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Big Lake and Miseners Long Beach  
Lower East Chezzetcook

‘Letting Nature Take Its Course’

A Case Study of Nature-based  
Coastal Adaptation in Nova Scotia



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## ACKNOWLEDGEMENTS

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Team members from the School of Planning at Dalhousie compiled the case studies. Other members of the Making Room for Movement team provided content and insight to one or more of the studies, including Nancy Anningson, Ecology Action Centre; Kirsten Ellis, CBWES, Inc; team members with CBCL Limited; Dr. Kate Sherren, Dalhousie University; Dr. Danika van Proosdij, Saint Mary's University; Dr. Tuihedur Rahman, McGill University; and Tony Bowron, CBWES, Inc.

This project was undertaken in Mi'kma'ki, the unceded ancestral territory of the Mi'kmaq. We acknowledge, honour, and pay respect to the traditional stewards of the land on which we live and conducted this work.

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## CASE STUDY CONTEXT AND PURPOSE

A small community on the shore of Big Lake, a barachois pond in Lower East Chezzetcook, Nova Scotia, relies on a barrier beach to preserve the lake and protect their properties from tidal and storm flooding. Storm waves have breached the barrier many times. The breaches usually close back up through natural processes. However, a breach in 2010 required artificial repair, and breaching has become more frequent with shorter intervals between storms. Opening to the sea puts properties on the shore at risk of tidal and storm flooding or erosion and saltwater inflow changes the ecology of the lake. Provincial Department of Lands and Forestry and the Halifax Regional Municipality needed to make decisions about the barrier beach at Big Lake (also known as Miseners Lake and Miseners Long Beach).

This case study draws on scientific and technical reports, municipal planning documents, media reports, and site visits to describe the natural environment and land use and development of the site; the projected impacts of climate change on the beach; the implications for lake shore properties behind the barrier; past efforts to stabilize the barrier beach; and the apparent decision to not repair breaches that do not reform naturally. The case study illustrates the possibility of the nature-based adaptation option of allowing coastal processes to evolve naturally, but with that approach comes the need to address land use at risk from the consequences of the decision, potentially through relocation or some form of accommodation to support exposed properties.

## BACKGROUND

Lower East Chezzetcook is a rural community of approximately 240 residents (Councillor David Hendsbee, n.d.) located within the Halifax Regional Municipality (HRM) on Nova Scotia's Eastern Shore (Figure 1). The community is 35 km east the Halifax-Dartmouth urban core. HRM is a large municipality of approximately 5490 km<sup>2</sup>, stretching 160 km east to west 'as the crow flies' and bordering the Atlantic Ocean. The municipality comprises urban, suburban, and rural communities, the majority of which have a coastline.

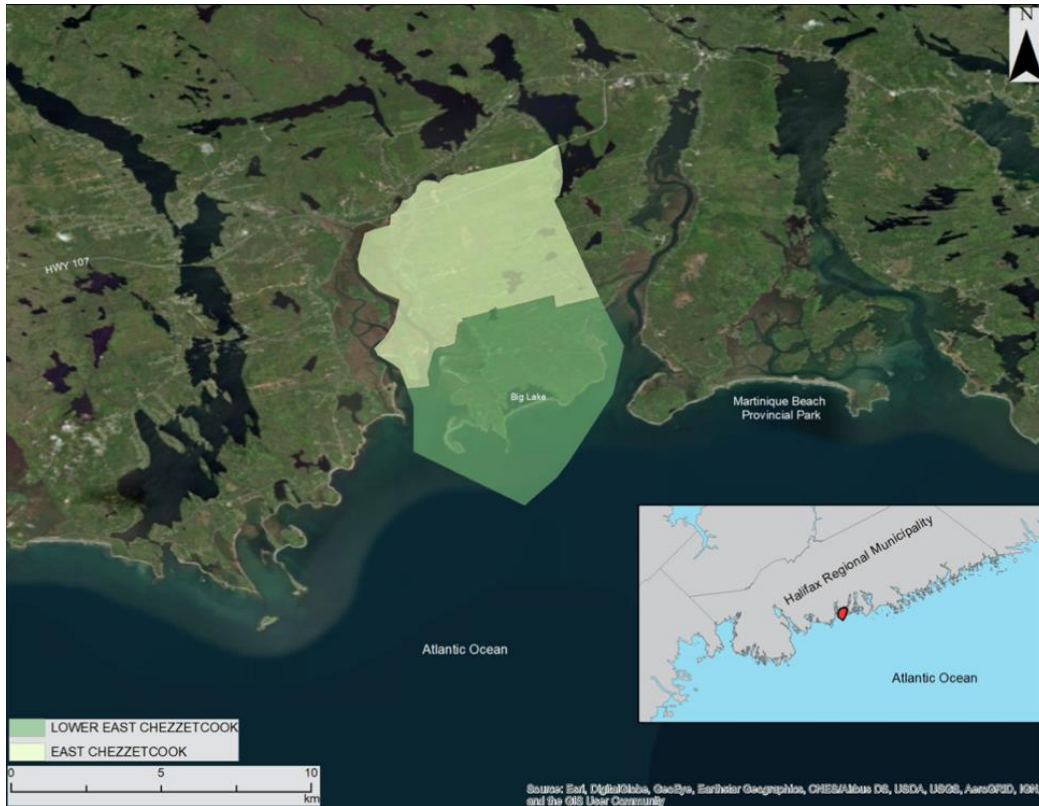


Figure 1: Lower East Chezzetcook, HRM, on Nova Scotia's Eastern Shore

Some of the residents in Lower East Chezzetcook live on the shore of Big (Miseners) Lake (Figure 2). Big Lake is a barachois pond separated from the Atlantic Ocean by a gravel barrier beach. The beach is known as Miseners Long Beach. Barachois ponds form behind barrier beaches and have brackish water which has a slightly higher salinity than fresh water, and a lower salinity than seawater (Davis & Brown, 1996). Ocean water enters the barachois pond through high tide over-topping, sea spray, and sometimes through a connecting channel. The degree of salinity depends on the source of salt water and the input of freshwater to the pond such as a stream, groundwater, or precipitation. Ponds that are entirely sealed from the ocean behind high barriers are freshwater ponds. The Natural History of Nova Scotia classifies barachois ponds as freshwater wetlands (Davis & Brown, 1996). However, barachois ponds, along with tidal lagoons, are classed as coastal saline ponds in the Nova Scotia Wetland Conservation Policy (Nova Scotia Environment, 2011). These coastal ponds, like coastal wetlands generally, are critical habitat for marine and terrestrial wildlife, and provide ecosystem services to humans that include food supply, water supply, water filtration, flood control,

shoreline erosion control, natural harbours, recreational activities, and much (Finlayson, *et al.*, 2005; Massachusetts Beach Task Force (MBBTF), 1994; Shaw, *et al.*, 2006; Taylor & Shaw, 2002).



Figure 2: Residential properties and roads infrastructure along the western side of Big Lake, Lower East Chezzetcook.

Barrier beach-coastal wetlands are a common coastal environment in Nova Scotia. A barrier beach accumulates sediment - sand, gravel, and cobble stone – forming a ridge that rises higher than the sea at high tide and runs more or less parallel to the shoreline. The wetland – a marsh or pond - forms between the ridge and the mainland. A continuous supply of sediment is important for maintaining the ridge that in turn maintains the pond. Storm waves can overtop a barrier and strong storms can break it down allowing ocean water to flow through the opening, called a breach. Wave overtopping does not necessarily lead to breaching (CBCL, 2018) and breaches that do form can close as sediment reaccumulates. However, many barrier beaches are at risk of disappearing. Rising sea levels magnify high tides and storm surges (ECCC, 2019).

The combination of rising sea level effects and more intense storms can lead to more frequent overtopping and breaching of barrier beaches. Very strong storms, or storms in quick succession can lead to a permanent opening. For example, Cow Bay, Lower Three Fathom Harbour, and Story Head barrier beaches, also on the Eastern Shore near Lower East Chezzetcook, are eroding and migrating landward (CBCL, 2018). A study of Story Head Beach described significant breaches in the barrier (Taylor et al., 1996). Barrier beaches with adequate sediment supply and room to move may adjust to rising sea levels by migrating landward. Armouring of eroding shorelines that normally supply sediment that replenishes beaches and limited accommodation space because of development at the shore, reduce the resilience of these natural coast ecosystems to respond to sea level rise.

The inflow of saltwater changes the ecology of the brackish or mostly freshwater wetland that forms behind the barrier. If the breach does not close, it may widen, the ridge may erode and lose elevation, and permanent inundation would follow. The loss of the wetland means a loss of coastal habitat and shoreline protection.

Until recently the Big Lake barrier beach at Lower East Chezzetcook has proven to be relatively stable, only displaying signs of minor landward movement (Taylor, et al., 1996). Earlier studies suggested that natural conditions at Big Lake should be enough to maintain a resilient barrier beach. For example, the beach face is steep, there is a range of sediment sizes, and the waves typically come in long swells (CBCL, 2018). From 1985-1996, wave overtopping appeared to have little effect on the beach (Taylor et al., 1996). However, intense storms and overtopping are becoming more common (CBCL, 2018; Taylor, 2014; Taylor et al., 2013). Ocean breaching of the barrier beach has become more frequent in recent years and sometimes the breach does not close naturally. Sea level rise may be creating new conditions where, during a storm, waves are more likely to overtop the beach (CBCL, 2018; Taylor, 2014; Taylor et al., 2013).

The Big Lake barrier beach is a protected beach under the Nova Scotia *Beaches Act* and is part of a 1.85 km<sup>2</sup> Provincial Park Reserve (Figure 3). The reserve is managed by the Nova Scotia Department of Lands and Forestry (NSDLF). The reserve was first established in 1976 to stop

the removal of sand and gravel from the beach. Historically, natural materials from the region were harvested for the plastering industry. The reserve has minimal infrastructure – a parking lot on the western end of the beach (CBCL, 2018). Foot paths lead to the beach and along the top of the cobble barrier.



Figure 3. Big Lake (Miseners Lake) and Park Reserve. The peninsula circled in red is the Big Lake community in Lower East Chezzetcook (Image from CBCL, 2018).

In Nova Scotia, almost 86% of the coast is privately owned land (CBCL, 2009). In the Big Lake area, most of the land, other than the provincial park reserve and the protected beach (Figure 3), is private property. In Lower East Chezzetcook, maintenance of the barrier beach is of high importance to the residents who own property and live on Big (Miseners) Lake. The barrier beach provides protection for their lake shore properties and local road access during large storms (Taylor, 1996). The barrier beach also protects the aquatic habitat of the barachois pond, which mostly has been sealed from the ocean and is freshwater. It is habitat for a variety of plant and animal species, including the fish which residents enjoy angling. The beach has a history of being repaired and re-enforced by the NSDLF (CBCL, 2018), but residents became frustrated with the lack of action by the NSDLF after major storms in 2018 and 2019 caused breaches (Figure 4) and exposed the lake shore to flooding (CBC News, 2018; Palmetter, 2018; Patil, 2019).





Figure 4. The breach at Big (Miseners) Lake in winter 2018.  
(Photo credit: NSDNR within CBCL Limited 2018)

Several residents pushed for continued maintenance of the beach as breaching and erosion become more serious. (Bell, 2019; Palmeto, 2018). The NSDLF hired engineering and environmental consulting firm, CBCL Ltd., to investigate the long-term effects of coastal change and provide recommendations for how to best address coastal damage at Big Lake (CBCL, 2018).

## HAZARDS AND RISKS IN LOWER EAST CHEZZETCOOK

As sea level rise and storms become more frequent and intense, barrier beach breaches are becoming more common across Nova Scotia. This coastal flooding negatively impacts coastal communities, such as Lower East Chezzetcook, dependent on the protection these natural features provide.

In their report, CBCL consultants explain how, under current conditions, mid-sized storms can create circumstances where ocean waters overtop the barrier beach at Big Lake. As a result, beach material is moved to the backside of the beach, and the beach migrates landwards and becomes shallower (CBCL, 2018; Taylor, 2014; Taylor et al., 2013). The lower elevation is more

easily overtopped in future storms. Based on a review of air photos over a 60-year period, project consultants, CBCL, estimate that between 1945-2003, the beach has migrated landward by 29 metres (Figure 5, CBCL, 2018). Barrier beaches are dynamic coastal structures and move in response to changing ocean energy and sediment supply.



Figure 5: Historical erosion at Big Lake, NS barrier beach showing landward migration between 1945 and 2003 (Analysis and image from CBCL, 2018)

Breaching of barrier beaches is a natural process. Nova Scotia experiences strong storms throughout most of the year, including tropical and post tropical storms and nor'easters, all of which can generate large waves and storm surges. Under past conditions, breaches in the Big Lake barrier beach have closed. However, the consultants and other coastal experts who have studied the beach report that the beach is showing signs of being unable to recover through natural processes (CBCL, 2018; Taylor, 2014; Taylor et al., 2013). The CBCL consultants explain that four large storms in 2010 damaged the beach, which the then NS Department of Natural Resources artificially repaired using approximately 80 gravel bags (CBCL, 2018). CBCL

consultants further explain that, for natural barrier beaches to keep up with sea-level rise, the following conditions must be met:

- The backside of the bay must be shallow to capture sediment and slow migration, and
- There must be enough sediment supply on the foreshore

CBCL identified that these conditions are not being met for Big Lake barrier beach (CBCL, 2018).

The breaching of the barrier beach poses three major hazards for the Lower East Chezzetcook community – loss of habitat and ecosystem damage, property damage or loss, and saltwater intrusion. CBCL reports how, in the 2000s, several storms caused damage to the barrier beach (CBCL, 2018; Taylor, 2014; Taylor et al., 2013). The storm in 2018 resulted in a significant breach (Figure 4), and the freshwater lake was flooded with ocean water. Barachois lake water flowed into the ocean, lowering the lake water levels (Bell, 2019; CBCL, 2018; Palmeter, 2018; Patil, 2019). Residents reported seeing fish dying on the newly drained sand and mudflats (Patil, 2019). The CBCL consultants also identified that a rapid increase in salty conditions in the freshwater lake is likely damaging for freshwater fish populations (CBCL, 2018).

The CBCL report documents how, over the winter and spring of 2018, breaches opened and then filled in naturally (CBCL, 2018). On a visit to Big (Miseners) Lake in August 2020, as part of documenting this case study, this research team observed a wide breach at approximately the same location as the winter 2018 breaches.

Properties are also at risk of flooding. Media stories about the issue reported that breaches in 2018 and 2019 lead to property flooding (Palmeter, 2018). There are 21 lots with waterfront access on Big Lake (Figure 6). There are 16 residences located within 20 metres of the shore and are relatively low lying. CBCL Ltd. estimated the flooding timeline with sea level rise for the properties on Big Lake (Figure 7) and determined that the risks increase with time, even if the breach were repaired, and erosion managed (CBCL, 2018).

Rising sea levels are also creating conditions for saltwater intrusion in Lower East Chezzetcook (CBCL, 2018). Saltwater intrusion occurs when ocean waters move into freshwater aquifers with

increases in sea level (Kennedy, 2012). Lower East Chezzetcook properties are not hooked up municipal sewer and water services, so residents rely on well water. A study by NSDLF identified Lower East Chezzetcook as “high risk” for saltwater intrusion. CBCL reports that approximately 90% of wells are at risk of being contaminated with saltwater (CBCL, 2018).

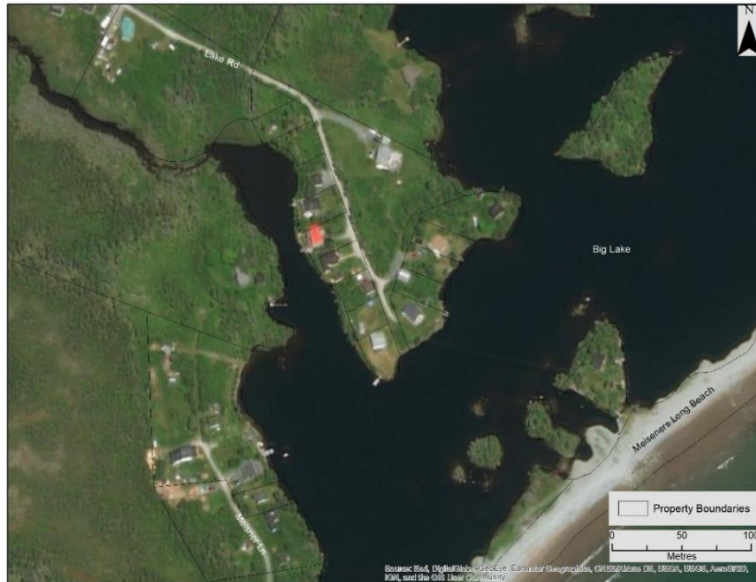


Figure 6: Google Earth view showing waterfront properties and buildings on Big Lake, Lower East Chezzetcook.

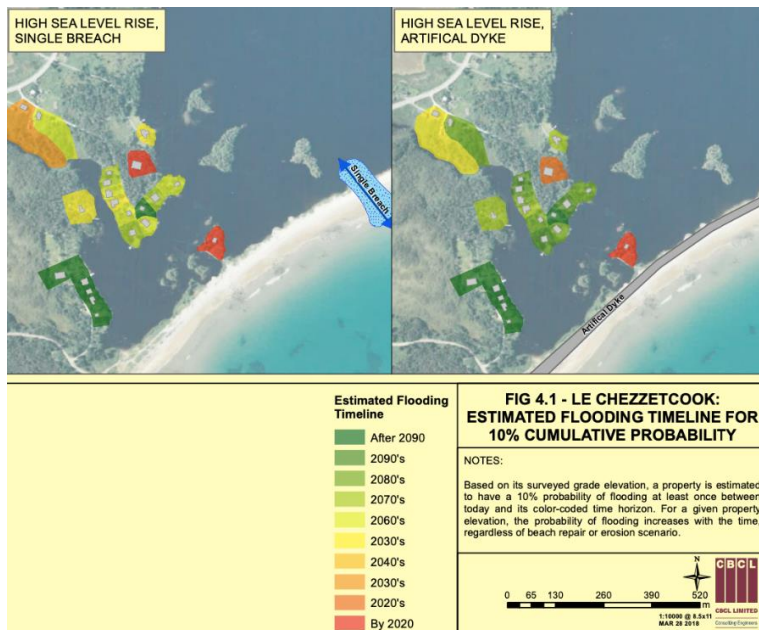


Figure 7: Estimated timeline for a 10% chance of property flooding at least once between 2018 and the date indicated by its colour code, using sea level rise projections

to 2100. Analysis suggests flooding with (right) or without (left) beach reinforcement. Reinforcement may delay but not stop flooding (Analysis and image from CBCL, 2018. For additional scenarios, see CBCL, 2018)

## SOCIAL VULNERABILITY TO HAZARD IN LOWER EAST CHEZZETCOOK

Flooding is a natural process that becomes a natural hazard when land development encroaches into flood prone areas, putting people, infrastructure, and land use activity at risk of flood impacts. Natural hazards affect populations differently. The impacts felt by a population, or a population's vulnerability to a hazard (such as flooding), is evident in the ability of the population's ability to respond to, cope with, and recover from the impact of the hazard. A variety of individual and social factors influence vulnerability of a population including income, employment, gender, age, race, education level, household composition, ability to speak the local language, among others. The greater the proportion of the population experiencing conditions that contribute to vulnerability (such as advanced age, unemployment, being a recent immigrant, etc.), the more vulnerable is the population in that area. Vulnerability is described through indices such as the Social Vulnerability Index (Cutter, *et al.*, 2003), or a marginalization index (Matheson, *et al.*, 2012), or a deprivation index such as the Canada Index of Multiple Deprivation (CIMD) (Statistics Canada, 2019). The analysis for this case study uses the CIMD.

The CIMD is an area-based index created by Statistics Canada using variables from the 2016 Census of Population at the Dissemination Area (DA) level (Statistics Canada, 2019). A Dissemination Area is the smallest population unit for which Statistics Canada reports the full set of demographic and social statistics, about 400 to 700 people. DAs are relatively stable geographic areas. Statistics Canada developed CIMD datasets across three geographic scales: national, regional (two, including Atlantic), and provincial (three), referenced to 2016. This case study used the Atlantic Region CIMD data set.

The CIMD comprises four dimensions of deprivation and marginalization, with each dimension incorporating influencing indicators derived from the census data: residential instability; economic dependency; ethno-cultural composition; and situational vulnerability. The indicators for each dimension are listed in Figures 8 to 11. DA-level factor scores were calculated for each

dimension using factor analysis. Scores were then ordered within each dimension into quintiles and the quintiles were assigned a value of 1 through 5, Quintiles represent fifths of a population; the first quintile is the lowest fifth of the data (1% to 20%) and receives the quintile value '1'; the fifth quintile is the highest fifth of the data (81% to 100%) and receives the quintile value '5'. For the CIMD, '1' represents the scores indicating the least deprived fifth of the population; and '5' indicates the most deprived.

Figures 8, 9, 10, and 11 are maps developed from the Atlantic Region CIMD data set to show the deprivation levels for Lower East Chezzetcook and adjacent areas, the social geographic context for Big Lake. The shades of green on the maps represent lesser (light) to greater (darker) deprivation. The higher the deprivation score, the more vulnerable the population is to hazards. Table 1 compares marginalization/deprivation in 2006 and 2016. The 2006 data are from an earlier index, the Canadian Index of Marginalization (Matheson, *et al.*, 2012). The two indices measure the same factors and are compatible for comparisons to identify trends.

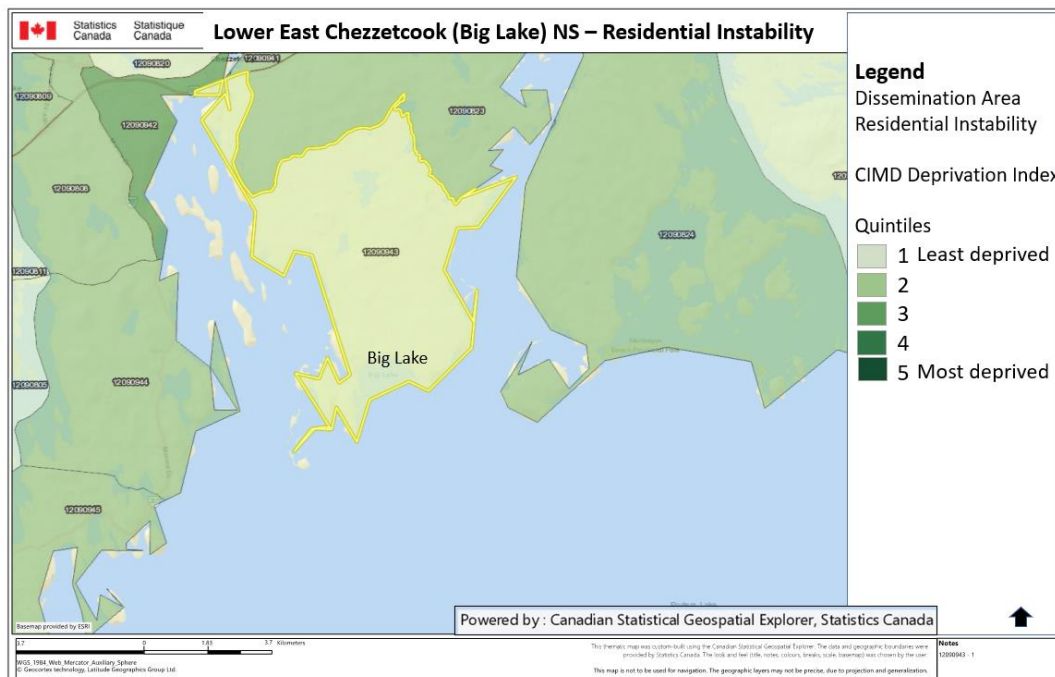


Figure 8: Lower East Chezzetcook and area - Residential Instability\* at 2016 Canadian Index of Multiple Deprivation (Statistics Canada, 2019).

\*Proportion of persons living alone, proportion of dwellings that are owned, proportion of dwellings that are apartment buildings, proportion of the population that is married or common-law, proportion of the population that moved in the last five years.

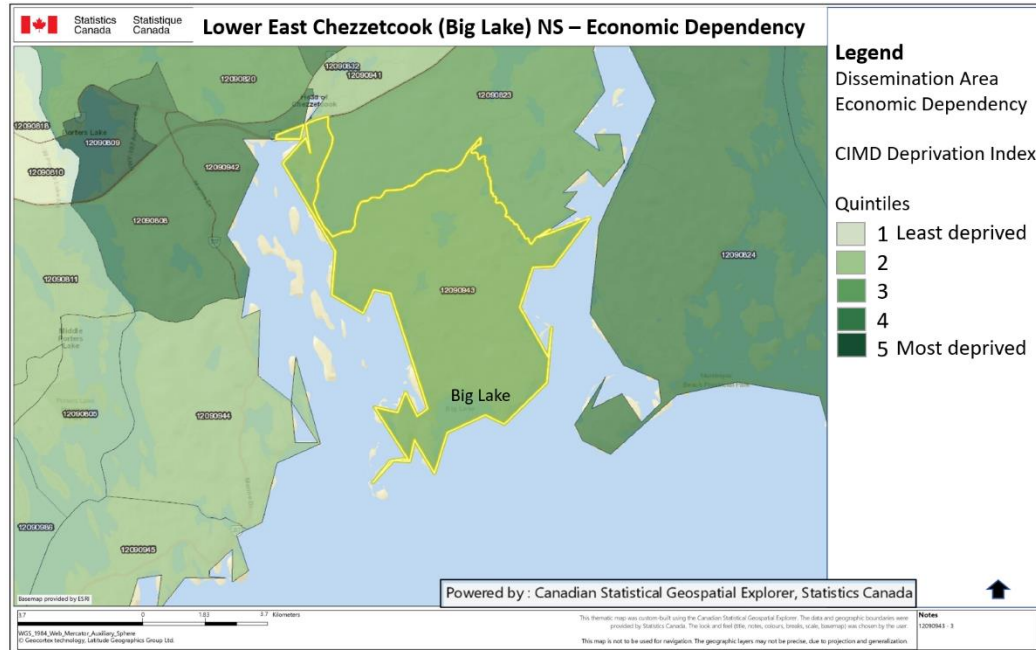


Figure 9: Lower East Chezzetcook and area - Economic Dependency\* at 2016 Canadian Index of Multiple Deprivation (Statistics Canada, 2019).

\*Proportion of population aged 65 and older; proportion of population participating in the labour force -15 and over; dependency ratio (population 0-14 and 65 and over divided by population 15-64; ratio of employment population proportion of population receiving government transfer payments.

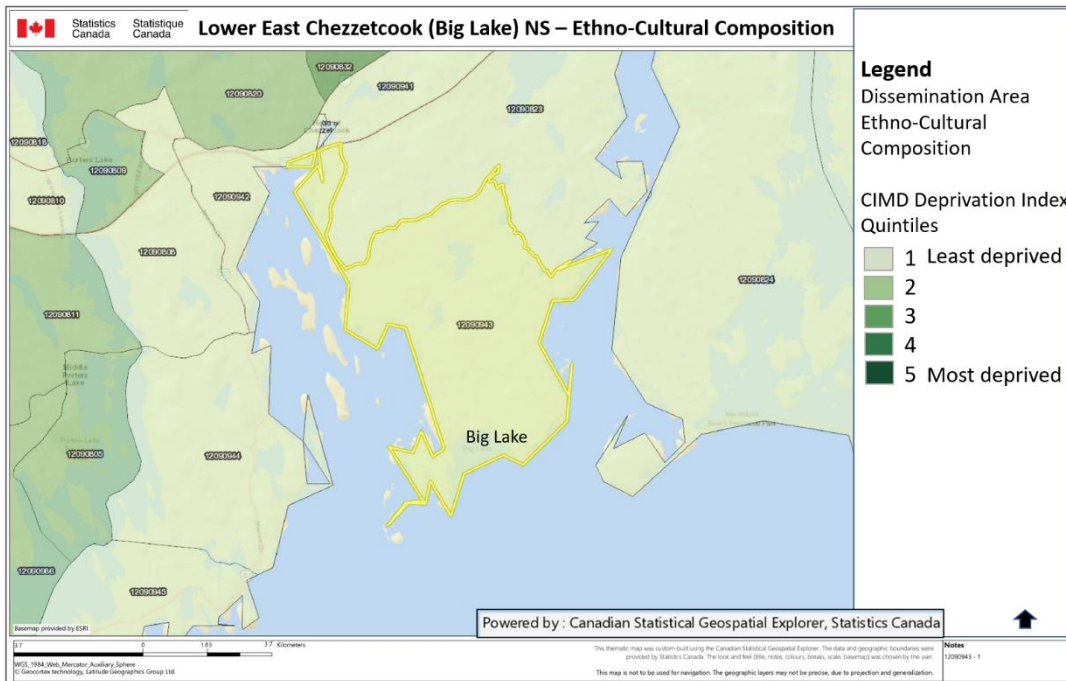


Figure 10: Lower East Chezzetcook and area -- Ethno-Cultural Composition\* at 2016 Canadian Index of Multiple Deprivation (Statistics Canada, 2019)

\*Proportion of population that is recent immigrants; proportion of population that has no knowledge of either official language.

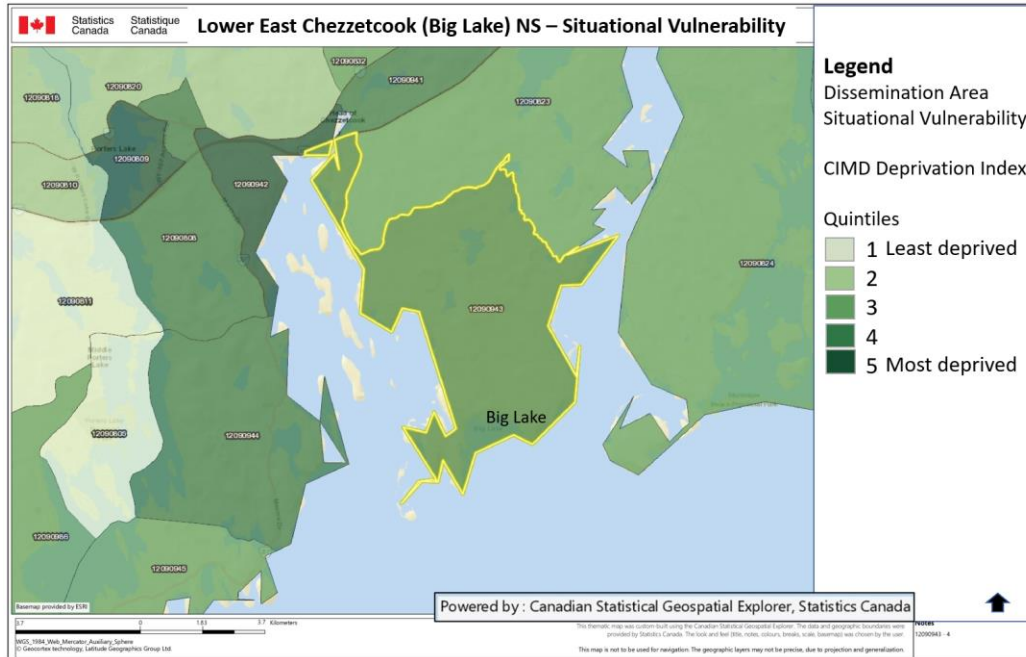


Figure 11: Lower East Chezzetcook and area - -- Situational Vulnerability\* at 2016 Canadian Index of Multiple Deprivation (Statistics Canada, 2019)

\*Proportion of the population that identifies as Aboriginal; proportion of dwellings needing major repairs; proportion of population aged 25 to 64 without a high-school diploma.

The Figures illustrate that Situational Vulnerability and Economic Dependency have the largest influence over vulnerability to hazard in Lower East Chezzetcook. Economic Dependency includes senior populations. Seniors (those 65+), are the fastest-growing demographic in Nova Scotia, and rural regions like Big Lake, Lower East Chezzetcook experience this growth more intensely than cities (CBCL, 2009). Seniors make up 15% of the population in Nova Scotia, and 25-30% in rural areas (CBCL, 2009). Economic Dependency includes reliance on government pensions; an older population will receive pensions. The high value might also suggest higher unemployment and receipt of employment insurance payments. Situational Vulnerability suggests a lower education among the population and housing needing major repair. Housing stock in need of repairs and indicators of economic dependency such as an older population or one with lower income status, in a coastal area at risk of storm flooding is noteworthy in considering options for coastal adaptations and reducing risk.

Calculation of the Canadian Marginalization indices in 2006 and the Canadian Index of Multiple Deprivation for 2016 (Table 1) suggests that vulnerability has decreased in some categories,



although it remains high in situational vulnerability (although somewhat improved) and has not changed in economic dependency.

<b>Big Lake - 2006</b>		<b>Big Lake - 2016</b>	
Residential Instability	2	Residential Instability	1
Dependency	3	Economic Dependency	3
Material Deprivation	5	Situational Vulnerability	4
Ethnic Concentration	2	Ethno-cultural Composition	1

Table 1. Comparison of vulnerability using Canadian Marginalization Index (2006) and the Canadian Index of Multiple Deprivation Indices 2016. (1= least marginalized/deprived; 5= most marginalized/deprived (Statistics Canada, 2019).

## GOVERNANCE, POLICY AND PLANNING

As a residential community, a park, a wetland, and public coastal land, Miseners Long Beach, and Big Lake fall under provincial and municipal jurisdictions. The barrier beach and provincial park reserve are under the jurisdiction of the Nova Scotia Department of Lands and Forestry. The beach is a protected beach under the *Beaches Act* (Nova Scotia Legislature, n.d.). The fresh lake provides habitat for fish. Fish in inland and coastal waters are under the jurisdiction of the Nova Scotia Department of Fisheries and Aquaculture. The barachois pond is a protected wetland under the *Nova Scotia Wetland Conservation Policy* (Nova Scotia Environment, 2011) and, because of its size, alterations to it are subject to approval under the *Nova Scotia Environment Act* (Province of Nova Scotia, 2018). As a coastal pond, the wetland and its shoreline are part of the coastal zone and may be subject to forthcoming regulations under the *Nova Scotia Coastal Protection Act* (Department of Environment and Climate Change, 2021). These policies and statutes are the mandate of the Nova Scotia Department of Environment and Climate Change.

Halifax Regional Municipality is the municipal governing body for the Lower East Chezzetcook region. Most of land in the area is privately owned. The land base is subject to HRM land use policies, planning, and regulations. Planning and regulation are tools that can be used to manage land use impacts on the environment and to protect land use and structures from environmental hazards including in the coastal zone. Examples of these tools include environmental protection

or conservation zones, horizontal or elevation setbacks or buffers, and lot sizes that consider environmental capacity, erosion risk, or climate change flooding projections.

<b>Department</b>	<b>Role</b>
Department of Fisheries and Aquaculture (NSDFA)	Responsible for inland and coastal fishery resources
Department of Environment (NSDE)	Responsible for the management and protection of the environment.
Department of Lands and Forestry (NSDLF)	Responsible for all crown land, provincial parks and reserves, trails on lands over watercourses, endangered species, and wildlife habitats.
Halifax Regional Municipality	Responsible for land use policies, plans and by-laws
Big Lake residents	Property and owners and primary stakeholders

Table 2: Key actors with responsibility for or interest in coastal, environmental and land use management and planning at Big (Miseners) Lake, Lower East Chezzetcook.

**Land use in the Halifax Regional Municipality and Lower East Chezzetcook and consideration of municipal policy and regulation with respect to nature-based approaches to adaptation**

The Halifax Regional Municipal Planning Strategy (Halifax Regional Municipality (HRM), 2014) (the Halifax Regional Plan) presents the overall vision and goals for the entire municipality. To facilitate planning for such a large municipality, the HRM has community planning areas. Lower East Chezzetcook is located within the Lake Echo/Porters Lake planning area. Each community planning area has a specific municipal planning strategy and land use bylaw.

The Halifax Regional Plan includes goals and policies for general planning requirements in HRM. The Plan specifically addresses rising sea level and the risks that it poses to coastal regions (Warren, 2020). The Regional Plan acknowledges the importance of the natural environment and climate effects such as coastal flooding and erosion. It also specifies the importance of having natural spaces for recreation (Warren, 2020). Several planning principals encourage preserving and promoting sustainability, such as protecting wetlands and floodplains, and implementing development practices that are responsive to climate change (Warren, 2020). Though the Regional Plan discusses climate change and the importance of natural spaces, they

are treated as separate issues in the Plan (Warren, 2020). However, HalifACT 2050 Acting on Climate Change Together – A Climate Action Plan for Halifax (Halifax, 2020), emphasizes natural areas and green infrastructure for storm water management as a mechanism in climate change adaptation.

Lower East Chezzetcook is subject to the Municipal Planning Strategy (MPS) and the Land Use By-Law (LUB) Districts 8 & 9 (Lake Echo/Porters Lake) (Halifax Regional Municipality (HRM), 2006 a, b). The MPS indicates the community’s desire to maintain open, undeveloped spaces (Warren, 2020). Much of the area is not developed and remains rural. The planning strategy encourages new development in already developed areas. Part 3 of the LUB prescribes the land use zones for the plan area, five of which encompass the case study area and border Big Lake. Each one permits various types and location of development (Figure 12). The list of permitted uses in each zone is in Appendix 1:

- Residential (RA)
- Rural Enterprise (RE)
- Mixed Resource (MR)
- Regional Park Zone (RPK)
- Protected Area (PA)

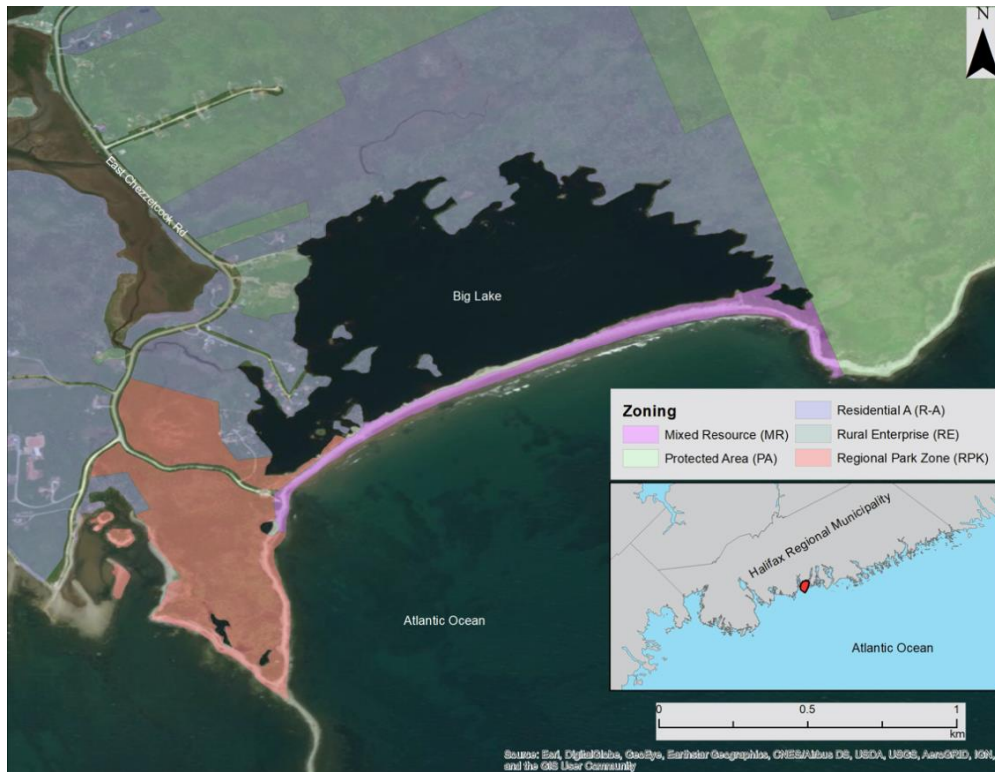


Figure 12: Land use Zoning around Big Lake, Lower East Chezzetcook

The barrier beach is zoned as MR (Mixed Resource). The MR zone allows for 17 uses, including residential, commercial, resource, and open space uses. The beach, however, is extremely narrow, limiting it to open space use which includes public and private parks. Furthermore, the beach is a protected beach (Figure 2) under the provincial *Beaches Act* (Nova Scotia Legislature, n.d.) further restricting use. RE (Rural Enterprise) permits almost all uses excluding salvage yards, fish processing plants, and any industrial or commercial use that is considered obnoxious. One lot with waterfrontage on Big Lake is zoned RE. RA (Residential A) is the dominant zoning for land around Big Lake. RA permits residential, commercial, institutional, agricultural, and open space uses. Provincial Crown Land to the west of Big Lake and connected to the beach is zoned as RPK (Regional Park), corresponding to the provincial designation of Park Reserve (Figure 3). No development is permitted in this zone. Permitted uses include recreation, conservation, and commercial uses accessory to public park use. Another block of Crown Land is east of the lake, bordering the coast but with no connection to the lake shore is zoned as PA (Protected Area), again corresponding to the provincial Park Reserve Designation (Figure 3). No

development is permitted in this zone. Permitted uses include scientific study and education (no buildings), trails and boardwalks, and conservation uses.

Part 4 of the By-law, General Provisions for All Zones includes regulations of relevance to the Big Lake community as residents face impacts to their properties from coastal flooding and erosion.

Section 4.18 Watercourse Setbacks and Buffers, prohibits development within 20 metres from the ordinary highwater mark, with exceptions that include accessory buildings, structures for water access, trails, among other similar uses. However, the setback does not apply to structures that existed before August 26, 2006 (Section 4.18(3)). The majority of the structures near the Big Lake waterfront do not comply with the 20 metre setback (Figure 13), and all but one are exempt because they were constructed before the new by-law date.

Section 4.10 Existing Uses, allows all existing uses present on the lot when the by-law came into effect “to expand, resume operation if discontinued, or be replaced or rebuilt if destroyed” (HRM, 2006a), subject to the requirements of the zone in which it is located. However, the Section does not specify if the infrastructure must comply with new zoning regulations that include setbacks and buffer zones, or with the regulations in place at the time the building was originally constructed. If buildings are required to meet new setback regulations, many lots do not have the space to accommodate the requirement. Consequently, many structures could not be rebuilt. The General Provisions section contains all the regulations for the setbacks, and because the General Provisions applies to all zones of the LUB, this may indicate that property owners would run into issues rebuilding or repairing their structures in the future.

Section 4.8 Existing Undersized Lots (4.8(a)), states that any use permitted in the zone will be allowed if the vacant lot was “held in separate ownership from adjoining parcels on the effective date of this By-Law” (HRM, 2006a) (for example, if a property was subdivided into lots and the lots were sold). The building must comply with all other regulations, although a variance may be issued.

Section 4.18A Coastal Areas, restricts development of dwellings on land abutting the Atlantic Ocean, “including inlets, bays and harbours”, within 3.8 metres elevation above the Canadian Geodetic Vertical Datum (CGVD28) (HRM, 2006a). Big Lake is a closed barachois pond and, as such, no properties are located on the Atlantic Ocean, they are on the shore of a small lake. However, if breaching continues, becomes permanent and then widens, the barachois pond could transition to an inlet and lake shore properties would be located on an inlet of the Atlantic Ocean. Existing dwellings are excepted, but if expanded a dwelling cannot reduce the existing elevation setback. CBCL assessed the elevation of existing buildings and showed that very few buildings met the elevation regulations (Figure 14). However, any new construction in the area would be subject to the 3.8 metre elevation requirement if Big Lake becomes an inlet of the Atlantic Ocean.



Figure 13: Infrastructure within a 20 metre shore buffer of Big Lake. All but one structure and the local road are less than 20 metres from the shore.

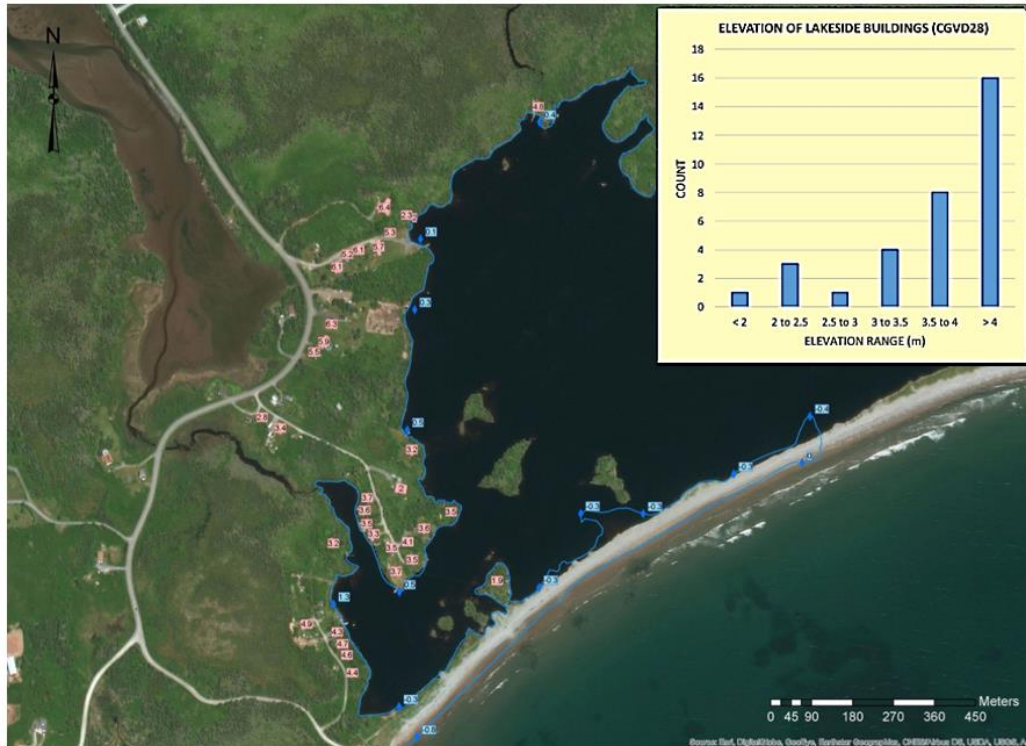


Figure 14: Building elevation (m) of properties on Big Lake (From CBCL, 2018)

### Land use conformity between provincial and municipal governments

Coastal governance of the Big Lake area is further complicated by some lack of agreement between provincial and municipal land use policies, designations, and regulations. HRM and the provincial government have contradictory land use designations for Miseners Long Beach. Under provincial legislation, the beach is a protected beach (Figure 3). Protected beaches are defined and governed under the *Beaches Act* (Nova Scotia Legislature, n.d.). The purpose of the *Beaches Act* is to:

1. provide for the protection of beaches and associated dune systems as significant and sensitive environmental and recreational resources;
2. provide for the regulation and enforcement of the full range of land-use activities on beaches, including aggregate removal, so as to leave them unimpaired for the benefit and enjoyment of future generations;

3. control recreational and other uses of beaches that may cause undesirable impacts on beach and associated dune systems.

The municipality has zoned the beach as Mixed Resource (Figure 12), and therefore conflicts with the *Beaches Act* and is not compatible with the protected status of the beach. The Mixed Resource zone permits a variety of uses that could negatively impact the beach's ecological integrity. There is closer agreement for the headland west of the lake which is provincial Park Reserve (Figure 3) with municipal Regional Park zoning (Figure 12). Regional Park zoning still permits uses, including commercial uses accessory to public park use. The land east of the lake is also Park Reserve. However, it is not considered protected under provincial regulation. Under municipal regulation, the reserve is zoned as a Protected Area. Protected Area zoning is the strictest zone in terms of environmental conservation and protection in Lower East Chezzetcook. Land use designations and zoning inconsistencies create uncertainty over the rules controlling land use, and in particular the level of environmental protection for, in this case, vulnerable coastal land.

## DECISION PROCESS

The complex nature of coastal governance leads to debate as to who is responsible for maintaining the barrier beach at Big Lake and residents' safety. The barrier beach is the responsibility of the province. However, the NSDLF argues that land use implications, such as allowing development on vulnerable coasts, are the responsibility of the municipality, development which will now be subject to provincial regulations under the *Coastal Protection Act* (Department of Environment and Climate Change, 2021). Reportedly, the NSDLF suggests that homeowners should fortify their properties to prevent flood damage (CBC, 2018). In 2018, the Minister of NSDLF stated in reference to residents at risk of coastal flooding in Big Lake, "That it is the responsibility of the municipality to acknowledge that there are some places where you just can't build." (CBC News, 2018). However, HRM responded, stating that the building permits for at-risk properties were issued before the *Municipal Government Act* (1998), which gave municipalities power over land use decision-making. The review of the land use by-law showed that municipal regulations are in place that could protect development from impacts



of coastal flooding and erosion, but most of properties on Miseners Big Lake are exempt from the regulations. Regardless of land management responsibilities and requirements, public or private, residents of Big Lake are situated in a coastal zone experiencing rapid change and at increasing risk to flooding and erosion. They are looking to the province and municipality to identify options for moving forward.

Residents of the Big Lake area are very attached to the place they call home. Many residents have lived on Big Lake for decades and intend to stay for much longer. Several residents have called for the beach to be repaired. Following the flooding in 2018, CBC reported residents stating, “We want a Band-Aid here before the whole thing gets destroyed.” and “The only area of the beach that really needs to be reinforced is about 100 feet.” (Palmer, 2018). In March 2018, residents took action. Approximately 30 residents attended a meeting with their local MLA to discuss the next steps for Big Lake regarding the increased frequency of breaching events (Patil, 2018). At the meeting, a representative from the NSDLF attended by phone (Patil, 2018). At this time, residents could ask questions and express their concerns (Patil, 2018). The NSDLF reported that they were not interested in making short-term solutions; rather, it was essential to have a long-term study to determine the best course of action (Bell, 2018).

### **Letting nature take its course**

In 2018, the NSDLF hired CBCL to complete a Coastal Risk Assessment and Adaptation Options at Miseners Long Beach (CBCL, 2018). The study investigated historical conditions, bathymetry, sea-level rise and storm surge predictions, erosion patterns, saltwater intrusion vulnerability, and options for coastal adaptation. This case study draws on the report to describe the circumstances at Big Lake. CBCL concluded that barrier beach breaching and flooding of Big Lake will persist. CBCL identified two possible options for addressing coastal flooding:

1. Coastal engineering on the barrier beach involving either
  - a) “short-term beach repair”, or
  - b) “long-term reinforcement of the barrier beach with rock material” (a dyke), or

2. “Leave the beach to evolve naturally, and intervene at the property level as necessary”  
(CBCL, 2018)

CBCL determined that coastal engineering will only delay the long-term impacts of sea-level rise on flooding and saltwater intrusion. Reinforcing the beach will only shift breaching hazards to other areas of the beach and will only delay the natural evolution of the beach. Options that “hold the line” will be expensive and are not feasible in the long-term. CBCL (2018) notes that reinforcing the beach will be expensive, with the predicted rate of sea-level rise.

CBCL’s alternative option combines leaving the beach to evolve naturally with adaptation actions that draw from the PARA framework (Protect, Accommodate, Retreat, Avoid) for climate change adaptation, specifically

1. Accommodate
  - Allows for continued use of coastal land
  - Uses and infrastructure may change as conditions change
  - Floodproofing at the property level, e.g., shift from drinking wells to tanks, raise residential buildings and electrical equipment, use fill (to raise land elevation on properties), raise access roads
2. Managed retreat
  - Relocation of assets
  - Develop a long-term strategy for adaptation in areas of high risk
  - Determine what can be left to natural succession processes
3. Avoid
  - Discourage/prevent future development in risk areas
  - Enhances environmental benefits
  - Increases public access to the waterfront
4. Planning
  - Education of climate change to decision-makers, stakeholders, and public
  - Incorporate local climate change information into community plans and policies  
(CBCL, 2018)

Reducing risk to climate change impacts at the coast requires options that develop resilience rather than enable practices that continue the risk or increase it, called maladaptive practices. The alternative option allows the beach to evolve with rising sea levels and to adjust land use and site and infrastructure design in response to the changing environment.

In 2018, representatives from NSDLF indicated a lack of interest in continuing barrier beach maintenance (Bell, 2019). This decision was finalized, and the beach will be left to evolve naturally.

## EXPECTED OUTCOMES AND LESSONS LEARNED

Big Lake is an example of many other low-lying communities or settlements along Nova Scotia's coast protected by natural coastal environments. Provincial and municipal governments will need to collaborate on addressing the effects of climate change on coastal land uses. Beyond the decision to no longer repair the barrier beach, there are no measures or a strategy for risk reduction for residents on Big Lake at the time of preparing this case study report. Using the nature-based adaptation option of making room for movement by 'letting nature take its course' requires parallel strategies to increase residents' safety and build resilience in land use.

Municipalities can permit different types of land use along the coast, as well as horizontal and vertical setbacks from the water, through policies and bylaws. HRM will need to consider future development in the Big Lake area carefully. The NSDLF will need to consider how to address barrier beach breaching in the future as they are common landforms across Nova Scotia. A collaborative approach is necessary to ensure that residents and their assets do not slip through the jurisdictional cracks of coastal legislation.

Coastal planning remains challenging because of the lack of comprehensive coastal policy. In 2019, the province passed the *Coastal Protection Act* that will come into effect with the approval of enabling regulations (Province of Nova Scotia, 2019; Department of Environment and Climate Change, 2021). The legislation aims to avoid unnecessary damage to coastal ecosystems and prevent development not tied to marine interests in places at risk of coastal flooding and

erosion. The regulations will create a Coastal Protection Zone that will run along the coast to include land and water-covered areas on either side of the high-water mark, and requirements for development permitting in the protection zone. The width of the zone was not specified at the time of this report, but the government proposes 80 to 100 metres inland of the highwater mark (Department of Environment and Climate Change, 2021). There is no distance defined for the seaward extent. There are two setbacks within the zone: a minimum building elevation above mean sea level for new construction that will be defined for different areas along the coast and a site-specific horizontal setback triggered by a building permit application and determined by a designated professional (defined in the regulations). Municipalities will administer the development permitting requirements. Landowners wishing to develop in the protection zone are responsible for obtaining the assessment. The setbacks consider an 80-year planning horizon. The elevation set back uses calculation for sea level rise to 2100 provided by Natural Resources Canada (James, *et al.*, 2015), tides, and storm surge. The horizontal elevation reflects erosion projections.

The *Coastal Protection Act* regulations, when they come into effect, will not apply to the existing development on the shore of Big Lake, except for redevelopment or expansion of structures that will need to adhere to the new requirements. It will also not affect maintenance of coastal protection structures already in place but may affect the installation of new barriers (Department of Environment and Climate Change, 2021). Residents of Big Lake, East Chezzetcook, will need to adapt to a new type of shoreline and possible impacts to their properties. Developing a strategy to support property owners in this, and similar situations elsewhere along coastal Nova Scotia, will be important to manage the transition to living along a dynamic shoreline. To this effect, education and communication are essential to using nature-based adaptation, of which ‘letting nature take it’s course’ is the most definitive approach. It is not an approach that can work alone along already developed coastlines.

Education and communication will encourage successful and proactive adaptation by

1. Providing the necessary tools to practitioners and decision-makers to make informed decisions about how to protect and responsibly use coastal regions

2. Providing the necessary tools to practitioners and decision-makers to make informed decisions about how to support vulnerable populations
3. Building stakeholder engagement and informed citizens
4. Promoting communication of science, climate change, hazards and risks to the general public
5. Encouraging collaboration between multiple groups and levels of government
6. Creating an opportunity to showcase success stories of nature-based adaptation in Nova Scotia
7. Developing support for the use of nature-based adaptation in the future

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## Appendix I

### Land Use By-Law Districts 8&9 (Lake Echo/Porters Lake) – Zones and permitted uses

Zone Name and Code	Permitted Uses
<b>Residential A (R-A)</b>	Single unit dwellings; Two-unit dwellings; Boarding and rooming houses; Day care facilities for not more than fourteen (14) children in conjunction with permitted dwellings; Business uses except kennels in conjunction with permitted dwellings; Agricultural uses; Fishery uses except fish and fish waste processing plants; Forestry uses except sawmills and other woodworking mills over one thousand (1,000) square feet (92.9 m <sup>2</sup> ) of gross floor area; Open space uses; and Institutional uses.
<b>Rural Enterprise (RE)</b>	A development permit shall be issued for all uses in an RE (Rural Enterprise) Zone except for the following: Fish waste processing plants; Salvage Yards; Adult entertainment uses; Beverage rooms and lounges over one thousand and five hundred (1,500) sq. ft. (139.4 m <sup>2</sup> ); Mobile home parks; Composting operations; C&D material transfer, processing, and disposal sites; and Any industrial or commercial use which is obnoxious
<b>Mixed Resource (MR)</b>	Single unit dwellings; Mobile dwellings; Two unit dwellings; Rooming and boarding houses; Day care facilities for not more than fourteen (14) children in conjunction with permitted dwellings; Business uses in conjunction with permitted dwellings; Intensive agricultural uses; Fishing Uses; Forestry uses; Extractive facilities; Composting operations Hunting and fishing lodges; Riding arenas; Kennels; Telecommunication transmission uses; Community Uses;

	Open space uses; and Cannabis production facilities
<b>Regional Park (RPK)</b>	Recreation uses; Conservation uses; Commercial uses accessory to a public park use; and Uses accessory to the foregoing uses
<b>Protected Area (PA)</b>	Scientific study and education, involving no buildings Trails, boardwalks, or walkways; Conservation uses; and Uses accessory to the foregoing uses