Photo credit: CBWES

Town of Shelburne
Bank Stabilization and Living Shoreline Project

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

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DALHOUSIE UNIVERSITY

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Team members from the School of Planning at Dalhousie University 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 Kirsten Ellis, CBWES, Inc.; Nancy Anningson, Ecology Action Centre; Dr. Kate Sherren, Dalhousie University; Dr. Danika van Proosdij, Saint Mary's University; Dr. Tuihedur Rahman, McGill University; and Tony Bowron, CBWES, Inc.; and team members with CBCL Limited.

Case study project participants contributed to documenting the projects by providing project descriptions and technical information. For this case study -- the town of Shelburne Living Shoreline Project -- the School of Planning project team thanks staff with the town of Shelburne; Samantha Battaglia, Coastal Action; and Kirsten Ellis, CBWES, Inc.

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

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Case Study Context and Purpose

In 2018, Coastal Action, an ENGO working in the coastal communities of Nova Scotia's South Shore region, approached the town of Shelburne about implementing a living shoreline to stabilize an eroding bank along the town's historic waterfront. The town agreed to use this nature-based approach. With private sector grant funding, Coastal Action partnered with CB Wetlands and Environmental Specialists Inc. (CBWES) and the town to install the living shoreline. The case study illustrates a partnership between local government, an ENGO, and the private sector to demonstrate and learn from using a new approach to shoreline protection. This case study draws on technical reports, input from project developers, media stories, municipal planning documents, and a site visit to describe the project site and context, project planning and development, partnerships for project implementation, the local planning regulation, predicted project benefits, project barriers and drivers, and the benefits and lessons of implementing nature-based adaptation in the Shelburne Living Shoreline Project.

Background

The town of Shelburne is a small municipality of about 1743 people (Statistics Canada, 2021) and covering approximately 9km^2 at the head of Shelburne Harbour (Figure 1) on Nova Scotia southwest coast. Shelburne Harbour is described as one of the best natural harbours in the world (Town of Shelburne, 2020). The harbour is a long inlet with two arms extending approximately 15 km from the open ocean. McNutts Island sits at the harbour entrance, protecting the inner harbours. The town is surrounded by the rural municipality of the district of Shelburne (Figure 1). The town shoreline extends 3.5 km along the shore of the eastern arm, from the mouth of Roseway River to the Shelburne (Irving) shipyards, located in the adjacent district of Shelburne. Shoreline land use includes residential development at the north end; the historic waterfront along Dock Street, commercial, some residential, and institutional uses; the Port of Shelburne marine terminal; and a yacht club. A section of Hammond St. also runs along the shore and is the principal route from the north end and town centre to Roseway Hospital at the south end of town. Municipal offices are located along Water Street that runs parallel to Dock Street.

Most of the area, including the town, is underlain by granite bedrock, which is extremely resistant to erosion, although overlying till exposed at the shoreline is erodible. However, much of the town's shoreline is armoured with a variety of engineered structures (Town of Shelburne, 2014). The harbour is sheltered, which protects the shore from high energy waves. The harbour front is at risk of flooding. Land between Water Street and Dock Street, which follows the shore, is between sea-level and 5 metres above sea level, but elevation increases landward of Water Street.

The Living Shoreline Project was implemented on a small section of public shoreline on the town's historic waterfront on Dock Street.

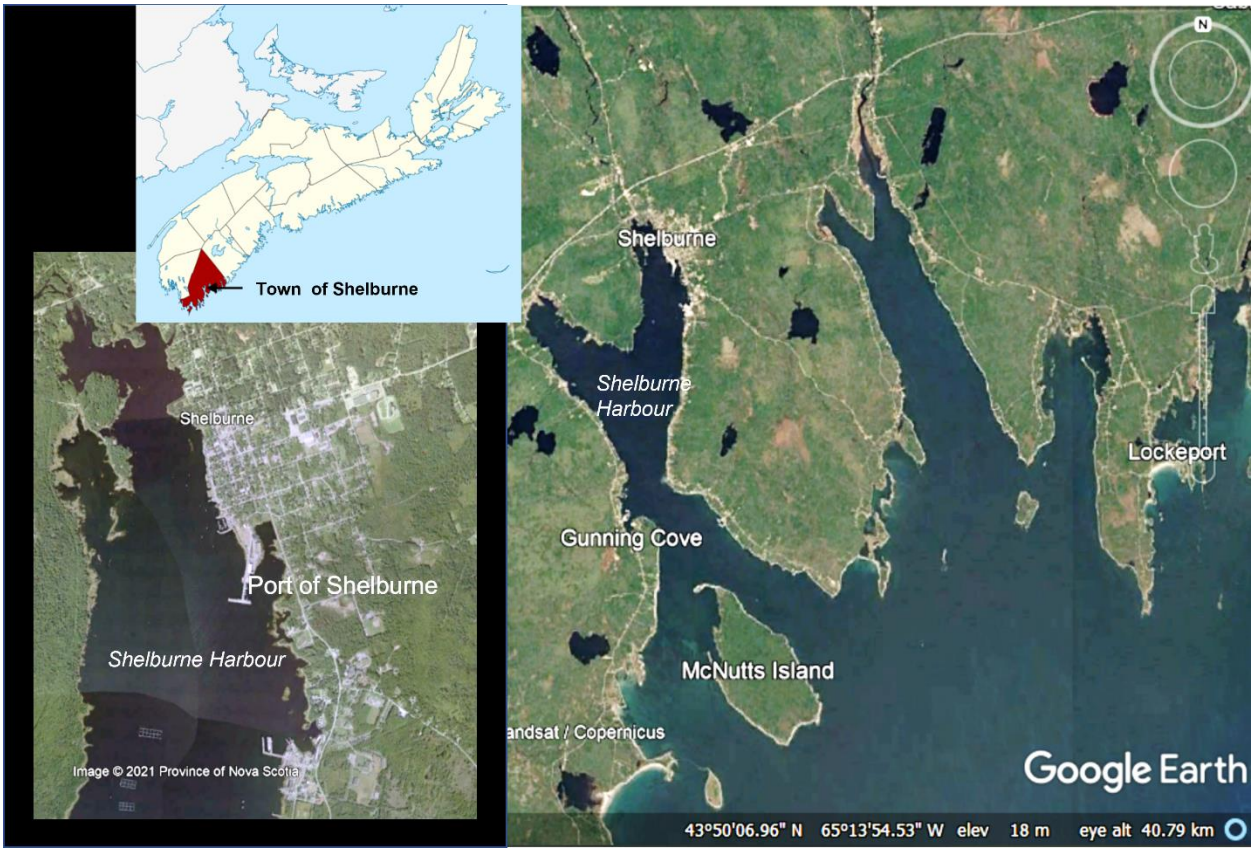

Figure 1. Town of Shelburne, southwestern Nova Scotia, surrounded by the district of Shelburne Municipality (red, in the provincial insert), the town on Shelburne Harbour and town development along the waterfront (adapted from Google Images and Google Earth View)

The Mi'kmaq have lived on and stewarded the land now known as Shelburne since time immemorial, long before European settlers colonized the area. Following the American

Revolutionary War in 1783, refugee Loyalists arrived at Shelburne for assurances promised by the British, including free land (Town of Shelburne, 2020). Among them was a large population of Black Loyalists who settled on the North-west arm of the Shelburne harbour. Named after General Birch, the town known as Birchtown was home to the first Black settlement in Canada (Town of Shelburne, 2020). By 1784, there were over 10,000 settlers in the Shelburne region (Town of Shelburne, 2020), making it the fourth largest city in North America at the time. That status was short-lived, however. By 1787, the population dropped to 300 people when the distribution of provisions ended (Town of Shelburne, 2020) and people migrated to other parts of the British colony. In the early 1800s, Shelburne became a fishing hub and ship building centre. Fishing and maritime industry remain central to Shelburne's identity today.

Many of the historic buildings along Shelburne's waterfront date back to the Loyalist immigration and anchor the town's tourist economy. Protecting the historic waterfront has long been a priority for the community.

Like most working waterfronts, Shelburne's natural coastline has been transformed through infilling coastal habitats and shoreline hardening (Town of Shelburne, personal communication, 2020). The addition of fill, armouring, wharves and boat launches has affected natural erosion and sediment transport and deposition, impacting the coast's natural resilience. The town's Municipal Climate Change Action Plan describes a variety and ages of shoreline hardening infrastructure and state of repair, including slumping of older structures. However, most the waterfront is reinforced by stone wall armouring, primarily round and rectangular granite stones. The town determined that the armouring remains relatively stable and the waterfront shows little sign of erosion (Town of Shelburne, 2014). Maintaining the infrastructure is predicted to be a serious undertaking for the town as climate change poses greater impacts at the shore. Private landowners have armoured their shorelines as well (Town of Shelburne, 2014).

Parking lots, historic and commercial buildings, and port facilities are the dominant infrastructure along the streets hugging the shore in town. The coastal roads are also the primary access to the local hospital, fire service, and the municipal wastewater treatment plant. Residential development partially occupies a low-lying area of forest and wetland between the

Roseway River and Blacks Brook, at the head of the harbour, along Dock Street at the north end of town, in the historic town core between Dock Street and Water Street, and along Hammond Road and Sandy Point Road in the south end.

Climate change and changing land use challenge the effectiveness of the human-made infrastructure built at a time of lower sea-levels without accounting for climate change. Despite extensive efforts to maintain and even extend the coastline, flooding and erosion are continuing concerns in Shelburne. Buildings and roads are located within meters of the coast and vulnerable to coastal process.

Hazards and Risks in the Town of Shelburne

As the atmosphere and ocean warm, Nova Scotia will experience the coastal impacts of sea level rise and a warmer and wetter climate with more intense storms (ECCC, 2019). More precipitation and stronger storms contribute to more overland flooding. Stronger storms also generate larger waves and higher storm surge at the coast. As sea level rises, ocean water encroaches further inland, magnifying high tides, the reach of waves, and storm surges (ECCC, 2019). In 2014, the Town of Shelburne developed a Municipal Climate Change Action Plan (MCCAP) (Town of Shelburne, 2014). The plan identified eight hazards and risks associated with changes in climate. Hazards specifically relating to flooding include coastal flooding, inland flooding, hurricanes, and winter storm events. The MCCAP also acknowledges erosion as a hazard which is exacerbated by rising sea level and storms.

Flooding risk is also influenced by land condition including elevation, slope, vegetation, and space for floodplain water storage and land use. Shelburne's history of armouring, infilling, and introducing impermeable surfaces at the coast, affects the natural ability of the land and shore to mitigate flooding and erosion. Removing vegetation and replacing it with parking lots and roadways increases overland flow. Overland flow occurs when water cannot be absorbed by the ground and flows over the surface. Saturated ground, compacted soil, or impermeable surfaces such as exposed bedrock or pavement and cement generate overland runoff, which is a primary cause of inland flooding, erosion, and scouring. Overland flooding and coastal flooding combine

in estuaries. The low area between the mouths of Roseway River and Black's Brook at the head of the harbour could be vulnerable to this combined flooding.

The Shelburne MCCAP describes coastal flooding and infrastructure impacts in the community. For example, when a major winter storm hit the province in 2013, approximately four feet of water flooded roads and properties at the Shelburne waterfront (CTV News, 2013). In 2018, a storm surge breached the armoured shore, damaging road infrastructure, residential, and commercial property (Stewardship Centre for BC, 2020). Several roads in neighbouring communities were closed by the Department of Transportation during this time.

Figure 2. Historic properties, indicated by red pins (Canada's Historic Places, 2020)

The MCCAP identifies sea walls, waterfront roads and buildings, and the marine terminals at risk of damage or disruption from flooding. The Ecology Action Centre, a provincial ENGO, has been educating people about the impacts of climate change on coastal communities in Nova Scotia, and estimates that water levels exceeding 3.4m would flood all of Dock Street, much of Water Street, and impact many of the town's historical landmarks (South Coast Today, 2014). There are 22 municipally registered and seven provincially registered heritage properties in the town of Shelburne (Figure 2) (Canada's Historic Places, n.d.), the majority of which are located

on Water Street and Dock Street and subject to flooding. The town's heritage buildings are essential elements of the town's identity and its tourism appeal (Figure 3).

Figure 3. Shelburne's historic waterfront. Note amour stone along the shoreline. (Dennis Jarvis. Creative Commons. CC BY-SA 2.0)

Overall, the town waterfront has low risk to erosion, mainly because it is armoured (Figure 3, 4). However, while the seawall materials resist ocean wave erosion, the land behind the wall is susceptible to scouring caused by overtopping or overland runoff. Scouring increases seawall instability. Following the storm in 2018, scouring occurred behind the seawall (Figure 5). The MCCAP notes that increasing damage to the waterfront seawall would be a financial burden on the town's already strained budget. Table 1 from the town MCCAP summarizes the flooding and erosion risk to public safety, systems, and property in the town of Shelburne.

Coastal flooding and storm surge		Erosion	
Public Safety	Moderate	Private property damage	Low
Ability to evacuate	Moderate	Damage to existing mitigation measures	High
Private property damage	High		
Infrastructure damage	High		
Power disruption	Moderate		
Economic disruption	Moderate		

Table 1. Town of Shelburne assets at risk (Town of Shelburne, 2014)

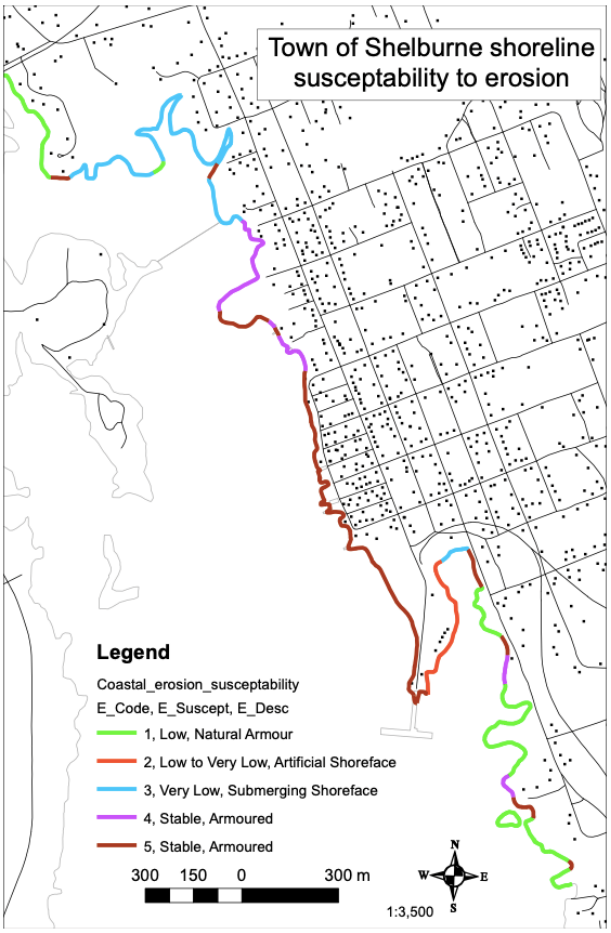

Figure 4. Shoreline susceptibility to erosion (Town of Shelburne, 2014)

Figure 5. Scouring behind seawall. Note that the wall is lower in elevation than the land behind it (The Ecology Action Centre, n.d.)

Social Vulnerability to Hazard in the Town of Shelburne and Surrounding Area

Flooding and erosion are natural processes that become natural hazards when land development encroaches into flood prone areas and areas of active erosion, putting people, infrastructure, and land use activity at risk. 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. 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 6 to 9. 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 6, 7, 8, 9 and 10 are maps developed from the Atlantic Region CIMD data set to show the deprivation levels for the Town of Shelburne and Shelburne Harbour area. 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 2 compares marginalization/deprivation in 2006 and 2016. The 2006 data are from an earlier index, the Canadian Index of Marginalization. The CIMD is an adaptation of the earlier index and the two indices are compatible for comparisons to identify trends.

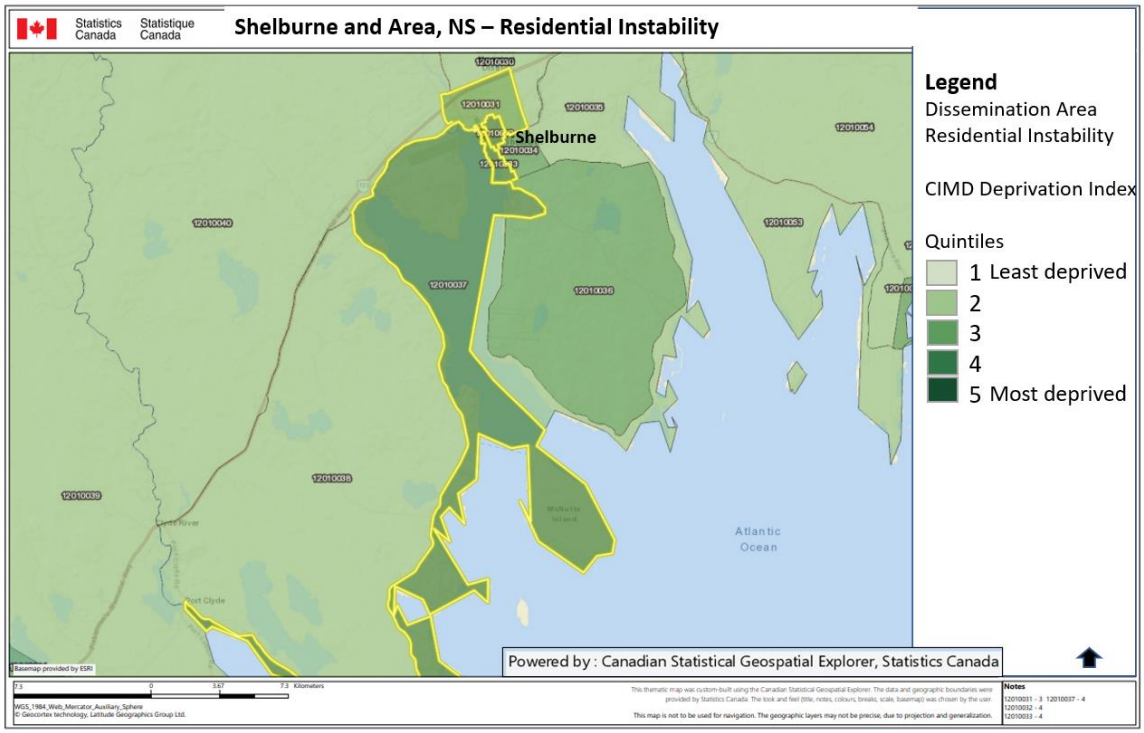

Figure 6. Shelburne and area - Residential Instability* at 2016
Canadian Index of Multiple Deprivation – (Statistics Canada, 2019)
*Proportion of persons living alone; proportion of dwellings that are owned; proportion of dwellings that are apartment buildings; proportion of the population that is married or common-law; proportion of the population that moved in the last five years.

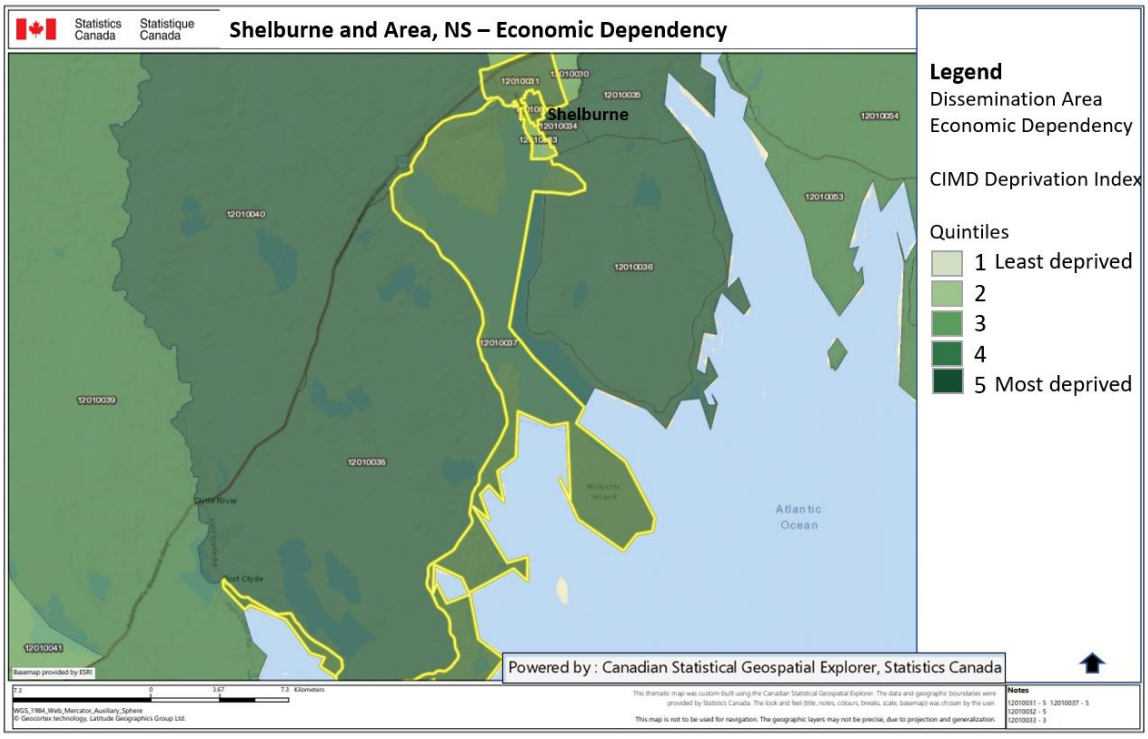

Figure 7. Shelburne and area - Economic Dependency* at 2016
Canadian Index of Multiple Deprivation - (Statistics Canada, 2019)
*Proportion of population aged 65 and older; proportion of population participating in the labour force -15 and over; dependency ratio (population 0-14 and 65 and over divided by population 15-64; ratio of employment population proportion of population receiving government transfer payments.

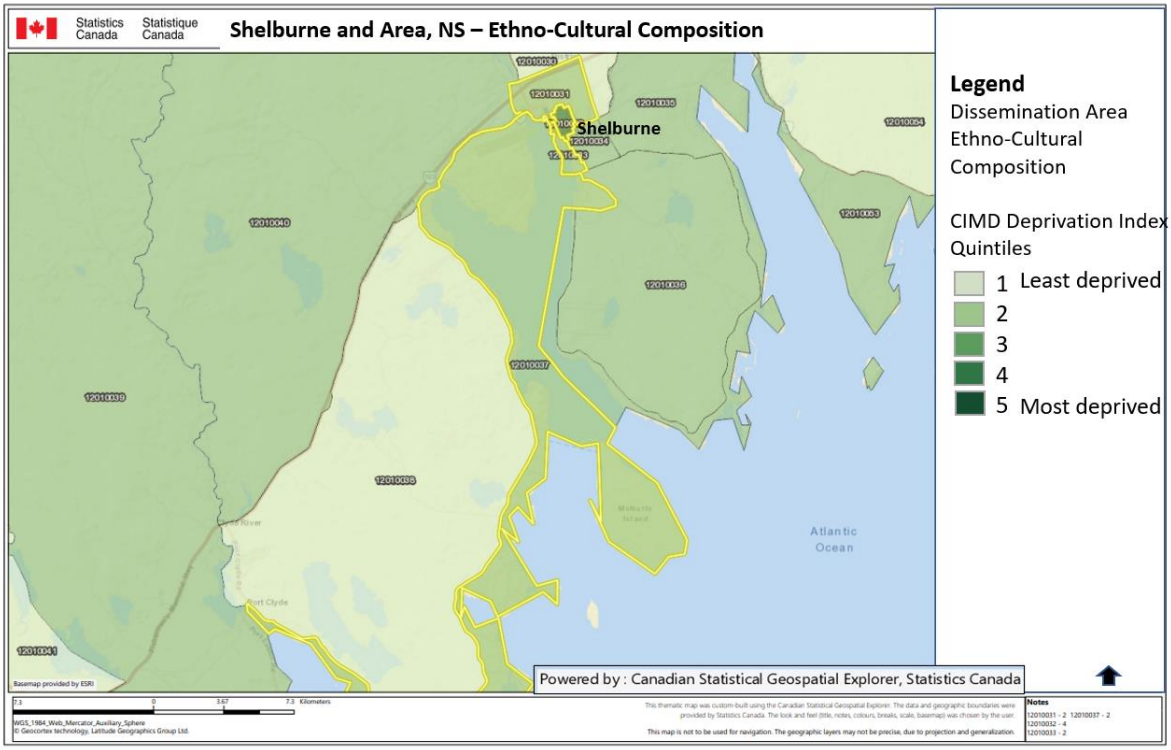

Figure 8. Shelburne and area - Ethno-Cultural Composition* at 2016
Canadian Index of Multiple Deprivation (Statistics Canada, 2019)
*Proportion of population that is recent immigrants; proportion of population that has no knowledge of either official language.

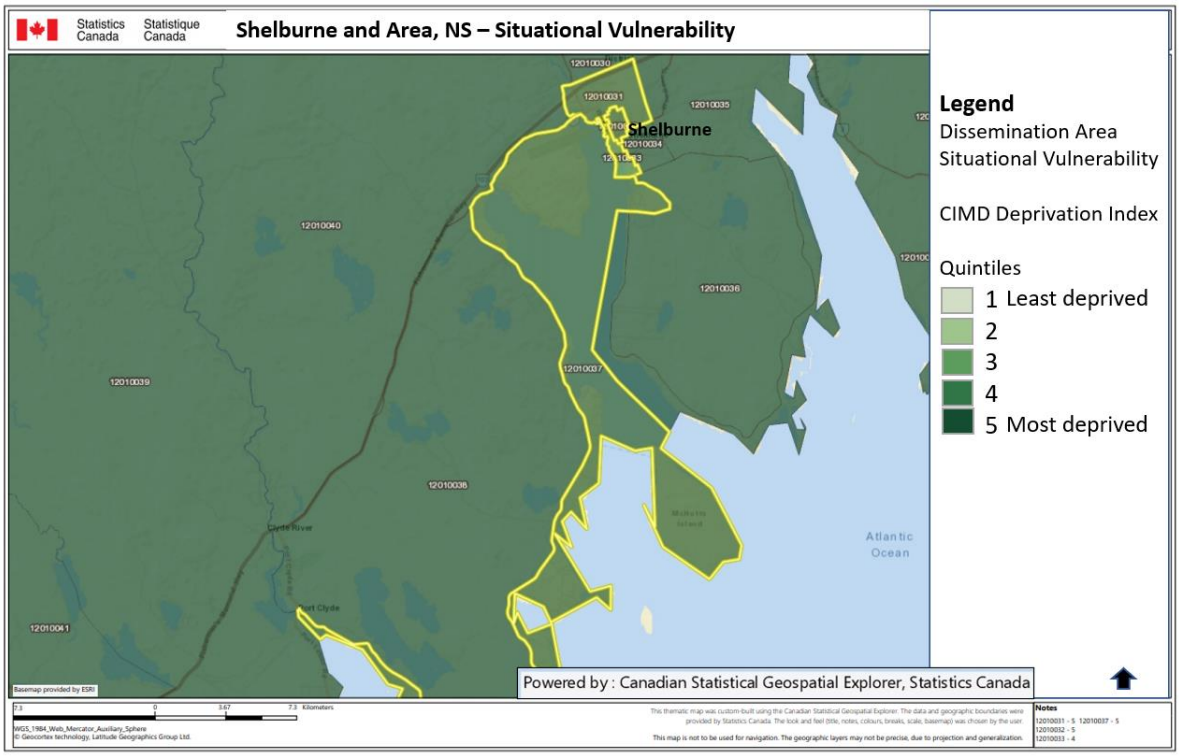

Figure 9. Shelburne and area - - Situational Vulnerability* at 2016
Canadian Index of Multiple Deprivation (Statistics Canada, 2019)
*Proportion of the population that identifies as Aboriginal; proportion of dwellings needing major repairs; proportion of population aged 25 to 64 without a high-school diploma.

Overall, the population of the Shelburne area has characteristics of moderate to high social vulnerability as measured by the CIMD in 2016, and the town of Shelburne demonstrates the highest vulnerability in the area. Although the CIMD values for Ethno-cultural Composition are moderate to low in the rural areas, the CIMD index is high in DA 12010032 in the centre of the town.

Table 2 compares the vulnerability indices measured in 2006 and 2016 for DA 12010032, covering Shelburne's town centre. The indices are different, but comparable. The CIMD replaced the Marginalization Index in 2016. DA 12010032 experienced the greatest change in a deprivation measure—Ethno-cultural Composition over 10 years. The change might be due to increased immigration to the area and, if so, the town and other organizations might look at how to support new members of the community in accessing information or services they might need in emergency situations. Material deprivation which broadly corresponds to Situational Vulnerability also increased.

12010032 - 2006		12010032 - 2016	
Residential Instability	4	Residential Instability	4
Dependency	5	Economic Dependency	5
Material Deprivation	4	Situational Vulnerability	5
Ethnic Concentration	1	Ethno-cultural Composition	4

Table 2. Canadian Marginalization Index (2006) and Canadian Index of Multiple Deprivation (2016) for Shelburne town centre.

Factors indicating residential instability in the population are high number of renters, people living alone, or people who recently moved into the area. The CIMD is higher in the town area than the surrounding rural area, which might suggest more renters in the town, or people recently moving to the town, or more people in town living alone. Factors contributing to high economic dependency include a large proportion of seniors or unemployed people (of working age) in the population. Seniors (65 years and older) are the fastest-growing demographic in Nova Scotia and rural regions, including rural small towns, 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). Factors used in measuring situational deprivation include the proportion of Indigenous people in the population, the population completing high school, and the state of repair of housing. This measure of vulnerability is consistently high across the area.

Social vulnerability and other aspects of vulnerability and exposure to hazard can be considered together to identify the implications of impacts from flooding and erosion. People with limited income and living in housing needing repair (indicated by situational vulnerability) located in a flood zone are vulnerable not only to flooding but also for their ability to recover from it. People displaced from rental housing impacted by flooding and in need of repair may be more vulnerable to longer term housing insecurity after a flood than homeowners. People living alone, may not have close social supports in an acute situation. The CIMD measures suggest moderate (Economic Dependency) to high (Residential Instability, Situational Vulnerability) social vulnerability in populations (dissemination areas) in the vicinity of the waterfront.

Connecting infrastructure at risk to social vulnerability, the town MCCAP (Town of Shelburne, 2014) indicates that Sandy Point Road, which connects the town and the adjacent district of Shelburne to the Roseway Hospital is at risk of flood damage. The road has already flooded in

low areas during storms. While not the only access to the hospital, it is the most direct and commonly used route from the north. Flooding could impede or cut off this important access. Connection to emergency services is essential for everyone in a community, but even more so in communities with a high proportion of elderly residents with greater reliance on these services.

Governance, Policy and Planning

The town of Shelburne governs and manages community development, planning, and land use through its statutory plan and regulations and stand-alone policies, and through guidance documents. The Municipal Planning Strategy (Town of Shelburne, 1988) directs community planning and development through policy, while the land use by-law (Town of Shelburne, 1988) describes and regulates land use zones within the town's boundaries. Non-statutory guidance plans and strategies include the Integrated Community Sustainability Plan (Town of Shelburne, 2010), the Business District Revitalization Plan (Ekistics Planning and Design, 2011), the Municipal Climate Change Action Plan (Town of Shelburne, 2014), the Economic Development Strategic Action Plan (Town of Shelburne, 2016), and the Shelburne Town Council Strategic Plan (Town of Shelburne, 2017). These guidance documents provide overall strategic direction for the town, guide the town in policy and plan-making, community development, and economic development in line with sustainable development goals and identify climate change hazards, risks, impacts and actions for climate mitigation and adaptation.

Land use and zoning

Policies in the Shelburne Municipal Planning Strategy cover protection of the historic waterfront, guiding the location and arrangement of residential, commercial, and industrial development, and ensuring adequate supply of land for community growth in these areas. The zoning by-law implements the policies through the following land use zones and regulations:

- Downtown Commercial (C-2)
- Historic Waterfront (H-W)
- Industrial (IND)
- General Residential (R-1)
- Lower Density Residential (R-2)
- General Commercial (C-1)

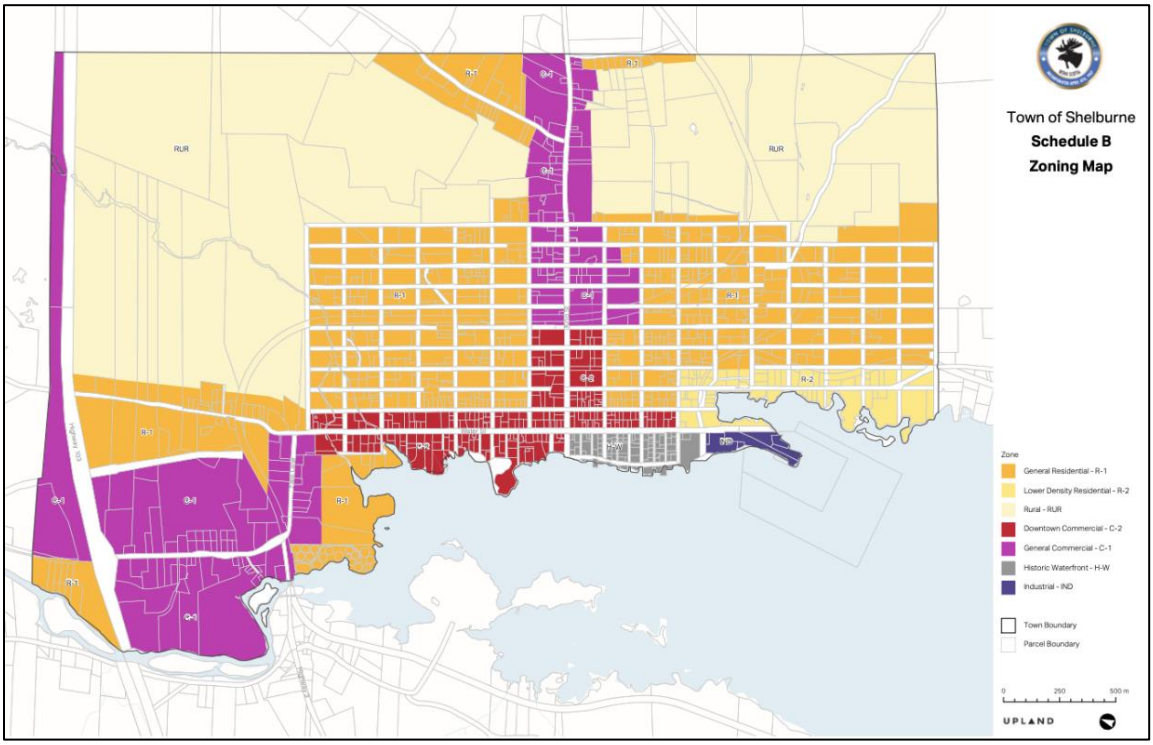

Figure 10. Land use zoning for the town of Shelburne (Town of Shelburne, 1988, amended to 2021)

While the zoning might suggest distinction between land uses, the zoning is general in practice. It is inclusive for Residential and Commercial, Commercial and Industrial, and Historic Waterfront and Rural and Commercial zones. For example, uses that are permitted in Rural and Commercial zones are also allowed in the Historical Waterfront zone. There is no open space or park zoning although parks are permitted uses in the General Residential (R-1) zone and, by extension, where R-1 uses are accommodate in other zones, and similarly for institutional uses.

Notably, there are no environmental protection or natural area conservation policies or regulations in the statutes, nor recognition of climate change. There are no building setback requirements from watercourses for properties that abut shorelines, including the coast or the steams flowing through the town. While the plan and by-law date to 1988, they contain amendments to 2021, but there are no amendments addressing open space or environmental protection. The later guidance documents are therefore significant for the strategic direction they

provide in addressing the environmental, social, and economic impacts of climate change. At the time of compiling this case study, the town was undertaking a plan and by-law review.

The town places great value on its historic waterfront which emerges as a key element in the economic and sustainable development strategies. The town's Historic Waterfront zone strives to protect the character of the area. The town also has an industrial waterfront, the Port of Shelburne, and a yacht club. The town is compact and walkable, with the waterfront a prime pedestrian area which connects to a rail-to-trail multi-use path.

The historic and modern working waterfront are core cultural and economic land uses for the town but lack policies and regulation to protect them from climate change impacts. As noted in the section 'Hazards and Risks', the town relies on shoreline armouring for protection which has already proven to be ineffective against flooding in recent large storms and is deteriorating in some locations.

The town of Shelburne could implement development controls along its coast to protect property and the coastal environment. Shelburne, like all municipalities in the province, has the power to protect buildings and other infrastructure, people, and the environment by establishing setbacks and standard lot sizes that consider climate change projections and are adaptive to changing conditions.

The Town of Shelburne Bank Stabilization and Living Shoreline project

A living shoreline is a nature-based approach to shoreline protection using natural habitat such as a salt marsh or reef. Living shorelines may or may not include extending the shoreline, removing seawalls, or using a combination of hard engineering and vegetation (Gittman, et al., 2014). Living shorelines have been shown to be effective in dissipating wave energy, reducing erosion, and creating habitat (Gittman et al., 2014; Gittman et al., 2016; Mitchell & Bilkovic, 2019). The goal of a living shoreline is to create an environment that adapts to changing conditions (Mitchell & Bilkovic, 2019). Although not maintenance-free, the level of maintenance for a living shoreline should decrease over time. Shelburne's sheltered harbour favours implementation of a living shoreline.

The previous sections have described how Shelburne relies on sea walls, stone armouring, and infilling to protect its waterfront. The town acknowledges that the upkeep of these traditional protection measures could become a burden on limited resources (Town of Shelburne, 2014). The Town identifies much of its existing armouring as resistant to wave erosion, although some sections appear vulnerable to erosion behind the wall or are slumping. There is evidence that the armouring is no longer able to address flooding risks. The town was willing to pilot a new approach to shoreline protection.

The Process

In 2018, Coastal Action, a local ENGO that works in communities on the South Shore of Nova Scotia, approached the town of Shelburne about installing a living shoreline along the town waterfront. Coastal Action had been implementing green stormwater management projects through its Green Streets project, funded by the Intact Foundation. As of 2019, Coastal Action had designed and installed 22 small-scale, nature-based storm water management adaptation projects like bioswales and rain gardens that help capture runoff and control localized flooding (Johnson, 2019).

Overland runoff can contribute to bank erosion at the coast so managing the runoff to and at the shore can help stabilize banks. A living shoreline installed at a bank can absorb and slow overland flow while also protecting against wave erosion. The living shoreline project in the town of Shelburne began as part of the Green Streets project.

The town of Shelburne owns a limited amount of land on the waterfront; most of the shoreline property is privately owned. It was challenging to identify land for the project that was both publicly owned and appropriate for a living shoreline. Coastal Action initially identified two locations where a living shoreline would have been appropriate to mitigate runoff, but discussions were only beginning when the municipality armoured the shoreline at those locations. Fortunately, the town and Coastal Action identified another location of 15 m along a gravel parking lot on Dock Street in the historic waterfront district where the bank and boulder

armouring were slumping and required attention. The town reserved this section of the waterfront for the project (Stewardship Centre for BC, 2020).

Coastal Action engaged CB Wetlands and Environmental Specialists, Inc. (CBWES Inc.) to design the project, including the living shoreline site plan, plant selection and installation, and site management and maintenance. CBWES Inc. noted that the need for maintenance would decrease with time as the living shoreline becomes established. After five years it should be mostly self sustaining and require only light maintenance such as pruning of the shrubs to maintain their health and desired size, which the town agreed to provide (Town of Shelburne, personal communication, 2020).

The Shelburne living shoreline installation uses logs, haybales, and native vegetation to naturalize and stabilize the bank (Figures 11 and 12). A log border at the edge of the parking lot marks the site boundary and prevents cars from driving onto the newly restored area. Logs are 20-30 cm in diameter, 1.8-2.4 m long, and secured with wire and ground anchors. Haybales limit potential wave scouring, absorb peak flows, deflect wave and wind energy, and provide nutrients.

There are four zones of vegetation planted between the top of the bank and water. The first zone closest to the parking lot includes, herbaceous perennials, flowering perennials, and small fruit-bearing shrubs. In addition to protecting from overland flow, the vegetation provides visual appeal. The second layer of vegetation is approximately 1.2m wide. A variety of medium-sized shrubs were planted in this zone to increase plant and habitat diversity. The third zone consists of large shrubs to protect the second zone of vegetation above it from wind and wave action. A row of haybales separates the third zone from the transition zone to the water, The transition zone, 2.4-3.7m wide. consists of salt-tolerant grasses and perennials. Vegetation reduces overland flow, reduces wind and wave energy, and increase shore stability.

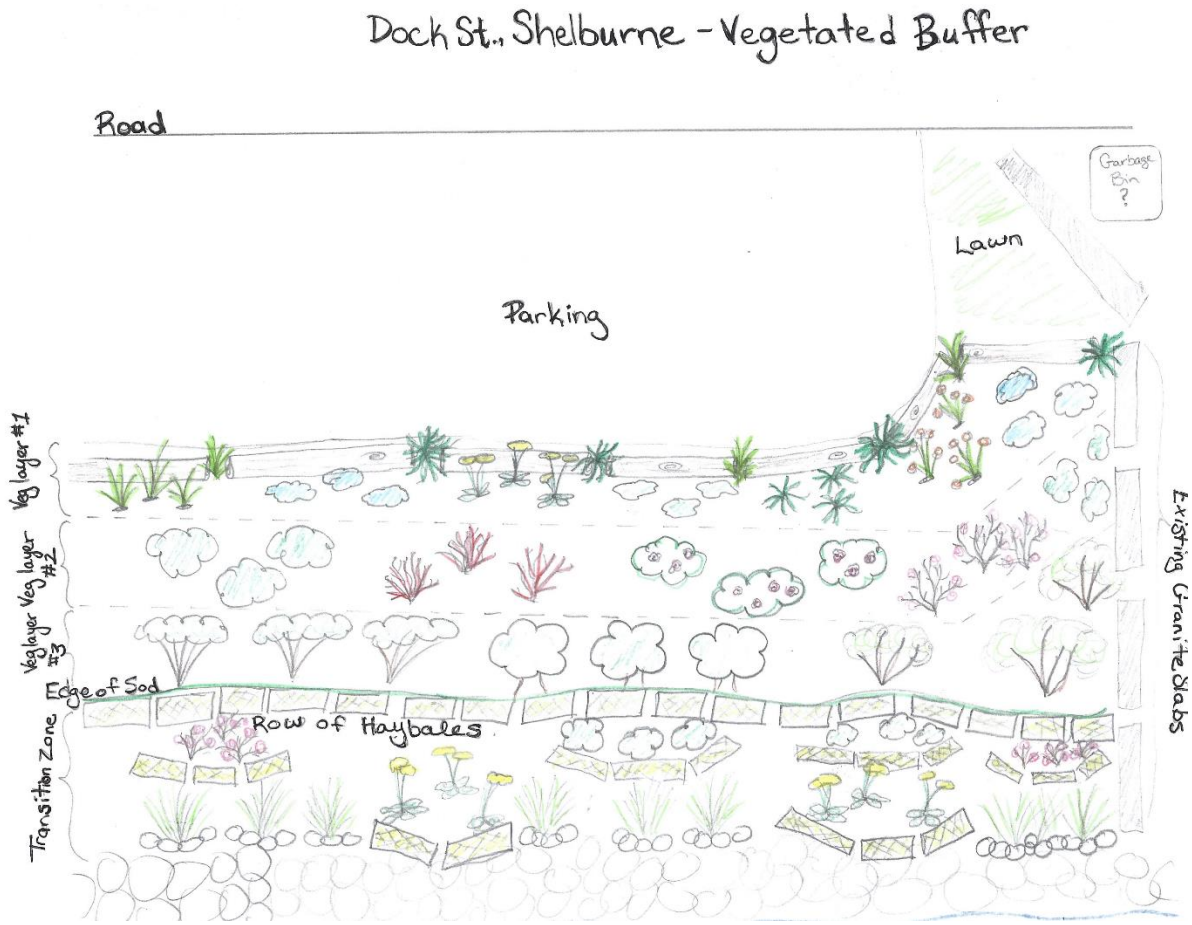

Figure 11. Design for living shore bank stabilization, Dock St., Shelburne (CBWES)

Coastal Action coordinated the living shoreline implementation event and engaged municipal staff to help gather local volunteers (Town of Shelburne, personal communication, 2020). Over 40 community volunteers, municipal staff, and project partners came together to install the living shoreline over a weekend in August 2020 (Town of Shelburne, personal communication; Stewardship for BC, 2020).

Figure 12. (Before implementation (March, 2020) and after implementation (August, 2020) (Photo credit: Coastal Action, CBWES)

<u>Provincial Government</u> Nova Scotia Department of Natural Resources and Renewables (NSDNRR), formerly Lands and Forestry (NSDLF) Nova Scotia Department of Environment and Climate Change (NSDECC)	Permits for coastal infilling, rock sills and breakwaters, armouring below the highwater mark Environmental Assessment Approval for alteration to wetlands and watercourses
<u>Federal Government</u> Department of Fisheries and Oceans Transport Canada	Fish habitat considerations Navigation
<u>Municipal Government</u>	Adherence to land use zoning requirements. Site grading and drainage.

Table 3. Permitting and other regulatory considerations that may be needed for a living shoreline.

Altering a shoreline requires approvals from provincial and federal levels of government (Table 3) although the same approvals would be required for constructing a seawall. Therefore, no additional regulatory approvals would be required to implement a living shoreline that are not already needed for the shoreline armouring already in use in Shelburne.

Installing a living shoreline is considered shoreline alteration and therefore may require permits and approvals depending on its position at the shore. A living shoreline that extends below the normal highwater mark is considered habitat alteration under the *Fisheries Act* and would require federal government permitting through Department of Fisheries and Oceans. The provincial

government has permitting requirements for construction work that extends into the intertidal zone since this is usually Crown land that is under the administration and control of the Minister of Natural Resources (Province of Nova Scotia, 2017). Permits would also be necessary for work that interferes with a stream course or wetland. There are also site management requirements for sediment control. Regulations under the provincial Coastal Protection Act (Government of Nova Scotia, 2021a), once introduced, will regulate construction impacts and the impacts of structures such as wharves, boat ramps, and shoreline armouring in the tidal zone. Restrictions will not apply to permitted projects or activities like living shorelines, undertaken to conserve or improve ecosystem function, however (Province of Nova Scotia, 2021). Projects must also take into consideration requirements of municipal land use zoning bylaws although such bylaws do not typically constrain work that might be considered landscaping. There may also be the need to consider alterations to site grade and drainage, such as a requirement to not direct drainage onto neighbouring properties, for example.

The Shelburne living shoreline installation is stabilizing the bank above the normal highwater mark. Since it does not extend into the tidal zone, or impact a wetland or stream, it does not require federal or provincial permitting. It is wholly contained on municipal land and is designed in part to manage overland drainage to the shore to prevent bank erosion; drainage is not being directed to other properties. There are no zoning constraints to this installation

Expected Outcomes and Project Benefits

The Shelburne living shoreline project

- demonstrates an alternative to shoreline hardening for erosion protection, with additional benefits
- built partnerships between the town, an NGO, and citizen volunteers
- built institutional capacity for nature-based adaptation
- improves the shoreline aesthetic
- demonstrates nature-based adaptation in Nova Scotia

The Shelburne Living Shoreline Project restored approximately 93 m^2 of self-sustaining, natural shoreline (Stewardship for BC, 2020). The living shoreline is predicted to absorb an average of

27.3 m^3 of storm water per year thereby reducing overland flow, erosion, scouring, and flooding impacts at this 15 m section of the waterfront. The municipality intends that this project provide the community with a best practice example for addressing shoreline climate change issues (Town of Shelburne, personal communication, 2020). It also improves the shoreline aesthetic along a section of the historic waterfront.

The project built partnerships across the community and engaged residents with hands-on involvement in shoreline restoration and climate change action (Table 3). The project also gained visibility through the Stewardship Centre for BC which runs the Green Shores program, educating about and promoting the use of living shoreline techniques.

Key Actors:

Coastal Action	Project lead, event coordinator, labour, public engagement, outreach
CB Wetland and Environmental Specialists (CBWES)	Technical consultant
Town of Shelburne	Labour, public engagement, outreach, volunteer recruitment, on-going maintenance
Shelburne volunteers	Workers installing the living shoreline
Stewardship Centre for BC	Included the Shelburne Living Shoreline Project in the Green Shores for Coastal Development Credits and Ratings guide. The project could receive between 2-5 points.

Table 4. Key actors in the Shelburne living shoreline project.

Education and consultation were key aspects, leading to high volunteer turn-out. For success with the living shoreline in the long term, not only to ensure plant health and the desired bank stabilization and erosion protection, but also as a demonstration project, it is important to communicate plans and commitments across the organizations involved to carry through with monitoring and maintenance.

Lessons, Barriers, and Drivers

The Shelburne living shoreline project did not encounter many barriers once it started. Barriers in the lead up to the project included lost opportunities for two municipal sites when the town

hardened the shoreline in those locations before the project could get underway. Fortunately, a third site was available.

Institutional barriers can include lack of financial and/or staff capacity to plan for, design, implement, and monitor a nature-based project like this one, and lack of will to consider, let alone adopt the approach. In this case, barriers were well-matched by drivers that moved the project forward. Coastal Action was already working in the area on other stormwater projects, so was known to the municipality. The municipality had a problem it needed to address – the slumping boulder seawall and erosion – and was interested to try the approach. The size of the site fit the budget for the work. The parking lot backing onto the shore is relatively low-risk infrastructure against which to test a new approach for erosion protection but has high visibility because it is not blocked from view by a building. The partnership arrangement worked. Coastal Action used grant funding to hire a technical specialist (CBWES), and coordinated volunteers to help install the living shoreline. The town provided the property, supported volunteers, and agreed to maintaining the site into the future.

With a commitment to on-going involvement, it will be important that information about this new piece of green infrastructure is communicated across municipal staff and units. Continuing to involve the public with information about the site also helps to maintain community interest. Having contributed volunteer labour, community members are already invested in the project. Their interest and a successful project could motivate the town and private lands owners to install more living shorelines.

Regulatory requirements are not barriers. They are necessary for project success. They protect the environment, the infrastructure, and occupational health and safety. But, in the coastal zone with overlapping jurisdictions, meeting all the requirements can be complicated and might be confusing for proponents trying to navigate the permitting layers. Jurisdictional overlap was not a concern for the Shelburne living shoreline because it is positioned above the normal highwater line, nor did it impact stream courses or wetlands. There were no federal or provincial regulatory requirements. The project has brought environmental benefits to the site including habitat and erosion control, aesthetic improvements, and potential cost reductions for slope protection.

Municipalities do not have jurisdiction in the marine space, but they do have jurisdiction in the coastal zone. They can set the tone for coastal development and protection. Municipalities can permit different types of land use along the coast landward of hightide through policies and bylaws. Coastal setbacks, or buffers, set up as environmental or conservation zones, are tools to protect shore habitats from development impacts, to preserve the shoreline protection provided by natural coastal structures, and to protect development from flooding and erosion. Shelburne does not have a coastal buffer or setback, but the introduction of the new regulations for the Coastal Protection Act (Government of Nova Scotia, 2021) will address that gap in municipal coastal regulation.

In 2019, the province adopted the *Coastal Protection Act*. This act aims to protect the coast from harmful coastal development by designating a "coastal protection zone" landward and seaward of the high-water mark (Province of Nova Scotia, 2019a). At the time of this reporting, the regulations to enforce the legislation were being developed as are implementation tools including province-wide flood line mapping (Province of Nova Scotia, 2021). The goal of the legislation is to ensure that new construction is in areas outside the reach of coastal flooding and erosion and to protect coastal processes and ecosystems from construction impacts of wharves, boat ramps, shoreline armouring and other structures (although repair to and maintenance of existing structures will not be affected by the regulations, unless there is an increase in size). As noted above, these restrictions will not apply to permitted projects or activities like living shorelines undertaken to conserve or improve ecosystem function. (Province of Nova Scotia, 2021). Municipalities will implement the coastal protection zone through the development application and building permitting process. The zone may be integrated into municipal land use planning and zoning, greatly enhancing tools for land use management along a municipality's shoreline.

As of December, 2019, the province of Nova Scotia now requires municipal land-use planning under the Municipal Government Act (Province of Nova Scotia, 2019b). As noted already, Shelburne does not have coastal setbacks and much of its shoreline is already developed. But, the new coastal protection zone under that Coastal Protection Act regulations will fill that gap for regulating new development at the shore. At the time of this reporting, Shelburne was reviewing

its municipal plan and by-laws. Plan review or renewal is an opportunity for a community to re-imagine its future and examine community development priorities. Shelburne has completed sustainability, climate change action, economic development, and business district revitalization planning. Shelburne values the economic and cultural assets of its waterfront and knows the risk posed by climate change to these assets. Hardening the shoreline is the town's 'go-to' approach, but the cost of repair and maintenance, noted in the town's MCCAP, and the lack of co-benefits from hard infrastructure may be drivers for the living shoreline approach that provides protection along with ecosystem service, aesthetic, and cost benefits.

Municipalities can provide an example for good shoreline management to other property owners. Setting development like parking lots and buildings back from the shore, and restoring shoreline to healthy natural conditions, demonstrates good practices. By installing a living shoreline, Shelburne is providing an example for property owners in the town as well as other communities to follow.

Even though much of the Shelburne shoreline remains armoured, sections can be restored to a natural state as the old infrastructure deteriorates, as happened along this short section of Dock Street. At the time of this reporting, Shelburne does not have plans to install move living shorelines (town of Shelburne, personal communication, 2020) but monitoring this living shoreline for performance that includes successful establishment of the vegetation and erosion prevention will be a driver for expanding the living shoreline approach. A successful living shoreline can also encourage private property owners to adopt the same approach.

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