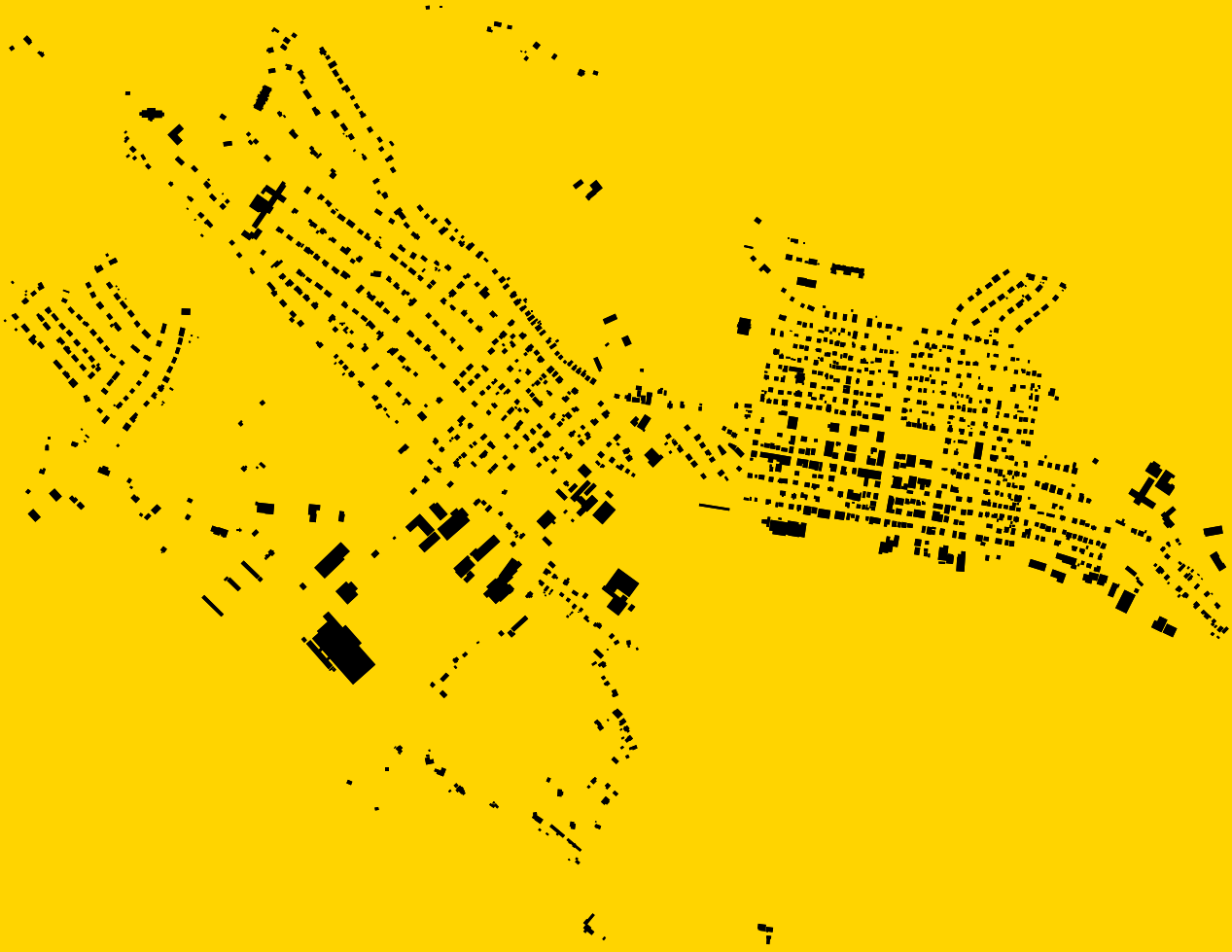
5/8

DISCUSSION PAPER

OCTOBER 2019

ENVIRONMENT AND SUSTAINABILITY



PROJECT LUNENBURG

Discussion Paper 5/8
Environment and Sustainability
October 2019

Project Lunenburg
Town of Lunenburg Comprehensive Plan

This report was prepared by Upland Planning and Design,
in association with CBCL Limited.

UPLAND

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Introduction

The natural environment fundamentally shapes our communities. Opportunities of the ocean and shoreline are the foundation of prosperity to the town. The topography and geology of Lunenburg connect it to the greater region, determine where clean drinking water is available; where forests grow; and where it is easier or more difficult to build infrastructure. The natural environment has shaped how Lunenburg has developed and changed over time, and will continue to do so.

This discussion paper is the fifth in a series of eight which provide context for the Town of Lunenburg and lay the foundation for the Town's Comprehensive Community Plan. This paper examines Lunenburg's natural environment and how the impacts of climate change could affect the town and surrounding area. It also provides an overview of the existing services and resources, as well as opportunities and alternatives.

LAND & HABITAT

Lunenburg has a small community footprint within a broader regional ecological area. How is Lunenburg situated with the lands of the South Shore?

Nova Scotia uses an ecological land classification model as a standardized method for describing the geography of its ecosystems. This model operates using a hierarchy of spatial scales (Table 1), linking ecosystems of different levels. Within these levels, landscapes are classified using environmental components such as bedrock geology, surficial materials, landform, present-day climate, and topography. Vegetation is also frequently utilized to understand an ecosystem.

Lunenburg lies within the Atlantic Maritime ecozone, and within that the Atlantic Coast ecoregion. This ecoregion covers a narrow strip along the coastline of Nova Scotia where the climate is strongly influenced by the Atlantic Ocean and has been characterized by cool, wet summers, and mild, wet winters. The ecoregion is exposed to high winds, high humidity, and fog during summer and fall; also experiencing a slow spring warm-up, and a frost-free period that is the longest in the Maritime provinces.

Within the Atlantic Coast ecoregion, Lunenburg is situated in the South Shore ecodistrict. This ecodistrict extends inland at some locations approximately 10 km and stretches about 180 km from the Aspotogan peninsula, west to Pubnico Harbour. The coastline is defined as irregular with many bays, inlets, islands, and headlands.

The climate of the South Shore is influenced by the warmer waters of the Gulf Stream more than other areas of the province. This allows the ecodistrict to be cooler in summer and milder in winter than the adjacent inland ecodistricts, and further distinguished by frequent periods of fog. Air flows and onshore winds elevate humidity, increase exposure, lower effective growing season temperatures and moderate annual temperatures.

Ecological Unit	Map Scale	Criteria for delineating units
Ecozone	1: 1 000 000	Global or continental climate as reflected by vegetation
Ecoregion	1: 500 000	Provincial climate as expressed through soils and vegetation
Ecodistrict	1: 250 000	Subdivisions of ecoregions characterized by distinctive assemblages of relief, geology, landform, soils and vegetation
Ecosection	1: 50 000	Enduring features of the ecodistrict such as soil drainage, topography, landform and soil texture. These usually arrange as repeating assemblages in the ecodistrict
Ecosite	1: 10 000	A uniformity of parent material, soil moisture and nutrient regimes and vegetation as expressed by slope, slope position, aspect, and exposure

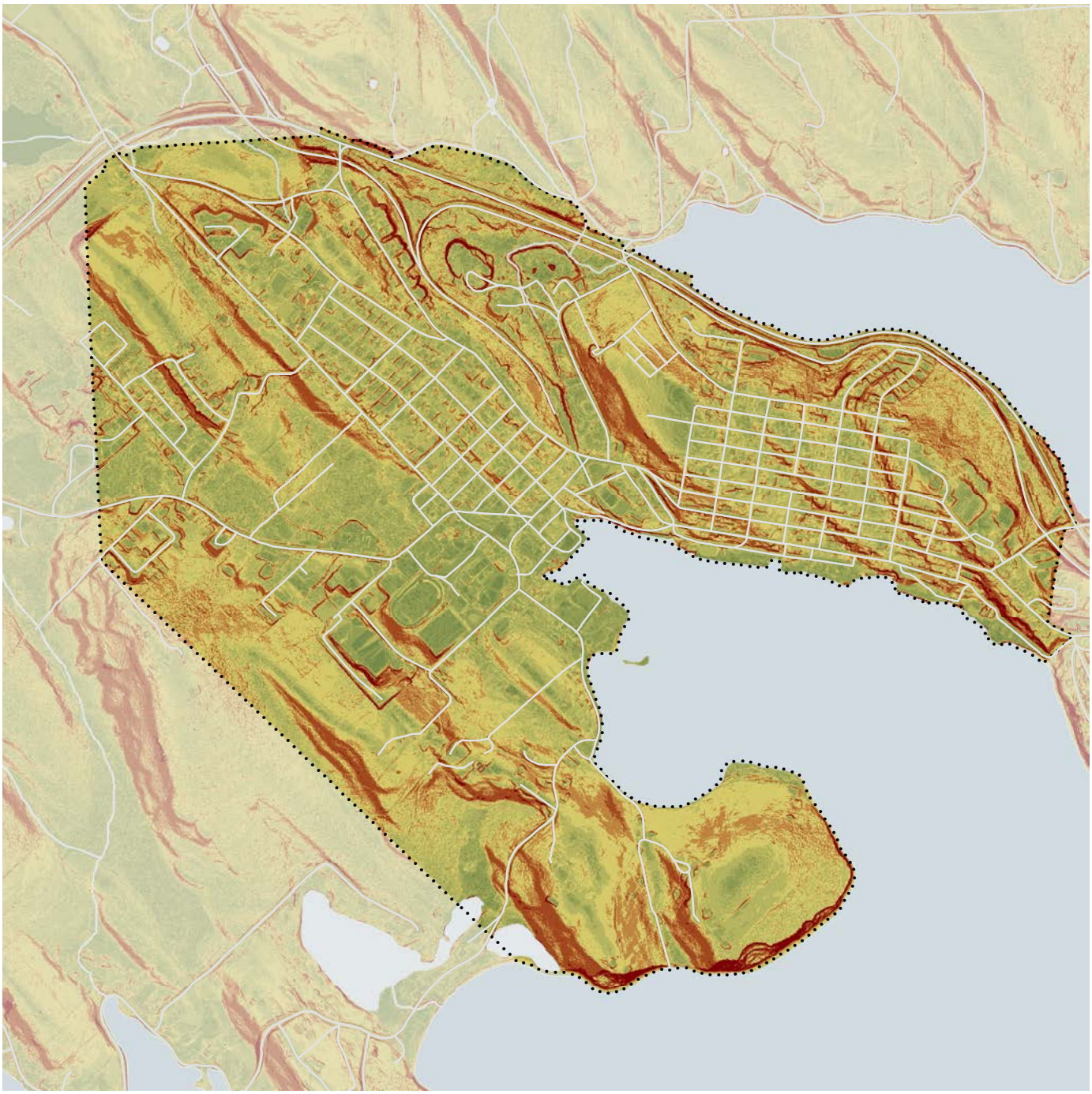
Table 1: Ecological Land Classification Guide

Topography

One of Lunenburg's defining characteristics is the town's orientation and positioning along and towards the waterfront. The town is laid out with little regard to the steep drumlin it sits upon, which runs to the waters edge, challenging the streets that are situated perpendicular to the waterfront.

Drumlins are geological land masses that are formed under moving glaciers and often manifest as oval hills. The drumlin which Lunenburg sits upon provided a natural buffer to the surrounding landscape for early development of the town. To the south there was the harbour, and to the west, east, and north were steep slopes that were impractical to develop on. When Lunenburg expanded and New Town was formed, it was built in the more low-lying areas to the West.

Significant topographical elements of the Town include Tower Hill - the highest peak, the abrupt slope of Old Town to the waterfront, and the low lying area west of the head of the harbour.


Slope (%)
0
1
4
10
17
25
50
100

Surficial Geology

The Atlantic Coast of Nova Scotia has been submerging extremely slowly, over the last 10,000 years. This slow sinking has resulted in a highly irregular coastline with drowned estuaries and headlands, fringed with islands. The underlying geology is primarily composed of granite, quartzite, or slate and a landscape of low hills and hummocks, extensive flats, and scattered drumlins.

The coastal ecoregion is dissected by many fault-controlled river and lake systems that drain into the ocean, closest to Lunenburg is the LaHave River.

Freshwater lakes are plentiful in the granite landscapes but elsewhere are less common, often shallow and associated with bogs. Brackish lakes and ponds are common behind barrier beaches.

Water Bodies

The ocean is, of course, the most significant water body in Lunenburg. It is not only the dominant environmental feature, but it is also essential to the town's identity and economy.

Fresh water bodies can be found outside of the town's borders with Masons Pond, Feeners, Dares, Cantelope, and Steverman Lakes all nearby. Water bodies are a key feature of the landscape, which help to manage and control surface drainage, and serve as important habitat to plants and wildlife. Dares Lake is also the municipal water supply.

Vegetation

Wildlife and vegetation in the South Shore ecodistrict includes relatively common species of plants, animals, and other organisms, along with some species that are rare and/or at risk in Nova Scotia.

The vegetation of Lunenburg can be described as the "Coastal Mixedwood Hills and Drumlins" element[1] of the South Shore ecodistrict. This element is characterized by well-drained drumlins and low hills, primarily along the coast of the ecodistrict.

Forests of black and white spruce with balsam fir are the dominant species on sites exposed to the ocean, inland on more sheltered sites yellow birch and red maple are co-dominant within the forest canopy. Red spruce and white pine are also possible on the sheltered sites farther inland. Where forests have been cleared for settlement and later abandoned, forests of white spruce and white pines are common. This coastal forest has more diversity than elsewhere in the Atlantic Coastal ecoregion and this may be attributed to warmer on-shore temperatures and the mixing of warmer waters of the Gulf Stream with the Nova Scotia Current.

Where balsam fir is dominant, the shrub layer is typically regenerating fir with scattered lambkill, false holly, and mountain-ash. Herb layer diversity is low. These forest types occur on a variety of topography features such as drumlins and low-level hills. High winds and exposure limit tree height. Embedded within forests are barrens, open woodlands, bogs, swamps, and fens.

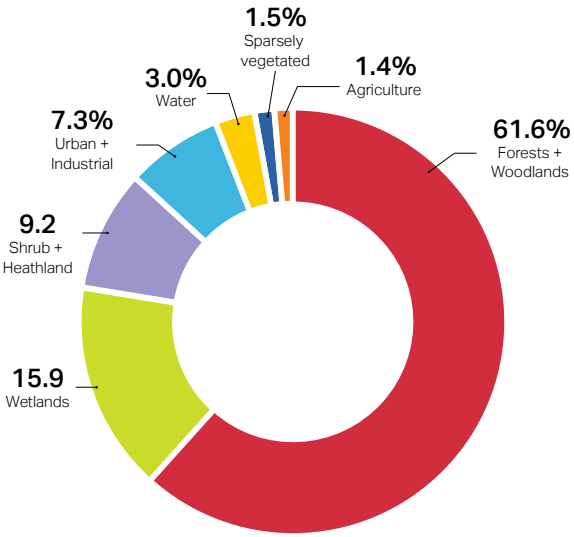


Figure 1: proportion of land area within the South Shore ecodistrict.

1 Landscapes are composed of smaller ecosystems, known as elements. Elements are described by their physical (e.g. soil, landform) and ecological features (e.g. climax forest type).

Species at Risk

While Lunenburg has a small community footprint, the natural habitats of the greater region are ecologically diverse and home to a wide range of species-at-risk. Inland aquatic habitats and rock barrens host the Long's Bullrush, Golden Crest, Redroot, and Eastern Lilaeopsis, among others. Both the Blanding's and Wood Turtles have been spotted within the region. The wetlands of the region are also home to the Eastern Ribbonsnake.

Piping Plover's are classified as endangered birds within Nova Scotia and Canada due to the deterioration of their habitat and natural predation, currently only 40 breeding pairs remain in Nova Scotia. Migratory bird habitats along the coast are sensitive to any environmental change or degradation and can be negatively affected by human development. With less than 1% of old growth forest remaining, forest biodiversity is at risk throughout the province.

The Atlantic Whitefish also calls the region home, found in the Petite Rivière watershed and representing the last remaining wild population of the species in the world. Currently they are listed as endangered under the Federal Species at Risk Act as well as the Nova Scotia Endangered Species Act.

The more inland Acadian forests of the region are home to flying squirrels. They are sensitive to forest fragmentation, and cannot live in isolated woodlots. Competition for food has also limited the size of this species population. It is speculated that pesticide use could be affecting populations as well, since these squirrels feed mainly on insects.

The specific reasons for population decline vary from species to species. However, a common cause, or at least contributing stressor, is the loss or damage of habitat human development. While direct protection of species at-risk is the responsibility of provincial and federal agencies, the Town can play a role when considering development proposals in areas with known species-at-risk habitat, and through education of developers and property owners.

Nova Scotia is already seeing warmer, wetter winters and hotter, drier summers compared to a few decades ago. The province is experiencing more frequent flooding and dry spells, and more frequent extreme weather events, compounded by rising sea levels. These climate change impacts will continue to affect coastal communities like Lunenburg, including their infrastructure and industries. Anticipated climate change impacts for the Town of Lunenburg include:

- **Warmer summers and droughts**

Even through increased amounts of precipitation can be expected as a result of climate change, soil conditions can still be very dry because of warmer temperatures and increased evaporation. Lunenburg will be affected by increased temperatures. There are currently about six hot days (exceeding 30°C) per year, but these are projected to increase to almost 32 days per year by 2080. Currently, there are zero very hot days (exceeding 35°C) per year, but these are projected to increase to 2.6 per year.

The primary concern about warmer summers is the risk of drought and strain on the Town's water supply. Falling water levels in streams, ponds and wetlands will also disrupt habitat for plant species and wildlife.

- **Warmer winters and more rain**

With increased temperatures, warmer winters with fewer cold (less than -10°C) and very cold days (less than -20°C) can be expected. Winter precipitation brings concerns about freezing rain and icy road conditions. Freeze-thaw cycles can also put stress on the built environment, such as concrete structures and asphalt roads, potentially resulting in cracks and potholes. As the climate warms over the long term, freeze-thaw cycles will decrease, but in the short and mid-term communities can anticipate freeze-thaw cycles as a potential impact in the winter months. Fluctuating winter climate conditions will also impact the timing and intensity of snow melt and spring run-off, which may impact the timing and intensity of potential flooding.

- **Invasive alien species**

An invasive alien species is one introduced outside its normal distribution, whose establishment and spread can affect ecosystems, habitats, or other species. In Lunenburg, Japanese knotweed and European green crab are locally relevant threats or existing issues. The Hemlock woolly adelgid and Emerald ash borer are emerging as regional threats.

Warmer winters combined with warmer summers are expected to hasten the spread of invasive species. Although not technically considered an invasive, climate warming and other environmental changes have contributed to the expansion of the range of several tick species into higher latitudes in North America, including Nova Scotia's south shore. It is anticipated to result in greater prevalence of tick-borne diseases including Lyme, as suitable seasons for tick activities increase.

- **Hurricanes, lightning, and wind**

Storms and hurricanes can bring high winds and lightning, which can damage property and critical infrastructure. Power and communications lines are especially vulnerable to high winds. Wet soil conditions can compound the impacts of storms, lightning and wind, as root systems and tree stability may be affected. Lightning strikes have the potential to cause fires in either treed areas or buildings.

- **Increased precipitation amounts, intensity, and flooding**

With climate change, increased amounts of precipitation and more intense rainfall events are anticipated. A 5% increase in the amount of rain by the 2020s, 9% by the 2050s, and 16% more rain by the 2080s can be expected. Heavy, sudden storms are concerning, but smaller slow moving storms can also bring heavy amounts of rainfall and pose flood risks.

- **Erosion and landslides**

Landslides are considered a minor, rare, and a small-hazard risk in Lunenburg. Coastal erosion is a major concern and could damage properties and infrastructure, contaminate water, disrupt habitat, and cause road access disruptions.

COAST

Lunenburg features a proud seafaring history that continues to be reflected in its ties to the waterfront. How can Lunenburg adapt to changing tides and develop with the coast in mind?

Figure 2: Sea level change at the Fortress of Louisbourg, Nova Scotia.

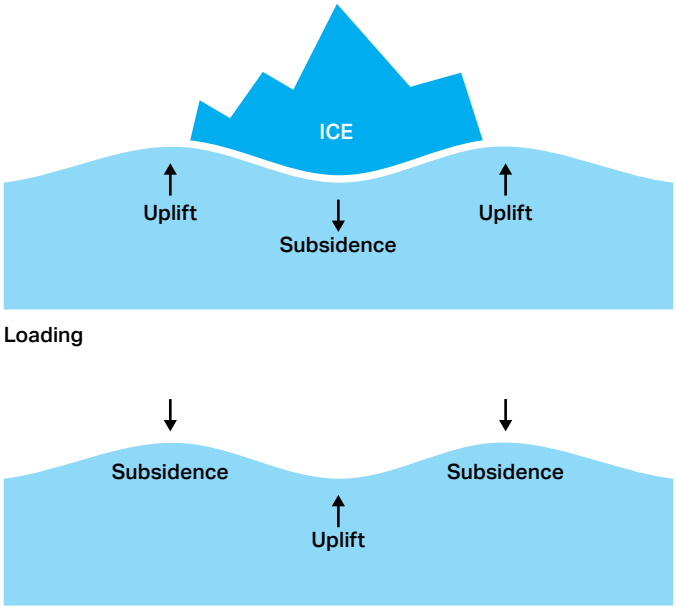


Figure 3: As the earth's crust rebounds from melting ice sheets, areas including Nova Scotia subside.

There is overwhelming evidence that suggests the earth's climate is changing. A key indicator of climate change is the increase in the global mean sea level. Global sea levels rose through the 20th century and are predicted to continue to rise through the 21st century and beyond. Much of the rise in sea levels can be attributed to the melting of glaciers, ice sheets, and ice caps, and the thermal expansion of oceans (as water is warmed, it takes up a greater volume).

Sea level rise threatens to increase flooding in coastal communities around the world. The south coast of Nova Scotia has been shown to have significant sensitivity to sea level rise and associated storm impacts due to its position in the Gulf Stream. This will affect coastal communities like Lunenburg and its infrastructure and industries.

Land subsidence could exacerbate the effects of sea level rise along Nova Scotia's coastline. Land subsidence results from the process in which the earth's surface gradually rebounds from the melting of the North American ice sheets. As areas of the earth's crust rebound upward where the ice sheets once sat, regions on the periphery, including Nova Scotia, subside downwards. The combined effects of global sea level rise and crustal subsidence determine the local sea level rise of 0.30 m in Nova Scotia over the 20th century.

Finally, storm surge will further the impacts of sea level rise. Storm surge describes the difference between the predicted tide and what is actually observed at a location. Storm surge is often caused by onshore winds and storms that result in a higher than predicted tide. The intensity of a storm surge also depends on the orientation of the coastline with the storm track. Although storm surges are temporary, they can cause extensive damage. As extreme weather hazards such as storm surges become more prevalent, coastal communities must learn to adapt and mitigate impacts.

Higher High Water at Large Tide (*HHWLT*) represents the highest astronomical tide possible for a given location.

International Panel on Climate Change (*IPCC*) is the United Nations scientific body responsible for assessing climate change.

Fourth Assessment Report (*AR4)* was the fourth report released by the IPCC in 2007 evaluating environmental and socio-economic data related to climate change. AR4 was followed by the ***Fifth Assessment Report*** *(AR5)*, released in 2014.

Storm Surge is the abnormal rise in seawater level during a storm, measured as the height of the water above the normal predicted astronomical tide.

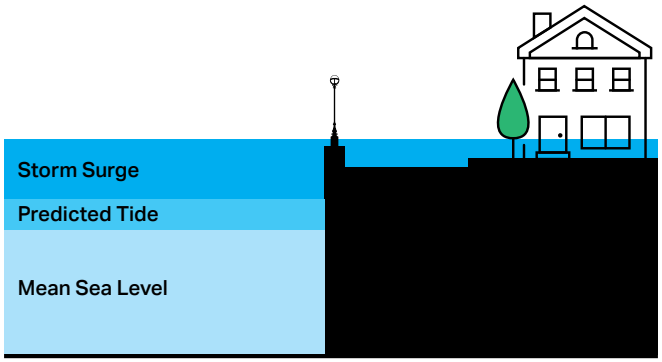
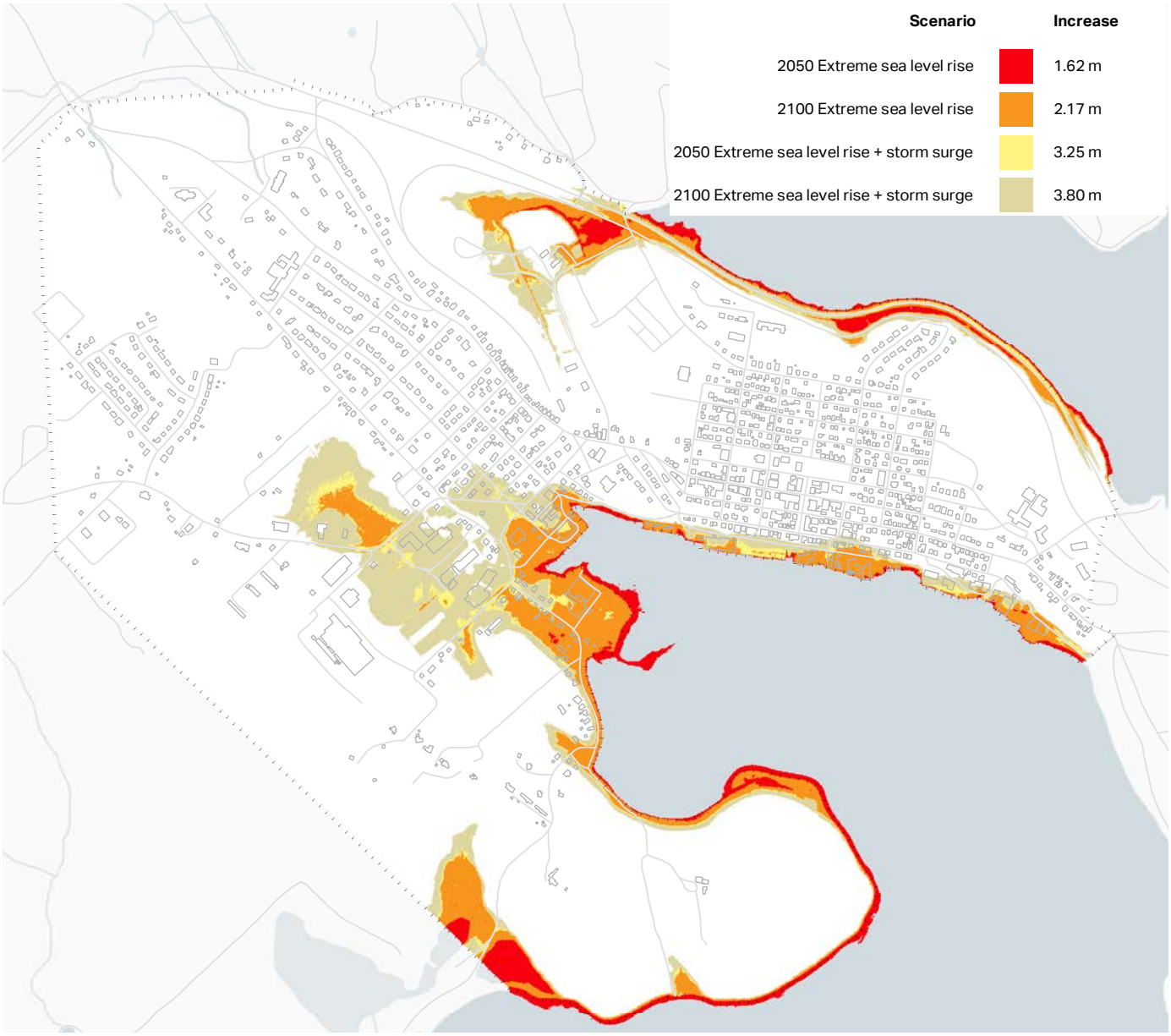


Figure 4: Storm surge can result in large amounts of over land flooding and cause extensive damage.

The International Panel on Climate Change (IPCC) continues to monitor climate change and provide global sea level rise projections. As monitoring continues and data collection methods improve, more precise estimates can be made. The Canadian Extreme Water Level Adaptation Tool (CAN-EWLAT) provides sea level rise estimates for small craft harbours across Canada, including for the Town of Lunenburg. These estimates are based upon data within the Fifth Assessment Report (AR5) from the IPCC and integrate land subsidence into the projections.

Sea level rise projection maps help to visualize the threat of flooding to communities. The mapping provided in this Disucssion Paper illustrates a basic model of what would happen if water were to rise to a certain elevation (predicted in this case by CAN-EWLAT) on the existing landscape. In reality, there are many factors that influence flood risk which are not accounted for in this model: wave action, overland flow rates and the confluence of overland and coastal waters, site orientation, and the hydrodynamics of an ever-changing coastline. Similarly, this mapping does not account for the margin of error in the elevation model and projections used to determine the extent of potential flooding. To precisely determine risk to specific structures and assets in Lunenburg, a site-specific flood risk assessment would be necessary.

The greatest value of visualizing sea level rise projections, no matter how basic, is to illustrate the fact that changing sea levels will undoubtedly impact our coastline, and to incite conversation about adaptation and mitigation. Knowing highly precise locations of future flooding in Lunenburg is not necessary for the purposes of understanding options and developing decision making processes for determining how to adapt to future conditions.



Sea Level Rise and Flood Risk Scenarios

This map depicts projected sea level rise for the Town of Lunenburg using the CAN-EWLAT data for the years 2050 and 2100. For the years 2050 and 2100, sea levels are expected to rise by 0.28 m and 0.83 m respectively. These values are then added to the HHWLT, the current highest astronomical tide in an area, to understand what areas will be permanently inundated. The 2050 and 2100 extreme sea level rise values are therefore 1.62 m and 2.17 m, respectively.

Using the precautionary principle, the worst case scenario is used as the basis for describing risk. For the years 2050 and 2100, a 1.63 m storm surge, the surge experienced during Hurricane Juan, was added to the extreme sea level values. The 2050 and 2100 extreme sea level rise values with the additional storm surge are 3.25 m and 3.8 m, respectively.

Sea Level Rise Mitigation and Adaptation

As a coastal community, Lunenburg will experience the impacts of climate change, especially sea level rise throughout the 21st century and beyond. There are two broad approaches to reducing the impacts of climate change and sea level rise: Mitigation and Adaptation.

- **Mitigation** is an approach that reduces climate change, specifically reducing the amount of heat trapping gases that are released into the atmosphere.
- **Adaptation** describes an approach where communities use actual or expected future conditions to reduce vulnerability to the impacts of climate change.

These two strategies will be discussed in the following pages.

Mitigating sea level rise is achieved through mitigating climate change. Specifically, this includes implementing strategies to reduce the amount of greenhouse gases that are released into the atmosphere. Greenhouse gases, especially those emitted into the atmosphere through the burning of fossil fuels, trap heat in the earth's atmosphere which causes the earth's temperature and climate to change.

There are multiple strategies to mitigate the impacts of climate change, some of which are explored in greater detail through other Discussion Papers. Alternative modes of transportation to the private automobile are explored in the Transportation Discussion Paper while the state of Lunenburg's urban forest which stores greenhouse gases was discussed in the Built Heritage and Streetscapes Discussion Paper. Developing a sustainable transportation system and carbon storage systems are two strategies to mitigate climate change. Another strategy to mitigate climate change is the implementation of renewable energy sources.

Within Lunenburg there has been limited uptake of renewable energy production. Although the town currently does not have any policy within its Municipal Planning Strategy regarding the application of renewable energy, current regulations within the Land Use Bylaw and Heritage Conservation Bylaw permit limited wind and solar application, provided design guidelines are met in certain scenarios.

In addition to renewable energy being applied at an individual level, municipalities and towns across Atlantic Canada are taking advantage of renewable energy production to reduce carbon emissions but also to reduce long term costs. In 2011, the Municipality of the District of Chester successfully applied for and installed a 2 megawatt wind turbine through the Community Based Feed-In Tariffs (COMFIT) program. More recently, Saint John, NB, who own their own power utility, are planning to develop a $60 million wind energy project on the outskirts of the city. As the Town of Lunenburg owns and manages its own power utility, this could represent an opportunity for the town.

Small coastal communities are unwise to rely on local and global climate change mitigation to prevent sea level rise impacts. Adaption is therefore an essential component of climate change action. Adaptation strategies can be grouped as follows:

- **Protect** is a reactive strategy to protect people, property and infrastructure from sea level rise and is typically the first response considered. Protecting the coastline through structural mechanisms such as dikes and seawalls has been the traditional approach to dealing with sea level rise in many parts of the world. With increasing sea level rise and coastal vulnerability, this strategy may be prohibitively expensive and have limited long-term effectiveness in highly vulnerable locations.

- **Accommodate** is an adaptive strategy that allows continued occupation of coastal areas while changes are made to human activities and/or infrastructure to adapt to sea level rise. Accommodation can also involve retrofitting a building or making it more resilient to the consequences of sea level rise. Other accommodation measures may include liability reduction, such as a covenant indemnifying governments from the consequences of coastal hazards regardless of protection works undertaken.

- **Retreat** or *Managed Retreat* refers to any strategic decision to withdraw, relocate or abandon private or public assets at risk due to sea level rise and associated coastal hazards. Retreat is an adaptive strategy to limit the use of structural protection, discourage development in areas subject to sea level rise, and plan for the eventual relocation of buildings and infrastructure to areas with no risk or lesser risk.

- **Avoid** involves ensuring new development does not take place in areas subject to coastal hazards associated with sea level rise or where the risk is low at present but will increase over time. This may involve identifying future "no build" areas within local government planning documents. A wide range of planning tools may be involved, leading to a decision to avoid development in areas subject to moderate to high risk. An avoid strategy may involve land acquisition or the transfer of development potential to areas of lower risk.

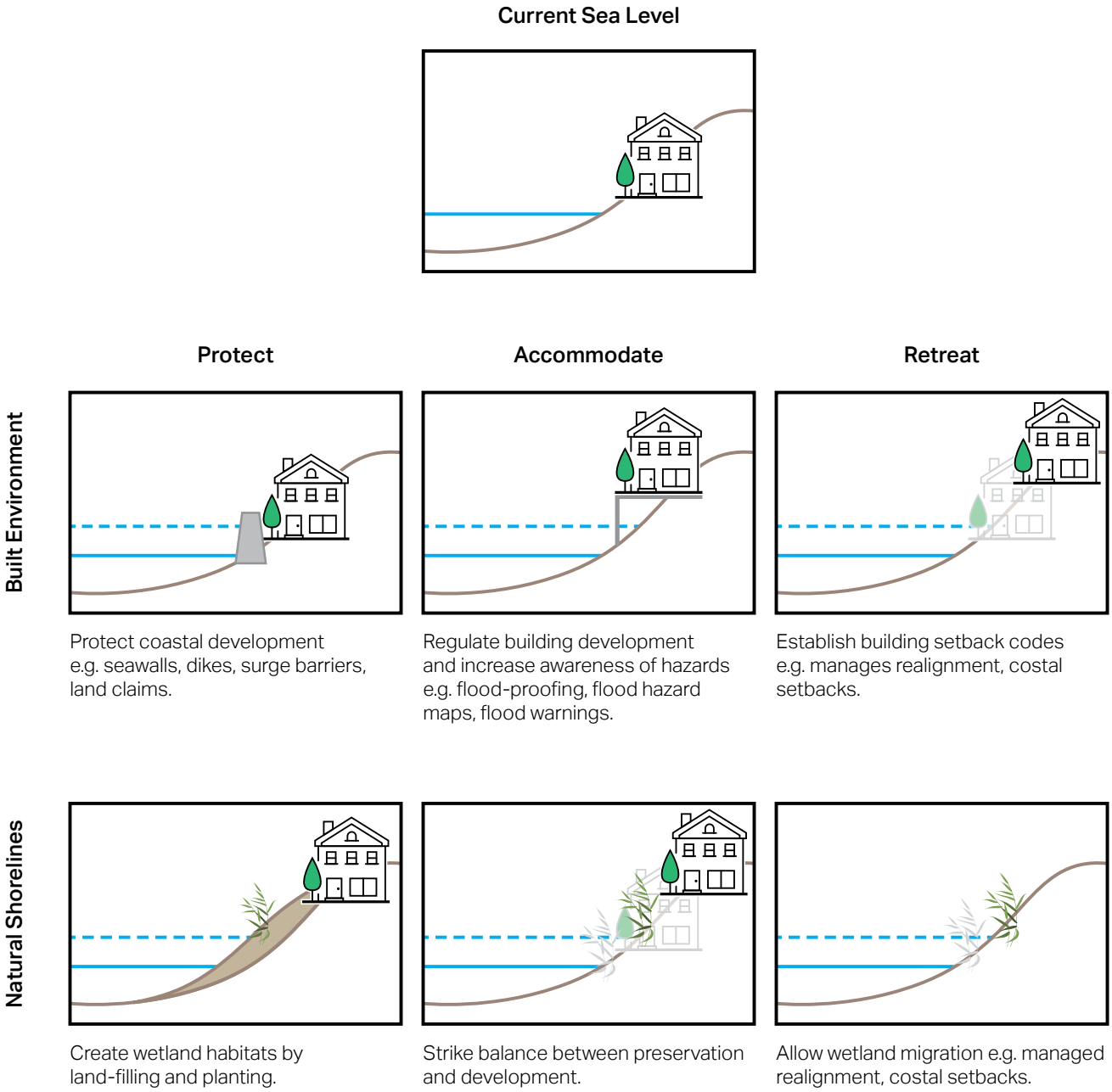


Figure 5: Sea level rise adaptation strategies as they apply to the built environment and natural shorelines.

Flooding

With sea level rise comes coastal erosion, inundation, and increased storm surge extents. Greater storm surge extents may result in runoff and drainage issues, localized flooding, and washout and erosion. Hazards such as saltwater intrusion, contamination of groundwater reserves, and building and infrastructure flooding will become more prevalent.

Powerful storm waves increase the risk of storm surges putting low-lying coastal areas at risk of flooding. This means that areas which have experienced flooding could potentially experience these floods more frequently, and areas previously safe from flooding could now be at risk.

While Lunenburg's Old Town is located on a steep drumlin, there are several low-lying areas in New Town and along the edge of the coast that are susceptible to flooding. Of specific concern is the Victoria Road area which already floods on occasion. This area includes a number of important community facilities that are immediately adjacent to the area that floods. These facilities include:

- The 'Blue Building' on Victoria Road, which is used as storage space for public works, the electric utility and the fire department
- The Community Centre, which also acts as an emergency shelter.
- The ambulance base. Victoria Road is the most direct link between the ambulance base on Hall Street and the main centre of population in the town.
- Bluenose Academy. While set farther inland than the area currently affected by flooding, it is immediately adjacent to the Community Centre.

The Fire Station, while near the waterfront, is situated on higher ground and is not projected to be directly affected by sea level rise. Other streets that have experienced flooding in recent years include Dufferin Street, McDonald Street, McKenzie Street, Archibald Street, Brook Street, and Montague Street which are all located near Victoria Road and/or along the waterfront. Most Town sewers are combined storm and sanitary pipes, which increases basement flooding risks in low-lying areas during heavy rain storms.

The *Coastal Protection Act* was introduced in 2019 to protect coastal ecosystems, eliminate inappropriate coastal development, and preserve the coasts to withstand the impacts of climate change.

Although coastal management is often categorized based upon legislative jurisdiction, non-governmental organizations, academia, citizens, and First Nations groups all have a role in managing and protecting our coastlines. The table below highlights some of the key stakeholders in coastal planning and management. The table also highlights some of the key legislation relevant for each level of government.

Coastal management and environmental stewardship have been continually evolving in the Town of Lunenburg. Coastal Action, a non-governmental organization, works with communities along the South Shore to address environmental issues including climate change. Additionally, the Town's Recreation Department has integrated climate change and environmental stewardship into its programming by offering eco-friendly workshops during the year as interest and passion for the subject has grown. Initiatives in the town to reduce the number of single-use plastics has both direct and indirect benefits. Reducing single-use plastics prevents these items from ending up in our landfills or in nature, but they also reduce the emissions that are required to manufacture these products.

	First Nations and Indigenous Groups	Landowners and Community	NGOs	Municipal Government	Provincial Government	Federal Government
Planning	Exercise indigenous rights to traditional lands and waters along the coast. Conduct or collaborate with levels of government.	Call for and participate in local consultations and planning programs.	Advocate for plans where needed. Participate in local consultations and planning programs. Acquire key coastal habitat for protection.	Prepare and implement planning strategies and zoning regulations.	Responsible for coastal zone planning. Address issues of land use, protection (Crown and private) and resource use.	Facilitate coastal zone planning under Canada's Ocean Strategy.
Legislation				*Municipal Government Act*, Planning Strategies and By-laws	*Beaches Act, Environment Act, Wilderness Areas Protection Act, Coastal Protection Act*	*Oceans Act, Fisheries Act, Wildlife Act, Species at Risk Act*

Table 2: Coastal management stakeholders and their legislative context.

Coastal Access and Ownership

Private land ownership accounts for 78% of the South Shore ecodistrict, which has an area of 104,513 hectares. About 16% is held by the provincial Crown and the remainder by other owners.

Although the land found between mean high and mean low tide belongs in the public domain the provincial government lacks any clear policy or legislation guaranteeing public access to it. As such, the public can not rely on the government to aid in securing access when the only way of reaching that public property is across private property.

Lunenburg features the waterfront, managed by Develop Nova Scotia, a crown corporation. Otherwise, Lunenburg's coastline is primarily owned through private land ownership with municipally managed public right-of-ways. While there are no provincial beaches within Lunenburg, there are several outside of the town; Second Peninsula and Rissers Beach Provincial Parks are short drives from the town. In planning for future development it is important to consider coastal access.

UTILITIES & RESOURCES

Lunenburg manages much of its own utilities and services. As conditions and expectations change, careful consideration needs to be given to how the town develops and manages its assets, and its waste.

Municipal Water Supply

Dares Lake is located 4 km from the Town of Lunenburg in the Municipality of the District of Lunenburg. The Dares Lake Protected Water Area Regulations establish rigorous restrictions on most activities and land uses, including prohibition of all recreation and built structures. It provides an abundant supply of clean water with a yield of approximately 3,000,000 gallons per day during a dry season. The Town owns and operates its municipal water supply utility which provides residents and municipal businesses with potable water and fire protection.

Lunenburg's water supply was initiated in the late 19th/ early 20th Century. Initially, untreated water was pumped through cast iron transmission pipes. A resevoir was constructed in 1902, and the main transmission pipe was expanded in the 1940s and the early 1960s using cement pipes. Improvements to water treatment facilities occured through the 1950s and 1960s. All new extensions to the system since the 1970s have been PVC pipe.

Water flows by gravity from Dares Lake and is pumped to the Water Treatment Plant located at 524 Northwest Road. The water treatment facility is designed to provide a continuous net production rate of 5,451 m^3/ day (1.20 million US gallons per day or 1,000 US gallons per minute) with one filter train out of service for up to twenty-four (24) hours. The treatment process includes redundant raw water pumping, multiple pretreatment options, and redundant filter trains.

In 2009 the water treatment plant and reservoir underwent significant renovations, bringing the overall supply and distribution system into regulatory compliance.

Waste Water Treatment

The Town of Lunenburg Wastewater Treatment Plant (WWTP) was constructed in 2003 and services a population of approximately 2,263 within the Town and adjacent serviced areas. Major elements of the system include the WWTP, gravity sewers (many are combined storm and wastewater), sewage pumping stations, and associated force mains. While the plant is relatively new, much of the collection system infrastructure dates back to the early 1900s.

The plant works by pumping wastewater flow via nine pump stations at various locations in the Town. Two large pump stations share a common force-main and pump to the WWTP. Five of the nine pump stations have overflows to allow overflow during high flow events. The pump stations at sea level lack back-flow prevention, allowing seawater into the stations during high-high tides/storm surge. This was the case during Hurricane Dorian, when sea back-flow caused damage and a temporary shutdown of the waste water treatment plant.

The system is generally a combined system with some areas separated in the past 20 years. The system is suspected to have high infiltration and inflow (I&I) due to the age of the system. Large rainfall events can be correlated with high flows to the treatment plant which points to I&I. A portion of the infrastructure is below the high tide level and salinity measurements at the WWTP indicate salt water intrusion into the system.

Recent renovations to the system include a biofilter installed in 2018 to address ongoing odour problems. The plant has also struggled seasonally with meeting some effluent criteria, in particular the bacterial criteria. The Town is currently working to rectify this issue and refurbish existing infrastructure.

Overall the Town currently has a good servicing capacity but the old, mostly combined, wastewater and storm sewer system may experience infiltration, particularly during heavy rains, leading to increased flow to the WWTP. While the current wastewater treatment capacity is sufficient for the existing usage levels, future growth and development pressures may be constrained without additional capacity and collection system upgrades.

Solid Waste

In 1990 Nova Scotia adopted a goal to divert 50% of solid waste by 2000. Recycling and compost became law in 1996, and the last municipal waste incinerator was closed in 2005. In 2006 second generation municipal solid waste landfills were established throughout the province. Far from previous"dumps", current landfills are required to be fully-contained, monitored disposal sites, in order to prevent runoff and protect the surrounding environment. Today, Nova Scotia is an international leader in waste management.

Since 2012 the Town of Lunenburg has been disposing residential curbside waste, including recyclables, at Kaizer Meadow Environmental Management Centre, through an agreement with the Municipality of Chester. This facility also accepts construction and demolition debris, tires and contaminated soil. The Lunenburg Regional Community Recycling Centre in Whynott Settlement provides municipal waste collection for other communities in the region, but also accepts private waste, which helps to prevent illegal dumping.

Despite significant improvements to solid waste management over the past 30 years that have diverted plastics, paper and metal from landfills, Nova Scotians have remained largely dependent on the export of "recyclable" plastics to other jurisdictions. Recently, some locations that had been accepting plastics waste from North America are no longer doing so. At the same time, there is growing concern about plastic pollution in our oceans and the contributions of plastic manufacturing to green house gas emissions.

Both locally, provincially, and nationally, there is a growing movement toward waste reduction, and plastics in particular. On June 10, 2019, the Federal Government announced it will ban single-use plastics and introduce extended producer responsibility, which makes manufacturers responsible for the entire lifespan of products they make. The Province has also announced that plastic bags will be banned in Nova Scotia. Locally, Plastics Free Lunenburg is a community organization collaborating with residents, businesses, and other stakeholders to address plastic pollution by eliminating single use plastics.

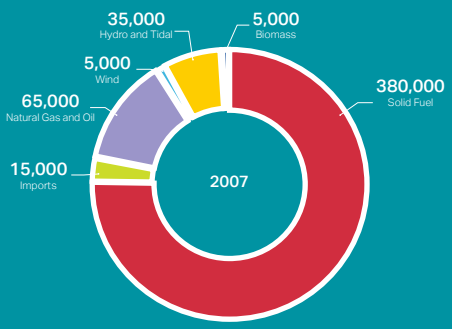
Electric and Power Utility

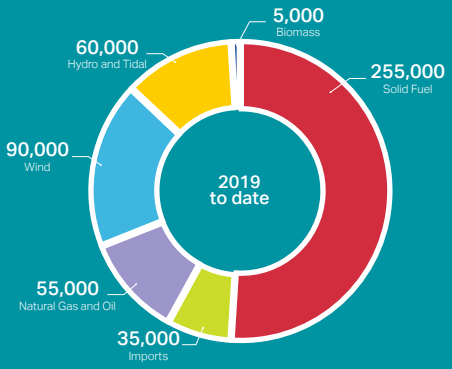
The Town of Lunenburg owns and operates its own electric utility providing residential and commercial services. Lunenburg is one of six municipalities (alongside Antigonish, Berwick, Canso, Mahone Bay, and Riverport) that operate their own municipal utilities, purchasing their electricity through an interconnection with Nova Scotia Power.

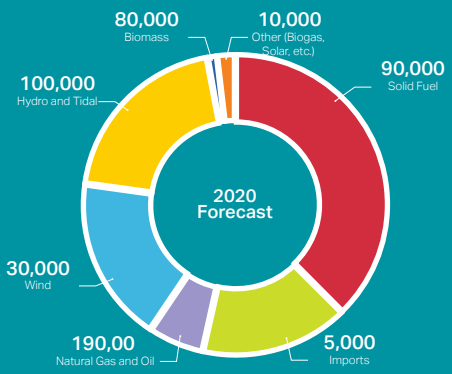
The Lunenburg Electric Utility distributes electricity in its service district extending to Mason's Beach and Blue Rocks in the Municipality of the District of Lunenburg and is divided into circuits.

Case Studies - Renewable Energy

The province of Nova Scotia achieved its goal of 25% renewable electricity by 2015, and is well on its way to have 40% of its electricity come from renewable sources in 2020. The following are some sources that are being tested in the province.







▸ Solar City, Halifax

The Solar City program, approved for exstention by the Halifax Regional Council in January 2019, and initiated in 2013, offers financial incentives to qualified property owners to help offset equipment installation costs - assisting with clean energy installations such as solar panels. Property owners then pay back the loan over 10 years, at a fixed rate of 4.75 per cent interest. There is no cost to taxpayers.

The program is available to both residential and commercial properties, as well as places of worship and charities. Applicants may also install solar energy systems by dealing with contractors themselvesm but they will have to pay the cost out of pocket.

According to Solar City Program Officer Kevin Boutilier, there have been 610 installations since the pilot program launched in 2013. That is enough solar power created to offset 2,200 tons of greenhouse gas emissions.

▸ Alternative Resource Energy Authority

The Alternative Resource Energy Authority (AREA) is a partnership between the Towns of Antigonish, Berwick, and Mahone Bay. The towns each operate electric utilities and distribute power to customers within their service areas.

AREA decided to use 10 Enercon wind turbine generators, located at the Ellerhouse Wind Farm, to provide clean energy for the three towns and the Riverport Electric Light Commission.

The maximum output of the farm is 23.15 MegaWatts. The Ellershouse Windfarm supplies 40% of the annual energy requirements for the municipal electric utilities of Berwick, Mahone Bay and Antigonish and the Riverport Electric Light Commission.

The project location is ideal for wind energy because it has a favourable wind resource, a very strong electrical grid interconnection and can be effectively integrated with the local community and environment. These factors combine to make this a model site for a small municipal wind farm.

▸ Retro-fitting Heritage Buildings

The need to achieve energy efficiency standards in new and existing buildings has triggered both research and design practice aimed at reducing their carbon footprint and improving their indoor comfort and functionality conditions.

The main steps usually pursued for a successful retrofit of historic buildings consist of energy auditing, building performance assessment, quantification of energy benefits, economic analysis, risk assessment, and measurement of energy savings.

References

Alternative Resource Energy Authority (N.D). *About AREA*. Retrieved from https://www.areans.ca/about-area/.

British Columbia Ministry of Envrionment. (2013). *Sea Level Rise Adaptation Primer: A Toolkit to Build Adaptive Capacity on Canada's South Coasts*. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/resources/slr-primer.pdf

Bouchard, C., Dibernardo, A., Koffi, J., Wood, H., Leighton, PA., and Lindsay, LR. (2019). *Increased risk of tick-bourne diseases with climate change.* Retrieved from the Public Health Agency of Canada at https://novascotia.ca/natr/ELA/pdf/ELA_2019part1_2/830SouthShoreParts1&2_2019.pdf

Forbes, Justin & Wightman, Jacqueline. (2013). *Planning for Climate Change in the Town of Lunenburg: Inventory of the Built Environment at Risk to Sea Level Rise and Storm Surge*. Retrieved from https://www.novascotia.ca/nse/climate-change/docs/Lunenburg_SLR_StormSurge_Part1.pdf.

Grant, Taryn. (July 12, 2019). *Nova Scotia Gives Green Light to Calgary Startup for New Tidal Project*. Retrieved from https://www.thestar.com/halifax/2019/07/12/nova-scotia-gives-green-light-to-calgary-startup-for-new-tidal-project.html.

Government of Canada. (2019). *Canadian Extreme Water Level Adaption Tool.* Retrieved from http://www.bio.gc.ca/science/data-donnees/can-ewlat/index-en.php

McCreadie, Danielle. (December 4, 2018). *Solar City Program Approved for Extension*. Retrieved from https://www.halifaxtoday.ca/local-news/solar-city-program-approved-for-extension-1146526.

Province of Nova Scotia, Department of Natural Resources. (N.D) *Provincial Landscape Viewer*. Retrieved from https://nsgi.novascotia.ca/plv/.

Province of Nova Scotia, Department of Natural Resources. (2015a). *South Shore - Ecodistrict 830 Maps*. Retrieved from https://novascotia.ca/natr/ELA/pdf/800/830SouthShoreMaps.pdf.

Province of Nova Scotia, Department of Natural Resources. (2015b). *Ecological Landscape Analysis South Shore Ecodistrict 830: Part 1 and 2*. Retrieved from https://novascotia.ca/natr/ELA/pdf/ELA_2015part1_2/830SouthShoreParts1&2.pdf.

Province of Nova Scotia, Department of Natural Resources. (2017). *Ecological Land Classification for Nova Scotia: Report for 2017-13*. Retrieved from https://novascotia.ca/natr/forestry/ecological/pdf/Ecological-Land-Classification-guide.pdf.

Province of Nova Scotia, Department of Natural Resources. (2019). *2019 Update Ecological Landscape Analysis South Shore Ecodistrict 83: Part 1 and 2*. Retrieved from https://novascotia.ca/natr/ELA/pdf/ELA_2019part1_2/830SouthShoreParts1&2_2019.pdf.

Rankin, Andrew. (October 5, 2018). *Provincial Regulator Investigates Lunenburg Utility, Nova Scotia Power Over Repeated Outages*. Retrieved from https://www.thechronicleherald.ca/business/provincial-regulator-investigates-lunenburg-utility-nova-scotia-power-over-repeated-outages-247910/.

Richards, William & Daigle, Réal. (2011). *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise - NS and PEI Municipalities*. Retrieved from https://www.novascotia.ca/nse/climate-change/docs/ScenariosGuidance_WilliamsDaigle.pdf

Statistics Canada. (2018). *Introduction to the Ecological Land Classification (ELC) 2017*. Retrieved from https://www.statcan.gc.ca/eng/subjects/standard/environment/elc/2017-1.

Town of Lunenburg. (2015). *Municipal Climate Change Action Plan for the Town of Lunenburg: Final Report.* Retrieved from https://www.explorelunenburg.ca/images/Lunenburg_MCCAP_dated_February_2015.pdf.

Withers, Paul. (June 26, 2019). *Shell Deal Puts Wind in Sails of Proposed Nova Scotia LNG Export Terminal.* Retrieved from https://www.cbc.ca/news/canada/nova-scotia/shell-deal-pieridai-energy-nova-scotia-lng-export-terminal-1.5191612.

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SUSTAINABILITY AND THE ENVIRONMENT

OCTOBER 2019

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