study has been completed for SDC #5, as a qualitative risk assessment had not previously been completed for the residential and commercial buildings in this area.

SDC #6 – East Beach Road (Clarington): Located on the east side of the federal navigation channel and jetties at Port Darlington, East Beach Road features a number of private properties situated atop a medium-high to high, actively eroding cohesive bluff. Three residential buildings are also located at the south end of South Service Road, where land elevations are significantly lower resulting in both flood and erosion risks. Natural erosion rates along this portion of Lake Ontario shoreline are relatively high due to wave exposure and lack of sediment supply, which is in part due to the presence of the Port Darlington jetties which trap sediment on their updrift (west) side, as is evident by the filet beach fronting West Beach Road (in SDC #5). Several properties within this SDC face acute risks due to their close proximity to the edge of the high, actively eroding cohesive bluff.

SDC #7 – Wilmot Creek (Clarington): The Wilmot Creek Retirement Community includes approximately 3 km of low, medium-high and high, naturally eroding cohesive bluffs on the shores of Lake Ontario. Seventy individual properties are potentially exposed to the shoreline hazards within the CLOCA portion of this community due to their proximity to the crest of the eroding bluff. An interim shoreline protection structure has been implemented along the majority of the bluff toe fronting this community over the past decade. However, labelled by the design engineers as an "interim" solution, this structure is porous and under-designed to fully mitigate erosion of the bluff.

1.2 PUBLIC ENGAGEMENT

In August 2021, an online public survey was circulated to all property owners within the SDCs who were identified by CLOCA as being potentially affected by the natural hazards. In total, 57 survey responses were received, with the distribution of respondents by SDC shown as a pie chart in Figure 2 below. Landowners were asked to rate and comment on their perceived short-term (next 5 years) and long-term (5+ years) risk due to the shoreline hazards (erosion, flooding, or dynamic beach). Their responses are also summarized in Figure 2 below, with 9% and 12% of respondents stating that their short and long-term risk, respectively, was "extreme". A further 26% of respondents felt that their short-term risk was at least high.

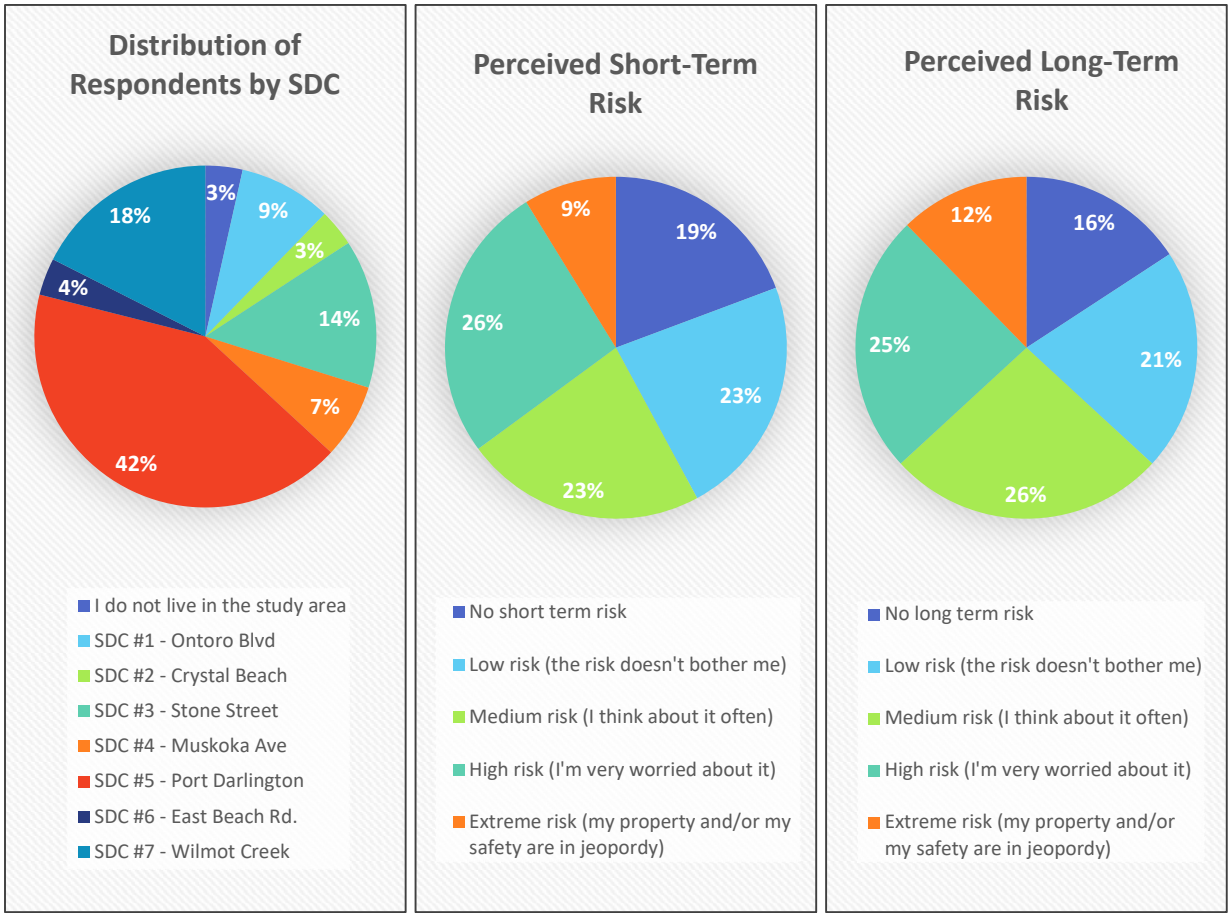


Figure 2 – Summary of public survey responses (57 respondents total)

Landowners also had the opportunity to provide comments and ask questions as a part of the online survey. Questions that were common to multiple respondents or of most relevance to the study were compiled to be addressed directly in a Public Information Centre (PIC), which was held virtually on December 8th, 2021. The PIC featured a technical presentation by members of the study team providing an overview of the study and work completed to date. A summary of responses to questions and comments received via the online survey was provided, and landowners were given another opportunity to voice their opinions and pose questions to the study team during a question and answer period. Key questions and comments received either via the online survey or during the PIC are summarized as follows, followed by answers provided from members of the study team:

- **QUESTION/COMMENT:** What are "shoreline hazards" and how are they defined?

  RESPONSE: There are three regulated shoreline hazards for Great Lakes shorelines in Ontario; the erosion hazard, flood hazard, and dynamic beach hazard. As per provincial policy, the shoreline hazards are based on a 100-year planning horizon. Each hazard is described in detail in Section 2.0 of this report.

- **QUESTION/COMMENT:** Why is my home still shown as being within or affected by the shoreline hazards when I've already invested in engineered shoreline protection?

  RESPONSE: Shoreline hazards (and corresponding risk) are assessed and mapped based on the presence of a natural shoreline, as per provincial policy. The presence and condition of shoreline protection is not accounted for in the assessment or mapping. The principal

reason for the omission of existing shoreline protection structures in the evaluation of shoreline hazards and corresponding risk in Ontario is that the performance of a coastal structure, quality of engineering, construction and materials, and occurrence of ongoing monitoring and maintenance can not be guaranteed or assumed over the 100-year planning horizon upon which the shoreline hazards are based.

- **QUESTION/COMMENT:** Shoreline protection is expensive, and someone should help pay for it.

  RESPONSE: Typically, private shoreline protection is not publicly funded in Ontario. If you own property along the shoreline, in general, you are responsible for mitigating the associated hazards.

- **QUESTION/COMMENT:** Why is non-engineered, lower-cost shoreline protection not permitted?

  RESPONSE: Shoreline protection that is not properly designed is likely to deteriorate or fail. Policies surrounding shoreline protection standards are meant to ensure good investment through adequate protection to human safety and private assets from the shoreline hazards. It is also necessary for the owner to mitigate negative impacts to neighbouring shorelines/properties and the coastal environment when applying for a shoreline protection permit.

- **QUESTION/COMMENT:** Erosion and flooding events in 2017 and 2019 were man-made and were the result of Plan2014.

  RESPONSE: Extreme high water levels and associated flooding and erosion experienced on Lake Ontario in 2017 and 2019 were the result of record breaking water supplies to the Great Lakes Basin. Notwithstanding this fact, the water level regulation plan that is presently in effect at the Moses-Saunders Dam, known as Plan2014, is presently under review by the International Joint Commission. This Shoreline Hazard Summary, Risk Assessment and Management Plan study will not evaluate the performance of Plan2014 during periods of extreme water supply nor will recommendations concerning water level regulation be made.

2.0 SUMMARY OF SHORELINE HAZARDS

Three shoreline hazards are recognized and regulated for Great Lakes shorelines in Ontario, as stipulated in the Guidelines for Developing Schedules of Regulated Areas (Conservation Ontario and MNR, 2005). These are the *erosion hazard*, the *flooding hazard*, and the *dynamic beach hazard*. Definitions for each hazard and acceptable processes for establishing the hazards are outlined in the Technical Guide for Great Lakes – St. Lawrence River Shorelines (MNR, 2001). Each hazard is based on a 100-year planning horizon, and is briefly described in the sections that follow.

Shoreline hazards for the CLOCA shoreline were most recently assessed and mapped as a component of the 2020 Lake Ontario Shoreline Management Plan (SMP). The SMP project included shoreline hazard mapping for more than 135 km of Lake Ontario shoreline and was thus done at a regional scale (refer to Zuzek Inc., 2020). For the present study, shoreline hazards affecting each of the 7 SDCs were reviewed, and revisions were made to improve their spatial accuracy where appropriate. This review process is also discussed in the sections that follow.

2.1 EROSION HAZARD

The erosion hazard is defined by the province as a 100-year erosion allowance plus a stable slope allowance measured horizontally from the future toe of the slope (CO & MNR, 2005). The 100-year erosion allowance is first established by determining the representative average annual recession rate (AARR + 1 standard deviation) for a natural, unprotected shoreline from a comparison of historical aerial imagery or other erosion measurements (where available) and multiplying by 100-years. The stable slope is then assumed to be 3:1 (horizontal:vertical), or some other value as determined by a detailed geotechnical study. A 15 metre horizontal buffer is typically added to the erosion hazard setback to form the *regulated area*, or the area in which the local conservation authority is mandated to regulate development as per provincial policy. A graphical definition of the erosion hazard is provided in Figure 3 below.

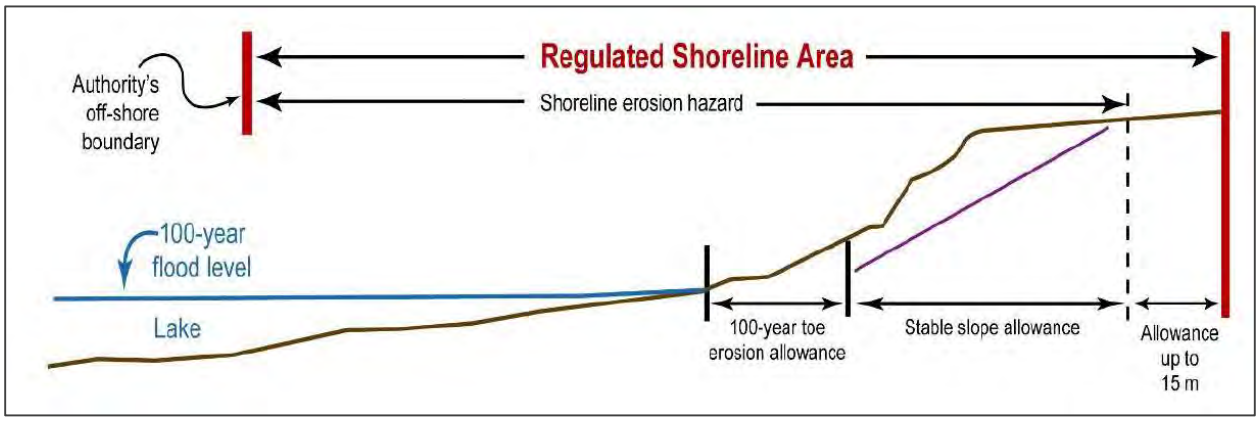


Figure 3 – Erosion Hazard definition sketch, as defined in the Guidelines for Developing Schedules of Regulated Areas (Conservation Ontario and MNR, 2005)

The stable slope setback as measured from the *existing* location of the toe of bluff/bank is often referred to as the "zone of pending failure". In a practical sense, this is the area adjacent to the bluff or bank crest that may be affected by a rapid failure of the slope. As discussed further in Section 3.0, where a building is located within the "zone of pending failure", the risk related to the *erosion hazard* is very high.

The erosion hazard as defined in the 2020 SMP was reviewed in detail for each SDC (except for SDC #5 – Port Darlington). Figure 4 presents an example of the analysis for SDC #3 – Stone Street. An average annual erosion rate of 0.20 metres per year was used in the SMP shoreline hazard mapping based on a comparison of historical aerial imagery for the broader region from 1954 to 2018. For the present study, recession rates between 1954 – 2018 and 1954 – 2020 were reviewed at 10 meter increments in the immediate vicinity of Stone Street. The resulting average annual recession rates (+ 1 standard deviation) were shown to range from 0.19 – 0.20 m/year, thus confirming the accuracy of the 2020 mapping completed as a component of the SMP (Zuzek Inc., 2020). No revisions to the erosion hazard mapping were therefore warranted for this SDC.

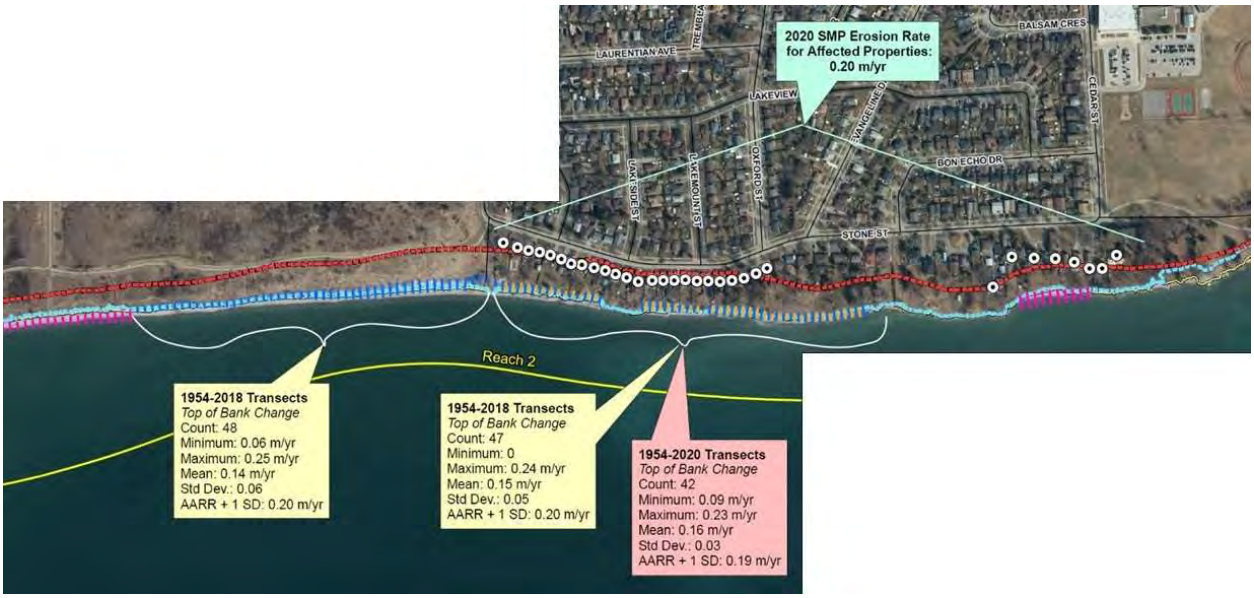


Figure 4 – Erosion rate analysis for SDC #3 (Stone Street) showing the AARR from the 2020 SMP, and the AARR as calculated from local erosion transects only, based on aerial imagery from 1954, 2018 and 2020.

A similar review of erosion rates at a high spatial resolution was completed for all 7 SDCs, with only SDC #2 – Crystal Beach resulting in a notable difference when compared to the erosion rates applied regionally in the 2020 SMP. In this area, local erosion rates for bluff shorelines to the east and west of Crystal Beach Boulevard were lower than that which was applied regionally in the SMP. As a result, the erosion hazard from the west end of the SDC to the transition from bluff shoreline to dynamic beach was remapped using an average annual recession rate of 0.20 m/year. The revised erosion hazard for this area is shown on the updated hazard mapping provided in Appendix A. Average annual recession rates used in the delineation of the erosion hazard are provided for all 7 SDCs in Table 1 below. All listed recession rates are based on shoreline change measured over a period of at least 64 years and for a natural, unprotected shoreline, as per provincial policy.

Table 1 – Average annual recession rates used in the determination of the erosion hazard for affected properties within each SDC.

Shoreline Damage Centre:	Average Annual Recession Rate (+ 1 S.D.)
SDC #1 – Ontoro Blvd.	0.15 m/year
SDC #2 – Crystal Beach	0.20 m/year[1]
SDC #3 – Stone Street	0.20 m/year
SDC #4 – Muskoka Ave.	0.20 m/year
SDC #5 – Port Darlington	0.22 m/year[2]
SDC #6 – East Beach	0.24 m/year
SDC #7 – Wilmot Creek	0.24 m/year

[1] Revised from 2020 SMP which used a regional AARR of 0.27 m/year

[2] No erosion rate applied for shoreline fronting West Beach Road

2.2 FLOODING HAZARD

The flooding hazard is defined by the province as the combination of the 100-year flood level and an allowance for wave uprush and other water related hazards (MNR, 2001). First the 100-year flood level must be assessed from a joint probability analysis of static lake levels and local storm surge. The 100-year flood level is the total water level having a probability of occurrence of 1% in any given year. Next, the elevation and landward extent of wave uprush corresponding to at least a 20-year wave event must be assessed through the use of acceptable empirical formulas or numerical modelling (MNR, 2001). The limit of wave uprush on the shoreline determines the landward extent of the flood hazard. Wave uprush is dependent on the offshore wave conditions, the lakebed slope, available depths in the nearshore, and the physical properties of the shoreline itself including beach slope and shoreline material (i.e. roughness). A graphical definition of the flood hazard is provided in Figure 5.

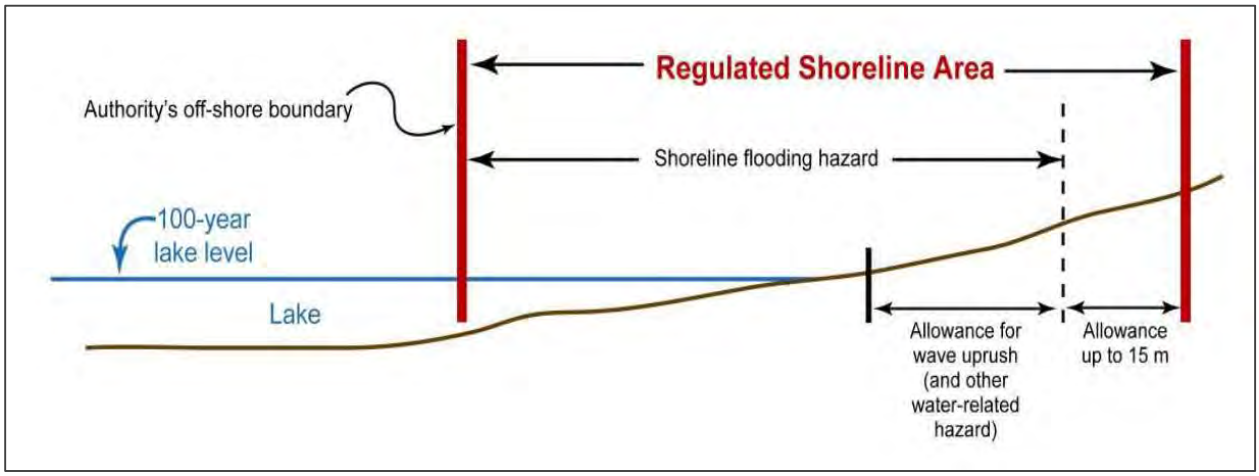


Figure 5 – Flood Hazard definition sketch, as defined in the Technical Guide (MNR, 2001) and the Guidelines for Developing Schedules of Regulated Areas (CO and MNR, 2005)

The flood hazard was assessed and mapped as a component of the 2020 SMP for the entire CLOCA shoreline (Zuzek Inc., 2020). The 100-year water level is relatively consistent along the CLOCA shoreline; however, the wave uprush component of the flood hazard can vary significantly due to local wave exposures and physical shoreline characteristics. Due to the scale of the 2020 SMP, the wave uprush component was assessed regionally for various types of shorelines (bluff, sandy

beach, cobble beach, etc.) using representative nearshore slopes and regional wave exposures. For the present study, wave uprush was reassessed using SJL's in-house composite slope wave uprush tool at multiple locations within each SDC (except for SDC #5 – Port Darlington) using local wave exposure and shoreline properties.

In general, revised wave uprush calculations resulted in wave uprush elevations within +/- 20 cm of those assessed as a component of the 2020 SMP for each of the SDCs (within the accuracy of the topography used in the hazard maps). The sole exception to this was in SDC #4 – Muskoka Avenue, where revised uprush calculations indicated that the wave uprush potential in the vicinity of the homes along Muskoka Ave. was on the order of 60 cm higher than that which was calculated for the broader region as a component of the 2020 SMP. As such, the flood hazard elevation was remapped in this area to an elevation of +78.27 m IGLD85', as is shown on the revised hazard mapping in Appendix A. Flood hazard elevations resulting from the combination of 100-year flood levels and wave uprush are provided in Table 2 below for all 7 SDCs.

Table 2 – Flood hazard elevation affecting properties within each SDC including 100-year flood level and wave uprush.

Shoreline Damage Centre:	Start (lat., long.)	End (lat., long.)	Flood Hazard Elevation (m IGLD85')
SDC #1 – Ontoro Blvd.	43.8285, -78.9792	43.8458, -78.9490	+77.68
SDC #2 – Crystal Beach	43.8481, -78.9004	43.8521, -78.8945	+77.82
	43.8521, -78.8945	43.8525, -78.8816	+77.79[1]
SDC #3 – Stone Street	43.8510, -78.8690	43.8584, -78.8331	+77.81[1]
SDC #4 – Muskoka Ave.	43.8510, -78.8690	43.8584, -78.8331	+78.27[2]
	43.8584, -78.8331	43.8593, -78.8311	+77.76
SDC #5 – Port Darlington	43.8782, -78.6843	43.8857, -78.6750	+77.74
	43.8857, -78.6750	43.8878, -78.6648	+77.64
SDC #6 – East Beach	43.8885, -78.6624	43.8895, -78.6617	+77.64
	43.8895, -78.6617	43.8967, -78.6257	+77.77
SDC #7 – Wilmot Creek	43.8895, -78.6617	43.8967, -78.6257	+78.02[3]

[1] minor revision from 2020 SMP which listed flood hazard elevation as +77.68 m – no revision to hazard map

[2] revision from 2020 SMP which listed flood hazard elevation as +77.68 m – revision made to hazard map

[3] minor revision from 2020 SMP which listed flood hazard elevation as +77.77 m – no revision to hazard map

2.3 Dynamic Beach Hazard

The dynamic beach hazard is the most restrictive of the three shoreline hazards, and is generally reserved for shorelines that are comprised of non-native, dynamic beach materials where the beach profile may evolve or erode rapidly under certain combinations of wind, wave, and water level conditions within the 100-year planning horizon. For a shoreline to be subjected to the dynamic beach hazard, the following criteria must be met (as per MNR, 2001):

- Beach or dune deposits exist landward of the water line, AND
- Beach or dune deposits overlying bedrock or cohesive material are equal to or greater than 0.3 metres in thickness, 10 metres in width, and 100 metres in length, AND
- The maximum fetch distance measured over an arc extending 60 degrees on either side of a line perpendicular to the shoreline is greater than 5 km.

For shorelines in which the above criteria apply, the dynamic beach hazard is defined by the province as the landward limit of the flood hazard (100-year flood level plus wave uprush, as defined in Section 2.2 above), plus an additional allowance to account for the dynamic nature of the beach and dune system. This additional allowance is generally taken as 30 metres, or some other distance as determined by a detailed, site-specific study (MNR, 2001). A definition sketch of the dynamic beach hazard is provided in Figure 6 below.

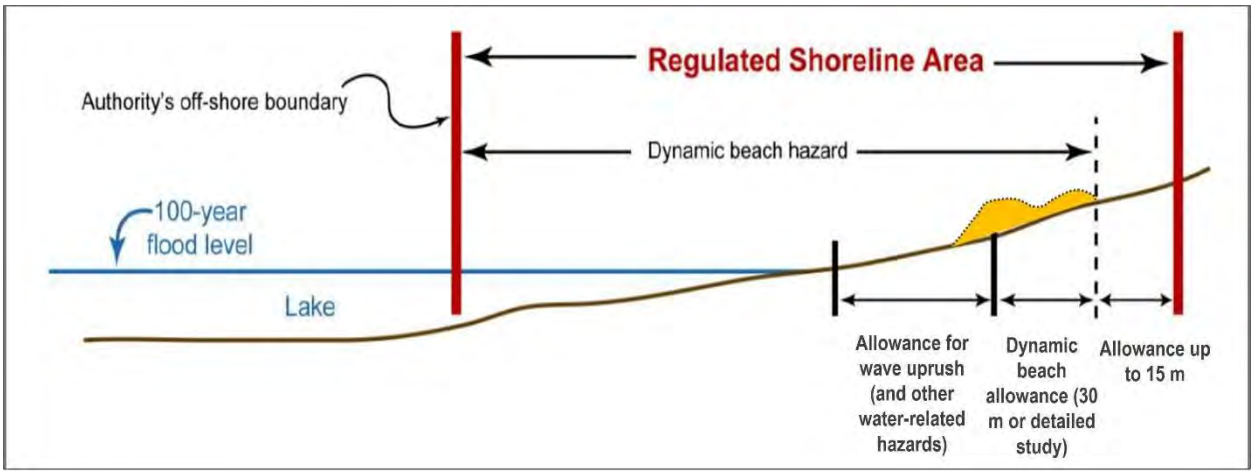


Figure 6 – Dynamic Beach Hazard definition sketch, as defined in the Technical Guide (MNR, 2001) and the Guidelines for Developing Schedules of Regulated Areas (CO and MNR, 2005)

For dynamic beaches on shorelines that also feature a long-term erosion trend, the dynamic beach hazard should also include an allowance for 100-years of erosion, based on the long-term average annual recession rate for the shoreline. This scenario is depicted in Figure 7. The methodology for the determination of long-term average annual recession rates is discussed in Section 2.1 above.

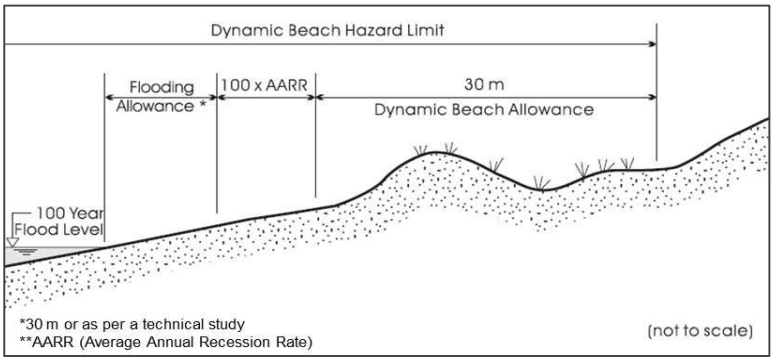


Figure 7 – Definition sketch for a dynamic beach with a long-term erosion trend, as per the Technical Guide (MNR, 2001).

There are several exceptions listed in the Technical Guide to the typical definition of a dynamic beach depicted in Figure 6 and Figure 7. One such exception that is of particular relevance to this study is for barrier beach systems. Barrier beaches are typically narrow, low-lying landforms that separate an energetic body of water (in this case Lake Ontario) from a sheltered lagoon, river outlet, marsh or coastal wetland. Barrier beaches form naturally and are comprised of dynamic sediment deposits such as sand and cobble. There are three barrier beaches within the 7 SDCs. Crystal Beach is a narrow, low lying barrier beach that separates Lake Ontario from Corbett Creek in SDC #2 (Crystal Beach). In SDC #5 (Port Darlington), Cedar Crest Beach Road and West Beach Road were constructed on barrier beaches that separate Lake Ontario from Westside Marsh and

Bowmanville Marsh, respectively. All three barrier beaches feature legacy residential developments, and are low-lying landforms comprised of erodible, non-native beach sediments (sand and cobble).

Figure 8 provides a graphical representation of how the dynamic beach hazard should be defined and mapped for low-lying, barrier beach shorelines, as per the Technical Guide (MNR, 2001). In this case, the dynamic beach hazard extends across the entire width of the barrier beach system below the 100-year flood elevation (100-year water level + wave uprush), to at least the toe of the slope on the sheltered side of the landform.

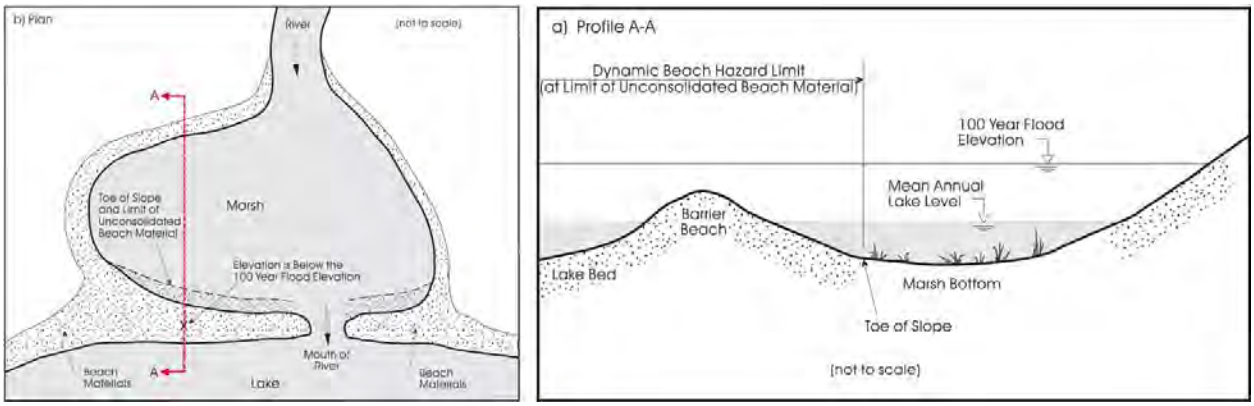


Figure 8 - Plan view (left) and cross-section (right) definition sketch of the dynamic beach hazard for a low-lying barrier beach.

The delineation of barrier beaches in the 2020 SMP hazard mapping was reviewed through each of the 7 SDCs, and it was determined that no revisions to the barrier beach hazard were warranted. For each mapped dynamic beach hazard, the criteria listed above were deemed to have been met, and the hazard mapped appropriately. Where a dynamic beach hazard is present within each SDC, it is shown on the hazard maps provided in Appendix A.

2.4 Riverine Flooding & Erosion Hazards

Riverine hazards were not assessed as a component of the 2020 SMP, which focused on coastal hazards only. However, a number of shoreline communities within the CLOCA watershed are affected by riverine flooding and erosion hazards from streams discharging floodwaters into Lake Ontario.

Riverine flooding studies have been completed for the various tributaries that enter Lake Ontario within the CLOCA jurisdiction. These include Corbett Creek which outlets through the barrier beach in SDC #2 (Crystal Beach), Westside Marsh and Bowmanville Marsh which both outlet within SDC #5 (Port Darlington). Riverine flood hazard mapping produced as a component of those studies was leveraged in the risk assessment portion of this study, in particular where it was shown to impact properties located on narrow barrier beach complexes.

Although regulatory riverine floodplain mapping is developed under the assumption that Lake Ontario water levels will be at long term average elevation during a severe riverine flood event, recent experiences with extreme Lake Ontario water levels created conditions where communities on barrier beaches were prone to riverine (landside) flooding even during moderate rain events. The extreme Lake Ontario water levels caused by record breaking water supplies to the Great Lakes basin in 2017 and 2019 backwatered the riverine stream outlets and significantly reduced the storage volume in the coastal marshes including Corbett Creek, Westside Marsh and Bowmanville

Marsh. Under these conditions, even moderate rain events can pose a flooding risk to the barrier beach communities including those in SDC #2 and SDC #5 due to riverine flooding.

Riverine flooding studies reviewed for this study are listed as follows (from newest to oldest):

- Corbett Creek Master Drainage Plan, The Municipal Infrastructure Group Ltd. (March, 2021)
- Functional Understanding of Westside Marsh, Dillon (March, 2018)
- Westside Creek Hydrologic and Hydraulic Modeling, CLOCA (March 2013)
- Bennett Creek Floodplain Mapping Update, CLOCA (April, 2013)
- Bennett Creek Hydrologic and Hydraulic Modeling, CLOCA (2012)
- Hydrologic Modeling for Bowmanville & Soper Creeks, CLOCA (July, 2011)
- Bowmanville Creek & Soper Creek Floodplain Mapping Study, Aquafor Beech Ltd. (June, 2009)
- Report on Hydrotechnical Analysis of Modifications to Westside Creek and Marsh Associated with Future Operations of Blue Circle Cement, Marshall Macklin Monaghan (April, 1998)

Barrier beaches are also vulnerable to erosion during a riverine flood event. Barrier beaches consist of non-native, unconsolidated sediment (sand and cobble) deposited over a long period of time through littoral drift. If subjected to the flow of extreme riverine floodwater over the barrier beach, the saturated and cohesionless soils may be eroded resulting in the loss of barrier beach material. The erosion of the barrier beach would have the potential to wash away road surfaces and eliminate road access to communities during a severe riverine flood. Figure 9 presents a graphical representation of the evolution of a narrow, elevated landform (barrier beach) comprised of cohesionless materials due to erosion associated with constant overtopping of floodwaters.

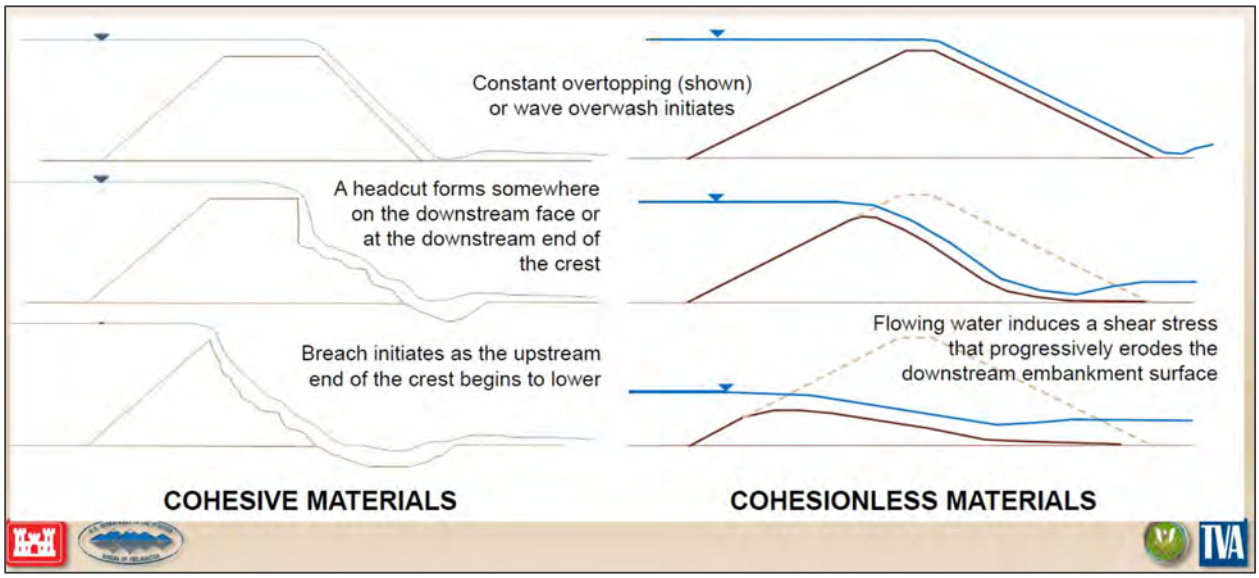


Figure 9 – Evolution of a narrow, elevated landform such as a barrier beach comprised of cohesionless materials (right) due to constant overtopping of floodwaters with erosive force (courtesy of the USACE).

3.0 RISK ASSESSMENT

A detailed, qualitative risk assessment was conducted for all primary residential buildings affected by the regulatory shoreline hazards within each SDC. Property parcels and building footprints were provided for this assessment by the Regional Municipality of Durham through their online open data portal. Shoreline hazards were those identified and summarize in Section 2.0 of this report, and shown on the shoreline hazard maps provided in Appendix A.

The risk assessment is based on a planning horizon of 100-years, commensurate with the definition of the shoreline hazards (refer to Section 2.0) and provincial policy. The shoreline hazards and associated risk are based on *projected* conditions over the next 100-years. These conditions are established following provincial guidelines and using the best available science, data, and statistical analysis. Shoreline hazards and associated risk are not based solely on *the last 100-years*, nor are they reliant specifically on the high water events of 2017 and 2019. The reader is encouraged to refer to the provincial technical guidelines (MNR, 2001 and CO-MNR, 2005) and the latest PPS (MMAH, 2020) for more information on the 100-year planning horizon upon which shoreline hazards are based.

3.1 RISK ASSESSMENT METHODOLOGY

A custom risk assessment template was developed for the project, based on the principals of the federal National Disaster Mitigation Program's (NDMP) Hazard Identification and Risk Assessment (HIRA) and Risk Assessment Information Template (RAIT). For this type of risk assessment, qualitative, relative risk is calculated by multiplying the likelihood or vulnerability of a building being impacted by the hazards (represented by an assigned score) by the impacts or consequences of that event actually occurring (represented by another assigned score). In general terms this approach can be summarized as follows:

(Likelihood/Vulnerability Multiplier) X *(Impacts/Consequences Score)* = *Risk*

The approach can generally be divided into two steps. First, an erosion or flooding multiplier is assigned to each building affected by one or more shoreline hazards, based on the building's exposure to the hazard. Buildings exposed to both erosion and flooding hazards are assigned two separate multipliers (and thus receive separate erosion and flooding risk scores). Buildings affected by the dynamic beach hazard are considered to be exposed to both erosion and flood risks and were therefore scored in both categories.

Each multiplier has two scoring components which are added together to form the overall erosion or flood multiplier. The first component relates to the likelihood of the hazard event occurring or the vulnerability of the building to the hazard and is scored from 0 - 5. The second component accounts for other considerations specific to the hazard and is scored from 0 - 3. The maximum erosion or flooding multiplier a building can receive is therefore a score of 8. A summary of the criteria used to assign erosion and flood multipliers to each residential building is provided in Table 3 below, with a more detailed description provided in Appendix B.

Table 3 – Criteria used to assign erosion and flood multipliers for each primary (residential) building affected by the shoreline hazards.

	EROSION MULTIPLIERS	SCORE	BRIEF DESCRIPTION
A	Likelihood / Vulnerability - Erosion	0	Building not affected within 100-year planning horizon
		1	Building likely affected within 100-year period
		2	Building likely affected within 50-year period
		3	Building likely affected within 20-year period
		4	Building likely affected within 5-year period (portion may be within stable slope)
		5	Imminent risk to building (within stable slope)
B	Other Considerations - Erosion	0	Risk not expected to change within 100-year planning horizon
		1	Risk may change due to climate change
		2	Risk may change due to climate change and changes in geology/morphology/wave exposure
		3	Risk may be higher due to erodibility of material and/or erosion forces from both the lake and landside (i.e. dynamic barrier beaches)

	FLOOD MULTIPLIERS	SCORE	BRIEF DESCRIPTION
C	Likelihood / Vulnerability - Flooding	0	Building not affected within 100-year planning horizon
		1	Possible wet foundation during 100-year event only
		2	Flood depth < 0.5 m during 100-year event and minor flooding possible more frequently
		3	Flood depth 0.5 - 1.0 m during 100-year event and moderate flooding possible more frequently
		4	Flood depth 0.5 - 1.0 m + possible direct wave impacts during 100-year event, and major flooding possible more frequently
		5	Flood depth > 1.0 m + direct wave impacts during 100-year event, and major flooding will occur multiple times in 100-year planning horizon
D	Other Considerations - Flooding	0	Risk not expected to change within 100-year planning horizon
		1	Risk may change due to climate change
		2	Risk may change due to climate change and changes in geology/morphology/wave exposure
		3	Risk may be higher due to high exposure to riverine flooding, resulting in a higher probability of occurrence for flooding events (i.e. barrier beaches with flooding potential from sheltered side)

Erosion Multiplier = A + B

Flood Multiplier = C + D

The second component of the risk assessment is to assign impact or consequence scores across five categories based on the impact or consequence of the hazard being realized. The five impact/consequence categories include (1) People & Societal Impacts, (2) Ecosystem Impacts, (3) Direct Economic Loses (based on MPAC assessed values), (4) Transportation / Emergency Access Impacts, and (5) Delivery of Energy / Utilities / IT. Table 4 below provides a summary of criteria used to assign scores within each of the impact/consequence categories, with additional details on how the scores were assigned for each hazard type provided in Appendix B.

Table 4 – Criteria used to assign impact/consequence scores across 5 categories based on the assumption that the shoreline hazard is realized.

IMPACTS / CONSEQUENCES	SCORE	BRIEF DESCRIPTION
People & Societal Impacts	1	No people & societal impacts expected
	2	Temporary displacement of occupants
	3	Permanent displacement of occupants
	4	Permanent displacement of occupants and injuries/health concerns are likely
	5	Displacement of occupants and fatalities are likely
Ecosystem Impacts	1	No ecosystem impact expected
	2	Temporary local impacts
	3	Temporary local impacts in proximity to high quality habitat (i.e. wetlands within 100 m)
	4	Temporary local impacts adjacent to high quality habitat (i.e. wetlands)
	5	Permanent local impacts
Direct Economic Losses (Buildings Only)	1	No economic loss expected
	2	Loss of 0k - 100k
	3	Loss of 100k - 500k
	4	Loss of 500k - 1M
	5	Loss of 1M +
Transportation / Emergency Access	1	No impact to transportation or emergency access expected
	3	Impacts limited to storm event
	5	Impacts extending beyond storm event
Delivery of Energy / Utilities / IT	1	No impact expected
	3	Impacts limited to storm event
	5	Impacts extending beyond storm event

The final *Erosion Risk Score* was calculated for each affected building as the sum of each impact/consequence score (5 categories) multiplied by the erosion multiplier. Similarly, the final *Flood Risk Score* was calculated as the sum of each impact consequence score (5 categories) multiplied by the flood multiplier. The final *Combined Risk Score* was then determined as the sum of the two risk scores, where appropriate. The risk assessment is qualitative and relative, in that scores are assigned and calculated following a consistent set of criteria for all buildings and all SDC's in order to determine buildings and areas with higher relative risk across the seven SDCs.

3.2 Risk Assessment Results

The risk assessment methodology outlined in Section 3.1 was followed for all residential buildings within or in close proximity to the shoreline hazards, within each SDC. Risk maps were subsequently created for each SDC, illustrating the relative risk associated with each building by colour coding the individual building footprints. Three risk maps were produced for each SDC, one for the *erosion risk*, one for the *flood risk*, and a final map showing the *combined risk* which is the sum of the individual risks. *Erosion* and *flood risk* was generally deemed to be high (relative to other evaluated buildings) for buildings with individual scores of 120 and up (the dark end of the colour gradation on the risk maps in Appendix C). For the *combined risk* scoring, additional categories were added to the risk maps (shown as purple) for properties with heightened risk due to their exposure to both the erosion and flood hazards. It should be noted that even buildings with a low risk score (i.e. light yellow on the risk maps) are subjected to some level of risk due to the hazards, with impacts expected at some point during the 100-year planning horizon. Only buildings scoring zero are deemed to have no exposure to a given hazard. The sections that follow provide a summary of the risk assessment results for each SDC, with the accompanying risk maps provided in Appendix C.

SDC#1 – Ontoro Boulevard (Ajax):

The governing risk for residential buildings on Ontoro Boulevard is the *erosion risk*. Although no homes within this SDC were identified to have high risk (120 and up), a handful of residential buildings scored as having medium erosion risk (scores of 60 – 120), namely buildings at the eastern and western-most ends of the road, where setbacks from the existing shoreline are smallest.

The only homes to register a (minor) *flood risk* are those at the east end of Ontoro Blvd., and specifically those adjacent to a small creek outlet. This has a minor impact on the *combined risk* of these buildings, though the impact is small.

SDC#2 – Crystal Beach (Whitby):

Properties in SDC #2 can generally be divided into three groups. The first is those properties at the west end of the road where residential buildings are close to the edge of a medium-high eroding bluff. These buildings scored medium-high to high in the erosion risk category.

The second group are those properties with residential buildings on the north side of Crystal Beach Blvd. in the transition area from the medium-high bluffs to the west and the low-lying barrier beach to the east. These homes generally have reasonable setbacks from the edge of the bluff and are not low-lying, meaning they scored relatively low in both individual and combined risk.

The third group of properties are those at the east end of Crystal Beach Blvd. which feature buildings founded on a low-lying barrier beach. These buildings scored as having both a medium erosion risk and high flood risk, meaning their combined risk scores were very high (180+).

An important aspect of the risk profile for residential buildings within SDC #2 is the presence of a municipal watermain beneath the road, which is well within the erosion hazard. This is accounted for in the risk evaluation under "delivery of energy/utilities/IT" where all residential buildings received an impact score of 5, due to the potential long-term loss of drinking water associated with a severe erosion event.

SDC#3 – Stone Street (Oshawa):

There are 53 individual properties on the south side of Stone Street in SDC #3, most of which sit atop a medium-high eroding bluff. Due to the elevation of the bluff there is no coastal flood risk for these properties. However, all residential buildings are subjected to some level of erosion risk, which is primarily a function of their individual setbacks from the bluff crest due to the consistent physical characterises and wave exposure along this portion of shoreline.

Most properties along Stone Street have large enough setbacks from the bluff crest that their erosion scores were low. There are two areas in which medium erosion risk scores were encountered. These include homes between the intersections with Lakefield St. and Oxford St., and those near the east end of Stone Street. Only one residential building within SDC #3 scored as high risk (refer to Risk Map in Appendix C). A portion of this building is very close to the eroding bluff and thus within the "zone of pending failure" (within the stable slope setback).

SDC#4 – Muskoka Avenue (Oshawa):

SDC #4 features 6 residential buildings located on the west side of a prominent headland, and a single residential building located atop the headland on Kluane Ave. This building is not subject to

a flood risk; however, its erosion risk is deemed to be high due to the combination of its high elevation (i.e. large area of potentially unstable slope) and average long-term recession rate.

The other 6 homes in this SDC are located on Muskoka Ave. in a transitional area between low-lying flood-vulnerable lands to the west and the high bluff headland to the east. As such, all six homes feature some level of both erosion and flood risk, with the homes at the west end of the grouping being more exposed to the flood hazard, while those at the east end are more exposed to the erosion hazard. The result is relatively high to very high combined risk for all five properties.

SDC#5 – Port Darlington (Clarington):

Properties within SDC #5 can be separated into three distinct groups. The first group is those properties on Cedar Crest Beach Rd. This residential development is located on a barrier beach and inlet system, that is both low-lying and features a long-term erosion trend (average annual recession rate for the natural shoreline of 0.22 m/year from 1954 to 2018). The road itself is below the 100-year coastal flood level and the regulatory riverine flood level, impacting the emergency accessibility of the area during severe flooding events. Virtually all residential buildings along Cedar Crest Beach Rd. have medium-high to high erosion and flood risk scores. The combined risk score for nearly every building along this road is therefore very high relative to other evaluated areas and buildings (purple).

The second group of properties are those with residential buildings located on Cove Rd., near the centre of the SDC. This area features much higher land elevations than the barrier beaches to the east and west, with the buildings being set back from the shoreline on relatively deep lots. As such, both erosion and flood risks for these homes generally scored low relative to other buildings in the SDC.

The third group of properties are those at the east end of the SDC, located on West Beach Road. Similar to the first group, these properties are located on a dynamic and low-lying barrier beach that separates Bowmanville Marsh from Lake Ontario. This landform is vulnerable to flooding from both the north (riverine) and south (coastal) sides and is generally comprised of highly erodible, unconsolidated sediments such as sand and cobble. The presence and stability of this landform is also predicated on the anchorage provided by the Port Darlington west jetty, which is in a state of significant disrepair. Finally, the elevation of West Beach Rd. is well below the 100-year coastal flood elevation for this area (100-year water level + wave uprush) and the 100-year riverine flood level for Bowmanville Creek (Aquafor Beech Ltd., 2009), therefore posing significant ingress/egress challenges during the regulatory flooding events. As a result of the above considerations, all residential buildings along West Beach Rd. score medium-high to high in both erosion and flood risk, with the combined risk being very high (purple) relative to other evaluated buildings and SDCs.

SDC#6 – East Beach Road (Clarington):

Properties subjected to coastal risk within SDC #6 can be divided into three distinct groups. The first group is those properties that are situated within Bowmanville Harbour on the shores of Bowmanville Marsh/Creek. This includes commercial and residential buildings at 70 and 120 Port Darlington Road. Due to their close proximity to the edge of an engineered (quay wall) shoreline, both properties are subject to some erosion risk as they would be within the stable slope should the shoreline infrastructure fail. Both properties also feature-medium high flood risk due to the low elevation of the properties compared to the 100-year riverine flood elevation for Bowmanville Creek (Aquafor Beech Ltd., 2009). The overall combined risk for these properties is therefore medium.

The second group of properties are those which feature residential buildings founded atop a medium-high to high eroding bluff fronting East Beach Rd. These include buildings at 70 – 89 East Beach Road, 188 Port Darlington Rd. and 220 Port Darlington Rd. Although these properties do not have a flood risk due to their high elevation, the erosion risk for all properties is significant. In particular, buildings at 76, 78 and 79 East Beach Rd. and a single dwelling at 188 Port Darlington Rd. are subject to high or very high erosion risks and are all within the stable slope setback for the shoreline (i.e. the zone of pending failure).

The third group of properties are those at the south end of South Service Rd. at the east end of SDC #6. Residential buildings on these properties are both low-lying and close to the eroding shoreline, meaning they are subjected to both erosion and flood risk. Of these properties, only the building at 2728 is subjected to high risk (flooding) given its extremely low land elevation. As such, its combined risk was determined to be very high relative to the other evaluated buildings.

SDC#7 – Wilmot Creek (Clarington):

Wilmot Creek is a retirement community located on the shores of Lake Ontario at the border between CLOCA and GRCA's watersheds. The portion of the development within CLOCA's jurisdiction features 70 residential buildings potentially affected by the erosion hazard. Due to the consistent physical characteristics and wave exposure of this shoreline, the relative erosion risk for these buildings is primarily a function of their individual setbacks from the bluff crest, and the height of the bluff which impacts the width of the stable slope setback (i.e. the zone of pending failure). The majority of buildings in this SDC scored relatively low, however a number of homes on Birch Tree Ln. between the intersections with Heatherlea Dr. and Wilmot Trail featured medium to medium-high erosion risk scores due to the land elevation and their proximity to the bluff crest. None of the buildings within this SDC are subjected to flood risk due to the elevation of the table lands. As such, their combined risk is synonymous with their erosion risk.

4.0 RISK MITIGATION

Risk mitigation strategies were developed and evaluated for each SDC based on the results of the hazard mapping and risk assessment. Strategies for risk mitigation were developed and evaluated under four broad categories as follows:

AVOID (relevant for all risk levels):

The objective of *avoid* strategies are to reduce future exposure of people and property to shoreline hazards and coastal risk by ensuring that new developments do not occur on hazardous lands. This category generally refers to planning and policy decisions, including:

- Planning and regulatory restrictions to prevent new development and limit re-development and additions to existing buildings within the hazards,
- Planning and zoning amendments to incorporate natural shoreline buffers and public open spaces.

ACCOMMODATE (low – high risk):

Under the *accommodate* category, adaptive strategies are developed that permit continued occupation of hazardous lands while implementing changes to human activities or infrastructure to reduce the overall risk. This category may include the following:

- Floodproofing homes through the installation of flood gates, opening shields, backflow valves, sump pumps, etc.
- Raising a building foundation to provide greater flood protection,
- Raising road elevations to provide better access during flood events,
- Upgrades to stormwater management systems, water supply and sanitary systems,
- Relocate high-value items to areas of highest elevation or furthest from the shoreline hazards within homes or property,
- Emergency preparedness and planning.

PROTECT (low – high risk):

The *protect* category is for strategies aimed at protecting people, property, and infrastructure from exposure to the risk, either through traditional engineering or nature-based solutions. This category may include:

- Conventional, shore-parallel shoreline protection structures including revetments, seawalls, breakwaters, etc.,
- Shore-perpendicular beach retention / shoreline stabilization structures such as groynes and artificial headlands,
- Beach nourishment,
- Dune restoration,
- Mechanical or hydraulic sediment bypassing (bypassing sediment around an obstruction such as a jetty).

RETREAT/RE-ALIGN (high – very high risk):

Retreat/Re-align is a category that encompasses strategic decisions to change land use and relocate public and private assets exposed to significant risk. *Retreat/Re-align* strategies are typically considered only when strategies under the other three categories are either not sufficient to

mitigate the risk or cannot be reasonably implemented due to constructability, permitting constraints related to environmental impacts, or most commonly, cost. Strategies in this category include:

- Relocate buildings a short distance away from the hazards where the depth/width of the lot is sufficient,
- Relocate buildings offsite to another existing or newly formed property parcel,
- Remove buildings, typically through a voluntary property disposition program (at fair market value) by the municipality on a willing seller/willing buyer basis.

4.1 Risk Mitigation Evaluation Criteria

Risk mitigation strategies listed above under the four broad categories of *avoid, accommodate, protect,* and *retreat/re-align* were evaluated for each SDC, with the exception of SDC #5. All residential buildings within SDC #1, 3, 4 and 7 were evaluated together (i.e., one set of recommendations for each SDC), while buildings within SDC #2 and SDC #6 were split into three sub-groups based on their geographic location and governing risk (as discussed in Section 4.2 below).

Similar to the evaluation of risk presented in Section 3.0, risk mitigation strategies were evaluated using an evaluation matrix. A summary of the evaluation matrix is provided as Figure 10 below, with higher scores indicating better overall strategies. First, flooding and erosion multipliers were established by adding the scores describing a given strategy's ability to mitigate the risk and its adaptability to future extremes (i.e. climate change). The flooding and erosion multipliers are subsequently multiplied by scores across eight (8) evaluation categories to determine the final flood and erosion risk mitigation scores, as shown in Figure 10. For SDCs exposed to both flooding and erosion risks, the two scores were averaged to create a combined risk mitigation score for each evaluated strategy.

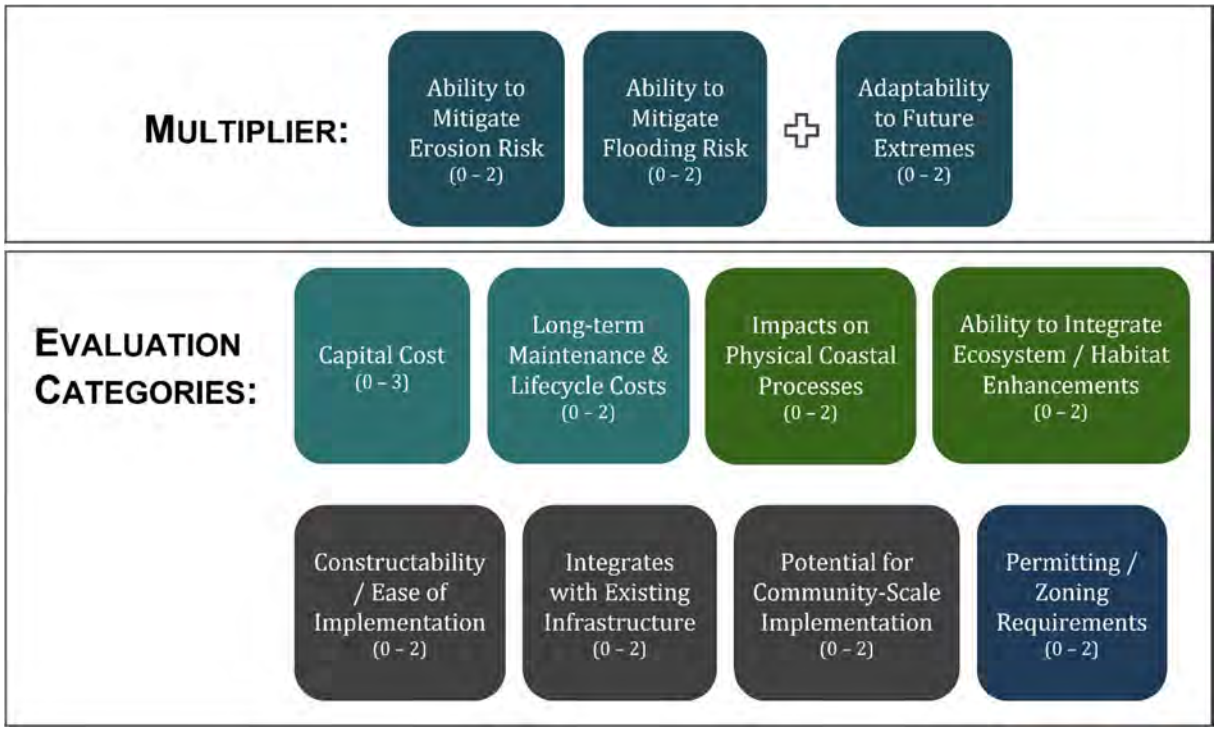


Figure 10 - Components of the risk mitigation strategy evaluation matrix.

A brief description of how each component of the risk mitigation evaluation matrix is scored is presented in Table 5 below.

Table 5 – Scoring categories and criteria for risk mitigation strategy evaluation matrix.

Multiplier / Evaluation Category	Score	Evaluation Criteria
Ability to Mitigate Erosion Risk	0	Cannot mitigate risk
	1	Can reduce risk
	2	Can mitigate risk
Ability to Mitigate Flood Risk	0	Cannot mitigate risk
	1	Can reduce risk
	2	Can mitigate risk
Adaptability to Future Extremes (i.e. climate change)	0	Low adaptability (cannot be adapted to function under future extremes)
	1	Medium adaptability (can be adapted to provide some risk mitigation under future extremes)
	2	High adaptability (can be adapted to mitigate risk under future extremes)
Capital Cost (per lot)	0	> $500,000
	1	$200,000 - $500,000
	2	$50,000 - $ $200,000
	3	$0 - $50,000
Long-Term Maintenance Requirements / Lifecycle Costs	0	Frequent maintenance requirements and cost (<10 years)
	1	Infrequent maintenance requirements and costs (>10 years)
	2	No maintenance requirements/cost
Constructability / Ease of Implementation	0	Access limitations and/or specialized construction equipment or skills required
	1	Typical medium-scale civil construction project
	2	Minor construction project / no-construction required
Integrates with Existing Shoreline Protection	0	Removal of existing shoreline infrastructure required
	1	Existing shoreline infrastructure can be reused in part
	2	Builds upon and integrates with exiting infrastructure
Applicable to Community-Scale Implementation	0	Cannot be readily scaled
	1	Scales to other properties but with considerable challenges
	2	Easily scaleable to adjacent properties or community at large
Impact on physical processes	0	May have significant negative impact on physical coastal processes
	1	May have minor negative impact on physical coastal processes
	2	Not expected to impact physical processes
Ability to Integrate Ecosystem / Habitat Enhancements	0	Negative impacts to ecosystem/habitat likely
	1	No net impacts to ecosystems/habitat expected
	2	Net positive impacts (improvements) to ecosystems / habitat possible
Regulatory / Zoning Requirements	0	Extensive regulatory / zoning requirements or considerations
	1	Regulatory / zoning investigations necessary
	2	Minor or no regulatory / zoning requirements expected

4.2 RISK MITIGATION RECOMMENDATIONS

The sections that follow provide recommended risk mitigation strategies for each SDC (and sub-group for SDC #2 and #6), based on the results of the risk mitigation strategy evaluation.

Following the evaluation process described in Section 4.1, *protect* and *retreat/re-align* strategies will generally score higher than *accommodate* strategies due to their superior ability to mitigate risk. Moreover, the scoring for *avoid* strategies is not relevant in comparison to the other three categories, as *avoid* speaks to measures that can be taken to mitigate risk exposure for future developments, while the other three categories are aimed at reducing risk for existing development. As such, recommendations are provided for each category, based on the relative scores of the various strategies within those categories. Where appropriate, *protect* and *retreat/re-align*

strategies are recommended as "Primary Risk Mitigation Strategies". *Accommodate* and *avoid* are grouped as "Other Risk Mitigation Considerations". For SDC's subject to *high* or *very high risk* (refer to Section 3.0), strategies were evaluated under all four risk mitigation categories (*avoid, accommodate, protect, retreat/re-align*). For all other SDCs, only the first three categories are considered (*avoid, accommodate, protect*).

Recommendations provided as a component of the 2020 Lake Ontario Shoreline Management Plan are also provided in the sections that follow, for reference.

SDC#1 – Ontoro Boulevard (Ajax):

Ontoro Boulevard (and Halls Road) features 15 residential buildings subjected to risk associated with the shoreline hazards, ranging from *low risk* to *medium relative risk*. Recommended risk mitigation strategies are provided as follows:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Conventional, engineered shoreline protection structures, preferably implemented consistently at a community-scale. Shoreline protection structures should be shore-parallel and placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes including littoral drift. Structures should be either conventional rubble-mound revetments, or composite revetment-seawall structures. Shoreline protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of existing and new shoreline protection structures should be carried out [Score = 36]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16]

AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06, and amendments to Ajax zoning by-law 95-200 (Ontoro Blvd.) and Whitby by-law 1784 (Halls Rd.)

The following additional considerations are provided for SDC #1:

- Maintain natural eroding bluffs to the west and east which supplies beach building material to the shoreline and barrier beaches downdrift (i.e. Cranberry Marsh barrier beach and Lynde Creek barrier beach).
- Environmental Protection (EP) zoning east and west of Ontoro Boulevard should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazards (i.e. Ontoro Boulevard should not be extended).
- The risk is not high enough to justify a "retreat/re-align" strategy at this time. However, erosion impacts at medium risk properties including 58, 56, 52, 14 and 2 Ontoro Blvd. should be monitored regularly.
- Ajax and Whitby do not presently have shoreline emergency plans. It is recommended that shoreline emergency plans be developed, with shared resources and coordination across the Region of Durham. Emergency plans should, at minimum, evaluate the ability to provide emergency services based on the available personnel and vehicle fleet, and the nature of the hazard.

The above recommendations are complimentary to those provided in the 2020 Shoreline Management Plan (Reach 1 – Lakeside Neighbourhood Park to Whitby Harbour), including:

- Monitor and maintain existing shoreline protection for damage and flanking,
- Shoreline protection structures should be engineered, and
- Additional shoreline hardening may have an impact on local beaches.

SDC#2 – Crystal Beach - West Section (Whitby):

The west end of SDC#2 features three properties with *medium* to *high relative risk* associated with the erosion hazard. Recommended risk mitigation strategies for these properties are provided as follows:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	Relocation of buildings further back on their lots (where possible), relocation offsite (new lot) or a voluntary property disposition program should be considered for all three properties at the west end of Crystal Beach due to their proximity to the bluff crest and the high risk associated with the erosion hazard [Score = 52].
PROTECT	If a retreat/re-align strategy is not possible or not supported by land-owners, conventional, engineered shoreline protection structures should be implement, preferably in a consistent manner across all three properties. Shoreline protection structures should be shore-parallel and placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes including littoral drift. Structures should be either conventional rubble-mound revetments, or composite revetment-seawall structures. Shoreline protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of new shoreline protection structures should be carried out [Score = 36].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16]
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Whitby zoning by-law 1784

The following additional comments are provided for SDC #2 (West Section):

- Beach retention structures (groynes) ranks 5th in the evaluation but would have adverse impacts on barrier beach and wetlands to the east and are therefore not recommended.
- Beach nourishment ranks 6th in the evaluation and may help preserve the integrity of the barrier beach to the east but will not remain stable along the Crystal Beach Blvd. shoreline due to its wave exposure and alignment.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Crystal Beach Blvd.).
- Whitby does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham. Emergency plans should, at minimum, evaluate the ability to provide emergency services based on the available personnel and vehicle fleet, and the nature of the hazard.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- There are high risk houses at the western end of Crystal Beach Blvd.
- Develop long-term retreat/re-align strategy for high-risk buildings on eroding shorelines.
- Maintain natural eroding bluffs where possible.

SDC#2 – Crystal Beach - Central Section (Whitby):

Properties in the central portion of SDC #2 located on the north side of Crystal Beach Blvd. were assessed to have *low* to *medium relative risk* associated with the shoreline hazards. Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Existing shoreline protection should be improved and extended west to protect the entirety of Crystal Beach Blvd. Shoreline protection should be a conventional, shore-parallel rubble-mound revetment and should be placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize its impact on littoral drift. Shoreline protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of new and existing shoreline protection structures should be carried out [Score = 40].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that properties are impacted by erosion within the 100-year planning horizon due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16].
AVOID	Planning/re-zoning should be considered to maintain vegetated, public open space on the south side of Crystal Beach Blvd. where possible. Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Whitby zoning by-law 1784

The following additional comments are provided for the properties in the central portion of SDC #2:

- As a component of the Protect strategy, the impacts of armouring the remainder of the bluff fronting Crystal Beach Blvd. on the supply of sediment from natural bluff erosion processes should be investigated and quantified as a component of the site-specific design and permitting process. Eroding bluffs fronting Crystal Beach Blvd. provide beach building material that is transported east to the Corbett Creek barrier beach. As such, depending on the percentage of sands/cobbles in the bluff and its contribution to the overall sediment budget for the shoreline, measurable negative impacts to the barrier beach may occur if the remainder of the Crystal Beach Blvd. shoreline is armoured.
- Beach retention structures (groynes) ranks 5th in the evaluation but would have adverse impacts on the Corbett Creek barrier beach and wetlands to the east and are therefore not recommended.
- Beach nourishment ranks 6th in the evaluation and may help preserve the integrity of the barrier beach to the east but will not remain stable along the Crystal Beach Blvd. shoreline due to its wave exposure and alignment.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Crystal Beach Blvd.).
- The risk is not high enough to justify a retreat/re-align strategy at this time.
- Whitby does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham. Emergency plans should, at minimum, evaluate the ability to provide emergency services based on the available personnel and vehicle fleet, and the nature of the hazard.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- Maintain natural eroding bluffs where possible.

SDC#2 – Crystal Beach - East Section (Whitby):

The five properties at the east end of SDC #2 were determined to have *very high risk* associated with both the shoreline flooding and erosion hazards (refer to Section 3.0). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	A voluntary property disposition program (willing buyer/willing seller) or building relocation (offsite) is recommended for properties at the east end of Crystal Beach Blvd. in order to mitigate the very high risk associated with both the flooding and erosion hazards. The lands should be restored to natural barrier beach [Score = 52].
PROTECT	If a retreat/re-align strategy is not implemented, significant shoreline protection upgrades could mitigate some of the risk. The erosion risk can likely be reduced through significant engineered upgrades to the existing revetment fronting Crystal Beach Blvd., including extending the structure to the north immediately adjacent to 462 Crystal Beach Blvd. The flood risk, however, cannot reasonably be mitigated due the low elevations of the lands and the threat of flooding from both the lake and marsh sides. Even if flood protection was implemented on both sides (higher revetment with flood protection on lake side and flood berm or levee on marsh side), static flooding would still occur due to flood waters infiltrating the groundwater on this narrow barrier beach landform which is likely comprised of porous, non-native, and unconsolidated sediments (sands, cobbles) [Score = 23].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	A number of accommodate strategies can be implemented to marginally reduce the combined flooding and erosion risk. These include raising the elevation of Crystal Beach Blvd. [Score = 20], emergency preparedness and planning by local landowners and local government [Score = 16], floodproofing of homes through the installation of flood gates or opening shields, backflow valves, sump pumps, etc. [Score = 13] and raising the first floor elevation of homes by raising their foundations [Score = 8].
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Whitby zoning by-law 1784

The following additional comments are provided for the properties at the east end of SDC #2:

- The access standard (MNR, 2001) is not met for properties at the east end of Crystal Beach Blvd., as the east end of Crystal Beach Blvd. is below the 100-year flood level and subjected to erosion risks. This provides support to the recommendation of a retreat/re-align strategy on the basis of provincial regulatory requirements for safe access (MMAH, 2020).
- Construction costs associated with erosion protection and flood proofing would be substantial (likely hundreds of thousands across all five properties). Landowners should consider whether the considerable cost to mitigate some, but not all of the risk through shoreline protection, has merit in relation to the value of the land.
- Beach retention structures (groynes) ranks 6th in the evaluation but would have significant adverse impacts on barrier beach and wetlands to the east and are therefore not recommended.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach. The stability of the barrier beach has a direct impact on the risk exposure for homes at the east end of Crystal Beach Blvd.

- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Crystal Beach Blvd.).
- Whitby does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham. Emergency plans should, at minimum, evaluate the ability to provide emergency services based on the available personnel and vehicle fleet, and the nature of the hazard.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- There are high risk houses at the eastern end of Crystal Beach Blvd.
- Develop long-term retreat/re-align strategy for high-risk buildings on eroding shorelines.
- Maintain natural eroding bluffs where possible.

SDC#3 – Stone Street (Oshawa):

There are 52 residential buildings along the south side of Stone Street with exposure to the shoreline hazards. In general, these properties were assessed as having *low* to *medium relative risk*, with the exception of a single property where the relative risk was evaluated as *high* (refer to Section 3.0 and risk map above). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Conventional, engineered shoreline protection structures, preferably implemented consistently at a community scale. Shoreline protection structures should be shore-parallel and placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes including littoral drift. Structures should be conventional rubble-mound revetments, designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of new shoreline protection structures should be carried out [Score = 36].
RETREAT/RE-ALIGN **(High Risk Property Only)**	If engineered shoreline protection is not implemented in front of the property evaluated as having *high relative risk*, a voluntary property disposition program is recommended due to the high erosion risk associated with the building due to its proximity to the bluff crest. The residential building is located within the "zone of pending failure" (i.e., stable slope allowance) [Score 52].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16].
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to City of Oshawa By-law 60-94.

The following additional comments are provided for SDC #3:

- Shoreline protection schemes implemented along Stone Street should include future flanking protection (e.g., a buried boulder trench along property line) where adjacent shorelines are likely to remain unprotected (refer to Section 4.3)
- If shoreline protection is not implemented in the medium-term (< 20 years), a voluntary property disposition program could be expanded to include all *medium risk* properties on the south side of Stone Street between Lakefield St. and Oxford St.
- Relative risks are not high enough to recommend a retreat/re-align strategy for all other properties along Stone Street not specifically referred to above.
- Beach retention structures (groynes) ranks 5th in the evaluation but would have adverse impacts on the Pumphouse Marsh barrier beach and wetlands to the east and are therefore not recommended.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach at Pumphouse Marsh.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Stone Street).
- Oshawa does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham. Emergency plans should, at minimum, evaluate the ability to provide emergency services based on the available personnel and vehicle fleet, and the nature of the hazard.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- Stone Street Residential Area – develop a long-term, community scale armouring solution or a retreat/re-align plan that re-locates homes and naturalizes the shoreline, particularly for high risk buildings on the eroding bluff shoreline.
- Existing shoreline protection fronting Stone Street is predominantly ad-hoc or under-designed (as of 2019). Structures should be monitored, and improvements should be considered.
- Flanking of protected portions of shoreline is prevalent along Stone Street where neighbouring properties are unprotected and erosion is ongoing.
- Shoreline hardening should be limited to the high density developed area. Maintain natural eroding bluffs elsewhere.
- Consider site-specific investigation into improvements at Stone Street Park to improve shoreline aesthetics and waterfront access.

SDC#4 – Muskoka Avenue (Oshawa):

There are 7 residential buildings in SDC #4 with exposure to the hazards, including 6 along Muskoka Ave. and 1 sitting atop a high bluff headland (Bonnie Brae Point). Residential buildings within this SDC were generally evaluated as having *high* to *very high relative risk* associated with the shoreline hazards (refer to Section 3.0). Recommended risk mitigation strategies for properties within SDC #4 include:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	A long-term voluntary property disposition program (willing buyer/willing seller) or building relocation offsite (new lot) is recommended for all 7 properties within SDC #4 due to the severity of the risks associated with the natural hazards [Score = 52]

PROTECT	If property re-acquisition is not supported or not possible, conventional engineered shoreline protection capable of mitigating the erosion risk and reducing the flooding risk is recommended for the 6 properties on Muskoka Ave. Shoreline protection should be engineered by a qualified coastal engineer based on site-specific design conditions, should preferably be consistent across all 6 properties, and should consist of either a conventional revetment or composite revetment-seawall structure [Score 23]. The overall protection scheme could include a small beach retention structure (stone groyne) immediately east of 61 Muskoka Ave. to anchor a beach in front of all 6 properties. The potential impacts of this structure on the downdrift headland shoreline would have to be investigated by a qualified professional [Score = 14]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion or flooding event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16]. Buildings subjected to high flood risk specifically (51 – 57 Muskoka Ave.) could be raised [Score = 9] or floodproofed including the installation of flood gates, opening shields, backflow valves, sump pumps, etc. [Score 7]
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to City of Oshawa By-law 60-94. Planning/zoning should consider maintaining the lands atop the high bluff headland as vegetated, public open space.

The following additional comments are provided for SDC #4:

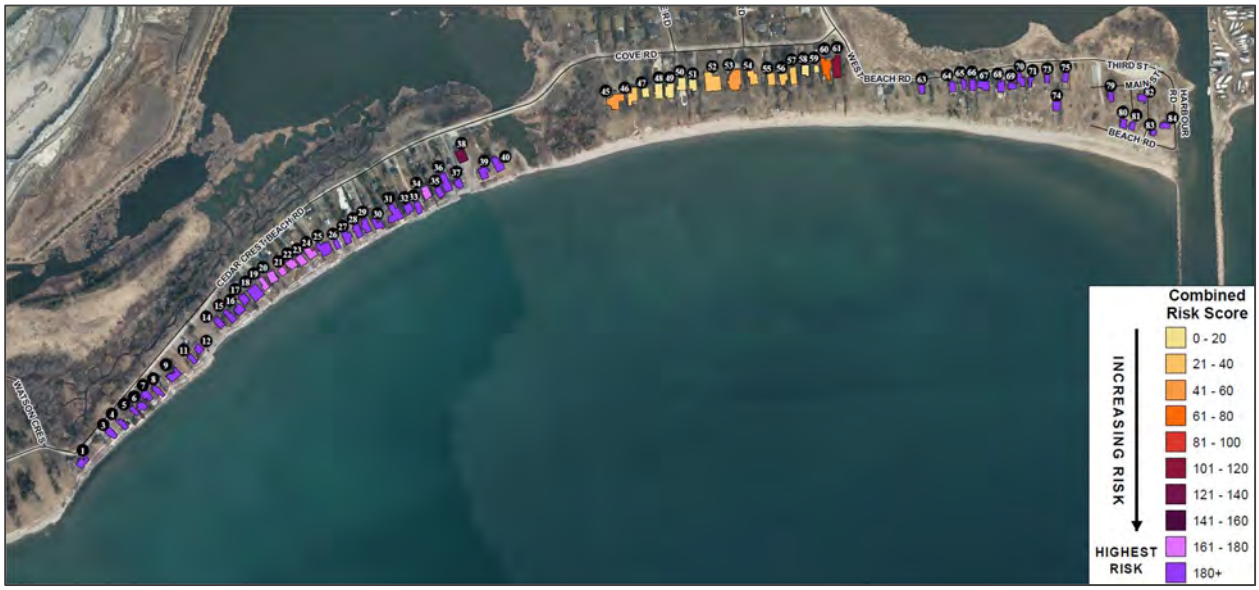
- Armouring the headland shoreline fronting 1575 Kluane Ave. (Bonnie Brae Point) is not recommended. Erosion of the headland is a critical natural process that generates beach-building material which is transported to the sediment-starved beaches to the east (Lakeview Park).
- A geotechnical study is recommended to determine the actual stable slope for 1575 Kluane Ave. For this study the relative risk to which the property is exposed has been assessed using the provincial standard stable slope of 3:1 (horizontal:vertical). This places the residential building within the "zone of pending failure" (stable slope setback). However, the hard glacial till bluff may be stable at a steeper slope resulting in a smaller "zone of pending failure".
- Oshawa does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham. Emergency plans should, at minimum, evaluate the ability to provide emergency services based on the available personnel and vehicle fleet, and the nature of the hazard.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- Develop a long-term retreat/re-align strategy for high-risk buildings on eroding shorelines
- Shoreline hardening should be limited to high density development areas. Maintain natural eroding bluffs where possible.

- Lakewoods Park Lookout (Bonnie Brae Point) and Lakeview Park: monitor trails and fencing to ensure park user safety is addressed.

SDC#5 – Port Darlington (Clarington):



Port Darlington (SDC #5) has been the subject of several technical studies in recent years to evaluate the shoreline hazards and to recommend risk mitigation strategies. Therefore, as per the original scope of work for this study, SDC #5 is treated differently than the other six SDCs with no new recommendations provided. Instead, the reader is directed to existing technical reports prepared by independent consultants in recent years with expertise in the field of coastal engineering. The following technical reports can be found on the CLOCA website:

- Port Darlington Shore Protection Concepts (W.F. Baird & Associates, 2018)
- Proposed Port Darlington (West Shore) Shoreline Management Report (Aqua Solutions 5 Inc., 2018)
- Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a)
- Cedar Crest Beach Shoreline Change Assessment (Zuzek Inc., 2020b)

SDC#6 – East Beach Road - West Section (Clarington):

The west section of SDC #6 includes properties situated on the shores of Bowmanville Marsh/Creek. This includes commercial and residential buildings on Port Darlington Rd. These buildings were generally evaluated as having *medium relative risk* associated with the shoreline hazards (refer to Section 3.0). Recommended risk mitigation strategies for properties within SDC #6 – West Section include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	A structural assessment of harbour quay walls fronting commercial and residential buildings on Port Darlington Rd. is recommended including an evaluation of their flood mitigation potential at water levels due to 100-year Lake Ontario and Bowmanville Creek flooding events. The assessment should be undertaken by a qualified coastal or structural engineer. If required, upgrades to shoreline infrastructure and regular maintenance of quay walls fronting both properties should be undertaken to improve the provided protection against flooding [Score 20]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant flooding event occurs due to the combination of high lake levels and storm waves on Lake Ontario or flooding of Bowmanville Creek [Score = 16]. High value assets within both properties should be relocated to areas of highest elevation within buildings or on properties where possible [Score = 7]. Floodproofing options should be considered including the installation of flood gates, opening shields, backflow valves, sump pumps, etc. [Score 6] and upgrades to stormwater management and landside drainage systems should be evaluated to assist in removing floodwaters from the properties and surrounding areas [Score = 4]

AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Municipality of Clarington By-law 84-63.

The following additional comments are provided for SDC #6 – West Section:

- The flood-risk associated with both Lake Ontario and Bowmanville Creek should be reassessed at regular intervals based on the availability of new riverine flood modelling tools and additional historical water level, rainfall, and flow rate data.

SDC#6 – East Beach Road - Central Section (Clarington):

The central portion of SDC #6 includes properties along East Beach Road and two properties further to the east on Port Darlington Rd. Residential buildings within this group of properties were generally evaluated as having *medium* to *high relative risk* associated with the erosion hazard (refer to Section 3.0). Recommended risk mitigation strategies for properties within SDC #6 – Central Section are provided as follows:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	A long-term voluntary property disposition program (willing buyer/willing seller) or building relocation offsite (new lot) is recommended for the homes east of East Beach Park, prioritized based on their relative risk scores [Score = 52]

PROTECT	If property re-acquisition is not supported or not possible, conventional engineered shoreline protection capable of mitigating the erosion risk is recommended for all properties. Shoreline protection should be engineered by a qualified coastal engineer based on site-specific design conditions, should preferably be consistent across adjacent properties, and should consist of either a conventional revetment or composite revetment-seawall structure such as that which was constructed in recent years to the west in front of East Beach Park [Score 32]. In addition to shoreline armouring, mechanical or hydraulic sediment bypassing of beach material from west beach (supported by an appropriate technical study) or the sand accumulated in the navigation channel to east beach is recommended. This sediment pathway is presently interrupted by the Port Darlington jetties creating long-term stability of the west filet beach while the East Beach shoreline is subjected to accelerated recession. Sediment bypassing (or another form of beach nourishment) may reduce the long-term erosion rate for the East Beach community [Score = 26]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in preparation for a significant and rapid erosion event [Score = 16]. A geotechnical slope stability assessment should be completed for the homes currently located in the zone of pending failure (stable slope setback).
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Municipality of Clarington By-law 84-63.

The following additional comments are provided for SDC #6 – Central Section:

- Beach retention structures (groynes) ranks 7th in the evaluation but would have adverse impacts on the downdrift shorelines to the east, including acceleration of erosion rates for bluff shorelines that have been recently developed with residential subdivisions. Beach retention structures are therefore not recommended.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 5 – Port Darlington to Port of Newcastle) for this area, including:

- Implement a sediment bypassing program from the Port Darlington west filet beach to nourish Port Darlington East Beach shoreline.
- A long-term, community scale solution is required for the East Beach community to reduce erosion and flood hazards, such as protection or retreat/re-align. For example, a voluntary land acquisition program for lands subject to acute hazards could be implemented to return the shore lands to public open space.
- Maintain naturally eroding bluff environments where possible to preserve natural sediment supplies.

SDC#6 – East Beach Road - East Section (Clarington):

The eastern end of SDC #6 includes properties at the south end of South Service Rd. This group features three residential buildings, two of which were evaluated to have *medium relative risk*. The third building (furthest west) was evaluated as having *very high relative risk* associated with both the erosion and flooding hazard (refer to Section 3.0 and risk map presented above). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN **(Very High Risk Building Only)**	A long-term voluntary property disposition program (willing buyer/willing seller), building relocation further landward within the property, or building relocation offsite (new lot) is recommended for the residential building receiving a *very high relative risk* score due to the combined risk posed by the erosion and flooding hazards [Score = 52]
PROTECT	Conventional, engineered shoreline protection capable of mitigating the erosion and flooding risk is recommended for all properties (including the *very high risk* property if *retreat/re-align* is not supported or not possible). Shoreline protection should be engineered by a qualified coastal engineer based on site-specific design conditions, should preferably be consistent across adjacent properties, and should consist of either a conventional revetment or composite revetment-seawall [Score 23]. In addition to shoreline armouring, mechanical or hydraulic sediment bypassing of beach material from west beach or the navigation channel to East Beach is recommended. This sediment pathway is presently interrupted by the Port Darlington jetties resulting in relative long-term stability of the west filet beach and accelerated erosion of the shoreline east of the jetties. Sediment bypassing (or another form of beach nourishment) may reduce the long-term erosion rate for the shoreline fronting South Service Rd. [Score = 12]

OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in preparation for a significant erosion or flooding event [Score = 16]. Floodproofing options should be considered for the building with *very high relative risk*, including raising the building foundation [Score = 9], the installation of flood gates, opening shields, backflow valves, sump pumps, etc. [Score 7]. High value assets within properties should be located in areas of highest elevation within buildings or on properties where possible [Score = 7]
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Municipality of Clarington By-law 84-63.

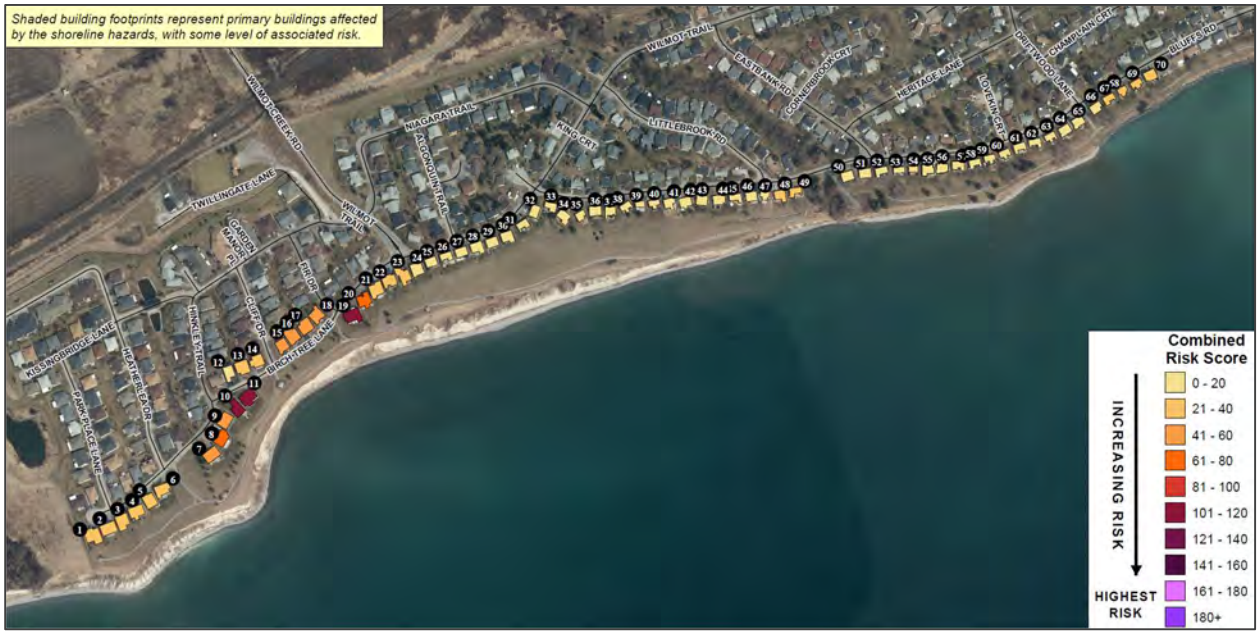
The following additional comments are provided for SDC #6 – East Section:

- Beach retention structures (groynes) ranks 5th in the evaluation but would have adverse impacts on the downdrift shorelines to the east, including acceleration of erosion rates for bluff shorelines that have been recently developed with large residential subdivisions. Beach retention structures are therefore not recommended.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within the hazardous lands.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 5 – Port Darlington to Port of Newcastle) for this area, including:

- Implement a sediment bypassing program from the Port Darlington west filet beach to nourish Port Darlington East Beach shoreline.
- Maintain naturally eroding bluff environments where possible to preserve natural sediment supplies.

SDC#7 – Wilmot Creek (Clarington):



There are 70 residential buildings within the CLOCA portion of the Wilmot Creek Retirement Community with exposure to the shoreline hazards. In general, these properties were assessed as having *low* to *medium relative risk* (refer to Section 3.0). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Existing "interim" shoreline protection should be redesigned and reconstructed to provide adequate, properly engineered erosion protection, starting with areas where *medium risk* buildings have been identified. Structures should be conventional rubble-mound revetments, constructed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes. Erosion protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance should be carried out [Score = 40].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual residents, CAPREIT (owner of Wilmot Creek community) and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16].
AVOID	Planning/re-zoning should be considered to maintain vegetated, public open space on the south side of Hinkley Trail, Birch Tree Lane, Wilmot Trail, and Bluffs Road, where possible. Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Clarington Zoning By-law 84-63.

The following additional comments are provided for SDC #7:

- Relative risks are not high enough to recommend a retreat/re-align strategy at this time, but erosion of the shoreline fronting homes on Birch Tree Lane in particular should be monitored.
- Beach retention structures (groynes) ranks 5th in the evaluation but would result in a period of accelerated erosion rates along the shoreline to the east which fronts a significant and recently constructed subdivision (Newcastle).
- Beach nourishment ranks 6th in the evaluation but is not recommended as sediment is not likely to remain stable along this portion of shoreline due to its orientation.
- Maintain natural eroding bluffs to the west, the east and in areas within the SDC where the assessed risk is negligeable or low, in order to preserve sediment supplies to downdrift shorelines.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within the hazardous lands.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 5 – Port Darlington to Port of Newcastle) for this area, including:

- Monitor shoreline protection and upgrade structures as required to provide the necessary protection.

4.3 CONCEPTS & ESTIMATES OF PROBABLE COST

Guidance for shoreline protection structures is provided in this section for the CLOCA shoreline. The guidance is generally based on regional coastal conditions commensurate with a 100-year planning horizon and covering the typical shoreline types encountered within the 7 SDCs. However, the design of shoreline protection is site-specific, as local shoreline conditions and wave exposure can vary significantly over short distances. Information provided herein including opinions of probable cost should be taken as a general guide only. Site specific advice and engineering should always be sought from a professional engineer specializing in coastal engineering before implementing shore protection works.

In general, sloping shore protection structures such as revetments are preferred over vertical structures due to their superior ability to dissipate wave energy. Vertical structures tend to reflect more wave energy causing increased lakebed erosion directly in front of the structure. This can lead to failures if the structure toe is not designed properly or founded deep enough. Several failures of pre-cast concrete block seawalls occurred between 2017 – 2019 in the study area for this reason, as pictured in the adjacent image.

Moreover, properly designed sloping structures tend to have gradual failure mechanisms such as displacement of structure elements (typically stones) or settlement over relatively long periods of time. By contrast, vertical structures tend to fail abruptly and catastrophically during a major storm event. Sloping structures can be monitored and maintained more readily throughout their design life relative to their vertical counterparts.

In general, structures comprised of items such as pre-cast concrete blocks, gabion baskets, timber and scrap concrete should be avoided on Great Lakes shorelines. These forms of shoreline protection are inadequate to resist the siginfincant loads and erosive forces on Lake Ontario over the long term, and are generally poor for the aquatic and shorelands environment.

Shoreline protection structures should generally be shore-parallel and placed against the existing bank or bluff (i.e. minimal lakeward projection) in order to mitigate potential impacts to longshore sediment transport and other coastal processes. Shore protection structures should be constructed from natural stone materials where possible. Natural stone materials such as quarried limestone and field stone are preferred over alternative construction materials such as concrete due to their higher density, durability and the fact that they are better for the aquatic environment and more closely replicate natural shoreline conditions and habitat.

All SDCs for which shoreline protection is presented in Section 4.2 as a viable and recommended option can be described as medium to high bluff or low-bank shorelines. **The recommended approach to shoreline protection for these types of shorelines is a conventional stone revetment**. Stone revetments are generally comprised of an outer 'primary' stone course, and underlying courses of smaller 'filter' stone. The 'primary' stone layer can be comprised of a single layer of tightly packed, blocky armour stone (quarried stone), or multiple layers of randomly placed irregular armour (quarry stone) or field stone (natural boulders). Single-layer armour stone structures require a smaller volume of material, however the cost of blocky armour stone is

typically much higher per tonne than irregular armour stone or field stone. Moreover, the construction of single-layer armour stone revetments requires a high level of operator expertise due to the specific stone placement requirements. Ultimately the selection between the two types of revetments is typically based on the availability of materials and cost, as both structure types can be designed to effectively resist wave loading and mitigate erosion for Lake Ontario shorelines. Figure 11 presents examples of single-layer blocky armour stone revetments, while Figure 12 presents examples of randomly placed armour or field stone revetments.

Figure 11 – Examples of single-layer, blocky armour stone revetments on Lake Ontario

Figure 12 – Examples of conventional rubble-mound revetments with multiple layers of randomly placed field stone (left) and irregular armour stone (right).

Concept-level cross sections for a single-layer armour stone revetment and multi-layer, irregular armour or field stone revetment are provided in Figure 13 and Figure 14, respectively (below). These cross-sections are typical for a medium to high-bank or bluff shoreline, where the necessary height of the revetment to limit wave overtopping to acceptable (no damage) levels is below the elevation of the top of bank or bluff. This is indicative of the shorelines encountered in the western half of SDC #1 (Ontoro Blvd.) and SDC #2 (Crystal Beach), all of SDC #3 (Stone Street), SDC #6 (East Beach) and SDC #7 (Wilmott Creek).

Figure 15 and Figure 16 below present similar cross-sections for single-layer armour stone and multi-layer irregular armour or field stone revetments fronting low-bank shorelines where the structure must be higher than the elevation of the table lands to mitigate wave overtopping to acceptable levels. Such a scenario might be encountered at the east end of SDC #1 (Ontoro Blvd.)

and SDC #2 (Crystal Beach), SDC #4 (Muskoka Ave.), SDC #5 (Port Darlington), and the east end of SDC #6 (properties on South Service Rd.).

For extremely low-elevation shorelines or where superior flood protection is necessary such as the east end of SDC #2 (Crystal Beach) or SDC #5 (Port Darlington), a composite revetment-seawall may be necessary. In these structures a near vertical, vertical or re-curved (return) wall is placed at the crest of the revetment to further mitigate wave overtopping. The vertical wall component of the structure can be comprised of stacked armour stone (refer to Figure 17), pre-cast concrete units (refer to Figure 18), or cast-in-place concrete.

Finally, for shorelines with existing vertical structures or shorelines where significant space limitations exist and the structural footprint must be minimized, an armour stone or field stone berm can be placed in front of a vertical wall to improve its stability, longevity, and ability to mitigate wave overtopping. Several examples of this concept already exist within SDC #1 (Ontoro Blvd.), where existing precast block walls have been rehabilitated with the addition of stone berms (refer to inset image).

For protected properties where the adjacent lot(s) are expected to remain unprotected, flanking protection is recommended. Flanking occurs when the adjacent, unprotected shoreline continues to erode, eventually progressing landward beyond the extent of protection at the property boundary between protected and unprotected properties. This can result in failure of the structure at its terminations, and rapid recession of the shoreline behind the structure. Flanking protection can be provided by burying the ends of the shore protection structure some distance into the bluff or bank face at either end of the structure. Where space allows, a simple form of flanking protection can be to burry a trench of stones just below ground level parallel to the property boundary some distance inshore. As the neighbouring property continues to erode these stones will become exposed and naturally fall to the base of the bluff or bank along the property line providing some level of flanking protection. Flanking of shoreline structures should always be monitored where an adjacent shoreline remains unprotected and continues to erode.

Construction costs for engineered revetments such as those discussed above and for the wave exposure encountered along the CLOCA shoreline generally range from $3,200 to $4,200 CAD per linear meter. To determine the approximate construction cost for an individual property, this number should be multiplied by the length of shoreline to be armoured. The estimated range of probable construction costs presented above is based on recent experience and quotations from a wide range of contractors across Ontario, with prices indexed to 2021. Prices may vary outside of this range depending on the specific design, material availability, location, contractor availability, construction timing, and site access, among other things. The above prices do not include contingencies, design fees or other professional costs associated with the implementation of shore protection. A minimum contingency of 20% should be added to these costs when considering the affordability of implementing shoreline protection.

The above section is presented as broad guidance for shoreline protection structures only and does not negate the requirement for site-specific engineering to be carried out by a qualified professional engineer. Moreover, all shoreline protection works will require work permits from the CLOCA, with additional permits or approvals likely required from the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) and the Department of Fisheries and Oceans (DFO) should any portion of the structure be situated lakeward of the high water line.

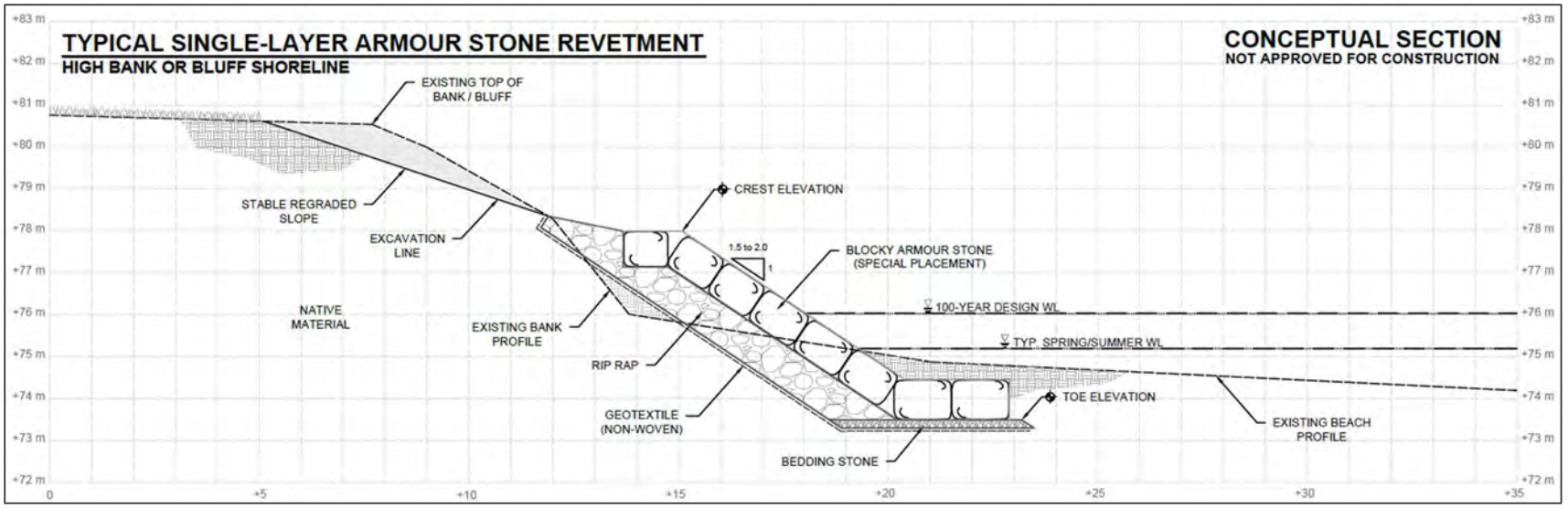


Figure 13 – Typical single-layer armour stone revetement concept for medium to high bluff/bank shoreline

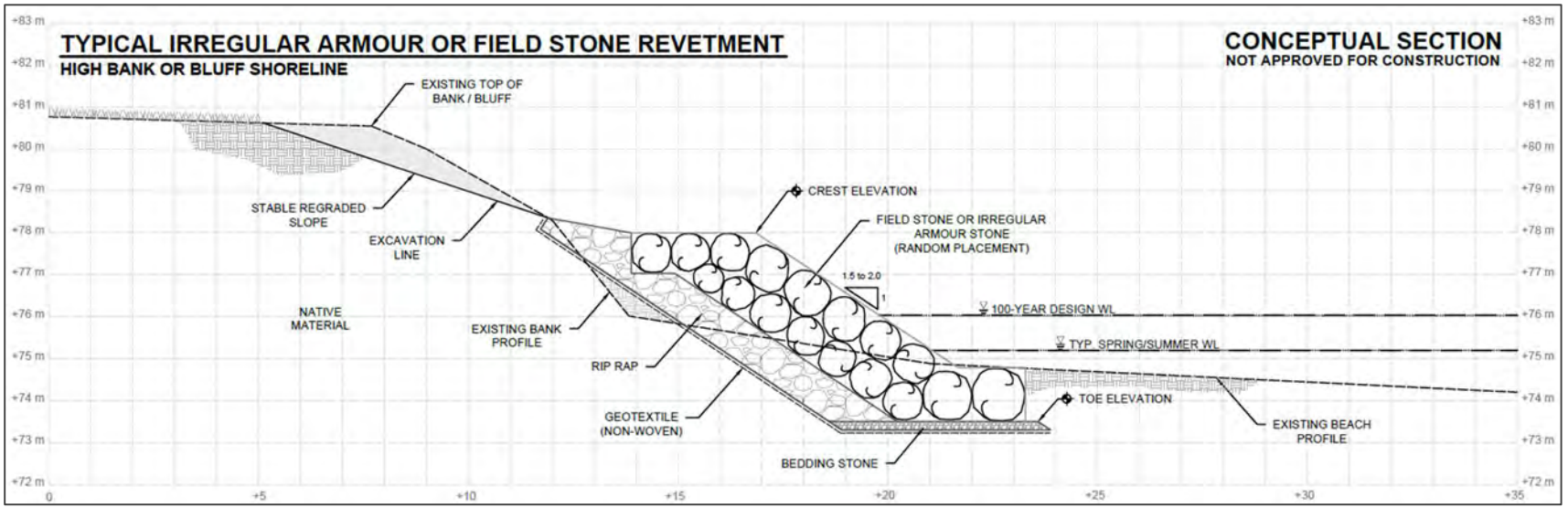


Figure 14 – Typical multi-layer, irregular armour stone or field stone revetment concept for medium to high bluff/bank shoreline

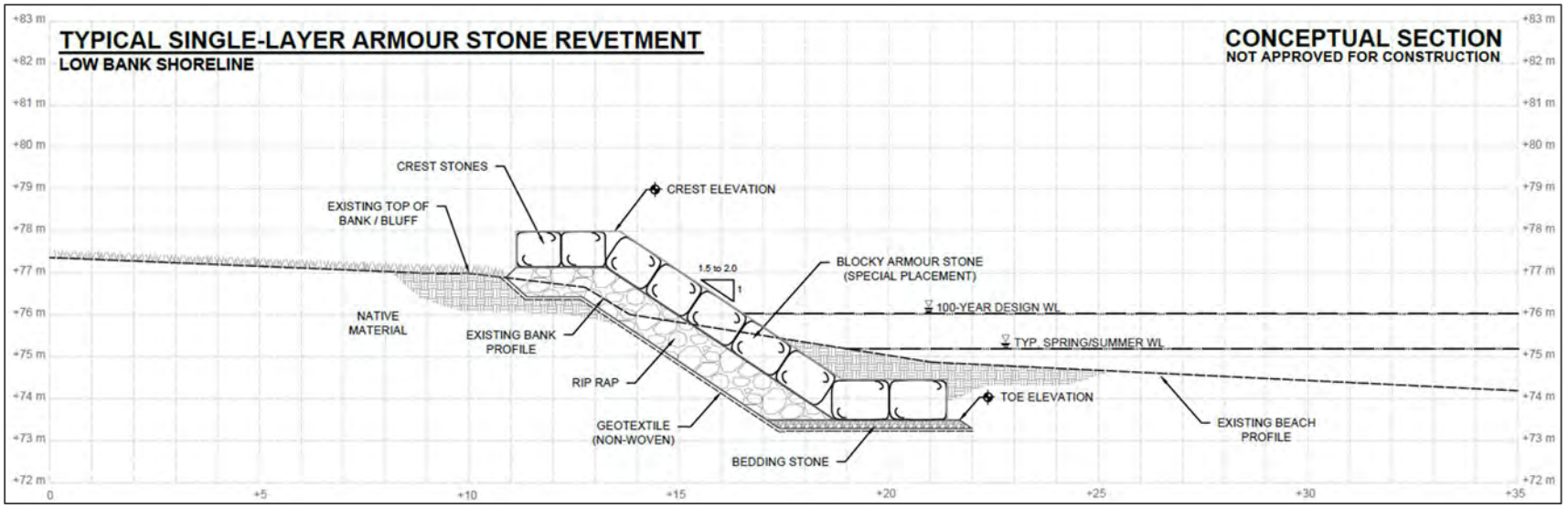


Figure 15 – Typical single-layer armour stone revetement concept for low bank shoreline

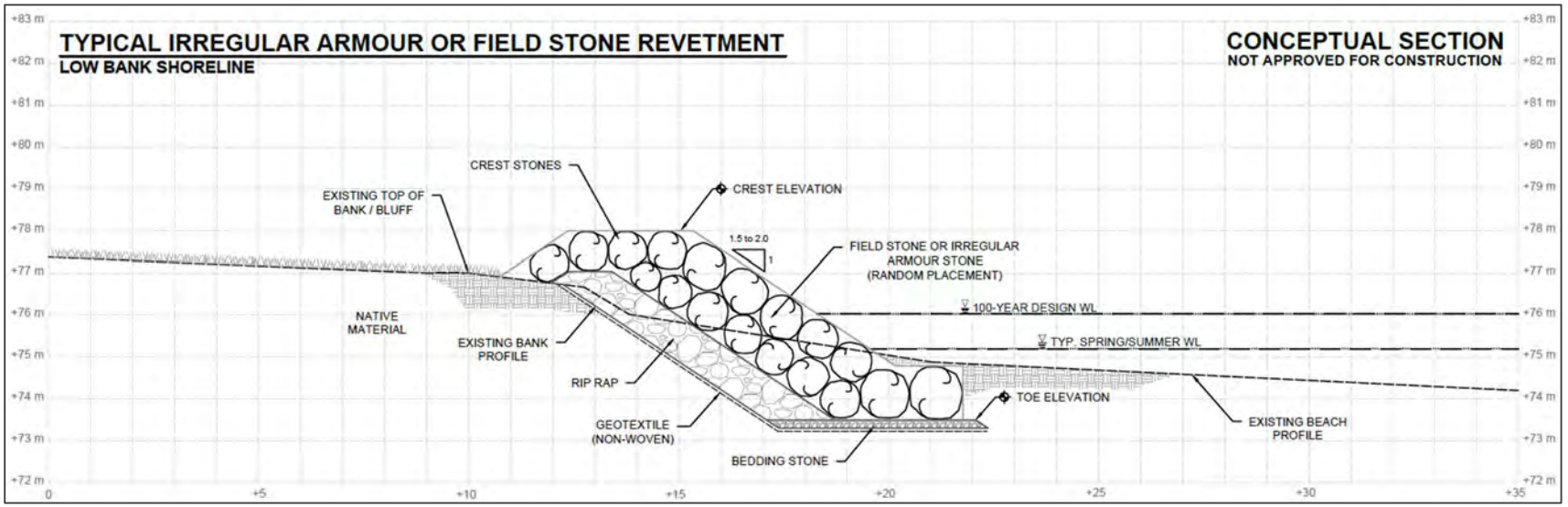


Figure 16 – Typical multi-layer, irregular armour stone or field stone revetment concept for low bank shoreline

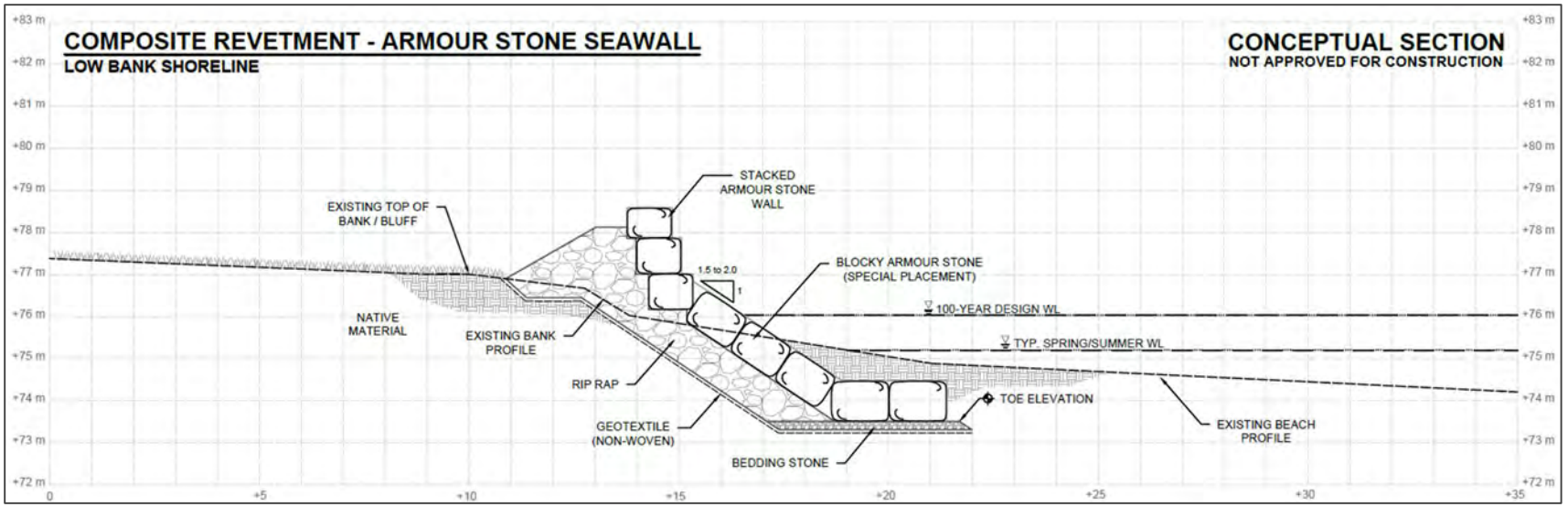


Figure 17 – Typical composite revetment – armour stone seawall concept for flood prone, low bank shoreline

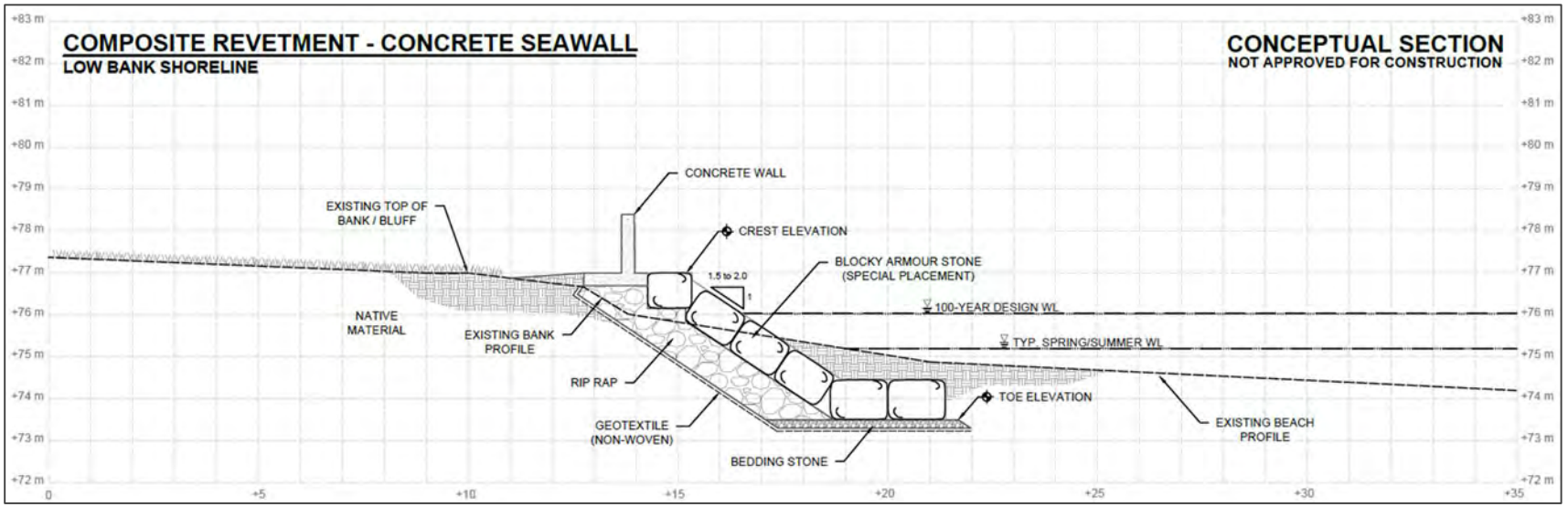


Figure 18 – Typical composite revetment – concrete seawall concept for flood prone, low bank shoreline

4.4 MONITORING & MAINTENANCE

To maximize the effective lifespan of new and existing shoreline protection structures, regular monitoring of the structure should be carried out by the property owner, with less frequent monitoring (every ~10 years or after a major storm event) carried out by a qualified coastal engineer. Regular monitoring should include photographs and visual observations documenting any apparent movement or displacement of stones, settlement, or loss of material. A coastal engineer should be contacted if any of these processes are observed by the owner. Less frequent, detailed monitoring to be carried out by an engineer may include surveying of the structure to look for changes in slope, toe or crest elevation, and underwater inspections where appropriate. Community-scale monitoring should be completed for community-scale shoreline protection projects, where possible.

In the event that it is required, structure maintenance should be completed in a timeline fashion by a qualified contractor. Appropriate maintenance measures should be determined by a coastal engineer. It is recommended that long-term monitoring and maintenance plans be a requirement of regulatory approvals for new shoreline protection structures.

4.5 MUNICIPAL ZONING RECOMMENDATIONS

The overall intent of the natural hazard policies provided through the Provincial Policy Statement, 2020 (PPS) under the Planning Act and the Conservation Authorities Act hazard regulation (specifically Ontario Regulation 42/06) is to direct development away from hazardous lands. Municipalities are responsible for preparing municipal policy documents and approval of applications submitted under the Planning Act, ensuring consistency with the natural hazard policies of the PPS. Additionally, municipalities are delegated the responsibility of identifying areas subject to natural hazards and to develop management plans (e.g., flood contingency plans) to limit exposure to public health and safety risks. This includes identifying flooding, erosion and dynamic beach hazards in municipal plans and incorporating policies to address new development consistent with the PPS. It is up to the municipality to determine how best to achieve this requirement, though updated municipal zoning that matches the delineation of the hazards is an essential step to ensuring the requirements of both the Planning Act and Conservation Authorities Act are met. It is therefore recommended that the revised shoreline hazards within each SDC, as delineated following provincial policy and shown on hazard maps included in Appendix A, be incorporated into the relevant Zoning By-Laws, both in terms of specific zoning regulations and associated mapping. Zoning By-Laws of relevance are listed as follows, with recommended amendments to each summarized in the sections that follow, grouped by SDC.

- Town of Ajax By-Law 95-2003 (SDC #1)
- Town of Whitby By-Law 1784 (SDC #1and #2)
- City of Oshawa By-Law 60-94 (SDC #3 and #4)
- Municipality of Clarington Zoning By-Law 84-63 (SDC #5, #6 and #7)

SDC#1 – Ontoro Boulevard (Ajax):

Zoning for Ontoro Blvd. is shown in Town of Ajax By-Law 95-2003, map 64. The majority of the developed properties along Ontoro Blvd. are shown as “CR” (Country Residential), with the creek floodplain and a narrow shoreline buffer both listed as “EP” (Environmental Protection). The landward extent of the shoreline “EP” buffer terminates lakeward of the governing shoreline hazard

(erosion). It is recommended that the "EP" zone be expanded to match the erosion hazard setback thereby including the entire width of hazardous lands. Refer to Figure 19 below.

Figure 19 – Shoreline hazards and municipal zoning affecting Ontoro Blvd. (SDC #1)

Lands to the west of Ontoro Blvd. are presently zoned as "EP" in By-Law 95-2003 (Town of Ajax). It is recommended that this zoning be maintained. By-Law 1784 (Town of Whitby) covers the area east of Ontoro Blvd. to Halls Road, where the shorelands are zoned as "G-4" (Greenbelt Zone, Exception 4). This zoning should also be maintained as it is restrictive and will not permit future shoreline developments within the natural hazards.

The property at 715 Halls Road and the entire barrier beach complex fronting Cranberry Marsh and Lynde Creek are zoned in By-Law 1784 as "A" (Agricultural). Although this zoning classification is restrictive, it does provide the opportunity for limited residential development. As such, it is recommended that areas within the delineated shoreline hazards (and including both barrier beaches to the east) be re-zoned as "G-4" (Greenbelt Zone, Exception 4). This would prohibit residential development within the hazards and be consistent with the shorelands zoning on the west side of Halls Road. Shoreline hazards and municipal zoning affecting the south end of Halls Road are shown in Figure 20 below.

Figure 20 – Shoreline hazards and municipal zoning affecting south end of Halls Road (SDC #1)

SDC#2 – Crystal Beach (Whitby):

All residential properties within SDC #2 are presently zoned as "A" (Agricultural) as per Whitby By-Law 1784. No shoreline buffer is provided in the current zoning. Undeveloped lands to the west of the community are zoned as "OS" (Open Space). It is recommended that a shoreline buffer be introduced extending to the landward most shoreline hazard and zoned as either "EP" (Environmental Protection) or as a continuation of "OS", which should be designed to prohibit development. This shoreline buffer should extend east to include the entire barrier beach complex. Shoreline hazards and existing municipal zoning affecting SDC #2 are illustrated in Figure 21.

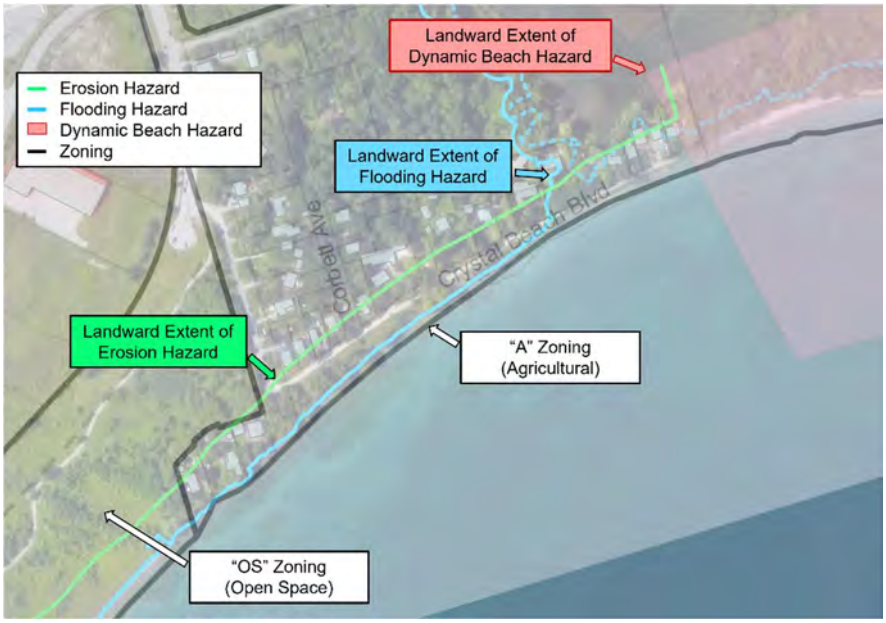


Figure 21 – Shoreline hazards and municipal zoning affecting Crystal Beach Blvd. (SDC #2)

SDC#3 – Stone Street (Oshawa):

The majority of the residential properties in the Stone Street community are zoned as "R2" (Residential-2), as per City of Oshawa By-Law 60-94. A narrow (~10 m wide) buffer along the shoreline is zoned as "OSW" (Waterfront Open Space), which is a development prohibitive zoning category. It is recommended that the "OSW" zone be widened such that the landward extent of the zone aligns with the erosion hazard setback, the governing shoreline hazard for this SDC. Shoreline hazards and municipal zoning affecting SDC #3 are illustrated in Figure 22 below.

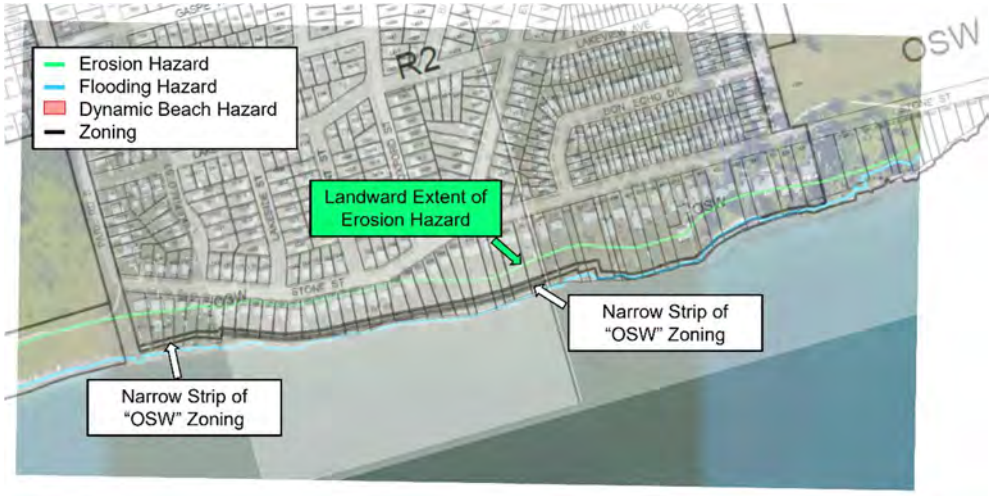


Figure 22 - Shoreline hazards and municipal zoning affecting Stone Street (SDC #3)

SDC#4 – Muskoka Avenue (Oshawa):

All properties affected by the shoreline hazards within SDC #4 are zones as "OSW" (Waterfront Open Space) as per City of Oshawa By-Law 60-94. This zoning category is generally residential development prohibitive. As such, the homes in this area are likely legacy developments predating the municipal zoning. There is presently no zoning buffer along the shoreline to account for shoreline hazards. It is recommended that a buffer be added to the official zoning covering the full extent of the hazardous lands (generally governed by the erosion hazard except at the west end of the SDC where it is governed by the flooding hazard). This buffer should be zoned "OSH" (Hazard Lands Open Space), as defined within By-Law 60-94. Shoreline hazards and municipal zoning affecting SDC #4 are provided in Figure 23 below.

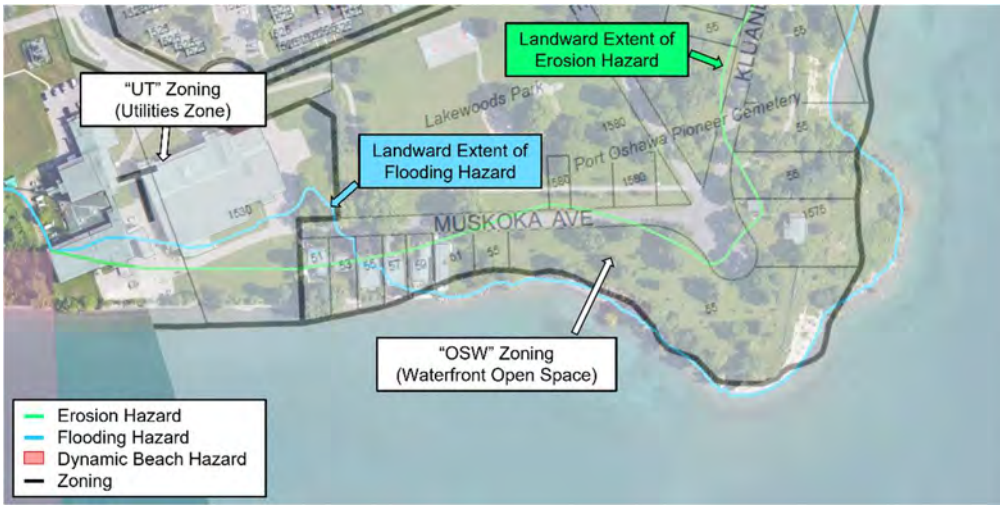


Figure 23 - Shoreline hazards and municipal zoning affecting Muskoka Ave. (SDC #4)

SDC#5 – Port Darlington (Clarington):

Properties affected by the shoreline hazards along Cedar Crest Beach Rd. and Cove Rd. are zoned as "RS" (Residential Shoreline). Properties on West Beach are zoned as "RS-1" (Residential Shoreline Exception), which is more restrictive, with only seasonal dwellings or single detached dwellings constructed prior to the passing of the By-Law permitted. All three zones are presently surrounded by "EP" (Environmental Protection), including a buffer of variable width along the Lake Ontario shoreline. It is recommended that the "EP" zone be expanded to include the entirety of the dynamic beach hazard for these three areas. This would place the Cedar Crest Beach Rd. and West Beach Rd. communities within the "EP" zone (as the entire barrier beach complex is a dynamic beach), and waterfront properties along Cove Rd. up to the landward extent of the hazard. Shoreline hazards and municipal zoning affecting SDC #5 are shown in Figure 24 below.

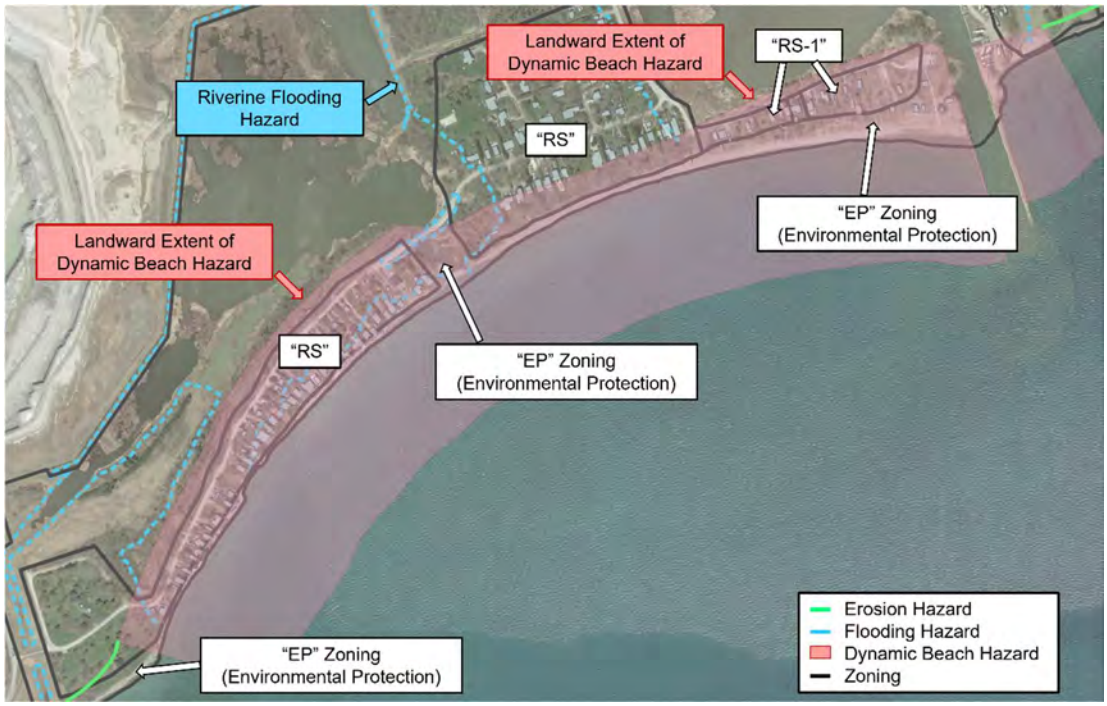


Figure 24 - Shoreline hazards and municipal zoning affecting Port Darlington (SDC #5)

SDC#6 – East Beach Road (Clarington):

The property at 70 Port Darlington Rd. and the north half of 120 Port Darlington Rd. are presently zoned as "C5-2" (Special Purpose Commercial Exception). The south half of 120 Port Darlington Rd. is zoned as "RS-3" (Residential Shoreline Exception). The entirety of Bowmanville Marsh to the west is zoned as "EP" (Environmental Protection). It is recommended that the "EP" zone boundary be amended to match the landward limit of the riverine flood hazard, identified by the blue dashed line in Figure 25 below.

Two blocks of properties on East Beach are zoned as "RS-2" (Residential Shoreline Exception). A shoreline buffer is zoned as "EP" (Environmental Protection) along the entirety of the Lake Ontario shoreline within this SDC, encapsulating the properties at the east end of the SDC at the southern end of South Service Rd. It is recommended that the "EP" zone be expanded to include all present "RS-2" zoning, at least up to the landward extent of the governing shoreline hazard (erosion). Shoreline hazards and municipal zoning affecting SDC #6 are illustrated in Figure 25 below.

Figure 25 - Shoreline hazards and municipal zoning affecting East Beach (SDC #6)

SDC#7 – Wilmot Creek (Clarington):

The entire Wilmot Creek development within the CLOCA's jurisdiction is zoned as either "R2" (Urban Residential Type 2) or "R4" (Urban Residential Type 4). An "EP" (Environmental Protection) buffer exists along the shoreline; however, it terminates significantly lakeward of the shoreline erosion hazard in many locations. It is recommended that the alignment of the "EP" buffer be amended such that it includes the entirety of the hazardous lands defined by the landward extent of the erosion hazard, as depicted in Figure 26 below.

Figure 26 - Shoreline hazards and municipal zoning affecting Wilmot Creek (SDC #7)

5.0 CONCLUSIONS AND NEXT STEPS

Following the issuance of the 2020 Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a), seven (7) coastal communities were identified withing the CLOCA watershed as having one or multiple residential buildings exposed to the shoreline hazards. These communities are referred to as Shoreline Damage Centres (SDCs), and include the communities of Ontoro Blvd. (Ajax), Crystal Beach (Whitby), Stone Street and Muskoka Ave. (Oshawa), Port Darlington, East Beach and Wilmot Creek (Clarington).

The objectives of the CLOCA Shoreline Hazards, Risk Assessment and Management Plan study were to (1) review, confirm and summarize the shoreline hazards affecting each SDC following provincial policy and technical guidelines, (2) evaluate the relative risk of each residential building within the SDCs to the shoreline hazards, and (3) identify, evaluate, and recommend risk mitigation strategies for each community.

Section 2.0 of this report provides an overview of the three regulated shoreline hazards in Ontario, including the flooding hazard, erosion hazard, and dynamic beach hazards. Existing regulatory riverine flooding and erosion hazards were also reviewed. A site-specific and high spatial resolution review of each shoreline hazard was completed for all 7 SDCs, and two minor revisions to the hazard mapping were identified. These included the erosion hazard within SDC #2 (Crystal Beach) and the flooding hazard within SDC #4 (Muskoka Ave.). Revised hazard maps for each SDC are provided in Appendix A.

A detailed, qualitative risk assessment was completed for all residential buildings and two commercial buildings within the SDCs affected by the shoreline and riverine hazards, as documented in Section 3.0 of this report. The risk assessment was performed using a custom risk evaluation matrix following the principles of the federal National Disaster Mitigation Program's (NDMP) Hazard Identification and Risk Assessment (HIRA) and Risk Assessment Information Template (RAIT). Following this methodology, likelihood/vulnerability multipliers were assigned to each building and for each shoreline hazard, based on a planning horizon of 100-years commensurate with provincial policy. These values were then multiplied by assigned scores across 5 impact/consequence categories. The risk evaluation was applied consistently to all affected buildings across all seven SDCs in order to determine the *relative* risk for each building affected by the shoreline hazards. The following ranges in relative combined (flooding and erosion) risk were determined from the risk assessment:

- SDC #1 – Ontoro Blvd.: *Low to Medium Risk*
- SDC #2 – Crystal Beach (West Section): *Medium to High Risk*
- SDC #2 – Crystal Beach (Central Section): *Low to Medium Risk*
- SDC #2 – Crystal Beach (East Section): *Very High Risk*
- SDC #3 – Stone Street: *Low to Medium Risk* (1 building rated as *High*)
- SDC #4 – Muskoka Ave.: *High to Very High Risk*
- SDC #5 – Port Darlington (Cedar Crest Beach): *Very High Risk*
- SDC #5 – Port Darlington (Cove Road): *Low to Medium Risk*
- SDC #5 – Port Darlington (West Beach): *Very High Risk*
- SDC #6 – East Beach (West Section): *Medium Risk*
- SDC #6 – East Beach (Central Section): *Medium to High Risk*
- SDC #6 – East Beach (East Section): *Medium to Very High Risk*
- SDC #7 – Wilmot Creek: *Low to Medium Risk*

Following the risk assessment, a risk mitigation strategy evaluation matrix was created to assist in developing shoreline management recommendations for each SDC. The evaluation of risk mitigation strategies is documented in Section 4.0 of this report. Risk mitigation strategies were developed under the four broad categories of *Avoid, Accommodate, Protect* and *Retreat/Re-align*. Strategies were first assigned multipliers for their ability to mitigate the risk both now and under future conditions (e.g. accounting for the projected impacts of climate change within a 100-year planning horizon). These values were then multiplied across 8 scoring categories and summed to determine the overall risk mitigation score for each strategy. Based on this evaluation, *Protect* and *Retreat/Re-Align* strategies were recommended, where appropriate, as "Primary Risk Mitigation Strategies" within each SDC. *Retreat/Re-Align* strategies were only recommended where one or more buildings were shown to have *high* to *very high relative risk*. *Accommodate* and *Avoid* strategies were recommended for all SDCs as "Additional Risk Mitigation Considerations" and provide ways in which risk to existing and future development can be reduced, respectively. A summary of recommended risk mitigation strategies is provided in Section 4.2 for each SDC.

For all those SDCs where "Protect" risk mitigation strategies were recommended, Section 4.3 provides an overview of preferred shoreline protection concepts for the range of shoreline types encountered within the SDCs. Concept-level cross sections and an opinion of the probable range in construction costs were provided based on 2021 unit costs. Monitoring and maintenance recommendations for new and existing shoreline protection structures is discussed in Section 4.4.

Finally, existing Municipal Zoning By-Laws were evaluated and compared to the shoreline hazards identified on the revised shoreline hazard maps for each SDC. Areas where the Municipal Zoning either contradicts or does not align with the natural hazards were identified. Recommended amendments to the municipal zoning were provided for each of these areas in accordance with the overall intent of Section 3.0 of the Provincial Policy Statement (2020), which is to direct development away from areas where there is an unacceptable risk to public health, public safety, or risk of property damage (i.e. hazardous lands).

5.1 NEXT STEPS

Following the acceptance and publication of this document, the report will be made publicly available for interested parties to:

- Engage residents and stakeholders within the communities or sub-communities of highest relative risk on the recommended risk mitigation strategies, including Avoid, Accommodate, Protect and Retreat/Re-align, to build consensus towards a community-scale solution.
- Seek site-specific engineering and construction cost estimates and verify lot by lot participation and interest in the preferred risk mitigation approach.
- Investigate potential funding streams to implement the recommended risk mitigation strategies beginning with the communities and buildings of highest relative risk. SJL Engineering Inc. is not presently aware of any such funding streams. Risk mitigation associated with shoreline hazards on private properties has historically been the responsibility of the private landowners in Ontario.
- Engage with municipal representatives to propose amendments to municipal zoning by-laws to ensure consistency between the municipal zoning, regulatory shoreline hazard mapping, and the overall intent of Section 3.0 of the PPS.

6.0 REFERENCES

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APPENDIX A

SHORELINE HAZARD MAPS

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #1
Ontoro Blvd.

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 (End Pt)
- Dynamic Beach (Start Pt)
- Road Network
- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

INTERPRETATION OF THE HAZARD MAPS:

This hazard map was prepared to support the CLOCA Shoreline Hazards Summary, Risk Assessment and Management Pan project. The hazard limits shown may not be reflective of the official regulatory limits of the Conservation Authority. Please contact CLOCA for additional details on the regulatory limit and implications for proposed 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 CLOCA Shoreline Hazards Summary, Risk Assessment and Management Plan Final Report 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.

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DATA SOURCES:

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

Inset Map: © OpenStreetMap contributors

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0 50 100 m

N W E S

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MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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CLOCA
SDC #1

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #2
Crystal Beach

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 (End Pt)
- Dynamic Beach (Start Pt)
- Road Network
- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

INTERPRETATION OF THE HAZARD MAPS:

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0 50 100 m

N W E S

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MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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CLOCA
SDC #2

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #3
Stone Street

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 (End Pt)
- Dynamic Beach (Start Pt)
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- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
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Inset Map: © OpenStreetMap contributors

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0 50 100 m

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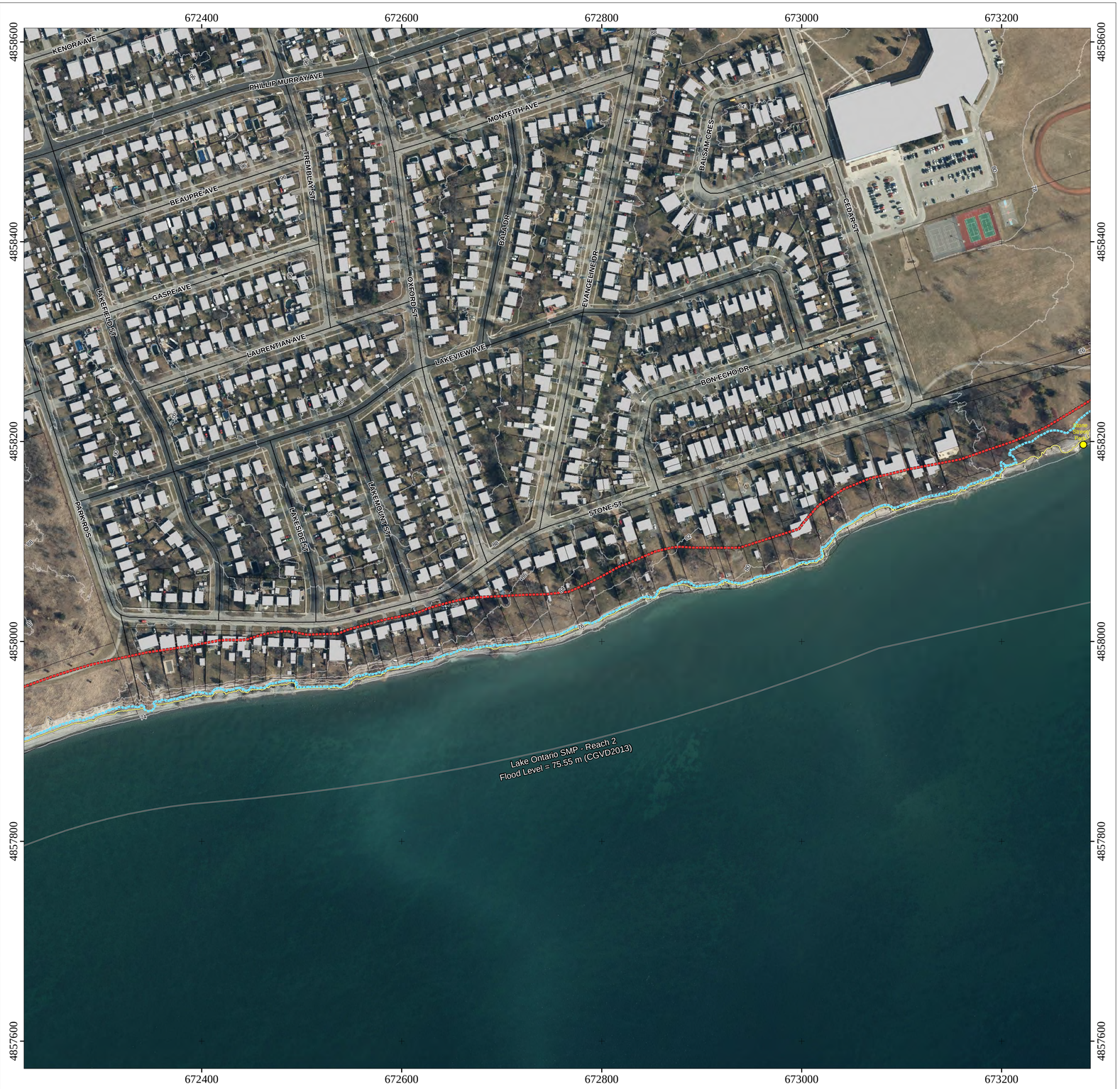

Mapping prepared by SJL Engineering Inc. for the Central Lake Ontario Conservation Authority.

MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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CLOCA
SDC #3

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #4
Muskoka Ave.

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 (End Pt)
- Dynamic Beach (Start Pt)
- Road Network
- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

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0 50 100 m

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Zuzek inc. ONE WORLD

PROFESSIONAL GEOSCIENTIST PETER J. ZUZEK PRACTISING MEMBER 1121 ONTARIO Dec. 20, 2021

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MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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Web: www.cloca.com/

CLOCA
SDC #4

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #5
Port Darlington

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 (End Pt)
- Dynamic Beach (Start Pt)
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- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

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0 50 100 m

N W E S

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PROFESSIONAL GEOSCIENTIST PETER J. ZUZEK PRACTISING MEMBER 1121 ONTARIO Dec. 20, 2021

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MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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Web: www.cloca.com/

CLOCA SDC #5

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #6
East Beach Road

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
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- Dynamic Beach (Start Pt)
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0 50 100 m

N W E S

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MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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Web: www.cloca.com/

CLOCA
SDC #6

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #7
Wilmot Creek

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:

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0 50 100 m

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MAP PUBLISHED DECEMBER 20, 2021

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CLOCA
SDC #7

APPENDIX B

RISK ASSESSMENT

SDC#1 - Ontoro Blvd.			IMPACT CATEGORY WEIGHTING =				1	1	1	1	1	1	1	1	1	1
			MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
1	1	Two Storey Dwelling	4	1	0	0	5	2	4	5	5					
1	2	Single Storey Dwelling	3	1	0	0	5	2	4	5	5					
1	3	Two Storey Dwelling	4	1	0	0	5	2	5	5	5					
1	4	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	5	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	6	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	7	No Building														
1	8	Two Storey Dwelling	1	1	0	0	5	2	5	5	5					
1	9	Two Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	10	Two Storey Dwelling	0	1	0	0	5	2	5	5	5					
1	11	Two Storey Dwelling	1	1	0	0	5	2	5	5	5					
1	12	Single Storey Dwelling	2	1	0	1	3	2	4	5	5	1	2	1	1	1
1	13	Two Storey Dwelling	2	1	2	1	4	2	5	5	5	2	2	2	1	1
1	14	Two Storey Dwelling	3	1	2	1	4	2	5	5	5	2	2	2	1	1
1	15	Single Storey Dwelling	0	0	0	1						1	1	1	1	1
1	16	Two Storey Dwelling	2	1	0	0	5	3	5	5	5					

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
25	10	20	25	25	0	0	0	0	0	105	0	Erosion	105
20	8	16	20	20	0	0	0	0	0	84	0	Erosion	84
25	10	25	25	25	0	0	0	0	0	110	0	Erosion	110
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
										0	0	n/a	0
10	4	10	10	10	0	0	0	0	0	44	0	Erosion	44
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
5	2	5	5	5	0	0	0	0	0	22	0	Erosion	22
10	4	10	10	10	0	0	0	0	0	44	0	Erosion	44
9	6	12	15	15	1	2	1	1	1	57	6	Erosion	63
12	6	15	15	15	6	6	6	3	3	63	24	Erosion	87
16	8	20	20	20	6	6	6	3	3	84	24	Erosion	108
0	0	0	0	0	1	1	1	1	1	0	5	Flood	5
15	9	15	15	15	0	0	0	0	0	69	0	Erosion	69
										0	0	n/a	0
										0	0	n/a	0
										0	0	n/a	0

*COLOUR INDICATES RELATIVE RISK SCORE (GREEN = LOW, RED = HIGH)

SDC#2 - Crystal Beach																
		IMPACT CATEGORY WEIGHTING =	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
2	1	Single Storey Dwelling	3	1	0	0	5	2	4	5	5					
2	2	Single Storey Dwelling	5	1	0	0	5	2	4	5	5					
2	3	Two Storey Dwelling	4	1	0	0	5	2	4	5	5					
2	4	Single Storey Dwelling	0	1	0	0	5	2	3	5	5					
2	5	Two Storey Dwelling	0	1	0	0	5	2	4	5	5					
2	6	Two Storey Dwelling	1	1	0	0	5	2	3	5	5					
2	7	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
2	8	Two Storey Dwelling	1	1	0	0	5	2	3	5	5					
2	9	Single Storey Dwelling	0	1	0	0	5	2	4	5	5					
2	10	Two Storey Dwelling	0	0	0	0										
2	11	Two Storey Dwelling	0	1	0	0	5	3	4	5	5					
2	12	Two Storey Dwelling	1	1	0	1	5	3	3	5	5	1	3	1	1	1
3	19	Two Storey Dwelling	0	0	0	1						1	3	1	1	1
2	13	Single Storey Dwelling	0	0	2	2						2	4	2	1	3
2	14	Single Storey Dwelling	1	3	4	2	3	4	4	5	5	4	4	4	5	5
2	15	Single Storey Dwelling	1	3	4	2	3	4	3	5	5	4	4	3	5	5
2	16	Single Storey Dwelling	1	3	4	2	3	4	3	5	5	4	4	3	5	5
2	17	Two Storey Dwelling	1	3	4	2	4	4	3	5	5	4	4	3	5	5
2	18	Single Storey Dwelling	1	3	5	2	3	4	3	5	5	5	4	3	5	5

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
20	8	16	20	20	0	0	0	0	0	84	0	Erosion	84
30	12	24	30	30	0	0	0	0	0	126	0	Erosion	126
25	10	20	25	25	0	0	0	0	0	105	0	Erosion	105
5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
5	3	4	5	5	0	0	0	0	0	22	0	Erosion	22
10	6	6	10	10	1	3	1	1	1	42	7	Erosion	49
0	0	0	0	0	1	3	1	1	1	0	7	Flood	7
0	0	0	0	0	8	16	8	4	12	0	48	Flood	48
12	16	16	20	20	24	24	24	30	30	84	132	Flood	216
12	16	12	20	20	24	24	18	30	30	80	126	Flood	206
12	16	12	20	20	24	24	18	30	30	80	126	Flood	206
16	16	12	20	20	24	24	18	30	30	84	126	Flood	210
12	16	12	20	20	35	28	21	35	35	80	154	Flood	234

*COLOUR INDICATES RELATIVE RISK SCORE (GREEN = LOW, RED = HIGH)

			IMPACT CATEGORY WEIGHTING =	1	1	1	1	1	1	1	1	1	1
SDC#3 - Stone Street			MULTIPLIERS					EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
3	1	Single Storey Dwelling	0	1	0	0	5	2	4	5	5					
3	2	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
3	3	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	4	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	5	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	6	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	7	Two Storey Dwelling	2	1	0	0	5	2	4	5	5					
3	8	Two Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	9	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	10	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	11	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	12	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	13	Single Storey Dwelling	5	1	0	0	5	2	5	5	5					
3	14	Two Storey Dwelling	4	1	0	0	5	2	3	5	5					
3	15	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	16	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	17	Two Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	18	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	19	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	20	Single Storey Dwelling	4	1	0	0	5	2	3	5	5					
3	21	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	22	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	23	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	24	Single Storey Dwelling	0	1	0	0	5	2	3	5	5					
3	25	Single Storey Dwelling	0	0	0	0										
3	26	Single Storey Dwelling	0	0	0	0										
3	27	Two Storey Dwelling	0	0	0	0										
3	28	Single Storey Dwelling	0	0	0	0										
3	29	Single Storey Dwelling	0	0	0	0										
3	30	Single Storey Dwelling	0	0	0	0										
3	31	Two Storey Dwelling	0	0	0	0										
3	32	Two Storey Dwelling	0	0	0	0										
3	33	Two Storey Dwelling	0	0	0	0										
3	34	Three Storey Dwelling	0	0	0	0										
3	35	Two Storey Dwelling	0	0	0	0										
3	36	Two Storey Dwelling	0	0	0	0			3	5	5					
3	37	Two Storey Dwelling	0	0	0	0			4	5	5					
3	38	Three Storey Dwelling	0	0	0	0			4	5	5					
3	39	Two Storey Dwelling	0	0	0	0			4	5	5					
3	40	Two Storey Dwelling	0	0	0	0			4	5	5					
3	41	Two Storey Dwelling	0	0	0	0			3	5	5					
3	42	Single Storey Dwelling	0	0	0	0			3	5	5					
3	43	Single Storey Dwelling	0	0	0	0			3	5	5					
3	44	Two Storey Dwelling	1	1	0	0	5	2	4	5	5					
3	45	Single Storey Dwelling	0	0	0	0										
3	46	Single Storey Dwelling	0	0	0	0										
3	47	Single Storey Dwelling	0	1	0	0	5	2	4	5	5					
3	48	Single Storey Dwelling	0	1	0	0	5	2	3	5	5					
3	49	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
3	50	Single Storey Dwelling	2	1	0	0	5	2	4	5	5					
3	51	Two Storey Dwelling	2	1	0	0	5	2	4	5	5					
3	52	Single Storey Dwelling	0	0	0	0										
3	53	No Building	0	0	0	0										

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
30	12	30	30	30	0	0	0	0	0	132	0	Erosion	132
25	10	15	25	25	0	0	0	0	0	100	0	Erosion	100
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
25	10	15	25	25	0	0	0	0	0	100	0	Erosion	100
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
										0	0	n/a	0

*COLOUR INDICATES RELATIVE RISK SCORE (GREEN = LOW, RED = HIGH)

SDC#4 - Muskoka Ave.			MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
		IMPACT CATEGORY WEIGHTING =	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
4	1	Two Storey Dwelling	1	1	4	1	5	2	3	5	5	4	2	3	3	3
4	2	Two Storey Dwelling	1	1	4	1	5	2	3	5	5	4	2	3	3	3
4	3	Single Storey Dwelling	4	1	4	1	4	2	3	5	5	4	2	3	3	3
4	4	Two Storey Dwelling	4	1	3	1	5	2	3	5	5	2	2	2	3	3
4	5	Two Storey Dwelling	4	1	0	1	5	2	3	5	5	1	1	2	1	1
4	6	Two Storey Dwelling	5	1	0	1	5	2	3	5	5	1	1	2	1	1
4	7	Two Storey Dwelling	5	1	0	0	5	2	4	5	5					

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
10	4	6	10	10	20	10	15	15	15	40	75	Flood	115
10	4	6	10	10	20	10	15	15	15	40	75	Flood	115
20	10	15	25	25	20	10	15	15	15	95	75	Erosion	170
25	10	15	25	25	8	8	8	12	12	100	48	Erosion	148
25	10	15	25	25	1	1	2	1	1	100	6	Erosion	106
30	12	18	30	30	1	1	2	1	1	120	6	Erosion	126
30	12	24	30	30	0	0	0	0	0	126	0	Erosion	126
										0	0	n/a	0
										0	0	n/a	0

*COLOUR INDICATES RELATIVE RISK SCORE (GREEN = LOW, RED = HIGH)

SDC#5 - Port Darlington

			IMPACT CATEGORY WEIGHTING =				1	1	1	1	1	1	1	1	1	1															
			MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES					EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
5	1	Single Storey Dwelling	2	3	5	1	3	4	4	5	5	5	4	4	5	5	15	20	20	25	25	30	24	24	30	30	105	138	Flood	243
5	2	No Building																									0	0	n/a	0
5	3	Two Storey Dwelling	3	3	5	1	4	4	4	5	5	5	4	4	5	5	24	24	24	30	30	30	24	24	30	30	132	138	Flood	270
5	4	Single Storey Dwelling	3	3	5	1	3	4	3	5	5	5	4	3	5	5	18	24	18	30	30	30	24	18	30	30	120	132	Flood	252
5	5	Single Storey Dwelling	2	3	5	1	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	6	Two Storey Dwelling	1	3	5	1	4	4	4	5	5	5	4	4	5	5	16	16	16	20	20	30	24	24	30	30	88	138	Flood	226
5	7	Two Storey Dwelling	2	3	5	1	4	4	4	5	5	5	4	4	5	5	20	20	20	25	25	30	24	24	30	30	110	138	Flood	248
5	8	Two Storey Dwelling	2	3	4	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	20	20	20	25	25	110	110	n/a	220
5	9	Three Storey Dwelling	2	3	4	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	20	20	20	25	25	110	110	n/a	220
5	10	No Building											4		5	5											0	0	n/a	0
5	11	Two Storey Dwelling	2	3	4	1	4	4	3	5	5	4	4	3	5	5	20	20	15	25	25	20	20	15	25	25	105	105	n/a	210
5	12	Two Storey Dwelling	2	3	5	1	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	30	24	18	30	30	105	132	Flood	237
5	13	No Building											4		5	5											0	0	n/a	0
5	14	Single Storey Dwelling	2	3	5	1	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	15	Two Storey Dwelling	2	3	5	1	4	4	4	5	5	5	4	4	5	5	20	20	20	25	25	30	24	24	30	30	110	138	Flood	248
5	16	Single Storey Dwelling	2	3	5	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	24	24	24	30	30	105	132	Flood	237
5	17	Single Storey Dwelling	2	3	5	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	24	24	24	30	30	105	132	Flood	237
5	18	Single Storey Dwelling	2	3	4	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	20	20	20	25	25	105	110	Flood	215
5	19	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	20	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	21	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	22	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	23	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	24	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	25	Single Storey Dwelling	2	3	4	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	20	20	20	25	25	105	110	Flood	215
5	26	Single Storey Dwelling	2	3	3	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	16	16	16	20	20	105	88	Erosion	193
5	27	Single Storey Dwelling	2	3	3	1	3	4	3	5	5	4	4	3	5	5	15	20	15	25	25	16	16	12	20	20	100	84	Erosion	184
5	28	Single Storey Dwelling	2	3	3	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	16	16	16	20	20	105	88	Erosion	193
5	29	Two Storey Dwelling	2	3	3	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	16	16	16	20	20	110	88	Erosion	198
5	30	Single Storey Dwelling	3	3	4	1	3	4	4	5	5	4	4	4	5	5	18	24	24	30	30	20	20	20	25	25	126	110	Erosion	236
5	31	Single Storey Dwelling	3	3	4	1	3	4	4	5	5	4	4	4	5	5	18	24	24	30	30	20	20	20	25	25	126	110	Erosion	236
5	32	Two Storey Dwelling	2	3	4	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	20	20	20	25	25	110	110	n/a	220
5	33	Single Storey Dwelling	3	3	4	1	3	4	3	5	5	4	4	3	5	5	18	24	18	30	30	20	20	15	25	25	120	105	Erosion	225
5	34	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	4	4	4	5	5	16	16	16	20	20	16	16	16	20	20	88	88	n/a	176
5	35	Single Storey Dwelling	2	3	4	1	3	4	3	5	5	4	4	3	5	5	15	20	15	25	25	20	20	15	25	25	100	105	Flood	205
5	36	Single Storey Dwelling	1	3	4	1	3	4	4	5	5	4	4	4	5	5	12	16	16	20	20	20	20	20	25	25	84	110	Flood	194
5	37	Single Storey Dwelling	3	3	4	1	3	4	3	5	5	4	4	3	5	5	18	24	18	30	30	20	20	15	25	25	120	105	Erosion	225
5	38	Two Storey Dwelling	0	3	2	1	4	4	4	5	5	2	4	4	5	5	12	12	12	15	15	6	12	12	15	15	66	60	Erosion	126
5	39	Two Storey Dwelling	2	3	3	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	16	16	16	20	20	110	88	Erosion	198
5	40	Two Storey Dwelling	2	3	3	1	4	4	4	5	5	3	4	4	5	5	20	20	20	25	25	12	16	16	20	20	110	84	Erosion	194
5	41	No Building																									0	0	n/a	0
5	42	No Building																									0	0	n/a	0
5	43	No Building																									0	0	n/a	0
5	44	Single Storey Dwelling	1	1	3	1	3	2	4	5	5	3	2	4	3	3	6	4	8	10	10	12	8	16	12	12	38	60	Flood	98
5	45	Two Storey Dwelling	0	0	3	1						3	2	2	3	3	0	0	0	0	0	12	8	8	12	12	0	52	Flood	52
5	46	Two Storey Dwelling	0	0	2	1						2	2	2	1	1	0	0	0	0	0	6	6	6	3	3	0	24	Flood	24
5	47	Two Storey Dwelling	0	0	1	1						1	2	2	1	1	0	0	0	0	0	2	4	4	2	2	0	14	Flood	14
5	48	Two Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
5	49	Two Storey Dwelling																									0	0	n/a	0
5	50	Two Storey Dwelling																									0	0	n/a	0
5	51	Two Storey Dwelling																									0	0	n/a	0
5	52	Two Storey Dwelling	0	1	0	0	5	2	5	5	5						5	2	5	5	5	0	0	0	0	0	22	0	Erosion	22
5	53	Single Storey Dwelling	1	1	0	0	5	2	5	5	5						10	4	10	10	10	0	0	0	0	0	44	0	Erosion	44
5	54	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	55	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	56	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	57	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	58	Two Storey Dwelling																									0	0	n/a	0
5	59	Two Storey Dwelling																									0	0	n/a	0
5	60	Two Storey Dwelling	1	1	1	1	3	4	4	5	5	1	3	4	3	3	6	8	8	10	10	2	6	8	6	6	42	28	Erosion	70
5	61	Single Storey Dwelling	1	2	1	2	3	4	4	5	5	2	4	4	3	3	9	12	12	15	15	6	12	12	9	9	63	48	Erosion	111
5	62	No Building																									0	0	n/a	0
5	63	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	64	Two Storey Dwelling	2	3	4	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	35	28	21	35	35	105	154	Flood	259
5	65	Single Storey Dwelling	2	3	4	3	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	35	28	21	35	35	100	154	Flood	254
5	66	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	67	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	68	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	69	Two Storey Dwelling	2	3	3	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	30	24	18	30	30	105	132	Flood	237
5	70	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	71	Single Storey Dwelling	2	3	3	3	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	72	No Building																									0	0	n/a	0
5	73	Two Storey Dwelling	2	3	3	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	30	24	18	30	30	105	132	Flood	237
5	74	Two Storey Dwelling	2	3	4	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	35	28	21	35	35	105	154	Flood	259
5	75	Single Storey Dwelling	2	3	3	3	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	76	No Building																									0	0	n/a	0
5	77	No Building																									0	0	n/a	0
5	78	No Building																									0	0	n/a	0
5	79	Single Storey Dwelling	2	3	3	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	30	18	12	30	30	90	120	Flood	210
5	80	Single Storey Dwelling	2	3	4	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	35	21	14	35	35	90	140	Flood	230
5	81	Single Storey Dwelling	2	3	4	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	35	21	14	35	35	90	140	Flood	230
5	82	Single Storey Dwelling	2	3	3	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	30	18	12	30	30	90	120	Flood	210
5	83	Two Storey Dwelling	2	3	4	3	4	3	2	5	5	5	3	2	5	5	20	15	10	25	25	35	21	14	35	35	95	140	Flood	235
5	84	Single Storey Dwelling	2	3	4	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	35	21	14	35	35	90	140	Flood	230
																											0	0	n/a	0

SDC#6 - East Beach Rd			IMPACT CATEGORY WEIGHTING =	1	1	1	1	1	1	1	1	1	1
			MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
6	1	Three Storey Commercial	0	1	3	2	5	4	5	5	5	2	4	5	3	3
6	2	Three Storey Condominiums	0	1	3	2	5	4	5	5	5	2	4	5	3	3
6	3	Single Storey Dwelling	2	2	0	0	5	2	3	5	5					
6	4	Two Storey Dwelling	3	2	0	0	5	2	3	5	5					
6	5	Two Storey Dwelling	3	2	0	0	5	2	4	5	5					
6	6	Two Storey Dwelling	4	2	0	0	5	2	3	5	5					
6	7	Two Storey Dwelling	4	2	0	0	5	2	3	5	5					
6	8	Two Storey Dwelling	5	2	0	0	5	2	3	5	5					
6	9	Two Storey Dwelling	5	2	0	0	5	2	3	5	5					
6	10	Two Storey Dwelling	5	2	0	0	5	2	4	5	5					
6	11	No Building														
6	12	No Building														
6	13	Two Storey Dwelling	5	2	0	0	5	2	4	5	5					
6	14	Single Storey Dwelling	2	1	0	0	5	2	4	5	5					
6	15	Single Storey Dwelling	3	1	4	1	3	2	3	5	5	4	2	3	5	5
6	16	No Building														
6	17	Two Storey Dwelling	1	1	2	1	4	2	4	5	5	2	2	2	3	3
6	18	Two Storey Dwelling	2	1	2	1	4	2	4	5	5	3	2	2	3	3

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
5	4	5	5	5	10	20	25	15	15	24	85	Flood	109
5	4	5	5	5	10	20	25	15	15	24	85	Flood	109
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
25	10	15	25	25	0	0	0	0	0	100	0	Erosion	100
25	10	20	25	25	0	0	0	0	0	105	0	Erosion	105
30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
35	14	21	35	35	0	0	0	0	0	140	0	Erosion	140
35	14	21	35	35	0	0	0	0	0	140	0	Erosion	140
35	14	28	35	35	0	0	0	0	0	147	0	Erosion	147
										0	0	n/a	0
										0	0	n/a	0
35	14	28	35	35	0	0	0	0	0	147	0	Erosion	147
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
12	8	12	20	20	20	10	15	25	25	72	95	Flood	167
										0	0	n/a	0
8	4	8	10	10	6	6	6	9	9	40	36	Erosion	76
12	6	12	15	15	9	6	6	9	9	60	39	Erosion	99
										0	0	n/a	0

*COLOUR INDICATES RELATIVE RISK SCORE (GREEN = LOW, RED = HIGH)

SDC#7 - Wilmot Creek

			IMPACT CATEGORY WEIGHTING =				1	1	1	1	1	1	1	1	1	1																
			MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES					EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
SDC #	ID	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
7	1	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	2	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	3	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	4	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	5	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	6	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	7	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	8	Single Storey Dwelling	3	1	0	0	5	2	3	5	5						20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
7	9	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	10	Single Storey Dwelling	5	1	0	0	5	2	3	5	5						30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
7	11	Single Storey Dwelling	5	1	0	0	5	2	3	5	5						30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
7	12	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	13	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	14	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	15	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	16	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	17	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	18	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	19	Single Storey Dwelling	5	1	0	0	5	2	3	5	5						30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
7	20	Single Storey Dwelling	3	1	0	0	5	2	3	5	5						20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
7	21	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	22	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	23	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	24	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	25	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	26	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	27	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	28	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	29	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	30	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	31	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	32	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	33	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	34	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	35	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	36	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	37	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	38	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	39	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	40	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	41	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	42	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	43	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	44	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	45	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	46	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	47	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	48	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	49	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	50	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	51	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	52	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	53	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	54	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	55	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	56	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	57	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	58	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	59	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	60	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	61	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	62	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	63	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	64	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	65	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	66	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	67	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	68	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	69	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	70	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	71																										0	0	n/a	0
7	72																										0	0	n/a	0

*COLOUR INDICATES RELATIVE RISK SCORE (GREEN = LOW, RED = HIGH)

APPENDIX C

RISK MAPPING

Shoreline Damage Centre #1: Ontoro Blvd.

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

LICENSED PROFESSIONAL ENGINEER S. J. LOGAN 100105144 2022/05/09 PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #1: Ontoro Blvd.

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #1: Ontoro Blvd.

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #2: Crystal Beach

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #2: Crystal Beach

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #2: Crystal Beach

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

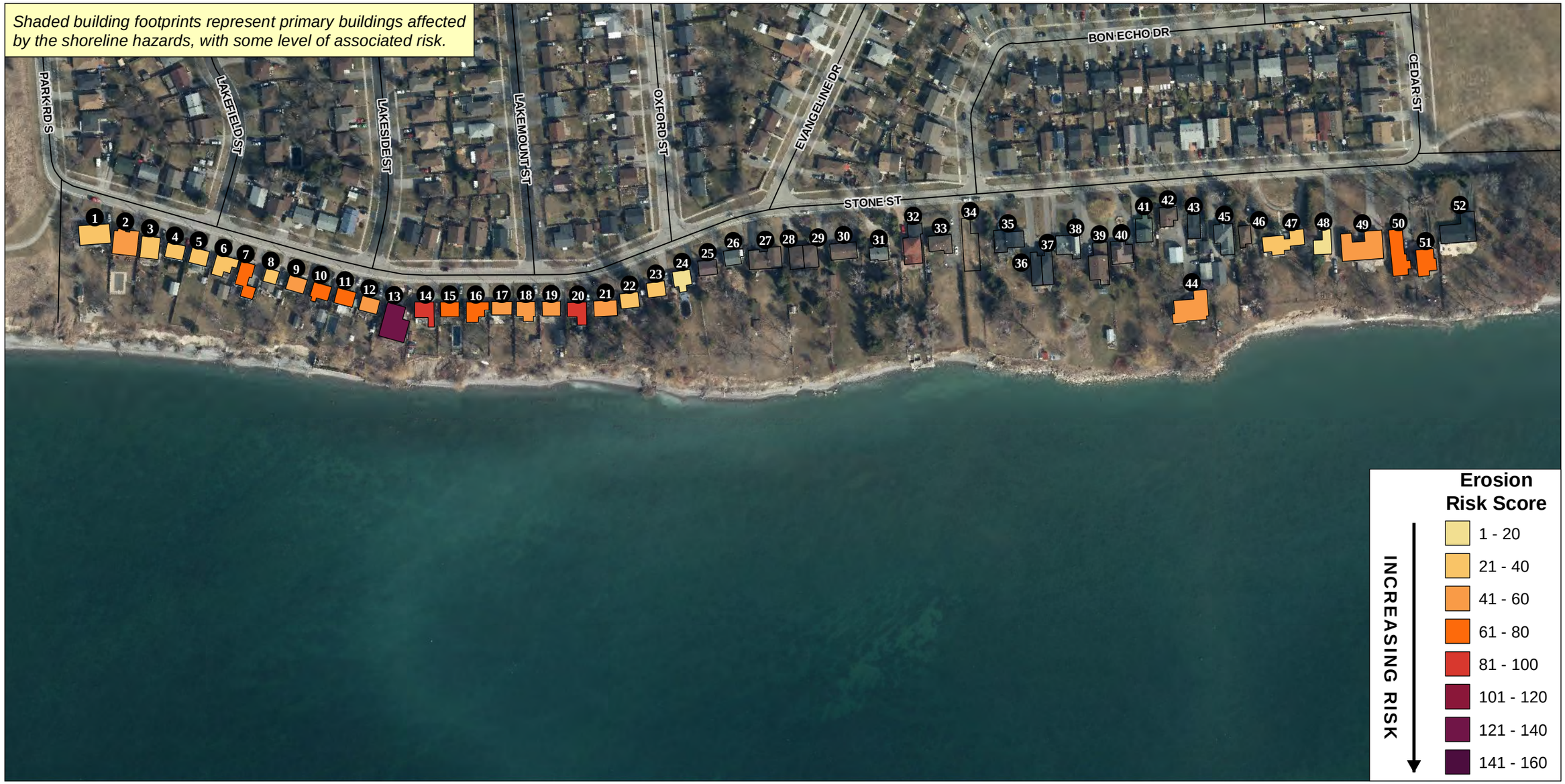
Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



Shoreline Damage Centre #3: Stone Street

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #3: Stone Street

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

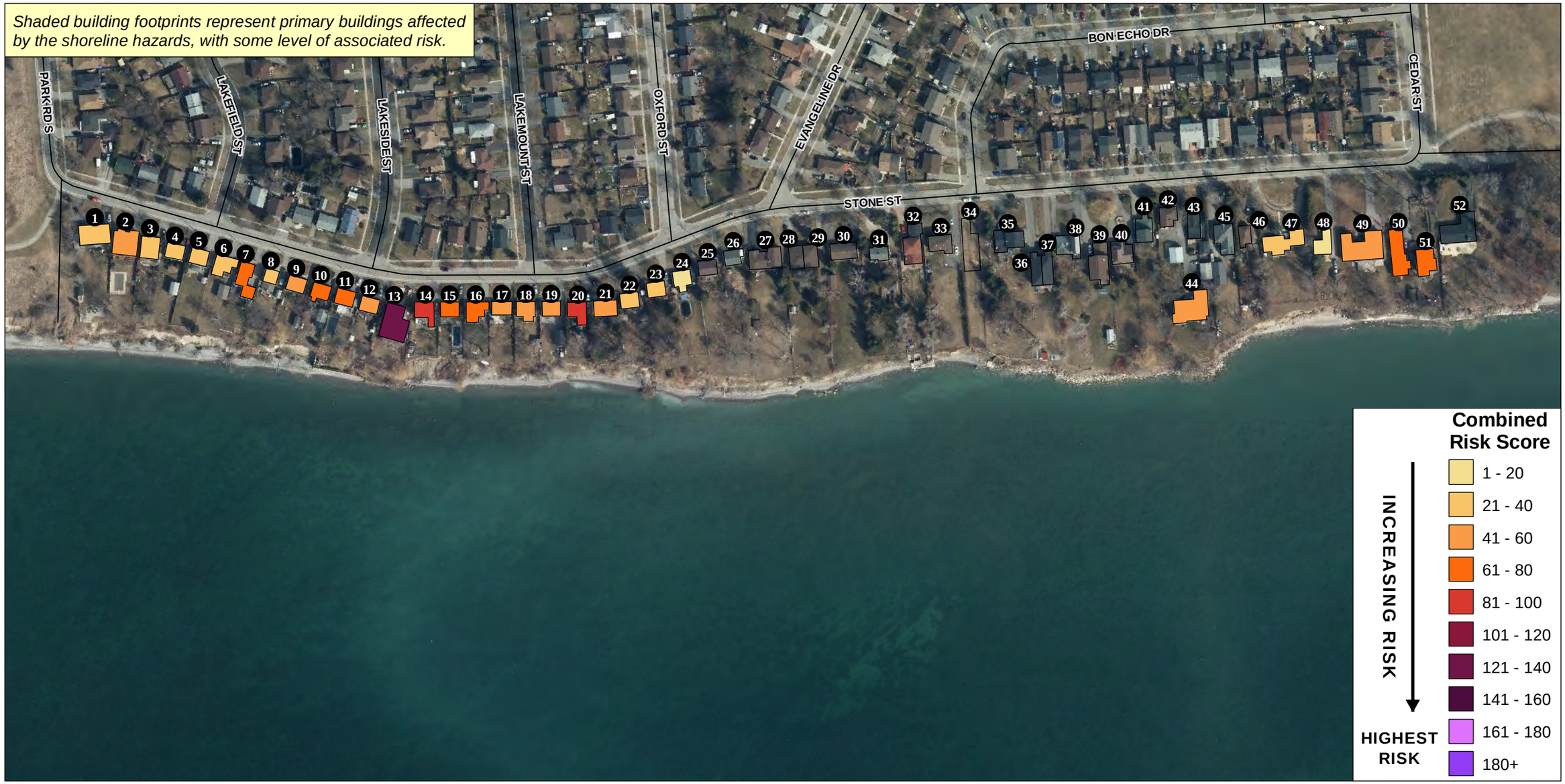
S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m



Shoreline Damage Centre #3: Stone Street

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 PROVINCE OF ONTARIO LICENSED PROFESSIONAL ENGINEER

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #4: Muskoka Avenue

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #4: Muskoka Avenue

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

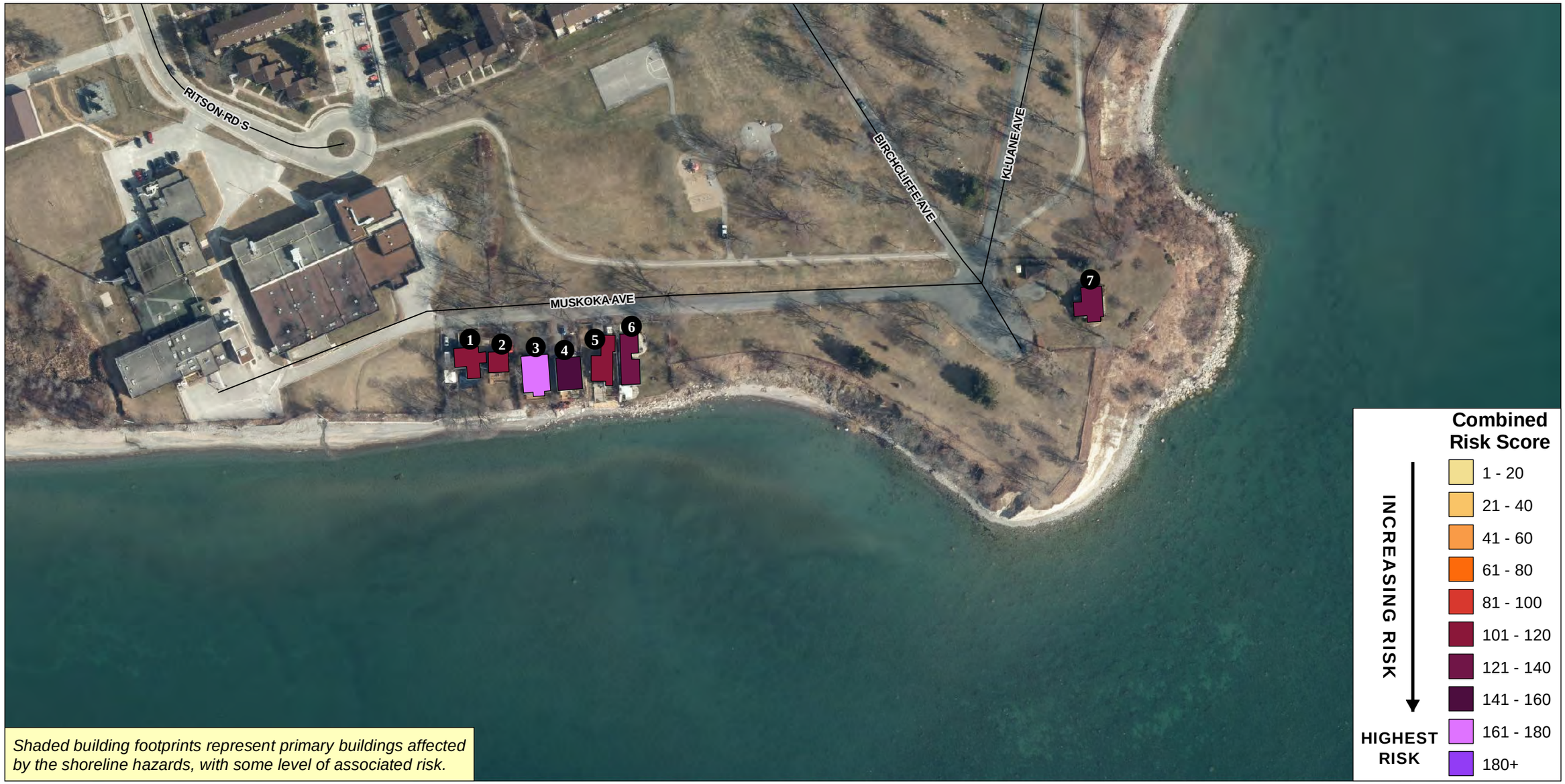
S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 m



Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #4: Muskoka Avenue

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #5: Port Darlington

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #5: Port Darlington

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #5: Port Darlington

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 PROVINCE OF ONTARIO LICENSED PROFESSIONAL ENGINEER

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shoreline Damage Centre #6: East Beach Road

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 PROVINCE OF ONTARIO LICENSED PROFESSIONAL ENGINEER

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shoreline Damage Centre #6: East Beach Road

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

LICENSED PROFESSIONAL ENGINEER
S. J. LOGAN
100105144
2022/05/09
PROVINCE OF ONTARIO

Zuzek inc.
ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N
W
E
S

0 50 100
m

Shoreline Damage Centre #6: East Beach Road

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 PROVINCE OF ONTARIO LICENSED PROFESSIONAL ENGINEER

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #7: Wilmot Creek

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR: Central Lake Ontario Conservation Authority

PREPARED BY: SJL Engineering; S. J. Logan, 100105144, Province of Ontario, 2022/05/09; Zuzek inc. — One World

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shoreline Damage Centre #7: Wilmot Creek

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR:

Central Lake Ontario Conservation Authority

PREPARED BY:

SJL ENGINEERING

S. J. LOGAN 100105144 2022/05/09 PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

Shoreline Damage Centre #7: Wilmot Creek

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

PREPARED FOR: Central Lake Ontario Conservation Authority

PREPARED BY: SJL Engineering; S. J. LOGAN 100105144 2022/05/09 Province of Ontario; Zuzek inc. One World

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

APPENDIX D

RISK MITIGATION STRATEGY EVALUATION

SDC #1 - Ontoro Blvd. (all at risk properties)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	0	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	1	0	2	1	1
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	2	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	2	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	1	2	0	0	0
			3	Beach nourishment	1	1	0	0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1	1	0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	12	6	
			2	Raising a building foundation	0	16	8	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	16	8	
			6	Emergency preparedness and planning	16	16	16	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	36	27	32	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	12	12	12	6
			3	Beach nourishment	13	0	7	5
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	10	10	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #2 - Crystal Beach A (2800, 2802, 2804 Thickson Road)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	2	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	36	0	18	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	12	0	6	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #2 - Crystal Beach B (2851 Thickson Road, 112 - 442 Crystal Beach Blvd., 111 McIntosh Road)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	1	1		0	3	2	2	2	2	2	2	0
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	2	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	15	0	8	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	40	0	20	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	13	0	7	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #2 - Crystal Beach C (448 - 462 Crystal Beach Blvd)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	1	3	1	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	1	0	2	1	1
			3	Raise road elevations	1	1	1	1	1	1	0	1	2	2	1	2
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	1	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	2	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0											
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	26	13	7
			2	Raising a building foundation	0	16	8	8
			3	Raise road elevations	20	20	20	4
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	9
			6	Emergency preparedness and planning	16	16	16	5
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	27	18	23	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	14	14	6
			3	Beach nourishment	14	0	7	9
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #3 - Stone Street (all at risk properties)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	Long-Term Maintenance Requirements / Lifecycle Costs	Constructability / Ease of Implementation	Integrates with Existing Shoreline Protection	Applicable to Community-Scale Implementation	Impact on physical processes	Ability to Integrate Ecosystem / Habitat Enhancements	Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	36	0	18	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	13	0	7	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #4 - Muskoka Ave

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	1	1		0	3	2	2	2	2	2	2	0
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	1	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	2	0	2	1	1
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	1	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	2	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0											
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	15	0	8	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	13	7	9
			2	Raising a building foundation	0	18	9	6
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	7
			6	Emergency preparedness and planning	16	16	16	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	27	18	23	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	14	14	5
			3	Beach nourishment	14	0	7	7
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #6 - East Beach Road A (70 & 120 Port Darlington Road)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	1	1	2	0	2	1	2
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	1		1	0	1	1	1	2	0	2	1	
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	1	1	1	1	1	0	2	2	2	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	0											
			3	Beach nourishment	0											
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0											
			2	Relocate buildings offsite (i.e. different or new property parcel)	0											
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	12	6	5
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	8	4	6
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	4
			6	Emergency preparedness and planning	16	16	16	3
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	20	20	20	2
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	0	0	0	
			3	Beach nourishment	0	0	0	
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	0	0	0	
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #6 - East Beach Road B (70 - 89 East Beach Rd., 188 - 220 Port Darlington Rd.)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	0	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		1	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	1	1		1	3	0	0	2	2	2	2	1
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1											
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	RANK
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	6
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	32	0	16	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	7
			3	Beach nourishment	26	0	13	4
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	24	0	12	5
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #6 - East Beach Road C (2728 - 2745 South Service Rd.)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	1	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	2	0	2	1	1
			3	Raise road elevations	1											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	1	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	2	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	1	1		1	3	0	0	2	2	2	2	1
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	13	7	10
			2	Raising a building foundation	0	18	9	7
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	8
			6	Emergency preparedness and planning	16	16	16	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	27	18	23	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	14	14	5
			3	Beach nourishment	14	0	7	8
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	24	0	12	6
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	11
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #7 - Wilmot Creek (all at risk properties)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	1	1		0	3	2	2	2	2	2	2	0
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	1	2	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	15	0	8	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	40	0	20	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	13	0	7	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

APPENDIX E

PUBLIC FEEDBACK ON DRAFT REPORT AND RESPONSES FROM THE PROJECT TEAM

A Draft Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan was circulated for public review on Monday, March 21, 2022. Comments were received until April 18, 2022. Several comment letters and emails were sent in and are included in Appendix E. The main concerns from residents have been summarized below, with responses provided adjacent to each comment from the CLOCA or the study team. Replies have not been provided for inquiries pertaining to individual properties and specific issues. These are best addressed by contacting CLOCA regulation staff.

No.	COMMENTS	RESPONSES
	BACKGROUND / HISTORY	
1	Residents within SDC#5 noted not all homes on Cedar Crest Beach and West Beach Road were impacted in 2017/2019, and that the two communities were not impacted to the same extent.	Section 1.1 of the report has been revised to provide more context and better differentiate between the impacts of 2017 and 2019 high water periods on Cedar Crest Beach Road and West Beach Road.
2	Some residents requested more discussion and analysis of Plan 2014 in the report. It was also noted that Plan 2014 is currently under review, and as such the Risk study is premature.	The Great Lakes Adaptive Magament Committee continues to provide public consultation and input with regard to water level regualtion plans for Lake Ontario. Although they will continue to review and adjust the plan to best manage flooding and the multiple concerns related to water levels, the water level regulation plan cannot prevent high water level events caused by extreme water supply scenarios due to the physical constraints of the Great Lakes - St. Lawrence System. More discussion has been added in the report.
3	Several comments noted impacts from St. Mary's Cement, Port Darlington Pier, and works within the Westside Creek Marsh are relevant to the study and were not discussed in the report.	The study is not intended to revisit the possible causes of flooding and erosion. It uses the existing and forecasted conditions to assess a level of risk. Please refer to reports by Dillon Consulting (2018) and Zuzek Inc. (2020b) for more information on these specific topics (referenced in Section 6.0 of the report).
4	Residents objected to the terminology used to describe the events in 2017/2019 (i.e. 'signficant' flooding).	Flooding during extreme water level years in 2017 and 2019 resulted in extensive efforts by property owners to protect property through sandbagging operations, municipal emergency services operations, and resulted in property damages. These were signifcant flooding events.
5	Residents objected to the use of the term "Shoreline Damage Center".	Natural hazards are defined by provincial policy and guidelines. The 1990 Lake Ontario Shoreline Management Plan (Sandwell, Swan and Wooster Ltd.) defined "Damage Centres" as areas of high risk due to flooding or erosion potential. They include shorelines subject to high erosion rates, low lying regions prone to flooding and areas where structures ae located in close proximity to the shorelines."
6	Why was a commercial property included in SDC#5, yet other shoreline properties were not included in the study, namely St. Mary's Cement, Darlington Nuclear, and East Beach Park?	Shoreline Damage Centres were communities identified through the Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a) as having one or more buildings affected by the shoreline hazards (i.e. within the provincially regulated hazardous lands). Only SDC #5 had commercial buildings (2) affected by the shoreline hazards. No permanent, occupied commercial or residential buildings at Darlington Nuclear Generating Facility, St. Mary's Cement or East Beach Park are located within the hazardous lands, as shown on CLOCA shoreline hazard maps #26, #27, #29, #30 and #33 issued as part of the Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a).
7	Residents questioned why St. Mary's was permitted to be constructed as well as two new homes built on Cedar Crest Beach Road since 2019.	It is our understanding that the St.Mary's pier was approved through both Federal and Provincial government-level approvals. CLOCA did not support the construction of the pier at the time. Our records indicate that only one new home has been lawfully built since 2019 on Cedar Crest Beach, which was a reconstruction assoicated with a home that was damaged beyond repair due to flooding. The replacement dwelling was required to be flood protected and was of an equal or smaller square footage in comparison to the destroyed dwelling.

	HAZARD LIMITS	
8	Several comments questioned the validity of using the "100 year event" in the risk assessment.	Natural hazards affecting Great Lakes shorelines including both flooding and erosion are defined by provincial policy and technical guidelines as being based on a 100-year planning horizon, and the occurrence of a 1 in 100-year event (i.e. an event with a probability of occurence of 1% in any given year). The risk associated with those hazards are therefore also based on a 100-year planning horizon. The report has been revised to add clarity on this topic.
9	Numberous comments objected to the risk assessment scores given the events in 2017/2019 did not result in catastrophic impacts according to residents.	The extreme water levels experienced in 2017 and 2019 did not reach the 100 year flood conditions for Lake Ontario upon which regulatory hazard mapping and the risk assessment are based. The 100 year flood hazard is the result of a combination of static lake level, storm surge, and wave uprush. Of these three processes, only static lake levels were "extreme" in 2017 and 2019 based on historical records. The largest surge event experienced in 2017 or 2019 in conjunction with the period of high lake levels was commensurate with a 1 - 2 year return period (i.e. typical annual or biennial event). Moreover, the risk assessment includes factors that account for higher extreme lake levels in the future due to climate change, as per the requirements of Section 3.1.3 of the Provincial Policy Statement (MMAH, 2020), which reads "Planning authorities shall prepare for the *impacts of a changing climate* that may increase the risk associated with the natural hazards". The best available research on the impacts of a changing climate on the Great Lakes has been leveraged for this study and suggests that a larger range in lake levels is likely in the future, including both higher highs and lower lows (Environment and Climate Change Canada, 2020).
10	A number of comments objected to the risk scores given that the presence of existing shoreline protection was not considered.	The study does not consider the presence of individual property shoreline protection in the determination of shoreline hazards and associated risk. As per provincial policy and following provincial technical guidelines, shoreline hazards and associated risk are to be based upon a natural, unprotected shoreline. The principal reason for this is that the level of design, quality of materials and construction, overall condition, and remaining design life of existing shoreline protection cannot be readily assessed at a property scale for regional hazard mapping and risk assessment studies, nor can the ongoing monitoring and maintenance of coastal infrastructure that is necessary to ensure its design life is realized be guarenteed for the 100-year planning horizon upon which the shoreline hazards and risk assessment are based. Section 1.2 of the report has been revised to include the above information. Where exposure to shoreline hazards exists with some level of associated risk, the implementation of properly designed and constructed shoreline protection or the rehabilitation and maintenance of existing shoreline protection can be an effective risk mitigation strategy, and has been recommended as such, where appropriate, in Section 4.0 of the report.

11	The 30 m wave uprush component of the flood hazard was found to be excessive and an overestimation of the hazard.	It is not clear what the commenter is referring to, as a "30 m wave uprush component" has not been applied to the flooding hazard for any of the seven evaluated SDCs. The wave uprush component is defined by the province as a standard 15 m, or another more accurate value as determined through site-specific wave uprush analyses. Such analyses have been completed as a component of the project for each SDC, with the resulting wave uprush elevations shown in Table 2 (Section 2.2) of the report. The uprush elevations were plotted to the corresponding topographic contour on the shoreline hazard maps as a component of the flooding hazard.
12	The erosion rate at West Beach Road & Port Darlington Jetty was questioned based on observations over the past number of years.	The stated erosion rate of 0.22 m/year for SDC #5 (Port Darlington) was only applied from the west end of the SDC to the east end of Cove Road, where this long term recession rate was established through a comparison of 1954 and 2018 shoreline positions. The shoreline fronting West Beach Road has been relatively stable over that period, and as such no erosion rate has been applied to West Beach. This has been clarified in the report through the addition of a footnote to Table 1 in Section 2.1.
	RISK ASSESSMENT	
13	Why do a Risk Assessment?	There are a number of steps in the process of addressing the impact of natural hazards on our properties and communities. Identifying floodplains and natural hazards through mapping projects is an important step that has been completed by CLOCA for our watersheds and shorelines. The next step in the framework is assessing the level of risk for properties within the natural hazard boundaries. The purpose of a risk assessment is to assign levels of relative risk based upon likelihood of an event and vulnerability of the properties to damage. A risk assessment is an important step to determine priority and possible strategies for future mitigation projects. Please refer to Figure 1 (below) for a schematic view of the Federal Flood Mapping Framework developed by Natural Resources Canada (NRC).
14	A number of comments objected to the use of "Extreme" to describe the areas of highest risk.	Risk rating terminology shown on risk maps has been revised from "extreme" to "highest". Terminology in the report has also been updated from "extreme risk" to "very high relative risk"
15	Residents disagreed with various risk assessment components being multiplied or summed as this artificially inflates the risk.	The risk assessment follows the principles of the federal National Disaster Mitigation Program's (NDMP) Hazard Identification and Risk Assessment (HIRA) and Risk Assessment Information Template (RAIT). The presence of multiple sources of risk (example: riverine and coastal flooding) for a single property greatly increases the likelihood of a damaging event, statistically speaking. The applied method is deemed appropriate.

16	The risk assessment methodology was criticized (Ecosystem impacts, Capital costs, Constructability, Applicability to community scale implementation, Ability to integrate ecosystems, Permitting and zoning, and Impacts to physical and coastal processes)	The risk assessment follows the principles of the federal National Disaster Mitigation Program's (NDMP) Hazard Identification and Risk Assessment (HIRA) and Risk Assessment Information Template (RAIT). The specific consequence categories reference in the comments were selected to describe the full risk profile and were established through a review of the federal and provincial guidelines and other risk assessments completed in Canada and the US. The overall methodology including categories and scoring structure to be used in the risk assessment were presented to project partners and the general public at the Public Information Centre held on December 8th, 2021. Feedback from the public was requested at that time, prior to the completion of the risk assessment.
17	Properties were not investigated to confirm main floor and possibly basement elevations such that consequences of various lake level conditions can be properly assessed.	Detailed investigations for each individual structure were not within the scope of the project.
	RISK MITIGATION	
18	Residents of SDC#5 questioned why recommendations for risk mitigation were not provided for SDC#5.	As communicated at the project onset and re-stated in the project report, SDC#5 has been extensively studied with respect to identification of existing hazards and proposed mitigation/management plans, therefore further recommendations have not been provided. Hazard risk mapping has been produced to provide consistency with the other damage centers.
19	The monitoring frequency requirements were found to be too frequent and unprecedented.	Regular monitoring and maintenance of coastal infrastructure is necessary if the design life of a structure is to be realized. Regular monitoring can be completed by private landowners and is not onerous. Less frequent monitoring every 5 - 10 years or after a major storm event by a coastal engineer or otherwised qualified individual is recommended to protect the original investment and to ensure that the structure continues to perform as expected throughout its design life. This is similar to requirements for other aspects of properties that are exposed to much less severe and more predictable impacts throughout their functional life (septic systems, wells, furnaces, foundations, etc.)
20	Residents of SDC#5 objected to the assignment of the avoid category.	Risk mitigation strategies were not evaluated for SDC #5, as per the study scope and as documented in Section 4.2 of the report.
21	A resident of SDC#5 believes if groynes or a breakwater to minimize wave uprush the 80 or so homes there would be 100% fine here for years to come, regardless of water levels.	These strategies and others were evaluated by Baird & Associates as part of the "Port Darlington Shore Protection Concepts" study (Baird, 2018). The two highest ranked mitigation strategies were estimated to cost between 10.4 and 16 Million (in 2018 CAD). Lower performance strategies were estimated to have capital costs upwards of 4 Million CAD, but with higher ongoing maintenance costs. The authors wrote in their summary remarks that "it is important to state that none of the concepts presented fully address the flood hazard from Lake Ontario. Neither do they address flooding from inland". For more information, please refer to Baird, 2018 (listed in Section 6.0 - References).

	FUNDING / PERMITTING	
22	Will any of the seven shorelines studied be eligible for funding under the NDMP.?	NDMP funding is for identification of hazards through mapping and risk assessment studies. It does not apply to large mitigation projects. By completing the risk assessment, priority areas will be identified in the event that funding for mitigation works becomes available in the future.
23	What is the time frame for implementing the Shoreline Management Plan, and how will it be applied?	The Risk Management Plan will be completed in 2022. By completing the risk assessment, priority areas will be identified in the event that funding for mitigation works becomes available in the future.
24	What is the time frame for this mitigation plan? How will it be applied? Will every property owner be required to be involved? (Failing total involvement would allow flooding and ersion to erode around any constructed barriers.)	See reply above. Community scale solutions are preferred over individual property projects, however, in the absence of funding programs, property owners must act independently.
25	As CLOCA/NDMNMF know what they will/will not approve for the remediation, why could you not put a basic plan forward, thereby cutting costs and multible enginering plans? Will we have to apply as individuals or as a group to move forward with any construction? Will there be a time frame for the needed work and constuction to receive any benefits from government sources should they become available?	See replies above. If funding programs are created, priority projects could be advanced and would include environmental assessment, design and implementation on a community scale. Otherwise, shoreline protection is the responsibility of the landowner and must be evaluated and designed on a site-specific basis and following the appropriate permitting process.

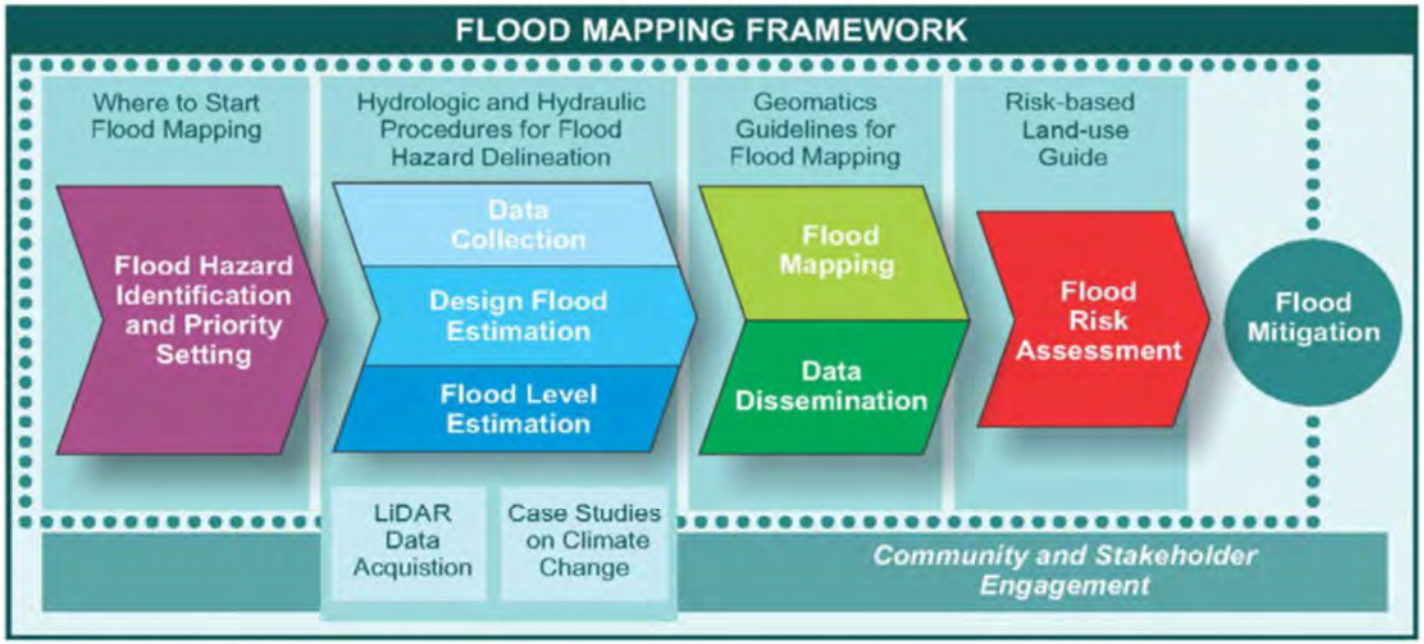


Figure 1: Flood Mapping Framework

Source: Federal Flood Mapping Framework; Natural Resources Canada 2018

From: [redacted]
To: Lucy Benham
Cc: [redacted]
Subject: Feedback to the Lake Ontario Shoreline Hazard Sumary, Risk Assessment and Management Plan
Date: March 24, 2022 5:13:53 PM

Dear Ms. Benham,

Thank you for the invitation to provide feedback regarding the draft Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan. I live at [redacted]., in the eastern section of the Port Darlington study area.

First, let me say that it is disappointing to find that various proposals for addressing shoreline restoration and protection in the Port Darlington area have been omitted from this report in favour of referring readers to previously released reports. I would have thought that it would be convenient and practical to consolidate all of that information in one document for ease of reference.

Second, the passages quoted below (my italics) highlight inaccurate or blatantly incorrect assessments of the West Beach Rd. section. Residents have consistently objected to or requested specific data supporting the assessments, to no avail.

p. 3 - "Homes on both Cedar Crest Beach Road and West Beach Road were subjected to *significant flooding and impacts from wave runup during the high water level periods in 2017 and 2019, and riverine flooding from the coastal Marshes.*"

p. 17 - "This landform [West Beach Rd.] is *highly flood prone from both the north (riverine) and south (coastal)* and is likely comprised of highly erodible unconsolidated sediments such silts, sands, and cobbles. *The existence of this landform is also predicated on the anchorage provided by the Port Darlington west jetty*, which is in a state of significant disrepair. Finally, *the elevation of West Beach Rd. is well below the 100-year flood level for this area* (100-year water level + wave uprush) and the *100-year riverine flood level for Bowmanville Creek* (Aquafor Beech Ltd., 2009), therefore posing *significant ingress/egress challenges during severe flooding events."*

Slide 73 - this table assigns high values of erosion risk to West Beach Rd properties.

Having experienced the 2017 and 2019 high water events directly, I would respond to the above quotations as follows.

1. NO homes or properties on West Beach Rd. were subjected to flooding and impacts from wave runup, or riverine flooding from the Bowmanville marsh, significant or otherwise, in either of the 2017 or 2019 high water events. At worst, there was some overtopping of beach areas from the lake, and partial overtopping of the road (2017

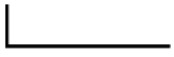
only) which was addressed by raising the road a few inches with extra gravel. All homes remained dry, and no septic systems were affected. The water table was higher than normal of course, but sump systems did their jobs.

2. The comment that the landform is "highly flood prone" appears to be based on the events of 2017 and 2019. At no other time in the history of this area has there been any significant incidence of flooding.
3. The claim that "The existence of this landform is also predicated on the anchorage provided by the Port Darlington west jetty" implies that this barrier beach did not exist before and would not exist without that jetty having been constructed. At best, this is pure supposition, and at worst, it leaves uninformed readers with the notion that the area is unnatural and not deserving of preservation.
4. The notion that West Beach Rd. is "well below the 100-year flood level for this area" is, at best, speculative, and at worst, misleading. In response to questions from residents at a public meeting held a few years ago at OPG's Darlington Training Centre, Perry Sissons and/or Chris Jones admitted that CLOCA's floodplain modelling had never been calibrated against historical data; that is, there was no history of flooding - riverine or coastal - in the West Beach area upon which to extrapolate or validate the models. Residents believe that it is irresponsible, and bad science, to speculate on what might happen under conditions that have never been seen in this area, especially when such speculations lead to excessively high erosion risk factors, and notwithstanding that past experience is no guarantee of future conditions. The notion of a "100-year flood level" is just that - notional.
5. The generalized statement of "significant ingress/egress challenges during severe flooding events" is unnecessarily alarmist and misleading, making it seem as though such challenges happen all the time, when, in fact, in the history of the area, it happened once, and it was easily managed.
6. To assign our properties a very high erosion risk, plus a very high flood risk, even though there is no documentation of significant erosion or flood at our properties, from the riverine or lake directions, and even though the lake level did not damage our properties during the record high lake levels of 2017 and 2019, is unconscionable.

If the drafters of this report are not prepared to amend their findings in order to accurately reflect what really happened here in 2017 and 2019, and if the drafters are not prepared to acknowledge that actual experience, both historical and present day, does not back up their modeling, then it at least behooves the drafters to qualify their opinions by citing the objections and observations of the residents who actually experienced the high water events of 2017 and 2019.

Thank you

Respectfully,



From: [redacted]
To: Lucy Benham
Subject: Stone St Erosion/ CLOCA Erosion Contral Report.
Date: March 28, 2022 4:11:46 PM

I would like to put forward the following observations after reviewing CLOCAs latest study. Although helpful it fails to provide many answers or solid directionl
My hope that the next phase will move forward with more haste

Natural Disaster Mitigation Program.
Will any of the seven shore lines studied be elidgable for funding under the NDMP.? If not please explain. I understand my property is my responsiblity.

Shoreline Management Plan
A plan is great news, but has little effect in assisting local property owners of its application, What is the time frame and how will it be applied.?
This ersion issue for us has been prior to 1980. We want answers so we can move forward.

Shoreline Study (SMP)
What is the time frame for this mitigation plan.? How will it be applied? Will every property owner be required to be involved for if one opts out surounding properties will fail.

Shoreline Flood and Risk Study
The effective plan would have to involve all propery owner and residences, Failing total involvement would allow flooding and ersion to erode around any constructed barriers..

Shoreline Protection Responibility of Landowner
Our Stone St. property is 165 ft. in depth not down to the beach or high water. There was a green belt and the beach which belongs to the City of Oshawa/ Prov.. Ontario/ & Crown Land these three levels of government failed to propect this area. Now that the erosion is at my property line it becomes our problem, at our expense and responsibility to comply with all permits and applications.

Public Shoreline Protection Project
We know that CLOCA/NDMNMF know what they will and will not approve for the remediation of the shore line. Why could you not put a basic plan forward. Thereby cutting costs and multible enginering plans. This is just adding to the expense.
Will we have to apply as individuals or as a group to move forward with any construction. I do not wish to find ourselves in the same situation as the property owners at Cedar and Stone St.
Will there be a time frame for the needed work and constuction to receive any benefits from government sources should they become available?

We look forward to CLOCA s answers.

[redacted]

Following are my comments on the recently released document "Lake Ontario Shoreline Hazard Summary, Risk Assessment And Management Plan, Draft Technical Report" (2022-02-10).

This document assigns an "Extreme" combined Erosion and Flood Risk score to my and my neighbours' properties on West Beach Road. (I live at [redacted].)

My comments focus on this question: How much sense does it make to assign an "Extreme" risk score to properties that have no documented history of even minor Flooding or Erosion?

Taking a careful look, the evidence used to assign the Risk scores in the CLOCA document is debatable at best and simply false at worst.

In particular, historical evidence from the record high-water years is cited incorrectly. On page 3 the document states:

> "Homes on both Cedar Crest Beach Road and West Beach Road were subjected to significant flooding and impacts from wave runup during the high water level periods in 2017 and 2019, and riverine flooding from the coastal Marshes."

In regards to West Beach Road, the above statement is simply false. In 2017 and 2019, both of which set new all-time records for Lake Ontario high water levels, there was no wave uprush impacting properties on West Beach Road, nor was there riverine flooding onto the properties.

The closest thing to flooding on our properties in those years was a few inches of water overtopping a section of West Beach Road. This water came across the road from the Bowmanville Marsh, which is open to the lake via the Bowmanville Creek channel, and therefore reliably adjusts to the level of Lake Ontario. At the peak of the high lake levels, this put some water onto the road, though it did not reach or damage any homes. The water was not deep enough to prevent vehicle access, let alone pedestrian access, so it did not pose a threat to life or limb. Furthermore, it was still water with no erosive force, as it was not a result of either wave uprush or riverine flooding. Therefore it caused no damage to the road. Finally, it is important to note that the road level has since been raised, so a repeat of the 2019 lake level would not cause even this minor degree of flooding on the road.

It is also relevant to note that there has been no shoreline recession here. We know this because of a survey of our property in 2020. As explained by the surveyor, the property line at the south end (lake side) of our property was a non-ambulatory line set to the typical high-water mark at the time the lots were first registered. That high-water mark as determined more than a hundred years ago closely matches the high water mark in 2017 and 2019. Therefore there has been no significant erosion of the shoreline. (By contrast, the CLOCA report on page 8 gives the average annual recession rate here as .22 meters/year. If that were true, then 22 meters of our property would have been lost to the lake over the past 100 years.)

It is important to keep these facts in mind when evaluating the Risk Scores. Although the Risk Scores rely on a multi-part formula and are presented with numerical precision, they rely on a series of judgment calls and interpretation.

In the case of both the Erosion and the Flood risk calculation, the "Multipliers" have a major impact on the calculated result. The Multiplier is the sum of the value assigned for "Erosion Likelihood/Vulnerability" and the value assigned for "Other Considerations".

Looking first at the Erosion risk, the assigned value for Likelihood is 2, meaning "Building likely affected within 50-year period". This is odd, given that the building is more than 100 years old, and the property has not been affected by erosion during this time. Given the known facts, it would be more defensible to assign an Erosion Likelihood score of 1 ("Building likely affected within 100-year period") if not 0 ("Building not affected within 100-year planning horizon").

For the "Other Considerations - Erosion" component of the multiplier, the report assigns a 3. This indicates "Risk may be higher due to erodibility of material and/or erosion forces from both lake and landside"). This is the highest possible value for this component. This is questionable given that in the history of the property, there has not been erosion from either the lake or landside.

Looking at Flood risk, the assigned value for Likelihood is 3, meaning "Flood depth 0.5 - 1.0 m during 100-year event and moderate flooding possible more frequently"). This is strange given that the flood depth on the road didn't come close to .5 meter even during a record high-water year (and no other instance of moderate flooding is known to have occurred, nor is there a record of the building being touched by flood at all). Given the known facts, it would be more defensible to assign a Flood Likelihood score of 2 ("Flood depth < .5 m during 100-year event and minor flooding possible more frequently"), or 1 ("Possible wet foundation during 100-year event only").

For the "Other Considerations - Flood" component of the Multiplier, the report assigns a 3. This indicates "Risk may be higher due to high exposure to riverine flood, resulting in a higher probability of occurrence for flooding events"). This is the highest possible value for this component. Again, this seems questionable given that in the history of the property, there has been no occurrence of significant riverine flooding.

For the effort to be fair and credible, it is essential that the Multiplier values be solidly defensible, given the outsize impact of even a slight variation in the Multipliers. For example, if the Erosion Likelihood were assigned a value of 1 instead of 2, and Erosion - Other Considerations were assigned a value of 2 instead of 3 (as suggested in both cases by known historical evidence) then the Total Erosion Risk Score for [redacted] would be 63 (instead of 105 as shown in the CLOCA report).

If the Flood Likelihood were assigned a value of 2 instead of 3, and Flood - Other Considerations were assigned a value of 2 instead of 3 (as suggested in both cases by known historical evidence) then the Total Flood Risk Score for [redacted] would be 88 (instead of 105 as shown in

the CLOCA report). The Combined Risk Score would then be 151, instead of 237 as shown in the CLOCA report – taking the Combined Risk Scores well out of the "Extreme Risk" category.

The above adjustments to more defensible values would apply equally for neighbouring properties on West Beach Rd.

Furthermore, the assigned values for Erosion and Flood Impacts/Consequences are equally questionable. To cite a couple of examples, for People & Societal Impacts, our properties are assigned values of 4 or 5 (respectively "Permanent displacement of occupants and injuries/health concerns are likely", and "Displacement of occupants and fatalities are likely"). For Transportation / Emergency Access, the assigned, and maximum, value of 5 corresponds to "Impacts extending beyond the storm event". If the assigned values were adjusted downward, so that they were not wildly out of line with historical evidence, the Erosion, Flood, and Combined Risk scores would be reduced further.

Finally, a few comments are in order about the alleged danger of riverine flooding. Although the report including the Risk maps and scores is focused on shoreline hazards, there are frequent mentions of riverine flooding as a major contributing factor to risk at West Beach Road. We also know from past CLOCA presentations that CLOCA considers riverine flooding, not lake flooding, to be the single biggest danger to the West Beach Road properties. It is unfortunate that this latest document does not clearly spell out the extent to which CLOCA's riverine flood model contributes to the "Extreme Risk" score. However, the riverine flood model cited (updated in 2009 by Aquafor Beech Ltd. and discussed by CLOCA in the Port Darlington Community Shoreline Management Plan in Nov. 2018), is dramatically at odds with observed reality. The model predicts a significant degree of overtopping of West Beach Road due to riverine flooding in 25 year, 50 year, and 100 year storm events. In reality, and as noted earlier, there was no overtopping of the road in historical memory prior to the 2017 and 2019 high lake level seasons, and even then there was no occurrence of *riverine* flooding. Since the flood model can't make sense of storms that happen about once in a generation or once in a lifetime, there is no reason to trust that the flawed model will accurately predict the impact of a far more rare "Regional flood".

In conclusion, this draft report assigns "Extreme Risk" scores to properties on West Beach Road that have never been significantly impacted by flood or erosion. In reaching that conclusion, the report relies on statements that are in direct conflict with the known history of this area. In particular, in spite of a veneer of numerical precision for the calculated risk scores, the calculations are not defensible in either their component parts or in the stated outcome.

The Risk scores, as presented, might have a dramatic negative impact on the values of our properties and/or the willingness of potential new owners to buy them. Since these Risk scores are not defensible, and they are unjustly damaging to the interests of the community, it is urgent that the Risk score maps for this area be redone or withdrawn.

–[redacted]

by [redacted]

From: [redacted]
To: Lucy Benham
Subject: Port Darlington Community Association response to CLOCA Lake Ontario Shoreline Risk Study update
Date: March 29, 2022 4:04:53 PM

[CAUTION]: This message comes from an external organization. DO NOT click links or open attachments unless you recognize the sender. If in doubt contact support@cloca.com or rwilmot@cloca.com

Good afternoon Lucy Benham,

As President of the ***Port Darlington Community Association***, I am writing on behalf of our Board to express our concerns with the CLOCA *Lake Ontario Shoreline Risk Study -update.*

Having lived on *West Beach Road* for 30 years and with first hand knowledge of what occurred on *West Beach Road and Cedar Crest Beach Road* during the flooding of 2017 and 2019, I can attest to the vast flooding differences between these two areas. On *West Beach Road* our houses, wells and septic systems were **not** adversely affected by high water levels. In 2017, I was quoted in the ***Clarington This Week*** as being pleased with the response from the Town and then,Fire Chief Weir, for the response to *West Beach Road*; but I was careful to note that we were **not** experiencing any of the same situations which were occurring on *Cedar Crest Beach Road.* To lump these two areas together in the framework of high water and flooding issues is both disparaging and a flagrant misrepresentation of facts. It appears it is simply promoting fear and adversely affecting property values.

You have received feedback from West Beach residents, [redacted], detailing the specific inaccuracies and numerous issues with the *Lake Ontario Shoreline Risk Study.* The ***Port Darlington Community Association*** would like to go on the record wholeheartedly supporting both of their letters and the concerns articulated in them. The ***Port Darlington Community Association*** asks that this study be reviewed and amended to address our strong objections and correct misinformation.

Sincerely,

[redacted]
Port Darlington Community Association President
[redacted]

Sent from my iPad

From: [redacted]
To: Lucy Benham
Subject: CLOCA Shoreline Risk Study
Date: March 30, 2022 1:25:03 PM

[CAUTION]: This message comes from an external organization. DO NOT click links or open attachments unless you recognize the sender. If in doubt contact support@cloca.com or rwilmot@cloca.com

Lucy
I am a resident of Port Darlington. I am writing to comment on this study:

1. You state: Please review and provide your feedback and any comments by **Monday, April 18, 2022** via email to lbenham@cloca.com.

Please note that an online Public Information Centre (PIC) for this Shoreline Risk Study was held on Wednesday, December 8, **2022**. This event was recorded and is available on CLOCA's YouTube channel.

Note the line I have made **red**, which states a PIC was held on Dec 8, 2022 - unless we're in a time warp, I think you mean Dec 8, **2021.**
Inaccuracies such as this do not inspire confidence.

2. I object to the broad way in which you describe that flood damage in 2017 & 2019 to West Beach Rd (WBR) was the same as that experienced by Cedar Crest Beach Rd (CCBR). This is NOT the case. The eastern portion of WBR experienced some flooding, but no where near to the extent as CCBR. In addition, there are several homes on WBR, mine being one, that experienced NO FLOODING whatsoever. If you look at a map, you will see a large portion of WBR runs roughly north-south and is no where near the east-west shoreline of Lake Ontario. Painting this incorrect picture of flooding hazards on WBR could have an unwarranted and damaging effect on our property values. Along with typos like the one in my point #1. it also further undermines the credibility of your report.

Sincerely

[redacted]
Bowmanville

From: [redacted]
To: Lucy Benham
Cc: [redacted]
Subject: Comments on Draft Lake Ontario Shoreline Hazard Summary by SJL Engineering - Project No. 1080.01 dated February 10, 2022
Date: April 4, 2022 10:45:16 PM

Ms. Benham,

I appreciate the opportunity to provide comments on the above-mentioned draft report. I live at [redacted] in Port Darlington. We purchased our home in Spring 2018. Our property lies within the area identified in the draft report as SDC#5.

There are a few items in the draft report that merit comment.

1. Section 1 Introduction - I take issue with the statement that the legal purpose of conservation authorities is to regulate development. Conservation Authorities have many purposes of which many are to promote programs that support their objects which include, among others, "to control the flow of surface waters in order to prevent floods or pollution or to reduce the adverse effects thereof".

2. Section 1.1 SDC#5 - this report is acknowledging it offers nothing new in terms of recommendations as there had been previous studies completed for this area. Unfortunately, they are relying on previous studies are that are deficient and based on flood modelling that is not reliable.

3. Section 1.2 Public Engagement - One of the questions asked is why a property is still considered at risk despite the efforts of installing shoreline protection. The response admits the report did not take into consideration any of the shoreline protection efforts made and is based on a natural shoreline. I assure you, there is nothing natural about our shoreline being that it has been severely influenced by the construction of the St. Marys pier and the deliberate efforts by the IJC to keep lake levels at higher levels for shipping based on Plan 2014. As for the marsh behind us, that was severely interfered with and redesigned because St. Marys wanted to expand their open mining pit. In addition, the pie charts are focusing on the so-called high to extreme risks based on responses by residents to how they feel they are at risk in their area. SDC#5 area residents provided almost half of the responses and generally felt that in the short term there was no to medium risk for 65% of the responses and for the long term it was 63%. Why doesn't the draft report speak to that and be honest about the responses.

Section 2.1 Erosion Hazard - Table 1 indicates that our area will expect an average annual recession rate of .22 metres. I was here in 2019 and went through the high

lake levels and wave uprush. Considerable effort was made by many to pressure the IJC to review Plan 2014 and with great relief to our community the lake levels were lowered through the Moses-Saunders Dam and by Summer 2020 there was a cobble beach forming along Cedar Crest Beach. I can't quite interpret when that approximately 9 inches of annual erosion was to start, but it hasn't been happening lately. I have serious doubts the author of this draft report has been following the very recent history of this area.

Section 3.2 Rick Assessment Results - This is flawed because it isn't based on reliable data to come up with these "scores". Historically, there is no recorded event of severe flooding as is being portrayed by CLOCA and this draft report. You can't put a score on risk factors when the natural 100 year flood hasn't occurred. The flooding experienced in 2017 and 2019 was generated by the mismanagement of the IJC and the influences of the St. Marys development. This draft report claiming that conservation authorities are legally responsible for regulating development obviously ignored the fact that CLOCA had their hand in the development by St. Marys so much so to allow and profit from the expansion of mining activities and obliterate a very large natural area.

Section 4.2 Risk Management Recommendations - With the draft report not addressing any recommendations because of previous reports makes this report incomplete. They went so far as to settle on Cedar Crest Beach to be at extreme risk based on flawed analysis of the misleading information and then not make any recommendations. This draft report is merely promoting more fear mongering and misinformation without any real facts.

Our property has taken a number of steps to mitigate the effects of any flooding risks by installing sump pumps and landscaping to draw overland flow from the house. Our shoreline has piled concrete to protect against wave uprush. Most of the homes along Cedar Crest Beach have shoreline protection, including [redacted] This is the same protection promoted by the municipality and approved by CLOCA in years past.

Other community areas, both public and private, have spent funds on shoreline protection contributed to by governments. For example, Lakeview Park in Oshawa and the base of the bluffs east of Brimley Road in Scarborough that lies below private homes.

I'm terribly disappointed by this draft report because it only perpetuates faulty and self-serving information from CLOCA.

Respectfully submitted,

[redacted]

From: [redacted]
To: Lucy Benham
Cc: [redacted]
Subject: [redacted] response to Draft CLOCA Lake Ontario Shoreline Risk Assessment [redacted] Port Darlington
Date: April 10, 2022 12:14:08 PM
Attachments: image278891.png
image948024.png
image629491.png
image051506.png
image865206.png
image674792.png
image771886.png
image111715.png
image582658.png

Hello Ms. Benham,
We are the owners of [redacted]. At this time we have two observations with respect to the risk assessment:

1. Our property is identified incorrectly as [redacted]. It is [redacted].
2. We fail to understand how our property can have anything but a zero risk assessment for the flooding and erosion risks. Can someone please provide an explanation ?

Thank you for considering our concerns.
Regards,

[redacted]

From: [redacted]
To: Lucy Benham
Cc: [redacted] GAnderson@clarington.net; corinna.traill@gmail.com; rhooper@clarington.net
Subject: Feedback to the Lake Ontario Shoreline Hazard Sumary, Risk Assessment and Management Plan
Date: April 17, 2022 8:28:02 PM

Ms. Benham,

This is in response to the request for feedback regarding the draft Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan.

I'd like to start by pointing out that the model is poorly specified and I'm surprised that it was commissioned to be drafted much less released for feedback request without being internally reviewed.

There are inconsistencies which point to the areas of invalidity and by extension, the intention of this report. It is also misleading based on speculative frameworks.

First, this report starts by calling the subjected communities 'Shoreline Damage Centres' (SDCs) (Page i) which immediately triggers pejorative connotations and simply goes on to substantiate that anchor effect. This bias is the start of poor modeling. As a resident in SDC#5, my feedback will be particular to that area. However, I will reflect on the overall document in this feedback as well. I expect for all feedback, not just mine, to be seriously considered and all questions and concerns addressed with the various submittals.

Scope misrepresentation:

The SDC is supposedly defined by CLOCA as "where one or more *residential* building falls within the lands susceptible to natural hazards." (Page 1) but yet includes risks to '*commercial*' buildings in SDC#6 on Page 17.

In addition, even though the report on Page 6 states that "This project included shoreline hazard mapping for more than *135 km* of Lake Ontario shoreline and was *thus done at a regional scale*" but omits a large section of shoreline between SDC #4 and SDC # 5, which is inclusive of St. Mary's Cement (a commercial/industrial establishment) – a large occupier of the shoreline and a legacy contributor to changes in the littoral drift.

Does St. Mary's Cement have good shoreline protection to mitigate erosion, flood and dynamic beach? Was this reviewed? If not, why are they not included in this report as a holistic review? The rest of the space between SDC#4 and SDC#5 is also a candidate for some development. Why is that space not included in this study? There is no mention of the newly established park on East beach that has new shore line protection. How is that holding up? If it's good, would that not be a mitigation against risks associated with erosion, flood and dynamic beach?

Attribution Error: Correlation is not causation

Page 11 states "Although regulatory riverine floodplain mapping is developed under the assumption that Lake Ontario water levels will be at long term average elevation during a severe riverine flood event, *recent experiences with extreme Lake Ontario water levels* created conditions where communities on barrier beaches were prone to riverine flooding even during *moderate rain events*." –

Is the drafter considering 2017 and 2019 as moderate rain events? Explain what is meant by moderate rain events and provide evidence of when moderate rain events have occurred in the past 20 years since Port Darlington has not flooded.

Furthermore, the drafter states on page 5 "Extreme high water levels and associated flooding and erosion experienced on Lake Ontario in 2017 and 2019 *were the result of record breaking water supplies* to the Great Lakes Basin." **Explain how 'moderate rain events' can then cause record breaking water supplies and extreme high water levels. Especially, when at best, the events of 2017 and 2019 are considered anomalies based on the IJC video report found using this link (https://vimeo.com/677453079) found by searching for "Phase 1 Review of Plan 2014 - Informing Deviation Decisions under Extreme Conditions"**

Inadequate Problem Definition (1):

Page 5: The answer was provided as "Notwithstanding this fact, the water level regulation plan that is presently in effect at the Moses-Saunders Dam, known as Plan2014, is presently under review by the International Joint Commission. This study will not evaluate the performance of Plan2014 during periods of extreme water supply nor will recommendations concerning water level regulation be made."

Again, it must be made clear and accepted that at best, the events of 2017 and 2019 are considered anomalies based on the IJC video report found using this link (https://vimeo.com/677453079) found by searching for "Phase 1 Review of Plan 2014 - Informing Deviation Decisions under Extreme Conditions".

Although Plan 2014 is going through its expedited review and has come up with a new 'interactive tool' the mitigation for the 2017 and 2019 scenario was not modeled for. Why was the risk assessment not done for this? Hence Plan 2014 should be considered as a contributing factor.

This is supported by the International Joint Committee (IJC) performing an "Expedited Review of Plan 2014, Phase 1: Informing Plan 014 Deviation Decision Under Extreme Conditions" which is out for public comment expected by the end of April 18, 2022. Why would this 'expedited' review be done, if there was not a reason for its impacts? To establish causal relationship, did this report attempt to understand the implications of why there is an expedited review of Plan 2014 underway?

Inadequate Problem Definition (2) – Anchor effect used:

Page 3. The reference "Homes on both Cedar Crest Beach Road and West Beach Road were subjected to significant flooding and impacts from wave runup during the high water level periods in 2017 and 2019, and riverine flooding from the coastal Marshes."

This insinuates that all homes were subjected to same impact significant flooding. This is also then drawn in conclusions in Appendix B for SDC #5. This is erroneous and simply not true.

To repeatedly use impacts from flooding in 2017 and 2019 (anchor effect) and to attribute it to 'moderate rain event' without providing the impact of Plan2014 is a biased view. If the complete assessment is not provided and referenced, then this study that draws the impacts of flooding is incomplete.

Page 11: "In these conditions, the barrier beach communities including those in SDC #2 and SDC #5 are at greater risk to riverine flooding." **Again – is this a moderate rain event? Or an anomaly that was not modeled for by Plan2014?**

Blatant omissions/misleading statements:

Page 20 states "Risk mitigation strategies listed above under the four broad categories of avoid, accommodate, protect, and retreat/re-align were evaluated for **each SDC**. All residential buildings within SDC #1, 3, 4 and 7 were evaluated together (i.e., one set of recommendations for each SDC), while buildings within SDC #2 and SDC #6 were split into three sub-groups based on their geographic location and governing risk (as discussed in Section 4.2 below)." **Even though this section states that 'each SDC' was reviewed, it leaves out SDC#5. This is an inconsistent review.**

Page 22 states "Recommendations provided as a component of the 2020 Lake Ontario Shoreline Management Plan are also provided in the sections that follow, for reference" **This was not done for SDC #5 – Port Darlington which would have allowed for a focus on what should be done to Protect the community. This was a missed opportunity and hence should be revised into the report.**

P19 – Protect (low to high risk) should apply for SDC #5. Look at the genesis of how the lake water came closer to the homes (which was not done in this report). There is much evidence and historical data of the existence of a beach between the homes and the high water level until the St. Mary's pier was put in. The allowance of the latter (St.Mary's pier) requires that SDC#5 be a candidate for Protect Risk Mitigation.

Page 32 "Port Darlington (SDC #5) has been the subject of several technical studies in recent years to evaluate the shoreline hazards and associated risk, and to recommend risk mitigation strategies. As such, this SDC is treated differently than the others in this section, with *no new recommendations* provided." **However, by erroneously labelling parts of SDC #5 as extreme risk which require specific approaches of Retreat/Re-Align (high-extreme risk) is, in fact, a recommendation. This is misleading.**

Page 3 "Only the risk assessment component of this study has been completed for SDC #5, as a *qualitative risk assessment* had not previously been completed for the residential buildings in this area." **However, to then apply quantified measures and produce quantified risk levels in Appendix B for homes SDC #5 is a blatant attempt to mislead what was declared on Page 3.**

Page 1 "Evaluate a variety of risk mitigation strategies for each SDC under four broad categories; Avoid, Accommodate, Protect, and Retreat/Re-align. Recommend preferred and alternative risk mitigation strategies including high-level concepts and costs for *each SDC* to address the risk highlighted through steps 1 and 2." **This was not done for SDC #5. No preferred or alternative risk mitigation strategy – it was left out even after declaring it would be done for 'each SDC'. This is misleading and was a missed opportunity to provide specific scenarios for what could be done to Protect the shoreline for SDC # 5.**

Page 13 "A custom risk assessment template was developed for the project, loosely based on the federal National Disaster Mitigation Program's (NDMP) Hazard Identification and Risk Assessment (HIRA) and Risk Assessment Information Template (RAIT)." **These are significant conclusions (Appendix B for SDC #5) to be drawn from 'loosely' based templates. How did this draft report get past the internal review?**

Conflicts within the document:

Take for example, SDC # 3 on Page 29, "Shoreline hardening should be limited to the *high density developed* area."

Based on Page 2 in the report, SDC #5 – Port Darlington has the highest density but there is no mention of shoreline hardening solutions. As a summary of Section 1.1 starting on page 2, see below for identified densities:

SDC #	# homes

1- Ontoro Boulevard	13
2 – Crystal Beach	19
3 – Stone Street	53
4 – Muskoka Avenue	6
5 – Port Darlington	**82**
6 – East Beach Rd	3
7 - Wilmot Creek	70

Page 44 "…with less frequent monitoring (every 5 – 10 years or after a major storm event) carried out by a qualified coastal engineer…with less frequent monitoring (every 5 – 10 years or after a major storm event) carried out by a qualified coastal engineer…. " **Please show us where this has been applied within Canada (or at least in the Toronto area).**

Page 48 "It is recommended that the "EP" zone be expanded to include the entirety of the dynamic beach hazard for these three areas. This would place the Cedar Crest Beach Rd. and West Beach Rd. communities within the "EP" zone (as the entire barrier beach complex is a dynamic beach), and waterfront properties along Cove Rd. up to the landward extent of the hazard"

Based on the poorly specified model in this report focused on the anchor effect of 2 flooding events erroneously attributed to 'moderate rainfall' and numerous biases, these recommendations are expected to be set aside.

The revision needed is to either remove SDC #5 in its entirety from this report or include ALL contributing factors inclusive of St. Mary's and Plan 2014 impacts along with Protection requirements for the community.

Thank you

[redacted]

From: [redacted]
To: Lucy Benham
Subject: RE: DRAFT Shoreline Risk Study ready for review
Date: April 17, 2022 10:27:11 PM

Lucy Benham. Thank you for providing the draft report regarding the Shoreline Risk Study for review. Please find below my comments respectfully submitted with a hope it will be acknowledged, considered and responded to. I have been a shoreline resident of SDC #5 for over 20 years at my home at [redacted]. My comments are also made as a Professional Civil Engineer.

Please note the following comments:

1. This study's objectives were to establish an appropriate management plan for the selected shoreline areas based on various risks and their associated impacts and possible mitigation measures. However, this study as stated in **Table 4 page 15** " ***is based on the assumption that the shoreline hazard is realized*"**. The purpose of this study I understood by way of the RFQ was to define the risks and consequences and rank their outcomes to enable decisions be made regarding Mitigation strategies, not start out by assuming the risks are realized.
2. Risk levels have been based on predevelopment conditions **without taking into consideration any existing shoreline protection measures currently in place**. As a result, the assessment significantly elevates the apparent risks, consequences and suggested hazard mitigation strategies. The National Disaster Mitigation Program (NDMP) states that the assessment must *"ensure that prevention, mitigation and preparedness activities for the proposed area take into account existing infrastructure, technologies and community/regional capabilities."*
3. The Final Risk Score must include scores from evaluating the consequences of **all possible lake levels and not just during a high water event**. This would provide an **overall picture** to the Authorities about the **relative consequences under a variety of conditions** and not just under an extremely rare condition occurring less than once in 100 years. Without doing so **this report assumes flooding is inevitable** and moves forward to suggest what should be done.
4. The reality is that a risk assessment analysis should have been completed before the Zuzek report was adopted and not after as a means to validate the recommendations already made. Secondly, to have the **validation made by the same firm** involved with the initial report by Zuzek is **purely wrong**.

RISK ASSESSMENT OF HAZARDS

5. Average recession rates are applied equally along each Damage Center. Recession rates of .22m/year cannot and should not be applied to basically 98% of all of the properties along the west side of SDC #5 which currently have shoreline protection. The armored shoreline has not receded and is considered stable. Armoring was only needed and built after the construction of the St Mary Cement Pier which has been validated to have significantly starved the shoreline of SDC #5 of nourishment from the West. This pier far outweighs any negative effects possibly created by any shoreline protection along SDC #5. The shoreline protection has experienced periodic damage during extreme conditions but is not receding! Suggesting there has been recession artificially drives up the risk assessment and significantly elevates the apparent risks, consequences and suggested hazard mitigation strategies.
6. The likelihood (probability) score factor used to identify the risk of various lake level conditions are ranked between 1 to 5. This **incorrectly models their likelihood**. Risks associated with lake levels which would likely occur every year are in fact 100 times more

likely to happen than the highest lake level (100 year flood). **Hence, this study must properly attribute the variation in probability and rank events on a scale of 1 to 100 not 1 to 5**

7. Properties have **not been investigated** to confirm main floor and possibly basement elevations such that consequences of various lake level conditions can be properly assessed.
8. The mapping of a Flood Hazard is a combination of the shoreline associated with the probability of the 1 in 100 year event coupled with an additional distance to account for Wave Uprush associated with a 1 in 20 year wave height probability. Lake levels and Wave heights are **mutually independent events**, meaning they do not happen as a result of each other. Severe wind storms create high waves not simply because the lake level is high. The probability of both these events happening at the same time must be calculated by multiplying the two together such that .01 x .2 = .002 (**This coupling of events corresponds to a probability of occurring only once in 2000 years)**. **Clearly an over design !!!**
9. To add to this overdesign the report utilizes a conservative default to determine the Flood Hazard limit which incorporates a 30m allowance for wave uprush. This is a very conservative assumption and disregards the need for any detailed wave uprush calculations. Wave Uprush calculations completed on several properties along SDC #5 have been shown to be considerably less than 30 meters due to the nature of the shoreline, top of bank elevation, beach material or rock armoring. This assumption again introduces significant and **unjustified overdesign, significantly elevating the apparent risks**, consequences and suggested hazard mitigation strategies. **Clearly an over design !!!**
10. To even further add to this overdesign the report includes for a Dynamic beach Hazard which further extends the Hazard limits an additional **30 meters inland.** The dynamic beach hazard relates to the fact that the **beaches** grow and receded due to a variety of mechanisms including the fluctuating long- shore transport of beach material and fluctuations in lake level. This is **not the case along the west side of SDC #5 including my own property** at [redacted] since shoreline protection has been built, yet the Hazard limit mapping suggest otherwise. **Clearly an improper use of a hazard criteria resulting in an over design !!!**
11. Within SDC #5, Cedar Crest and West Beach road areas have been rightfully labeled barrier beaches. These barrier beaches have slowly formed as a result of longshore sediment transport from the west and entrapment caused by the Port Darlington harbour groins. These areas have been stable now for centuries and show **no signs of potentially being wiped** out even after the effects of hurricane Hazel and the historic highs on lake Ontario experienced in 2019. **In fact, the inland marshes created by the land spit and barrier beaches are slowly infilling as all marshes do**. The West Creek marsh was even dredged 15 years ago as compensation to St Mary's Cement to allow for their open pit expansion and to restore the deteriorating conditions of the marsh at the time. The Darlington creek marsh on the East Side of SDC #5 is also silting in due to the yearly cycle of dying vegetation and lack of flushing action from the Lake. I fact, CLOCA attempted years ago to obtain approval for damming parts of the marsh next to the creek to increase water levels in the marsh and to improve conditions.
12. The 100 year flood levels along SDC #5 were increased by Zuzek from 75.66m to 76.01meters following their study which assessed climate change. The flood Hazard level including the wave uprush allowance suggested by this report indicates an elevation of 77.74m and 77.64m along the West and East ends of SDC #5. This flood hazard level will never occur since the native ground do not rise indefinitely away from the water's edge to these levels. In fact, the average grade through out these two areas is around 76.2 m. **Once the extent of the wave uprush reaches the top of bank elevation, flood levels cannot keep increasing but rather remain constant until lake levels rise to meet the top of bank.**
13. Riverine flood modeling and hazard mapping from the West Side Creek Marsh has been shown to be inconsistent with actual conditions. (refer to my report June 10, 2020 to CLOCA and response received) Further to my analysis, the Marsh overflow has been shown and accepted to have been modeled with incorrect boundary conditions and that it has not function as designed since constructed. CLOCA and St Mary's Cement have since acknowledged the issue and CLOCA is currently completing a detailed technical analysis along with a review of possible remedial measures including those I suggested. With a properly designed overflow system there should never be a condition worse than what would be experienced from lake levels and wave uprush. **Riverine flood levels cannot add to Lake flood levels,** firstly because they are independent events and secondly because a proper

overflow balances levels between the lake and Marsh.

14. Riverine flood modeling from the Bowmanville / Soper Creek also suggests conditions which are inconsistent when compared to actual results. Modeling of the Regional Storm event is predicted to result in a water level of 78.06 m, overtopping West Beach Road by 1.94m which is currently at 76.12m. *(refer to Appendix 4 CLOCA Technical Report: Flood Mitigation for West Beach Road 2018)*. Considering that the historic maximum level of Lake Ontario is 75.92m recorded in 2019, this translates to the flood water levels dropping 2.14m down to historic high lake level as it overflows across the West Beach Road properties. A regional storm if occurring when Lake levels are at their average would translate to massive rapids with a drop in creek level of 3 meters. This simply would not happen. This same difference in actual verses modeled levels is also found using the 100 year storm. **Clearly the boundary conditions used in the model are not set correctly and result in significantly over estimated riverine flood levels in the marsh on the north side of West Beach Rd properties.**
15. Nominal damages experienced along the west side of Port Darlington SDC #5 in 2017 & 2019 were all a result of wave up rush and overtopping of the banks depending on the shoreline make up and condition, whether it be a beach, sloping large boulders or stepped boulders. **With proper design upgrades, flooding hazards can be significantly reduced without the need for significant risk mitigation strategies.**
16. In addition to the overtopping of the beach along the East end of SDC #5, the calming effects from breaking of waves off shore due to the very shallow areas does not appear to have been accounted for in the report. Conversely, high waves tend to break almost at the shore protection structures along the central portions of SDC #5 and near my home. Again not discussed in the report.
17. The quantitative risk assessment in this report produced very little differences between properties within the Port Darlington SDC #5 area excluding those on the hill despite significantly differences West to East in their ability to weather erosion and high water levels. I can only validate my statement having resided in the SDC #5 for over 20 years. The differences are in fact significant once you consider the critical wind driven wave attack angle, associated fetch and localized dynamics of longshore transport of material and sheltering effects of the Pier and Harbour entrance.
18. Adding the scores for "*likelihood of erosion"* and "*other considerations"* before multiplying them with the consequence ratings should again **not be done since they are firstly independent events** and **secondly the probability of any one of the *other considerations* actually occurring has not been established.** I suggest that all the other considerations be eliminated based on the following:
    a. The category of "*risk not expected to change within the 100 year planning horizon"* should be removed since this assumes no mitigation measures are undertaken and presumes a defined increase in environmental conditions.
    b. The category of a "*change in risk due to climate change"* should again be removed. The ability to "*mitigate future extremes (climate change)"* is not an evaluation criteria. Mitigating measures can be designed to accommodate whatever added level of safety for future conditions is contemplated. For example, protection structures can be built higher to accommodate increased lake levels driven by climate change.
    c. The category "*change in risk due to climate change"* must be modified since the severity of climate change for driving up lake levels is unknown and therefore probabilistically it has not been assigned a value. **Therefore the consequences of climate change associated with flood and erosion risks can neither be quantified or predicted.**
    d. The category of "*Risks may be higher due to erodibility of material and / or erosion forces from both the Lake and landside (ie dynamic barrier beaches)*." should be eliminated since Firstly, **there is clearly no erosion risks from the landside marshes** of the barrier beach. Secondly, the **risk probability of Riverine flooding, even if marginal, cannot be considered to occur simultaneously with the lake flood risk** and therefore cannot be added together as done in the matrix.
19. Multipliers therefore must be re-evaluated since **their scores bear no correlation with any clear probability nor are ranked in relative probability between each other**.

IMPACT ASSESSMENT

20. The Impacts (Consequences) associated with Risks must be considered for a variety of lake

levels (not just flood levels). All of the impacts / consequences must be re-evaluated based on the following reasoning:

a. The Total Risk Score **should include scores from evaluating the consequences of all possible lake levels** and not just a flood risk. This would provide an overall picture to the Authorities about the full range of conditions experienced by the shoreline over time and the corresponding range of consequences not just under an extremely rare event. By not doing so, this report assumes flooding is inevitable, so now what should be done. **The reality is that actual flooding is an extreme remote risk with acceptable low consequences**.

b. The various impacts are **far from being of equal importance** but are considered equal by way of the analysis matrix used in this report.

c. *Societal impacts* relates to the displacement of occupants but fails to recognize that high lake level conditions do not happen catastrophically but rather with warning. This is significant considering that in SDC #5 there is an emergency preparedness plan and volunteers constantly monitoring the situation and warning residence. My home at [redacted] in SDC #5 was assigned a score of 4 out of a maximum of 5 for both flood and erosion hazard to suggest I would be permanently displaced, experience injuries and likely with health concerns. This is far from the truth since even under the historic high levels 2017 and 2019 **only 3" below the established 100 year flood level**, I was actively helping the neighborhood curtail any damage and experienced no physical damage to my home. **Clearly a poorly selected score**.

d. *Ecosystem impacts* **have not been defined such as to justify their relevance** and review by others. It is understood that one priority of municipal, provincial and federal governments is to protect Canada's natural environment. Therefore, protecting shorelines, beaches and landforms should be considered with appropriate measures rather than suggest shore protection hurts the ecology. My home was assigned a score of 4 out of a possible 5 for both flood and erosion hazards suggesting there would be temporary local impacts adjacent to high quality habitats. Firstly, **If the impact is temporary why include it as a significant criterion**. Secondly, the referenced high-quality habitats must be the West Side Creek Marsh, yet I would argue that it is protected by the barrier beaches I live on.

e. *Economic losses* relating to buildings appear to have been assessed on a very crude scale. Suggesting that losses could range from zero to over 1 million dollars suggests floods like experienced in 2019 could result in catastrophic loss to a home needing over 1 million dollars to restore. The vast majority of homes in the SDC #5 area would not cost much more than $500,000 to rebuild in their entirely. The **anticipated flood levels may in fact never reach the main floor** of a residence and most often depending on if there is a basement only result in minor damage to finishes. My home has been scored 4 out of 5 for both flood and erosion hazards suggesting a loss of $500k to 1 million even though **I did not experience any building damage in 2017 or 2019**. **Clearly an over estimation of score with no justification**.

f. *Transportation / Emergency Access* is a credible criteria but one must consider that the elevation of a **granular road is much easier raised compared to attempting to raise or move homes**. The *" impact of extending beyond storm event*" is presumed to mean that following a high water event the roads are totally unpassable and destroyed. The reality is that in SDC #5 even the gravel roads survived with virtually no damage during the 2017, 2019 extreme high-water events. My home was assigned the worst score of 5 out of 5 for both the flood and erosion hazards suggesting access to my home was permanently destroyed following a major high water event. The reality is that there is a paved road in perfect condition leading to my home which never received any damage during the 2019 event. **Clearly an over estimation with no justification**.

g. Delivery of energy / utilities is a credible criteria but assumes that high water levels would disrupt power supply. **The reality is that there were no power outages for any resident in the SDC #5 area during the high water event in 2017**. Even if power were cut as is quite often the case several times each year, the consequences are not life threatening. My home received the worst score indicating the highest impact from a

power failure. **A Power outages score of 5 does not merit being considered equal to a Societal impact with a score of 5 suggesting displacement of occupants and likely fatalities.** Clearly this impact and rating scores need to be re-evaluated.

RISK MITIGATION EVALUATION CRITERIA

21. The risk mitigation **evaluation matrix is not provided** in the report but is necessary to justify the four strategies the study arrived at !!!!!!!! **The main component of the study is hidden from public scrutiny.**

22. All of the Evaluation impacts / consequences associated with each mitigation strategy must be re-evaluated based on the following reasoning:
    a. "*Capital costs*" have been assessed **without any appropriate knowledge of each home**s main floor level and basement elevation as it relates to the risk from specific lake levels. Damages to homes which occurred in SDC #5 in 2017 and 2019 were minimal and restricted to finishes in the worst case. A couple of septic system may have been prevented from functioning for a short period of time during the high water, but did not result in any long term damage.
    b. "*Constructability*" as an evaluation criteria is immaterial since it is taken into account by the cost factor and **not an independent issue**.
    c. "*Integrates with existing shoreline protection*" is not relevant. **Are we saying we cannot add rocks to existing rock shore protection ?**
    d. "*Applicability to community scale implementation*" again **is not a consequence.** Any mitigation measures can be done on a large scale. **The question is rather, should we be forced to select one type of mitigation strategy throughout** ?
    e. "*Ability to integrate ecosystems*" is again **not a consequence** since this predicates that there is a potential desire to convert residential properties back to natural features.
    f. "*Permitting and zoning*" cannot be considered an evaluation consequence. They are **regulations which can be changed and not a yard stick to measure options by**.
    g. "*Impacts to physical and coastal processes*" is not a variable consequence but rather always applies. Mitigation measures by design will enhance shoreline resilience and reduce the overall net impact to coastal processes. **The present condition of the shoreline in SDC #5 would have been much worse if shoreline protection had never been implemented.**
23. The use of a total risk mitigation score derived from "**adding"** the risk scores from flooding and erosion **should again not be done** since **flooding and erosion are also very much independent events and must be multiplied together as noted under previously in my comments to derive the correct probability.** In addition to a greatly reduced likely hood of both occurring simultaneously, combining the two events tends to cancel out any uniqueness each have and result in values with very little range or significance.
24. Assigning the **avoid category** to all properties without justification negates any benefit derived from a properly developed risk assessment. It basically suggests the first line of defense is not to allow any development irrespective to the true consequences.
25. Even though this report doesn't provide any recommendation nor risk mitigation strategies for the Port Darlington SDC #5, there is an inference by way of providing hazard risk evaluation scores what the writers recommendations would be. In order for the report to be conflict free, this report should have also been silent on the risk analysis which has already been provided in the reports by others.
26. Shoreline protection structures throughout Lake Ontario have successfully utilize a variety of materials including precast concrete, gabions, scrap concrete and rocks depending on their location and impact from waves. To generalize in the report that they are "*inadequate to resist the significant loads and erosive forces on Lake Ontario over the long term, and are generally poor for the aquatic and shorelands environment*", **is misleading and not validated**. For example, large concrete blocks are more stable than rocks from overturning and Concrete is not a toxin towards aquatic species or vegetation.
27. There is no discussion regarding the deteriorated condition of the Port Darlington Harbour groins contributing to the excessive wave heights and erosion in the SDC #5 area nor that they need to be restored. **Simply, put that it is a present condition the land owners must accept and deal with**. The Federal Authorities should rather be immediately notified about this concern not held silent.

28. The suggested mitigation measure for extremely low-elevation shorelines or where superior flood protection is necessary such as the east end of SDC #2 (Crystal Beach) or SDC #5 (Port Darlington) is proposed as a composite revetment-seawall. This option is employed typically on most coastal situations but make little sense along a beach scenario such as SDC #5.

SHORELINE PROTECTION CONCEPT DETAILS

29. Figure 16 – 18 represent conditions where the revetments are built higher than the native grades inland. When these designs were built along SDC #5 Port Darlington they have resulted in significant flooding partially due to the splash zone from incoming waves overtopping the shoreline and secondly by the inability of the overtopped water to return to the lake efficiently and continually build up. I have witnessed this extensively where the splash will rise easily over 20 feet high and land well onto properties beyond.
30. Figure 16 – 18. There would be significant overtopping and seepage through the top armoring during a sustained storm when waves that break almost on the shore build up significantly when compressed and **add to the reflected waves**. Designs that create reflected waves rather than dissipate wave energies like a natural beach does, actually create even more problems.
31. Wave uprush should be shown on these sketches to illustrate how it is managed by the shore line design.
32. The report's suggestion that a long-term monitoring and maintenance plans must be a requirement of regulatory approvals for new and existing shoreline protection structures.
    a. This type of measure may be appropriate for public lands but not for private property. It effectively imposes a tax on the property to pay for inspections and forces landowners to comply with one inspecting engineer's recommendations. There are no mandates for regular inspection of people's homes by an engineer to ensure compliance with current building codes, So to enforce this on private property is unwarranted.

MITIGATION STRATEGIES

33. This study further dilutes any differences between risks by assigning the AVOID mitigating strategy to be applicable to all properties. Clearly there is an underlying premise that development should never had happened in SDC #5.
34. Based om the statement. "*are not sufficient to mitigate the risk or cannot be reasonably implemented due to constructability, **permitting constraints**, negative environmental impacts or most commonly costs*". **Why would permitting constraints ever be justified as an excuse not to carry out mitigation?** Again risks and mitigation strategies must consider the **risk tolerance of the property owner** and not based solely on the public's perception.
35. Effectively only two categories remain. Low with no risk mitigation strategies needed or extreme requiring significant restrictions and mandate for property disposition.
36. The mitigation strategies must be validated based on a properly developed risk assessment and a detailed analysis of actual conditions and historical evidence concerning impacts and consequences.

Sincerely;

[redacted]

Bowmanville

From: Lucy Benham, Senior Water Resources Engineer, Central Lake Ontario Conservation Authority

From: [redacted]
To: Lucy Benham
Cc: [redacted]
Subject: Response to the Draft Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan
Date: April 18, 2022 4:17:23 PM

Attention Lucy Benham
Senior Water Resources Engineer
CLOCA

Please see the following feedback as requested to the above draft report.

I am writing in response to the request for feedback regarding the **DRAFT** Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan. I am a resident of [redacted] Road apparently living in a Shoreline Damage Centre for the past 25 years. Both my husband and I have enjoyed our waterfront home and at absolutely no time did either of us feel threatened by wave uprush or riverine flooding including the years 2017 and 2019. We have raised our daughters here and would never have placed their lives in jeopardy. We have taken steps over the last decade to mitigate the impact of wave uprush during high winds by building a wall. We have repaired at our expense this wall several times and it is now part of our regular yearly home maintenance. The care of our shoreline is a given. We take steps to protect our property and did not see this discussed in your report. It has been written in a way to admonish our decisions and dismiss our valuable knowledge of lived shoreline experience.

In speaking of omissions, I note that there is no discussion of lake levels and Plan 2014 which is currently under review and very much a culprit in the 2017 flooding event on our road. Also, there is no discussion of the ongoing nature of our 'starved beach'. As the previously commissioned Baird report stated the concerns about erosion in the Port Darlington community have been and continue to be impacted by the change in littoral drift caused from the building of the St Marys pier. Mitigation recommendations were given in that report and unfortunately dismissed. Riverine flooding is seen as problematic in our area, however by omission there was no discussion of the reconstruction of Westside Marsh which removed a large portion of berm that protected the residences on Cedar Crest from marsh waters; reduced the marsh water area significantly thereby reducing the area to contain runoff during periods of rain; and created small rivulets running parallel and just north of our road that could fill during rain events and subsequently flood the road if the barrier beach did not break open.

I have observed through various reports completed on the Port Darlington community over the last quarter of a century, a desire to destroy this very vibrant community. Threats of expropriation have been long standing. The Port Darlington Community Association was founded to protect our community and was lauded for its strength in securing the support of the Crombie report in the early 1990's. We have been under many rules and restrictions in this area for as long as I have lived here and yet we continue to love and cherish our home and neighbourhood.

The **DRAFT** Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan is another report that has been added to continue to fulfill an agenda that is not to protect our area and support its residents but to dissolve the community. The report as written is a greater threat to our

community than the lake itself. It completely misrepresents life in the Port Darlington area.

[redacted]

From: [redacted]
To: Lucy Benham
Subject: CLOCA Shoreline Risk Study Review
Date: April 18, 2022 4:42:04 PM

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Hello,

Thank you for providing the draft report regarding the Shoreline Risk Study for review. We have been shoreline residents of SDC #5 for about 12 years now at [redacted] Road.

We have studied the responses that were submitted by [redacted]. Their responses reflect our thoughts as well.

Although we are in a location subject to potential damages during extreme high-water events and or storm conditions, we believe our level of safety is good, and that we are not in physical danger nor consider that the consequences would be devastating.

You may respond to us at this email address.

Respectfully,

[redacted]

[redacted]

From: [redacted]
To: Lucy Benham
Cc: [redacted]
Subject: Response to draft
Date: April 18, 2022 6:27:21 PM

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Response to draft Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

I have been a resident and home owner on [redacted] Road for 25 years and have always felt fortunate to live here. I have witnessed the progress of erosion and have worked hard and took expensive steps to diminish the erosive risks that we have observed. I have also reviewed the observations and recommendations of previous studies on our area and was disappointed to find that none of the recommendations suggested in those reports (specifically the Baird report) were likely to be followed. **It seems like this current assessment and study was undertaken to produce recommendations other than those that have been suggested in previous studies and reports. If this study did not provide the conclusions that CLOCA had been looking for, how many more studies would have been undertaken ?**

It also appears that the high water levels of Lake Ontario and consequent flooding in 2017 and 2019 in some areas, have provided an opportunity for the regional and municipal governments to rid themselves of the responsibility to assist residents in this area in the protection of their shoreline in Port Darlington area properties and to carry out a repeated agenda to remove residents and homes from this area. I believe that assigning a high risk designation to my residence and neighbourhood does not reflect a concern for me, my family or my neighbourhood and it does not reflect reality.

In our 25 years of residing on Cedar Crest Beach road (including 2017 and 2019), we have never experienced flooding from Lake Ontario waves or from the swelling of the Westside marsh. While we have witnessed waves of impressive size and have watched the marsh swell and empty, we have never been concerned for the safety of ourselves or our house. While some homes were “subject to significant flooding and impacts from wave run up and riverine flooding from coastal marshes,” many if not most homes did not. What was most impressive was the community effort to assist neighbours who were experiencing difficulty and I am very pleased to be part of a community who responds to the needs of each other in this manner.

Having reviewed the draft of the Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan, I am impressed with efforts to present assessment findings in a scientific manner but am left with the conclusion that these findings are based on pseudoscience and data which conveniently supports the not so subtle attempts to discourage the residents in this neighbourhood from residing here. While the visual observations and aerial photographs provide evidence for the study, residents of this portion of shoreline have observed and experienced changes in water levels and wave behaviour on a daily basis and it is extremely disappointing that our observations have not been requested or taken into account in this study.

Because Cedar Crest Beach Road was extensively looked at in previous studies data from here was not collected in the present study. Yet risk levels were still assigned. Sadly while some of the information from previous studies was used in the current studies, the recommendations from those studies appear to be ignored. It is also puzzling why the study did not address measures undertaken by residents to attenuate the risk of erosion and flooding due to wave uprush. Would not these measures reduce erosion and minimize the threat of flooding? While it is suggested that assessments and maps are based on the presence of a natural shore line (as per provincial policy), there are a number of un-natural structures (i.e., the St. Mary’s pier and the Port Darlington pier) that have a significant impact (on the dynamic beach for example) these were not discussed. Nor was the impact of the marsh reconstruction, another unnatural event. Channels were cut into the marsh which brought marsh water closer to the road. With high lake water the marsh had no place to empty into. It is not surprising that our road had water covering it.

I **do not believe this study would have been undertaken if it were not for the high water levels of Lake Ontario in 2017 and 2019. It seems like Plan 2014 would be extremely relevant to this assessment and resulting discussion, given the problems due to wave uprush only happened in these years. The assignment of risk levels to residences prior to the review by the International Joint**

Commission is premature and irresponsible. It seems important to note that New York State provided funds to repair properties and enhance protective measures following these high water level years prior to the conclusion of this review. Unfortunately, rather than assisting the residents in their efforts to protect their homes and properties, our government has opted to issue an eviction notice.

I guess residents on Cedar Crest Beach Road learned an important lesson from these high water years. That is, not to request help from municipal and provincial governments. Did our government express concerns over the impact of high lake water on the residents of our area? It appears that the request for government assistance provided an opportunity to push an agenda to remove and devalue the properties of the residents here. When I have been asked about the hazards of living on Cedar Crest Beach Road, my concerns are not about a flooding hazard from wave uprush or flooding from the Westside Marsh, the major threat to my residence and peace of mind comes from an uncaring government that attempts to collect data that supports someone's agenda or vision for the future with out concern for the people who live here. Measures can be taken to protect our neighbourhood from high water levels, particularly wave up rush as was concluded in previous studies. We have done this with great effort and at considerable expense. From reading the draft our efforts and expenditures have been judged to be fruitless and inconsequential. I object to the premise of this study, the methodology with which this was undertaken, the accuracy of the observations and object to the harmful assignment of risk value to my neighbourhood and residence.

Sincerely

From: [redacted]
To: Lucy Benham
Subject: CCBR
Date: April 18, 2022 6:35:07 PM

Hi Lucy
I totally agree with what my neighbours [redacted] and [redacted] had to say about your draft regarding our shoreline and feel no need to add to their comments but wanted to be sure you know where I stand.

I have lived at [redacted] since summer 2015. That fall we had at least 20ft of beach in front of my property. My percepetion is that Plan 2014 had an extreme negative effect on our dynamic beach. Obviously it was a predicted effect also from the St. Mary's pier built in the 70's (as it was in their report back then that the littoral drift was starving our beach as the pier was blocking its replenishment).
My house had no damage from both 2017 and 2019 events other than some landscaping damage on lakeside.
My feeling is that if there were groynes or a breakwater to minimize wave uprush the 80 or so homes here would be 100% fine here for years to come, regardless of water levels.
Thankyou [redacted]

Attention: **Lucy Benham**

Thank you for providing the opportunity to review and reply to the Lake Ontario Shoreline Hazard Risk Assessment and Management Plan_Draft Technical Report.

Allow me to begin with: reading the draft document with no expertise in the subject matter is cumbersome and it would take me a lot longer to understand the various criteria being used and then apply it logically in my response. Therefore, I can only respond as a local resident with my concerns on and appreciate your understanding of this approach.

First, some background: as a full time resident at [redacted] since 2016, and as the granddaughter of the family that built their summer cottage at [redacted] in the 1940's, I have spent a significant part of my life on this road and have been privy to the changes that it's gone through over the years.

Throughout the approximately 50 years I spent as a cottage resident, never at any point in time outside of Hurricane Hazel, am I aware of any flooding on Cedar Crest Beach and our cottage was (and still is) at what is now defined as the highest risk point of the road. The depth of beach and slope to the shoreline was significant…until St Marys' pier was installed. Yes, St Marys' pier is coming into this discussion because after it was built is when we arrived to open for the season and found about 30 feet less beach than when we'd closed in the fall. From that point onwards it was a challenge to keep the erosion at bay. Thousands were spent at that time to install gabions and rock walls that finally, for all intents and purposes, it seemed to work. Also, there were never any concerns about flooding from the marsh and we spent many hours hunting frogs and toads to have races with.

Fast forward to 2016, when we decided to retire to the place I'd always wanted to return to, it was my dream come true. Watching the lake rise in the spring of 2017 still did not foretell of what was to come. A perfect storm was brewing and we, the whole of Cedar Crest Beach Rd, the Port Darlington community, CLOCA and Clarington, weren't prepared. Needless to say, we learned a lot in a very short period of time. The details of how we managed are long and unnecessary for this response, but we did manage and learned to mitigate our risk as best as we could.

Along came numerous 'studies'. They all came to the conclusion that Cedar Crest Beach basically couldn't be saved, it was too high a risk of future flooding based on a lot of numbers and analysis. The term '100 year flood' was introduced and used as the measure for future floods. Various mitigation categories were included in this latest risk assessment and yes, it still points out we're still at high risk with little options provided outside of moving our home to a different location, raising it above it's current foundation or a 'buy/sell between willing partners'.

I do want to reply to a few items though:

- The following question/response that appear on page 11 raises concerns. We have spent thousands of dollars on protecting our shoreline in 2018 and 2020 and despite the risk assessment reporting risk down to each individual home and even shed, any mitigation taking by the homeowner was basically ignored. How can an assessment be done on an individual home-by-home basis and steps the homeowner has taken are not accounted for? Isn't the purpose of this assessment to identify and mitigate risk?

- QUESTION/COMMENT: Why is my home still shown as being within or affected by the shoreline hazards when I've already invested in engineered shoreline protection? RESPONSE: Shoreline hazards (and corresponding risk) are assessed and mapped based the presence and condition of shoreline protection is not accounted for in the assessment or mapping on the presence of a natural shoreline, as per provincial policy. The presence and condition of shoreline protection is not accounted for in the assessment or mapping.

- Then, the very next question/response confirms that homeowners can take steps to mitigate flooding on their property. Ok, we did that, we took ownership and paid thousands out of our own pocket to protect and help prevent future flooding of our property, never approached the municipality or other governing bodies for financial assistance, but our efforts can't be accounted for in this risk assessment? The assessment that studied **each property individually**?
  - QUESTION/COMMENT: Shoreline protection is expensive, and someone should help pay for it. RESPONSE: **Typically, private shoreline protection is not publicly funded in Ontario. If you own property along the shoreline, in general, you are responsible for mitigating the associated hazards.**
- While the introduction of Plan 2014 is not solely the reason for flooding in 2017 and 2019, it certainly is a factor that can't be excluded. The introduction of higher 'F' and 'L' limits and criteria that removed the ability to easily adjust flow rates combined with a lake at its highest in years and an extreme spring combination of runoff and rain. Yes, the IJC is reviewing their strategy and have adjusted it somewhat. Time will tell if it requires further action but then again, that would likely require another flood year so let's hope not.
  - QUESTION/COMMENT: Erosion and flooding events in 2017 and 2019 were man-made and were the result of Plan2014. RESPONSE: Extreme high water levels and associated flooding and erosion experienced on Lake Ontario in 2017 and 2019 were the result of record breaking water supplies to the Great Lakes Basin. Notwithstanding this fact, the water level regulation plan that is presently in effect at the Moses-Saunders Dam, known as Plan2014, is presently under review by the International Joint Commission. This study will not evaluate the performance of Plan2014 during periods of extreme water supply nor will recommendations concerning water level regulation be made.

Risk Assessment:

1. It's interesting that, while the assessments were done and reported on an individual residence basis, that the whole community was brushed with the same 'extreme' rating. While our property had some flooding from the wave uprush it should be noted that we were never at risk of flooding from the marsh. There were homes that were at risk of flooding from the marsh but not as affected by the wave uprush. I find it difficult to understand how this general evaluation is acceptable and if each home and shed is assessed as an individual unit, so should their risk be and should be. These broad statements have serious and negative impacts to the biggest assets that we own! Obtaining mortgage or insurance will become difficult and as such, this assessment appears to put the ability to finance and insure our homes at as big a risk, if not more of a risk than the flooding would.
2. It is interesting that the whole shoreline around St Marys and its pier is blatantly absent from the assessment. Has their shoreline magically changed between the west end of Cedar Crest Beach Rd and the pier? What about the nuclear plant we have within our midst, don't they have a critical concern? What have they done to stop shoreline erosion and mitigate their risk? Have they found an approved

method of mitigating their flood risk that we don't know about? Can it be shared? Please update the assessment to include all other properties and shorelines that lie within CLOCA's borders so we can identify those that are not at risk and learn from their methods. If this is a risk assessment of shorelines within CLOCA's area of responsibility, it should include all shorelines, not just those at risk. Surely, our beach cannot be the only dynamic or barrier beach along this stretch of Lake Ontario?

Mitigation:

1. This document speaks to mitigation options and for the 'extreme' category it states:

   Retreat/Re-align is a category that encompasses strategic decisions to change land use and relocate public and private assets exposed to significant risk. Retreat/Re-align strategies ***are typically considered only when strategies under the other three categories are either not sufficient to mitigate the risk or can not be reasonably implemented due to constructability, permitting constraints, negative environmental impacts or most commonly, cost.***

   As a resident that has been involved in meetings, studies and surveys since 2017, I am unaware of any number of alternate steps being considered or assistance being offered that could help, such as the following from the **Accommodate** category:

   - Floodproofing homes through the installation of flood gates, opening shields, backflow valves, sump pumps, etc. (*many residents have installed one or more sump pumps since the flooding)*
   - Raising a building foundation to provide greater flood protection, *(this was considered by some but was cost prohibitive)*
   - Raising road elevations to provide better access during flood events, *(this has been discussed for Cedar Crest Beach Rd but never pursued, it would also help reduce the risk of flooding from the marsh to the south side of Cedar Crest Beach Rd)*
   - Upgrades to stormwater management systems, water supply and sanitary systems, *(why is a culvert on the north side of Cedar Crest Beach Rd not being considered to manage and route any flood water from the marsh towards the marsh exit under the bridge)*
   - Relocate high-value assets to areas of highest elevation or furthest from the shoreline hazards within homes or property,
   - Emergency preparedness and planning ***(this option has been implemented by residents organizing the community Port Darlington Emergency Committee in 2017 who have since worked closely with Clarington Emergency and Clarington Operations as a combined unit to prepare for and communicate flood risk situations to the Port Darlington community)***

   From the **Protect** category:
   The protect category is for strategies aimed at protecting people, property, and infrastructure from exposure to the risk, either through traditional engineering or nature-based solutions. This category may include:
   - Conventional, shore-parallel shoreline protection structures including revetments, seawalls, breakwaters, etc.,
   - Shore-perpendicular beach retention / shoreline stabilization structures such as groynes and artificial headlands,

- Beach nourishment,
- Dune restoration,
- Mechanical or hydraulic sediment bypassing (bypassing sediment around an obstruction such as a jetty).
  (there are thousands of ocean facing seawalls etc. around the world, surely there's a feature that is working elsewhere that can be considered for lake flooding? Why is this not being pursued?)

After the flood of 2017, the community took steps to help mitigate flood risk and established the Port Darlington Emergency Committee, a sub-committee of the Port Darlington Community Association, that has taken the following steps to help safeguard our community and mitigate flood risk:

- Established a working group with the Clarington Emergency and Clarington Operations teams
- Participated in monthly or more frequent meetings with this team to ensure lake levels are being monitored and steps taken to be prepared if flooding risk is near
- Organized sandbagging events with local residents assisting with filling and deploying sandbags
- Organized individual property flood risk assessments to ensure properties are best protected
- Monitor water and wave heights in order to alert local residents of potential flood events so they are prepared
- Other steps too numerous to mention at this point

To date, the only steps I'm aware that CLOCA has taken is help mitigate flood risk to put high water level alarms in the marsh, I'd love to hear if I'm mistaken and they've taken additional steps outside of this assessment.

To label any of the areas within the Port Darlington area as 'retreat/realign' or 'extreme risk' is overkill. While the beach has changed over the years, the risk of flooding might have increased but at no time have lives been at risk. We've all watches scenes of much more devastating flood situations in other parts of Canada and worse case scenario in 2017 and 2019 was a flooded basement. While other homes did get some water damage, it in no means matched some of the flooding in other areas at the time.

Assigning any of these status to a home or group of homes puts the owners at more risk of property devaluation than flood! Certainly, our home is part of our retirement plan and to put that at risk just by assigning a broad-stroke assessment is irresponsible.

CLOCA and SJL Engineering have completed a home-by-home assessment based on number crunching and assumptions based on two singular incidents in the past 100 years and put this community in more jeopardy than was required. Would it not be more responsible to consider the communities and how to mitigate our risk than recommending options that are just unlikely to ever be adopted? The likelihood of any of these being considered is extreme:

- Relocate buildings a short distance away from the hazards where the depth/width of the lot is sufficient, (We can't even afford to have our house raised let alone moved, who will cover this cost?)
- Relocate buildings offsite to another existing or newly formed property parcel, (see above)
- Remove buildings, typically through a voluntary property disposition program (at fair market value) by the municipality on a willing seller/willing buyer basis. (as the current real estate market stands, most homes along Cedar Crest Beach Rd and West Beach Rd are in the $1.5 to $2 million range. After two years of Covid and costs incurred by the municipality, province and federal governments, it's

not even likely on the horizon of consideration especially with an unknown risk factor of it even happening again in our life time)

In closing, most of the report is spent defining beach types, erosion, flood risk numbers etc, and while the report really doesn't provide much more detail than previous reports, it continues to sustain the belief that residents are at high risk of flooding and personal danger.

Defining Port Darlington as:

The Port Darlington region has significant risk associated with natural hazards due to the prevalence and severity of all three shoreline hazard types (erosion, flooding and dynamic beach), as well as riverine flood and erosion hazards. The western portion of the SDC features 40 lakefront properties on Cedar Crest Beach Road, a development that was constructed many decades ago on a dynamic barrier beach and former inlet. The eastern portion of the SDC features 22 properties on West Beach Road which was also constructed on a low-lying barrier beach that separates Lake Ontario from Bowmanville Marsh and Harbour. The two low-lying dynamic beaches are separated by an area of higher elevation which features a further 20 lakefront properties on the south side of Cove Road. Homes on both Cedar Crest Beach Road and West Beach Road were subjected to significant flooding and impacts from wave runup during the high-water level periods in 2017 and 2019, and riverine flooding from the coastal Marshes. Emergency access is also a serious consideration for these communities as both Cedar Crest Beach Road and West Beach Road feature road elevations similar to or lower than the 100-year flood elevation for this portion of Lake Ontario shoreline

Port Darlington has existed as it sits for almost if not over 100 years with the same beaches and rivers and just because we're now documenting the geographical makeup of this area doesn't mean it will change. What has changed is what has been allowed to change by the various levels of government.

Permitting a massive gravel and cement company to raze what we are being told is a nature sensitive area and then allowing them to realign the riverines in the marsh to provide them with additional access to the north is likely doing more damage to nature than our homes. This is a community that welcome all animals that are being displaced by the growth of this cement company to the west and north and large housing developments to the east. We recognize that we are in a conservation area and harbour nature, feed birds, rabbits, chipmunks, possum, deer and coyote; that takes the time to alert drivers to the presence of turtle nests and transport those babies once they're born to make sure they cross the road safely.

By accepting any of the recommendations in this risk assessment is akin to putting the whole community at risk of a loss greater than a flood would accomplish.

Thank you for your attention to our concerns,

[redacted]

[redacted]

Bowmanville, ON

April 11, 2022

This is a response to the request for feedback regarding the draft "Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan, Draft Technical Report" (2022-02-10)

As residents of [redacted] since 2014, we have read CLOCA's report and feel the need to respond.

It is quite a leap from no flooding in 100 years to living in an "extreme high risk" area because of the flooding that occurred in 2017 and 2019.

In 2017 a perfect storm came together:

1) The erosion caused by St. Marys Cement, which continues to be a highly debatable subject. However, many engineering studies have resulted in documents directly linking the pier to shoreline erosion. The most recent study was procured by the Conservation Authority, The Baird Report, November, 2018.
2) The emergency barrier beach that St. Marys is supposed to maintain was blocked with debris and took pressure from our fire Chief Weir to get them to open it. Most times the barrier at the bridge is the primary opening and that is maintained or dredged if necessary but there was an issue with lack of maintenance at St. Marys along with the changes to the natural marsh layout to accommodate St. Marys mining at the north end of the marsh. The flooding from the marsh was due to the high spring run offs and the high lake levels not allowing the marsh to drain at the bridge. Once the lake was higher than the marsh it can't drain into the lake so the alternate barrier beach was required. The flooding from the marsh is what impacted us personally.
3) Plan 2014. The changes to water level high and low points were changed in 2017 to follow the implementation of Plan 2014 resulting in higher lake levels in a year with exceptional spring run off that was complicated by having to slow the release of water at the Moses-Saunders Dam to avoid further flooding upstream in Quebec.
4) Speaking from our point of view as homeowners on Cedar Crest Beach Rd in 2017, there had been no issues of flooding for 100 years. The comment that the landform is "highly flood prone" is only based on the

events in 2017 and 2019. As I stated there has been no other significant flooding in the past 100 years. We had one pump in operation in 2017. In 2019 we had 3 pumps and were not impacted by the "flooding", at all that year.

In 2017 the community came together to build and deploy sandbags. Many homes spent large amounts of money to safeguard their properties. We now have an emergency plan that is closely monitored. There are alarms in the marsh.

There were no power outages during these events. There were no injuries but mostly we did not need to evacuate, yet we are deemed extreme high risk.
We previously lived in two homes that experienced flooding. Neither were on a lake and we were not deemed extreme high risk.

The Conservation Authority now has a public acquisition strategy, and they actively block our efforts to repair our homes and seek solutions.

Interestingly, CLOCA is now interested in doing an assessment and naming our properties on Cedar Crest Beach as "extreme high risk".

At least two new homes were built on Cedar Crest Beach Road after 2017. Why was this allowed? Were the dangers you describe as "extreme high risk" not in evidence?

All of the above concerns that I have listed can be mitigated. Again, as a community we have sat on committees, participated in all the meetings, written countless letters and presented many, many delegates in regards to areas of mitigation. but we are no further ahead. All we seem to get are more expensive studies.

However, it is probably easier to name our street as "extreme high risk", reducing our house value and thereby taking away the only asset most of us have, than it is to sincerely look at the situation without any "agenda" and be instrumental in preserving this very beautiful and unique community.