Melanson Settlement, G. Heming, 2013

Municipality of the County of Annapolis

Municipal Climate Change Action Plan

September 2013, Revision 5

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Executive Summary

On September 27, 2013 the Intergovernmental Panel on Climate Change released a synopsis of its Fifth Assessment Report on Climate Change. The full report which will be released in stages over the next few months can be summarized as follows: a review of all the available scientific research on climate change has now confirmed that the climate is changing, that the burning of fossil fuels is the major cause of this change, and if governments, businesses and individuals fail to act decisively, the effects of climate change will intensify and the costs to adapt and mitigate these effects will increase exponentially.

"In council chambers and municipal offices across the province, administrators and councilors are focusing on the potential climate change impacts on their communities. Climate change by its very nature is ever changing and complex. Even when climate threats are understood, the localized nature of impacts and the seemingly distant timeframes can make it hard to design and implement policies to address climate change."

Increasingly over the course of the last decade or so, scientists, environmentalists, and political and business leaders have been able to raise our awareness of climate change and have pointed to the resulting social, economic and environmental costs both to the world community and to local communities. In response, the Province of Nova Scotia has mandated that all municipalities prepare Municipal Climate Change Action Plans (MCCAP's) to meet obligations outlined in the 2013-14 Gas Tax Agreement and the Municipal Funding Agreements.

The Municipality of the County of Annapolis established a committee to develop its Municipal Climate Change Action Plan (MCCAP) in order to identify the impacts of climate change on municipal infrastructure and services and to put forward clear recommendations for adaption and mitigation.

The Committee determined that (i) hotter, drier summers and warmer winters, (ii) extreme storms and (iii) storm surges are anticipated to present the highest risk to Municipal infrastructure and operations. Specifically, as a result of the predicted changes, the Municipality can anticipate the following affects:

- Further reaching storm surge flooding of low-lying coastal areas;
- Inland flooding from more intense or frequent storms;
- Disruption of services caused by high winds;

- Changing climate could possibly bring new species, and possibly increase the incidence of agricultural/forestry-related pests and diseases.
- Longer "shoulder" tourist seasons due to warmer winters and longer summers; and
- Increased water deficit during the summer months, thus reducing the Municipality's ability to sustain an adequate amount of potable water.

Priorities were established for developing adaptation measures for taking action on climate related hazards and impacts. Generally speaking, more immediate concerns were prioritized above longer-term concerns. Likewise, issues or hazards that may impact public safety or the delivery of services were high on the list of priorities. The following lists some of the key **adaptation measures**:

1. Potable water infrastructure
    - Develop Source Water Protection Plans
2. Wastewater collection and treatment infrastructure
    - Conduct an infiltration reduction assessment
3. Stormwater Infrastructure
    - Develop Stormwater Management Plans for select areas
4. Roads
    - Review road construction design standards
5. Recreational Facilities
    - Review safety risks associated with climate change at new/existing sites
6. REMO Plan
    - Review Emergency Plan to include climate change hazards
7. Land use Management
    - Assess setbacks in vulnerable areas; continual development of flood plain mapping

Additionally, **mitigation measures** to reduce greenhouse gas emissions generated by municipal operations were identified:

a. Reducing energy demand;
b. Retrofitting existing facilities to maximize efficiency; and
c. Ensuring any new infrastructure is designed to current standards for energy efficiency.

Upon adoption of the MCCAP by Council, adaptation and mitigations measures will be implemented by way of various policy development/adoption processes as well as capital and operating budget planning.

In summary, the Municipality is experiencing many of the same effects of a rapidly changing climate as other municipalities throughout the province. The Municipality of the County of Annapolis is also experiencing several unique challenges that are particular to our local geography, microclimate, and municipal infrastructure and operations. While this report makes a series of recommendations for adaption and mitigation, Council in consultation with staff, may want to make further recommendations. It would be wise for Council to maintain an ongoing understanding of the science of climate change and its effects on the Municipality. While much is now certain about the physical science of climate change, some aspects are still unknown and uncertain. Adaption and mitigation measures outlined in the Municipality of the County of Annapolis Municipal Climate Change Action Plan reflect current knowledge, and future knowledge may require new measures to effectively address the social, economic and environmental impacts of climate change.

1.0 Adaptation Committee

The goal of this section was to list the members of the Municipality of the County of Annapolis' Municipal Climate Change Adaptation Committee, outline the list of stakeholders to be involved throughout the plan development process, and provide a Terms of Reference for committee operation.

1.1. Committee Membership

The Municipality of the County of Annapolis established a Climate Change Action Plan Team to develop its Municipal Climate Change Action Plan. The Committee was resourced through the participation of Municipality staff and Council.

The importance of the Committee's composition cannot be underestimated, as members are responsible for plan preparation. In order to develop a complete plan to address the needs of the community related to climate change adaptation, it's critical that the Committee draws on all relevant municipal programs or departments. The following table lists the members of the Municipality's Municipal Climate Change Adaptation Committee, as of December 2012. It shows both their role at the Municipality of the County of Annapolis, as well as the role they played as part of the Adaptation Committee (either Chair or Member at Large).

Table 1.1: Municipality of the County of Annapolis Adaptation Committee Members

Name	Affiliation/ Role	Role on Committee	Email
Albert Dunphy	Director of Planning and Protective Services	Chair	adunphy@annapoliscounty.ca
Cheryl Mackintosh	Senior Planning Technician/ Civic Address Coordinator	Member	cmackintosh@annapoliscounty.ca
Stephen McInnis	Director of Engineering and Public Works	Member	smcinnis@annapoliscounty.ca
Dave McCoubrey	Regional Emergency Management Coordinator	Member	dmccoubrey@annapoliscounty.ca
Cody Joudry	Manager of Economic Development and IT Services	Member	cjoudry@qannapoliscounty.ca
Gregory Heming	Councillor–District 5	Member	district5@annapoliscounty.ca
Wanda Atwell	Senior Administrative Assistant	Support	watwell@annapoliscounty.ca

1.2. Stakeholder Consultation

As per the SNSMR *Municipal Climate Change Action Plan Guidebook*, public consultation is not a mandatory part of MCCAP preparation. However, the Committee recognized the importance of consulting with stakeholders affected by climate change issues in order to tap into community resources and establish the most complete picture of how climate change is – or could – impact the Municipality. The input of stakeholders was critical to the development of an inclusive plan. The level and type of engagement varied from stakeholder to stakeholder.
The following list of stakeholder groups to be consulted was established by the Adaptation Committee during Step 1 of MCCAP development:

- Nova Scotia Agriculture
- Nova Scotia Transportation and Infrastructure Renewal
- Nova Scotia Power
- Municipal Recreation Services

The following table was completed for each stakeholder that was consulted in the MCCAP process. It describes how their participation informed plan development. A more detailed discussion of stakeholder engagement is included in Section 4.3.

Table 1.2: Example - Stakeholder Summary

Name of Stakeholder Group	Representative of Group (Role)	What did they contribute?
Nova Scotia Power	J. Smith	Provided a description of key facilities, describing issues that are anticipated to affect NSP infrastructure

1.3. Purpose of the Committee

The purpose of the Committee was to act as a temporary advisory body to the Municipal Council of Annapolis County with regards to the development of the Municipal Climate Change Action Plan, as required by SNSMR. The MCCAP addresses the anticipated needs of the Municipality and provides a clear description of how climate change mitigation and adaptation will impact daily management and operations. Upon adoption of the MCCAP by Council, it will be implemented by way of various policy development/adoption processes as well as capital and operating budget planning. It is understood that essential staff will facilitate the implementation of the MCCAP via day to day operations.

1.4. Methodology

Scientific evidence has increased public awareness of climate change[i], in response the Province of Nova Scotia has mandated that all municipalities prepare *Municipal Climate Change Action Plans* (MCCAPs) to meet obligations described in the 2013-14 Gas Tax Agreement and the Municipal Funding Agreements.

Service Nova Scotia and Municipal Relations (SNSMR) developed a Guidebook[ii] for the preparation of MCCAPs. There are two primary tasks in addressing climate change: (i) adaptation and (ii) mitigation. The adaptation plan is "*…an adjustment in natural or human systems in response to actual or expected climatic effects, which moderate harm, or takes advantage of beneficial opportunities.*"[iii] Adaptation planning is subdivided into six (6) tasks:

ADAPTATION PLAN		
Task	**Title**	**Description**
Step 1	Adaptation Committee	Assemble team, define mandate and authority
Step 2	Impacts and Hazards	Types of climate-related changes experienced in the past
Step 3	Affected Locations	Identify locations within the Municipality where issues have occurred
Step 4	Affected Facilities and Infrastructure	Identify key infrastructure and facilities (that are operated by the Municipality) and vulnerability
Step 5	Social, Economic and Environmental Considerations	Determine which residents, economic sectors and environmental assets will be most affected by climate change
Step 6	Priorities for Adaptive Actions	Prioritize climate change adaptation issues and integrate into municipal planning documents/procedures

The objective of the mitigation plan is to reduce greenhouse gas (GHG) emissions, and subsequently lower to the volume of carbon that enters the atmosphere. The mitigation plan will include the following tasks:

MITIGATION PLAN
• Completion of an energy audit or UNSM corporate energy and emissions spreadsheet
• Emission reduction efforts to-date
• Goals for reducing energy demand and GHG emissions
• Time frame and responsibility for each goal

The seven (7) sections of this report correspond to the tasks and steps as follows:

Section 1.0 Step 1: Adaptation Committee
Section 2.0 Step 2: Impacts and Hazards
Section 3.0 Step 3: Affected Locations
Section 4.0 Step 4: Affected Facilities and Infrastructure
Section 5.0 Step 5: Social, Economic and Environmental Considerations
Section 6.0 Step 6: Priorities for Adaptation
Section 7.0 Mitigation Plan

1.5. Deliverable and Schedule

The Committee was accountable to Municipal Council for the delivery of the Municipal Climate Change Action Plan.
The Committee met bi-monthly, or as determined by the Committee Chair. The format of the meetings were similar to a workshop, and lasted several hours each. Meetings continued until the plan was submitted to SNSMR.

"We would be ill-advised to appoint either government or industry to lead us in climate change adaptation, though both will assume a significant role. For its all of us as citizens and consumers who are ultimately responsible for making healthy choices for our individual lives and for the lives of our grandchildren. We determine the economic and environmental future of our communities. And now – by either a quirk of evolution or a simple twist of fate – it is us who will determine the future of the Earth. It is 'us' who must lead."

Dr. Gregory Heming, Municipal Councilor, Annapolis County

2.0 Climate Change Issues & Hazards

The objectives of this step were to help the Committee develop a deeper understanding of the types of weather related and climate related changes that the Municipality has been experiencing in the recent past, determine what new or exacerbated hazards are expected in the future, and determine if there are any opportunities that exist from future climatic changes.

2.1. Types of Issues & Hazards

Given the diverse geography of Annapolis County, various climate related trends have been observed in the past several years, which are manifested differently in each geographic region. The primary climate related trends that have been identified are:

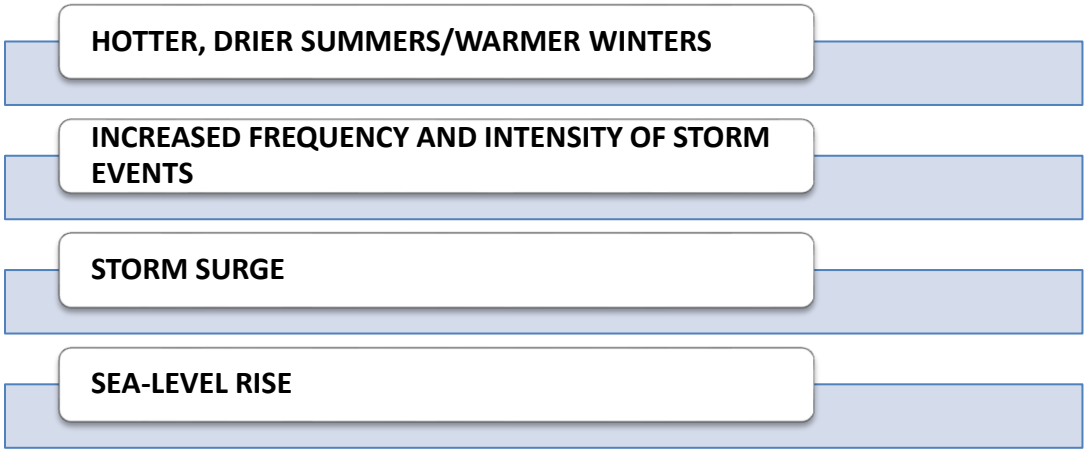


Table 2.1 in Appendix A describes the climate change related trends experienced by the Municipality in recent years, and the resulting impacts.

2.2. Issues Currently Being Experienced

Generally speaking, the Committee identified the quality and quantity of the water supply as the most pressing climate change related issue being experienced, followed closely by issues caused by extreme storm events. The concerns related to the water supply are due to recent hot, dry summers, which have negatively impacted municipal water supplies. Table 2.1 included in Appendix A describes current and potential impacts associated with climate change. The following graphics summarize the findings.

HOTTER, DRIER SUMMERS/WARMER WINTERS

Increased incidences of drought	• Reduced recharge of groundwater/ surface water • Reduced agricultural productivity
Lengthened shoulder seasons	• Lengthened tourism season • Longer growing season

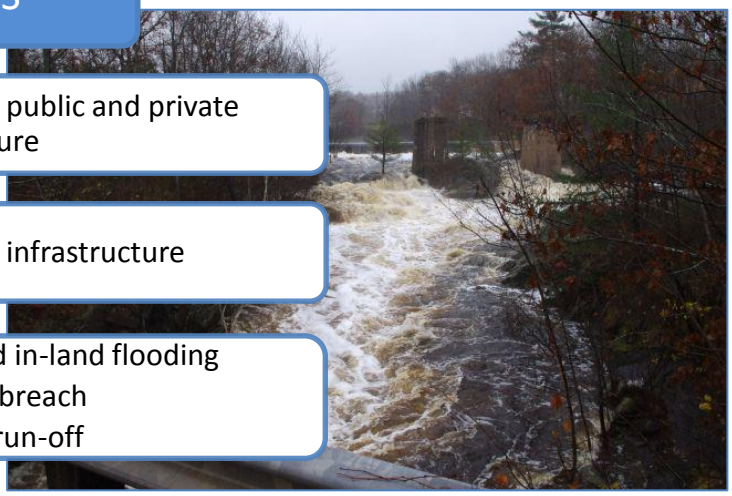
Brooklyn Rd, Annapolis County, 2013 (N. Barteaux)

The closest Environment Canada long-term climate observation station was located in Clarence, Annapolis County. Data from the weather station was collected twice day, starting in May of 1958; the station was decommissioned in 1993. Using the climatology of the observation station for the period of 1971-2000 as the baseline; the model projected changes between 1971-2000 and the future time periods (2020s, 2050s and 2080s) are then added to the observed baseline. Monthly, seasonal and annual projected values of temperature and precipitation are then calculated.

The annual average temperature is projected to increase by approximately 2.4°C by the 2080's. The largest temperature increases will be realized in the winter and summer months, resulting in hotter summers and warmer winters. The most significant increase in precipitation is projected to be in the winter months, with the least increase in precipitation in the summer months. This results in drier summers and wetter winters.

EXTREME STORM EVENTS

Hurricanes and high winds	• damage to public and private infrastructure
Increased lightning strikes	• damage to infrastructure
Increased volumes of rain and snow	• coastal and in-land flooding • dam/dyke breach • increased run-off



Nictaux Dam, 2010

Extreme storm events (i.e. hurricane-like weather associated with post tropical depressions) have caused the Annapolis River to flood roads, bridges and homes, and overwhelm the municipal wastewater system. Further, ice storms have taken down power lines, causing outages for extended periods. The frequency of storm events that cause damage are thought to be every three to four years. These events result in costly damage to infrastructure and impact public health and safety.

"The Annapolis River flooded one March when there was still ice & snow in the woods and the heavy rain lasted for about three days. In Brickton, houses were flooded, causing people to evacuate, oil barrels were displaced causing some pollution to the river, roads were closed, bridges were closed, and parts of major roads were washed out… Repairs to the infrastructure took months. The County was called upon to provide residents with sand bags…"

MCCAP Committee Member

STORM SURGE

Coastal erosion, flooding, high winds

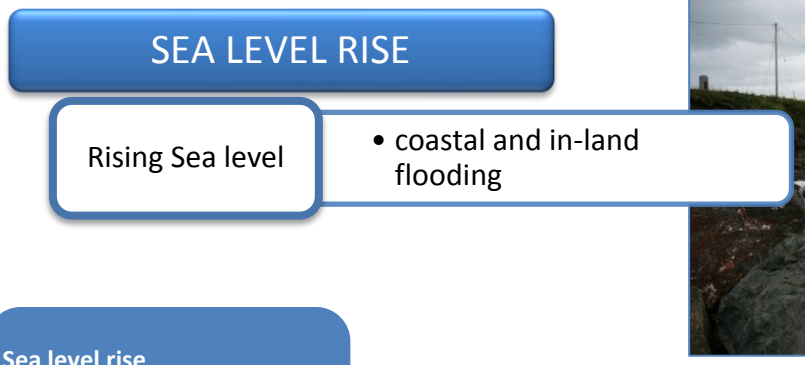
- damage to public and private infrastructure

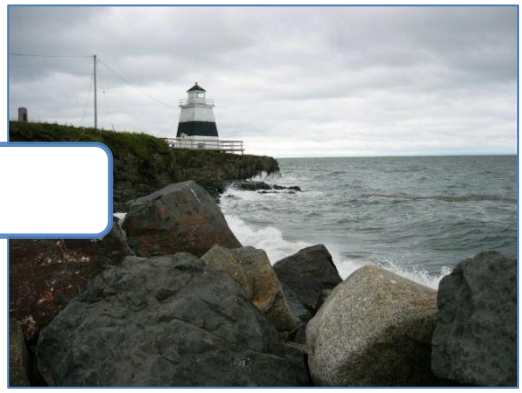
Fundy Shore, 2013 (C. Mackintosh)

Storm surges with heavy winds at high tide have caused additional damage to breakwaters and wharves, and led to some coastal flooding. The Atlantic Region is subject a wide range of seasonal events, including winter storms and tropical cyclones. Current research indicates a trend towards greater extremes and increased frequency[iv].

A storm surge is defined as the elevation of the water resulting from meteorological effects on sea level. That is, the difference between the observed water level during the storm and the level that the tide would normally rise to in the absence of a storm. In the past 20 years, storm surges have resulted in extensive property damage to coastal communities and infrastructure. The North Atlantic has been undergoing an increase in hurricane magnitude and frequency over the past 10 years. The most common events typically intensify or re-form off the U.S. east

coast; the centre of these storms typically crosses Nova Scotia and tracks through the Gulf of St. Lawrence[v]. At present, a storm surge in excess of 3.6 metres above mean sea level occurs approximately once every 40 years in the southern Gulf of St. Lawrence[vi].





Margaretsville Lighthouse. 2013

Sea level rise
the global average increase in sea level

Subsidence
the sinking of the Earth's surface (in some places there is subsidence and in others there is uplift)

Relative sea level rise
sea level rise + subsidence

MCCAP Assistant, SNSMR 2012

Sea-level changes are driven by a combination of local, regional, and hemispheric factors. Each coastal area responds differently to a particular combination of these factors, and the change in sea-level varies along Nova Scotia's coastlines. Total sea-level rise is the net sea-level rise based on estimated sea-level rise and subsidence of a particular region[vii].

Based on estimates of crustal subsidence in coastal around Nova Scotia, Table 2.2 quantifies the total predicted sea-level rise for various communities.

Table 2.2: Estimates of anticipated changes in total sea-level in metres for the years 2025, 2055, 2085 and 2100

Municipality or Area	Global Sea-Level Rise (2100)	Crustal Subsidence (2100)	Total Change (2025)	Total Change (2055)	Total Change (2085)	Total Change (2100)
Halifax	0.90 ± 0.43	0.16± 0.05	0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
Lunenburg	0.90 ± 0.43	0.16 ± 0.05	0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
Liverpool	0.90 ± 0.43	0.16± 0.05	0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
Yarmouth	0.90 ± 0.43	0.16 ± 0.05	0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
Digby	0.90 ± 0.43	0.15± 0.05	0.15 ± 0.03	0.42 ± 0.15	0.82 ± 0.36	1.05 ± 0.48
Hantsport	0.90 ± 0.43	0.20± 0.05	0.16 ± 0.03	0.45 ± 0.15	0.86 ± 0.36	1.10 ± 0.48

3.0 Affected Locations

The purpose of this section of the MCCAP was to determine the zones (coastal, mountains, valley etc.) and general locations of hazards and impacts identified in Section 2.0 (Step 2 of the MCCAP Guidebook, SNSMR). It was noted that only hazards and impacts that have an effect on the management and operations of the Municipality of the County of Annapolis were addressed.

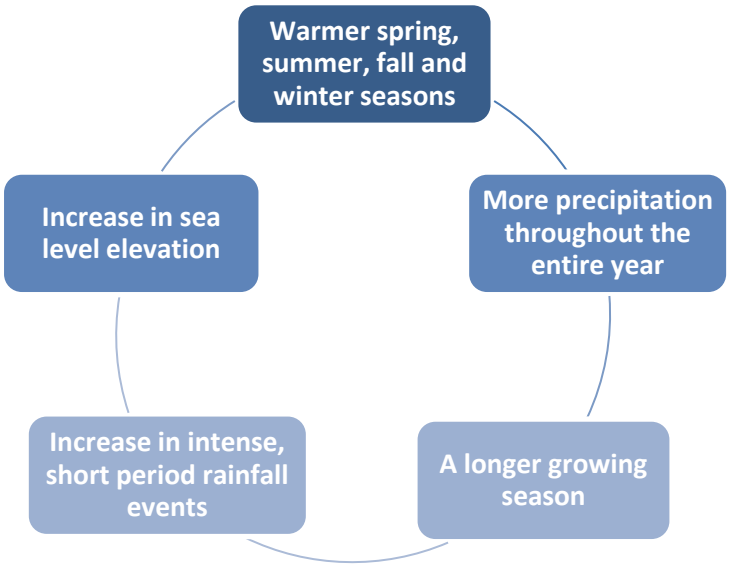
The objectives of this step were to develop a deeper understanding of the types of weather related and climate related changes that the Municipality has been experiencing in the recent past, determine what new or exacerbated hazards are expected in the future, and determine if there are any opportunities that exist from future climatic changes.

3.1. Background Research

To predict future climate change impacts and the Municipality's vulnerabilities, a review of past and current research on forecasted regional trends was completed. Following is a list of the key studies that address Nova Scotia regional trends:

a. Scenarios and Guidance for Adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities. W. Richards & R. Daigle, August 2011. ACAS Association.
b. Vulnerability of Nova Scotia's Coastal Groundwater Supplies to Climate Change. G. Ferguson & C. Beebe, May 2012. ACAS Association.
c. The Municipal Climate Change Action Plan Assistant – Learning from Others. Service Nova Scotia and Municipal Relations. 2011.
d. *Canadian Climate Change Scenarios Network*. http://www.cccsn.ec.gc.ca/
e. From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Region. L. Vasseur & N. Cato. 2007

In *Scenarios and Guidance for Adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities* (2011), Richards and Daigle model the climate change characteristics of a number of factors (including temperature, precipitation, and sea level rise) for municipalities throughout Nova Scotia and Prince Edward Island.



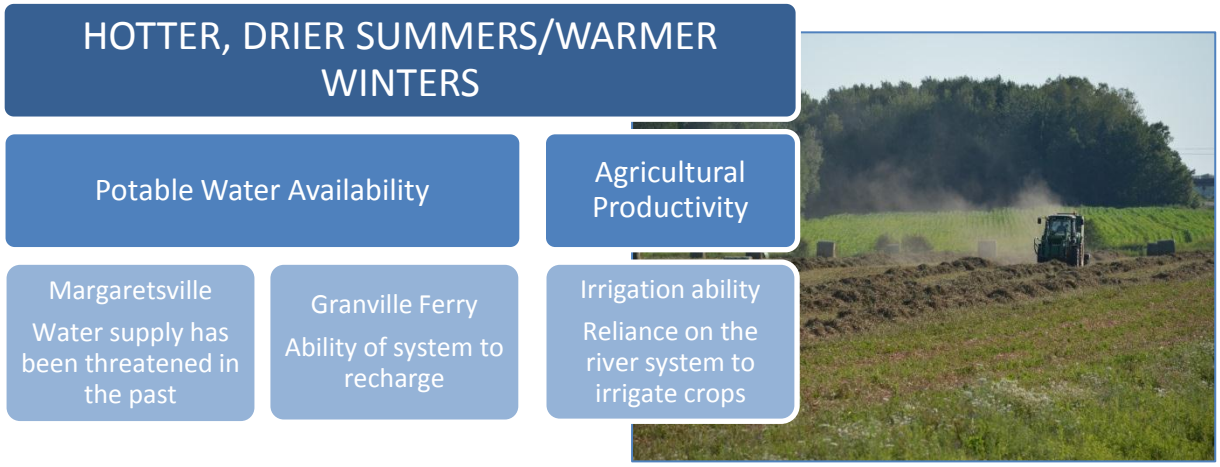
The environmental changes that are predicted in these models for the Annapolis area of south western Nova Scotia (based on measurements from the Weymouth weather station) include:

- Warmer spring, summer, fall and winter seasons. The greatest warming is projected for the winter months[viii].
- More precipitation throughout the entire year from 1291.9 mm in the 1980s to 1378.1 mm in the 2080s and with more days with rain and days with snow, although significantly decreasing the number of freeze-thaw cycles during the year, in particular during the autumn and spring.
- A longer growing season by over 50 days by the 2080s.
- An anticipated increase in intense, short period rainfall events.
- Increase in sea level elevation from 0.15 +/- 0.03 m by 2025 to 1.05 +/-0.48 m by 2100 above the 1990-2000 sea surface when measured High High Water at Large Tide. (Richards & Daigle, 2011, p. 65)

3.2. Location of Issues Currently Being Experienced

The Municipality of the County of Annapolis is characterized by several distinct geographic zones. Given the varying issues associated with each zone, most hazards and impacts are common to only a particular zone, as opposed to the entire Municipality. For the purpose of the Climate Change Action Plan, the Municipality has been divided into 5 zones: (1) coastal, (2) valley floor, (3) basin, (4) north mountain and (5) south mountain. Refer to Figure 1 in Appendix B. Trends were identified in Section 2.0, along with events, impacts and hazards. A

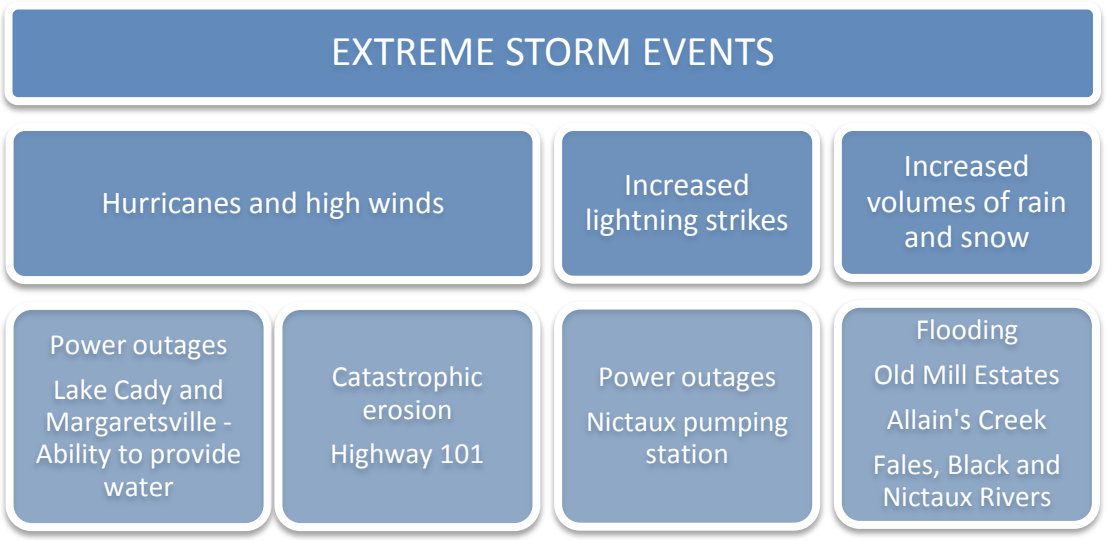
description of where trends and impacts have been experienced in the Municipality is discussed below.



Brooklyn Rd, Annapolis County, 2013 (N. Barteaux)

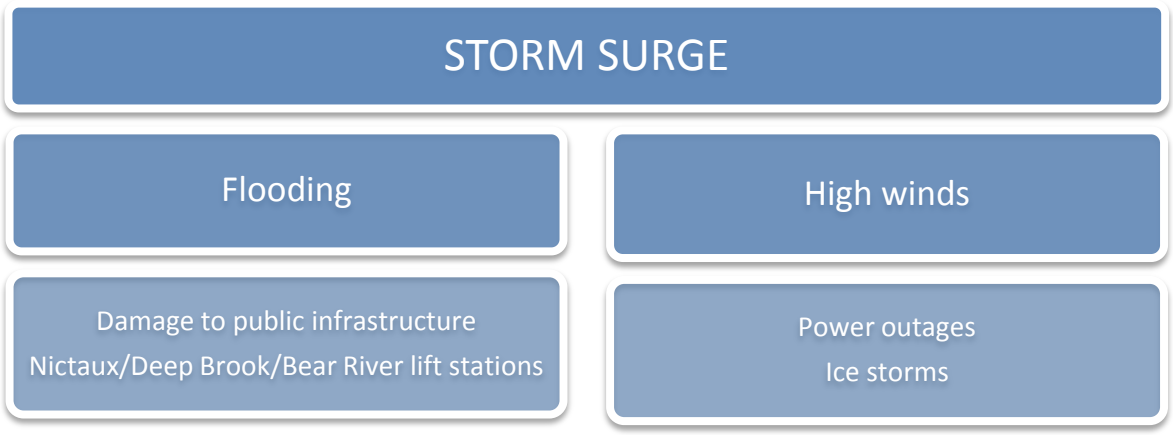
Margaretsville Water Supply

Impacts that are currently being experienced in the Municipality include the Margaretsville water supply beign threatened during the summer of 2007, at which point conservation measures were implemented. This event led to an investment in the redevelopment of existing shallow wells in order to create additional capacity. Agricultural productivity has been impacted by periodic decreases in river flows and compromised ability to irrigate crops. Particularly, the Annapolis, Black, Nictaux and Fales rivers. In 1997 and 1998, farmers in the Annapolis Valley faced a growing season with drought. Farmers accustomed to 80 to 90 mm of monthly rain had to make do with as little as 5 to 10 mm. For the first time, the Nova Scotia government provided significant compensation to cover a portion of the estimated $50 million in losses[ix]. This is most likely a condition that will become exacerbated in the future. Based on current research and observations of past events, it is anticipated that hot, dry summers and warmer winters will recur more frequently in the future.



Annapolis Royal Boardwalk, 2008

"Heavy rains in 2008 spelled ruin for many growers in Eastern Canada in 2008; it was the worst year ever for hay growers. In parts of Nova Scotia hay production was down 50 to 80 per cent. At times, farmers in Atlantic Canada were up to their ankles in water, unable to drag machinery through the muck. Partial compensation helped Maritime farmers offset millions in losses"[x] .



Fundy Shore, 2013 (C. Mackintosh)

Historically, the largest storms to hit the Annapolis Valley have coincided with high-tide, the most notable being the Saxby Gale of 1869, the Groundhog Day storm of 1976 and the storm of January 2000. These storms caused extensive damage to wharves, coastal buildings and boats. Dykes were breached and flooded low-lying areas.

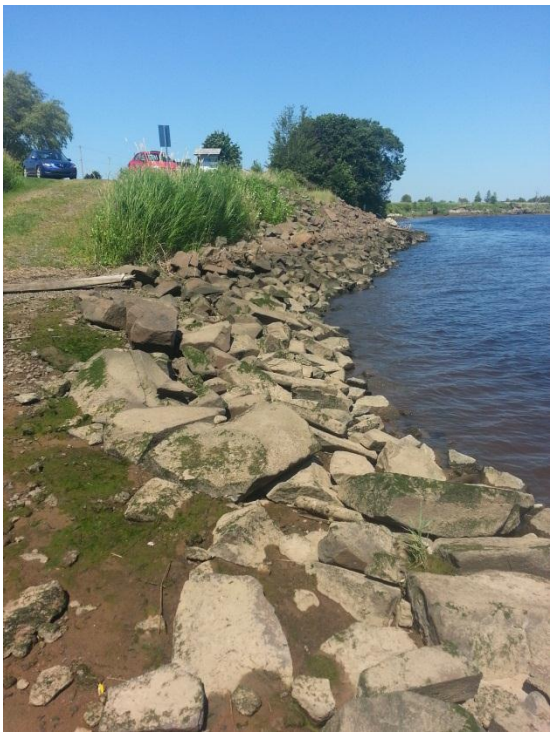
Maritimers called the January 2000 storm another "storm of the century". One of the wildest winter storms in years slammed into Atlantic Canada on January 21. In little more than a day, the explosive, weather "beast" raced from the American Carolinas towards Nova Scotia. Forecasters warned the public against a litany of weather misery - blizzards, heavy snow, intense rains, hurricane-force winds, storm surges and coastal flooding. The blizzard, the second in five days, dumped up to 54 cm of snow in parts of Nova Scotia and PEI. But it was water - not the white stuff - that caused most problems.[xi]

Parker's Cove, Annapolis County

SEA-LEVEL RISE

Coastal and In-Land Flooding

Damage to public infrastructure
Hebb's Landing



Hebb's Landing

Sea-level rise will only impact coastal and basin zones in Annapolis County. The impact will depend on various factors, such as population distributions, industry and physical properties. The potential issues associated with sea-level rise include:

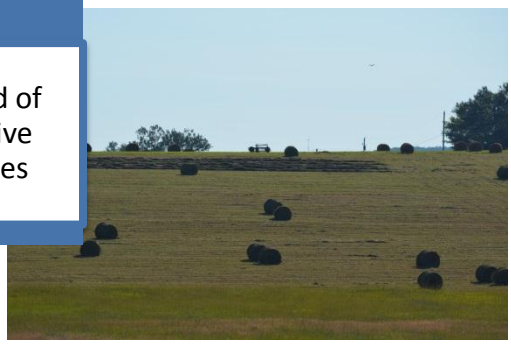
i. Coastal erosion; and
ii. Coastal and in-land flooding.

3.3. Detailed Breakdown of Climate Hazards

Through identifying past impacts, vulnerable areas for future climate hazards were identified. As previously discussed, (i) increased incidences of drought, (ii) hurricanes, high winds and lightning strikes, and (iii) increased frequency and intensity of precipitation were the primary hazards recognized as being most likely to occur and to have an impact on the Municipality. The following graphics and lists summarize the impacts and locations. A detailed table is included in Appendix A (Table 3.1).

Increased Incidences of drought

potable water availability	forest fires	reduced agricultural productivity	spread of invasive species



Brooklyn Rd, Annapolis County, 2013 (N. Barteaux)

Unusually hot, dry weather has Nova Scotia corn farmers expecting a mixed bag in terms of the size and quality of their crop this year. "It's the driest year I've ever seen, even areas with clay ground are very dry this summer," Gerry Fulton, who has been farming corn for the past 40 years. It rained Tuesday, but it is too late to make up for the lack of pollination.

The Chronicle Herald, August 2012

Increased incidences of drought - reduced water recharge - forest fires

a) Potable water availability
   - 3 water supplies managed by the Municipality: Margaretsville, Granville Ferry and Lake Cady
   - During a drought, private well users may become dependent on municipal systems – may need to increase capacity. Municipality costs would increase to implement/manage water supply business
   - Ability of Granville Ferry system to recharge
   - Granville Ferry, Margaretsville, Lake Cady
   - Zone: All

b) Forest fires
   - Impact on water quality of surface water supplies (Lake Cady and Margaretsville) from contaminated runoff
   - Increased water treatment costs
   - Increased demand on water supply
   - Affect firefighting availabilities/capacity – reservoirs are not designed to handle multiple events
   - Impact on forestry industry and recreation/portage routes and trails
   - Lake Cady, Margaretsville
   - Zone: N/S Mountain, All

c) Reduced agricultural productivity
   - Irrigation ability may necessitate switch over to different crops (traditional crops include wheat, berries, root vegetables, corn, fruit and hay). Availability of water directly impacts crop yield
   - Switch from traditional crops will involve

Local Farmer

a changeover process and subsequent low crop yield initially; crop yield will affect ability of farmers to pay municipal taxes

- Reduced crop yield will impact both subsistence and industrial farming
- Rivers are currently the primary irrigation source
- Fales Eddy, Nictaux River, Black River, Annapolis River
- Zone: Valley Floor

Some Annapolis Valley areas experienced poor pollination of the corn crop because of the dryness and heat, resulting in small corncobs with missing kernels. In some cases, the crop had only 30 per cent pollination.
"In the month of August, I would say we got less than an inch of moisture, when the average is around four or five inches. So this dry weather has taken its toll."

The Chronicle Herald, August 2012

d) Spread of new diseases/invasive species
- Public health – impact on hospitals and ability to handle increased demand
- Agriculture – crop yield, may have to change crops
- Forestry – reduction in volume of harvestable timber and market value
- Zone: North/South mountain, Valley Floor

Annapolis Royal, 2008

Hurricanes/high winds

a) Damage to public infrastructure
   - Power outages – standby generation capacity, ability to provide water
   - Increased demand on Public Comfort Centres (as identified in REMO); limited capacity
   - Increased tree cutting (less downed power lines)
   - Fishing equipment and infrastructure – wharves, boats, fish farms
   - Seven wharf authorities on the Fundy Shore – funding requests increase post-storm event
   - Flooding – Highway 1 Allain's Creek
   - Lake Cady, Margaretsville – water supply/treatment
   - Zone: All

All along Nova Scotia's Atlantic coast, the Category 1 hurricane delivered steady downpours and strong winds, knocking out power, forcing cancellations of flights and events, and drawing onlookers hoping to catch a glimpse of crashing waves.

The Chronicle Herald, August 2009

b) Damage to private properties
   - Damage to dykelands, increased maintence costs, increased size of dykes
   - Hurricanes/high winds – causeway breach; dykelands damage
   - Zone: Basin and Valley Floor

Lightning strikes

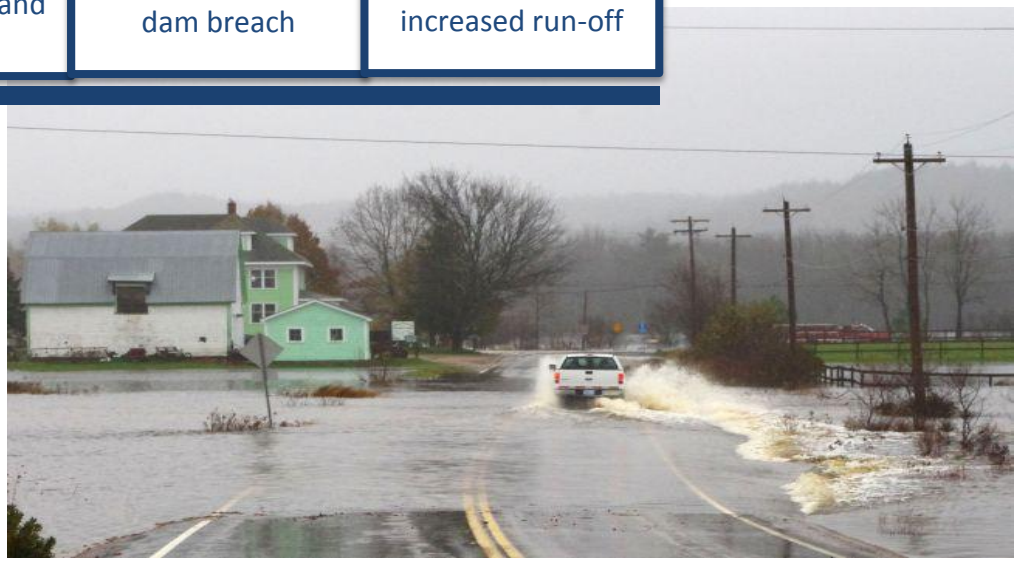
c) Forest fires
   - Lightning strikes – damage to lift stations and sewer systems (i.e. Nictaux); damage to communications towers (loss of 911 service)
   - Forest fires – impact on surface water quality (Lake Cady, Margaretsville), treatment; damage to municipal buildings; negative impact on forestry industry (tax base)

Forest fire, Gibson's Lake, 2007

- Forest fires – private residence damage
- Increased insurance claims
- Municipal infrastructure – lift stations/sewer systems, towers, buildings
- Zone: All

Increased frequency and intensity of rain and snow

coastal and in-land flooding	dam breach	increased run-off



Paradise Lane, 2010

Increased frequency and intensity of rain and snow

a) Coastal and in-land flooding
   - Individual septic systems may be impacted
   - Flooding – Fales River, Black River, Nictaux River, Old Mill Estates
   - *F*ish farms in the basin – designed for the high-water mark
   - Hebb's Landing – Upper Granville
   - Zone: Basin Dykelands – both private and public (managed by Department of Agriculture)
   - Zone: All

"…more extreme flooding is likely to happen more often now, given the combined changes in relative sea levels. The 1.6 metre storm surge of 1976, is likely to return now at a minimum of two-metres."

The Spectator, December 2008

b) Dam breach
   - NS Power – Nictaux, Lequille, Paradise Hydro Systems; operate and maintain dams; these affect Paradise, Grey and Trout Lakes
   - Zone: All


Mount Hanley, 2010

c) Increased run-off
   - Increased precipitation may result in additional (more frequent) maintenance of surface storm drainage system (culverts, ditching)
   - Zone: All

STORM SURGE

Coastal erosion – flooding – high winds

a) Damage to public infrastructure
   - Fishing infrastructure – wharves
   - Seven wharf authorities on the Fundy Shore – funding requests increase post-storm event
   - Deep Brook lift station
   - Zone: Coastal

b) Damage to private infrastructure
   - Fishing equipment
   - Residences
   - Zone: Coastal

Refer to Table 3.1 in Appendix A for a summary of the hazards and locations.


Paradise Lane, 2010

3.4. Summary of Impacts

The location of most anticipated impacts are concentrated in the Basin and Valley Floor areas. Agricultural areas and the majority of municipal infrastructure are located in these zones.

Of course, these projections provide only an overview of potential changes to local climate. As the Municipality is home to several zones (i.e. mountains, inland basin, coastal areas), it is likely that these changes will occur to different degrees, in different locations and vary throughout the Municipality.

As a result of the predicted changes noted in the Richards and Daigle Report, the Municipality of the County of Annapolis and adjacent municipalities can anticipate the following affects:

- Further reaching storm surge flooding of low-lying coastal areas;
- Inland flooding from more intense or frequent storms;
- Disruption of services caused by high winds;
- Changing climate could possibly bring new species, and possibly increase the incidence of agricultural/forestry-related pests and diseases. This could reduce resource and agricultural productivity and could pose public health hazards.
- Longer "shoulder" tourist seasons due to warmer winters and longer summers;
- Increased damage to private property caused by high winds; and
- Increased water deficit during the summer months, thus reducing the Municipality's ability to sustain an adequate amount of potable water; and increasing the risk of saltwater intrusion occurring.

Overall, this could mean several things for the future of the Municipality:

- Reduced economic viability due to damage to agricultural crops from invasive species OR enhanced agricultural production due to a longer growing season.
- Potential increase in tourism opportunities.
- Enhanced risk to public utilities and private property caused by unpredictable storm activity.
- Enhanced concerns for public health & safety, due to potentially reduced quantity of potable water (i.e. drought), increase in pests (i.e. ticks), and loss of services for prolonged periods (i.e. power outage during storm).

3.5. Benefits of Climate Change

Several economic opportunities were identified arising from the projected climate change impacts as outlined above, mostly associated with the longer growing seasons and warmer

temperatures. The increase in growing season could enhance agricultural productivity of the Municipality, and warmer temperatures could provide a longer tourism season.

Additionally, warmer winters with fewer freeze – thaw cycles could reduce the negative impact of snow and winter conditions on roads and municipal facilities. This could also benefit municipal budgets by requiring less winter road maintenance (i.e. salt or sand application). Also, warming temperatures will likely serve the tourism industry by lengthening the shoulder seasons. This may be particularly attractive to the growing demographic of retirees who prefer to travel during the less crowded seasons (fall and early spring), rather than during the peak tourism period (May – August).

3.6. Vulnerable Areas

As predicted by the Committee, (i) hotter, drier summers and warmer winters, (ii) extreme storms and (iii) storm surges are anticipated to present the highest risk to Municipal infrastructure and operations. The hazards associated with these trends and the associated overall risk ratings are detailed in Table 3.3 in Appendix A.

Eden Golf Course, flooded (the Municipality)

The hazard-impact matrix (Table 3.1 in Appendix A) presents the real and perceived risks and the locations. Given that past and anticipated impacts have been concentrated in the Basin and Valley Floor, these zones are expected to be the most vulnerable to climate change hazards. In order to focus on hazards that present the greatest risk to Municipal operations; the severity, frequency, area and level of risk tolerance were assessed for each hazard. Each parameter was assigned a value between 1 and 3, with 1 being the lowest and 3 being the highest (i.e. most severe). The severity and frequency and multiplied and then the risk tolerance rating is added to get the overall risk score:

[(severity * frequency) + risk tolerance] = overall risk rating

A maximum score of 12 can be achieved (i.e. 3 * 3 + 3); thus, the score was then divided by 4 to give an overall risk rating out of 3. Locations with an overall risk rating of 2 or higher were considered for further evaluation. Refer to Table 3.2 in Appendix A for results.

Analysis of the overall risk rating determined that warmer, wetter winters and sea level rise were not predicted to have an appreciable impact on Municipality infrastructure and operations. It was noted that warmer, wetter winters are anticipated to have a positive impact on the agriculture industry due to a decrease in the number of freeze/thaw cycles during the shoulder seasons, thus creating a longer growing season (noted that a slight increase in the number of freeze/thaw cycles during winter months is anticipated)[xii].


Paradise Lane, 2008 (College of Geographic Sciences)

The potential hazards associated with sea level rise in Annapolis County were identified as (i) coastal erosion, and (ii) coastal and inland flooding. The Municipality has minimal infrastructure and a low population density along the coast. Also, the coastal morphology along the Fundy Shore is generally well above mean sea level and thus not hospitable for development. As per the *ACAS Vulnerability of Nova Scotia's Groundwater Supplies to Climate Change* study, there was no strong evidence of saltwater intrusion in test sites (Wolfville and Pugwash). While the study did not address a specific location within the Municipality, it is predicted that climate change will be a minor factor in the management of most coastal aquifers when compared to groundwater use[xiii]. Sea-level rise in of itself may not present a high risk to the Municipality, but it is considered further in the assessment of storm surge impacts as sea-level is integral in predicting the height and zone of impact of storm surges. Sea level rise increases the vulnerability of coastal property and infrastructure to flood damage from storm surge. This is true even where property is at an elevation that is safe from permanent inundation. Major storms in Nova Scotia are increasingly producing extreme water levels beyond what has previously been experienced in the area, and are intended to increase in intensity and frequency in the future due to climate change.

4.0 Facilities and Infrastructure

The purpose of Step 4 of the MCCAP process was to identify municipally-owned infrastructure that is susceptible to impacts due to climate change. The previous steps have evaluated the risk associated with various trends. The hazards with impacts of two (2) or greater were further evaluated with respect to associated infrastructure. This was completed using the spreadsheet developed by SNSMR to gauge the impact on municipal infrastructure.

4.1. Vulnerable Infrastructure

SNSMR prepared a worksheet to assist municipalities in the evaluation of the risk to municipal infrastructure. Table 4.1 on the following page lists the infrastructure associated with each hazard.

Nictaux Sewage Treatment Plant

Table 4.1: At-Risk Municipality Infrastructure

Impacts	Hazards/Issues	Specific Location	Municipality Infrastructure
1. TREND: Hotter, Drier Summers/Warmer Winters			
• **Increased incidences of drought** • **Increased forest fires** • **Reduced water recharge**	Reduction in quantity of potable water; changes in raw water quality	Lake Cady, Margaretsville, Granville Ferry	Municipal Water Systems
		Private well users throughout the Municipality	Increased demand on Municipal Water Systems extensions
	Forest Fires	Lake Cady water supply	Water system, sanitary sewer system, storm sewer system
2. TREND: Extreme Storms			
• **Hurricanes** • **High winds** • **Ice storms**	Damage to public infrastructure	Standby power generation Public Comfort Centres	Generators, water systems (Cornwallis, Granville Ferry, Margaretsville)
• **Increased lightning strikes**	Forest fires risk increase	Lake Cady and Margaretsville water supply	water system, sanitary sewer system, storm sewer system
	Damage to public infrastructure	Communication Towers - loss of 911 service Loss of equipment (sewer/lift stations)	Cornwallis, Bear River, Granville Ferry, Nictaux, Deep Brook, Carleton Corner - sanitary sewer systems
• **Increased frequency and intensity of rain and snow**	Coastal and In-Land Flooding	Storm water management (flooding, washouts) On-site septic system flooding (Municipality may have to extend sewer service, contamination from ill-functioning systems) Increased I/I to sanitary system (overflow frequency/volume increase)	Cornwallis, Bear River, Granville Ferry, Nictaux, Deep Brook, Carleton Corner - sanitary sewer systems

3. TREND: Storm Surge			
• Coastal erosion • Flooding • High winds	Damage to public infrastructure	Nictaux/Deep Brook/Bear River lift station, Bear River WWTP (to be decommissioned) Cornwallis Park Raw Watermain	Sanitary sewer systems (Deep Brook, Bear River) Cornwallis Park Raw Watermain (along Moose River)

4.2. Discussion of Vulnerable Infrastructure

The infrastructure was evaluated for each community being considered using the spreadsheet developed by SNSMR to gauge the impact on municipal infrastructure. Table 4.2 illustrates the format and variables that were rated. Tables for each community with municipal infrastructure at risk are included in Appendix C.

Table 4.2: Bear River Municipal Infrastructure Evaluation

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Sanitary Sewer System																				
Wastewater Treatment Plant/Buildings	L	1	N	0	L	1	N	0	M	2	L	1	N	0	L	1	N	0	6	L
Wastewater Gravity Sewer	L	1	N	0	L	1	N	0	M	2	L	1	N	0	L	1	N	0	6	L
Wastewater Pressure Sewer (Forcemain)	L	1	N	0	L	1	N	0	M	2	L	1	N	0	L	1	N	0	6	L
Pumping Stations	L	1	N	0	L	1	N	0	M	2	L	1	N	0	L	1	N	0	6	L
Total	**4**		**0**		**4**		**0**		**8**		**4**		**0**		**4**		**0**		**24**	

Each asset was evaluated and assigned a low, medium or high risk rating. A value was then generated based on the risk level (i.e. low = 1, medium = 2, high = 3). The values were then summated to provide an overall risk evaluation for each asset and each climate change trend. An additional spreadsheet was then generated for each asset that was assessed as high risk. None of the municipal assets were assessed as high risk; therefore, no further evaluation

Paradise Lane, 2010

was necessary. The following sub-sections provide an overview of the Municipality's infrastructure.

Potable Water Treatment and Distribution Infrastructure

The Municipality operates two (2) surface water systems and one (1) ground water system. The largest climate change risks that will impact the potable water infrastructure is more frequent drought conditions. Higher temperatures and reduced precipitation for raw water recharge will reduce available quantity of water for primarily the surface but also the ground water supplies. Drought conditions could also impact the quality of raw water and therefore the requirement for treating the water. An increase in surface water temperature could increase growth of organics in the water leading to the requirement for additional treatment additives (flocculants, disinfectants), changes in process cycle time (more frequent backwashes) and while not likely could even lead to changes or expansion to current treatment processes.

Droughts in the summer could also have a compounding impact should local residents' wells fail. Some residents would look to fill water containers from municipal supplies increasing the demand on water systems in the short term. If wells continue to fail, residents may push the Municipality to expand municipal water systems in the longer term.

Although not experienced in Annapolis County to date, in the summer of 2012 some water supplies across Nova Scotia had to flush consistently to maintain the chlorine residual as higher than normal organic growth consumed the disinfectant at an increased rate. Continually flushing during droughts increases the demand on a water source which is not being replenished at the normal rate.

Additional climate change risks to the Municipality's water system infrastructure may include the following:

- Erosion of the bank along the Moose River undermining the Lake Cady Raw Watermain supplying Cornwallis Park.
- A forest fire in the Lake Cady watershed impacting the quality of water in the Lake.
- An increase in storm intensity and runoff that could washout roads containing watermains.

Wastewater Collection and Treatment Systems

The Municipality owns wastewater facilities, including:

- Wastewater treatment plants at Bear River, Cornwallis and Nictaux; and
- Collection systems at Lequille, Granville Ferry and Carleton Corner, which are transferred to and treated at adjacent facilities.

A key concern for wastewater infrastructure is increased flooding and run-off due to increased frequency and intensity of rain events. Wastewater collection infrastructure including gravity sewers, pump stations, forcemains and treatment plants are often located near low elevations. Pump stations specifically tend to be located close to rivers or streams. Should the watercourse flood its banks, it could inundate the pump station with runoff as the covers to pump stations tend not to be water tight.

Localized flooding can produce increased Inflow and Infiltration (I/I) in sanitary sewers. I/I increases costs for pumping and treating runoff. With increased I/I there is also the risk of sewers backing up into homes and businesses, increase in pump station overflow frequency and volume and "washout" of wastewater treatment plants impacting overall discharge objectives.

Additional climate change risks to the Municipality's wastewater infrastructure may include:

- Lightning strikes shorting out pump stations or treatment plants.
- Damage to pump stations controllers mounted on utility poles should the utility poles topple in wind or ice events.
- Increase in damage to above ground pump stations due to ice storms.
- An increase in erosion negatively impacting buried infrastructure.
- Storm surge entering pump stations and sewer system in low areas.

Figure 2 in Appendix B shows the location of water treatment plants, wastewater treatment systems and lift stations.

Storm Water Infrastructure

Storm Water infrastructure owned by the Municipality includes primarily ditches, catch basins, storm sewers and culverts. The key concern with storm water management infrastructure is that it may be designed for the "new normal" storms. Under sized piping will lead to additional water pooling on the surface and increased erosion should the pooled water find a new drainage path.

Road culverts exist at low points in the road and should they back up they could overtop and washout the road. With increased flooding there is an increased risk of damage to facilities and the associated cost of repairs. Flooded roads can also limit access for first responders and there is also the risk of residents trying to cross the flooding area and getting stranded or stuck.

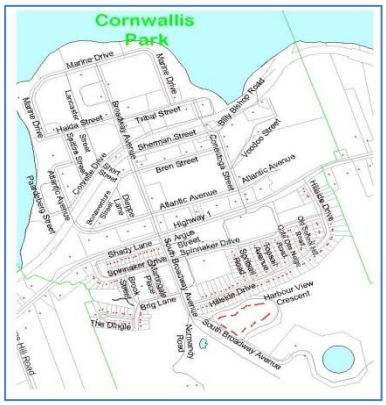
Additional climate change risks to the Municipality's stormwater infrastructure may include:

- Erosion of slopes along the shore edge and steep banks;
- Flooding of Municipality facilities and infrastructure as well as flooding of residents homes;
- Erosion of dykes due to stormwater runoff and/or storm surge.

Allain's Creek, Annapolis County, 2013

Road Infrastructure

The Municipality currently owns 22 kilometres of municipal roads. The sections of roads owned by the Municipality include the asphalt surface, road gravels, sidewalks, guide rails and other street features.



The roads maintained by the Municipality are located in Cornwallis Park and the East End. The street names are as follows:

<u>Cornwallis Park</u>

Atlantic	Broadway	Bren	Corvette	Tribal
Hiada	Billy Bishop	Sherman	Spitfire	Marine
Connestoga	Hillside	Martingale	Cot de Neiges	Brook
Spritsail	South Broadway	Harbor View	The Dingle	Brig
Topsail	Spinnaker	Shady	Old School Hill	

<u>East End Streets</u>

Chateau	Bradley	Olympiad	Alexander Campbell	Belle
Sherwood	Dr. Lewis Johnston	Fairview	Adam	

The primary risk that climate change presents road infrastructure is flooding and erosion of roads due to increased run-off. Buried storm water infrastructure is considered the minor drainage system. When runoff surpasses the capacity of the minor drainage system, the roads become the major drainage routes. Overland flow can cause minor erosion on the shoulders of the road or can cause complete road washout. As noted in the municipal services sections above, road washouts create impassable barriers for emergency personnel and damage any municipal services contained within the road.

Additional climate change risks to the Municipality's road infrastructure may include:

- High winds causing damage to street features (i.e. light standards).
- Changes in freeze-thaw cycles could impact road weight capacity.

Building Infrastructure

The Municipality is the owner the following buildings (in addition to the water and wastewater infrastructure discussed above):

- Administration Building, 752 St. George Street, Annapolis Royal
- Public Works Building, 5483 Granville Ferry, Annapolis Royal
- Basinview Centre, 1043 Highway 1, Cornwallis Park, Cornwallis
- Administration Building, 396 Main Street, Lawrencetown
- Animal Shelter, 308 Church Street, Bridgetown

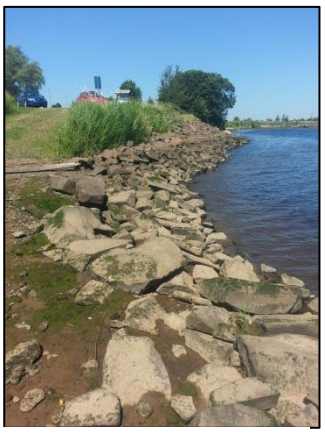
Administration Building, Annapolis Royal

These have not been identified as structures that are high risk due to climate change hazards but are worthwhile noting with respect to damage that may be incurred from extreme storm events. Maintenance (weather proofing – as buildings are aging) and repair costs will impact budgeting and should be considered.

Recreational Facilities

The Municipality has six (6) recreational facilities which include:

- Raven Haven Beachside Family Park, 2239 Virginia Rd, West Springhill
  - Located on Sandy bottom Lake
  - Site contains cabins (2), a hostel, boat launch, washrooms and showers and a campground.
- Hebb's Landing Park and Boat Launch, 7464 highway 1, Upper Granville
  - Located on the Annapolis River
  - eroding
- Old Mill Trail, 213 Adam Dr, South Farmington
  - The trail is situated on 2.2 acres of land along the Annapolis River and has benches, picnic tables and bridges
  - Recently re-opened with a new section of trail
- Delaps Cove, 2077 Shore Road West, Delaps Cove



Hebb's Landing, 2013

- Vulnerable to storm surge and coastal flooding

- Young's Cove Coastal Access Park, 6169 Shore Road, Young's Cove
- Shannon River Canoe Access Park, 4081, Route 8, Albany Cross

Figure 3 in Appendix B identifies the location of these sites.

Young's Cove, Annapolis County

4.3. Stakeholder Consultation

It was recognized that infrastructure that is not owned or operated by the Municipality is vulnerable to climate change, and may consequently have an impact on operations. Based on hazards identified in the previous steps, a list was generated of stakeholders who have infrastructure within the Municipality that may be impacted by climate change; as well, additional Municipality departments were engaged:

a. Nova Scotia Power (NSP)
b. Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR)
c. Nova Scotia Department of Agriculture (NSDA)
d. Recreation Services (RS)

Discussions focused on preparedness of these agencies for climate change, and whether they had assessed or modified their operations to adapt to potential hazards. Additionally, an overview of current operations was provided as well as any "problem" areas or vulnerabilities that were currently being experienced. Table 4.3.1 is a list of the contacts:

Table 4.3.1: Stakeholder Contact Information

Name of Stakeholder Group	Representative of Group (Role)	When involved?
NSP	E. Don W. Trimper R. Doran J. Lorette	Step 4: Facilities and Infrastructure
NSTIR	T. Harvey	Step 4: Facilities and Infrastructure
NSDA	K. Wong-Petrie D. Smith J. Wentzell	Step 4: Facilities and Infrastructure
RS	D. Ryan	Step 4: Facilities and Infrastructure

A summary of the concerns and discussions are summarized in Table 4.3.2.

Table 4.3.2: Stakeholder Discussions

Stakeholder	Concern	Discussion
NS Power	Operates and maintain 4 hydro systems in the Municipality: (i) Lequille (ii) Nictaux and (iii) Paradise and (iv) Bear River. Have they addressed climate change in their operations? Alternatives to hydro power being considered?	• NSP has a Dam Management Plan • a flood assessment is completed every 7 years (modelling, inundation mapping) • use 10,000 year flood design criteria – very conservative • Emergency Preparedness System • Recording devices on dams (piezometers) • Follow the CDA for climate change – no CCAP • Clearing around transmission lines to minimize impact from extreme storm events • Drought is not an issue for dam structure • Limit on wind power – transmission capacity is maxed out; additional wind power development would require infrastructure upgrades
NS Department of Transportation and Infrastructure Renewal	Roads and bridges – flooding and maintenance issues? Access to emergency/key infrastructure may be compromised	• Have 300 bridges in the County • 1 in 500 year flood design • 1,300 km of road • NSTIR has initiated climate change adaptation planning

NS Department of Agriculture	Dykelands – who maintains? All dykes? Current practices and issues	• Budgeting to maintain dykes and conduct studies with respect to climate change • 16 aboiteaux • 5 marshes: (i) Queen Anne NS 4, (ii) Dentiballis NS 13, (ii) Ryerson NS 18, (iv) Dugau NS 5, and (v) Allan River NS 30 • Protect agriculture primarily; some tourist sites • Dykes in area are in relatively good shape • Dykes are inspected twice per year • Erosion is cause of deterioration • Developing a quantitative approach to prioritize maintenance activities • NSDA believes that responsibility for Annapolis River Marsh Bodies NS 103 is with NSP • NSDA does not maintain dykes up stream of the causeway • Set construction level has been increased by 2-3 ft due to climate change considerations
Recreation Services	Facilities located in coastal areas; Facilities with infrastructure	• 4 sites that have experienced climate change impacts: Hebb's Landing – erosion, east embankment has had rip rap installed, west bank is failing Raven Haven – washout issues, losing beach, it is on a slope Delaps Cove – Bay of Fundy; storm event (15 yrs ago) resulted in boulders and fallen trees across the trail Old Mill Trail – Annapolis River, has flooded in twice in the recent past

4.4. Preparedness of Municipality

Changes in climate can directly impact people. In the event of a climate-related emergency some residents will be more vulnerable than others. Given the demographics within the Municipality, more than 27% of the population is over 65 years old[xiv], combined with geography, a lot of residents live in rural isolated areas, emergency response is a key component of planning [xv]. Additionally, the Integrated Community Sustainability Plan (ICSP) will provide the social objectives identified by the Municipality, a review of these and an update to incorporate climate change considerations will assist in defining social considerations.

4.5. Regional Emergency Plan

In August 2012, the Regional Emergency Management Organization of Annapolis (the REMO) completed their *Regional Peacetime Emergency Plan.* The purpose of this document is to address peacetime emergencies, defined as situations or the threat of impending situations which "*abnormally affect the lives and property of our society, which by their nature or magnitude, require a coordinated response by a number of agencies, both governmental or private, under the direction of the appropriate elected officials as distinct from routine operations carried out by agencies as normal day-to-day procedures*" (Regional Emergency Management Organization Annapolis, 2012, p. 1).

The plan identifies the most likely major threats to the communities as "flood, prolonged power outages due to hurricane, blizzard, or freezing rain, hazardous material spills (traffic accidents), a pandemic, aircraft accident and major fire." (Regional Emergency Management Organization Annapolis, 2012, p. 2). These major threats include most of the identified by the MCCAP Committee which involve the imminent threat to life in the County. One notable exclusion is the possibility of drought, which is not addressed in the EMO plan.
In the case of flooding, power outages, and major fires, the Plan outlines the possible major effects, and the potential actions that could be taken, as well as identifying the authorities responsible for each action.

Generally speaking the Committee feels that despite having legislative authority to create plans, the Municipality is unprepared for a large storm or drought event, and would likely have to call on neighbouring communities and the province for assistance in the case of a large scale emergency. The following specific points of concern were raised:

- There are not enough large capacity power generators to power wells and treatment plants in the case of a long term power outage related to storm activity. Most residents do not have a secondary heat source if there is a prolonged power outage.
- Community centres do not have back-up power supplies.

- The County/REMO does not know where the most vulnerable people are located, should an emergency take place.
- There is a general lack of education among residents related to how to prepare for a weather related emergency.

4.6. Integrated Community Sustainability Plan (ICSP)

The Municipality has developed an ICSP, following is a summary of the items identified with respect to social initiatives:

a. Develop communications strategy to highlight core municipal services and raise public awareness regarding municipal priorities;
   - Re-design Municipality web site to make it more user friendly, comprehensive, functional and up to date
   - Develop a social media strategy to reach more residents in a timely fashion
   - Build relationships with local media
   - Highlight core services and priorities in a bi-annual newsletter

Climate Change: use a tool for dispersal of information regarding emergency preparedness, weather warnings, muster stations etc.

b. Strengthen transportation routes from rural housing to town centres
   - Meet with representatives from surrounding areas to define any joint initiatives

Climate Change: identify routes that are vulnerable to climate change impacts and that may subsequently impede/prohibit emergency services access

c. Focus on developing the Community Hall/Fire Hall network as a key location for community service information

Climate Change: use as muster stations and comfort centres in the event of climate change related emergencies

5.0 Social, Environmental & Economic Implications

Climate change can have social, environmental and economic impacts. The objective of this section was to address these parameters for the anticipated impacts on municipal operations and infrastructure. Each of these are considered in the subsequent sections.

5.1. Summary of Social, Economic and Environmental Considerations

Social Impacts

As the Municipality has an aging demographic, the development of adaptation measures was focused primarily on emergency services delivery and associated planning. The *Regional Peacetime Emergency Plan* (prepared by REMO) and the Integrated Community Sustainability Plan (ICSP) are the key instruments in addressing climate related social impacts. Adaptation measures include:

- Education on how to prepare for weather related emergencies
- Use Communications strategy (ICSP) as a tool for dispersal of information regarding emergency preparedness
- Identify routes that are vulnerable and may impede emergency services access
- Identify community halls/fire halls as muster stations/comfort centres in the event of climate change emergencies.

Economic Impacts

The major economic implications for the Municipality are related to infrastructure maintenance and upgrades. Additionally, given that a large segment of the population relies on agriculture for their income, the following adaptation measures were identified:

- ensuring that land use planning protects agricultural lands
- liaise with NS Power and NS Department of Agriculture about best management practices and maintenance of the dykelands
- upgrade of municipal heating systems to renewable energy sources
- upgrade and/or increased maintenance of water and wastewater infrastructure

Environmental Considerations

Environmental impacts as a result of climate change in Annapolis County are associated primarily with natural vegetation, invasive species, impacts on coastal features and inland

waterways (Annapolis River and tributaries). Water availability (drought conditions) can impact the types of vegetation that will thrive and facilitate the spread of invasive species. Storm events and storm surges can increase sediment load in watercourses, permanently alter the foreshore environment, and damage conservation areas (habitat, species at risk). Adaptation measures that the Municipality can implement include:

- land use planning to limit development in ecologically sensitive areas
- liaison with local conservation groups and government departments to identify sensitive areas

On the following page, Table 5.1 summarizes the concerns that were identified by the committee as having the potential to be adversely impacted by climate change.

G. Heming, 2005

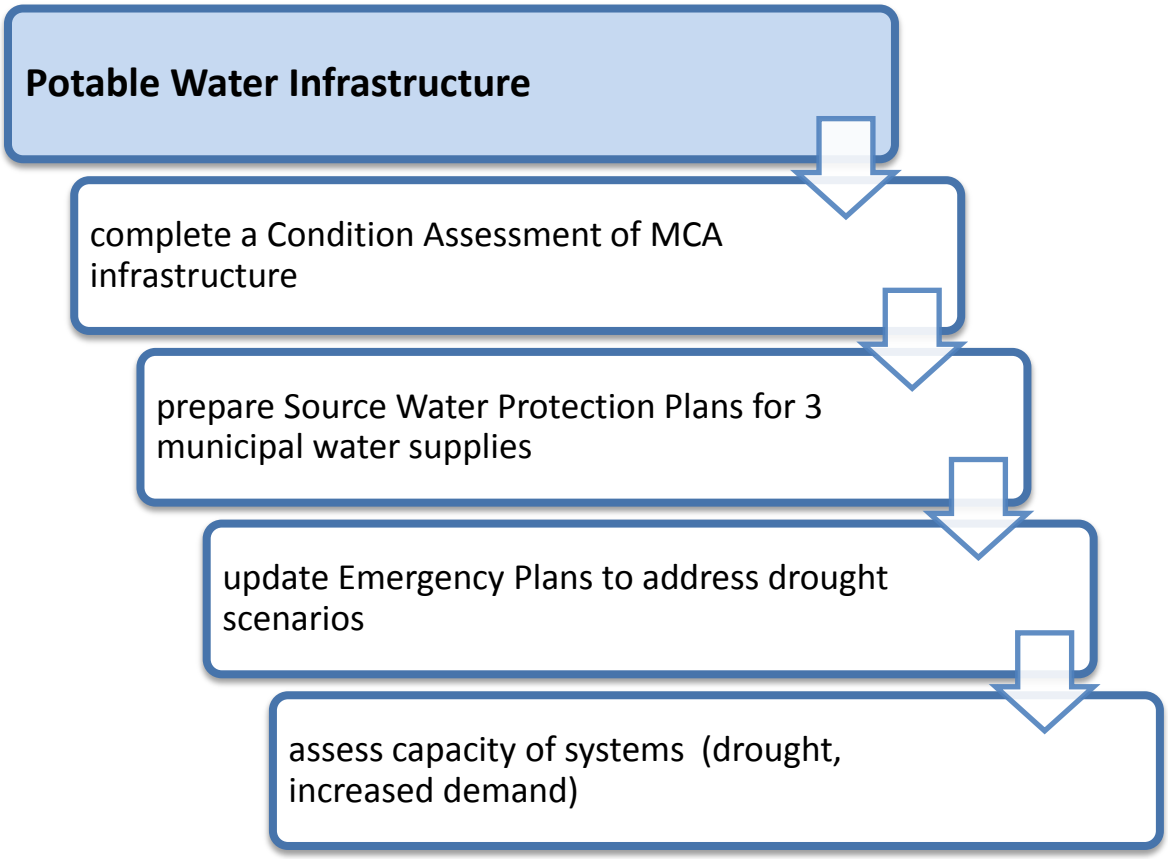
Table 5.1: Social, Economic and Environmental Concerns

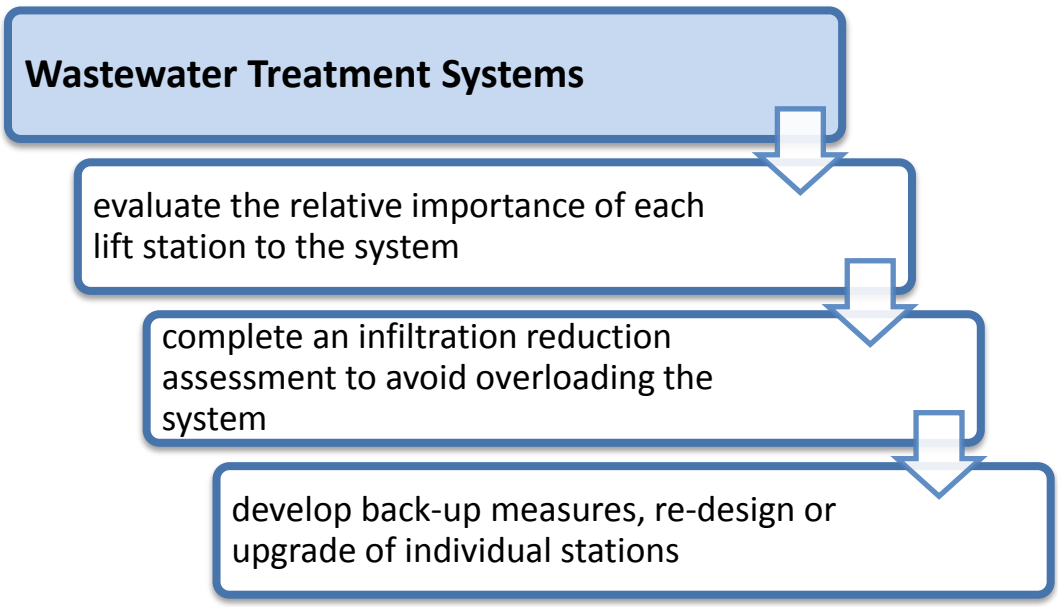
HAZARDS/ISSUES	SOCIAL	ECONOMIC	ENVIRONMENTAL
TREND: Hotter, Drier Summers/Warmer Winters			
Reduction in availability of potable water	vulnerable demographic (elderly, special needs), isolated areas residents who rely on dug wells	increased maintenance requirements, expansion of water distribution system	impacts of increased demand on surface and groundwater water supply, and decreased precipitation (recharge) Types of vegetation Spread of invasive species
Forest Fires	vulnerable demographic (elderly, special needs), isolated areas, forestry workers	increased firefighting costs (equipment etc.)	ecological, watershed, loss of habitat
Reduced agricultural productivity	Agricultural workers	decreased tax base	ecological
Spread of new diseases/pests	Agricultural workers	impact may be positive or negative for tax base	ecological
	public awareness	increased demand on REMO and facilities	
	crop change over	temporary decrease in tax base	ecological
	loss of employment, recreational areas	decreased tax base	ecological, watershed

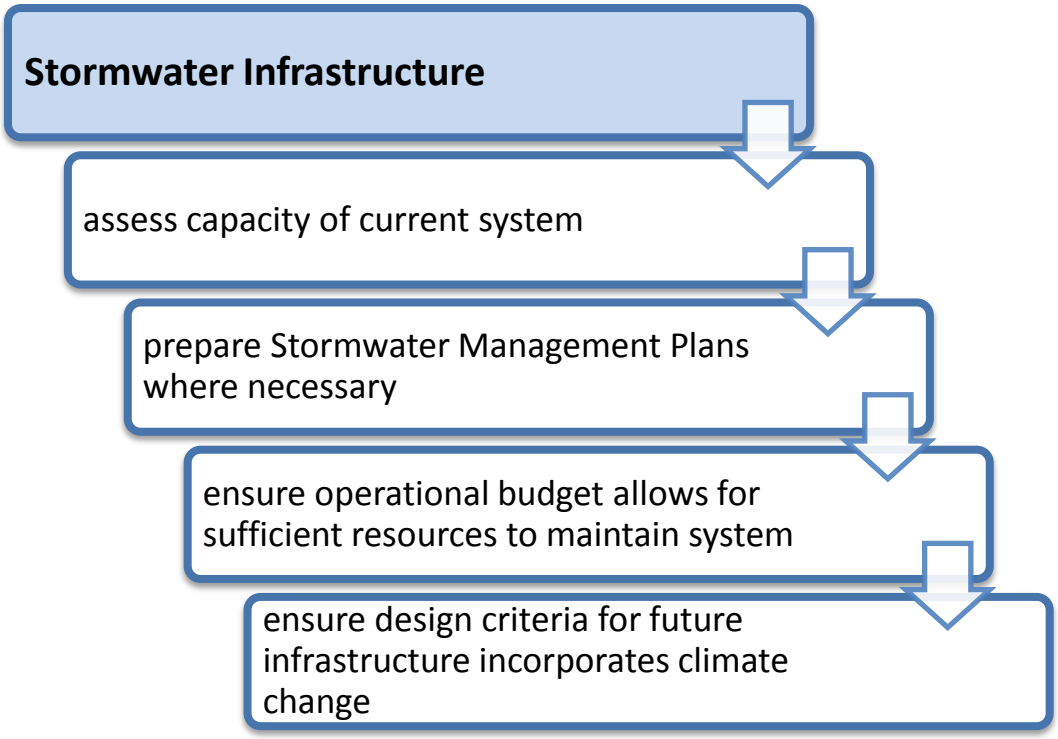
TREND: Extreme Storms			
Damage to private infrastructure	vulnerable demographic (elderly, special needs), isolated areas basin and coastal residents	increased emergency response costs	
Forest Fires	vulnerable demographic (elderly, special needs), isolated areas	increased firefighting costs (equipment etc.)	ecological, watershed
	vulnerable demographic (elderly, special needs), isolated areas		ecological, watershed
Damage to public infrastructure	emergency services; communications	sanitary system upgrade and/or repairs	soil/groundwater contamination from failed sanitary/septic systems
Coastal and In-Land Flooding	vulnerable demographic (elderly, special needs), isolated areas	sanitary system upgrade and/or repairs; expansion	soil/groundwater contamination from failed sanitary/septic systems; damage/ loss of foreshore; increased sediment load
TREND: Storm Surge			
Damage to public infrastructure	vulnerable demographic (elderly, special needs), isolated areas	sanitary system upgrade and/or repairs; expansion	soil/gw contamination from failed sanitary/septic systems

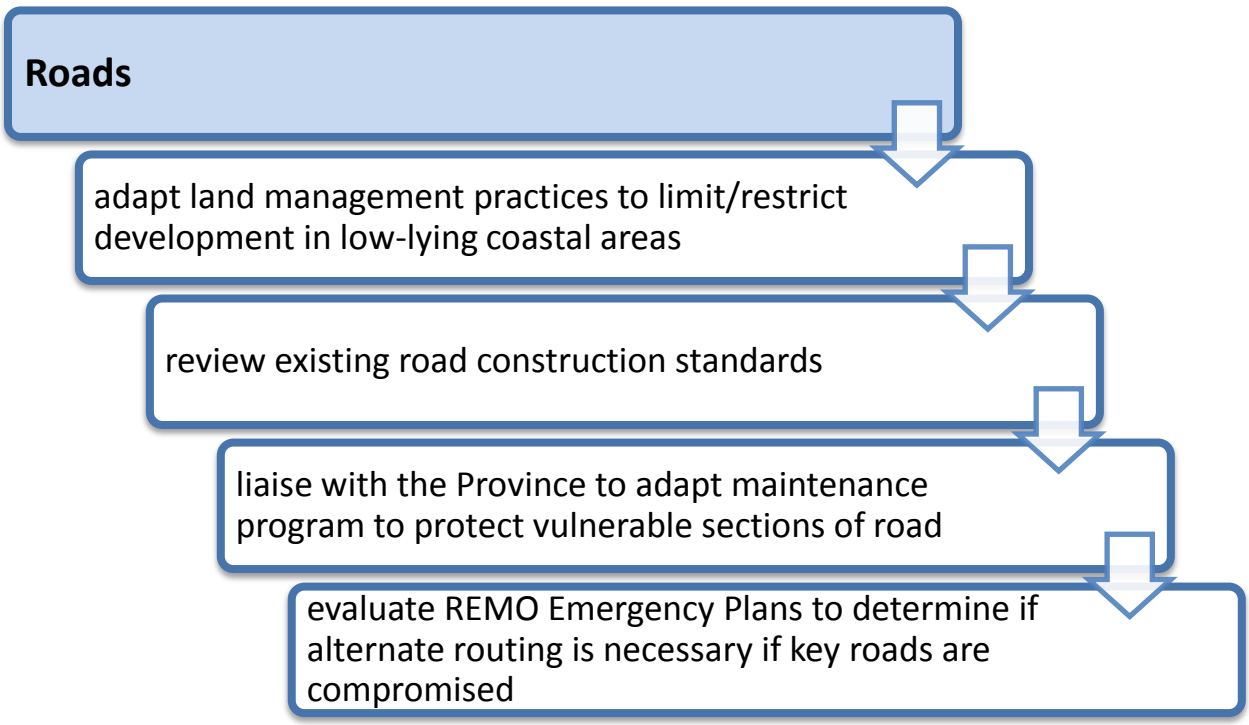
6.0 Priorities for Adaptation

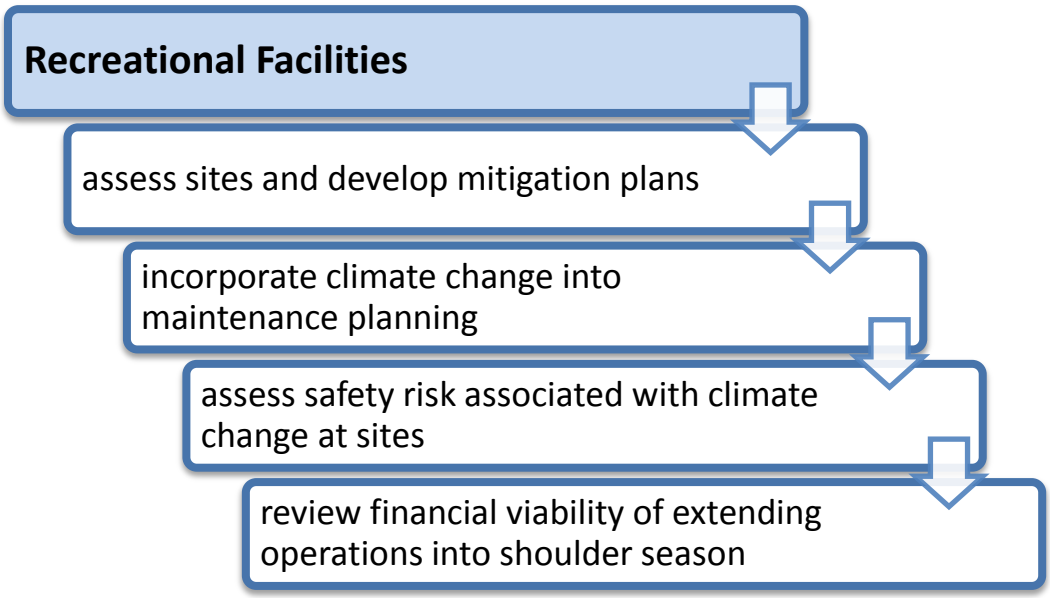
The main objective of the Municipal Climate Change process was to establish priorities for taking action on climate related hazards and impacts. Generally speaking, more immediate concerns were prioritized above longer-term concerns. Likewise, issues or hazards that may impact public safety or the delivery of services are high on the list of priorities, while those that are less immediate tend to have a lower priority. Table 6.1 in Appendix A presents the highlighted issues where the Municipality may be vulnerable and adaptation measures. The following graphics summarize the key recommendations.

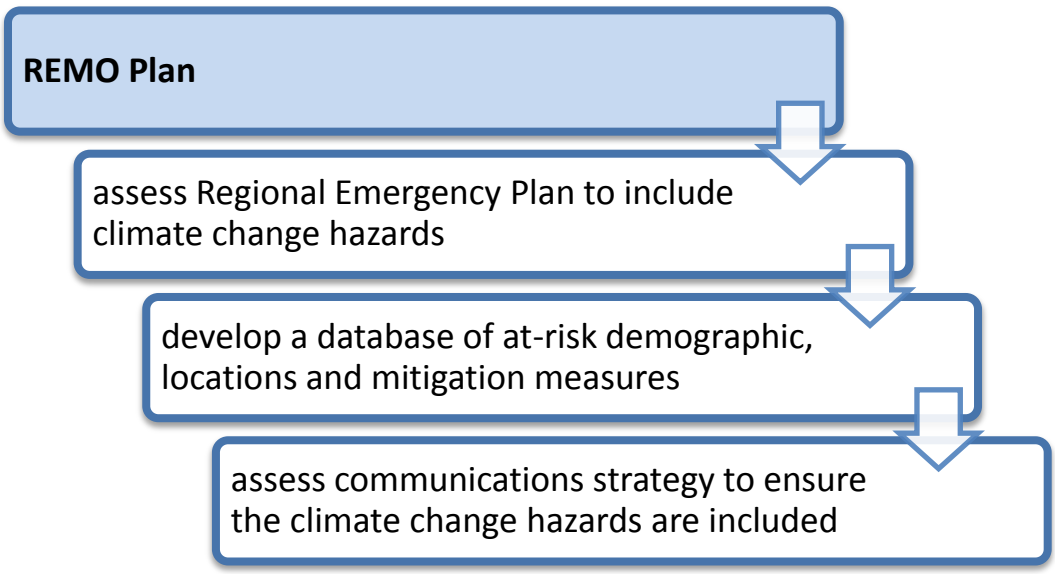



Wastewater Treatment Systems
evaluate the relative importance of each lift station to the system
complete an infiltration reduction assessment to avoid overloading the system
develop back-up measures, re-design or upgrade of individual stations


Stormwater Infrastructure
assess capacity of current system
prepare Stormwater Management Plans where necessary
ensure operational budget allows for sufficient resources to maintain system
ensure design criteria for future infrastructure incorporates climate change


Roads
adapt land management practices to limit/restrict development in low-lying coastal areas
review existing road construction standards
liaise with the Province to adapt maintenance program to protect vulnerable sections of road
evaluate REMO Emergency Plans to determine if alternate routing is necessary if key roads are compromised


Recreational Facilities
assess sites and develop mitigation plans
incorporate climate change into maintenance planning
assess safety risk associated with climate change at sites
review financial viability of extending operations into shoulder season



Ensuring implementation of adaptive measures is key to the success of the MCCAP, incorporating these into decision-making at the Council and operational levels are paramount. This can be achieved by modifying bylaws, policies and planning documents to include climate change initiatives. The Municipality has 20 bylaws and over 50 operational policies, as well as a Municipal Planning Strategy and Land Use Bylaw (Annapolis County) and five (5) individual area planning strategies and Land Use Bylaws for areas under their jurisdiction (Cornwallis Park, East End, Lake Cady, Lawrencetown and Upper Clements). The following graphic groups the actions identified in Table 6.1 into various municipal documents and development of new policies.

Land Use Management

- Incorporate protection of environmental features into land use policies
- Assess setbacks in vulnerable areas; new lots may need to be deeper
- Climate change considerations in regulating new municipal roads
- Review of coastal properties and developments
- Continuous development of flood plain mapping and review of land use zoning; Incorporate flood plain management practices into planning documents

Harbour Authorities Societies Capital Assistance Program (AM - 1.4.3)

- monitoring of climate change impacts to coastal infrastructure
- financial assistance to Annapolis County Wharfs Association

Development Control Modification

Review the Engineering Standards in the Annapolis County Subdivision By-law, specifically:

- Road and Street Standards Manual
- Drainage Works Standards Manual
- Sanitary Sewerage Works Standards
- Water Works Standards Manual

New Policies

General Climate Change Policy

Policy to be proactive in mitigation of climate change hazards

Policy to monitor the impacts of climate change

Setbacks Policy (coastal and basin)

Policy to limit/restrict development in coastal and low-lying area

7.0 Climate Change Mitigation

The Municipality of the County of Annapolis' key responsibilities involve the operation and maintenance of water and wastewater treatment facilities and municipal buildings.

The goal of mitigation measures is to reduce greenhouse gas emissions generated by municipal operations by:

a. Reducing energy demand;
b. Retrofitting existing facilities to maximize efficiency; and
c. Ensuring any new infrastructure is designed to current standards for energy efficiency.

7.1. Energy and Emissions Information

The Municipality of the County of Annapolis engaged *Enerplan Consultants* to complete an energy audit in 2009. An assessment of all municipal infrastructure was completed. The Municipality's primary energy consumption is in the operation of the water and wastewater systems, and municipal buildings, and to a lesser extent, vehicles and equipment. The Energy Audit completed in 2009 is included in Appendix D. A summary of the energy usage data for each facility is provided below in Table 7.1. The Building Envelope Performance Index (BEPI) is defined as the equivalent total annual energy consumption divided by the total square footage of the conditioned areas of the building. It is a means of assessing a buildings efficiency compared to similar buildings[xvi]. The lower the number, the more efficient the building is.

Table 7.1: Summary of Energy Data for Facilities

Building	BEPI
Raven Haven Beachside Family Park	7.45
Cornwallis Park Booster Station	7.96
Nictaux Sewer Pond	10.09
Lawrencetown Planning Office	18.48
Annapolis Municipal Building	20.10
Granville Ferry Water Treatment Building	22.07
Annapolis Digby Economic Development Bldg	30.29
Granville Ferry Public Works Building	32.05
Animal Shelter	36.73
Basinview Centre	47.06
Cornwallis Park Water Treatment Plant	71.40
Cornwallis Sewage Treatment Plant	73.91

Nictaux #7	81.36
Margaretsville Water Treatment Plant	88.88
Nictaux Waste Water treatment Plant	429.55
Lift Stations and Pumps	Not applicable

Energy modeling was completed to evaluate total end use through accounting of energy related components. The objective of Enerplan Consultants was to create an accurate model to predict the energy consumption of existing conditions and potential conditions[xvii]. The estimated energy consumption for each category, prior to any modifications or upgrades is:

- Water and sewer systems 3,934 GJ
- Municipal buildings 11,542 GJ

7.2. Goals and Actions

The Municipalities' primary energy consumption is in the operation of the water and wastewater systems, and municipal buildings. The energy audit targeted a 16.8% reduction in energy consumption costs. The Municipality has taken a major step in reducing its consumption by initiating the conversion of 50% of its municipal buildings (Basinview Centre, Cornwallis and the Administration Building, Annapolis royal) to grass pellet fueled heating systems.

A summary of the recommendations of the energy audit that have been implemented to date is provided in Table 7.2 on the following page

Table 7.2: Energy conservation measures implemented to date

Building	Action Completed
Annapolis Royal Municipal Building	• Conversion to high efficiency lighting • Conversion of some thermostats to digital control thermostats
Lawrencetown Planning Office	• All windows have been replaced • Conversion to high efficiency lighting
Basinview Centre	• Some lighting has been converted to high efficiency lighting
Granville Ferry Public Works Building	• Main doors have been replaced • New seals in roof to wall construction joint has been installed • New windows have been installed • New weather stripping has been installed around windows • Installed a high efficiency furnace
Nictaux Wastewater Treatment Plant	• Automated system installed to vary run-times of the blowers based on dissolved oxygen levels
Cornwallis Sewage Treatment Plant	• Weather stripping installed around main doors • Conversion to high efficiency lighting
Lift Stations and Pumps **Carleton Corner Pump #2 (BT #2)** **Carleton Corner Pump #1 (BT #3)** **Cornwallis East (CW East)**	• Converted motors to high efficiency models

The Municipality has identified conversion to alternate energy sources and the upgrade of building envelopes as an effective means to reduce energy consumption and consequently, greenhouse gas emissions. The following lists the remaining items to be implemented from the recommendations of the energy audit, in order of priority based on the Building Envelope Performance Index (BEPI).

1 Nictaux Waste Water Treatment Plant

- Install weather stripping at door sweeps.
- Install new seals in the roof to wall joints.
- Re-install seals on windows.

- Install LED lighting fixtures

2 Margaretsville Water Treatment Plant

- Upgrade Scheduled for 2013/2014.

3 Nictaux #7

- Replace remaining incandescent lamps with LED lights.

4 Cornwallis Sewage Treatment Plant

- Install new seals in the roof to wall joints.
- Re-install seals on windows.
- Install programmable Thermostats.
- Install automatic Dissolved Oxygen control System.

5 Cornwallis Park Water Treatment Plant

- Install Weather stripping at door sweeps.
- Install new seals in the roof to wall joints.
- Install weather stripping around windows.
- Replace lighting with LED lights.
- Replace remaining incandescent lamps with LED lights.
- Install a modern direct digital control EMCS.

6 Basinview Centre

- Replace lighting with LED lights.
- Upgrade exit lamps to LED technology.
- Install a Glycol based heat reclaim system.
- Install a pool strip curtain to separate the two zones.
- Install a CO2 control sensors in the gym, and stores.
- Install an occupancy sensor in the gym to control ventilation as needed.
- Update the EMCS with updated schedules as needed.
- Install a split system heat pump to cool the fitness studio.
- Install a pool blanket to reduce evaporation and heat loss when pool is not in use.
- Install Night curtains on up right refrigerator display cases in the grocery store.
- Construct a Grass Pellet Boiler for space and pool heating.

7 Animal Shelter

- Install weather stripping at door sweeps.
- Install a new attic hatch seal and apply insulation.
- Install new seals in the roof to wall joints.
- Insulate roof and walls to a minimum of R20.
- Retrofit dog doors with weather tight flaps.
- Replace incandescent light with LED lights.
- Consider Solar domestic hot water system.

8 Granville Ferry Public Works Building

- No further action required.

9 Granville Ferry Water Treatment Building

- Retrofit existing T12 lamps with LED lights.

10 Annapolis Municipal Building

- Install weather stripping at door sweeps.
- Install new seals in the roof to wall joints.
- Install weather stripping around windows.
- Replace windows with broken seals
- Replace lighting with LED lights.
- Construct a Grass Pellet Boiler for heating.
- Audit and upgrade aging building HVAC systems.

11 Lawrencetown Planning Office

- Install weather stripping at door sweeps.
- Install new seals in the roof to wall joints.
- Replace lighting with LED lights.
- Install a modern direct digital control (DDC) based EMCS.
- Consider solar domestic hot water.

12 Nictaux Sewage Treatment Lagoon

- Replace remaining incandescent lamps with LED lights.

13 Cornwallis Park Booster Station

- Upgrades scheduled for 2013/2014

14 Raven Haven Beachside Family Park

- Replace remaining incandescent lamps with LED lights.
- Install energy management controllers on the vending machines.

15 Annapolis-Digby Economic Development Corporation Building

- Install Weather stripping at door sweeps.
- Install new seals in the roof to wall joints.
- Install weather stripping around windows.
- Replace lighting with LED lights.
- Replace remaining incandescent lamps with LED lights.
- Upgrade exit lamps to LED technology.
- Install a modern direct digital control (DDC) based EMCS.

16 Lift Stations and Pumps

- At the end of their service life, replace the following pumps with high efficiency models:
    - Granville Ferry Pump Station #1
    - Granville Ferry Pump Station #2
    - Church Road Lift Station (BT#1)

The Municipality is currently completing an update to the energy audit, focusing primarily on the Basinview Centre as it is the largest energy consumer. The above recommendations deal with building envelope improvements. In addition to engineering controls, the Municipality can address energy conservation through planning practice such as, development agreements, pre-design studies, servicing studies, capacity elevations energy audits and renewable energy options. Table 7.2.2 on the following page presents goals that could be established by the Municipality to achieve reduced greenhouse gas emissions, and energy costs.

17 Street Lighting

During the development of this report, the County has begun the process of replacing the standard street lights with LED lights. This undertaking is a Provincial requirement to replace all street lights with lower power LED Lights.

18 Grey Water Reuse

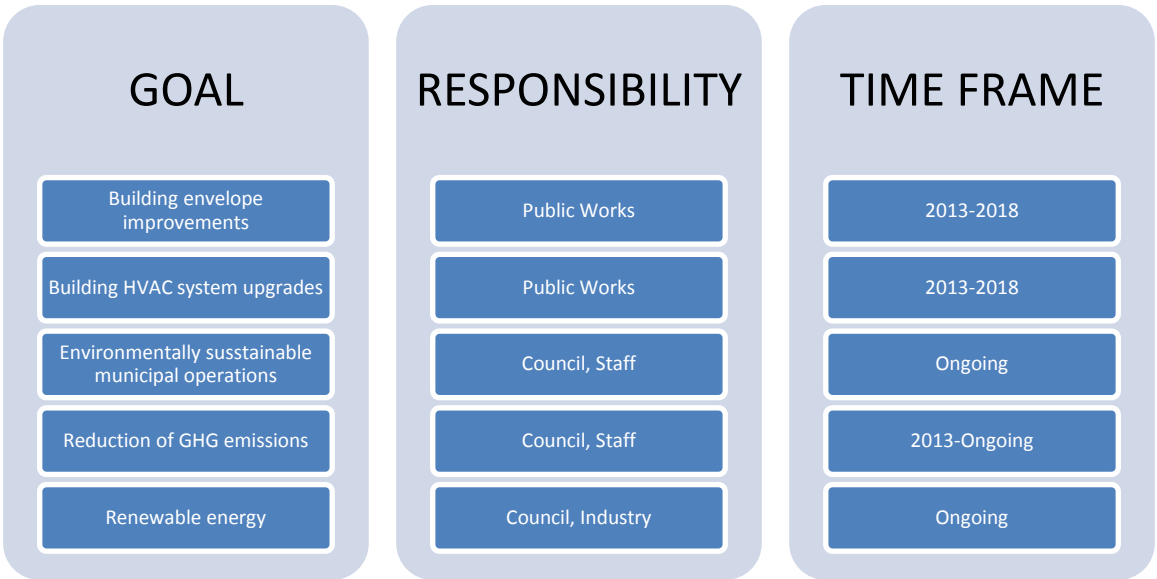
Grey water is water that is not suitable for drinking, but that has not been contaminated with biological wastes. Grey water can be water from washing, rain water or other similar. Grey water reuse could be considered in a new structure, but is generally not financially feasibility with existing buildings. Grey water heat recovery could also be considered in existing and new construction. Recovering heat from grey water should be considered where significant hot water is used for building. Where little hot water is used, such as office buildings, there is little financial incentive.

Table 7.2.2: GHG Emissions Reduction Goals

RANK	GOAL	DESCRIPTION
1	Building envelope improvements	Ongoing. Continue to address recommendations in yearly planning and budgeting
2	Building HVAC system upgrades	Conversion to grass pellets
3	Environmentally sustainable municipal operations	Incorporate sustainability into municipal operations, policies and planning documents: water usage, temp. regulation, transportation initiatives, procurement practices
4	Establish a percentage and timeframe to reduce GHG emissions (i.e. 5% by 2015)	The establishment of measurable goals will assist in staying on track and assigning accountability
5	Renewable energy	Continue to investigate renewable energy technologies, for both Municipal operations and economic development.

7.3. Implementation

The Municipality is committed to achieving the goals identified in the MCCAP. Assigning responsibility (and accountability) and time frames for the implementation of each goal will be instrumental in the success of the Municipality reaching their defined goals. The following graphics outline the recommended implementation path, and is subject to available funding.



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Richards, W., & Daigle, R. (2011). *Final Report: Scenarios and uidance for Adapting to Climate Change and Sea-Level Rise - NS and PEI.* Halifax: Atlantic Climate Adaptation Solutions Association, NS Department of the Environment.

Endnotes

[i] http://www.gov.ns.ca/snsmr/municipal/planning/climate-change.asp
[ii] Municipal Climate Change Action Plan Guidebook. SNSMR, 2011
[iii] Municipal Climate Change Action Plan Guidebook. SNSMR, 2011
[iv] From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Region. L. Vasseur & N. Cato. 2007
[v] Scenarios and Guidance for Adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities. W. Richards & R. Daigle, August 2011. ACAS Association.
[vi] From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Region. L. Vasseur & N. Cato. 2007
[vii] The Municipal Climate Change Action Plan Assistant – Learning from Others. SNSMR, 2011
[viii] It is interesting to note that even though precipitation is projected to increase in the future at all sites, the water surpluses are mostly projected to decrease and water deficits to increase. These indicators, especially increased summer water deficits, should be considered when assessing fresh water supplies.
[ix] http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=3DED7A35-1
[x] http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=7122944B-1
[xi] http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=CE6ACEC1-1#t4
[xii] Scenarios and Guidance for Adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities. W. Richards & R. Daigle, August 2011. ACAS Association
[xiii] Vulnerability of Nova Scotia's Coastal Groundwater Supplies to Climate Change. ACAS, G. Ferguson & C. Beebe. May 2012
[xiv] Statistics Canada, 2011.
[xv] Municipal Climate Change Action Plan Guidebook. SNSMR, November 2011
[xvi] Energy Audit – County of Annapolis. *Enerplan Consultants, June 2009*
[xvii] Energy Audit – County of Annapolis. *Enerplan Consultants, June 2009.*