Municipal Climate Change Action Plan for the Municipality of East Hants

Planning & Development Department

November 28th, 2013

EAST HANTS
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Forward

Municipalities across Nova Scotia are required to complete Municipal Climate Change Adaptation and Mitigation Plans as part of the 2010-2014 Municipal Funding Agreement. The purpose of the plans is to help municipalities reduce green house gas emissions and identify priorities for climate change adaptation.

East Hants Council also recognizes the need for the community to plan for, and to live with, the results of climate change. Identifying climate change hazards and identifying needed research was required to prepare an adaptation plan that will guide Council, staff and citizens when important decisions are made. The actions identified within this plan will help create a resilient and sustainable East Hants.

Mapping Disclaimer

The information provided is to be used as a guide, with the understanding that is not guaranteed to be correct or complete. Any conclusions drawn from the maps in this report are the sole responsibility of the user.

Step One: Adaptation Committee

The initial requirement in the Municipal Climate Change Action Plan (MCCAP) process was to form an Adaption Committee. It was determined at the initial meeting that the MCCCAP would be completed in-house and no additional funds were to be used preparing the MCCAP. The Adaptation Committee was comprised of two Council members, the Municipal Chief Administrative Officer (CAO) and the six Municipal Directors, from the following departments: Economic & Business Development; Administration; Finance; Infrastructure &Operations; Planning & Development; and Recreation & Culture. Stakeholders and remaining Councilors were only consulted when specific input and advice was required. The following table shows members of the East Hants Adaptation Committee.

Membership of the East Hants Adaptation Committee	
Core Adaptation Committee	- Two Municipal Councilors - Municipal Staff 8 (including the CAO and 6 Directors)
Stakeholders – brought in when required	1. Agricultural Advisory Committee for the Municipality of East Hants. 2. Emergency Measures Organization 3. Economic & Business Development Department 4. Planning & Development Department 5. Recreation & Culture Department 6. Infrastructure & Operations 7. Finance & Administration

Authority

On April 25, 2012, Council established the Adaptation Committee through motion C12(128) which read: ***Council approves the establishment of an Adaptation Committee to complete the MCCAP Adaptation Template, as outlined in the MCCAP Guidebook***. The Committee was established to complete the MCCAP as per the requirements of the 2010-2014 Municipal Funding Agreement, with the goals of reducing greenhouse gas emissions and identifying priorities for climate change adaptation. Resources for the MCCAP were limited to internal staff resources and expertise. Therefore, intensive investigation into climate change hazards was not conducted. The Adaptation Committee recognizes that many of the climate change issues should be investigated further.

Mandate

Mandate of the East Hants Adaptation Committee

The East Hants Adaptation Committee is a committee set-up in accordance with the 2010-2014 Municipal Funding Agreement requirements, with the mandate to prepare a Municipal Climate Change Action Plan that will allow the Municipality to better understand climate change impacts and effects, in order to undertake substantive actions that will make East Hants more resilient to the harmful effects of weather and climate. As a municipal committee, the Adaptation Committee will receive input from stakeholders in the East Hants community to ensure the MCCAP will address a diverse range of impacts and hazards.

Terms of Reference

East Hants Adaptation Committee

Background

The East Hants Adaptation Committee has been established to prepare the Municipal Climate Change Action Plan and is accountable to Service Nova Scotia and Municipal Relations (SNSMR) in regard to any elements of the plan. The Adaptation Committee has been established by Council, in accordance with the requirements of the Municipal Climate Change Action Plan (MCCAP) Guidebook. Members are bound by the Terms of Reference and are ultimately responsible to Municipal Council and SNSMR.

Purpose

The purpose of the Adaptation Committee is to be responsible for preparing the Municipal Climate Change Action Plan, by reviewing and making recommendations to documents written by Municipal Staff, to implement the plan, and to be fully responsible and accountable to SNSMR in regards to any elements of the plan.

Goals

To prepare a Municipal Climate Change Action Plan, in accordance with the MCCAP Guidebook, by:

a) Identifying significant climate change issues and hazards affecting East Hants.
b) Identifying areas of East Hants that are subject to climate change issues.
c) Identifying and describing how existing (and proposed) Municipally-owned and operated facilities and infrastructure are vulnerable to climate change.
d) Identifying whom within the Municipality might be most adversely affected by climate change issues.
e) Indentifying potential economic implications of climate change.
f) Identifying potential environmental issues, which could result from climate change impacts.
g) Identifying priorities for adaptive action.

Scope

The Adaptation Committee shall consider the following when preparing the plan:

a) The effects of climate change on resource industries such as agriculture.
b) The effects of climate change on the residents of East Hants.
c) The effects of climate change on business operating in East Hants.

Process

The Adaption Committee will prepare the MCCAP in accordance with MCCAP Guidebook and will provide updates to Municipal Council, through Planning Advisory Committee (PAC), twice a year, or when required, until the Plan is complete and has been accepted by SNSMR.

Membership

a) The Adaptation Committee shall consist of two Municipal Councillors and eight (8) additional staff members.
b) Members are appointed as follows:
   Municipal Councillors (2)
   Municipal Staff (8)
c) Stakeholders will be brought in only when necessary to provide specific advice and input on the development of the MCCAP.

d) A Chair and Vice-Chair shall be elected at the first meeting and shall serve for the duration of the committee until the MCCAP has been accepted by SNSMR. Should the Chair and Vice-Chair be absent from the meeting, the remaining members of the Committee may appoint an acting Chair.

Quorum

Quorum constitutes of a majority of the total number of Adaptation Committee members.

Meetings

a) The Adaptation Committee shall meet quarterly or more frequently as required.
b) Agenda items will be compiled by the Planning & Development Department.
c) Decisions of the Adaptation Committee shall be decided by a majority vote of those members present at the meeting.
d) Meetings shall be open to the public.
e) The Adaptation Committee meeting notes are public and shall be made available to residents of East Hants upon request.

End Date

The Municipal Climate Change Action Plan is due to Service Nova Scotia and Municipal Relations by December 31, 2013. The Adaptation Committee shall dissolve upon written acceptance of the MCCAP by SNSMR.

Step Two: Impacts & Hazards

The Adaptation Committee consulted with our stakeholder groups to help determine the climate change impacts and hazards affecting East Hants. Stakeholders were asked to complete a questionnaire to determine how climate change impacted their industries or organizations. Results of these questionnaires are summarized in the table below. The full questionnaire results are attached as Appendix A.

In addition to stakeholder's comments, staff collected data and images from Municipal reports and interviewed Municipal employees to identify climate change hazards impacting East Hants.

Identification of Climate Change Hazards

Hazard	Category	Description of climate change hazard as it pertains to East Hants
Flooding	Severity – Severe Frequency – Often Area - Large	Flooding is one of the most severe and frequent hazards affecting homes, businesses, agricultural lands, and recreation lands in East Hants. Extreme flooding sometimes requires roads to be closed, leaving some residents isolated. Flooding may also force some residents to evacuate their homes. Residents sometimes need temporary emergency shelter.
		Businesses in East Hants are concerned about the cost of increased flood proofing measures. They are also worried about the loss of commercially zoned lands due to increased flooding and increased precipitation.

		More frequent storm and flooding events reduce the lifespan of recreation infrastructure. Items such as playgrounds may need more frequent repair and replacement. In addition, historic sites are particularly vulnerable to severe weather events, as flooding may cause rapid aging of older structures.
		Agricultural land owners are concerned about storms that flood farmland. Water running off fields, in addition to water from high rivers that breach dykes, can flood farmland. In these situations, the dykes also act as barriers to water draining off the land.
		Heavy rainfall produces heavy inflows to sewage treatment plants. This hazard is discussed in Step Four of this report.
Sea Level Rise	Severity – Moderate Frequency – NA Area – Large	Many of the Municipality's natural assets, trails, open spaces, and tourism related businesses are located along the Bay of Fundy, even though the majority of the population of East Hants lives well south of the coastline. Sea level rise will make these attractions more vulnerable to the impacts of climate change. Many small community groups, with limited resources, have difficulty raising thousands of dollars to address land reclamation and infrastructure repairs.
		The impacts of sea level rise on the tidal Shubenacadie River are unknown. An increase in sea level could have major flooding impacts up river in the more developed portions of the Municipality.
Storm Surges	Severity - Severe Frequency – Sometimes Area - Large	In East Hants the greatest risk of coastal flooding occurs during storm surges. The most notable storm surge was the Saxby Gale in 1869, with a storm surge of approximately 10.1 metres. Storm surges will significantly impact the Bay of Fundy coastline for several reasons: sea level rise, increased erosion rates, and increased storm frequency.
Erosion	Severity – Moderate Frequency – Sometimes Area – Large	High, uncontrolled stormwater flows into receiving waterbodies cause flooding and erosion. Significant rainfall events have increased the rate of erosion along river banks and have washed away valuable soils from farmer's fields. Erosion of river banks may increase the chance that agricultural lands will be flooded. In addition, the erosion may reduce the amount of farmland for one property owner and increase the amount of farmland for another property owner by depositing the eroded soil down river.
		Coastal erosion along the Bay of Fundy Shoreline is an existing problem that will increase along with other climate change hazards. One result of coastal erosion is that property owners try to protect their lands by armoring the shoreline; this may speed erosion on neighbouring properties.
Hurricanes & High Winds	Severity – Severe Frequency – Sometimes Area – Large	Hurricanes, high winds, and significant snowfall are generally predictable events that emergency services can prepare for. These events, however, may lead to residents being isolated and cut off from their communities. It may also be difficult for emergency services to reach an isolated resident in case of a medical emergency. A prolonged severe weather event may exhaust emergency response personnel, causing problems within the emergency response system.

		Hurricanes and high winds may also cause costly damage to homes, businesses, farms, community facilities and infrastructure in East Hants. Repairing and replacing homes and businesses may be too expensive for residents. Applying for emergency relief funding is often complicated.
Drought	Severity – Moderate Frequency – Sometimes Area – Large	Changes in precipitation and higher temperatures will likely lead to extended hot and dry periods. East Hants has expansive forests. Forest fires can be a significant problem during droughts. There is a potential for property loss and loss of forest resources.
		Drought may also impact water supplies in East Hants by causing wells to run dry and by lowering the quantity and quality of the Municipality's own water supply. Water may need to be trucked in to fill wells. Drought may impact Municipal sewage treatment plants by reducing inflow and reducing dilution of effluent. These climate hazards are detailed in Step Four of this report.
		Drought is also a concern for agricultural land owners, who may need to import water for livestock and crops. Importing water is expensive for farmers.
Salt Water Intrusion	Severity – Minor Frequency – Rarely Area – Small	Salt water intrusion into drinking water wells may become a problem for residents along the Bay of Fundy coastline. Rising sea levels could push the boundary between saltwater and fresh water further inland, affecting wells near the shore.
		Climate change may also impact the rate of aquifer recharge, putting put more pressure on groundwater supplies. Growing demand for freshwater resources may also pull saltwater into the groundwater aquifer, thereby contaminating groundwater supplies.
Karst Sinkholes	Severity – Moderate Frequency – Rarely Area - Small	The underlying Karst geography in many parts of East Hants, especially in the Corridor, may become more vulnerable to sinkholes as precipitation patterns change. Development that exposes bedrock or changes groundwater patterns also increases the risk of sinkholes.

Further Climate Change Research

Like many municipalities in Nova Scotia, East Hants does not have the financial resources or employee time to complete an in-depth analysis of every climate change hazard that will impact our community. Therefore, the Adaptation Committee has identified research that needs to be conducted to better understand how the identified climate change hazards may impact East Hants. It is only with the financial support of the Province and the Federal Government that East Hants can complete the following projects:

- Floodplain mapping study of the Shubenacadie River from Shubenacadie to the Minas Basin.
- Floodplain mapping study of the Nine Mile River.
- Impacts from sea level rise along the coastline (LiDar Mapping and Analysis).
- Impacts from sea level rise and erosion on communities along the Minas Basin Shoreline, with regard to housing, economic costs of moving dwellings and businesses, historic/social costs, loss of infrastructure (roads, septic systems, salt water intrusion into wells) and options for these communities.
- Review of dykelands (condition, maintenance responsibility, rebuilding of aboiteaus that need to be replaced, impacts from not maintaining).
- Impacts of acid rain on Municipal water resources.

- Research on the availability of ground water in non-serviced areas.
- Conceptual study of methane gas flaring or electrical generation at the waste management facility.

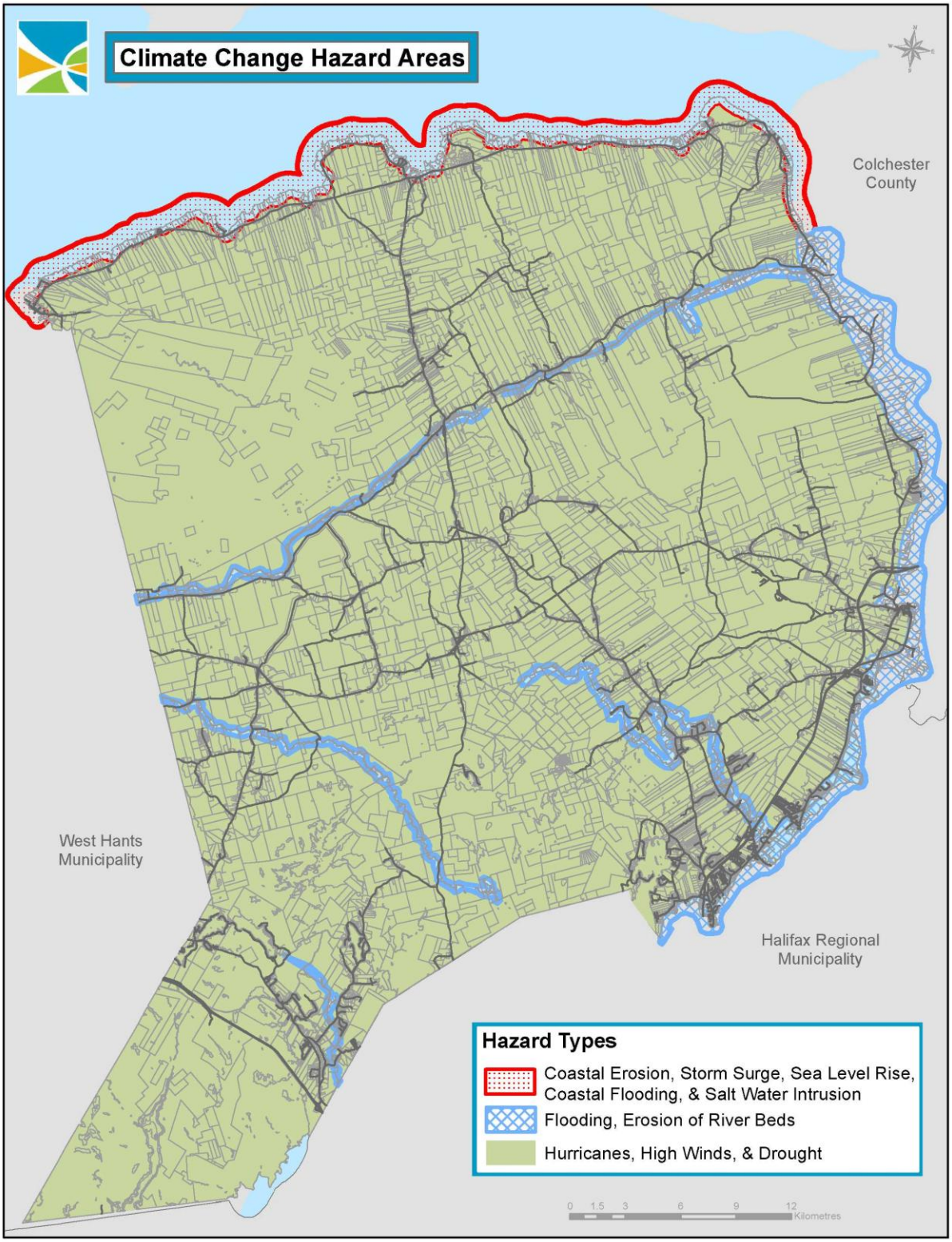
Benefits of a Changing Climate

Stakeholders contacted during Step Two of the MCCAP identified some potential benefits from climate change. For the agricultural industry, a warming climate could potentially allow farmers to diversify the types of crops they plant and harvest, and may also provide them with a longer growing season. A longer growing season, warmer temperatures and fewer nights with frost potential could result in higher yields from some crops. Although no one knows the exact effects of climate change, the hazards of climate change to agriculture are likely greater than the potential benefits.

The construction industry may benefit from climate change. More extreme weather events may increase the demand for repairs and renovations. Homes and businesses may need repairs, buildings may need to be flood proofed and structures near the coastline may need to be moved inland to avoid the impacts of sea level rise and coastal erosion. Other business opportunities include selling and installating alternative energy sources (e.g. solar panels) and selling products to mitigate climate change hazards (e.g. armour for coastlines). Sources at the Province indicate demand for armoured coastlines has been growing for several years, as warmer winters with little or no sea ice leave the coastline exposed to winter storms, increasing erosion rates in some parts of the province. Property owners are armouring their coastlines to protect their properties.

Location of Climate Change Hazards

The Adaptation Committee has developed a rudimentary map of where the major identified climate change hazards are likely to occur within the Municipality of East Hants. The entire Municipality is susceptible to hurricanes, high winds and drought. Areas of special concern include the Minas Basin shoreline, which is vulnerable to sea level rise, storm surge and coastal erosion, and the Shubenacadie River floodplains, which are vulnerable to flooding and river bed erosion. Step Three and Step Four of this report discuss specific locations and hazards in greater detail.


Climate Change Hazard Areas
Colchester County
West Hants Municipality
Halifax Regional Municipality
Hazard Types
Coastal Erosion, Storm Surge, Sea Level Rise, Coastal Flooding, & Salt Water Intrusion
Flooding, Erosion of River Beds
Hurricanes, High Winds, & Drought
0 1.5 3 6 9 12
Kilometres

Step Three: Affected Locations

Corridor Region

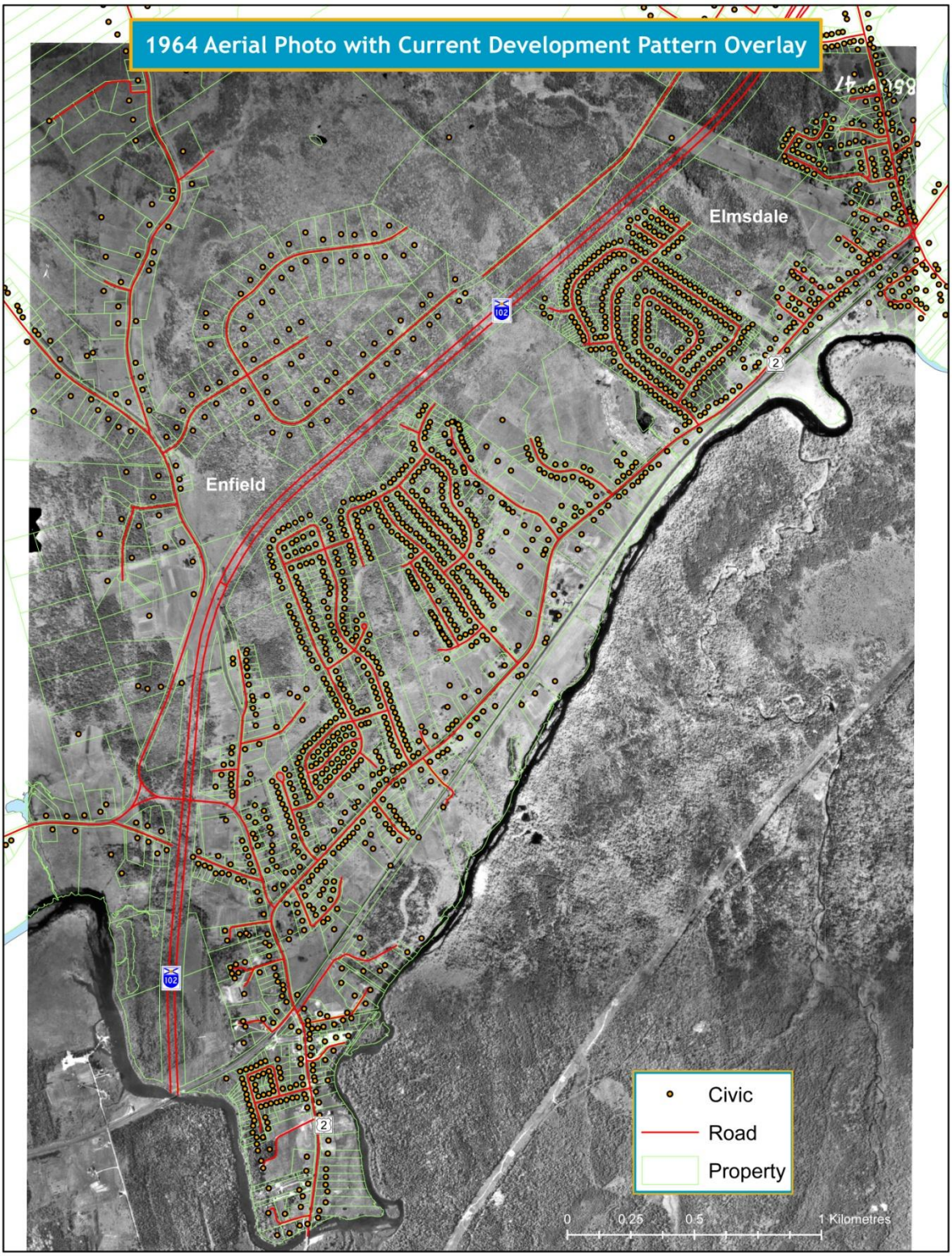
The Municipality of East Hants covers 1909 km^2 of varied terrain, with different areas vulnerable to different climate change hazards. A region of special concern for the Municipality is the Corridor Region; which includes the communities of Enfield, Elmsdale, Lantz, Milford, Subenacadie, Belnan, and Nine Mile River. These communities (with the exception of Belnan and Nine Mile River) extend along 47.5 km of the Shubenacadie River, and are the most populated communities in East Hants.

The Corridor Region has developed extensively in the past fifty years. Between 1961 and 2011 the population increased from 10,857 to 23,195. To the left is an aerial photograph of Enfield and Elmsdale from 1964. On the following page is the same aerial photograph with an overlay map of the current development pattern. Extensive development in the area, coupled with changing weather patterns, has impacted the Shubenacadie River floodplains. The Municipality recently hired CBCL Limited to complete a floodplain study, including LiDar imaging and floodplain mapping of the Corridor Region. As part of the study the consultant was asked to take into consideration climate change when making predictions about future flood events. Details of the floodplain study are described in the following section.

Flooding

Several areas within the Corridor Region are prone to flooding. Shubenacadie is one of these areas. Much of the community was developed prior to floodplain mapping, resulting in homes and businesses located in both high and moderate flood risk zones. There have been many occasions in the past where roads in the community have been washed out and residents have become stranded. In one flood event the Shubenacadie Volunteer Fire Department was unable to respond to emergency calls due to their station being flooded. Uncontrolled stormwater flows during major rains are a major hazard that result in significant flood risk and erosion.

One of the largest floods in recent decades occurred in 1998 in the late winter. Photos of this flood are on page 13.


1964 Aerial Photo with Current Development Pattern Overlay
Elmsdale
Enfield
102
2
Civic
Road
Property
0
0.25
0.5
1 Kilometres

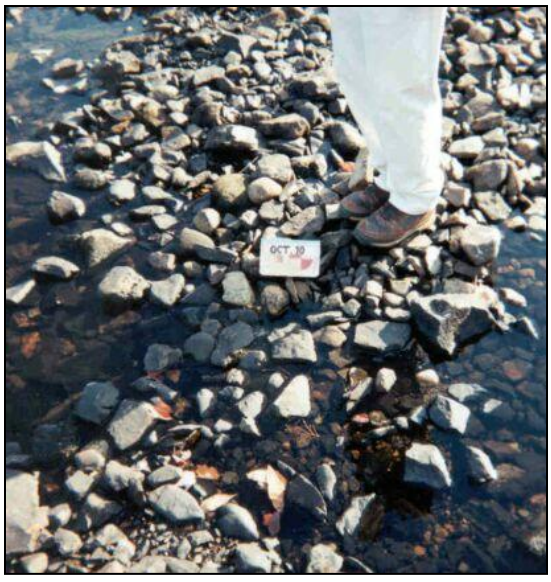
Another area prone to flooding is Elmwood Subdivision. In March 2006 SGE Acres released a report discussing the factors that affected flooding in the area and proposed some solutions. When the Elmwood Subdivision was designed and constructed storm water systems were designed for local situations and followed standard Nova Scotia Transportation and Infrastructure Renewal practices for ditched systems. SGE Acres believes these systems were probably never sized to handle flows for suburban subdivisions. In addition, the existing stormwater system‘s capacity may have been reduced by ditches being landscaped or other changes in front of properties. As a result, during heavy rains stormwater flow is high and uncontrolled, with water intended to flow in a ditched system instead flowing across lawns and streets. Due to the high water levels in the ditches, sanitary sewer systems get overloaded as water enters the system through manhole tops and manhole joints. Water also backs up and enters house foundation drains.

Although some measures have been taken to reduce the impacts of flooding in the Elmwood Subdivision, flooding is still a problem. The area will likely continue to be at risk of flooding in the future due to continued development in the area and precipitation changes.

Below are pictures from a September 2012 rainfall event. September 2012 was one of the wettest months on record. On average, 100 mm of rain falls in September; however in 2012, 386.8 mm of rain fell in September.

Drought and Low River Flow

In September and October of 2001, a prolonged summer and early fall drought caused extremely low water levels in the Shubenacadie River. The Enfield water treatment plan draws water from the river for distribution to Enfield, Elmsdale and Lantz. During the drought, water levels below the water treatment plant's intake slowed to a trickle. Withdrawal rates for the water system reached 90% of the River's total flow during the drought; had the Municipality withdrawn the amounts permitted under provincial regulations, the river would have stopped flowing. At the worst portion of the drought the Municipality was days from placing restrictions on water use. Two large rainfalls near the end of October brought an end to the dry spell and water levels increased over the coming weeks and months.



Before 2001, staff realized they might encounter problems if they asked Nova Scotia Environment to increase withdrawal limits from the Shubenacadie River for the Enfield Water Treatment System. The 2001 drought confirmed this and reinforced the need to develop a Regional Water Resource Strategy. The Corridor Water Resource Options Study (CBCL 2005) confirmed the viability of the existing Enfield Water Treatment Plant site. However, future and greater, water resource needs would have to be provided from Grand Lake. Ultimately, increased treatment capacity was constructed at the existing Enfield Plant in 2007. Staff had been planning to obtain future water supply via a raw water pipeline or by 'a system' that would pump from Grand Lake to the river. Instead, the Engineered Spring was commissioned in 2011 at Grand Lake to supplement river volumes in times of drought and low river flow.

Coastal Communities of East Hants

Further research needs to be conducted to determine the exact climate hazards and required mitigation along the Minas Basin shoreline. East Hants does not have the resources to undertake these studies as part of this plan; however, impacts for coastal communities include rising sea levels, salt-water intrusion into wells, loss of infrastructure and buildings, increased coastal erosion and storm surges. Higher sea levels will also impact tidal rivers in the Municipality.

Historical storms suggest the hazards faced by coastal communities are very significant. In October 1869, the Saxby Gale pushed a massive storm surge up the Bay of Fundy and the Minas Basin, which flooded over most of the area's dykes. Parts of Truro, Great Village and Maitland were flooded, along with large areas of marshes, lowlands and farmlands. Two surviving buildings in Maitland provide clues as to how high the storm surge reached in East Hants. Local history says that the bottom shelves on the Frieze and Roy General Store were wet, and a home on Cedar Road is said to have been surrounded by water but not flooded. Accounts of the storm from East Hants and surrounding communities described significant coastal erosion and damage to the dyke system. The salty flood water took several days to drain from behind the dykes. Across the Maritimes and Maine, perhaps 100 people lost their lives.

Although historical, the descriptions of the Saxby Gale provide a vivid example of the strength and danger of coastal storms, a threat that will likely grow with sea level rise and climate change. The storm was a rare re-intensification of a tropical storm, and the historical evidence suggests when it hit the Bay of Fundy it may have been as strong as a Category 2 hurricane, with sustained winds above 150 kilometers per hour. A particularly high spring tide when the storm hit contributed to the size of the storm surge, although high tide would have been two feet higher had the storm hit a few days later. Many reliable data points from across the Maritimes show the height of the storm surge, and these points could be plotted to create a map of areas that would be flooded today by a similar storm. Although rare, a powerful storm that arrives on a high tide, like the Saxby Gale, could be more damaging in the future as sea level rises.

The impacts of shoreline erosion are already happening along the Minas Basin shoreline. In June, 2013 Municipal Council granted $20,000 to carry out urgent repairs to the dyke at the Walton Shore Fire Department. Shoreline erosion was putting the fire hall building in jeopardy. Coastal buildings being threatened by changing shorelines is not a new issue in the municipality. Approximately 80 years ago the Forrester's Hall in Maitland was moved inland to its current location due to rapid shoreline erosion. These two examples show the potential severity of the shoreline erosion problem to coastal communities.

Shubenacadie River Floodplain Study

CBCL carried out a review of the 20-Year and 100-Year flood risk zones on the Shubenacadie River, between Enfield and Shubenacadie, and on the Nine Mile River. The purpose of the study was to update the Municipality's flood risk zones to accommodate predicted precipitation changes and to provide more accurate floodplain predictions using advanced modeling and new LiDar elevation data. The major conclusions of the study are that future floodlines will be generally wider than current floodlines, especially in downriver areas. Another important recommendation is to carefully control the amount and type of development in the Nine Mile River watershed,

which could be heavily impacted by development. Both issues – floodlines and associated zoning, and stormwater development standards – will be important considerations in the upcoming Municipal Plan review.

Identification and Mapping of Community Assets

The Adaptation Committee worked with the Municipal GIS Technician to develop maps showing important assets for East Hants residents. The maps on the following pages identify community assets, such as schools, police, emergency medical services (EMS), fire departments and comfort centres.

A second set of maps uses an overlay to show which of these community assets is at the greatest risk of being impacted by climate change hazards. Floodplain mapping for the Shubenacadie River within the Corridor Region is considered accurate based on the recent study completed by CBCL Limited. When identifying other areas at high risk of flooding, around the Bay of Fundy and the remainder of the Shubenacadie River, The Adaptation Committee took a liberal approach when considering risk. The boundaries for coastal erosion, storm surge, sea level rise, coastal flooding and salt water intrusion are not accurate and may extend well beyond areas that are identified as being at high risk from these events. As identified in Step Two, further research is needed to understand the true impact of sea level rise, storm surge and coastal erosion on the Bay of Fundy coastline and the lower portions of the Shubenacadie River.

Further climate change mapping based on data from the province and federal government has been included as Appendix B.

- 100 Year Hurricane Track through East Hants
- Saltwater Intrusion Map of East Hants
- Flood Prone Areas of the Bay of Fundy Shoreline

Step Four: Facilities, Infrastructure & Service Delivery

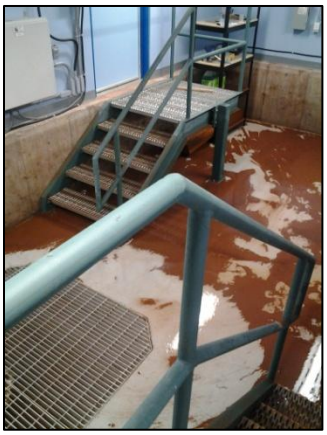
The Adaptation Committee identified both Municipal and Provincial infrastructure and facilities necessary for service delivery in East Hants. The infrastructure risk assessment spreadsheets are attached as Appendix A.

Identification of Municipally-Owned Infrastructure

Sanitary Sewer Systems

The Municipality of East Hants owns a wastewater collection system and operates waste water treatment plants in Milford, Shubenacadie and Lantz. All three plants discharge their effluent into the Shubenacadie River. Due to infiltration and inflow, the system experiences significant excess loading during rain events. It is anticipated that climate change will exacerbate the current issues. In order to reduce the inflow and infiltration problems at all three wastewater treatment plants, the wastewater collection system itself needs to be reviewed to identify sources of unnecessary loading. Reducing unnecessary loading will reduce loading on both lift stations and treatment plants, and may free up capacity for additional development.

The Regional Sewer System serves the communities of Enfield, Elmsdale, and Lantz. The wastewater treatment plant was commissioned in 1989 and is located in Lantz. It is a Facultative/Aerated Lagoon with chlorine disinfection and sulfur dioxide dechlorination. The plant is located in the High Risk Floodplain (HF) Zone and designs for additional loading will need to consider the impact of changing Shubenacadie River flood levels. Expansion of the regional system may be limited due to encroachment into the flood plain. Although this section of the Shubenacadie River is minimally impacted by tides in the Bay of Fundy, changing tidal impacts may occur with rising sea levels. For example, with a rising sea level, backwater effects may occur during extreme storm events when high stormwater flows coincide with high tides. The most notable climate change impact on the system will be higher or lower water flows due to weather extremes. Low flows during times of drought will affect dilution of the effluent.



The Milford wastewater treatment plant was commissioned in 2011/2012 and services just the community of Milford. The plant uses a sequencing batch reactor with ultra violet disinfection. In September of 2012 the plant experienced flooding and drainage issues due to extreme rainfall. These drainage issues are now being addressed by adding a retention pond. As with the Regional System, the Milford wastewater treatment plant may also be impacted by higher and lower water flows due to extreme weather.

The Shubenacadie wastewater treatment plant is over 30 years old. The plant is an oxidation ditch followed by a clarifier for secondary treatment and chlorine disinfection. The plant is currently over capacity and will need to be upgraded or replaced to accommodate future development. The plant is not located in the floodplain, but like the other treatment plants it is vulnerable to extreme weather events such as heavy rainfall or drought. If the plant is to be replaced climate change considerations will have to be evaluated during the site selection and design process.

Public Water Systems

There are two municipally owned, public water systems within East Hants: the Regional Water System servicing the communities of Enfield, Elmsdale, and Lantz; and the Shubenacadie Water System. The Regional Water System draws its water from the Shubenacadie River and the Subenacadie Water System draws its water from a ground water supply. Both plants are new, have back-up power supplies and have adequate storage. Climate change hazards are not expected to have a major impact on water storage and distribution systems; however, it is expected that both water systems will be impacted during droughts, when resident's demand for water will peak. Climate change impacts on the Regional System will include more extreme fluctuations in river levels. In 2001 low water levels on the Shubenacadie River nearly impacted the Municipality's water distribution system. An engineered spring has been installed on Grand Lake in order to address times of low flows in the Shubenacadie River and to offset volume removed by the water treatment plant.

East Hants Waste Management Centre

The East Hants Waste Management Centre, located in Georgefield, offers the following services:

- Waste & Recyclables Transfer Station
- Organics Transfer Station
- Residential Household Hazardous Waste depot
- Construction & Demo Disposal
- ERPA - Nova Scotia - Depot Drop-off (electronic waste)
- Metal Pile
- Tire Pile

The waste management centre is subject to frequent road washouts around the scale house caused by heavy rains on dirt roads. These road washouts are expected to worsen as severe storms become more common. The roads require significant upgrades to redirect water from rainfall and storm events. In addition, since the site is the highest point in the area, buildings regularly suffer wind damage. The Municipality recently replaced half of the organics building walls, which will require a full retrofit in the coming years. Lightning has struck buildings twice in the last five years. The stability of the dam structures around the holding ponds should be reviewed to determine their reliability.

Parks

The Municipality owns two small pieces of land on the Minas Basin shoreline that are at risk from sea level rise and coastal erosion. The Walton Lighthouse is a small site with hiking trails, picnic area and a small community operated gift shop. Burncoat Head is a municipally owned property with a 19th century lighthouse, a flower pot island and access to the shoreline. At low tide mud visitors can walk on mud flats on the ocean floor. The Burncoat property consists of a parking area, picnic tables and a short trail to the shoreline.

Identification of Provincially-Owned Infrastructure

Storm Drainage

Most of the Municipality's storm drainage infrastructure is open ditches and culverts, with the exception of some serviced areas where buried storm sewer has been installed for sidewalk projects or newer developments. The majority of the storm drainage infrastructure is owned by Nova Scotia Transportation and Infrastructure Renewal (NSTIR) as part of their road infrastructure. Storm Drainage is already a major issue for the Municipality. A number of areas in the Municipality, such as Elmwood subdivision, flood during large storms. Storm drainage problems will only increase with climate change, as increased precipitation and more severe weather leads to increased flooding.

Staff and consultant's reports have identified several areas with storm drainage issues. Some recommendations from these reports have been carried out, and other recommendations will be undertaken through municipal sidewalk projects, through improvements required for new developments and through NSTIR's maintenance and capital upgrading programs. Municipal requirements for buried storm sewers and lot grading plans in new developments in serviced areas will help reduce concerns from minor storms. Developers are now required to indentify impacts on downstream infrastructure and mitigate the situation. Changes to the Municipality's Lot Grading and Drainage By-law may be needed in response to climate change and new research into storm drainage.

Provincial Roads

Most roads in East Hants are owned and maintained by Nova Scotia Transportation and Infrastructure Renewal. Concerns have been raised about several roads and bridges. There are concerns about the hydraulic capacity of a bridge on Indian Road at Mill Village, and concerns about the condition of Indian Road between Shubenacadie and MacPhee's Corner. Concerns have also been expressed regarding the impacts of rising sea level and extreme river flows on Gosse Bridge and its approaches. The Walton Bridge connecting East and West Hants also appears vulnerable to rising sea levels. High tides and high river levels could impact this infrastructure, which provides many residents with access to health and emergency services.

NSTIR will be evaluating the flood risk to transportation infrastructure across Nova Scotia as part of their climate change adaptation measures. They will study low-lying areas that might be vulnerable to rising sea levels and storm surges, particularly flood prone areas around the Bay of Fundy and the Northumberland Strait. Due to historic events, Municipality of East Hants staff feel that roads along the Fundy Shore should be evaluated for impacts on culverts, bridges and their general condition. These roads are key routes for both the public and emergency vehicles.

Dykelands and Aboiteaus

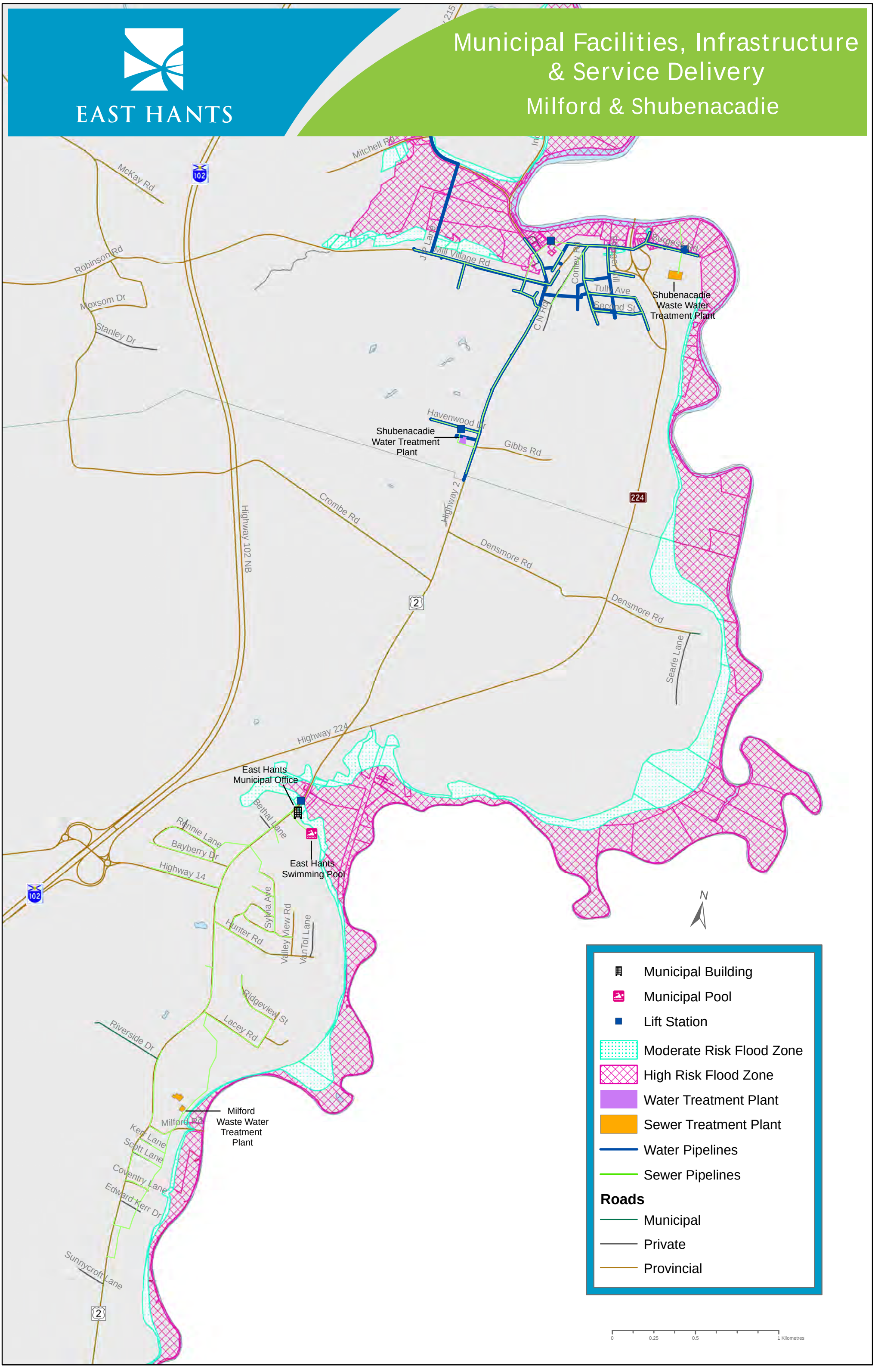
Dykes and aboiteaus along the Fundy Shore and tributaries are the responsibility of the Central District of Nova Scotia Department of Agriculture. NS Agriculture is aware that the dykes and aboiteaus will be impacted by climate change and that they may require funding to repair and upgrade these structures. Municipal staff have concerns with the aboiteaus along Highway 215, outside of Shubenacadie. Recent improvements by NSTIR to Highway 215 did not include raising the roadway or replacement of the aboiteaus. At this location the Highway encroaches on a bend in the river and is subject to flooding or washouts during extreme weather events. However, Provincial staff caution that raising dykes or other

structures prevents the Shubenacadie River from expanding onto its natural floodplain. This confines the flow at peak runoff and may exacerbate flooding in other areas or cause flooding where it has not previously occurred, particularly during high tides. The situation along Highway 215 will continue to be monitored.

EAST HANTS

Municipal Facilities, Infrastructure & Service Delivery

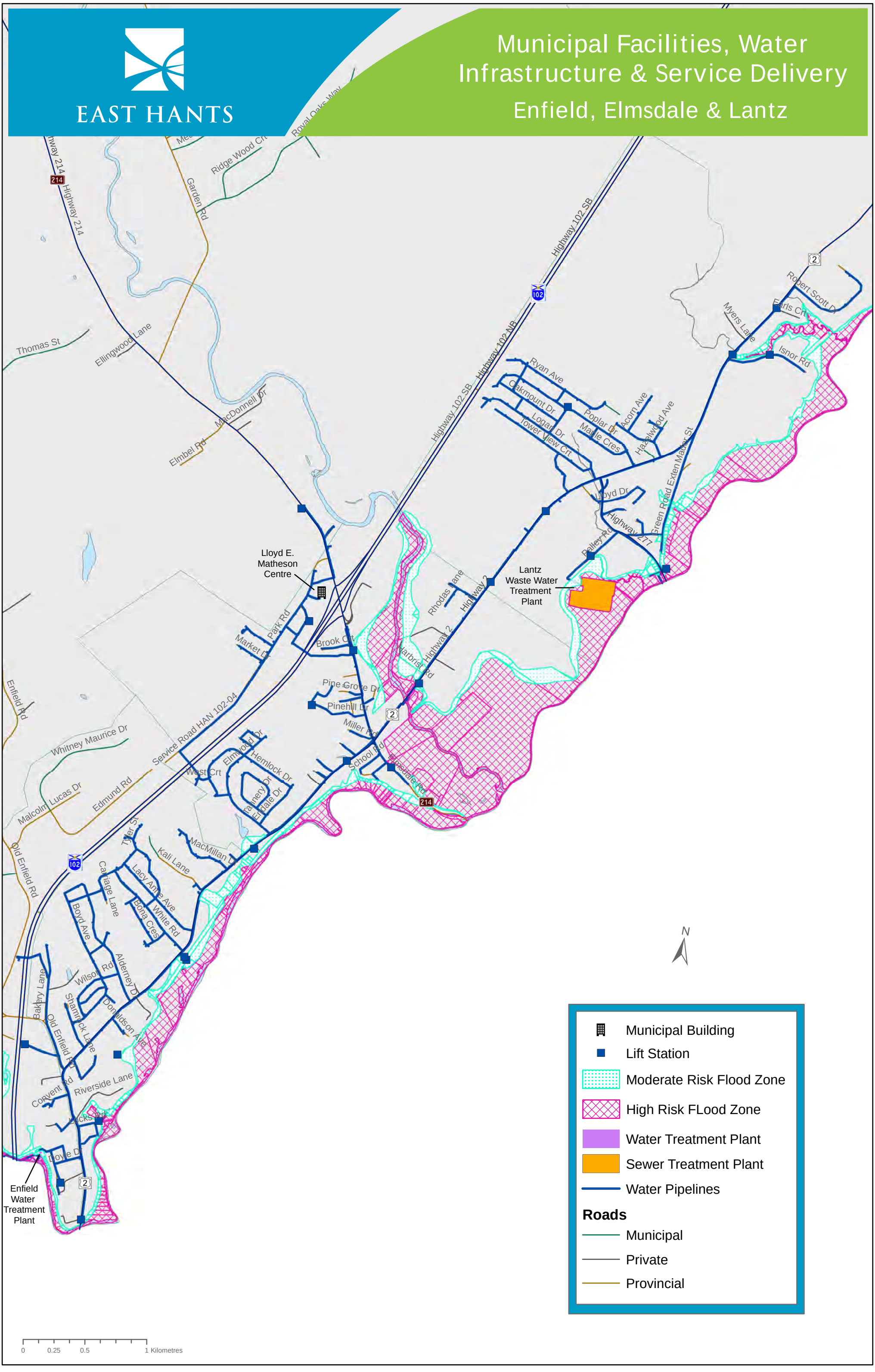
Milford & Shubenacadie



EAST HANTS

Municipal Facilities, Water Infrastructure & Service Delivery

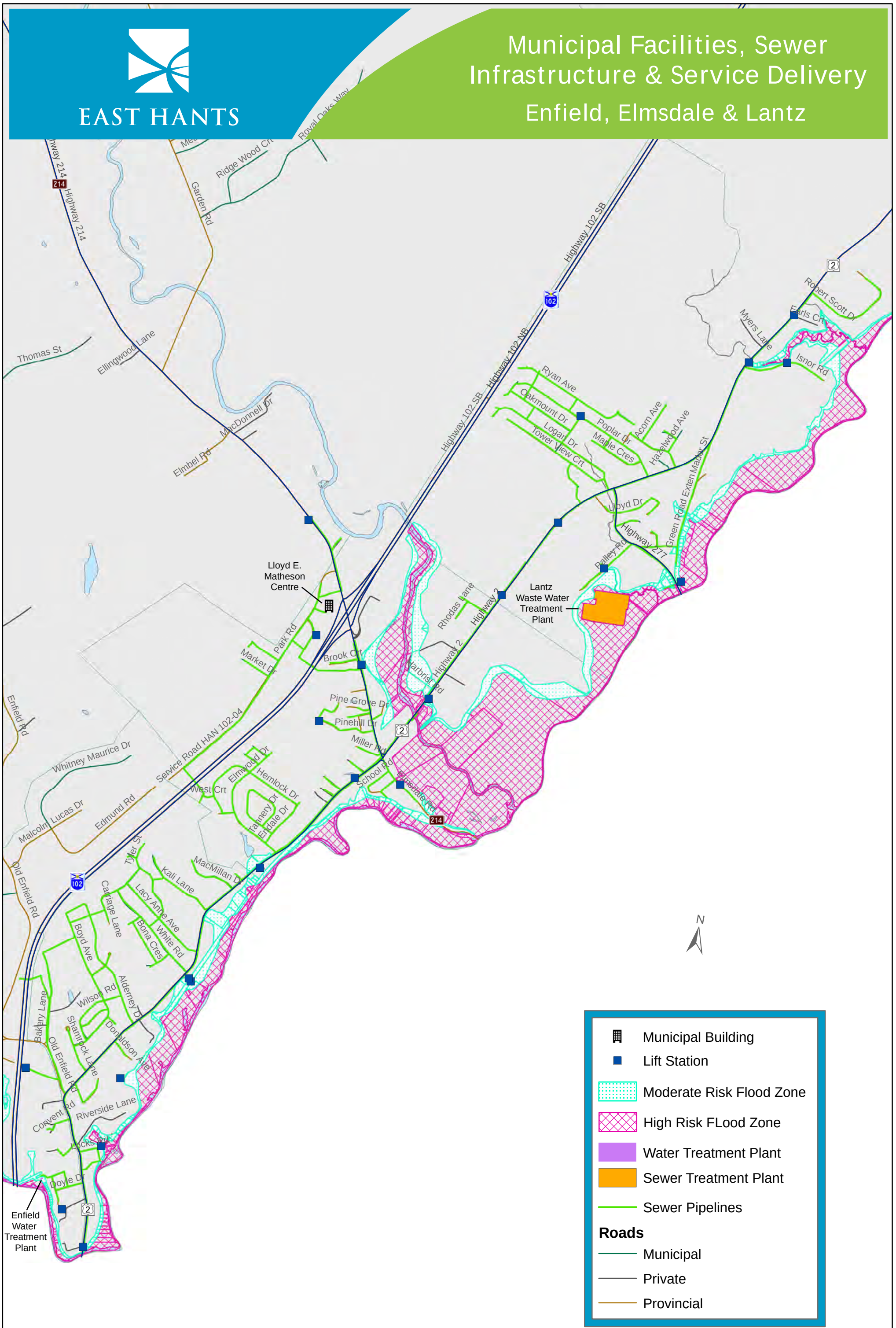
Enfield, Elmsdale & Lantz



EAST HANTS

Municipal Facilities, Sewer Infrastructure & Service Delivery

Enfield, Elmsdale & Lantz



Step Five (a): Who will be Affected

The most dramatic short term threat to East Hants residents is from extreme weather events that damage infrastructure and leave communities and residents isolated. The Indian Brook First Nation recently experienced this type of hazard. In September of 2012, Nova Scotia experienced near record rainfalls, causing flooding throughout the Province. Stormwater flooded and shut down two access roads in the Indian Brook First Nation, leaving 135 residents stranded for a day. Similar events have impacted other communities, groups and individuals throughout the Municipality. Flooding throughout Shubenacadie and the Corridor Region has cut off individuals from the greater community. Flooding has also forced the closure of parts of Highway 2, restricting residents from accessing the entire community. The temporary loss of services – power, roads, water, police, fire departments and paramedics – is a threat for all East Hants residents, especially as climate impacts increase. Inspecting and protecting vulnerable infrastructure, as discussed in Steps 3 and Steps 4, is essential, as is implementing Emergency Measures Plans that consider climate change hazards.

As in most communities across Nova Scotia, some groups within East Hants may be particularly vulnerable to climate change hazards. One particularly vulnerable group is seniors. More heat waves and higher levels of ground level ozone will strain the elderly and individuals with breathing problems. Also, seniors are less likely to drive and may have more difficulty accessing services, especially during an emergency. Nursing homes, especially if located in a coastal zone or a flood risk zone, should be specially considered during emergency planning.

Communities and residents in flood plains and coastal zones will be exposed to increased climate change risks. In coastal zones the risks are from both short term events, such as storm surges and coastal flooding, and long term hazards such as coastal erosion, flooding of coastal lowlands and destruction of infrastructure and property. Further research should be conducted to determine the exact climate hazards and required mitigation along the Minas Basin shoreline. The Shubenacadie Floodplain study concluded that the 20-Year and 100-Year flood zones along the Shubenacadie River will generally be wider in the future due to climate change impacts.

The overall social impact of climate change adaptation and mitigation on East Hants residents may be substantial. Many of the heritage buildings in East Hants are located along the Minas Basin shoreline. Additionally, many recreational areas and tourist attractions are located in areas potentially threatened by sea level rise. These cultural and recreational assets are important to resident's enjoyment of community and to the community's sense of place. All residents will be affected by the costs of protecting vulnerable areas, and repairing and upgrading essential Municipal infrastructure. Provincial roads, bridge and drainage infrastructure will also need to be prepared for climate change. Identifying adaptation priorities is essential to prepare for extreme weather and to ensure that future infrastructure costs do not strain funding for other services.

EMO Plans

The purpose of the East Hants Emergency Measures Plan is "*to protect the lives of people and reduce the chances of damage to homes, property and loss of essential services to the residents of East Hants at the time of an emergency. This plan identifies types of emergencies likely in East Hants and keeps updated lists of agencies, and copies of their emergency plans required to cope with an emergency*."

The Plan lists a number of emergency events that may impact the Municipality:

Spontaneous Events – High Possibility

Forest/Brush Fire
River Flood
Train Derailment
Oil Spill
Water Pollution
Water Shortage
Massive Automobile Wreck
Major Watermain Break
Massive Snow Storm
Flash Flood

Moderate Possibility

Critical Waste Disposal Problem
Electrical Blackout
Hurricane
Major Hail Storm
Major Industrial Accident
Plane Crash

Many of the events anticipated in the Emergency Measures Plan, including forest fires, river flooding, water shortages, massive snowstorms, hurricanes and hail storms, may become more frequent and severe with climate change. The Emergency Measures Plan will be substantially amended in the coming months; this would be an excellent time to consider the impacts of climate change, especially in vulnerable areas such as coastal communities.

Step Five (b): Economic Implications

The most important economic area in the Municipality is the Corridor Region. Most residents and most commercial activity in East Hants are located in the Corridor. The proximity of the Corridor to the Shubenacadie River means that some infrastructure and property will be at higher risk from flooding, as outlined in the Shubenacadie Floodplain Study. Ensuring property, infrastructure and basic services in the Corridor are protected from climate change risks is essential to protecting the economy of the Municipality. Steps Three and Four discuss many of the locations at risk from climate change and the action required to protect infrastructure.

Agriculture is an important industry in East Hants. 192 farms occupy 57,000 acres and employ almost 450 people. The climate change impacts on farming may include opportunities, such as a longer growing season, more frost free days and less winter kill. Challenges for agriculture will include loss of farmland to erosion or flooding, increased drought and different types of crop diseases and pests.

Forestry is another important primary industry in East Hants. Primary industries account for six percent of the employment in the Municipality, as of the Municipality's 2006 Socio-Economic Study. The forestry industry may have to adapt to climate change hazards, including increased blow-down from high winds, higher forest fire risk, different pest species and potential changes in forest composition.

Step Five (c): Environmental Issues

Many climate change hazards have already been considered in this report with respect to their impact on property, buildings and infrastructure; however, climate change will also impact East Hants' natural environment. Current environmental issues will likely worsen with climate change. It is important to identify climate change hazards and, where possible, recommend adaptation measures to protect the natural environment. Natural processes and natural areas provide many valuable services to East Hants residents, including recreational opportunities, clean water and forestry products.

Flooding and river bank erosion, as described in Step Three, is a significant problem in East Hants. Development impacts downstream water quality, because developed areas produce more stormwater than natural areas, and stormwater carries more pollutants and sediment. Climate change is expected to lead to more intense rainfall events, which will create more stormwater runoff, further decreasing water quality and increasing the risk of flooding. Better stormwater management and stormwater infrastructure will protect both property and the natural environment. The Municipality's Land Use By-law currently has several zones to protect watercourses from improper development: the High Risk Floodplain (HF) Zone; the Moderate Risk Floodplain (MF) Zone; and the Watercourse Greenbelt (WG) Zone. Controlling stormwater runoff will also help reduce loading on the Municipality's sewage treatment plants, which are essential infrastructure to ensure water quality and public health.

Sea level rise will likely impact sensitive natural areas, especially salt water marshes and tidal portions of the Shubenacadie River. These areas often provide important habitat and can be stop-over spots for migrating birds. Beaches, dunes and salt marshes often migrate inland as sea levels rise; however buildings, lawns or infrastructure may hinder that process. Currently the Minas Basin coastline is an un-zoned portion of East Hants. New coastal zone regulations may be required, both to protect property and to protect sensitive natural features like salt marshes. As noted before, the Municipality does not currently have the resources to undertake intensive studies to determine the full impacts of sea level rise.

Climate change will impact the natural environment in several other significant ways. Changing temperatures and precipitation patterns may alter groundwater recharge and catchment areas, leading to shifts in the water table. Warmer temperatures might change the composition of forests and the distribution of animal species; some native species may be threatened and some invasive species may thrive. Finally forest fires may become more common because of higher temperatures, more blown-down trees and longer droughts. Although these impacts may be significant in East Hants, the Municipality will probably not be the lead in proposing adaptations to these issues.

Hayes Cave is the largest cave in mainland Nova Scotia, located in gypsum cliffs on the banks of the Five Mile River. The cave is an important bat habitat. Surrounding topography includes Karst landscape and Karst sinkholes. As Karst topography, the cave may be susceptible to changing rain patterns due to climate change. In the past, six major sinkholes have developed in the gypsum above and adjacent to the cave. Falling debris has closed the mouth of the cave to a small hole. The Provincial Government's proposed Our Parks and Protected Areas plan suggests designating a 2016 ha Wilderness Area around Hayes Caves, an idea which has been supported by the Municipality.

Step Six: Priorities for Adaptation

Adapting to climate change is a big commitment. Hundreds of important adaptation projects could be identified. With limited time and resources, the Adaptation Committee decided to choose a small list of projects that address the most pressing priorities within East Hants. The Committee identified flooding/ erosion and sea level rise/ storm surge as the highest priorities. Other issues identified in this plan are recognized as important, but action may have to wait. Flooding/ erosion and sea level rise/ storm surge were chosen as priorities by the Committee because they pose large risks to public health and safety and critical infrastructure. The Committee considered the following adaptation responses in these priority areas.

Flooding/ Erosion	**Floodplain mapping of the Nine Mile River -** The cost of this action made it difficult to identify as a priority.
	Floodplain mapping of the Shubenacadie River below Shubenacadie - The cost of this action made it difficult to identify as a priority.
	Review of Dykelands - This falls under Provincial jurisdiction and therefore was not considered a priority for the Municipality.
	Stormwater Study - High, uncontrolled flows during heavy rains currently cause flooding and erosion throughout the Municipality. A detailed stormwater study will allow the municipality to improve infrastructure and protect property and water quality. **PRIORITY ACTION**
	Review Flood Risk Zones - Changes to the High Risk Floodplain (HF) and Moderate Risk Floodplain (MF) Zones are needed to prepare for climate change. **PRIORITY ACTION**
	Low Impact Development Standards - Low impact development standards would help reduce the volume of stormwater, decrease flooding and improve water quality in local rivers and streams. **PRIORITY ACTION**
Sea Level Rise/ Storm Surge	**Update EMO Plans** - The current EMO plans consider hurricanes as a moderate possibility, but do not consider potential storm surge impacts. They should be updated to include the vulnerable areas and populations identified in this report. **PRIORITY ACTION**
	Impacts from sea level rise along the coastline (LiDar Mapping and Predictions) - This is a very important project for the Municipality, however the cost of LiDar mapping and computer based predictions is very high. This level of detail is not a priority, due to cost.
	Sea Level Rise Assessment - Currently there is not enough information to plan for sea level rise, or to create scientifically defensible setbacks to protect property and natural areas. The Committee would like to partner with neighbouring municipalities and the Province to undertake an assessment of the Minas Basin shoreline's vulnerability. **PRIORITY ACTION**

Immediate Priority Projects

These projects are given the highest priority because they need to be started now in order to respond to a severe, current threat, or in order to properly plan for and fund future adaptation projects.

Update EMO Plans

Existing EMO Plans do not consider potential climate change impacts. The chances of extreme weather events will increase with climate change. Flooding and storm surge dangers will increase. Contingency plans for flooding and

road washouts in particular should be updated. The community asset mapping and vulnerability mapping in this study should help EMO officials determine the places and people that are at the greatest risk.

Department: Planning & Development

Capital planning for infrastructure adaptation

This report identifies critical municipal infrastructure that is at risk from climate change. Additionally, many residents and businesses are at risk, especially from flooding. With finite resources, it is even more important to prioritize infrastructure projects early in order to respond to these risks. Since capital expenditures are often planned many years in advance, the Municipality should start planning now. Part of this planning should include continual education of Council about the state of municipal infrastructure, about ongoing projects and about the anticipated threats to infrastructure from climate change. Although this project should start immediately, capital planning for infrastructure is clearly a long term undertaking.

Departments: Finance & Administration; Infrastructure & Operations

High Priority Projects

These projects respond to severe climate threats that are anticipated to be greatest in the future. Although the greatest threats may be in the future, actions should happen quickly to prepare.

Review flood risk zones in light of climate change impacts

CBCL recently completed a floodplain study of the Shubenacadie River. The study results indicate changes to the Municipality's High Risk Floodplain (HF) and Moderate Risk Floodplain (MF) Zones are needed to prepare for climate change. Changes to flood risk zones will be an important part of the upcoming Municipal Plan Review.

Department: Planning & Development

Stormwater study

Flooding is a major problem in many areas of the corridor. High, uncontrolled flows during heavy rains currently cause flooding and erosion throughout the Municipality. The Municipality's stormwater system needs to be reviewed to identify choke points where stormwater infrastructure is under capacity and to identify solutions to existing stormwater problems. A detailed stormwater study will allow the municipality to improve infrastructure and protect property and water quality. Additionally, a stormwater study will provide recommendations on how to better manage stormwater on-site in new developments, which will limit the amount of stormwater entering the Municipality's system. Stormwater management standards and approaches will be incorporating into land-use planning policy during the upcoming Plan Review.

Departments: Infrastructure & Operations, Planning & Development

Groundwater assessment policy for new developments

Several unserviced subdivisions in East Hants regularly have wells that run dry. Climate change will lead to longer and more severe droughts, exasperating this problem. A policy requiring groundwater assessments for new wells will ensure homeowners have access to a reliable supply of drinking water. The upcoming Municipal Plan Review may provide background research and enabling policy to support this project.

Department: Planning & Development

Public education and incentives for water efficiency

Changing precipitation patterns may lower the Municipality's water supply at the same time that more heat leads to more demand for water. Encouraging water efficiency is a cost effective way to help ensure that resident's have access to a reliable supply of drinking water.

Department:

Moderate Priority Projects

These projects support high priority projects and beginning them within five years appears feasible.

Low impact development standards for stormwater

Flooding is a significant problem in East Hants. Areas like the Elmwood Subdivision have inadequate drainage for a suburban area. Although infrastructure upgrades can help, they are expensive. Low impact development standards would help reduce the volume of stormwater, decrease flooding and improve water quality in local rivers and streams. The upcoming Municipal Plan Review will provide an opportunity to discuss stormwater standards.

Departments: Planning & Development; Infrastructure & Operations

Sea level rise assessment

The Minas Basin shoreline will be more susceptible to sea level rise and storm surges as the climate changes. Currently there is not enough information to plan for sea level rise, or to create scientifically defensible setbacks to protect property and natural areas. The Committee would like to partner with neighbouring municipalities and the Province to undertake an assessment of the Minas Basin shoreline's vulnerability. This is an important but ambitious project that will be easier to undertake collaboratively.

Department: Planning & Development

Future Projects and Research

Other potential projects were identified by the Committee, but due to cost, feasibility or urgency, are not considered priorities. Some of these future projects are outside municipal jurisdiction and would therefore require cost-sharing and partnering with other levels of government.

- Municipal Plan Review – anticipated to begin in Spring 2014
- Floodplain mapping study of the Shubenacadie River from Shubenacadie to the Minas Basin.
- Floodplain mapping study of the Nine Mile River.

- Impacts from sea level rise along the coastline (LiDar Mapping and Predictions).
- Impacts from sea level rise and erosion on communities along the Minas Basin Shoreline, with regard to housing, economic costs of moving dwellings and businesses, historic/social costs, loss of infrastructure (roads, septic systems, salt water intrusion into wells) and options for these communities.
- Review of dykelands (condition, maintenance responsibility, rebuilding of aboiteaus that need to be replaced, impacts from not maintaining).
- Impacts of acid rain on Municipal water resources.
- Research on the availability of ground water in non-serviced areas.
- Conceptual study of methane gas flaring or electrical generation at the waste management facility.

Municipal Plan Review

The Municipality of East Hants is preparing to review the Municipal Planning Strategy and other land use policy. Many adaptation actions are land use planning issues. A preliminary scoping study for the Plan Review identified the following issues that are related to environmental protection and climate change adaptation.

Environmental: Water and Wastewater Management

- Manage municipal storm water.
- Protect floodplains and implement the CBCL Floodplains Study
- Implement specific plan for the Sackville River Headwaters
- Manage and plan for coastal erosion
- Environmental best practices during construction
- Watershed planning and delineation

Protect Special Places: Environmental and Architectural

- Protect and establish new parks and protected areas as required

The Plan Review is anticipated to finish in 2016. It will be a comprehensive review of goals, priorities and regulations for development and land use. Staff will suggest an emphasis on sustainability and smart growth principles, both of which will support other adaption and mitigation actions.

Climate Change Mitigation

Energy and Emissions Inventory

Using the Corporate Energy and Emissions Spreadsheet, the table below shows the calculated annual emissions for the Municipality of East Hants in the 2013 Fiscal Year. The Municipality's 10 buildings, 12 vehicles and all sewage lift stations, water treatments plants, sewage treatment plants and pumping stations are included. The emissions from solid waste are based on the volume of mixed waste in the Municipal landfill. A similar inventory from 2008/2009 found the Municipality's corporate operations generated 5,234 tonnes of CO_2 equivalents per year.

Emission Category	Energy Type	Energy Consumption	Units	Emissions (tC02e)
Buildings	Electricity	1,271,133	kWh	1,053
	Furnace Oil	17,034	L	46
Vehicle Fleet	Gasoline	43,668	L	102
	Diesel	22,676	L	60
Streetlights	Electricity	2,410	kWh	2
Water and Wastewater	Electricity	2,130,118	kWh	1,765
	Furnace Oil	1,470	L	4
Solid Waste	-	-	-	2,531
Total Annual Emissions				**5,563**

Recent Mitigation Actions

In October of 2009 Council approved a municipal Energy and Emissions Inventory and Audit. In December of 2009, CBCL Ltd. began an inventory and audit to reduce greenhouse gas emissions from operations and to identify potential mitigation projects. A screening audit was conducted for all municipal buildings, vehicles and operations. Six buildings were identified as "low hanging fruit" - opportunities to improve energy efficiency and reduce emissions with short pay-back periods. In 2010/ 2011 the following upgrades made for each building were:

- Municipal Main Office Building - Lighting and building envelope upgrades
- East Hants Swimming Pool - Lighting, building envelope and heating upgrades (Solar Hot Water)
- Lloyd E. Matheson Centre - no upgrades undertaken - potential upgrades did not meet payback criteria of being under ten years.
- Waste Management Centre, Maintenance Building - Lighting, building envelope and heating upgrades (Installed a ventilation air heating solar wall)
- Mount Uniacke Public Library - Light and building envelope upgrades
- Enfield Regional Water Treatment Plant - Lighting, building envelope and heating upgrades (Installed an air heating solar wall)

Throughout 2010 and 2011, these Municipal buildings were upgraded to reduce energy use. The municipality invested $335,000 into improving energy efficiency and reducing emissions. A comparison of actual energy use

from before and after the renovations revealed a 10% reduction in electrical use, a 3% reduction in furnace oil use and an 11% reduction in $C0_2$ emissions (220 tons $eC0_2$) for buildings.

Ongoing Mitigation Actions

The Municipality actively participates in waste reduction education programs and initiatives. This includes encouraging proper waste separation through public presentations, business assessments and audits, and a comprehensive curbside collection program. In 2013 East Hants will target waste reduction efforts on apartments, institutions (schools, government agencies), and professional offices (insurance and real estate firms, law offices, banks) specifically working on reducing paper waste and diverted organics from landfills.

East Hants provides solid waste collection to commercial and multi-unit residential customers. Many municipalities do not provide this service, and instead private haulers collect waste for commercial and multi-unit customers. Collecting solid waste from more customers reduces the number of trucks on the road, and reduces energy use and emissions.

Future Mitigation Actions

The Municipality is open to partnering on any new Provincial or Federal programs designed to reduce greenhouse gas emissions and standardize mitigation or monitoring efforts across Nova Scotia or Canada. The Municipality has not set emission reduction targets; however, future mitigation actions are under consideration.

Buildings

Solar hot water systems were considered for the Lloyd E. Matheson Centre and the Mount Uniacke Public Library in the 2010 energy audits. Due to higher than anticipated costs the projects did not meet the 10 year pay-back criteria. If the cost of solar hot water systems decreases, or the cost of energy rises, these improvements could be reconsidered.

Replacing the current Municipal Pool is a capital project under consideration, which represents a major opportunity to improve energy efficiency.

Vehicle Fleet:

Routine vehicle fleet replacement will result in better fuel mileage and lower emissions as auto industry standards improve.

Streetlights

The Municipality has already replaced all of its streetlights with LED streetlights. No further emission reductions are anticipated.

Water and Wastewater

The most promising projects are building new energy efficient treatment plants to replace aging infrastructure. These would be long term projects, with many other infrastructure considerations involved.

Solid Waste

A conceptual study for methane gas flaring at the municipal landfill is being considered. Gas flaring could significantly reduce greenhouse gas emissions.

Appendix A – Stakeholder Questionnaires

How does Climate Change Impact Agriculture?

The Agricultural Advisory Committee was identified as a stakeholder in the Municipal Climate Change Action Plan, as they represent agricultural land owners in East Hants. The committee met on May 7, 2012 to discuss the impacts of climate change on the agricultural industry in the Municipality. The results of this discussion, combined with additional research from Planning Staff, have been explained in the chart below.

Climate Change Hazard	How does Climate Change Impact Agriculture?	Rank
Rising Sea Level, Storm Surges, Flooding, and Erosion	**Dykelands** Rising sea levels, storm surges, flooding and erosion have all impacted dykelands within East Hants. Climate change related seal level rise, accompanied by increasing storm frequency and intensity are raising flood risks in many low lying coastal areas around the world[1]. In East Hants the greatest risk of coastal flooding occurs during storm surges. The most notable storm surge was the Saxby Gale in 1869. This resulting storm surge reached a sea level of approximately 10.1 metres[2]. Freshwater storm events also contribute to the flooding of agricultural lands. Water from storm events and from local rivers breaching dykeland becomes trapped and floods farmland. In these situations the dykes act as barriers to keep the water from draining. Erosion of dykeland also contributes to dykes being breached. In areas where there is a lack of a vegetative cover there would presumably be higher rates of erosion due to bare ground being exposed to the greatest energy during high tides and storm surges. Actions that should be taken to address climate change impacts on dykelands include conducting a dykeland vulnerability study, including mapping, for East Hants. The study would show where elevations need to be built up and where vegetation could be planted to reduce erosion.	
Erosion, Flooding	**Agricultural Soils** Significant rainfall events have impacted the rate of erosion along river banks and have washed away valuable soils from farmer's fields. A study of the Coastal Dykelands in the Tantramar Area has indicated that over the past 25 years the frequency of storms has more than tripled compared to records over the past century. It is presumable that the storm frequency would be comparable to those experienced by East Hants residents. Erosion of river banks may increase the chance that agricultural lands will be flooded. In addition, the erosion may reduce the amount of land available to farm for one property owner and increase another agricultural land owner's area by having the eroded soil deposited farther along the river.	

[1,2] Lieske, D.J. (2011). Coastal Dykelands in the Tantramar Area: Impacts of Climate Change on Dyke Erosion and Flood Risk. Atlantic Climate Adaptation Solution Association. Mount Allison University, New Brunswick.

Province of Nova Scotia (2005). Adapting to a Changing Climate in Nova Scotia: Vulnerability Assessment and Adaptation Options. Nova Scotia.

Flooding, Drought, Storm Surges, Hurricanes and High Winds	**Extreme Weather Events** The frequency of extreme weather events (storms, floods, drought, high winds, and hail) is impacting agricultural land owners in East Hants. Farmers in East Hants indicated that even within Nova Scotia different agricultural areas can experience different weather conditions across the Province. A drought season in the Annapolis Valley may not be an issue in East Hants, where instead flooding may be an issue. The unpredictability and increased frequency of extreme weather events makes it difficult for farmers to prepare for these events. Measures that may be taken to minimize the impacts from extreme weather events include: - Diversification of crops - Investigation into crops that are more resilient or less vulnerable to climate change impacts. - Irrigation	
Hurricanes & High Winds	**Wind Damage** Crops, especially corn, were identified as being the most impacted by high winds and hurricanes. Because of today's building code requirements farmers were not extremely concerned about their buildings withstanding strong winds usually felt in Nova Scotia. However, they did note that if the intensity of hurricanes hitting Nova Scotia were to increase they would anticipate more damage would occur to their farm buildings.	
Pests	**Pests** The only concerns that agricultural land owners had about pests, related to climate change, was that our warmer winters were not killing bugs off and keeping their populations inline. It was also noted, although not related to climate change, that insects were becoming harder to kill because they were becoming tolerant to chemical pesticides. In addition, new insects were being introduced to Nova Scotia through shipments from other countries.	

[1,2] Lieske, D.J. (2011). Coastal Dykelands in the Tantramar Area: Impacts of Climate Change on Dyke Erosion and Flood Risk. Atlantic Climate Adaptation Solution Association. Mount Allison University, New Brunswick.

Province of Nova Scotia (2005). Adapting to a Changing Climate in Nova Scotia: Vulnerability Assessment and Adaptation Options. Nova Scotia.

How does Climate Change Impact Recreation Facilities and Activities?

Questions

1. What hazards or impacts resulting from the changing climate and the weather have become issues for recreational facilities and activities in East Hants?
    - The primary impact changing climate and the weather has on recreation centre is on our natural assets, Trails and Open Space. Our coastal trails and Open Space are challenged by erosion and the effects of tides. The ripple effect is that the small community groups with limited resources are put in difficult positions as they try to fundraise the thousands of dollars to address land reclamation and infra-structure. Within the Parks and Playgrounds the impact is a little less obvious although what makes a park desirable may be an existing watercourse which when affected by heavy rain can cause significant flooding which will cause damage to playground infra-structure.

2. What hazards or impacts resulting from the changing climate and the weather have become issues for our historic sites?
    - Our heritage infra-structure is challenged by the effects of changing climate and the weather. Storms contribute to advance aging of the materials used to construct them. Stone and mortar are weaken by acid rain and intense storms are causing stronger effects on weakened buildings and structures.

3. What kind of actions or measures should be undertaken in order to address or respond to these issues?
    - The actions considered now are to some degree are being implemented include; installation of tidal valves to reduce the effects of high river flows on park property. Drainage plans are being developed and acted upon for inland areas with poor drainage. In some cases synthetic materials are used to better resist the impact of weather. More consideration is being put into how and where recreational properties are located.

4. How often do these hazards occur?
    - There are effects in one form or another every year.

5. Rank the hazards, 1 being the least hazardous and 10 being the most hazardous.

Climate Change Hazard	How does Climate Change Impact Recreation Facilities & Activities?	Rank
Rising Sea Level		7

	As sea levels arise we can anticipate a loss of surrounding lands some of which are recreation oriented.	
Erosion	Erosion of trails and supports around playground infra-structure and walkways.	1
Flooding	Damage to playground equipment and to parkland, soccer and ball fields. Impact is significant on the volunteers	2
Storm Surge	High Storm surge causes erosion on coastal trails and access points. There is concern for us during storms that will yield storm surges on our waterfront docks	5
Hurricanes & High Winds	Damage to playground equipment and to the forests on and around trails. The impact fallen trees have on community groups who are responsible for clean up.	6
Drought		4
Other	The increase in the effects of the sun of materials and on people means that we need to consider during construction developing shade opportunities and to materials that stand up to the effects of sun.	3

How does Climate Change Impact Emergency Services?

Questions

1. What hazards or impacts resulting from the changing climate and the weather have become issues for Emergency Services in East Hants?

   Please see table below.

2. What kind of actions or measures should be undertaken in order to address or respond to these issues?

   MEH has an active Emergency Planning Committee meets regularly to review the Municipality Emergency Preparedness Plan. The Plan is prepared in response to the hazards identified by the Committee to ensure resources are identified to support first responders in protecting the people and property of East Hants.

3. How often do these hazards occur?

   Please see the table below.

4. Do the East Hants Emergency Services providers have the capacity (manpower and equipment) to respond to an extreme weather event?

   To the extent that it is humanly possible to respond, yes.

5. How has EMO prepared for extreme climate and weather events and what additional information could help them continue to be prepared?

   MEH has an active Emergency Planning Committee meets regularly to review the Municipality Emergency Preparedness Plan. The Plan is prepared in response to the hazards identified by the Committee to ensure resources are identified to support first responders in protecting the people and property of East Hants.

6. Rank the hazards, 1 being the least hazardous and 10 being the most hazardous.

Climate Change Hazard	How does Climate Change Impact Emergency Services?	Rank
Rising Sea Level	The potential exists for rising sea levels to flood areas of the Municipality (i.e. along the shore and Shubenacadie River). Extreme flooding could potentially require roads to be closed leaving some people isolated. As well, extreme flooding may require people be evacuated from their homes and some of whom may require temporary arrangements for accommodation. Occurrence requiring EMO Response: Rare	4
Erosion	It is highly unlikely normal erosion would create the need for a response by the Municipality's Emergency Management Operations. Occurrence requiring EMO Response: Rare	1
Flooding	The potential for flooding in the Municipality requiring a response by the Municipality's EMO is very real. As outlined above, extreme flooding could potentially require roads to be closed leaving some people isolated. As well, extreme flooding may require people be evacuated from their homes and some of whom may require temporary arrangements for accommodation. Occurrence requiring EMO Response: Occasional	8
Storm Surge	With a significant part of the Municipality boarding on the Cobequid Bay and Shubenacadie River, a significant storm surge would result in flooding along this shore line and river. As previously stated, extreme flooding could potentially require roads to be closed leaving some people isolated. As well, extreme flooding may require people be evacuated from their homes and some of whom may require temporary arrangements for accommodation. Occurrence requiring EMO Response: Rare	4
Hurricanes, Significant Snow Fall & High Winds	Severe weather events (i.e. Hurricanes, significant snow fall and high winds) may result in roads being closed leaving some people isolated. As well, extreme weather may prevent people from remaining in their homes some of whom may require temporary arrangements for accommodation. Occurrence requiring EMO Response: Occasional	10

Drought	Drought, in and of itself, is not an issue for EMO. However, a lengthy period of time with no rain significantly increases the potential for forest fires. In cases where forest fires encroach on the residential areas of the Municipality the potential exists for roads to be closed leaving some people isolated. As well, it may be necessary to evacuate people if a forest fire poses a threat to their homes and property.	10
Other		

How does Climate Change Impact Economic Development?

Questions

1. What hazards or impacts resulting from the changing climate and the weather have become issues for commercial development in East Hants?
2. What kind of actions or measures should be undertaken in order to address or respond to these issues?
3. How often do these hazards occur?
4. Rank the hazards, 1 being the least hazardous and 10 being the most hazardous.
5. Are there any benefits or opportunities for local businesses related to a changing climate?

Climate Change Hazard	How does Climate Change Impact Economic Development?	Rank
Rising Sea Level	We see the main effects as being on agriculture, tourism, and possibly other businesses located close to waterways. Agriculture has been summed up well in their report. From a tourism perspective some of our major attractions are right on the water, and have already been affected to some degree. (Walton Lighthouse is creeping closer to the edge, Burntcoat will continue to change and lose ground, the river rafting places will continue to lose ground, etc...)	**2**
Erosion	Higher water levels and storms will continue to erode banks, and in a few key places (Selma / Maitland) the banks may reach the roads which could either isolate areas, or become huge capital projects to repair – obviously, this will have a negative impact on any commercial and tourism related operations in the area.	**2**
Flooding		**3**
Storm Surge	The increase in significant weather events like Hurricane Juan and "White Juan" exposes businesses to increased risk in the form of damaged or destroyed facilities and inventories, interruption in operations (directly as well as indirectly through the loss of essential utilities, products and services) All of these examples and others represent significant potential challenges and financial hardship of varying degrees. There are numerous things that can be done to mitigate risk from buried cables to sourcing local product. EBD would be happy to join forces with Planning	**3**

	& Development to create a Tip Sheet for businesses.	
Hurricanes & High Winds	See Storm Surge comments	**3**
Drought	See Agriculture Report and Storm Surge section	**3**
Other	**Reduced Availability of Commercial Land:** In the fall of 2011, the NS Government issued a new Wetland Conservation Policy (www.gov.ns.ca/nse/wetland/conservation.policy.asp) This policy was introduced with good reason– "Healthy wetland ecosystems have a wide range of functions such as : climate regulation - carbon cycling; absorption of toxins; flood control/erosion reduction; genetic and biological diversity; provide a critical refuge and breeding ground for many species ; often contain a high diversity of species ; maintain groundwater levels; and play a large role in water purification (particularly in urban and agricultural areas). Wetlands are already at risk, their ecological, economic and socio-cultural value having not been fully appreciated. It is estimated that more than half of the world's wetlands have disappeared during the last century. This figure is expected to increase." Excerpt from: "*Global Climate Change and Wetlands: Issues and Awareness*" (www.wetlandscanada.org/Global%20Climate%20Change.pdf) While the new Wetland Policy is an important and worthwhile initiative, the reality is that it does mean the loss of some lands that would otherwise be available for commercial development. Using the MEH business parks, for example, a substantial amount of land originally planned for development has been lost due to the presence of wetlands. Obviously, this means less capacity for commercial development within our business parks but businesses outside the business parks looking to build or expand must also abide by the Wetland Conservation Policy which could have a negative impact on their development plans. While it is possible to develop on a wetland, developers must compensate by creating more wetland elsewhere – the cost of which is often far too prohibitive to be considered a valid option. EBD is working to proactively assess the wetland situation in its business parks to identify challenges, issues and opportunities to ensure that lots, roads and	**1**

	infrastructure is laid out in the best manner possible. HRM has created a Developer's Guide to Risk Management for Climate Change. Something like this (if not yet in existence) could be a great tool for MEH developers. EBD would be pleased to work with Planning & Development on such an initiative should it come to fruition. http://www.halifax.ca/climate/documents/DevelopersGuidetoRiskManagment.pdf **Other:** It's possible that new and future regulations imposed on businesses in an effort to lessen the impacts of climate change may be burdensome at the outset (short term pain for long term gain)	

How does Climate Change Impact Residential Development?

Questions

1. What hazards or impacts resulting from the changing climate and the weather have become issues for Developers in East Hants?

2. What kind of actions or measures should be undertaken in order to address or respond to these issues?

3. How often do these hazards occur?

4. Rank the hazards, 1 being the least hazardous and 10 being the most hazardous.

Climate Change Hazard	How does Climate Change Impact Development?	Rank
Rising Sea Level	Hazards and impacts from rising sea levels include increased flooding to coastal communities and buildings. In East Hants the greatest risk of coastal flooding occurs during storm surges. Coastal flooding has not been a significant issue in recent years as dykes have been built to protect areas such as Maitland. With rising sea levels, storm surges could destroy or breach dykes causing flooding to communities and buildings. To address flooding issues, developers need to take account of providing greater setbacks but property owners want to be closer to the water to take account of the views. There is also an increased build cost associated providing flood proofing measures in a dwelling. There is uncertainty regarding how much rising sea levels will affect coastal communities and there is a lack of guidance being provided from any levels of government regarding rising sea levels and development. More guidance and/or direction should be provided by the Provincial Government on how rising sea levels will affect Nova Scotia. Coastal vulnerability mapping should be undertaken to identify the areas most at risk.	4
Erosion	Coastal erosion is an existing problem along the Minas Basin shoreline. Any new buildings need to be setback from the shoreline to ensure that	7

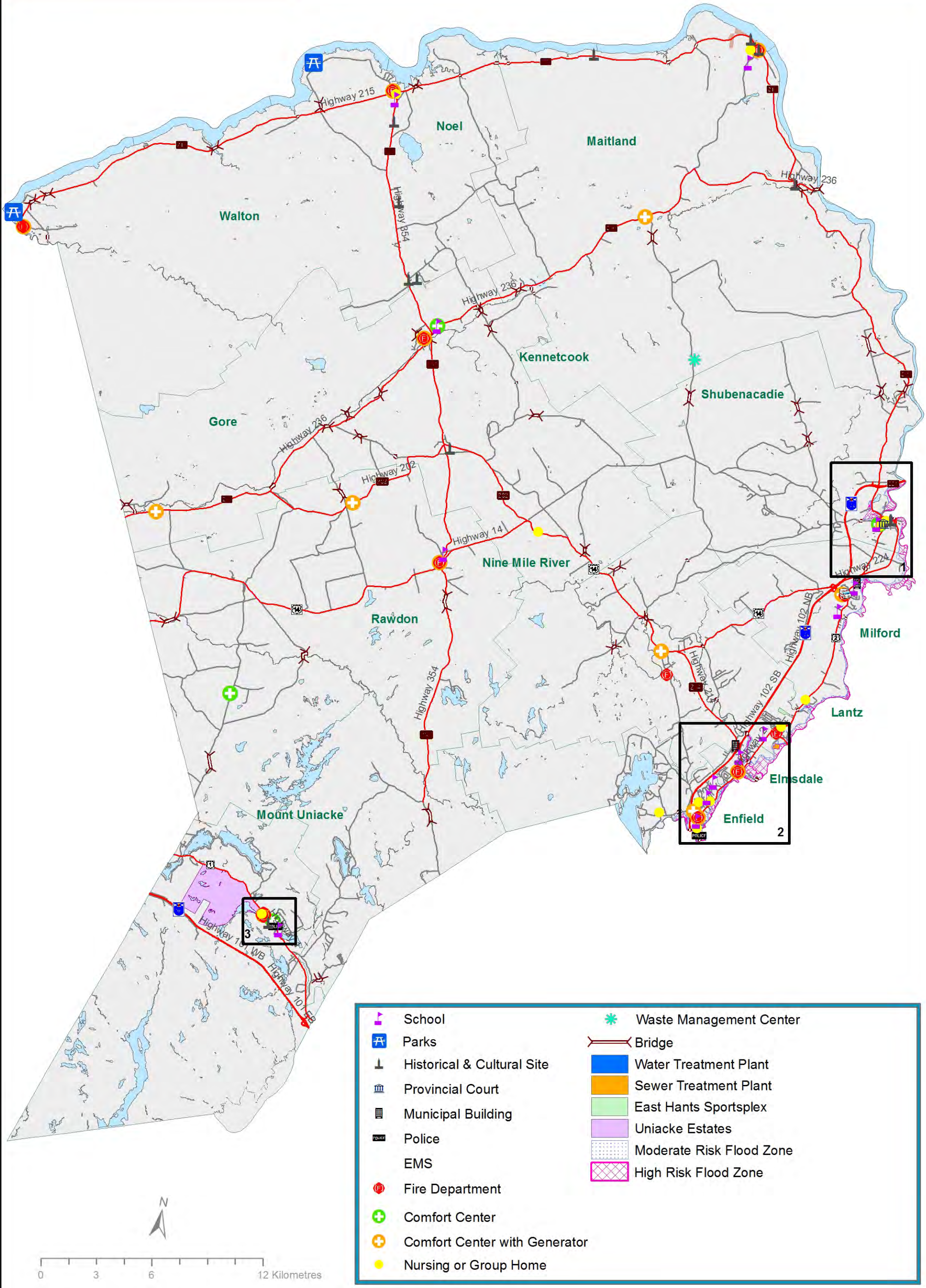
	coastal erosion does not result in the loss of the buildings. Climate change is expected to increase the frequency and severity of storms. This increase in storms could have a dramatic effect on increasing the rate of coastal erosion. There is an unknown therefore, as to how much coastal erosion will increase due to climate change. This could make it difficult to establish how far the setback from the coast should be. Coastal vulnerability mapping should be undertaken to identify the areas most at risk and provide suggested setbacks based on climate change models and rates of coastal erosion. This will give developers the ability to identify where dwellings should and shouldn't be located. Significant rainfall events have impacted on the rate of erosion along river banks. Erosion of river banks may increase the chance of properties and buildings being flooded. There is an increased cost associated with building flood proofing measures into dwellings and developers do not necessarily like setbacks because it detracts from the view associated with a riverfront property. To assist in determining appropriate setbacks flood plain mapping should take into account climate change.	
Flooding	An increase in the severity of extreme storm events results in an increase in the potential for flooding. East Hants has floodplain mapping for the more heavily populated areas of the Municipality. This mapping however needs to be updated including taking account of climate change and its impact on flooding. The insufficient detail provided in the existing mapping does not provide an accurate picture of where flooding is anticipated now and into the future. A lack of sufficiently detailed floodplain mapping has caused frustrations for developers in wanting to develop their land where flooding may not be realistically an issue. Developers also experience an increased cost of providing flood proofing measures into buildings so an increase in flooding means that developers are having to increase their costs to address this. Another issue to the development industry is the availability of insurance for new buildings although it's not clear how this can be addressed. Updated and more detailed floodplain mapping needs to be undertaken to more accurately reflect where there is a potential for flooding now and in the future as climate change impacts flooding events. Another potential reason for flooding is stormwater being unable to drain away adequately. This impact has increased for some areas of the Municipality as more areas have been developed and the area of land	8

	available for stormwater to soak into, has decreased. Municipal regulations require that developers address stormwater issues when developing a site or subdivision. This increases the cost of building, as Engineers design lot grading and also storm water management systems. In addition to professional fees of Engineers, the actual cost of grading the land and constructing the storm water management system will increase the build cost.	
Storm Surge	Coastal flooding has not been a significant issue in recent years as dykes have been built to protect areas such as Maitland. With rising sea levels, storm surges could destroy or breach dykes causing flooding to communities and buildings.	4
Hurricanes & High Winds	Hurricanes and high winds are not a regular occurrence in East Hants. Due to colder waters off the Canadian coast, hurricanes hitting Nova Scotia are generally not the higher category storms which cause extensive damage to properties. Despite this, storms do hit East Hants which cause significant damage, including Hurricane Juan which hit in 2003, although these types of events not frequent. Despite significant events such as Hurricane Juan, Hurricanes and High winds do not have a major impact on the development industry sufficient enough to require actions or measures to be undertaken. This may change in the future as climate change is expected to increase the frequency and severity of hurricanes.	2
Drought	A drought can affect ground water resources and also water levels in lakes and rivers. These water sources supply water to buildings within East Hants whether this be through a Municipal services supply or a private supply such as a well. This has not had a significant impact on the development industry in Nova Scotia. In the future climate change may increase the number and severity of droughts which may have a knock on effect on water resources.	2
Other		

Appendix B - Climate Change Hazard Mapping

EAST HANTS

Community Assets



EAST HANTS

Community Assets
Milford & Shubenacadie

Tin Smith Museum
Bennett's Rest Home
Shubenacadie District Elementary
Royal Canadian Legion
Sunnybrook Manor
Mitchell
Indian Rd
MacKay Rd
Robinson Rd
Jackson Dr
Stanley Dr
Mill Pond Rd
Cemetery Rd
Conder Rd
Hall Rd
Burgess Rd
Tulloch Rd
Gibbs Rd
Crombe Rd
Highway 2
Densmore Rd
Densmore Rd
Searle Lane
Highway 102 NB
Highway 224
224
Bethel Lane
Highway 102 SB
East Hants Rural High School
Milford Recreation Hall
Cynthia Lane
Valley View Rd
VanTol Lane
Riverside Dr
Riverside Education Centre
Milford Rd
Kent Lane
Kent Lane

- Civic
- School
- Historical & Cultural Site
- Provincial Court
- Municipal Building
- Police
- EMS
- Fire Department
- Comfort Center
- Comfort Center with Generator
- Nursing or Group Home
- Bridge
- Water Treatment Plant
- Sewer Treatment Plant
- Moderate Risk Flood Zone
- High Risk Flood Zone

N

0 0.25 0.5 1 Kilometres

EAST HANTS

Community Assets
Enfield, Elmsdale & Lantz

Maple Ridge Elementary

Adult Learning Assoc.

Elmsdale District Elementary

Enfield District Elementary

MacAskill's

Magnolias

Enfield Legion

E.H Home Elementary

Metropolitan H.A

Civic	Bridge
School	Water Treatment Plant
Historical & Cultural Site	Sewer Treatment Plant
Provincial Court	Moderate Risk Flood Zone
Municipal Building	High Risk Flood Zone
Police	
Fire Department	
Comfort Center	
Comfort Center with Generator	
Nursing or Group Home	

N

0 0.375 0.75 1.5 Kilometres

EAST HANTS

Community Assets
Mount Uniacke

N

Highway 1

Johnson Dr

Parkview Dr

Uniacke Fire Hall

Demmings Dr

Veterans Lane

Alder Lane

Uniacke Legion

Old Mines Rd

Rockwell Dr

POLICE

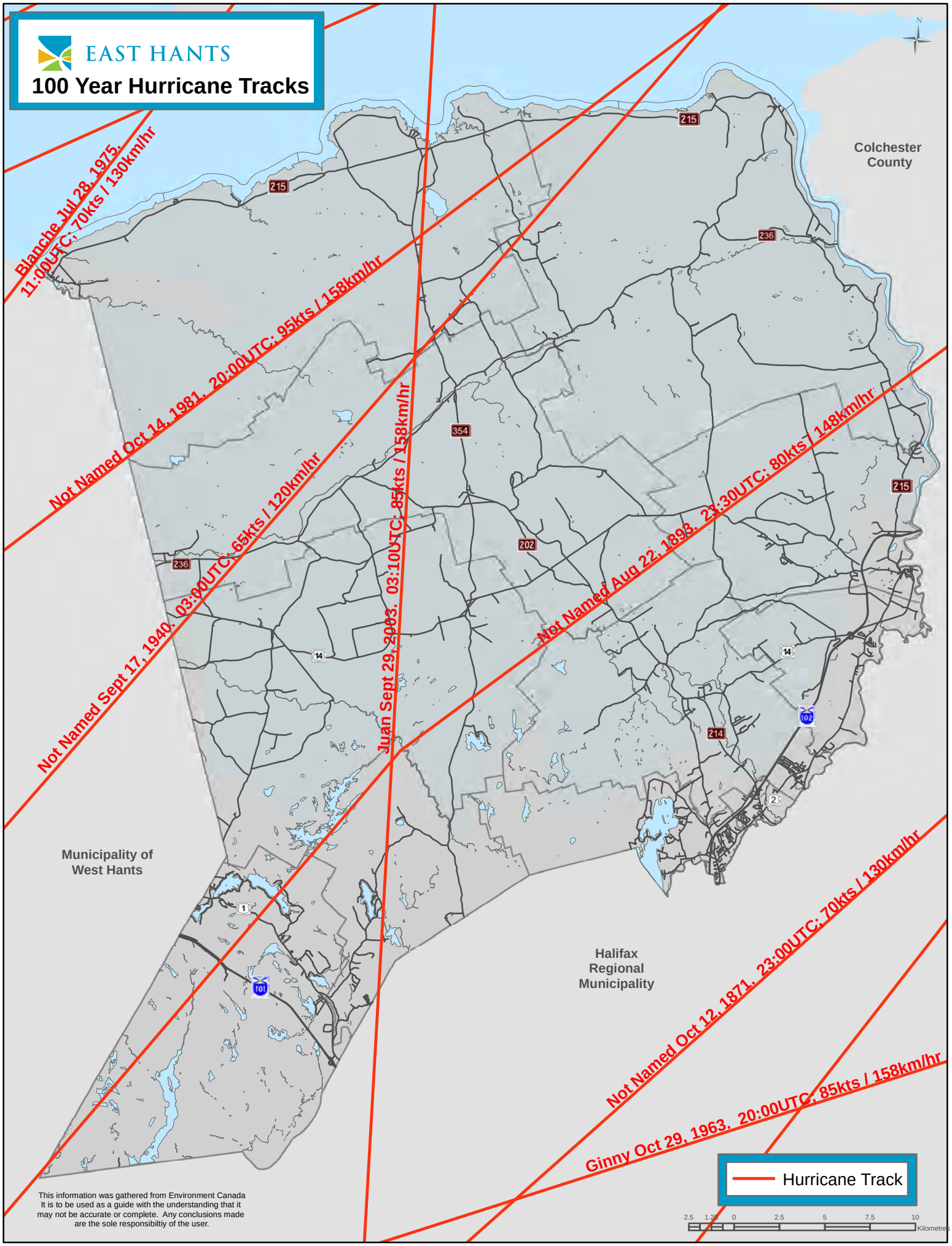
Uniacke District Elementary

Lady Slipper Lane

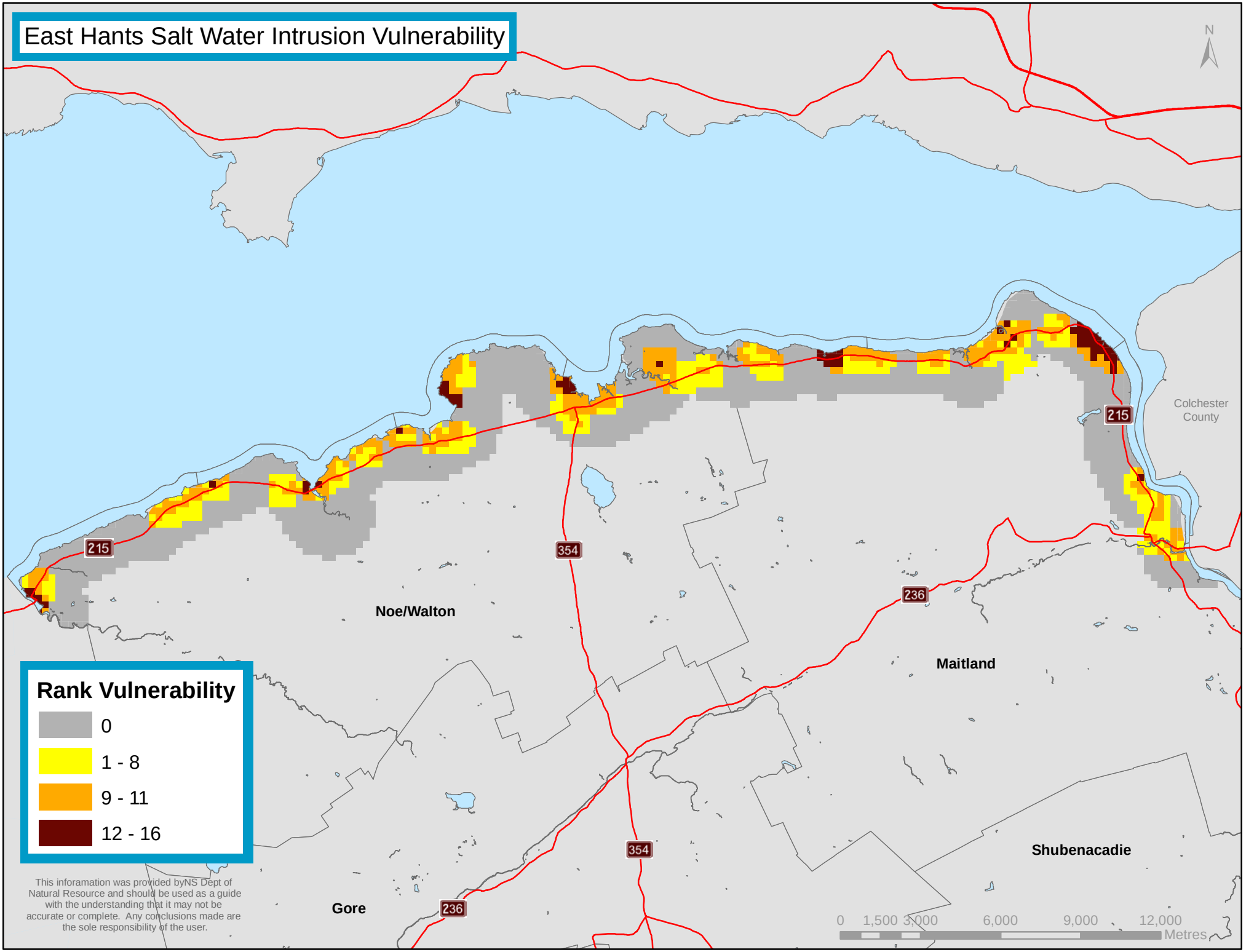
Bentz Lake Dr

- Civic
- School
- Historical & Cultural Site
- Police
- Fire Department
- Comfort Center
- Comfort Center with Generator
- Nursing or Group Home

0 0.125 0.25 0.5 Kilometres


EAST HANTS
100 Year Hurricane Tracks
Blanche Jul 28, 1975, 11:00UTC; 70kts / 130km/hr
Not Named Oct 14, 1981, 20:00UTC; 95kts / 158km/hr
Not Named Sept 17, 1940, 03:00UTC; 65kts / 120km/hr
Juan Sept 29, 2003, 03:10UTC; 85kts / 158km/hr
Not Named Aug 22, 1893, 23:30UTC; 80kts / 148km/hr
Not Named Oct 12, 1871, 23:00UTC; 70kts / 130km/hr
Ginny Oct 29, 1963, 20:00UTC; 85kts / 158km/hr
Colchester County
Municipality of West Hants
Halifax Regional Municipality
215
236
354
202
214
14
102
101
1
2
Hurricane Track
2.5 1.25 0 2.5 5 7.5 10
Kilometres
This information was gathered from Environment Canada
It is to be used as a guide with the understanding that it may not be accurate or complete. Any conclusions made are the sole responsibiltiy of the user.

East Hants Salt Water Intrusion Vulnerability



Climate Change Adaptation Plan

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Water System																				
Water Source (Wells, Surface Water, Other)	N	0	L	1	L	1	L	1	M	2	L	1	L	1	L	1	L	1	**9**	**L**
Water Treatment Plant	N	0	N	0	L	1	L	1	L	1	L	1	L	1	L	1	L	1	**7**	**L**
Water Storage Facilities	N	0	N	0	N	0	M	2	N	0	L	1	M	2	N	0	M	2	**7**	**L**
Water Pumping Facilities	N	0	N	0	N	0	N	0	N	0	N	0	L	1	L	1	L	1	**3**	**L**
Water Distribution System	N	0	N	0	N	0	N	0	N	0	N	0	M	2	L	1	M	2	**5**	**L**
Individual Water Service Lines	N	0	N	0	N	0	N	0	N	0	N	0	M	2	M	2	M	2	**6**	**L**
Total	**0**		**1**		**2**		**4**		**3**		**3**		**9**		**6**		**9**		**37**	
Sanitary Sewer System																				
Wastewater Treatment Plant	L	1	M	2	H	3	L	1	H	3	L	1	M	2	L	1	M	2	**16**	**M**
Buildings	L	1	L	1	M	2	L	1	M	2	N	0	L	1	L	1	M	2	**11**	**M**
Wastewater Gravity Sewer	L	1	L	1	H	3	N	0	H	3	N	0	L	1	L	1	L	1	**11**	**M**
Wastewater Pressure Sewer (Forcemain)	L	1	L	1	M	2	N	0	M	2	N	0	L	1	L	1	L	1	**9**	**L**
Pumping Stations	L	1	L	1	H	3	L	1	H	3	N	0	M	2	L	1	M	2	**14**	**M**
Total	**5**		**6**		**13**		**3**		**13**		**1**		**7**		**5**		**8**		**61**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Storm Sewer System																				
Catchbasins	L	1	M	2	M	2	N	0	M	2	N	0	M	2	L	1	L	1	**11**	**M**
Manholes	L	1	N	0	L	1	N	0	L	1	N	0	N	0	L	1	L	1	**5**	**L**
Pipes	L	1	L	1	H	3	N	0	H	3	N	0	M	2	L	1	L	1	**12**	**M**
Total	**3**		**3**		**6**		**0**		**6**		**0**		**4**		**3**		**3**		**28**	
Municipal Buildings																				
Buildings	N	0	L	1	M	2	M	2	L	1	L	1	L	1	L	1	M	2	**11**	**M**
Total	**0**		**1**		**2**		**2**		**1**		**1**		**1**		**1**		**2**		**11**	
Landfills/Solid Waste Facilities																				
Flooding	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Access Road	N	0	M	2	M	2	N	0	L	1	N	0	L	1	M	2	L	1	**9**	**L**
Leachate Collection	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Leachate Treatment	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Buildings	N	0	L	1	L	1	M	2	N	0	N	0	L	1	N	0	L	1	**6**	**L**
Total	**0**		**3**		**3**		**2**		**1**		**0**		**2**		**2**		**2**		**15**	
Dams																				
Flooding	H	3	L	1	H	3	H	3	H	3	N	0	N	0	M	2	H	3	**18**	**M**
Control Gates	M	2	L	1	L	1	L	1	L	1	N	0	L	1	L	1	L	1	**9**	**L**
Access Road	M	2	L	1	M	2	M	2	M	2	N	0	L	1	M	2	M	2	**14**	**M**
Fish Passage	N	0	N	0	N	0	N	0	N	0	N	0	L	1	L	1	H	3	**5**	**L**
Total	**7**		**3**		**6**		**6**		**6**		**0**		**3**		**6**		**9**		**46**	

Municipal Asset	Sea Level Rise	Precipitation (extreme event)		Extreme Wind	Flooding	Temperature		Erosion	Earthquake	Total	Risk
		Snow	Rain			High	Low				

Roads																			
Bridges	M	2	L	1	H	3	L	1	M	2	L	1	L	1	M	2	M	2	**15**	**M**
Traffic Signals	N	0	N	0	L	1	M	2	L	1	N	0	L	1	L	1	L	1	**7**	**L**
Street Lighting	N	0	L	1	L	1	M	2	L	1	N	0	L	1	L	1	L	1	**8**	**L**
Signs	N	0	L	1	L	1	H	3	L	1	L	1	N	0	L	1	N	0	**8**	**L**
Culverts	L	1	L	1	H	3	N	0	M	2	N	0	M	2	M	2	M	2	**13**	**M**
Sidewalks	N	0	L	1	M	2	L	1	M	2	N	0	L	1	M	2	M	2	**11**	**M**
Local Roads	M	2	M	2	H	3	L	1	H	3	M	2	M	2	H	3	H	3	**21**	**H**
Collectors	L	1	M	2	M	2	L	1	M	2	N	0	L	1	M	2	M	2	**13**	**M**
Total	**6**		**9**		**16**		**11**		**14**		**4**		**9**		**14**		**13**		**96**	

*Please note all of the drop boxes must be filled in for each of the asset classes

Risk Assessment Adaptation Measures - Water System

Water System	Water Source (Wells, Surface Water, Other)	Water Treatment Plant	Water Storage Facilities	Water Pumping Facilities	Water Distribution System	Individual Water Service Lines
Sea Level Rise						
Extreme Snow						
Extreme Rain						
Extreme Wind						
Flooding						
High Temp						
Low Temp						
Erosion						
Earthquake						
Impacts						
Possible Adaptation Measures						

Risk Assessment Adaptation Measures - Sanitary Sewer System

Sanitary Sewer System	Wastewater Treatment Plant	Buildings	Wastewater Gravity Sewer	Wastewater Pressure Sewer (Forcemain)	Pumping Stations
Sea Level Rise					
Extreme Snow					
Extreme Rain	**X**		**X**		**X**
Extreme Wind					
Flooding	**X**		**X**		**X**
High Temp					
Low Temp					
Erosion					
Earthquake					
Impacts	1) WW flows may exceed capacity		1) WW flows may exceed capacity		1) WW flows may exceed capacity
	2)WWT Plant site may be flooded		2) Connections may be submerged		2) Pumping Station site may be flooded
Possible Adaptation Measures	1)Reduce Inflow/Infiltration		1)Reduce Inflow/Infiltration		1)Reduce Inflow/Infiltration
	2)Raise or seal off critical components		2)Raise or seal off critical components		2)Raise or seal off critical components
	3)Introduce Surge tanks and/or overflows		3)Introduce Surge tanks and/or overflows		3)Introduce Surge tanks and/or overflows
	4) Increase capacity		4) Increase capacity		4) Increase capacity

Risk Assessment Adaptation Measures - Storm Sewer System

Storm Sewer System	Catchbasins	Manholes	Pipes
Sea Level Rise			
Extreme Snow			
Extreme Rain			X
Extreme Wind			
Flooding			X
High Temp			
Low Temp			
Erosion			
Earthquake			
Impacts			
Possible Adaptation Measures			1) Provide detention storage
			2) Install inlet control devices
			3) Provide Major Storm Routing
			4) Increase capacity

Risk Assessment Adaptation Measures - Municipal Buildings

Municipal Buildings	Buildings
Sea Level Rise	
Extreme Snow	
Extreme Rain	
Extreme Wind	
Flooding	
High Temp	
Low Temp	
Erosion	
Earthquake	
Impacts	
Possible Adaptation Measures	

Risk Assessment Adaptation Measures - Landfills

Landfills/Solid Waste Facilities	Flooding	Access Road	Leachate Collection	Leachate Treatment	Buildings
Sea Level Rise					
Extreme Snow					
Extreme Rain					
Extreme Wind					
Flooding					
High Temp					
Low Temp					
Erosion					
Earthquake					
Impacts					
Possible Adaptation Measures					

Risk Assessment Adaptation Measures - Dams

Dams	Flooding	Control Gates	Access Road	Fish Passage
Sea Level Rise	**X**			
Extreme Snow				
Extreme Rain	**X**			
Extreme Wind	**X**			
Flooding	**X**			
High Temp				
Low Temp				
Erosion				
Earthquake	**X**			**X**
Impacts	Flooding behind dyke			Dyke failure
	Dyke failure			
Possible Adaptation Measures	Raise dyke level if not restricting flow in river			review floodplain limits
	Allow controlled flooding in extreme cases			restrict floodplain uses
	review floodplain limits			
	restrict floodplain uses			

Risk Assessment Adaptation Measures - Roads

Roads	Bridges	Traffic Signals	Street Lighting	Signs	Culverts	Sidewalks	Local Roads	Collectors
Sea Level Rise								
Extreme Snow								
Extreme Rain	**X**				**X**		**X**	
Extreme Wind				**X**				
Flooding							**X**	
High Temp								
Low Temp								
Erosion							**X**	
Earthquake							**X**	
Impacts	1) Capacity and Stability Compromised			1) Traffic control compromized	1) Capacity and Stability Compromised		1) Flooding and erosion	
	2) Community access compromized			2) Personal or Property damage	2) Community access compromized			
Possible Adaptation Measures	1) NSTIR Review impact, improve as needed			1) Review Stability, improve as needed	1) NSTIR Review impact, improve as needed		1) Provide detention storage	
	2) Plan alternate routes for contingency				2) Plan alternate routes for contingency		2) Provide Major Storm Routing	
							3) Increase drainage capacity	
							4) Plan alternate routes for contingency	