La Municipalité de Clare

Municipal Climate Change Adaptation Plan

January 8, 2013

Prepared By:

GENIVAR

File # 111-56303-00

Table of Contents

1. Clare's Responsibility

> "Because of the complexity of the problem, environmental skepticism was once tenable. No longer. It is time to flip from skepticism to activism."
>
> - Michael Shermer

Climate Change in a Changing World

Observational evidence dating back to the 1950s, coupled with modern empirical research, is demonstrating a radical change in climatic extremes across the globe.[i] Most notably, global temperatures are rising and reaching all-time highs. Caused by both natural processes and human activities, global warming is resulting in the increased frequency and severity of global weather-related events. Sea levels are rising, ocean currents are shifting, and regional precipitation events are becoming increasingly drastic and unpredictable.[ii] These rapid and volatile climatic changes are likely the cause of many of today's natural disasters, such as severe drought and extreme storms.

The potential impacts of climate change are far-reaching for both humans and our natural environments. Humans are becoming more exposed and vulnerable to climate change as our economies, infrastructure, social services, and health care are impacted by the threat and reality of natural disasters. Additionally, climate change is affecting our natural landscapes and wildlife that inhabit them.[iii]

In Atlantic Canada, we are beginning to see the real effects of climate change. Atlantic Canada's natural coastal landscape and ocean-side communities are becoming increasingly vulnerable and impacted by the effects of sea level rise, storm surge, and coastal erosion and flooding. Coastal risks are real, and their impacts are potentially severe.

Specifically, Nova Scotia's coastal areas are home to approximately 70% of the province's population. Furthermore, a majority of Nova Scotia's infrastructure and industry is located in coastal communities.[iv] According to *Nova Scotia's Climate Change Action Plan*, Nova Scotia can expect to see warmer average temperatures, higher sea levels, more extreme rainfalls, and more frequent and extreme storms. Higher ocean water temperatures may impact the biodiversity of Nova Scotia's marine animals and resources, landscapes may be damaged, and several native plant and wildlife species may not be able to survive the new climatic conditions. On the human scale, Nova Scotia's very old and very young may become vulnerable to the health effects of air pollution and heat waves, and local economies and buildings may become threatened by extreme climactic shifts. The threat of natural disaster and extreme weather events poses significant risk to all Nova Scotians.[v]

Climate change is a reality of our time and place. The winds of change are around us; how we, as members of the global community, decide to respond to these changes is up to us.

Accepting the Challenge, Managing the Risks

In first realizing how we, as individuals and communities, are contributors to the causes of climate change, community leaders must then take on the challenging role of trying to understand how to adapt to the effects of climate change.

'Adaptation Planning' has become an important method through which municipalities can identify current and potential climate change impacts and establish a set of directives aimed to decrease the potential effects resulting from climate change. Actions taken today may significantly influence how municipalities and their residents are able to respond and adjust to actual or anticipated climate change issues. Through adaptation planning, municipalities may begin to explore progressive and innovative planning policies and procedures that can help them guide the future decision-making processes.

The Municipality of Clare – through the direction of Service Nova Scotia and Municipal Relations (SNSMR) - has identified a need to respond to climate change. Since 2005, The Municipality of Clare has been working on a 'Municipal Energy Concept'[vi] aimed to develop and promote the innovative use of renewable green energy solutions.

Adaptation – Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.

Anticipatory Adaptation – Adaptation that takes place before impacts of climate change are observed (also referred to as *proactive adaptation*).

Autonomous Adaptation – Adaptation that does not constitute a conscious response to climate stimuli but is triggered by ecological changes in natural systems and by markets or welfare changes in human systems (also referred to as *spontaneous adaptation*).

Planned Adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Source: Adapting to Climate Change in Ontario, 2009

In furtherance of accepting the challenge and commitment to reduce to the potential impacts of climate change, the Municipality of Clare has prepared this Climate Change Action Plan in an effort to identify priority adaptation impacts and actions for the Municipality. Through adaptation planning, Clare is now in a position to prepare for an uncertain climatic future.

Clare's continued commitment to climate change issues will likely lead to a more resilient, safe, and prosperous municipal environment – both physical and natural - for many years to come.

2. Clare's Climate Change Adaptation Vision

> "The problems of the world cannot possibly be solved by skeptics or cynics whose horizons are limited by the obvious realities. We need men who can dream of things that never were."
>
> *- John F. Kennedy*

Vision Statement

> *The Municipality of Clare shall accept vulnerability and prepare for the uncertainty of climate change through a commitment to plan for a safer, responsive, and more sustainable municipality that respects change to the natural and built environment.*
>
> *La Municipalité de Clare accepte la vulnérabilité et se préparer pour l'incertitude du changement climatique par le biais d'un engagement au plan pour une municipalité plus sûre, souple et plus durable qui respecte le changement concerne l'environnement naturel et bâti.*

Through adaptive planning and preparation, the Municipality of Clare will continually strive to become a more sustainable and resilient community to the effects of climate change. In accepting that climate change is everyone's concern, Clare will foster a mentality that promotes a Municipal-wide responsibility for adaptation and mitigation strategies. Clare will be proactive in the implementation of adaptive policy and will strive to become a leader in sustainable planning practices.

Furthermore, Clare understands that its assets and values extend beyond the physical environment. When considering both the causes and effects of climate change, Clare will approach adaptation planning from a variety of Municipal perspectives, including, but not limited to, the social, economic, environmental and political domains.

ADAPTATION APPROACHES

Preserve and enhance lands for natural resource and habitat values (e.g., the preservation of land surrounding wetlands and beaches to allow for their inland migration as the seas rise).

Avoid developing in areas considered at moderate to high risk to a hazard. Avoidance measures are typically limited in application to future development or redevelopment (e.g., setbacks, zoning that aligns land use with flood risk).

Protect areas considered at moderate to high risk to a hazard from development. Avoidance measures are typically limited in application to future development or redevelopment.

Accommodate climate change effects by adapting land-based structures and activities to tolerate an impact (e.g. warning and evacuation protocols, rolling easements).

Managed Retreat is defined as any strategic decision to withdraw, relocate or abandon private or public assets that are at risk of being impacted by coastal hazards.

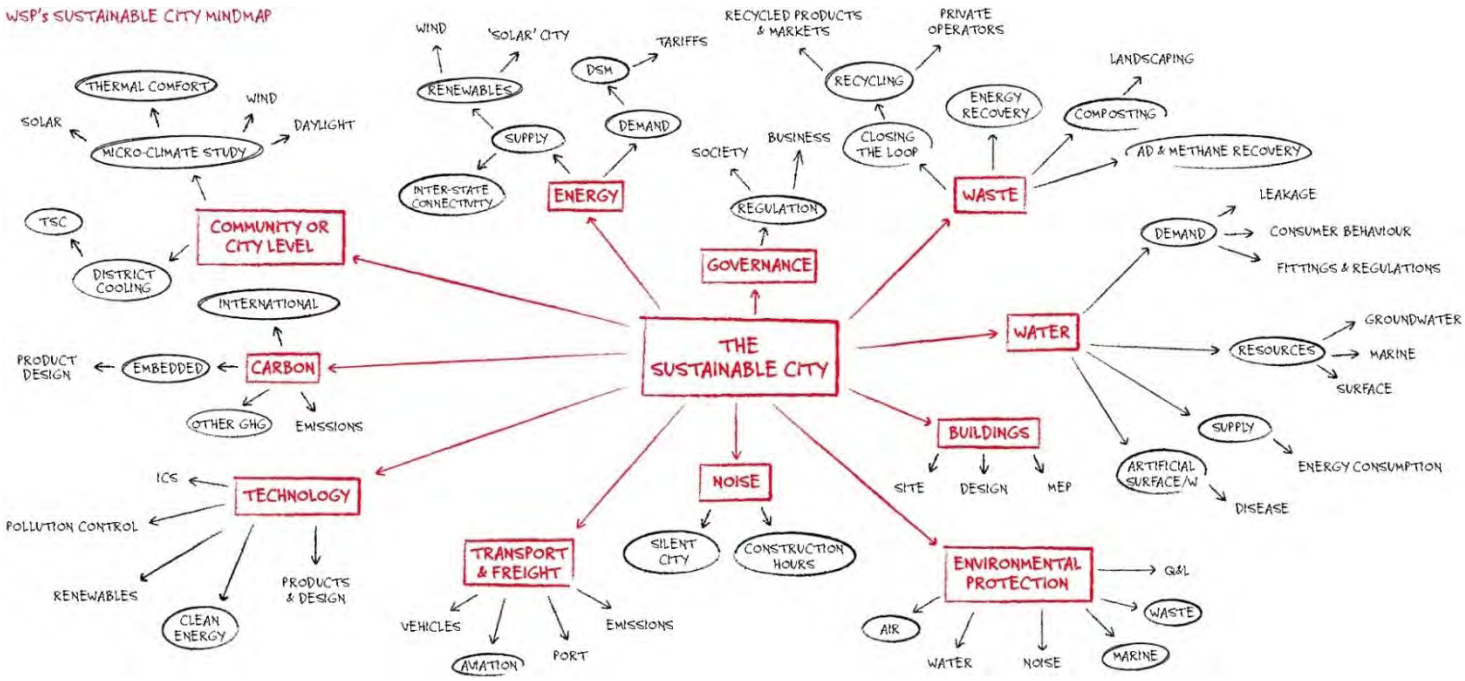
The Municipal Climate Change Action Plan Assistant – Learning From Others

Governance

There are many elements that influence the adaptivness and responsiveness of a sustainable community. In recognizing that there is a need to balance resource management, infrastructure development and upkeep, and personal understanding of individual environmental impacts, Municipalities must take an active role in developing adaptive and preventative climate change policies.

The importance of Municipal governance and leadership in this regard is essential. The Municipality of Clare needs to consider regulatory action and policy intervention in order to best prepare for the effects of climate change. This Plan shall, therefore, act as a framework decision-making tool that will help prioritize actions and facilitate future policy implementation.

The illustration below represents a visual framework when considering what municipal assets and systems need to be measured when planning for sustainable communities:



3. Project Framework

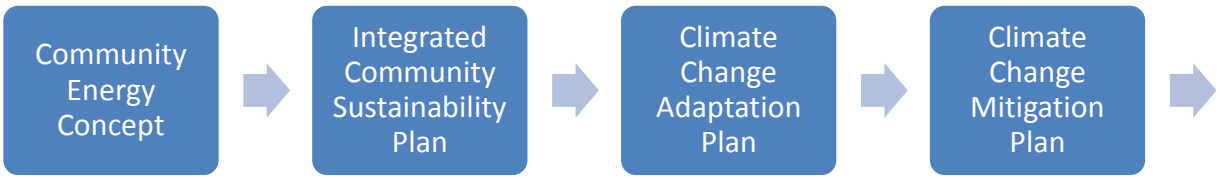
> "One thing we do know about the threat of climate change is that the cost of adjustment only grows the longer it's left unaddressed."
>
> - Jay Weatherill

Continuing Action

Since 2005 Clare has been committed to climate change action planning. Research and visioning exercises began with the establishment of the *Clare Energy Concept* from which the Municipality prepared an energy audit identifying municipal energy consumption and greenhouse gas (GHG) emission levels. To this day, the *Clare Energy Concept* initiative continues to focus on energy reduction efforts through mitigation strategies and the introduction of green energy resources.

In 2009, the Municipality of Clare embarked on a process to produce their first *Municipal Planning Strategy*, while simultaneously creating an *Integrated Community Sustainability Plan*. Completed in 2011, this community-based plan has particular focus on environmental and cultural protection. The MPS/ICSP provides policy direction for climate change adaptation and mitigation initiatives.

The *Climate Change Adaptation Plan* represents an effort to incorporate the policies set forth in the MPS/ICSP in order to implement Municipal actions that are specifically designed to reduce and minimize the potentially harmful consequences of climate change. Conversely, the adaptive actions set forth in this Plan are also designed to take advantage of potential opportunities that may result from climate change.



- Municipal Energy Audit
- Identifies carbon emissions and energy consumption

- Municipal Planning Strategy
- Land Use Bylaw
- Community-based planning process

- Identifies hazards and affected areas
- Considers ecological, social and economic municipal resources
- Identifies priorities for adaptive actions

- Continued exercise through the Sustainability Coordinator's office
- Sets out strategies to reduce emissions

Project Methodology

Project work was organized into the following phases as recommended by SNSMR:

1. *Establishment of a Project Team*
2. *Municipal Assets & Climate Change Events Identification*
3. *Change Risks Impacts Assessment*
4. *Climate Change Action and Adaptation Planning*

1. Project Team

As per SNSMR requirements, a Climate Change Adaptation Committee (CCAC) was formed in order to guide the development and implementation of the project deliverables. Clare's Planning Advisory Committee (PAC), whose membership consists of Municipal staff members, community volunteers, emergency services officials, and engaged citizens, functioned as the CCAC. The CCAC's responsibility was to provide expertise and historical knowledge on local climate change issues and hazards, as well as to provide adaptation strategies for future policy implementation. Additionally, the Planning Team from GENIVAR Inc. added professional expertise in helping to identify actual and anticipated climate change issues in order to help develop a set of adaptation action priorities.

The Adaptation Committee represented a cross-departmental, community-minded team, all of whom were responsible for fulfilling SNSMR project requirements. The project analysis and teamwork used to produce this final document is represented through a shared vision to plan for the Municipality's safer, more environmentally sustainable future.

2. Municipal Assets & Climate Change Events Identification

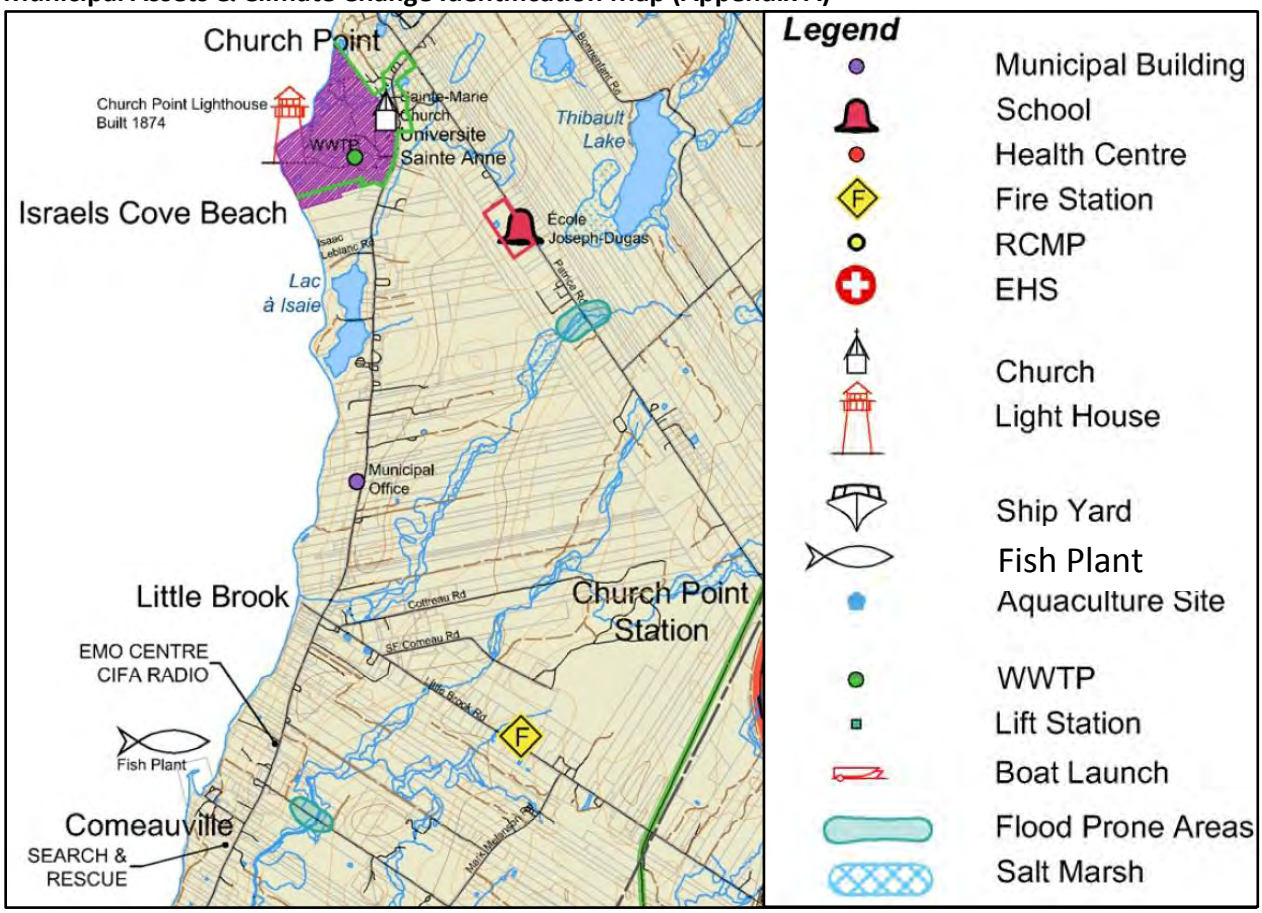
Local knowledge, coupled with historic environmental data, helped identify six key climate change events that have and are anticipated to continue impacting the Municipality of Clare:

Sea Level Rise	Erosion	Flooding	Storm Surge	Storm Events	Extreme Temperatures

These events were assessed in terms of their level of threat against local assets, and then mapped on a Municipal scale. The Project Team then set out to locate and map various municipal assets based on their ecological, economic, and social importance. Organized into eight different categories (or 'Sectors', as identified in the graphic below), these Municipal Assets were then mapped and overlaid with climate change events to see where the effects of climate change may be most drastically felt.

Municipal Infrastructure	***Cultural and Historical Resources***
Transportation and Mobility	***Ecosystems and Parks***
Buildings & Dwellings	***Health Services***
Agiculture and Industry (Economy)	***Emergency Services***

Municipal Assets & Climate Change Identification Map (Appendix A)



3. Climate Change Risks and Impacts Assessment

Within each identified Municipal Sector, the Project Team identified and assessed actual and anticipated climate change impacts. Each impact was given a 'risk rating' of either 'High', 'Medium', or 'Low', intended to guide the development of prioritized actions. This was generally a descriptive process based on qualitative understanding of each asset's significance to the Municipality and based on case study research across Canada.

4. Adaptation Planning: Prioritizing Actions

Taking local knowledge, combined with an understanding of existing and theorized best practices, the Project Team developed a set Climate Change Action Strategies for each Municipal Asset category. The proposed actions are either supported by existing MPS policy, proposed new policies, or recommended actions for future investigations or study.

The intent was to create a set of actions that may influence actual policy and bylaw change. In addition, these actions have been ranked on a either a 'Short Term, 'Medium Term', or 'Long Term' basis. The priority level is intended to determine the immediacy of latency of potential policy action.

4. Climate Change and Clare

Actual and Anticipated Climate Change Issues

Sea Level Rise – According to recent reports, the present rates of sea level rise in Nova Scotia are higher than the global mean.[vii] It is anticipated that Nova Scotia will see a total sea level rise of 70 to 140 cm over the next century.

Figure 1 depicts the sensitivity of Nova Scotia's coastline to the anticipated sea level rises.[viii] As is shown in yellow, the Municipality of Clare is expected to experience moderate to high coastal sensitivity. Sensitivity here means the degree to which a coastline may experience physical changes as a result of sea level rise.

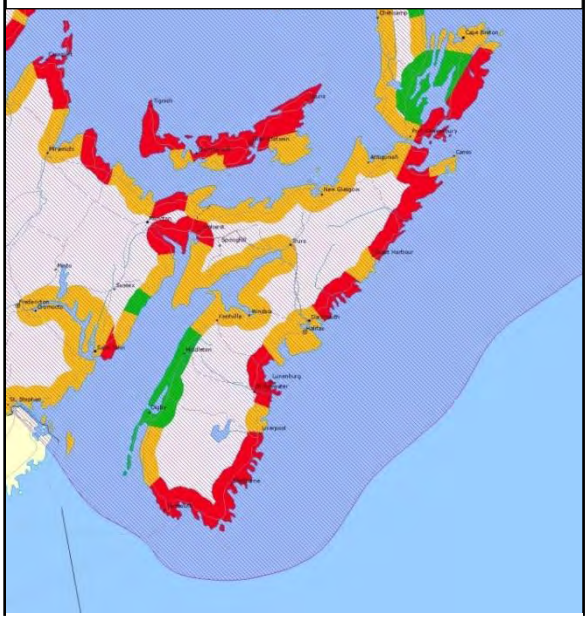
Anticipated sea level rise is determined by a number of factors: global temperatures, tides, subsidence, and storm surge. Therefore, in order to assess and map the potential impacts resulting from sea level rise, historical and projected data must be coupled to develop a sequence of sea level rise scenarios.

Figure 2 depicts possible sea level rise scenarios along Clare's coastline. This high-level assessment layers four possible sea level rise scenarios over topographical data to show areas vulnerable to anticipated sea levels. The severity of sea level rise is denoted by the shades of blue over inland areas. (Refer to **Appendix B** for complete Sea Level Rise map)

(Note that elevation data is derived from 1:10,000 Provincial topographical mapping, and, therefore, several assumptions have been made to accommodate the generality of the elevation data. It is recommended that more detailed topographic mapping be carried out along Clare's coastline to capture more accurate contour/elevation data.)

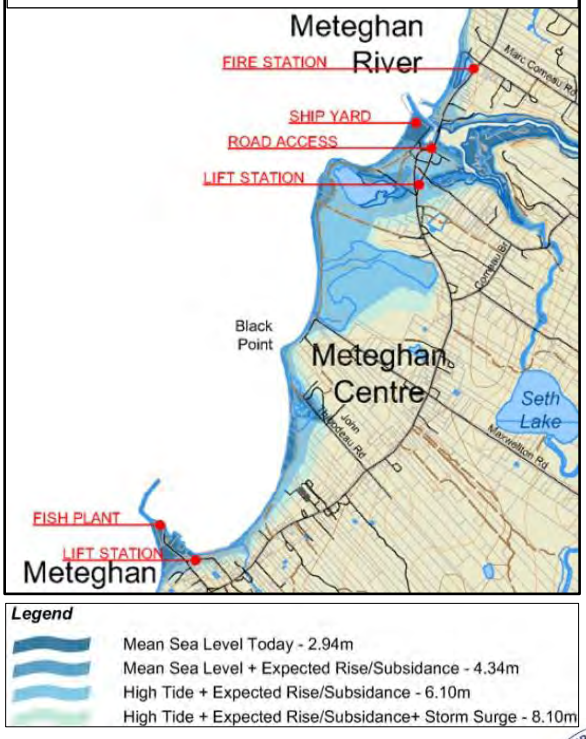
As is more clearly shown in Appendix B, as well as in *Figure 2*, Clare is particularly vulnerable to the effects of sea level rise in low-lying areas such as beaches, estuaries, and wetlands. Many of Clare's historical, cultural and ecological assets are located in these

Figure 1 – Coastal Sensitivity to Sea Level Rise



Coastal Sensitivity to Sea-level Rise
Low (0 - 4.9)
Moderate (5.0 - 14.9)
High (15 and up)
Present-day Submerging of Coasts
Present day submerging areas

Figure 2 – Sea Level Rise in Clare - Appendix B



areas as well, which may be damaged or lost as a result of rising sea levels. Similarly, a number of Clare's Municipal infrastructures, roads, and industries are located along the coast in areas possible affected by sea level rise.

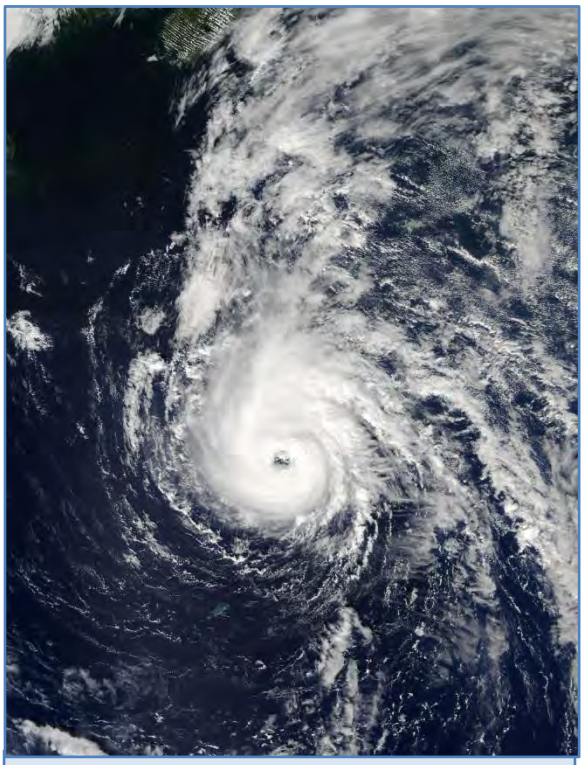
Sea level rise will likely result in more severe coastal impacts from other climate change threats as well. Threats include storm surge, coastline erosion, flooding, and beach migration. Regardless of the severity of sea level rise over the next one hundred years, Clare is likely to see impacts on a number of coastal assets.

Storm Events – Atlantic Canada is primarily affected by two main types of severe storm events: the tropical cyclone (hurricanes) and the extra-tropical cyclone (Nor'easters). As a result of increasing tropical sea surface temperatures, Atlantic Canada is likely to experience more storm events with larger peak wind speeds and heavier precipitation levels.[ix]

Over the next century, data projections suggest that the Clare region is expecting to see more hot days, more precipitation, and an increase in the intensity of precipitation events.[x] Both coastal and inland areas are susceptible to the threat of storm events, and recent events such as Hurricane Juan (2003) and Tropical Storm Sandy (2012) demonstrate the immediate and long term impacts.

Whether expected or unexpected, high winds, high waves, heavy rains and heavy snows, may have detrimental impacts on short and long-term well-being of Clare's populations and Municipal assets. Severe storms may have serious ecological, physical and economic impacts for many of Clare's municipal assets such as, but not limited to, infrastructure, buildings, environmental resources and health care services.

Tropical Storm Sandy, Roland Saumon (2012)



Hurricane Juan, 2003

This image, taken from a NASA satellite, shows Hurricane Juan approaching Nova Scotia from the South-Atlantic. The southern tip of Nova Scotia can be seen in the upper portion of this photo.

Source: http://visibleearth.nasa.gov/view.php?id=68664

The Winds of Change

Analysis of model simulations suggest that for each 1°C increase in tropical sea surface temperatures, hurricane surface wind speeds will increase by 1 to 8% and core rainfall rates by 6 to 18%.

Source: Weather and Climate Extremes in a Changing Climate, 2008.

Storm Surge – Coupled with the reality of rising sea-levels and the frequency of coastal storm events, Clare's coastal areas are becoming increasingly vulnerable to storm surge. And, as global temperatures continue to rise, the frequency of these events is also likely to increase.

Defined as an abnormal rise in water levels along the coast, storm surge events pose a high safety risk to coastal roads, buildings, and ecosystems. Severe events can cause damage to municipal infrastructures, threaten human lives, and cause harm natural coastal environments.

Erosion – Coastal erosion is often the result of severe storm surges whereby large waves, driven by high winds and low pressure systems, pile onshore. The negative biophysical effects include land instability, changes to natural landscapes and ecosystems, and salt water seepage into freshwater aquifers.[xi] Coastal erosion may also lead to individual or municipal property damage to buildings or infrastructure.

Storm Surge: the difference between the observed water level and the predicted astronomical tide

Storm Surge Return Period: the average time between occurrences of an event exceeding a giving level

Source: *The Municipal Climate Change Action Plan Assistant – Learning From Others*

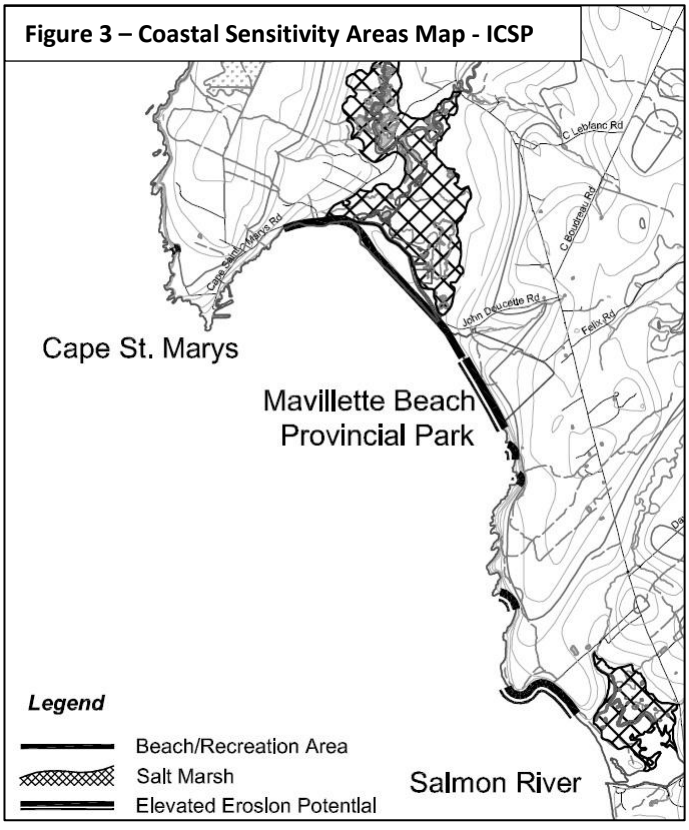
http://www.farmzone.com/news/storm_watch_stories3&stormfile=maritimes_brace_for_more_sto_041011?ref=ccbox_news_topstories

There are already several areas along Clare's coastline that are experiencing signs of damaging erosion. Several unconsolidated cliffs are experiencing accelerated erosion, and, as a result, new beach formations are being created.

The Municipality of Clare has proactively prepared a Coastal Sensitive Areas Map (CSA) as part of the MPS and ICSP implementation process. Figure 3 illustrates an excerpt from the CSA Map which identifies areas of elevated erosion risk. Criteria involved in determining areas of elevated erosion risk included: lack of bedrock outcropping; Tilly glacial sediment meeting shore at slop; wave surge; and, vegetation removal, amongst other criteria. Coupled with the threat of anticipated climate change hazards, coastal erosion sensitivity is likely to increase.

Erosion is also a risk to non-coastal lands. Heavy precipitation events may lead to

Figure 3 – Coastal Sensitivity Areas Map - ICSP



flooding, thus causing erosion to lands adjacent rivers, lakes and wetlands. There are six identified watersheds influencing Clare, and erosion impacting one area of a watershed could cause serious damages to natural ecosystems and wildlife in an adjacent watershed system.

Flooding – Flooding is a common occurrence in Clare, both in coastal areas as well as inland. Flooding can cause road washouts, required emergency response evacuation, and damage to physical and ecological landscapes.

Chemin À Moise in Bangor, for example, was closed on November 10th, 2010 and homes on the point were evacuated. Later that same week, Dick Thériault Road, in Belliveau Cove was closed on November 16th, 2010 due to flooding. In Little Brook, residents have inquired regarding an ongoing dangerous road situation on Highway 1, where a large amount of water always pools on a specific section of the road causing hydroplaning.[xii]

Bangor has also seen flooding in the past, near the Bangor Saw Mill. Reference to the Municipal Assets & Climate Change Identification Map in **Appendix A** demonstrates where flood prone areas have been witnesses in the past, and where they are likely to occur again in the future. Not including coastal areas susceptible to flooding as a result of sea level rise, historical evidence and the CCAC we able to identify nine areas prone to flooding, all of which have direct impacts on municipal roads or other assets. The image below represents an excerpt of this Map showing the area along the Meteghan River susceptible to flooding:

Municipal Assets & Climate Change Identification Map – Appendix A

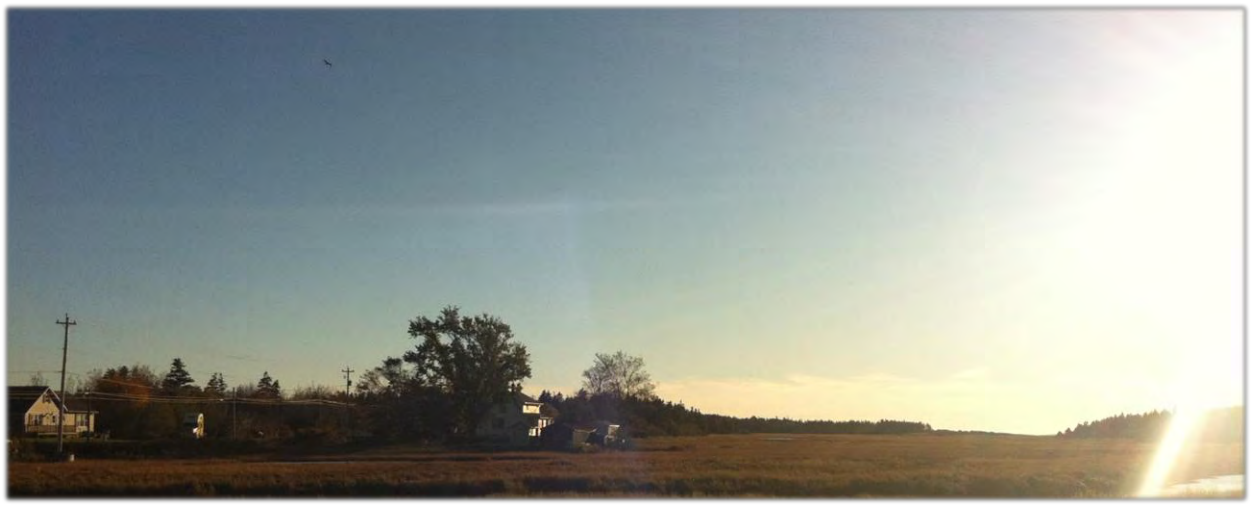
Changing Temperatures – Average annual temperatures are expected to rise. Rising temperatures can have severe impacts on both humans and ecological systems. For example, extreme heat can threaten the lives of the elderly and very young populations. Stroke, exhaustion or dehydration can become very real threats if services and infrastructures are not prepared to respond to emergency situations. Moreover, increased temperatures can facilitate the spread of mosquito and tick-borne diseases as invasive pest populations thrive in warmer climates.

Warmer temperatures also directly influence precipitation patterns causing more severe and unpredictable weather patterns. Droughts can threaten livestock and agricultural industries, while severe storms can threaten lives and damage ecosystems.

According to recent data projections, the Clare region is expected to see annual average temperatures rise to 11.0°C by 2080, up approximately 2.5°C from today's average. By 2080 the Clare region is also likely to experience increased precipitation levels (mm) especially in the winter and spring months when freeze-thaw cycles are most likely to impact roads and other infrastructures. The Table below presents predicted average temperatures (°C) and annual precipitation levels (mm) in the Municipality over the next 60 years:

Parameter	1980s	2020s		2050s		2080s	
	Value	**Value**	**SD**	**Value**	**SD**	**Value**	**SD**
Temperature - Annual	7.3	8.5	0.4	9.7	0.6	11.0	1.0
Winter	-2.6	-1.4	0.6	0.1	0.8	1.5	1.1
Spring	5.4	6.5	0.4	7.6	0.7	8.8	1.1
Summer	17.2	18.3	0.4	19.5	0.7	20.7	1.0
Autumn	9.2	10.4	0.4	11.5	0.6	12.8	0.9
Precipitation - Annual	1291.9	1327.4	31.7	1338.4	36.8	1378.1	48.0
Winter	367.4	385.3	14.6	394.5	18.8	416.0	24.1
Spring	313.9	324.3	13.3	329.0	17.8	341.9	23.4
Summer	268.6	273.2	15.9	272.3	21.1	272.7	35.0
Autumn	342.0	346.1	15.5	345.6	16.4	353.4	25.4

Source: Richards & Daigle, *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities*, 2011[xiii]



5. Sector Review

Overview

In order to better understand the threat of climate change, we need to recognize the interconnectivity of Clare's physical, ecological, economic and social assets. The effects of climate change on one Municipal Asset are likely to have effects on another.

For example, a severe storm event may cause flooding on a road which not only damages municipal infrastructure, buildings and ecosystems, but is may also pose as a health and safety risk for area residents; emergency response personnel may need to use an alternative route to access persons in distress should flooding become severe; and, should the flood linger, it may become difficult for Clare's economic sector's to transport goods and services.

In understanding that climate change is a legitimate reality and concern for the entire Municipality, the Municipality may then begin thinking about proactive adaptation measures through which the effects of climate change can be better managed.

The following section has been broken down into the following eight sections, each describing how climate change is anticipated to impact the associated sector:

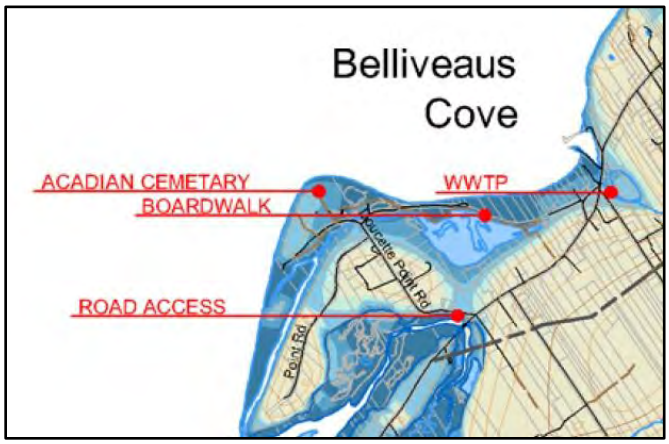
Municipal Infrastructure – *Sewers, Pumping Stations, Wells & Power*
Transportation & Mobility – *Roads, Bridges, Sidewalks & Community Vehicles*
Buildings & Dwellings – *Private and Public Properties*
Agriculture & Industry *(Economy)* – *Shipbuilding, Fisheries, Farming & Tourism*
Cultural &Historical Resources – *Churches, Schools & Community Facilities*
Ecosystems & Parks – *Beaches, Trails, Natural Environments & Landscapes*
Health Services – *Social, Physical & Mental Health*
Emergency Services – *Fire, Police & Medical Emergency Response Services*

Adaptation Actions may range from anything from education programs to engineering solutions or from land use policy interventions to new studies identifying areas needing a greater understanding of the issues. What is important to consider, though, is that no action should be considered a singular solution to a problem, and no asset functions in isolation from the rest of the Municipality; rather, each action should function as a strategic tool intended to help make the entire community, as a whole, more resilient to climate change as its potential impacts.

Municipal Infrastructure

"To make efficient use of community infrastructure, particularly municipal water and waste water facilities."

- Statement of Interest, Nova Scotia Municipal Government Act, Section 198



There are no central water facilities in Clare; however, Clare currently hosts three waste water treatment facilities (WWTP): Belliveaus Cove, Church Point, and Meteghan. Each of these facilities is also supported by a number of lift or pumping stations. According to the Sea Level Rise Impact map in Appendix B, two of the three WWTP's may be impacted by sea level rise, and a number of the lift stations may also become impacted should a sea levels rise drastically.

These facilities may be damaged by salt water intrusion and flooding, causing backups and overflows. Future renovations or expansions to these facilities and services, subject to *MPS Policy Env-12*, should take into consideration climate change impacts and areas vulnerable to sea level rise and flooding. Measures should be taken to protect and monitor the operation of these infrastructure systems.

Other public services, such as power grids, pipelines, roads, and municipal buildings, such as fire stations and health services, also need to be considered in the context of climate change. Storm events may damage power and transmission lines, and Municipal buildings may become damaged if not properly protected to weather extreme climactic scenarios. By setting an example for the rest of the community, the Municipality of Clare should consider how best to protect its buildings from an uncertain climactic future.

IMPACTS ASSESSMENT

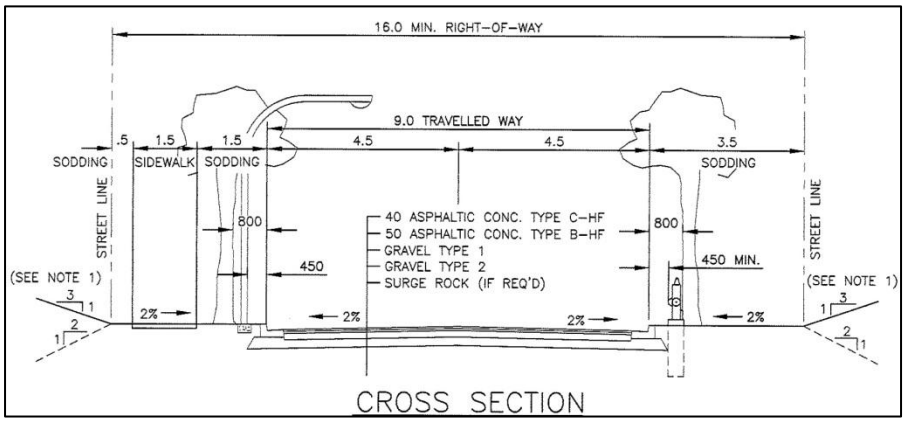
Hazard	Potential Impacts	Risk
Sea Level Rise	Saltwater intrusion into water supplies – loss of potable drinking water (private dwellings and buildings)	High
	Destruction/damage to WWTP	High
	Destruction/damage to pump/lift stations	High
	Roads and bridges may go underwater	Medium
	Loss of Municipal lands/parks	Medium
Erosion	Destruction/damage to WWTP	Medium
	Destruction/damage to pump/lift stations	Low
Flooding	Flooding may overwhelm pumping and treatment stations causing overflows and backlogs	High
Storm Surge	Pump and lift stations may flood/become overwhelmed	Medium
	Temporary road and bridge cut-offs may delay repair and construction response times	Low
Storm Events	Heavy rain and snow events can increase sediment loads into private wells	Medium
	Severe storm events can cause blackouts and electrical failures	Medium
	Undersized culverts may cause flooded roads (increased frequency)	Low
Extreme Temperatures	High temperatures and low rainfall may diminish groundwater supplies	Low
	High temperatures can result in poor odor and taste in private water supplies	Low
	High temperatures may cause anoxia or algae in private wells	Low

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
1-1	Perform LiDAR mapping and modeling along the coastline to investigate more accurately potential sea level rise impacts	Policy Env-1, Env-2, Recommended New Study	Short Term
1-2	Identify high priority municipal buildings for structural upgrades – Eco-friendly retrofits	Recommended Study	Short Term
1-3	Introduce coastal setbacks for private water systems	Policy S-11, Env-1, Env-2, Env-3	Medium Term
1-4	Initiate inflow and infiltration monitoring of priority sewers	Recommended Study	Medium Term
1-5	When planning for future expansions to Municipal infrastructures, no structures should be built within the sea-level rise impact areas (Appendix B)	Recommended New Policy	Long Term

Transportation & Mobility

Given the size and geography of Clare, there are a number of road networks, many of which are not are not well serviced or safe for travelers or residents.



Halifax Regional Municipality, Road Design Standards

The Municipality has identified a need to develop and implement engineering design standards for the construction of all new public roads. Through developing proper road design standards, the Municipality can ensure that all new roads are built according to best practices for safety as well as structurally. Properly designed roads are much more resilient to the effects of climate change; although, some climate change events are hard to avoid altogether.

As previously mentioned, flooding has impacted roads such as Chemin À Moise in Bangor and Dick Thériault Road in Belliveau Cove, which has led to home evacuations and dangerous roads for driving. Temperature is also a major factor that can affect road operation. Rapid freezing can create hazardous roads (particularly on bridges), and extreme heat can cause vehicles to overheat and tires to deteriorate.

Transport de Clare is another service that is important to the quality of life for many people in Clare. Should heating or freezing cause vehicles to stall or become inoperable, or should flooding or other climactic events prevent the service from operating, many individuals who rely on the service could become isolated and let in dangerous situations.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Coastal roads may become flooded and require repairs/closures	Medium
	Coastal bridges may become flooded and require repairs/closures	Medium
	Marine Transportation – docks and piers may sink due to increased sea levels	Low
Erosion	Landslides and wash-outs can destroy coastal roads	Medium
	Recreation paths and trails can wash away and/or become dangerous	Low
Flooding	Water damage shortens the life expectancy of roads and sidewalks	Medium
	The stress of water damage requires more frequent and costly repairs	Medium
	Temporary pooling on roads may cause dangerous driving conditions	Medium
	Bridges in low-lying areas may flood limiting access to essential services	Low
Storm Surge	High waves may cause damage to roads and sidewalks	Medium
	Pedestrians may be vulnerable to high waves on coastal paths and beaches	Medium
	High waves may cause damage to road signs and infrastructure	Low
Storm Events	Increased frequency and severity in precipitation events may disrupt road traffic and service delivery (food, supplies)	Medium
	Increased frequency and severity in precipitation events may delay construction periods and road repairs	Low
	Severe storms can threaten marine transportation	Low
	Increased rain and snowfall may limit active mobility options of residents	Low
Extreme Temperatures	Bridges and roads may become more susceptible to freezing and ice	Medium
	Extreme heat can cause vehicles to overheat and tires to deteriorate	Low
	Extreme cold can cause vehicles to stall and/or malfunction	Low
	Paved areas will have a greater potential for heat island effect	Low
	Positive* - Milder winters/less cold days may reduce cold-weather damage to vehicles	N/A

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
2-1	Introduce Municipal Engineering Standards for private & public road design	Recommended New Policy	Short Term
2-2	Monitor and maintain the integrity of existing sea walls	Recommended New Policy	Medium Term
2-3	Investigate new sea wall or berm opportunities adjacent roads susceptible to storm surge and flooding	Recommended Study	Medium Term

Buildings & Dwellings

According to Census data, there are approximately 4,478 private dwellings in Clare Municipality; a majority of which are located along Highway 1 and in coastal communities. These homes, and other commercial or municipal buildings located in these communities, are becoming increasingly susceptible to the effects of sea level rise and storm events. Buildings located on the coast can face coastal erosion, high winds and water damage.

Clare is also seeing increased pressure from developers to build new lots in low lying coastal areas. Clare currently lacks the bylaws to prohibit such subdivisions or regulate them in a manner to fully take into account climate change and its affects.

Inland flooding has also seen the evacuation of several homes. Homes located close to watershed tributaries face the risk of physical damage from flooding or isolation due to road closures.

Clare should begin considering policies and bylaws requiring proper setbacks from areas susceptible to climate change, and the Municipality should also begin considering building design guidelines which promote higher energy-efficient standards. Municipal buildings, including offices, schools, fire stations, and emergency response centres, amongst other Municipal buildings, should begin to set a standard for the rest of the community in this regard.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Salt water intrusion into private wells could damage water supplies	High
	Loss of developable land for future buildings (loss of existing property to tides, higher water levels)	Medium
	Basement flooding and property damage	Medium
	Physical damage to coastal buildings	Medium
Erosion	Landslides and wash-outs can destroy coastal homes and cottages or other buildings; access to properties may be limited	Medium
	Erosion adjacent lakes and rivers can damage building foundations and structural security	Medium
	Developable land may shift as a result of beach migration and erosion	Low
Flooding	Property damage and personal insurance increases	Medium
Storm Surge	Physical property damage to coastal buildings	Medium
	Salt water intrusion into private wells could contaminate/damage water supplies	Medium
Storm Events	Heavy snowfalls can damage roofs, and cause flooding to older homes	Medium
	Heavy rainfall may result in flooding and property damage (dwellings, businesses, farms, etc)	Medium
Extreme Temperatures	Extreme heat in summer time may increase dependency on cooling technologies – increased GHG emissions	Medium
	Forest fires may impact homes and other buildings	Medium
	Warmer temperatures may increase demand for cottages – Land use considerations (pressure to develop requires better lot standards)	Low
	Positive* - Passive Solar heating opportunities in winter time	N/A

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
3-1	Investigate and introduce coastal setbacks and 'no-development zones' for new buildings	Policy Env-3	Short Term
3-2	Introduce setbacks from flood-prone areas	Policy Env-11	Short Term
3-3	Develop Subdivision Bylaw promoting eco-friendly ('Green') design standards	Recommended New Municipal Document	Medium Term
3-4	Identify high priority municipal buildings for structural upgrades	Recommended Study	Medium Term
3-5	**Mitigation**: Investigate solar design building standards for Municipal buildings and new private homes	Policy Env-6	Medium Term
3-6	**Mitigation**: Upgrade/retrofit Municipal buildings to achieve higher energy-efficient standards	Policy Env-5, Env-5	Long Term

Agriculture & Industry (Economy)

Of key importance for protecting future economic activity is ensuring adaptation is proactive rather than reactive. Through proactive climate change adaptation, Clare's economic producers may enjoy competitive advantages and strengthen their long-term economic stability.

Although climate change has the potential to impact every aspect of Clare's economy, there are four key agriculture and industry sectors that have been identified as being considerably vulnerable to the effects of climate change, including: Shipbuilding, Aquaculture & Fisheries, Mink Farming, and Tourism.

Coastal industries, such as shipbuilding and aquaculture, are particularly vulnerable to the effects of sea level rise and storm events. Reference to the Sea Level Rise Impacts Map in Appendix B highlights that a majority of these industries are located within the impacted areas of potential sea level rise scenarios. Furthermore, severe storm events may cause direct physical damage to these industries by way of waves and high winds.

Extreme heat and an overall climactic shift may also threaten aquaculture and mink farming operations. If not solely for heat causing livestock death by way of heat stroke and dehydration, pests and other invasive species thrive in warmer temperatures which can infiltrate farming systems infecting livestock.

In lieu of the threats posed to Clare's economy, climate change may also present several opportunities for eco-ventures and the tourism industry. In understanding that climate change is occurring, businesses should be encouraged to invest in 'green' initiatives and market Clare as a leader in eco-friendly business. Warmer and longer summers may also help Clare's tourism industry as more tourists can enjoy the outdoors and summer activities. Existing Policies supporting eco-friendly opportunities include:

Policy - EC-3: Council shall utilize the Community Energy Plan as an opportunity to market Clare as a leader in renewable energy and energy efficiency.

Policy - EC-10: Council shall work with community groups and the tourism industry to develop strategies such as active living, eco-tourism and bicycle tourism strategies.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Higher tides can pull land/industry-based toxins into the ocean	High
	Changes to tidal movements and currents may affect aquaculture	Low
	Aquaculture facilities may sink and require significant repairs to adapt	Low
Erosion	Coastal businesses may be damaged by landslides and wash-outs	Medium
	Erosion may cause sediment intrusion into marine industries	Medium
	Loss of resource land (i.e. agricultural fields)	Low
Flooding	Flooded lands can inhibit agricultural growth	Medium
	Flooded roads may cut off important transport routes for goods and services	Low
Storm Surge	Severe waves may cause physical damage to coastal industries – Shipbuilding/Aquaculture	Medium
	Damage to coastal plants and equipment	Medium
Storm Events	Sever rain storms may cause Mink farm runoffs to enter adjacent ecosystems	High
	Severe storms can damage inland farms and crops	Medium
	Damaged trees can impact forestry	Low
Extreme Temperatures	Increased heat may cause drought will increase water demand and irrigation infrastructure; heat waves can impact mink production (mink death)	Medium
	Increased sea temperatures may result in an increase in incidence of outbreaks of unwelcome marine parasites and infections	Medium
	Invasive species compete with indigenous species for resources	Medium
	Increased sea temperatures threatens aquaculture habitats due to oxygen depletion	Medium
	Positive* - rising sea temperatures increases the opportunity for new aquaculture stock/species	N/A

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
4-1	Develop marketing strategy for eco-tourism	Policy EC-9, EC-10	Short Term
4-2	Encourage private industries to consider climate change hazards and adaptation strategies	Recommended New Policy	Medium Term
4-3	Monitoring animal disease outbreaks through veterinary outreach activities, evolving biosecurity practices and protocols, disease surveillance, and early detection.	Recommended Study	Medium Term
4-4	**Mitigation**: Investigate Municipal opportunities for sustainable energy projects	Policy EC-1, EC-2, EC-3, EC-4	Short Term

Cultural & Historic Resources

"The Acadian heritage of Clare links people to their historical roots. It is essential for a sustainable culture to recognize, be proud of, celebrate, teach and protect its heritage for future generations."

- Municipal Planning Strategy of Clare

The protection of Clare's cultural and historic assets is of upmost importance to the residents of Clare. Churches, schools, dams, markets, homes, schools, cemeteries, and natural parks and landscapes are scattered throughout the community, and all serve as beacons of the Acadian heritage. Given the age and locations of a number of these assets, there is a need to protect them from climate change trends.

Coastal assets are particularly vulnerable to wind and water damage arising from high tides, storms and heavy precipitation events. Inland, storms and wind can cause debris which damages buildings, and heavy precipitation or rapid freeze-thaw cycles may cause flooding damage.

In order to mitigate and prevent cultural losses or damages to cultural vestiges, it is likely that engineering or construction solutions are the best, most immediate adaptation strategies. Renovations to existing structures, the construction of protective sea walls, and other conservation methods such as protective landscaping, can offer comprehensive and proactive adaptation strategies.

Policy – C-5: Council shall work with all levels of government to identify methods to protect and conserve the environmental, historical and cultural areas of Baie Sainte-Marie.

Policy – C-6: Council shall work with all levels of government to protect and maintain historically and culturally significant sites and buildings.

IMPACTS ASSESSMENT

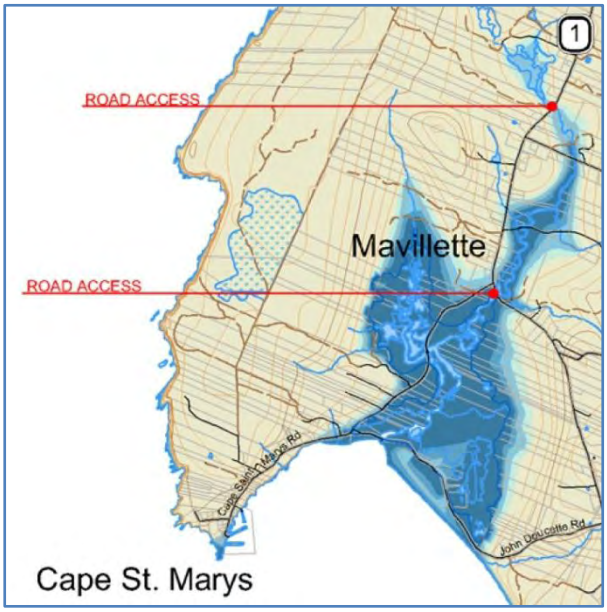
Hazard	Potential Impacts	Risk
Sea Level Rise	Damage, loss or changes to of culturally significant sites along the coast (Graveyard, Beaches, Churches, Trails, Parks)	High
	Loss of beaches may impact tourism (Mavillette)	High
	Clam beds may be lost, displaced or contaminated	High
Erosion	Sediment contamination (i.e. clam beds)	High
	Beach migration and loss of coastal wildlife	Medium
Flooding	Sediment contamination (i.e. clam beds)	Medium
	Municipal costs are expected to rise for protective measures and repair	Medium
	Temporary loss of access to coast	Low
Storm Surge	Damage to coastal industries and cultural livelihoods	High
	University population threatened by storms	Medium
Storm Events	Temporary closures of schools, University, fishing, tourism	Medium
	Damage to physical buildings and properties as a result of high winds	Medium
	Extreme events may cause school cancellations, or cancellations of important community events	Low
Extreme Temperatures	Unpredictable weather patterns could impact tourism	Medium
	Increased number of pests/insects in tourism areas	Low
	Positive* - Warmer summers could benefit tourism	N/A

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
5-1	Develop an adaptation strategy for key historical and cultural properties, including costs analysis	Policy C-5 & C-6	Medium Term

Ecosystems & Parks

Clare has a number of significant environmental systems, wildlife protection areas, and provincial beaches and parks. In considering that the entire coastline is an important cultural and ecological asset, adaptation efforts should be focused on land use policy aimed to protect natural ecosystems, beaches and parks. Coastal setbacks should be considered, as well as setbacks from environmentally sensitive areas and identified coastal sensitivity areas.



There are also two identified species at risk in the Municipality of Clare: the Sweet Pepperbush – an Atlantic Coastal Plain Plant - and the Moose.[xiv] Flooding, erosion, severe storms, and extreme temperatures are factors that may influence migration patterns, ecosystems, and species' lives.

Clare should also support conservation efforts and education programs that aim to protect wildlife, natural landscapes and biodiversity.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Loss of beaches	High
	Loss of wetlands and freshwater systems	High
	Loss of coastal wildlife sanctuaries	High
	Saltwater intrusion into freshwater ponds, rivers and lakes	High
Erosion	Deterioration of dunes and cliffs	Medium
	Beach Migration	Low
	Change in marine shoreline habitat	Low
Flooding	Areas that flood regularly may influence a shift in plant growth and animal migration patterns	Low
Storm Surge	Large waves may damage coastal habitats	Low
Storm Events	Forest destruction due to high winds, heavy snowfall, and ice storms	Low
Extreme Temperatures	Change in frequency severity of invasive species and pests	Medium
	Extreme heat and drought can lead to forest fires	Low
	Extreme heat and cold can threaten health of species at risk – Sweet Pepperbush and Moose	Low

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
6-1	Develop coastal hazard zones which designate setbacks allowing for natural coastal migration and erosion	Policy S-7,	Short Term
6-2	Protect coastal parks and trail systems by discouraging development in ecologically sensitive areas	Policy EC-9	Short Term
6-3	Develop education programs for schools and community groups demonstrating the effects of climate change on the natural landscapes, ecosystems, and wildlife	Policy EC-5	Medium term
6-4	**Mitigation**: Promote active transportation by developing and 'Active Transportation Plan'	Policy EC-10	Medium Term

Health Services

Clare has long recognized that it is home to an aging population that requires increased need for housing and health care support. The Municipality should be making efforts to ensure that future health care facilities, seniors' homes, and medical support services are located in areas unlikely to be impacted by climate change.

Education programs and materials should also be made available to vulnerable populations, such as seniors and people with young children. Extreme temperatures, for example, can cause heat stroke and dehydration, while invasive pests can also carry and spread harmful diseases.

Clare should also continue to encourage healthy and active lifestyles through active transportation. As a mitigation strategy, Clare should be encouraging people to get outside and become more active and think of alternative transportation options. The promotion of active transportation is a great way to raise awareness of the realities of climate change, whilst encouraging healthy and active lifestyles.

Clare Medical Centre: Source, Delmar Construction, http://delmarconstruction.ns.ca/

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Access to Seniors' Villa may be cut off	Medium
	WWTP back-ups can cause unsanitary overflows/back-ups	Medium
	Loss of beaches and coastal trails can mitigate physical activity opportunities	Medium
Erosion	Loss of coastal trails, beaches and parks	Medium
Flooding	Flooding over roads can impede emergency vehicle access	Medium
	Loss of sidewalks and roads can impede pedestrian mobility	Low
Storm Surge	Severe storm surge can threaten pedestrian and vehicle safety	Medium
Storm Events	Power outages can impact the provision of health services	Medium
	Road closures limit access to necessary health services	Medium
	Weather patterns may impact the mental health of individuals	Medium
Extreme Temperatures	Increased likelihood of insect & water-borne diseases	Medium
	Heat-waves may impact vulnerable populations – elderly and young	Medium
	Degraded air quality as a result of heat and dry weather can impact breathing	Low

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
7-1	Develop public awareness programs educating citizens on household adaptation and mitigation strategies	Recommended New Study	Short Term
7-2	Work with community health organizations to upgrade facilities to support climate change adaptation measures (ex. Air conditioning in case of severe heat wave)	Policy S-2	Medium Term
7-3	**Mitigation**: Promote active transportation and healthy living	Policy S-8, S-12, Env-8	Medium term

Emergency Services

Clare currently hosts fire protection services (8 departments), an RCMP detachment in Meteghan, and an Emergency Measures Operation (EM0) plan and coordinator.

According to members of the Adaptation Committee, Clare is confident in its emergency response plan which addresses many of the issues associated with climate change. The EMO addresses hazards, risks, and vulnerabilities, and also incorporates an emergency response and recovery plan through the coordination of various Municipal departments.

Above and below: http://www.rcmp-grc.gc.ca/ns/detach/Meteghan-eng.htm

The risks associated with climate change must be anticipated on all levels, including, but not limited to the following events:

- Animal Diseases
- Human Diseases and Pandemics
- Extreme Precipitation Events
- Landslides
- Localized and Flash Flooding
- Forest Fires
- Heat Waves & Freezing Temperatures
- Telecommunication Failure

It is the Municipality's responsibility to be proactive to climate change events, and to anticipate threats to both human life and the physical environment. The EMO plan shall be reviewed on a timely basis and with climate change events and impacts in mind.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Blocked evacuation routes	High
	No access to medical facilities	High
	Access to personal health care services may be limited	Medium
	Limited access to seniors facilities	Low
Erosion	Physical damage to medical facilities	Medium
Flooding	Flooded roads may restrict important emergency services routes	Medium
Storm Surge	Temporary road closures may delay emergency services response times	Medium
	Power failures may impact health services and visibility	Medium
Storm Events	Power failures may impact EMO response times and service effectiveness	Medium
	Transmission failures may decrease EMO response time and coordination efforts	Medium
Extreme Temperatures	Increased fire risks	Medium
	Extreme heat can facilitate the spread of communicable diseases	Medium

PRIORITIZED ACTIONS

Action		MPS Policy Implications	Priority
8-1	Conduct an annual review of the Emergency Response Plan taking into consideration climate change impacts on municipal sectors	Recommended new policy	Short Term
8-2	Improve and expand telecommunications infrastructure so that emergency services are better protected against climate change events	Recommended new policy	Medium Term

6. Implementation

Action to Policy: Policy to Action

In total, 29 actions have been identified in this Action Plan, many of which are already supported by MPS Policy or are currently being executed and explored as part of the Municipal Energy Concept. Although this Plan does not represent official MPS policy, nor are any of these actions mandatory, the overall objective of this Plan is for Clare to recognize that there are many challenges to be faced, governance decisions to be made, studies to be tested, and actions to be ratified. In first recognizing that Clare is vulnerable to climate change, appropriate steps may be taken to best prepare for an uncertain future.

In order to ensure that actions and policy are being following through, we recommend that the *Municipal Climate Change Adaptation Plan* be reviewed and revisited every 5 years in conjunction with mandatory MPS review processes. Through this process, Municipal Staff, Councilors, business leaders and community members alike will have the opportunity to assess what has been done, what new challenges have arisen, and what new actions need to be considered.

The Municipality of the District of Clare will continue to be proactive in its adaptation planning, and will continually face climate change through a lens of understanding, preparedness and community partnerships.

References

[i] IPCC, 2012: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change.*
[ii] Ibid.
[iii] Canada's Action on Climate Change, 2012: Website: http://climatechange.gc.ca/default.asp?lang=En&n=F2DB1FBE-1.
[iv] Government of Nova Scotia, 2009: *The 2009 State of Nova Scotia's Coast Technical Report*, Nova Scotia.
[v] Nova Scotia Environment, 2009: *Toward a Greener Future - Nova Scotia's Climate Change Action Plan*.
[vi] Lewis Engineering, 2006: *Municipality of the District of Clare: Community Energy Plan Milestone No. 1 Report*.
[vii] *State of Nova Scotia's Coast Technical Report*.
[viii] Natural Recourses Canada, "The Atlas of Canada", Online
[ix] IPCC.
[x] W. Richards, 2011: *Scenarios and Guidance for Adapting to Climate Change and Sea-Level Rise.*
[xi] *State of Nova Scotia's Coast Technical Report*.
[xii] Municipality of the District of Clare, 2010: *Planning Advisory Committee Minutes*.
[xiii] Richards & Daigle, 2011: *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise - NS and PEI Municipalities*.
[xiv] Nova Scotia Department of Natural Resources, 2012: *Conservations & recovery of Nova Scotia's Species at Risk,* Website: http://www.speciesatrisk.ca/municipalities/mun_clare.htm.

Other Sources

Elemental Sustainability Consulting Ltd., 2011: *The Municipal Climate Change Action Plan Assistant: Learning From Others.*

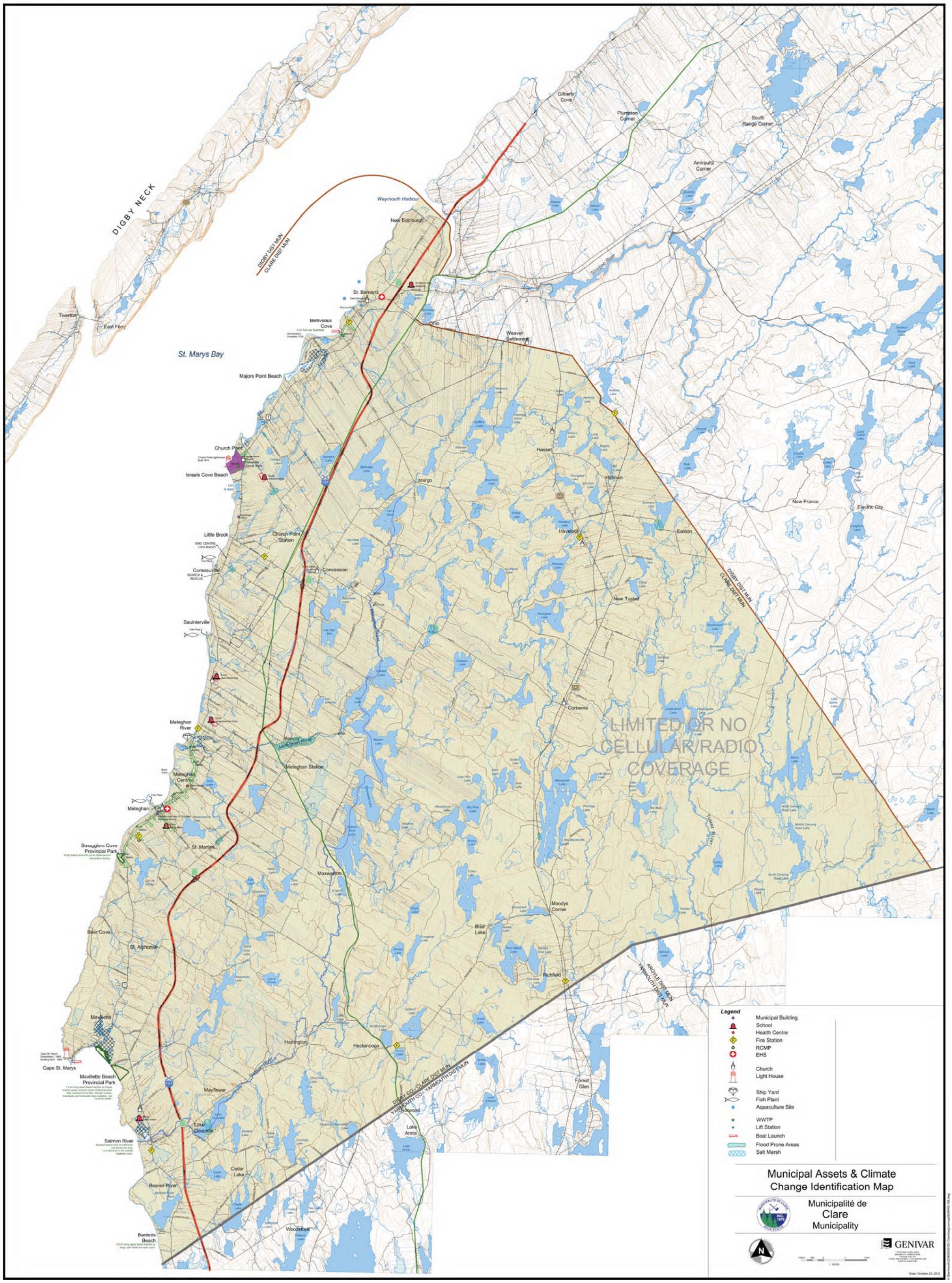
Elemental Sustainability Consulting Ltd., 2012: *Developing Climate Change Capacity at the Municipal Level in Nova Scotia Report - Appendix 3 - Mentor's Report for the Municipality of the District of Lunenburg*.

*Unless otherwise identified, all photos are courtesy GENIVAR Inc.

GENIVAR

APPENDIX A

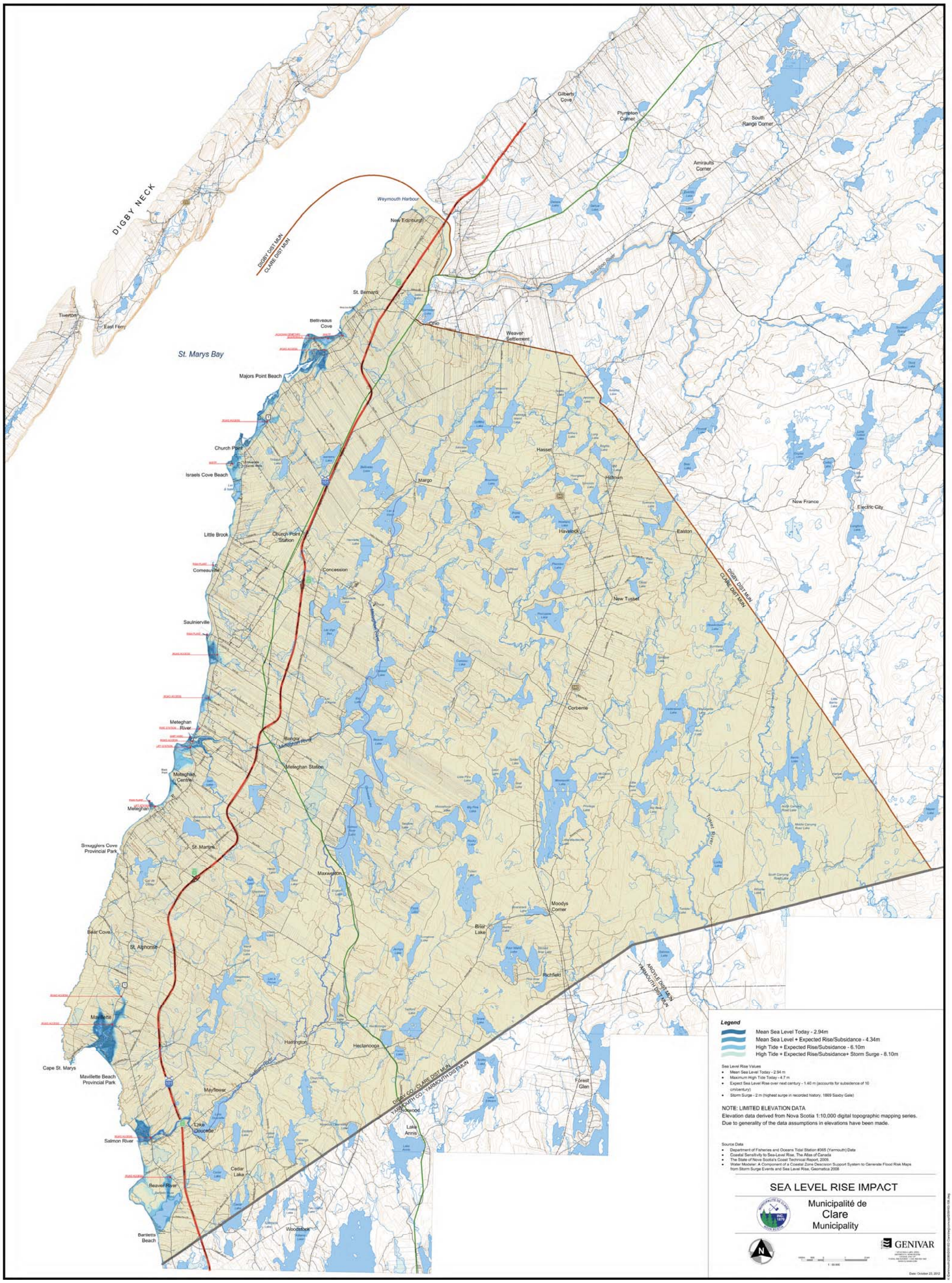
MUNICIPAL ASSETS & CLIMATE CHANGE INDENTIFICATION MAP


DIGBY NECK
Tiverton
East Ferry
St. Marys Bay
Weymouth Harbour
New Edinburgh
DIGBY DIST MUN
CLARE DIST MUN
St. Bernard
Belliveaus Cove
Majors Point Beach
Church Point
Israels Cove Beach
Little Brook
Comeauville
Saulnierville
Meteghan River
Meteghan Centre
Meteghan
Smugglers Cove Provincial Park
St. Martins
Bear Cove
St. Alphonse
Mavillette
Cape St. Marys
Mavillette Beach Provincial Park
Salmon River
Beaver River
Barnetts Beach
Church Point Station
Concession
Bangor
Meteghan River
Meteghan Station
Maxwelton
Mayflower
Lake Doucette
Cedar Lake
Woodstock
Harrington
Hectanooga
Ohio
Weaver Settlement
Hasset
Margo
Hilltown
Havelock
New Tusket
Corberrie
Brier Lake
Moodys Corner
Richfield
Lake Annis
Forest Glen
Gilberts Cove
Plympton Corner
South Range Corner
Amiraults Corner
Sissiboo River
New France
Electric City
Easton
Tusket River
DIGBY DIST MUN
CLARE DIST MUN
YARMOUTH CO
CLARE DIST MUN
YARMOUTH DIST MUN
ARGYLE DIST MUN
YARMOUTH DIST MUN
LIMITED OR NO CELLULAR/RADIO COVERAGE
Legend
Municipal Building
School
Health Centre
Fire Station
RCMP
EHS
Church
Light House
Ship Yard
Fish Plant
Aquaculture Site
WWTP
Lift Station
Boat Launch
Flood Prone Areas
Salt Marsh
Municipal Assets & Climate Change Identification Map
Municipalité de Clare Municipality
GENIVAR
Date: October 23, 2012

GENIVAR

APPENDIX B

SEA LEVEL RISE IMPACT MAP



Legend

- Mean Sea Level Today - 2.94m
- Mean Sea Level + Expected Rise/Subsidance - 4.34m
- High Tide + Expected Rise/Subsidance - 6.10m
- High Tide + Expected Rise/Subsidance+ Storm Surge - 8.10m

Sea Level Rise Values

- Mean Sea Level Today - 2.94 m
- Maximum High Tide Today - 4.7 m
- Expect Sea Level Rise over next century - 1.40 m (accounts for subsidence of 10 cm/century)
- Storm Surge - 2 m (highest surge in recorded history, 1869 Saxby Gale)

NOTE: LIMITED ELEVATION DATA

Elevation data derived from Nova Scotia 1:10,000 digital topographic mapping series. Due to generality of the data assumptions in elevations have been made.

Source Data

- Department of Fisheries and Oceans Tidal Station #365 (Yarmouth) Data
- Coastal Sensitivity to Sea-Level Rise, The Atlas of Canada
- The State of Nova Scotia's Coast Technical Report, 2009.
- Water Modeler: A Component of a Coastal Zone Descision Support System to Generate Flood Risk Maps from Storm Surge Events and Sea Level Rise, Geomatica 2008

SEA LEVEL RISE IMPACT

Municipalité de Clare Municipality

GENIVAR

1 : 50 000

Date: October 23, 2012

GENIVAR

APPENDIX C

SERVICE NOVA SCOTIA & MUNICIPAL RELATIONS
RISK ASSESSMENT TABLE

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)	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Water Treatment Plant	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Storage Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Pumping Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Distribution System	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Individual Water Service Lines	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**3**		**2**		**2**		**1**		**2**		**1**		**1**		**2**		**0**		**14**	
Sanitary Sewer System																				
Wastewater Treatment Plant	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Buildings	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Wastewater Gravity Sewer	H	3	M	2	M	2	N	0	M	2	L	1	L	1	M	2	N	0	**13**	**M**
Wastewater Pressure Sewer (Forcemain)	H	3	M	2	M	2	N	0	M	2	L	1	L	1	M	2	N	0	**13**	**M**
Pumping Stations	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Total	**15**		**10**		**10**		**3**		**10**		**5**		**5**		**10**		**0**		**68**	
Storm Sewer System																				
Catchbasins	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Manholes	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Pipes	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	
Municipal Buildings																				
Buildings	M	2	M	2	M	2	M	2	M	2	M	2	M	2	M	2	N	0	**16**	**M**
Total	**2**		**2**		**2**		**2**		**2**		**2**		**2**		**2**		**0**		**16**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
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	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**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	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	
Dams																				
Flooding	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Control Gates	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Access Road	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Fish Passage	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	
Roads																				
Bridges	M	2	L	1	L	1	L	1	L	1	M	2	M	2	M	2	N	0	**12**	**M**
Traffic Signals	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**9**	**L**
Street Lighting	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**9**	**L**
Signs	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**9**	**L**
Culverts	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	N	0	**7**	**L**
Sidewalks	L	1	L	1	L	1	N	0	L	1	L	1	L	1	M	2	N	0	**8**	**L**
Local Roads	M	2	L	1	L	1	N	0	M	2	L	1	M	2	M	2	N	0	**11**	**M**
Collectors	M	2	L	1	L	1	N	0	M	2	L	1	M	2	M	2	N	0	**11**	**M**
Total	**14**		**8**		**8**		**4**		**10**		**9**		**11**		**12**		**0**		**76**	

*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	**X**					
Extreme Snow						
Extreme Rain						
Extreme Wind						
Flooding						
High Temp						
Low Temp						
Erosion						
Earthquake						
Impacts	Saltwater intrusion into private wells					
	Loss of potable drinking water					
Possible Adaptation Measures	Prepare LiDAR mapping for accurate sea level data					
	Introduce coastal setbacks for private water systems					

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	**X**	**X**	**X**	**X**	**X**
Extreme Snow					
Extreme Rain					
Extreme Wind					
Flooding					
High Temp					
Low Temp					
Erosion					
Earthquake					
Impacts	Destruction and/or damage to infrastructure	Destruction and/or damage to infrastructure	Destruction and/or damage to infrastructure	Destruction and/or damage to infrastructure	Destruction and/or damage to infrastructure
Possible Adaptation Measures	Locate future expansions outside of impact areas	Locate future expansions outside of impact areas	Introduce quarterly I/I flow monitoring studies	Introduce quarterly I/I flow monitoring studies	Locate future expansions outside of impact areas
					Introduce quarterly I/I flow monitoring studies

Risk Assessment Adaptation Measures - Storm Sewer System

Storm Sewer System	Catchbasins	Manholes	Pipes
Sea Level Rise			
Extreme Snow			
Extreme Rain			
Extreme Wind			
Flooding			
High Temp			
Low Temp			
Erosion			
Earthquake			
Impacts			
Possible Adaptation Measures			

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				
Extreme Snow				
Extreme Rain				
Extreme Wind				
Flooding				
High Temp				
Low Temp				
Erosion				
Earthquake				
Impacts				
Possible Adaptation Measures				

Risk Assessment Adaptation Measures - Roads

Roads	Bridges	Traffic Signals	Street Lighting	Signs	Culverts	Sidewalks
Sea Level Rise						
Extreme Snow						
Extreme Rain						
Extreme Wind						
Flooding						
High Temp						
Low Temp						
Erosion						
Earthquake						
Impacts						
Possible Adaptation Measures						

Local Roads	Collectors