Region of Queens Municipality

Municipal Climate Change Action Plan

Region of Queens Municipality

April 2014

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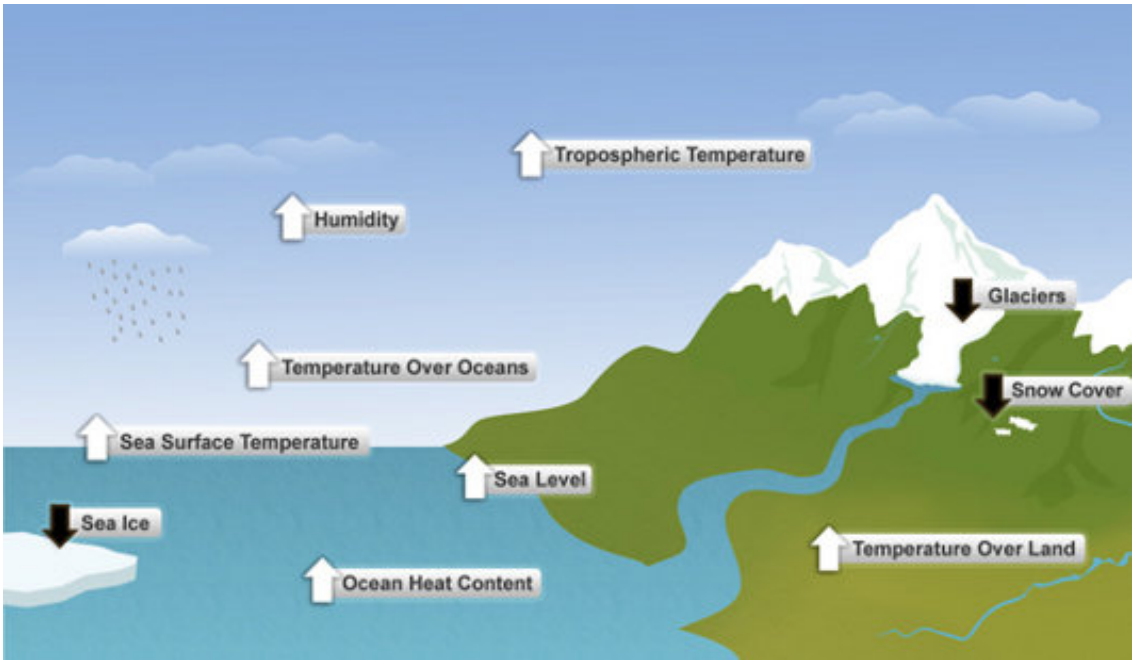
1. Introduction

Council of the Region of Queens Municipality (RQM) recognizes that that the earth's climate is changing and understands that the effects of this change could have serious implications for the residents of Queens. Increasing temperatures in both winter and summer, increasing amounts of precipitation and increasing intensity and frequency of storms are some of the key trends that we are seeing as a result of climate change. There is increasing evidence that human activity worldwide is contributing to this change, and with this in mind, municipalities have a key role to play in implementing adaptive measures to counter the effects of climate change. Changes to the weather patterns experienced here in the Region of Queens Municipality have the potential to significantly impact the local population and infrastructure, as well as our built and our natural environments. Through this plan, it is the intention of Council to take a proactive approach in trying to adapt to and mitigate climate change here in Queens.

What is Climate Change?

> *"changes in the earth's weather, including changes in temperature, wind patterns and rainfall, especially the increase in the temperature of the earth's atmosphere that is caused by the increase of particular gases, especially carbon dioxide"*
> Oxford Dictionary



Indicators of Climate Change – National Oceanic and Atmospheric Administration (NOAA)

Under the terms of the 2010 – 2014 Gas Tax Agreement and Municipal Funding Agreements, all municipalities are required to prepare a Municipal Climate Change Action

Plan (MCCAP). The MCCAP addresses both climate change adaptation and mitigation and sets out how municipalities plan to respond to climate change.

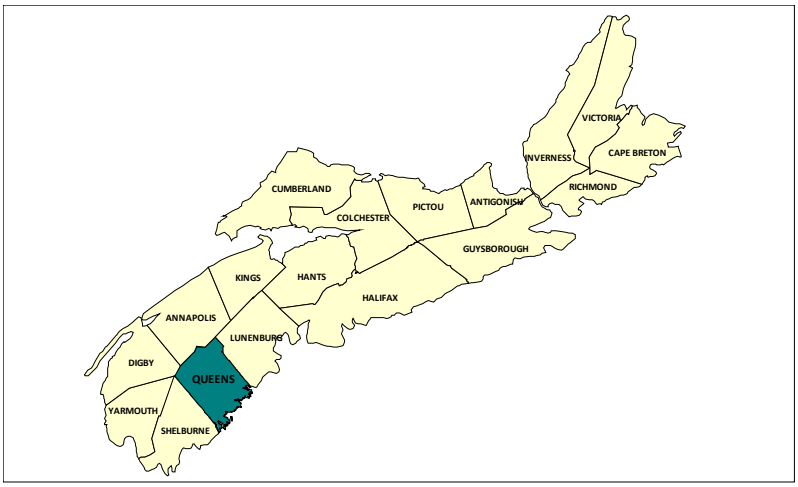
The MCCAP will focus on:

- identifying hazards which are most likely to have an impact on the Region of Queens Municipality, as a result of climate change,;
- identifying areas within the Municipality which are most vulnerable to these hazards; and
- determining how the Municipality can adapt to limit the negative impacts that may result from climate change.

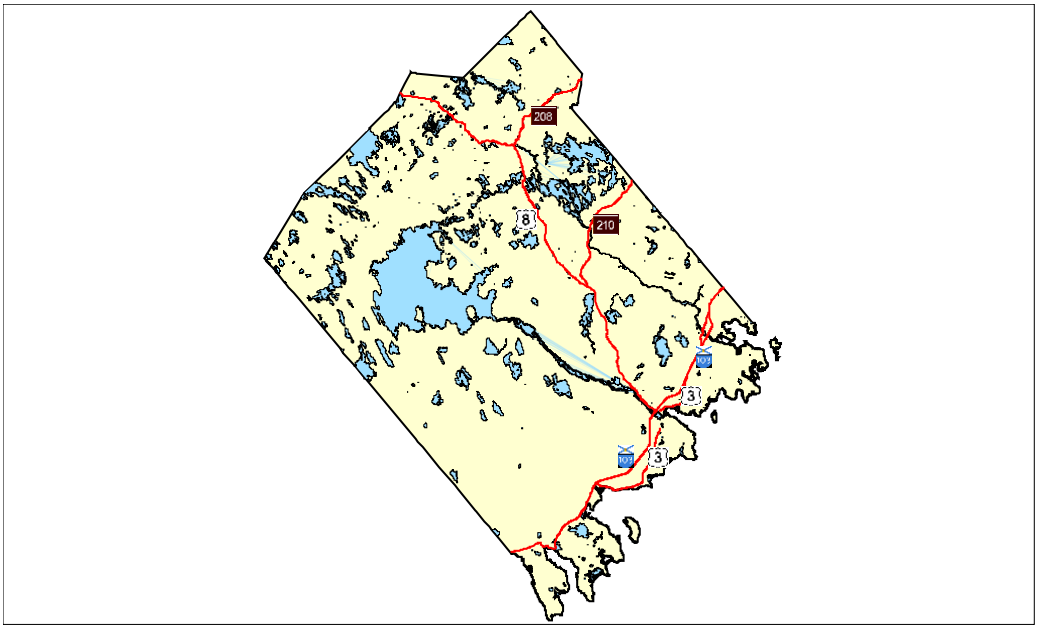
2. Background

Geographic Setting

- Located on the South Shore of Nova Scotia, the Region of Queens Municipality is centrally located between Halifax in the east and Yarmouth in the west.
- The Region encompasses approximately 2,760 km^2 or 276,100 hectares.
- Approximately 220 kilometres of shoreline on the Atlantic Ocean.
- Approximately 13% of the Region is covered by freshwater bodies.
- Vast wilderness areas and pristine shorelines.
- Accessed along Highway 103, the Lighthouse Route (Trunk 3) and Kejimkujik Scenic Drive (Trunk 8).



Map 1 –Nova Scotia Context



Map 2 – Queens County

Population Demographics

2011 Statistics Canada Census data. The data reveals several population trends in the Region, including percentage of the population by age. These statistics show that the Region has an aging population with approximately 23% of the population over the age of 65. The average for the Province is 16.6%.

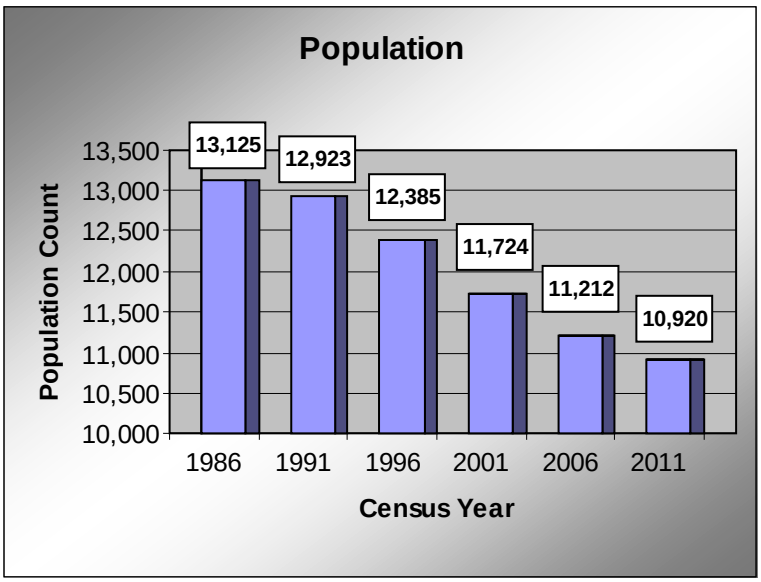


Table 1 (Data Source – Statistics Canada)

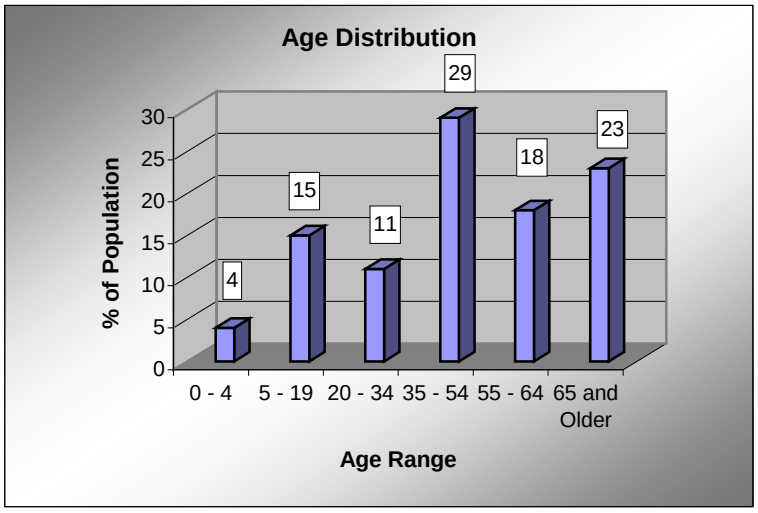
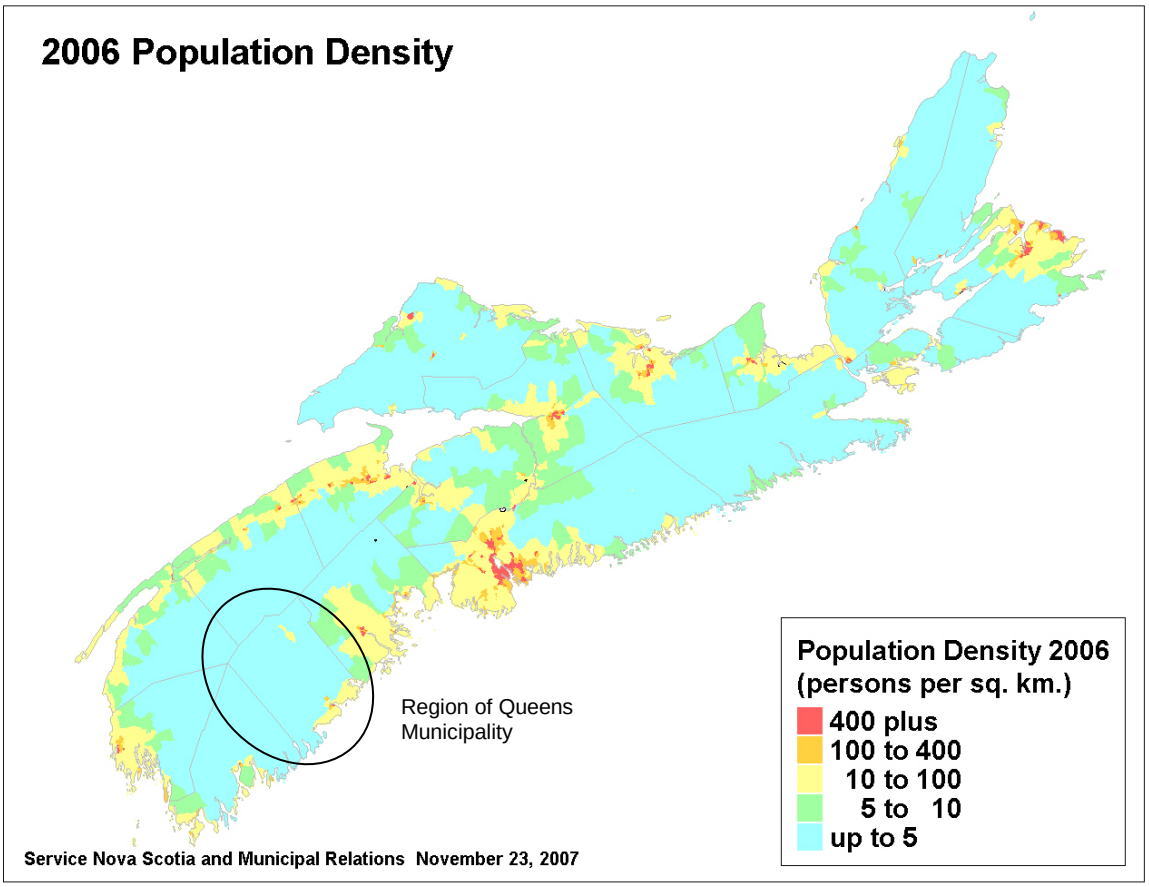


Table 2 (Data Source – Statistics Canada – 2011 Census)

Population Density



Map 3

3. Climate Change Adaptation (Step 1)

Background:
As part of the requirements for the preparation of the Municipal Climate Change Action Plan, the Region of Queens Municipality formed a Climate Change Adaptation Committee consisting of municipal staff, Councillors and other stakeholders, as necessary.

Membership:
The Adaptation Committee is made up of:

- Mike MacLeod — Planner
- Kathleen Rafuse — Chief Administrative Officer
- Brad Rowter — Director of Engineering and Works
- Colin VanBuskirk — Planning / Development Technician
- Susan MacLeod — Councillor / PAC Chair
- Darlene Norman — Councillor
- Raymond Fiske — Councillor

Other Stakeholders:

- Queens EMO
- NS Department of Transportation
- Nova Scotia Power
- RQM Economic Development Department

Term of Committee:
The Adaptation Committee is an ad hoc committee with a term running until the MCCAP has been accepted by Service Nova Scotia and Municipal Relations.

Meetings:
The Committee met on an as needed basis for the duration of the Plan preparation. Meetings of the Adaptation Committee.

Mandate:
The Adaptation Committee is responsible for preparation of the Municipal Climate Change Action Plan and is accountable to Council and to Service Nova Scotia and Municipal Relations in regards to any elements of the Plan. The Committee coordinates the work of Municipal Staff by reviewing and making recommendations on development of the Plan.

Goals of the Adaptation Committee:

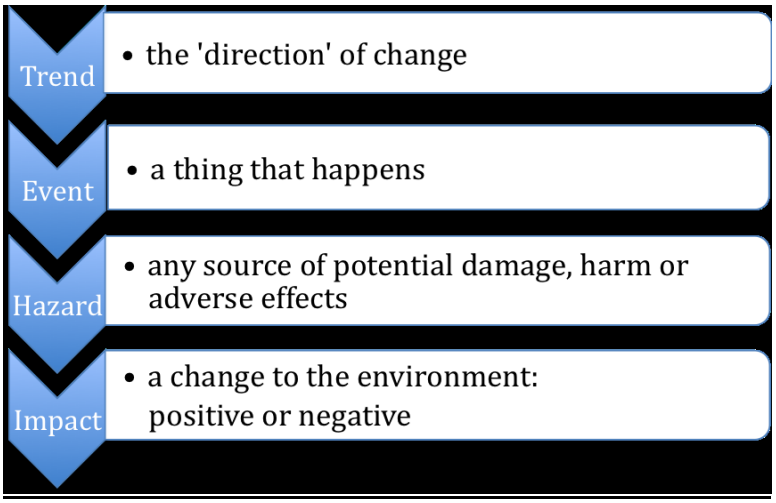
1. Identify the impacts and hazards of climate change on the Region of Queens Municipality;
2. Identify areas of the Region of Queens Municipality where the impacts of climate change could, or will, become an issue;

3. Identify municipally owned facilities, infrastructure and service delivery which could, or will, be affected by climate change;
4. Identify who within our Municipality will be most adversely affected by the impacts of climate change, where they are located and how we can help;
5. Identify the economic impacts which could, or will, result from the impacts of climate change;
6. Identify how changes in the climate can lead to negative changes in our natural environment;
7. Identify priority issues for action in adapting to climate change; and
8. Identify solutions designed to reduce and minimize the impacts of climate change.

4. Impacts and Hazards (Step 2)

The evaluation of climate change and how it will impact our Municipality ranges in scope from broad trends to area specific hazards and impacts. It is the intention of the MCCAP to:

- provide a better understanding of the weather and climate related changes that have been occurring in our area;
- look at how these changes to the weather and climate patterns may worsen existing hazards;
- look at how these changes to the weather and climate patterns may lead to new hazards; and
- identify opportunities which may result from climate change in the future.



Relationship between Trend, Hazard and Impact: (MCCAP Assistant learning From Others – Elemental Sustainability Consulting Ltd. – 2011)

In looking at what climate change impacts could be experienced in the Region of Queens Municipality, the Adaptation Committee focuses on three general climate trends:

1. Increase in annual temperatures;
2. Increase in annual precipitation; and
3. Increase in frequency and intensity of storms.

A trend can be defined as *the general direction in which something is changing*.

Projected Temperature Change:

Parameter	**Historical 1980's**	**Projected 2020's**	**Projected 2050's**	**Projected 2080's**
Temperature (°C)				
Annual	7.4	8.5	9.8	11.0
Winter	-3.2	-1.9	-0.5	1.0
Spring	5.3	6.4	7.5	8.6

Summer	18.0	19.1	20.3	21.4
Autumn	9.4	10.5	11.7	13.0

Table 4 - Source: *Scenarios and Guidance for adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities* William Richards and Réal Daigle, 2011

Projected Change in Precipitation:

Parameter	**Historical 1980's**	**Projected 2020's**	**Projected 2050's**	**Projected 2080's**
Precipitation (mm)				
Annual	1,646.7	1,691.9	1,705.9	1,756.5
Winter	502.3	526.7	539.3	568.7
Spring	424.1	438.2	444.5	461.9
Summer	287.2	292.0	291.1	291.5
Autumn	433.0	438.3	437.6	447.5

Table 5 - Source: *Scenarios and Guidance for adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities* William Richards and Réal Daigle, 2011

Out of these general climate trends arise a number of hazards and resulting impacts, which the Adaptation Committee felt have the greatest potential to affect the Region of Queens Municipality.

Hazards:

- Sea Level Rise
- Storm Surge
- Flooding
- Erosion
- Drought
- Forest Fires
- Hurricanes / Tropical Storms

4.1 Sea Level Rise –

Over the last 100 years, sea level in Nova Scotia rose approximately 30 centimeters (cm). According to some researchers, we could expect an additional increase from 70 to 140 cm over the next century.[1] Sea level rise can be attributed to a number of factors, including polar ice melt, warming of ocean temperatures, which in turn causes expansion of the water and subsidence of the land.[2]

[1] "*Our Coast. Live. Work. Play.Protect*", 2009 State of Nova Scotia's Coast Summary Report Province of Nova Scotia, 2009.
[2] *MCCAP Assistant Learning From Others* – Elemental Sustainability Consulting Ltd., SNSMR - 2011

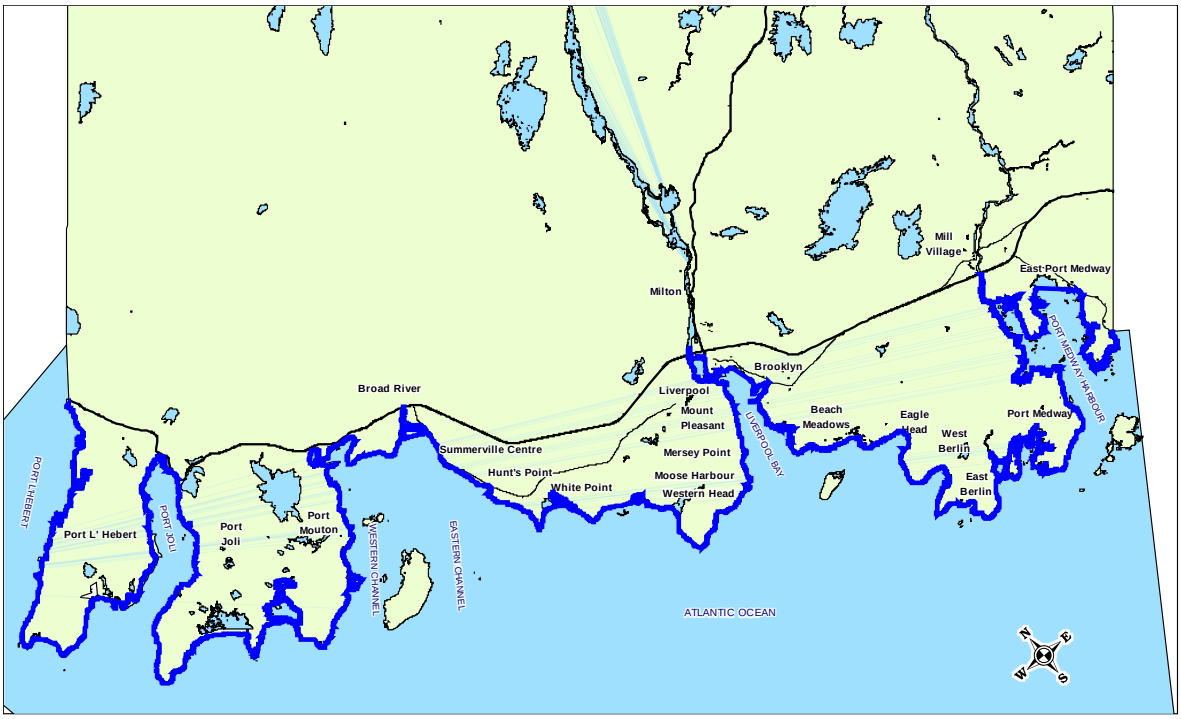
Water Level Phrase	What it Means
Total Sea Level Rise	This is another way of saying Relative Sea Level Rise: estimated sea level rise + subsidence (sinking) of a particular region.
Extreme TSL (total sea level)	This is how high the water will be if you add: • relative sea level rise (change in general water level) • a significant storm-surge event for the respective return-periods (10 year, 20 year, 50 year, 100 year) • the highest astronomical tide possible at a given location. In other words, this is where the water will be during a BIG storm if it occurs during your highest tide.
Plausible Upper Bound Water Level	This is how high the water will be if you add relative sea level rise to the truly worst case flooding scenario resulting from a storm surge as previously recorded by meteorologists (e.g., Saxby Gale in 1869, Groundhog Day storm of 1976, Hurricane Juan in 2003), and if it occurs during the highest astronomical tide possible at a given location.

Table 6 - (Source – *MCCAP Assistant learning From Others – Elemental Sustainability Consulting Ltd., SNSMR, 2011)*

Anticipated Total Sea Level Rise for Climate Station Liverpool Milton, for the years 2025, 2055, 2085 and 2100:

Parameter	2000	2025	2055	2085	2100
Total Sea Level Rise (TSL) (m)		0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
Extreme TSL – 10 Year Return	3.01 ± 0.20	3.16 ± 0.23	3.44 ± 0.35	3.84 ± 0.56	4.07 ± 0.68
Extreme TSL – 25 Year Return	3.11 ± 0.20	3.21 ± 0.23	3.54 ± 0.35	3.94 ± 0.56	4.17 ± 0.68
Extreme TSL – 50 Year Return	3.18 ± 0.20	3.33 ± 0.23	3.61 ± 0.35	4.01 ± 0.56	4.24 ± 0.68
Extreme TSL – 100 Year Return	3.25 ± 0.20	3.40 ± 0.23	3.68 ± 0.35	4.08 ± 0.56	4.31 ± 0.68

Table 7 – Source: *Scenarios and Guidance for adaptation to Climate Change and Sea Level Rise – NS and PEI Municipalities* William Richards and Réal Daigle, 2011



Map 4 – Queens County Coastline

What does this mean for Queens County? With approximately 220 kilometers of coastline, Queens County is quite susceptible to the effects of sea level rise. According to the *2009 State of Nova Scotia's Coast Technical Report* prepared for the Government of Nova Scotia, about 70% of the population of Nova Scotia live in coastal communities. In reviewing data from Statistics Canada, this number would hold true for Queens County as well; therefore, sea level rise has potential to have some form of impact on the majority of our population. The elevation of the coastline in Queens County varies and therefore the effects of a rise in sea level will vary as well. The lack of accurate topographical data for Queens County makes it a little more challenging to anticipate the areas which will be most significantly affected. However, the data we do have to work with; the Provincial 5 meter contour intervals and building data; gives us a reasonably good understanding of where we should be concentrating our adaptation efforts.

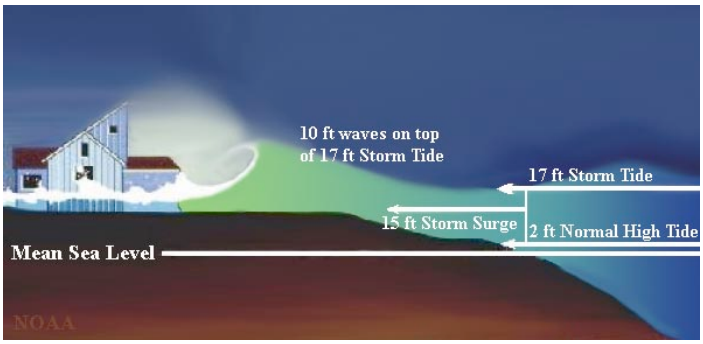
Primary Impacts which Queens County could see as a result of sea level rise include:

- Coastal flooding;
- Further reaching storm surge;
- Coastal erosion;
- Salt water intrusion into drinking water sources.

4.2 Storm Surge –

A storm surge has been defined as an abnormal rise in water levels along the coast, resulting from high winds generated by a storm. On exposed coastlines, storm surges are

often accompanied by high waves. Storm surges can hit quickly and with little time for preparation.[3]



Depiction of a fifteen foot hurricane storm surge occurring at high tide of two feet about mean sea level, creating a seventeen foot storm tide. Note that there are 10-foot waves on top of the 17-foot storm tide, so the external high water mark (HWM) left on the outside of structures by this hurricane could be 27 feet or higher.

Image credit: National Hurricane Centre (NOAA SLOSH Display Training Manual)

Storm surges associated with events like hurricanes and severe winter storms have resulted in considerable damage to property and infrastructure here in Queens County over the years. One of the more recent examples of local damage from storm surge was the destruction of the causeway in Western Head during Hurricane Bill in 2009.

Photo Credit: Ron Shupe

Photo Credit: Kim Masland

Current research indicated that there is a trend toward more frequent and more intense storms occurring in the Atlantic Canada region.[4] With this change in storm patterns, accompanied by the rise in sea level, it is anticipated that Queens County will experience an increase in frequency and severity of storm surge events.

Primary Impacts which Queens County could see as a result of storm surge include:

- Coastal and inland flooding;
- Coastal erosion;
- Property and infrastructure damage; and
- Service disruptions

[3] EMO Nova Scotia, 2013
[4] *From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Canada.* Liette Vasseur and Norm Cato, 2007

4.3 Flooding –

Flooding on the Liverpool Waterfront (2011)

Whether it is coastal flooding as a result of a storm event or heavy rainfall on top of snow melt in the spring of the year, incidents of flooding are a fairly regular occurrence here in Queens County. There are a number of areas which are more prone to flooding than others, some of which include coastal Queens, Liverpool waterfront, and numerous sections along the Medway River.
Flooding has been and continues to be a real issue for Queens. Anticipated increases in annual amounts of precipitation, sea level rise and frequency and intensity of storms resulting from changes in the climate will lend themselves to more frequent incidents of flooding.

Primary Impacts which Queens County could see as a result of flooding include:

- Property and infrastructure damage;
- Traffic disruptions;
- Evacuation / displacement of residents;
- Environmental issues – contamination of water sources

4.4 Coastal Erosion –

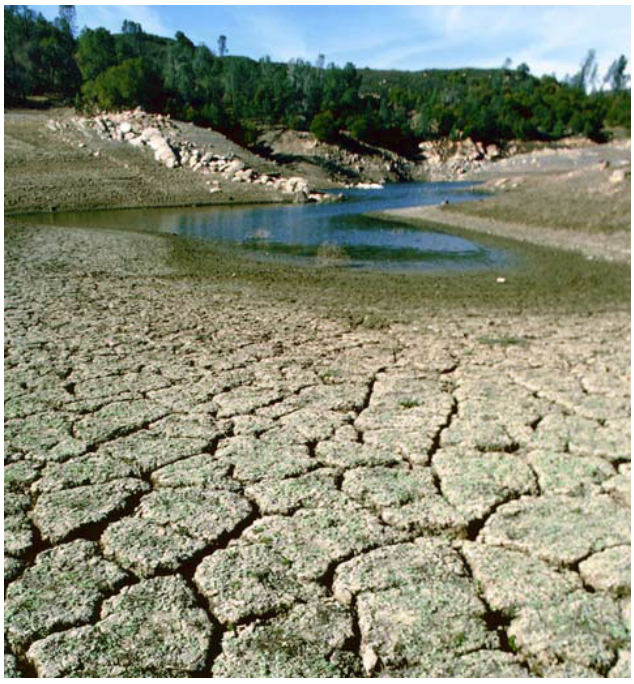
The Queens County coastline, for the most part, is quite dynamic and erosion is part of the natural processes. However, the locations and rate at which erosion occurs depend on many factors. The geological make up of the coastline plays a significant role in determining how susceptible or sensitive a shoreline will be to erosion. A soil survey prepared by Agriculture Canada shows a variety of soil classifications along coastal Queens, ranging from sandy and gravelly beaches to rock lands made up of 50 – 90 percent rock, outcrop or boulders.[5] Human interaction with the coastline, ie. development, also has a role to play in erosion.

It is anticipated that the effects of changing weather patterns such as sea level rise and predicted increase in incidents of storms and storm surge will only serve to accelerate coastal erosion here in Queens County.[6]

Primary Impacts which Queens County could see as a result of erosion include:

- Property loss / damage;
- Damage to infrastructure

4.5 Drought –



[5] *Soil Survey of Queens County Nova Scotia*, Agriculture Canada, D. B. Cann and J. D. Hilchey, 1959 and 1978.
[6] *From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Canada.* Liette Vasseur and Norm Cato, 2007

Projected increases in annual temperatures in Atlantic Canada; hotter and drier summers and warmer winters; are anticipated to increase incidents of drought. Although there is projected to be increased amounts of precipitation, this does not necessarily mean that there will be more water in our rivers, lakes and wetlands. Warmer temperatures will also lead to greater evaporation, which has the potential to exceed precipitation.[7]

A reduction of our water resources, both surface water and groundwater, can have far reaching effects for the people of Queens County. We rely on these resources for so many aspects of our daily lives.

Primary Impacts which Queens County could see as a result of drought include:

- Drinking water supply; municipal system and private wells - quantity and quality of water;
- Agricultural sector – reduction in crop yield, increase in cost of goods;
- Increase risk of forest fire.

4.6 Forest Fire –

Queens County encompasses an area of approximately 276,100 hectares and of this, it is estimated that approximately 86% of this is still forest resource land. The forestry industry has been, and continues to be, a significant contributor to the local economy.

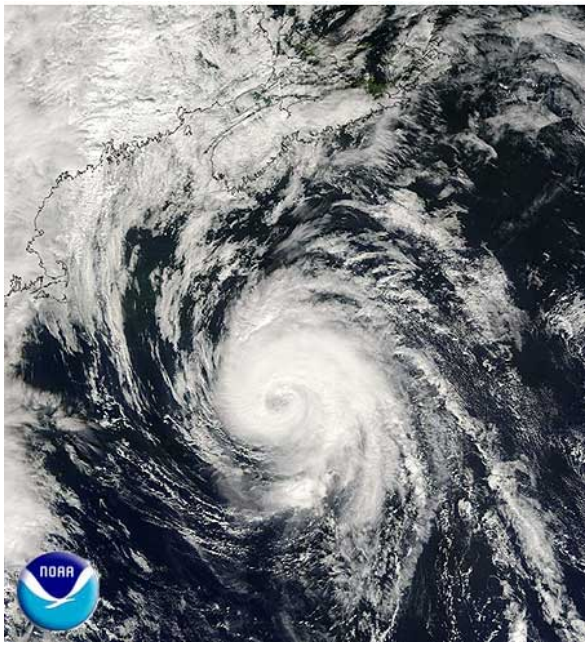
The trends we are seeing toward increased yearly temperatures and increased frequency and intensity of storms have the potential to increase the probability of forest fires and create a longer forest fire season. Hotter and drier summers, warmer winters and increased storm activity, ie. thunder and lightning, can be a hazardous combination for our forests.

[7] *From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Canada.* Liette Vasseur and Norm Cato, 2007

Primary Impacts:

- ❖ Property damage / loss;
- ❖ Forestry industry – economic loss;
- ❖ Wildlife habitat loss;
- ❖ Service interruptions;
- ❖ Evacuation / displacement of residents

4.7 Hurricane / Tropical Storm –



Hurricane Juan – 2003: Photo Credit: National Oceanic and Atmospheric Administration (NOAA)

Hurricanes and tropical storms are very much a reality here in Atlantic Canada. Over the last 10 years, there have been 166 named storms in the north Atlantic, averaging 16 per year. Of these numbers, there have been 7 significant storms that have either made landfall in Nova Scotia or their centres have come within 100 km of our coastline.[8] These storms bring with them high winds, heavy precipitation, and incidents of storm surge.

2010 – Hurricane Earl – landfall
2009 – Hurricane Bill – just off shore
2008 – Hurricane Kyle and Hurricane Hanna (Extratropical Storm) – landfall
2007 – Hurricane Noel (Extratropical Storm) – landfall
2006 – Tropical Storm Beryl – (Extratropical Storm) – landfall
2005 – Hurricane Ophelia – (Extratropical Storm) – just off shore
2003 – Hurricane Juan – landfall

[8] National Oceanic and Atmospheric Administration (NOAA) Data Archives, 2013

Predictions of increased frequency and severity of hurricanes and tropical storms increases the likelihood that Queens County will experience more frequent extreme storm events, with potentially catastrophic results.

Primary Impacts:

- Property damage from high winds, storm surge;
- Power outages;
- Tree fall;
- Flooding.

4.8 Hazard / Impact Matrix –

Based on past history here in Queens, the following table indicates an estimation of how our area may be affected by a particular climate change related hazard.

Hazard	Severity	Frequency	Area
Sea Level Rise	Moderate	/	Medium
Storm Surge	High	Sometimes	Medium
Flooding	High	Sometimes	Medium
Erosion	Moderate	Often	Medium
Drought	Low	Rare	Large
Forest Fire	High	Sometimes	Large
Hurricane / Tropical Storm	High	Sometimes	Large

Table 8

4.9 Level of Municipal Preparedness

Determining the level of preparedness of the Municipality to respond to emergencies related to climate change is a challenging exercise. Every situation or event is different, some areas are more vulnerable than others to the effects of climate change and there are many unknowns or variables in trying to predict what the future holds respecting changes to our weather patterns. The Region of Queens Municipality does have an Emergency Measures Plan in place which identifies a number of weather related hazards and establishes a set of protocols which Queens EMO utilizes to deal with a particular incident. Based upon historical data, we have a pretty good idea where to concentrate our focus respecting things like flooding, storm surge and erosion and we can reasonably assume that these areas will be affected in the future. However, hazards like sea level rise, drought, forest fires and hurricanes are more challenging to prepare for.

4.10 Benefits of Climate Change –

While the primary focus of this section of the Plan has centered on the negative impacts resulting from climate change, there can also be some benefits associated with these climate change trends. An increase in the yearly temperatures usually seen here in Queens County could have the positive effects of:

- Lengthening our summer tourism season;
- Lengthening our agricultural growing season;
- Decrease winter road maintenance costs;
- Reduced fossil fuel used for heating purposes.

5. Affected Locations (Step 3)

The effects of climate change on Queens County are likely to vary from area to area. In this section, we will look at a number of factors which could affect how climate change impacts all, or particular parts of, our County. In an effort to develop a better understanding of the impacts of climate change, the MCCAP:

1. looks to the past to identify where issues have previously occurred; and
2. attempts to identify what new hazards and impacts we could expect in the future.

Utilizing this information we can identify where climate change impacts could, or will, become an issue requiring the implementation of adaptive measures.

A number of the factors which could play a role in the effects of climate change include:

- Topographic characteristics of the land;
- Geology;
- Current adaptive measures, ie. zoning regulations;
- Proximity to the ocean;
- Existing development patterns.

Step 2 of the MCCAP identified a number of trends, hazards and potential impacts of climate change.

Trend - Increase in yearly temperatures;
Increase annual precipitation; and
Increase in frequency and intensity of storms.

5.1 Hazard - Sea Level Rise -

Sea level rise, taken in isolation, is not anticipated to have a dramatic affect on Queens County. With a projected rise of approximately 50 to 70cm this century,[9] significant changes for our area are not going to be realized in the short term. Sea level rise becomes more of a concern when considered in conjunction with other hazards resulting from climate change, such as an increased frequency and intensity of storms. Impacts we could see are further reaching storm surge, coastal and inland flooding, coastal erosion and salt water intrusion.

Queens has about 220 km of coastline, much of which is at a relatively low elevation. All coastal communities from Port L'Hebert to East Port Medway have been seeing, and will continue to see, impacts from sea level rise.

Review of contour data and civic address data for Queens, as well as historical data, the Committee feels that the following areas may be increasingly susceptible to impacts of sea level rise:

- St. Catherine's River Road in Port Joli;

[9] *From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Canada.* Liette Vasseur and Norm Cato, 2007

- Burgess Road in Port Mouton;
- Highway 3 at Summerville Centre, Hunts Point
- Five Rivers Drive, White Point Estates;
- Mersey River from the Liverpool Waterfront to Bridge Street in Milton;
- Western Head (Victoria Lake);
- Brooklyn Shore Road at Herring Cove;
- Vicinity of Beach Meadows Beach;
- Eagle Head Bay; Blueberry Bay in West Berlin,
- Ragged Harbour in East Berlin;
- Long Cove Road in Port Medway;
- Southwest Cove in Port Medway;
- Northwest Bay in East Port Medway

5.2 Hazard – Storm Surge -

Storm surge has and will continue to have an effect on all 220 km of the coastline of Queens County. The impacts thereof, according to climate change predictions, will be more far reaching. What we can expect as a result of storm surge:

- Damage to private property / development along the coast from flooding – dwellings, commercial / industrial businesses, commercial fishing gear;
- Accelerated coastal erosion;
- Damage to public infrastructure such as wharves. In Queens County, there are 7 public wharves supporting the region's fishing industry (East Port L'Hebert, Port Mouton, Hunts Point, Moose Harbour, Brooklyn, West Berlin and Port Medway) which are managed operated and maintained by local Harbour authorities;
- Traffic disruptions due to public road closures. Several public road systems in Queens are immediately adjacent to, or in close proximity to, the coast. Given elevation and proximity to coast, of particular concern are:
  - Trunk 3 in Summerville Centre
  - Trunk 3 in Hunts Point
  - Shore Road in Western Head
  - Brooklyn Shore Road in Brooklyn
  - Brooklyn Shore Road in Beach Meadows
  - Eastern Shore Road in Beach Meadows
  - Eastern Shore Road in Eagle Head
  - Eastern Shore Road in West Berlin
  - East Berlin Road in East Berlin
  - Port Medway Road in Port Medway
  - Commercial Street in Port Medway
  - Long Cove Road in Port Medway
  - Route 331 in East Port Medway

Vulnerable area(s): All of coastal Queens;

5.3 Hazard - Flooding –

Inland and coastal flooding can result from such events as significant rainfall, storm surge, and precipitation associated with hurricanes and tropical storms. Prediction of an increased volume of precipitation is of particular concern for Queens County. History has shown that not only are we susceptible to coastal flooding, but inland flooding has been very problematic for our area as well.

Two significant watercourses run through the County; the Mersey River and the Medway River, both of which are tidal influenced. Over the years, incidents of flooding around these water systems have been numerous, particularly along the Medway.

Nova Scotia Power operates hydro dams along both of these rivers. While there are obviously other influencing factors, in times of heavy precipitation, these dam systems have some opportunity to regulate the amount of down stream flooding through control of water passing through the dams. This being said; however, control at the dams diminishes with the higher volumes of water entering the water system.

The presence of the hydro dam systems in Queens has been beneficial; historically; from a flooding perspective. However, the systems themselves also create a potential hazard – dam breach. While Nova Scotia Power has a very comprehensive emergency management plan for its hydro systems, possible dam breach is a reality.

What we could expect as a result of flooding:

- Damage to private property and belongings;
- Damage to public property and infrastructure;
- Road closures / disruption of travel routes;
- Dam breach;
- Displacement of residents;
- Power disruptions;
- Disruption of service provision,
- Contamination of environment resulting from overflow of private sewage disposal systems;
- Contamination of environment resulting from overflow of municipal storm and wastewater systems;
- Contamination of environment from spilled petroleum products

Vulnerable area(s):

- All of coastal Queens;
- Adjacent to Medway River system from MacGowan Lake to Mill Village;
- Adjacent to the Mersey River system from Lake Rossignol to Liverpool Bay, including the Liverpool waterfront;

5.4 Hazard - Erosion -

“Erosion occurs on the most sensitive coastlines, such as sand dunes, sand and pebble gravel beaches, or where unconsolidated sediments or weakly consolidated bedrock forms

coastal bluffs".[10] Erosion is a natural factor in the interaction of land and water and can occur along many areas of our coastline. Queens County has many such locations. However, an increase in frequency and intensity of storms, sea level rise, storm surge and human interaction can all play a role in the rate of erosion.
What we could expect as a result of erosion:

- Property loss;
- Damage to buildings and structures built in close proximity to shore line;
- Damage to public infrastructure such as roads and bridges.

Vulnerable area(s):

- Most of coastal Queens. Of particular concern are the sensitive sand beach and pebble beach areas at:
  - Lighthouse Beach in East Port L'Hebert;
  - East Port Joli Harbour;
  - Boyds Cove, Port Joli Head and St. Catherines River Beach in Port Joli;
  - Little Port Joli Beach in Port Joli;
  - South West Port Mouton Beach and Carters Beach in Port Mouton;
  - Summerville Beach in Summerville Centre;
  - Hunts Point Beach in Hunts Point;
  - White Point Beach in White Point;
  - Western Head by causeway and clay headlands in the vicinity of Pierce Point subdivision;
  - Beach Meadows Beach;
  - Ragged Harbour Beach.

5.5 Hazard - Drought -

Predictions of increases in annual temperatures in Queens County has the potential to create a situation where water evaporation exceeds the precipitation required to recharge our surface water and groundwater supplies.

What we could expect as a result of drought:

- Decreased availability of potable water; municipal system and private wells - quantity and quality of water.
  - Town Lake watershed – Municipal supply – Liverpool and Brooklyn;
  - Reduction in groundwater table could result in rationing of water for non essential uses like landscaping and recreational uses.
- Agricultural sector – primarily located in the central and north Queens areas -
  - reduction in crop yield , which is directly related to the availability of water.

[10] *From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Canada.* Liette Vasseur and Norm Cato, 2007 – P. 137.

- Drier conditions may result in farmers looking at alternate crops that are more suited to drier conditions. This would effect the availability of certain local crops.
- weaken local economy – Lower crop yields mean less local product to sell and to buy, affecting both the producer and consumer. May lead to increases in imported products to meet local demand. Money does not stay in community.

❖ Increase risk of forest fire –
- Drought conditions in the woodland areas of Queens County greatly increase the potential for forest fires resulting from both manmade (ie. discarded cigarette or unattended campfire) and natural causes (ie. lightning strike).

Vulnerable area(s):

❖ All of Queens County.

5.6 Hazard - Forest Fires -

Increases in yearly temperatures and more frequent and intense storms resulting from climate change could dramatically increase our potential for forest fires. Forest resource lands account for approximately 85% of the land area in Queens County and with that, the affects of a forest fire could be quite significant. In 1955, a forest fire swept through the Western Head area, causing considerable damage and destruction. In 2006, fire crews fought diligently to protect property and homes from a forest fire in South West Port Mouton. The potential for forest fires currently exists in Queens and if climate change predictions hold true, the potential will only increase.

What we could expect as a result of forest fire:

❖ Damage or destruction of property and infrastructure.
❖ Forestry industry –
  - economic impacts resulting loss of resource, both direct and indirect.
❖ Wildlife habitat loss;
❖ Loss of recreational resources. Many of Queens County's recreational resources such as trails and parks are ties to our abundant forests.
❖ Contamination of water sources – resulting from contaminated runoff after fire.
❖ Service disruptions – damage to utilities and infrastructure.
❖ Evacuation / displacement of residents.
❖ Health concerns – respiratory illness aggravated by smoke.

Vulnerable area(s):

❖ All of Queens County.

5.7 Hazard - Hurricane / Tropical Storms -

Anticipated increases in the number and frequency of storms to pass through Atlantic, and in particular, Queens County is cause for considerable concern. As noted earlier, residents of Queens County are familiar with hurricanes and tropical storms and the results thereof: high winds, heavy rain, storm surge and flooding.

What we could expect as a result of hurricanes and tropical storms:

- Heavy rain – flooding:
- High winds –
  - downed trees,
  - downed power lines – prolonged power outages,
  - damage to property and infrastructure
- Storm surge –
  - flooding,
  - erosion,
  - property and infrastructure damage.
- Lightning strikes
- Economic impacts –
  - fishing industry – fragile fishing grounds

Vulnerable area(s):

- All of Queens County. Of particular concern are the coastal areas of the County.

5.8 Degree of Risk Associated with Vulnerable Areas

Evaluation of the possible impacts of climate change, and the areas of Queens that will be most susceptible to these changes, is a difficult process. There are many influencing conditions and unknown factors that can affect how changes in our weather patterns will impact particular areas of Queens County.
Based on historic data, local knowledge and research from experts in the field of climate change, we attempt to make predictions on the future impacts which could be experienced at the local level.

Hazard	Issue	Severity	Frequency	Area	Level of Risk
Sea Level Rise		Moderate	/	Medium	
	Further reaching storm surge				Low
	Flooding				Low
	Erosion				Low
	Salt water intrusion				Low
Storm Surge		High	Sometimes	Medium	
	Property damage				High
	Erosion				High
	Infrastructure damage				Medium
	Traffic disruptions				Medium

Flooding		High	Sometimes	Medium	
	Property damage				High
	Infrastructure damage				Medium
	Traffic disruptions				Medium
	Dam breach				Low
	Displacement of residents				Medium
	Power disruption				Medium
	Service disruption				Medium
	Contamination of environment				Medium
Erosion		Moderate	Often	Medium	
	Property loss				High
	Damage to buildings and structures				High
	Infrastructure damage				High
Drought		Low	Rare	Large	
	Potable water				Medium
	Agriculture				Medium
	Forest fire				Medium
Forest Fire		High	Sometimes	Large	
	Property and infrastructure damage				Medium
	Forestry industry				Medium
	Habitat loss				Medium
	Loss of recreational resources				Medium
	Contamination of water resources				Medium
	Displacement of residents				Medium
	Health concerns				Medium
	Service disruptions				Medium
Hurricane / Tropical Storm		High	Sometimes	Large	
	Flooding				High
	Property damage				High
	Infrastructure damage				Medium
	Service disruptions				Medium
	Shoreline erosion				High
	Lightning strikes				Medium
	Economic loss				Medium

Table 9

Refer to Appendix D – Vulnerable Area Maps -

6. Facilities, Infrastructure and Service Delivery (Step 4)

One of the primary reasons for preparing a municipal climate change action plan is to assess existing infrastructure and key facilities to determine their susceptibility to the effects of climate change. In this section, we will:

- Identify key facilities and infrastructure in the Region of Queens Municipality;
- Identify where key facilities and infrastructure are located;
- Determine what facilities and infrastructure are most susceptible to the effects of climate change;
- Evaluate the impacts of climate change on the delivery of municipal services.

In identifying the key facilities and infrastructure within the Municipality, the Committee conducted a preliminary risk assessment on existing assets and prioritized them from the stand point of anticipated impacts on the community if the assets were no longer able to be used or accessed.

Facilities:

Water treatment plant
Sewage treatment plant – Brooklyn and Caledonia
Solid Waste Management Facility
Municipal Office
Works Department
Queens Place Emera Centre
Hillsview Acres

Infrastructure:

Water system
Sanitary Sewer system
Storm sewer system
Transportation networks

Service Delivery:

Solid waste collection
Water
Sewer
Recreation
Streetlighting

Refer to Appendix E for map of Key Municipal facilities and infrastructure.

Service Nova Scotia and Municipal Relations have developed a spreadsheet to assist municipalities in evaluating the risk to municipal facilities and infrastructure. Each asset is assessed for risks associated with sea level rise, extreme precipitation, high winds, temperature variations, erosion and earthquakes. A sample of this analysis is outlined below.

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)	L	1	L	1	M	2	L	1	M	2	M	2	L	1	L	1	L	1	12	M
Water Treatment Plant	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Water Storage Facilities	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Water Pumping Facilities	L	1	L	1	L	1	N	0	M	2	L	1	L	1	L	1	L	1	9	L
Water Distribution System	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Individual Water Service Lines	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Total	6		6		7		3		8		7		6		6		6		55	
Sanitary Sewer System																				
Wastewater Treatment Plant	M	2	L	1	M	2	L	1	M	2	L	1	L	1	L	1	L	1	12	M
Buildings	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Wastewater Gravity Sewer	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Wastewater Pressure Sewer (Forcemain)	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Pumping Stations	M	2	L	1	M	2	L	1	M	2	L	1	L	1	L	1	L	1	12	M
Total	7		5		7		3		7		5		5		5		5		49	

Table 10

Refer to Appendix A for full Municipal Facilities and Infrastructure Risk Assessment.

Municipal Facilities and Infrastructure Risk Assessment - Summary

Municipal Asset	Overall Risk
Water System	Low
Sanitary Sewer System	Low
Storm Sewer System	Medium
Buildings	Medium
Solid Waste Management Facility	Low
Dams – Town Lake	Low
Roads	Medium

Table 11

Results of the preliminary risk assessment indicate that none of the Municipalities facilities and infrastructure are at a high risk from the impacts of climate change.

Water System – The Municipal drinking water supply comes from the Town Lake Watershed, just west of Liverpool. This system supplies Liverpool and portions of Milton and Brooklyn. The remainder of the County is supplied by private wells. The climate change hazard which has the greatest potential to impact the Region's water supply is drought. Decreased amounts of precipitation will have a direct impact on the availability of

potable water to municipal customers. As well, higher annual temperatures can have an effect on the quality of water at Town Lake, requiring additional treatment prior to entering the municipal system.

Sanitary Sewer System – The Region of Queens Municipality operates two sanitary sewer systems, one on Hank Snow Drive in Liverpool and the other on Highway 8 in Caledonia.. Perhaps the greatest concern to these systems, as a result of climate change is flooding. Some of the key components associated with the sanitary sewer system are located at lower elevations and are therefore at risk to the impacts of flooding.

Storm Sewer System – The municipality's storm sewer system is comprised of catch basins, pipes, culverts and ditches. Sea level rise, increase in frequency and intensity of storms are perhaps the most significant concern to this system. Heavy rainfall over a short period of time, as well as location and elevation of outfalls, can cause the system to become overloaded resulting in flooding issues.

Municipal Buildings – The Municipality owns 30 buildings/facilities throughout Queens County. Some are strictly utilized by the Region, while others are leased to other groups or organizations. Hurricanes / tropical storms are perhaps the most concerning hazard to these structures. Damage from high winds, heavy precipitation and tree fall is always a possibility during these extreme weather events.

Solid Waste Management Facility – The Region's Solid Waste Management Facility is located in the community of Milton in the vicinity of Ten Mile Lake. Given the nature of the operation, location and forest management around the site, the effects of climate change on this facility are not deemed to be significant.

Dams – Town Lake – The Town Lake Watershed area incorporates a small dam structure, that form an important component of the overall municipal water supply system. The greatest climate change related concern to this infrastructure would be extremely heavy precipitation, compounded with snow melt, which could raise the potential of a dam breach.

Roads – The Region of Queens Municipality owns and maintains approximately 29 kilometres of roads, the majority of which are located in the former Town of Liverpool. The primary risk to municipal roads is flooding. Given the relative low elevation and proximity to the Mersey River, Henry Hensey Drive, Water Street and Legion Street are deemed to be most affected by flooding.

While the preliminary risk assessment completed above was for municipally owned facilities and infrastructure, the Committee recognized that there are other important facilities and infrastructure in Queens that are owned and operated by other groups and organizations, which may be impacted by the effects of climate change.

Facilities -

Fire Halls (Liverpool, Mill Village, Port Medway, Charleston, Greenfield and North Queens)
RCMP
Hospital (Queens General Hospital and North Queens Medical Centre)
Schools (JC Wickwire Academy, South Queens Middle School, Liverpool Regional High School, Mill Village Consolodated School, Greenfield Elementary School, and North Queens Schools)
EHS base
Queens County Ground search and Rescue

Infrastructure –

Nova Scotia Power Inc. dams
Power utility
Transportation networks
Communication networks

Refer to Appendix F for Key Non-Municipal Facilities and Infrastructure.

Stakeholder Consultation –

Stakeholder consultation included discussions with Nova Scotia Power Inc. (NSPI) and Nova Scotia Transportation and Infrastructure Renewal (NSTIR) respecting their level of preparedness in dealing with hazards which could result from climate change. A summary of this consultation is outlined below.

NSPI –

- Operates two hydro systems in Queens County; the Mersey Hydro System and the Harmony Hydro System. The Mersey System incorporates six (6) hydroelectric generating stations, while the Harmony System incorporated one (1) hydroelectric generating facility. NSPI has a detailed emergency preparedness plan (EPP) in place for each of these systems, which is updated on an annual basis. The plans include emergency action instructions and notification procedures in the event of:
  - Dam failure;
  - Potential dam failure;
  - Sudden release of water;
  - Severe storms; and fire and oil or chemical spills.

- NSPI tries to takes a proactive approach to maintenance of their transmission lines through regular tree trimming. Transmission lines are most susceptible to the impacts of increased frequency and intensity of storms like hurricanes, tropical storms and ice storms.

NSTIR –

- NSTIR maintains approximately 750 km of roads in Queens County. Within this road system, the Department inspects 168 bridges every year.
- Storm surge, erosion and flooding are the primary weather related hazards affecting TIR infrastructure.
- Regular monitoring and inspection of infrastructure are part of the TIR maintenance program, particularly following a weather related event. History has revealed a number of "hot spots" which they pay particular attention to during and after storm events, some of which include:
    - Long Cove in Port Medway;
    - Ragged Harbour in East Berlin;
    - Hays Road in West Berlin;
    - Western Head causeway; and
    - Trunk 3 in Summerville Centre by Quarterdeck
- NSTIR has plans to initiate its own climate change action planning program, as part of the overall provincial government response to climate change.

7. Social, Economic and Environmental Considerations (Step 5)

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.

7.1 Social Considerations –

Step 5 (a) will look at the impacts of climate change on the people of Queens County. The objectives of the Committee were to:

- Identify those within our communities who will be most affected by the impacts of climate change; and
- Identify those individuals, groups, agencies and organizations that have the capacity to reduce the risks to those most vulnerable.

Within our communities, there are certain segments of the population which may be more vulnerable than others to climate change related emergencies. Getting a better understanding of those who could be most effected will assist in developing procedures to deal with such emergencies. The following list includes those segments of the population that the Committee felt could be most vulnerable to the effects of climate change:

- The elderly;
- The very young;
  (Over one quarter of the population of Queens County are either under the age of 4 years old or over the age of 65 years old.)
- Individuals with special needs; and
- Individuals living in isolated areas of the County.

In looking at the potential implications of climate change on the health and well being of the residents of Queens County, the Committee felt that severe weather events were likely to have the most drastic effect.

- Prolonged power outages, particularly in the winter months;
  - Potential for freezing or hypothermia
- Potential displacement of residents from their homes – flooding, power outages;
- Damage to or loss of property;
- Restrict or limit emergency service provision – flooding, snow, downed trees
- Service disruption;
- General stress of dealing with a disaster;

Nursing homes /homes for special care:

- Queens Manor – Liverpool
- Hillsview Acres Home for Special Care – Middlefield
- North Queens Nursing Home - Caledonia
- Meadow Brook Manor – South Brookfield

Supported Living:

- Queens Association for Supported Living –
  - 131 Queens Street, Liverpool
  - 128 Brunswick Street, Liverpool
  - 154 Brunswick Street, Liverpool

Response to climate change related events will vary, depending on the nature of the situation. However, there are many groups, agencies and organizations that would likely have a role to play in assisting those in need during an emergency.

- Region of Queens Municipality
- Fire department(s)
- RCMP
- EHS
- West Queens First Responders
- NS Department of Community Services
- NS Department of Health
- NS Department of Transportation and Infrastructure Renewal
- NS Department of Environment
- Department of Natural Resources
- EMO Queens
- EMO Nova Scotia

Other groups, agencies and organizations could include:

- Nova Scotia Power Inc.
- Red Cross
- Ground Search and Rescue
- Community groups – shelters
- Queens Association for Supported Living

What can we do?

Council recognizes that educating the public on the potential hazards of weather related events can reduce the social impacts felt here in Queens County. Through Queens EMO, and in conjunction with the Provincial Emergency Management Organization, we could initiate a public education program respecting dealing with various weather related emergencies.

- Make presentation to various groups and organizations throughout the County.
- There is a considerable amount of published information available respecting weather related emergencies. Information to be made available at the Municipal Office and on the Municipality's website.

7.2 Economic Considerations –

The impacts of climate change have the potential to adversely affect the local and regional economies. Impacts could include:

- Loss of business;
- Loss of revenue – reduction in disposable income;
- Loss or damage to property and infrastructure – increase in maintenance / repair costs;
- Disruption of supply lines (transportation);
- Changes to unique ecosystems, which bring people to our area for research purposes.

Coastal Queens is home to numerous commercial fishery wharves and facilities, tourist accommodations and other commercial and industrial establishments. An increased frequency of storm events, storm surge and sea level rise will all have a direct effect on these operations.

Fishing industry –

- ability to maintain their gear – fewer days on the water;
- damage to gear (repair or replacement costs);
- damage to wharf infrastructure (repair or replacement costs);
- increases in water temperature can change the migration / mobility patterns of fish species, affecting catches;
- Introduction of invasive species to the local area.

Tourism industry –

- Coastal erosion of our sensitive sand beach areas could make the area less appealing for tourists;
- Closure of tourist establishments and disruption of travel routes as a result of a climate change event; even for a short period of time; can have a significant economic impact on a tourist business operator and the people who work there;
- Warmer temperatures during the summer and fall could extend the length of the tourist season, which would be a positive for the tourism industry.

Forestry industry – increases in annual temperatures and changes in the amount of summer precipitation can lead to:

- Drought conditions, which increase the risk of forest fire. Forest fires result in less resource being available to generate revenue in industry;
- Increase in incidents of pests and disease affecting our forests, thereby reducing the resource being available to generate revenue in industry;
- Change to Acadian Forest species mix;
- Significant costs incurred in fighting forest fires.

Agricultural industry – the effects of changing weather patterns can have a dramatic influence on the agricultural industry. Drought conditions, later incidents of frost, heavy rainfalls close to harvest time and increased pests have a direct impact on crop yield.

- Climate change may change or limit the types of crops that can be commercially grown here in the region.
- Warmer temperatures may lead to longer growing seasons, increased productivity and extended employment, all of which would benefit the local economy. (Benefit)
- May present new economic opportunities within the agricultural industry. (Benefit)

As a note of interest, in 2011, Community Business Development Corporations (CBDCs) of Yarmouth, Shelburne, and Queens/Lunenburg initiated a project to assess weather conditions and their influence on agriculture potential in the counties of Queens , Lunenburg, Shelburne, Digby and Yarmouth; the *South West Nova Scotia Temperature and Solar Radiation Study.* This three year project saw the deployment of numerous weather stations throughout the five counties to measure both temperature and solar radiation. The changing climatic patterns may make alternative agricultural crops more feasible in our area. The outputs from the project have already shown a warming climate as good for our area and the information is being readily used by people hoping to establish agricultural businesses here in. A Phase 2 is currently being planned for this project, which will involve collection of the same type of data as before for another 3 years, but in addition some new components will be studied: wind speed and direction, precipitation amounts and relative humidity.

Municipal implications –

As the Region of Queens Municipality looks at future implications of climate change, a number of economic challenges and benefits present themselves.

- Protection of public infrastructure from incidents of flooding and storm surge can come at a significant cost;
- Decreased winter road maintenance costs (Benefit);

Stakeholder Consultation -

Region of Queens Municipality Economic Development Department – Jill Cruikshank and Richard Lane

7.3 Environmental Considerations –

How will climate change effect the environment? As with the social and economic consideration just discussed, climate change has the potential to significantly affect the local environment. The Committee felt that climate change could affect Queens County on a number of fronts, based on current trends, and could include:

Increase in annual temperature –

- ❖ Diminish important wetland areas
- ❖ Increase spread of pests and disease
- ❖ Spread of invasive species

Increase in annual precipitation – particularly in the winter months

- ❖ Increase in incidents of freezing rain – damage to trees and other natural vegetation
- ❖ Increase in incidents of flooding

Increase in intensity and frequency of storms -

- ❖ Accelerated coastal erosion
- ❖ Loss of sand beach and dune systems and other ecologically sensitive areas
- ❖ Salt water intrusion into private drinking water supplies
- ❖ Tree fall from wind and ice storms
- ❖ Release of hazardous materials into the environment – ie. failed septic systems and overturned oil tanks as a result of flooding.

Region of Queens Municipality Emergency Management Plan - In 1996, the Region of Queens Municipality adopted a Municipal Emergency Measures Bylaw, the intent of which was to put in place mechanisms to prepare for, respond to and manage emergency situations that may occur in Queens County. In 1999, the Region of Queens Municipality Emergency Measures Plan was approved by Council, which established procedures and protocols to be utilized by EMO Queens in dealing with particular emergency events. Both the Bylaw and Plan have been amended on several occasions since they were first adopted. The Emergency Measures Plan contains a detailed analysis of the potential hazards or disasters that are most likely to affect Queens County and its residents. Both possible effects and potential actions are listed in a general order of significance and / or priority. The analysis outlines possible major effects, potential actions and responding agency(s).

Maps of Comfort Centers and Shelters (EMO Plan) – Appendix C.

8. Priorities and Actions (Step 6)

One of the primary objectives of developing a municipal climate change action plan is to identify, establish and prioritize issues related to climate change, in an effort to determine a course of action that Municipalities will take in managing and adapting to climate change hazards and impacts. In this section, the Committee sought to:

- Prioritize climate change adaptation issues which are considered to present the greatest risk to the Municipality;
- Identify possible course(s) of action for issues identified as priority; and
- Develop an approach to integrate the adaptation priorities into municipal planning documents.

In attempting to prioritize climate change adaptive issues, the Committee looked at the issues that are of a more immediate concern and gave them a higher priority, and the more long term issues as a lower priority. As well, the Committee gave higher priority to issues that may impact public safety and delivery of services.

8.1 Priorities for Adaptation -

Sea Level Rise

	Adaptation Issues	Priority
1.1	Coastal flooding	Low
1.2	Further reaching storm surge	High
1.3	Coastal erosion	Low
1.4	Salt water intrusion into drinking water sources	Low

Storm Surge

	Adaptation Issues	Priority
2.1	Coastal and inland flooding	High
2.2	Coastal erosion	High
2.3	Property and infrastructure damage	High
2.4	Service disruptions	High

Flooding

	Adaptation Issues	Priority
3.1	Property and infrastructure damage	High

3.2	Traffic disruptions	Medium
3.3	Evacuation / displacement of residents	Medium
3.4	Environmental issues – contamination of water sources	Medium

Erosion

	Adaptation Issues	**Priority**
4.1	Property loss / damage	Medium
4.2	Damage to infrastructure	Low

Drought

	Adaptation Issues	**Priority**
5.1	Drinking water supply; municipal system and private wells - quantity and quality of water	Medium
5.2	Agricultural sector – reduction in crop yield	Medium
5.3	Increase risk of forest fire	High

Forest Fires

	Adaptation Issues	**Priority**
6.1	Property damage / loss	Medium
6.2	Forestry industry – economic loss	Medium
6.3	Wildlife habitat loss	Medium
6.4	Service interruptions	Medium
6.5	Evacuation / displacement of residents	Medium

Hurricanes / Tropical Storms

	Adaptation Issues	**Priority**
7.1	Property damage from high winds, storm surge	High
7.2	Flooding	High
7.3	Power outages	High
7.4	Tree fall	Medium

8.2 Future Adaptive Actions -

Sea Level Rise

	Action	Response
1.1	Incorporate increased development setbacks along the coast.	Planning
1.2	Incorporate minimum elevation requirements for development along the coast.	Planning
1.3	Education of coastal property owners.	Planning / EMO
1.4	Assess storm water system, particularly on the Liverpool Waterfront, in regard to anticipated rise in sea level.	Engineering
1.5	Assess impacts on waste water treatment systems, including location and elevation of lift stations.	Engineering

Storm Surge

	Action	Response
2.1	Investigate reinforcement of shorelines to reduce impact on infrastructure.	Engineering
2.2	Education of coastal property owners.	Planning / EMO
2.3	Incorporate minimum elevation requirements for development along the coast.	Planning
2.4	Consult with the Province respecting maintenance programs aimed at protecting vulnerable roads.	Planning / Engineering / TIR

Flooding

	Action	Response
3.1	Restrict development in areas prone to flooding.	Planning
3.2	Update Emergency Measures Plan dealing with flooding situations.	EMO
3.3	Storm water management plan for areas prone to flooding.	Engineering
3.4	Ensure design criteria for new municipal infrastructure takes into account effects of climate change.	Engineering

3.5	Evaluate capacity of existing storm water system	Engineering
3.6	Investigate acquisition of more detailed topographical mapping for use in flood risk mapping.	Planning

Erosion

	Action	**Response**
4.1	Planned retreat of areas experiencing significant erosion.	Planning
4.2	Investigate erosion control measures to reduce impact on infrastructure.	Engineering
4.3	Acquire data for areas experiencing erosion	Planning

Drought

	Action	**Response**
5.1	Assess capacity of municipal watershed to deal with drought situation and still meet user needs.	Engineering
5.2	Investigate a water rationing plan.	Engineering
5.3	Review source water protection plan.	Engineering
5.4	Update Emergency Measures Plan	EMO

Forest Fires

	Action	**Response**
6.1	Greater education of public regarding potential dangers and damages of forest fires; use caution during dry periods.	EMO / DNR
6.2	Update Emergency Measures Plan	EMO

Hurricanes / Tropical Storms

	Action	**Response**
7.1	Public education – “Be Prepared”	EMO
7.2	Communication Strategy – Queens EMO	EMO

The implementation of adaptive measures to deal with climate change is key to the success of a municipal climate change action plan. The Committee recognizes that the Region's Municipal Planning Strategy will be one of the primary tools for adapting to climate change.

8.3 Current Planning Policy -

As the impact of climate change on Nova Scotia's coastline becomes better understood, it may become necessary for Council to establish policy to try to mitigate damage to coastal properties resulting from sea level rise and storm surge.

> ***Policy 7.3.14***
> *It shall be the intention of Council to set out special provision in the Land Use Bylaw for the removal of the natural vegetation within the vegetative buffer for the construction of erosion control measures. These provisions will apply to areas that abut the Atlantic coastline as shown on "Schedule B" of the Land Use Bylaw.*

> ***Policy 7.3.15***
> *It shall be the intention of Council to assess the potential impacts of climate change on our coastal communities through projected sea level rise and storm surges based on current coastal elevation mapping data and will consider implementing appropriate regulations in the Land Use Bylaw to reduce impacts on people and property.*

The Medway River is one of the major rivers running through Queens County, and has experienced several severe flooding incidents. The upper section of the Medway is dammed at McGowan Lake, which raises the possibility of flooding due to structural failure or emergency water release during severe weather events. Given the likelihood of an increasing number of flooding events related to climate change, there is a clear need for new development to reflect these concerns.

Low lying and subjected to regular flooding, wetlands along the Medway River play an important role in regulating water levels during severe weather events including drought. As such, development around these areas must be carefully thought out.

> ***Policy 7.3.7***
> *Where an application is made to develop within 15 metres of an area identified as **River Wetlands** on "Schedule B" of the Land Use Bylaw, Council shall require that a qualified person or persons verify the extent of the wetland to ensure all development is setback a minimum of 7.5 metres from these areas.*

The management of land use within the Municipality will continue to evolve as new information becomes available, as situations change and as necessity dictates. The Region's Municipal Planning Strategy and Land Use Bylaw are meant to be living documents that evolve over time. Changes to the climactic patterns affecting Queens County will most certainly necessitate changes in how we address land use management in our planning documents. Adaptive measures related to climate change could include:

- Tighter regulations around new development along our coastline; ie. minimum elevation standards;
- Increased protection of environmentally sensitive/significant areas;
- Enhancement of flood plain / flood risk mapping.

9. Climate Change Mitigation (Step 7)

While the Council of the Region of Queens Municipality recognizes the important role it has to play in adapting to climate change, it also recognizes the role it can play in mitigating the effects of climate change. Climate change mitigation has been defined as *human intervention to reduce the sources and enhance the sinks of greenhouse gases*.[11]

Mitigation can take many forms, some of which include: reduction of reliance on fossil fuels by switching to renewal energy sources, improving insulation of buildings and conversion of standard heating and lighting equipment and fixtures to more energy efficient products. The primary objective of mitigation is to reduce the amount of greenhouse gases (GHG) being emitted into the atmosphere.

In 2009, the Region of Queens Municipality contracted the services of I.B. Storey Inc. to conduct a custom energy assessment on municipally owned facilities, as part of the Eco Nova Scotia for Clean Air and Climate Change program. The final report presented the findings of an assessment conducted at 28 facilities in the Region of Queens Municipality during the period from January 2009 to December 2009. Using historical energy consumption data, along with onsite data collection and observations, the distribution of annual energy consumption was determined. Several potential energy saving opportunities were identified for each facility. Estimated energy and cost savings values, along with estimated implementation costs and simple payback values have also been included in the report.

As noted above, 28 separate facilities were included as part of the Custom Assessment and included the following:

Administration Building	RQM Waste Management Facility
Dog Pound	New MRF Building
Washroom at Ballfield	Hillsview Acres
Liverpool Fire Hall / Works Garage	Airport Terminal Building
Liverpool VIC	North Queens Pool
Former Town Hall & Astor Theatre	OLS Online Support
Court House	New Water Treatment Plant
Queens Memorial Arena	Pump Station
Former Mount Pleasant School	Liverpool Sewage Treatment Facility
Fort Point Lighthouse Park	2 Pump Stations
New Works Garage	Pump Station
Queens Ground Search & Rescue	Caledonia Sewage Treatment Facility
Milton Centennial Pool	Pump Station
Port Medway Lighthouse Park – Concrete Building	Well Pump Station

Table 12

[11] *Municipal Climate Change Action Plan Guide*, Service Nova Scotia and Municipal Relations – Canada – Nova Scotia Infrastructure Secretariat, 2011.

9.1 Energy and Emission Inventory -

Energy Consumption by Facility

Building	Civic Address	Electricity	Fuel Oil	Propane	Total ekWh
Administration Building	249 White Point Rd, Liverpool	256,800	0	0	256,800
Dog Pound	242 White Point Rd, Liverpool	3,173	0	0	3,173
Washroom @ Ballfield	85 Old Port Mouton Rd, Liverpool	3,060	0	0	3,060
Liverpool Fire Hall / Works Garage	520 Main St / 191 Henry Hensey Dr, Liverpool	144,915	35,095	0	522,183
Liverpool VIC	38 Henry Hensey Dr, Liverpool	2,846	0	0	2,846
Former Town Hall &Astor Theatre	219 Main St & 59 Gorham St, Liverpool	58,120	16,773	0	238,429
Court House	137 Church St, Liverpool	29,760	5,061	0	84,166
Queens Memorial Arena	157 Old Bridge St, Liverpool		0	10,456	73,192
Former Mount Pleasant School	108 College St, Mount Pleasant	42,080	9,557	0	144,818
Fort Point Lighthouse Park	21 Fort Point Lane, Liverpool	27,241	0	0	27,241
New Works Garage	142 Bristol Ave, Liverpool	28,255	4,654	0	78,280
Queens Ground Search & Rescue	20 Old Cobb's Barn Rd, Brooklyn	9,155	5,602	0	69,380
Milton Centennial Pool	287 Highway 8, Milton	9,738	0	0	9,738
Port Medway Lighthouse Park - Concrete Building	1687 Port Medway Rd, Port Medway	8,679	0	0	8,679
ROM Waste Management Facility	3750 Highway 8, Milton	77,520	0	2,289	93,543
New MRF Building	3750 Highway 8, Milton	59,220	0	17,950	184,870
Hillsview Acres	14 Middlefield Rd, Middlefield	100,000	27,267	15,055	498,501
Airport Terminal Building	80 Airport Rd, Greenfield	8,657	2,282	0	**33,192**
North Queens Pool	9708 Highway 8, Caledonia	10,331	0	0	10,331
OLS Online Support	54 Harley Umphery Drive, Liverpool	**961,360**	0	0	**961,360**
New Water Treatment Plant	345 Lake Two Road, Milton	487,080	0	0	487,080
Pump Station	15 Bristol Ave, Liverpool	16,575	0	0	16,575
Liverpool Sewage Treatment Facility	142 Bristol Ave, Liverpool	415,560	0	0	415;560
2 Pump Stations	4164 Highway 3, Brooklyn	30,420	0	0	30,420
Pump Station	4073 Highway 3, Brooklyn	13,320	0	0	13,320
Caledonia Sewage Treatment Facility	10062 Highway 8, Caledonia	59,985	0	0	59,985
Pump Station	158 Bristol Ave, Liverpool	155,850	0	0	155,850
Well Pump Station	733 Main St, Liverpool	5,862	0	0	5,862

Table 13 - Source – *RQM Municipal Energy Assessment* - I.B. Storey Inc. - 2009

The thermal energy consumed by the facilities evaluated in the inventory has been calculated in equivalent kilowatt hours (ekWh), and obviously, the larger the number the more energy that has been consumed. The total energy consumed by all facilities over the 1 year evaluation period was 4,346,761 ekWh.

Of the 28 facilities evaluated, the top 5 energy consumers make up for over 65% of the total energy consumed, at 2,884,684 ekWh, with the top energy consumer accounting for 22% of the total energy consumed, at 961,360 ekWh.

9.2 Energy & Emissions Inventory Summary Table -

Emission Category	Energy Type	Energy Consumption	Cost ($)	Units	Emission Factor (tCO2/Units	Emissions (tCO2e)
Buildings	Electricity Nat. Gas Fuel Oil	2,160,110 / 106,290	231,365 / 73,923	kWh M3 L	 / 2.68	1,874.98 / 284.86
Water & Wastewater	Electricity	1,184,652	112,193	kWh		1,028.28

Streetlights	Electricity	n/a	275,702	kWh	n/a	n/a
Vehicles	Reg. Gasoline Diesel	51,662 440,297	43,183 422,798	L L	2.34 2.63	121 1,158
Solid Waste	n/a				0.40	21,513
						25,980.12

Table 14

Refer to Appendix B for a copy of the full municipal energy and emission spreadsheets.

9.3 Opportunities for Energy Savings –

The audit prepared by I.B. Storey detailed the energy being consumed by municipal facilities, as well as identifying a number of energy savings opportunities that could be implemented to help achieve an overall reduction in energy usage at these facilities. The report refers to these improvements as Opportunities, since they provide facility owners with just that — opportunity to improve energy performance and reduce costs. While it is true that energy savings can be realized by simply turning down space temperatures and shutting off lighting, it is usually inappropriate to do so as it will have a number of negative implications. In total, 7 major opportunity categories exist with the selected facilities.[12]

Energy Savings Opportunities by Facility

Building	Intelligent Heater Control/OA Feedback	Energy Efficient Lighting System	Zone Forced-Air Furnace	Vending Meiser	Existing Dectron for HR to Air	Propane Radiant Heaters	Air Source Heat Pump
Administration Building				X			
Dog Pound	X						
Washroom @ Ballfield							
Liverpool **Fire Hall / Works Garage**	X					X	
New Water Treatment Plant					X		
Liverpool VIC							
Former Town Hall &AstorTheatre	X	X					
Court House		X					
Queens Memorial Arena	X						
Former Mount Pleasant School		X	X				
Fort Point Lighthouse Park							
Pump Station	X						
New Works Garage		X					
Liverpool Sewage Treatment Facility	X						
2 Pump Stations	X						
Queens Ground Search & Rescue	X	X					
Pump Station	X						
Milton Centennial Pool		X					
Port Medway Lighthouse Park - Concrete Building							
RQM Waste Management Facility		X					
New MRF Building		X					
Hillsview Acres	X	X					
Airport Terminal Building		X					
North Queens Pool		X					
Caledonia Sewage Treatment Facility	X						
Pump Station	X						
Well Pump Station	X						
OLS Online Support							X

Table 15 - Source – *RQM Municipal Energy Assessment* - I.B. Storey Inc. - 2009

[12] *RQM Municipal Energy Assessment* - I.B. Storey Inc. - 2009

9.4 Energy conservation measures that have been implemented to date -

- Liverpool Fire Hall – all light fixtures were replaced with the most energy efficient products available.

- The old heating plants in the Astor Theatre / Town Hall, former Mount Pleasant School, Hillsview Acres Facility and the Queens Ground Search Building have all been taken out of service and replaced with modern energy efficient models, sized for reasonable heat loads.

- Queens Place Emera Centre (Multi Purpose Recreational Facility), which opened in late 2012, has incorporated many "green" features and technologies in an effort to reduce the facilities carbon footprint. A key component of the new facility's design is the energy recovery system, which allows the reuse of a portion of the available waste heat given off from the facilities refrigeration system. In conjunction with a specialized heating, ventilation and air conditioning (HVAC) designs, this heat recovery technology has significantly reduced the facility's thermal consumption, when compared to a conventional design. The technologies incorporated to increase heat recovery and overall efficiency include:
  - Ammonia refrigeration system, which is able to provide cooling more efficiently than conventional Freon-based chiller systems.
  - In-floor heating and ventilation heating coils designed to utilize low-grade rejected heat from the refrigeration system.
  - Plate-and-frame heat exchangers, which are capable of operating at lower approach temperatures between the working fluids than conventional shell-and-tube heat exchangers, thus allowing equipment to operate at optimum efficiencies.
  - Glycol Thermal storage tank and Phase Change Material (PCM) storage tank, which allow the facility to store heating or cooling capacity (depending on the season) in order to optimize overall efficiency of the system.
  - Specialized dehumidification unit integrated with the PCM storage tank to provide dehumidification via a cold coil in summer months,- and then by introducing fresh air in winter months (heated to desired temperature with reclaimed heat).

9.5 Additional Energy Conservation Measures -

- Conversion to LED Streetlights – as mandated under the new Energy-efficient Appliance Act and Regulations, the Region of Queens Municipality is in the process of converting all of its conventional street light to LED technology, which will result in a considerable reduction in energy consumed by the asset. A report prepared by LED Roadway Lighting respecting the conversion of contemporary streetlighting in RQM to LED will result in a reduction in greenhouse gas emissions in the area of 413 tonnes per year.

- ❖ Replace the 40 year old central heating / cooling plant in the Municipal Office with a new energy efficient heat pump.

9.6 Goals for Mitigation -

Establishing goals respecting the reduction of greenhouse gas emissions, and the associated actions to meet these goals, is an integral part of a mitigation plan.

1. Establish a new (current) benchmark for energy being consumed by municipally owned facilities, which would better enable the Municipality to identify opportunities to reduce greenhouse gas emissions. As noted earlier, the existing energy audit was prepared in 2009 and the Committee members felt that they could not reasonably establish a target for reduction in greenhouse gas emissions with this somewhat outdated information.
2. Incorporate energy efficient technology in new municipal construction and when upgrading existing equipment, where applicable.
3. Improve energy performance of municipal buildings and facilities.
4. Promote sustainable transportation.

9.7 Implementation –

Council is cognizant on the importance of establishing realistic goals for reducing green house gas emissions and is committed to achieving those identified in the MCCAP, subject to budget limitations. A key component in the success of the Municipality in attaining its mitigation goals is assigning responsibility for action and establishing reasonable timeframes in which to complete particular goals.

GOAL	RESPONSIBILITY	TIME FRAME
Establish a new benchmark for energy consumed by municipally owned facilities.	Municipal Staff – Finance Department and Engineering and Works Department	December 31, 2015
Incorporate energy efficient technology in new municipal construction and when upgrading existing equipment, where applicable.	Council and Municipal Staff	Ongoing
Improve energy performance of municipal buildings and facilities.	Council and Municipal Staff	Ongoing
Promote sustainable transportation within the Municipality.	Council and Municipal Staff	Ongoing

Table 16

APPENDIX A

Municipal Facilities & Infrastructure Risk Assessment

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)	L	1	L	1	M	2	L	1	M	2	M	2	L	1	L	1	L	1	12	M
Water Treatment Plant	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Water Storage Facilities	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Water Pumping Facilities	L	1	L	1	L	1	N	0	M	2	L	1	L	1	L	1	L	1	9	L
Water Distribution System	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Individual Water Service Lines	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Total	**6**		**6**		**7**		**3**		**8**		**7**		**6**		**6**		**6**		**55**	
Sanitary Sewer System																				
Wastewater Treatment Plant	M	2	L	1	M	2	L	1	M	2	L	1	L	1	L	1	L	1	12	M
Buildings	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Wastewater Gravity Sewer	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Wastewater Pressure Sewer (Forcemain)	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	L	1	8	L
Pumping Stations	M	2	L	1	M	2	L	1	M	2	L	1	L	1	L	1	L	1	12	M
Total	**7**		**5**		**7**		**3**		**7**		**5**		**5**		**5**		**5**		**49**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Storm Sewer System																				
Catchbasins	M	2	M	2	M	2	N	0	M	2	N	0	L	1	L	1	L	1	11	M
Manholes	M	2	M	2	M	2	N	0	M	2	N	0	L	1	L	1	L	1	11	M
Pipes	M	2	M	2	M	2	N	0	M	2	N	0	L	1	L	1	L	1	11	M
Total	**6**		**6**		**6**		**0**		**6**		**0**		**3**		**3**		**3**		**33**	
Municipal Buildings																				
Buildings	L	1	L	1	L	1	L	1	L	1	L	1	L	1	M	2	L	1	10	M
Total	**1**		**1**		**1**		**1**		**1**		**1**		**1**		**2**		**1**		**10**	
Landfills/Solid Waste Facilities																				
Flooding	N	0	L	1	L	1	L	1	L	1	L	1	L	1	N	0	L	1	7	L
Access Road	N	0	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	8	L
Leachate Collection	N	0	L	1	M	2	L	1	L	1	L	1	L	1	N	0	L	1	8	L
Leachate Treatment	N	0	L	1	M	2	L	1	L	1	L	1	L	1	N	0	L	1	8	L
Buildings	N	0	L	1	L	1	L	1	L	1	L	1	L	1	N	0	L	1	7	L
Total	**0**		**5**		**7**		**5**		**5**		**5**		**5**		**1**		**5**		**38**	
Dams																				
Flooding	L	1	L	1	M	2	L	1	M	2	L	1	L	1	L	1	L	1	11	M
Control Gates	L	1	L	1	M	2	L	1	M	2	L	1	L	1	L	1	L	1	11	M
Access Road	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Fish Passage	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	9	L
Total	**4**		**4**		**6**		**4**		**6**		**4**		**4**		**4**		**4**		**40**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Roads																				
Bridges	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Traffic Signals	L	1	L	1	L	1	M	2	L	1	L	1	L	1	N	0	L	1	**9**	**L**
Street Lighting	L	1	L	1	L	1	M	2	L	1	L	1	L	1	L	1	L	1	**10**	**M**
Signs	L	1	L	1	L	1	M	2	L	1	L	1	L	1	L	1	L	1	**10**	**M**
Culverts	L	1	M	2	M	2	L	1	M	2	L	1	L	1	L	1	L	1	**12**	**M**
Sidewalks	L	1	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	**10**	**M**
Local Roads	L	1	M	2	M	2	L	1	M	2	L	1	L	1	L	1	L	1	**12**	**M**
Collectors	L	1	M	2	M	2	L	1	M	2	L	1	L	1	L	1	L	1	**12**	**M**
Total	**7**		**11**		**10**		**10**		**10**		**7**		**7**		**6**		**7**		**75**	

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

APPENDIX B

Region of Queens Municipality
Energy & Emissions Spreadsheets

Name of Municipal Government:	Region of Queens
Province or Territory:	Nova Scotia
Corporate Inventory Year:	2006
Completed by:	I.B. Storey Professional Energy Solutions

Colour Coding Scheme:

Required Input	Energy Use: Required to calculate total emissions
Recommended Input	Cost: Not required to calculate emissions
Calculated	Greenhouse Gas Emissions (eCO2): Emissions that are automatically calculated based on energy input multiplied by emissions coefficient
Calculated	Air Pollutant Emissions: Emissions that are automatically calculated based on energy input
Recommended Input	Indicators: Used to calculate relative energy and emission performance (e.g. per user, per unit area etc). Not required to calculate emissions

NOTE: Emissions coefficients* are embedded into this spreadsheet. To view emissions coefficients, unhide all sheets and all rows. To unlock worksheet ten, please contact Peggy Crawford at the Union of Nova Scotia Municipalities [(902) 423-8331 crawfopl@gov.ns.ca].

This spreadsheet has been prepared solely for the use of the Union of Nova Scotia Municipalities, and therefore should be used as a tool to facilitate the creation of an emissions inventory for member municipalities.

The coefficients utilized in this spreadsheet are those best known and valid as of December 2007. Coefficient values will be regularly updated as required to keep this toolk current for Nova Scotia Municipalities. This will ensure the quality and accuracy of the emissions inventory, which is a necessary step prior to sharing the results of the inventory exercise and planning for GHG emissions reductions. All inquiries can be directed to crawfopl@gov.ns.ca, or mainunsm@eastlink.ca.

kWh Coefficients

Greenhouse Gas (GHG) Coefficients for Electricty Generation
1990-2006

Inventory Year	Coefficient (kg eCO_2/kWh)
1990	0.801
1991	0.828
1992	0.851
1993	0.835
1994	0.773
1995	0.748
1996	0.782
1997	0.788
1998	0.785
1999	0.864
2000	0.937
2001	
2002	
2003	
2004	0.855
2005	0.871
2006	0.868

kWh Coefficient	0.868

Buildings **Region of Queens**
Corporate Inventory

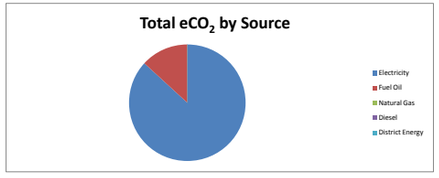
A) Energy Consumption - Buildings

				Emissions Coefficients																												
				Type Selected Coefficient			AP	2.68 kg eCO2/L			AP	50.79 kg eCO_2/GJ			AP	2.63 kg eCO2/L			AP	50.79 kg eCO2/GJ												
	1. Indicators			2. Electricity (kWh)				3. Fuel Oil (L)				4. Natural Gas				5. Diesel				6. District Energy			TOTALS								
Building or Building Group Name	Occupants	Operating Hours	Total Floor Area (m^2)	Total Use (kWh)	Cost ($)	Total eCO_2 (t)	Total $SO_{2\ (KG)}$	Total Use (L)	Cost ($)	Total eCO_2 (t)	Total $SO_{2\ (KG)}$	Total Use (GJ)	Cost ($)	Total eCO_2 (t)	Total $NO_{x\ (KG)}$	Total Use (L)	Cost ($)	Total eCO_2 (t)	Total $NO_{x\ (KG)}$	Total Use (L)	Cost ($)	Total eCO_2 (t)	Total Cost ($)	Total eCO2 (t)	Cost ($) / Operating Hour	Total Cost ($) / Occupant	Cost ($) / m^2	eCO_2 (t) / Operating Hour	eCO_2 (t) / Occupant	eCO_2 (t) / m^2
White Point Rd.	Admin. Building		1,129	256800.00	27607.41	222.90	462.24	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	27607.41	222.90	#DIV/0!	#VALUE!	24.46	#DIV/0!	#VALUE!	0.20
	Dog Pound		22	3173.00	680.53	2.75	5.71	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	680.53	2.75	#DIV/0!	#VALUE!	30.79	#DIV/0!	#VALUE!	0.12
Old Port Mouton Rd.	Ballfield Washroom		10	3060.00	451.12	2.66	5.51	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	451.12	2.66	#DIV/0!	#VALUE!	45.57	#DIV/0!	#VALUE!	0.27
	Firehall/Works		1,677	144915.00	16507.54	125.79	260.85	35094.70	24474.28	94.05	299.01			0.00	0.00			0.00	0.00			0.00	40981.82	219.84	#DIV/0!	#VALUE!	24.44	#DIV/0!	#VALUE!	0.13
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Liverpool VIC		29	2846.00	465.32	2.47	5.12	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	465.32	2.47	#DIV/0!	#VALUE!	16.05	#DIV/0!	#VALUE!	0.09
Astor Theatre And Museum	Astor Theatre		1,112	58120.00	6793.63	50.45	104.62	16772.90	11714.85	44.95	142.91			0.00	0.00			0.00	0.00			0.00	18508.48	95.40	#DIV/0!	#VALUE!	16.64	#DIV/0!	#VALUE!	0.09
Church St.	Court		210	29760.00	3469.87	25.83	53.57	5061.00	3568.00	13.56	43.12			0.00	0.00			0.00	0.00			0.00	7037.87	39.40	#DIV/0!	#VALUE!	33.48	#DIV/0!	#VALUE!	0.19
	Queens Mem Arena		2,402	319200.00	34801.59	277.07	574.56	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	34801.59	277.07	#DIV/0!	#VALUE!	14.49	#DIV/0!	#VALUE!	0.12
	Mt. Pleasant School		681	42080.00	6203.46	36.53	75.74	9557.00	6350.68	25.61	81.43			0.00	0.00			0.00	0.00			0.00	12554.14	62.14	#DIV/0!	#VALUE!	18.45	#DIV/0!	#VALUE!	0.09
	Fort Point Lighthouse		84	27241.00	3547.94	23.65	49.03	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	3547.94	23.65	#DIV/0!	#VALUE!	42.24	#DIV/0!	#VALUE!	0.28
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
142 Bristol Ave	Works Dept.		537	28255.00	3435.85	24.53	50.86	4653.50	2450.12	12.47	39.65			0.00	0.00			0.00	0.00			0.00	5885.97	37.00	#DIV/0!	#VALUE!	10.96	#DIV/0!	#VALUE!	0.07
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4160 Hwy #3	Gr. Searsch & Rsc.		185	9155.00	1209.85	7.95	16.48	5602.30	3593.91	15.01	47.73			0.00	0.00			0.00	0.00			0.00	4803.76	22.96	#DIV/0!	#VALUE!	25.91	#DIV/0!	#VALUE!	0.12
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Milton Cent. Pool		86	9738.00	1782.00	8.45	17.53	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	1782.00	8.45	#DIV/0!	#VALUE!	20.63	#DIV/0!	#VALUE!	0.10
	Port Medway LH Park		187	8679.00	1141.96	7.53	15.62	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	1141.96	7.53	#DIV/0!	#VALUE!	6.12	#DIV/0!	#VALUE!	0.04
Highway 8	Landfill		522	77520.00	8148.90	67.29	139.54	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	8148.90	67.29	#DIV/0!	#VALUE!	15.60	#DIV/0!	#VALUE!	0.13
3750 Hwy #8	New MRF		1,059	59220.00	7718.19	51.40	106.60	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	7718.19	51.40	#DIV/0!	#VALUE!	7.29	#DIV/0!	#VALUE!	0.05
14 Middlefield	Hillsview		829	100000.00	10550.34	86.80	180.00	27266.60	20335.03	73.07	232.31			0.00	0.00			0.00	0.00			0.00	30885.37	159.87	#DIV/0!	#VALUE!	37.25	#DIV/0!	#VALUE!	0.19
	Airport - Greenfield		220	8657.00	1130.54	7.51	15.58	2282.30	1437.09	6.12	19.45			0.00	0.00			0.00	0.00			0.00	2567.63	13.63	#DIV/0!	#VALUE!	11.65	#DIV/0!	#VALUE!	0.06
	North Queens Pool		86	10331.00	1206.32	8.97	18.60	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00			0.00	1206.32	8.97	#DIV/0!	#VALUE!	14.03	#DIV/0!	#VALUE!	0.10
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
						0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Online Support		3,046	961360.00	94513.37	834.46	1730.45	0.00	0.00														94513.37		#DIV/0!	#VALUE!	31.03			
						0.00	0.00																0.00		#DIV/0!	#DIV/0!	#DIV/0!			
						0.00	0.00																0.00		#DIV/0!	#DIV/0!	#DIV/0!			
Totals	0	0	14,113	2160110.00	231365.73	1874.98	3888.20	106290.30	73923.96	284.86		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	305289.69	1325.37	#DIV/0!	#DIV/0!	21.63	#DIV/0!	#DIV/0!	0.09

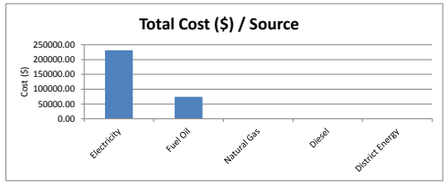
B) Air Pollutants

	2. Electricity - Air Pollutants			3. Fuel Oil (L)			4. Natural Gas			5. Diesel		
	Total Use (kWH)	AP Coefficient	Total AP (KG)	Total Use (L)	AP Coefficient	Total AP (KG)	Total Use (GJ)	AP Coefficient	Total AP (KG)	Total Use (L)	AP Coefficient	Total AP (KG)
Carbon Monoxide (CO)	2160110.00	N/A	N/A	106290.30	0.000600	63.774180	0.00	0.035368	0.000000	0.00	0.015595	0.000000
Sulphur Dioxide (SO2)		0.001800	3888.198000		0.008520	905.593356		0.000253	0.000000		0.004761	0.000000
Oxides of Nitrogen, expressed as NO2 (NOx)		0.000750	1620.082500		0.002400	255.096720		0.042105	0.000000		0.072396	0.000000
Volatile Organic Compounds (VOCs)		N/A	N/A		0.000024	2.550967		N/A	N/A		0.005910	0.000000
Total Particulate Matter (TPM)		N/A	N/A		0.000240	25.509672		0.000800	0.000000		0.005089	0.000000
Particulate Matter less than or equal to 10 microns (PM10)		N/A	N/A		0.000120	12.754836		0.000800	0.000000		0.005089	0.000000
Particulate Matter less than or equal to 2.5 microns (PM2.5)		N/A	N/A		0.000030	3.188709		0.000800	0.000000		0.005089	0.000000

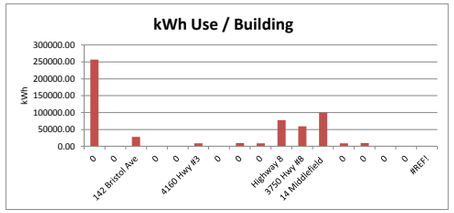
Total eCO_2 by source	
Electricity	1874.98
Fuel Oil	284.86
Natural Gas	0.00
Diesel	0.00
District Energy	0.00



Total Cost ($) / Source	
Electricity	231365.73
Fuel Oil	73923.96
Natural Gas	0.00
Diesel	0.00
District Energy	0.00



kWh Use / Building	
0	256800.00
0	0.00
142 Bristol Ave	28255.00
0	0.00
0	0.00
4160 Hwy #3	9155.00
0	0.00
0	9738.00
0	8679.00
Highway 8	77520.00
3750 Hwy #8	59220.00
14 Middlefield	100000.00
0	8657.00
0	10331.00
0	0.00
0	0.00
#REF!	#REF!



Insert comments here:

Vehicle Emissions
Corporate Inventory

Region of Queens

A) Vehicle Emissions

			Emissions Coefficients																				
			2.34 kg CO_2 / L			2.63 kg CO_2 / L			1.52kg CO_2 / L			50.79kg CO_2 / GJ			2.22kg CO_2 / L								
	2. Indicators		3. Gasoline (L)			4. Diesel (L)			5. Propane (L)			6. Natural Gas (GJ)			7. Ethanol Blend (L)			8.Totals					
1. Vehicle or Vehicle Group Name	Total Vehicle KM's	# of Vehicles	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total Use (GJ)	Cost ($)	Total eCO$_2$ (t)	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total Cost ($)	Total eCO$_2$ (t)	Total Cost ($) / Km	Total Cost ($) / # of Vehicles	Total eCO$_2$ (t) / Km	Total eCO$_2$ (t) / # of Vehicles
Works Vehicles	unavailable	31	51661.00	43182.63	120.89	348272.00	338589.81	915.96			0.00			0.00			0.00	381772.44	1036.84	#VALUE!	12315.24	#VALUE!	33.45
Hillsview Acre Vehicle	unavailable	1	0.00	0.00	0.00	143.00	109.33	0.38			0.00			0.00			0.00	109.33	0.38	#VALUE!	109.33	#VALUE!	0.38
Landfill Vehicles	unavailable	8	0.00	0.00	0.00	90820.00	83262.56	238.86			0.00			0.00			0.00	83262.56	238.86	#VALUE!	10407.82	#VALUE!	29.86
Admin Vehicle	unavailable	1	0.00	0.00	0.00	498.00	428.25	1.31			0.00			0.00			0.00	428.25	1.31	#VALUE!	428.25	#VALUE!	1.31
Water Vehicle	unavailable	1	0.00	0.00	0.00	564.00	408.37	1.48			0.00			0.00			0.00	408.37	1.48	#VALUE!	408.37	#VALUE!	1.48
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
					0.00			0.00			0.00			0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Totals	0	42	51,661	43,183	121	440,297	422,798	1,158	0	0	0	0	0	0	0	0	0	465,981	1,279	#DIV/0!	11,095	#DIV/0!	30

B) Air Pollutant Calculator

Vehicle Type or Vehicle Group Type	Fuel Type	Fuel Consumed (L)	Average Fuel Consumption (L / 100 KM)	Total Distance Travelled (KM)	CO (KG)	SO$_2$ (KG)	NO$_x$ (KG)	VOCs (KG)	TPM (KG)	PM 10 (KG)	PM 2.5 (KG)
Light Duty Passenger Vehicle - Automobile	Gas			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Diesel			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Propane			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Natural Gas			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Ethanol Blend			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Light Duty Passenger Vehicle - Truck	Gas			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Diesel			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Propane			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Natural Gas			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Ethanol Blend			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Heavy Duty Commercial Vehicle	Gas			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Diesel			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Propane			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Natural Gas			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Ethanol Blend			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

C) Conversion of Distance Travelled to Total Fuel Consumption

If your municipality does not have fuel use figures available for each vehicle or vehicle group, you can use the distance travelled in these vehicles or groups to calculate total fuel use. Follow these steps:
1. Identify the exact vehicle or a representative vehicle based on your vehicle group's composition.
2. Visit Natural Resources Canada's Office of Energy Efficiency (see link below) and select a representative year, class, manufacturer and fuel type, then select two units of measure: L / 100KM and Model / Make.
3. Submit the appropriate information and draw your attention to the Consumption (L / 100 km) column.
4. Select the coefficient that you feel is the most appropriate based on your vehicle group's activity and convert (you will find city driving and highway driving coefficients).

To illustrate the conversion, we have selected a vehicle in the table to the right. Simply plug in the appropriate coefficient in the table, along with the KM travelled and calculate the total fuel use from that vehicle or vehicle group. You can enter this number in the rows above to calculate total eCO2.

Representative Vehicle Selected											
Make/Model	Class	Eng Size/	Trans #gears	Fuel			Consumption		Rank		CO$_2$ kg per year
							L/100km				
		# Cyl		Type	$/yr	L/yr	City	Hwy	Class	All	
Chevrolet C1500 Avalanche	PU	5.3 / 8	E4E	X	$1,960	2839	16.4	11.5	88	864	6814

Conversion Table				
Vehicle Type	Vehicle Activity	L / 100KM	Total KM Travelled	Litres of Fuel Consumed
Chevrolet C1500 Avalance	Hwy	11.5	500	57.5

NRC Office of Energy Efficiency: Click on Fuel Consumption Ratings tool.
http://oee.nrcan.gc.ca/transportation/tools/compare/compare-search-one.cfm?attr=8

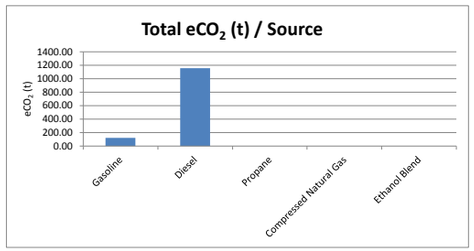
Vehicle Efficiency for Different Fuels (L/100km)

Fuel Type	Heavy Truck	Bus
Gasoline	43.5	35.7
Diesel	39	32

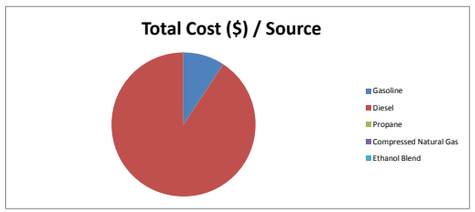
Insert Comments here:

Total kms not available

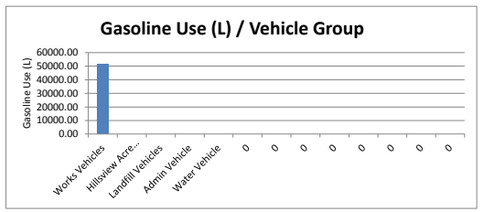
Total eCO2 (t) / Source	
Gasoline	120.89
Diesel	1157.98
Propane	0.00
Compressed Natural Gas	0.00
Ethanol Blend	0.00



Total Cost ($) / Source	
Gasoline	43182.63
Diesel	422798.31
Propane	0.00
Compressed Natural Gas	0.00
Ethanol Blend	0.00



Total Gasoline Use (L) / Vehicle Group	
Works Vehicles	51661.00
Hillsview Acre Vehicle	0.00
Landfill Vehicles	0.00
Admin Vehicle	0.00
Water Vehicle	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



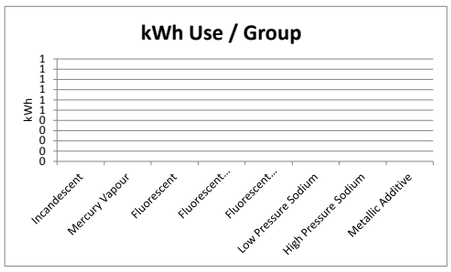
Streetlights **Region of Queens**
Corporate Inventory

		Emission Coefficient				
		2. Indicators	3. Electricity (kWh)			4. Total
Description		# of Lights	Total Use (kWh)	Cost ($)	Total eCO_2 (t) / Group	Total eCO_2 (t) / Streetlight
Incandescent						
LOW WATT:			0		0	#DIV/0!
HIGH WATT:			0		0	#DIV/0!
Mercury Vapour						
LOW WATT:		191	0		0	0
HIGH WATT:		21	0		0	0
Fluorescent						
LOW BULB #:			0		0	#DIV/0!
HIGH BULB #			0		0	#DIV/0!
Fluorescent Crosswalk: Continuous Burning						
LOW BULB #:			0		0	#DIV/0!
HIGH BULB #			0		0	#DIV/0!
Fluorescent Crosswalk: Photocell Operation						
LOW BULB #:			0		0	#DIV/0!
HIGH BULB #			0		0	#DIV/0!
Low Pressure Sodium						
LOW WATT:			0		0	#DIV/0!
HIGH WATT:		1	0		0	0
High Pressure Sodium						
LOW WATT:		1,751	0	275,702	0	0
HIGH WATT:		36	0		0	0
Metallic Additive						
LOW WATT:			0		0	#DIV/0!
HIGH WATT:		3	0		0	0
Totals		2,003	0	275,702	0	0

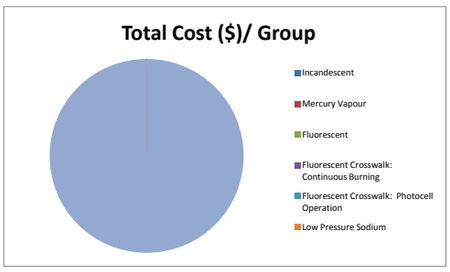
B) Air Pollutants

	2. Electricity - Air Pollutants		
	Total Use (kWH)	AP Coefficient	Total AP (KG)
Carbon Monoxide (CO)	0.00	N/A	N/A
Sulphur Dioxide (SO2)		0.001800	0.000000
Oxides of Nitrogen, expressed as NO2 (NOx)		0.000750	0.000000
Volatile Organic Compounds (VOCs)		N/A	N/A
Total Particulate Matter (TPM)		N/A	N/A
Particulate Matter less than or equal to 10 microns (PM10)		N/A	N/A
Particulate Matter less than or equal to 2.5 microns (PM2.5)		N/A	N/A

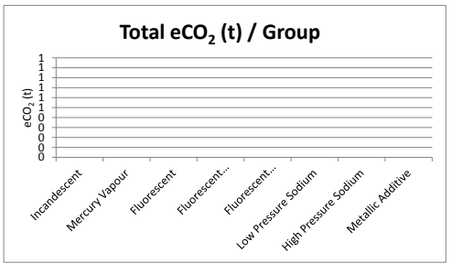
kWh Use / Group	
Incandescent	0
Mercury Vapour	0
Fluorescent	0
Fluorescent Crosswalk: Continuous Burning	0
Fluorescent Crosswalk: Photocell Operation	0
Low Pressure Sodium	0
High Pressure Sodium	0
Metallic Additive	0



Total Cost ($) / Group	
Incandescent	0
Mercury Vapour	0
Fluorescent	0
Fluorescent Crosswalk: Continuous Burning	0
Fluorescent Crosswalk: Photocell Operation	0
Low Pressure Sodium	0
High Pressure Sodium	275,702
Metallic Additive	0



Total $eCO_{2\,(t)}$ / Group	
Incandescent	0
Mercury Vapour	0
Fluorescent	0
Fluorescent Crosswalk: Continuous Burning	0
Fluorescent Crosswalk: Photocell Operation	0
Low Pressure Sodium	0
High Pressure Sodium	0
Metallic Additive	0



Insert Comments Here:

Note: Municipality is charged a flat rate for traffic/street lights, so kWh values are unavailable.

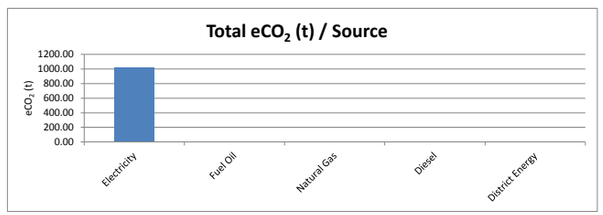
Water and Sewage
Corporate Inventory

Region of Queens

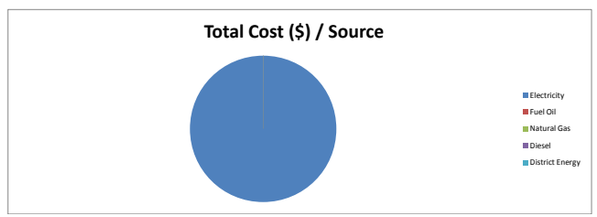
		Emissions Coefficients																						
		Type Selected Coefficient			AP	2.68 kg eCO2/L			AP	50.79 kg eCO$_2$/GJ			AP	2.63 kg eCO2/L			AP	50.79 kg eCO2/GJ						
	Indicators	Electricty (kWh)				3. Fuel Oil (L)				4. Natural Gas				5. Diesel				6. District Energy			TOTALS			
Facility or Facility Group Name	Output (1000L)	Total Use (kWh)	Cost ($)	Total eCO$_2$ (t)	Total SO$_2$ (KG)	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total SO$_2$ (KG)	Total Use (GJ)	Cost ($)	Total eCO$_2$ (t)	Total NO$_x$ (KG)	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total NO$_x$ (KG)	Total Use (L)	Cost ($)	Total eCO$_2$ (t)	Total Cost ($)	Total eCO$_2$ (t)	Total Cost ($) / Output (L)	Total eCO$_2$ (t) / Output (L)
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
New Wtr. Plant		487080.00	46742.37	422.79	876.74			0.00	0.00			0.00	0.00			0.00	0.00			0.00	46742.37	422.79	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
Pump Station		16575.00	2020.87	14.39	29.84			0.00	0.00			0.00	0.00			0.00	0.00			0.00	2020.87	14.39	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
Liverpool Sewage Treat.	1650442.00	415560.00	33727.41	360.71	748.01			0.00	0.00			0.00	0.00			0.00	0.00			0.00	33727.41	360.71	0.00	0.00
2 Pump Stations		30420.00	3880.82	26.40	54.76			0.00	0.00			0.00	0.00			0.00	0.00			0.00	3880.82	26.40	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
Pump Station		13320.00	2140.86	11.56	23.98			0.00	0.00			0.00	0.00			0.00	0.00			0.00	2140.86	11.56	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
				0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!
Caledonia Sewage Treat.		59985.00	5771.38	52.07	107.97			0.00	0.00			0.00	0.00			0.00	0.00			0.00	5771.38	52.07	#DIV/0!	#DIV/0!
Town Well Building		5862.00	627.06	5.09	10.55			0.00	0.00			0.00	0.00			0.00	0.00			0.00	627.06	5.09	#DIV/0!	#DIV/0!
158 Bristol Ave		155850.00	17282.26	135.28	280.53			0.00	0.00			0.00	0.00			0.00	0.00			0.00	17282.26	135.28	#DIV/0!	#DIV/0!
Totals	1650442.00	1184652.00	112193.03	1028.28	2132.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	112193.03	1028.28	0.00	0.00

	2. Electricity			3. Fuel Oil (L)			4. Natural Gas			5. Diesel		
	Total Use (kWH)	AP Coefficient	Total AP (KG)	Total Use (L)	AP Coefficient	Total AP (KG)	Total Use (GJ)	AP Coefficient	Total AP (KG)	Total Use (L)	AP Coefficient	Total AP (KG)
Carbon Monoxide (CO)	1184652.00	N/A	N/A	0.00	0.000600	0.000000	0.00	0.035368	0.000000	0.00	0.015595	0.000000
Sulphur Dioxide (SO2)		0.001800	2132.37		0.008520	0.000000		0.000253	0.000000		0.004761	0.000000
Oxides of Nitrogen, expressed as NO2 (NOx)		0.000750	888.49		0.002400	0.000000		0.042105	0.000000		0.072396	0.000000
Volatile Organic Compounds (VOCs)		N/A	N/A		0.000024	0.000000		N/A	N/A		0.005910	0.000000
Total Particulate Matter (TPM)		N/A	N/A		0.000240	0.000000		0.000800	0.000000		0.005089	0.000000
Particulate Matter less than or equal to 10 microns (PM10)		N/A	N/A		0.000120	0.000000		0.000800	0.000000		0.005089	0.000000
Particulate Matter less than or equal to 2.5 microns (PM2.5)		N/A	N/A		0.000030	0.000000		0.000800	0.000000		0.005089	0.000000

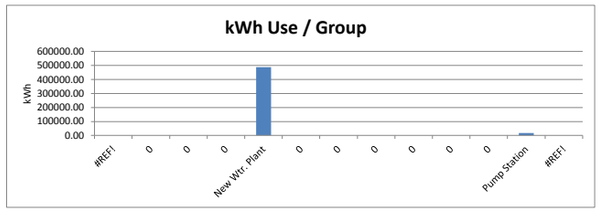
Total eCO$_2$ / Source	
Electricity	1028.28
Fuel Oil	0.00
Natural Gas	0.00
Diesel	0.00
District Energy	0.00



Total Cost ($) / Source	
Electricity	112193.03
Fuel Oil	0.00
Natural Gas	0.00
Diesel	0.00
District Energy	0.00



kWh Use / Group	
#REF!	0.00
0	0.00
0	0.00
0	0.00
New Wtr. Plant	487080.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
Pump Station	16575.00
#REF!	#REF!



Insert Comments Here:

Waste **Region of Queens**

Corporate Inventory

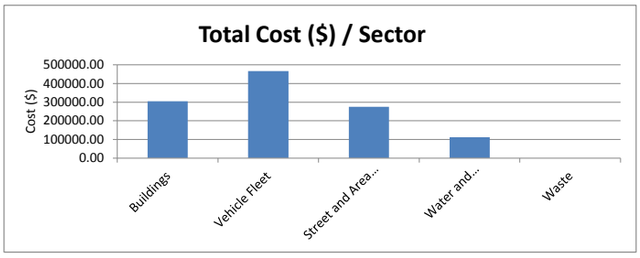
		3. Landfill Without CH4 Recovery			4. Landfill With CH4 Recovery (Landfill gas flared or used for energy generation)						
		Emissions Coefficient (tonne eCO2 / tonne waste)			Emissions Coefficient (tonne eCO2 / tonne waste)						
		Paper - 0.58	Trimmings - 0.238	Food - 0.400	Paper - 0.114	Trimmings - 0.059	Food - 0.100				
1. Type of Waste	**2. Number of Employees**	**Waste to Landfill (wet t)**	**Cost of Landfilling**	**Total eCO_2 (t)**	**Waste to Landfill (wet t)**	**Cost of Landfilling**	**Total eCO_2 (t)**	**Total Cost ($)**	**Total eCO2 (t)**	**Cost per Employee ($)**	**eCO2 per Employee (t)**
Paper				0			0	0	0	#DIV/0!	#DIV/0!
Yard Trimmings				0			0	0	0	#DIV/0!	#DIV/0!
Food Scraps				0			0	0	0	#DIV/0!	#DIV/0!
Totals		0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!
OR											
Mixed Solid Waste		43027.29		21513.645			0	0	21513.645	#DIV/0!	#DIV/0!

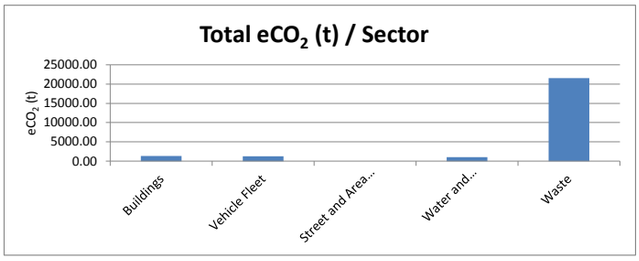
Insert Comments Here:

Summary **Region of Queens**
Corporate Inventory

Cost and Tonnes of eCO2 / Sector

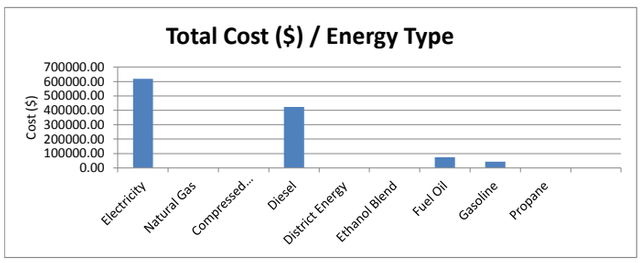
Sector	Total Cost	Total eCO2
Buildings	305289.69	1325.37
Vehicle Fleet	465980.93	1278.87
Street and Area Lights	275702.34	0.00
Water and Sewage	112193.03	1028.28
Waste	0.00	21513.65
Totals:	1159166.00	25146.16

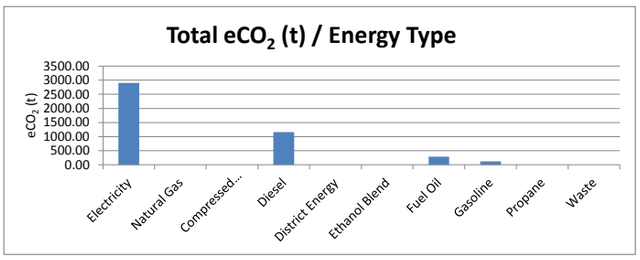




Cost and Tonnes of eCO2 / Energy Type

Energy Type	Total Cost	Total eCO2
Electricity	619261.10	2903.25
Natural Gas	0.00	0.00
Compressed Natural Gas	0.00	0.00
Diesel	422798.31	1157.98
District Energy	0.00	0.00
Ethanol Blend	0.00	0.00
Fuel Oil	73923.96	284.86
Gasoline	43182.63	120.89
Propane	0.00	0.00
Waste	-	0.00
Totals	1159166.00	4466.98





Unit Conversion Factors

Mass			
1 pound (lb)	453.6 grams (g)	0.4536 kilograms (kg)	0.0004536 metric tons (tonne)
1 kilogram (kg)	2.205 pounds (lb)		
1 short ton (ton)	2,000 pounds (lb)	907.2 kilograms (kg)	
1 metric ton (tonne)	2,205 pounds (lb)	1,000 kilograms (kg)	1.102 short tons (tons)

Volume			
1 cubic foot (ft^3)	7.4805 US gallons (gal)	0.1781 barrel (bbl)	
1 cubic foot (ft^3)	28.32 liters (L)	0.02832 cubic meters (m^3)	
1 US gallon (gal)	0.0238 barrel (bbl)	3.785 liters (L)	0.003785 cubic meters (m^3)
1 barrel (bbl)	42 US gallons (gal)	158.99 liters (L)	0.1589 cubic meters (m^3)
1 litre (L)	0.001 cubic meters (m^3)	0.2642 US gallons (gal)	
1 cubic meter (m^3)	6.2897 barrels (bbl)	264.2 US gallons (gal)	1,000 liters (L)

Energy			
1 kilowatt hour (kWh)	3,412 Btu (btu)	3,600 kilojoules (KJ)	
1 megajoule (MJ)	0.001 gigajoules (GJ)		
1 gigajoule (GJ)	0.9478 million Btu (million btu)	277.8 kilowatt hours (kWh)	
1 Btu (btu)	1,055 joules (J)		
1 million Btu (million btu)	1.055 gigajoules (GJ)	293 kilowatt hours (kWh)	
1 therm (therm)	100,000 btu	0.1055 gigajoules (GJ)	29.3 kilowatt hours (kWh)
1 hundred cubic feet of natural gas	1.03 therm (therm)		

Other			
Kilo	1,000		
Mega	1,000,000		
Giga	1,000,000,000	To convert from kg to metric tons, multiply by:	0.001
Tera	1,000,000,000,000		
1 land mile	1.609 land kilometers		
1 nautical mile	1.15 land miles	1 cubic meter (m^3) = 0.038 GJ	
1 metric ton carbon	3.664 metric tons CO_2		

For additional unit conversion factors, visit www.onlineconversion.com.

Coefficients
Corporate Inventory

Fuel & Waste Coefficients

Energy Consumption Type	KG CO_2	UNIT	Source
Natural Gas	50.79	GJ	Heritage Gas: Nova Scotia based provider of natural gas www.heritagegas.com
District Energy	50.79	GJ	Heritage Gas: Nova Scotia based provider of natural gas www.heritagegas.com (NOTE: Natural gas coefficient assumed for District Energy. A replacement is required if your source of district energy differs from this source)
Fuel Oil	2.68	Litre	CO2 Emissions from Fuel Use in Facilities. Version 2.0. June 2006. Developed by World Resources Institute (WRI) and copyrighted. Available at www.ghgprotocol.org.
Diesel	2.63	Litre	CO2 Emissions from Fuel Use in Facilities. Version 2.0. June 2006. Developed by World Resources Institute (WRI) and copyrighted. Available at www.ghgprotocol.org.
Propane	1.52	Litre	CO2 Emissions from Fuel Use in Facilities. Version 2.0. June 2006. Developed by World Resources Institute (WRI) and copyrighted. Available at www.ghgprotocol.org.
Compressed Natural Gas	50.79	GJ	Heritage Gas: Nova Scotia based provider of natural gas www.heritagegas.com (NOTE: Natural gas coefficient assumed for District Energy. A replacement is required if your source of district energy differs from this source)
Ethanol Blend	2.22	Litre	ICLEI Inventory Quantification Support Spreadsheet Emissions Coefficients / UNFCCC, IPCC Emissions Coefficients

Waste Coefficient

Waste	0.4817 tonnes CO2 / tonne of waste

NS Power kWh Coefficients / Year

Inventory Year	Coefficient (kg CO2 / kWh)
1990	0.801
1991	0.828
1992	0.851
1993	0.835
1994	0.773
1995	0.748
1996	0.782
1997	0.788
1998	0.785
1999	0.864
2000	0.937
2001	
2002	
2003	
2004	0.855
2005	0.871
2006	0.868

Emissions Coefficients from 1990 to 2000 were retrieved directly from the original ICLEI Inventory Quantification Support Spreadsheet Emissions Coefficients. Nova Scotia Power Incorporated provided 2004 to 2006 data, however, they could not provide emissions coefficients from the year 2001 to 2003. NSPI is currently re-calculating emissions coefficients for each one of these years, and all years previous to this where possible. Representatives from NSPI estimate that this project may be complete by the end of 2007, but can't be certain. Emissions coefficients from the year 2006 onward can be located by visiting the Government of Canada's Federal GHG Reporting website at http://www.ghgreporting.gc.ca/, or by folooming up with Nova Scotia Power each year.

Electricity Consumption - Facilities

Category	Location	SO2 (kg/kWh)	NOx (kg/kWh)
Electricity	Nova Soctia	0.00180	0.00075
Source: Based on internal Jacques Whitford data. Currently undergoing revision and may change. Current efforts are being undertaken to calculate additional Criteria Air Contaminants for electricity generation and will be included in future toolkits.			

Fuel Oil Consumption - Facilities

Substance Name	Emission Factor	Units	kg/L
Carbon Monoxide (CO)	0.6	kg/m^3	0.0006
Sulphur Dioxide (SO2)	8.52	kg/m^3	0.00852
Oxides of Nitrogen, expressed as NO2 (NOx)	2.40	kg/m^3	0.0024
Volatile Organic Compounds (VOCs)	0.024	kg/m^3	0.000024
Total Particulate Matter (TPM)	0.24	kg/m^3	0.00024
Particulate Matter less than or equal to 10 microns (PM10)	0.12	kg/m^3	0.00012
Particulate Matter less than or equal to 2.5 microns (PM2.5)	0.03	kg/m^3	0.00003
Source: Distillate Fuel Oil (#2 Oil) Combustion. Based on NPRI toolbox provided by Environment Canada. Emission factors are from AP-42 (Chapter 1.3) and US-EPA WebFIRE (December 2005) database. See US EPA AP-42 for EF rating definitions. Emission factors are based on 0.5% sulfur content in #2 Fuel Oil.			

Natural Gas Combustion - Facilities

Substance Name	Emission Factor	Units	kg / GJ
Carbon Monoxide (CO)	1344	$kg/10^6m^3$	0.03537
Sulphur Dioxide (SO2)	9.6	$kg/10^6m^3$	0.00025
Oxides of Nitrogen, expressed as NO2 (NOx)	1600	$kg/10^6m^3$	0.04211
Volatile Organic Compounds (VOCs)***	NA	$kg/10^6m^3$	NA
Total Particulate Matter (TPM)	30.4	$kg/10^6m^3$	0.00080
Particulate Matter less than or equal to 10 microns (PM10)	30.4	$kg/10^6m^3$	0.00080
Particulate Matter less than or equal to 2.5 microns (PM2.5)	30.4	$kg/10^6m^3$	0.00080
Source: Natural Gas Combustion. Based on NPRI toolbox provided by Environment Canada. Emission factors are from AP-42 (Chapter 1.4) and US-EPA WebFIRE (December 2005) database. See US EPA AP-42 for EF rating definitions.			

Diesel - Facilities (as generation < 600 hp)

Substance Name	Emission Factor	Units	kg / L
Carbon Monoxide (CO)	15.595	kg/m^3	0.01560
Sulphur Dioxide (SO2)	4.761	kg/m^3	0.00476
Oxides of Nitrogen, expressed as NO2 (NOx)	72.396	kg/m^3	0.07240
Volatile Organic Compounds (VOCs)	5.910	kg/m^3	0.00591
Total Particulate Matter (TPM)	5.089	kg/m^3	0.00509
Particulate Matter less than or equal to 10 microns (PM10)	5.089	kg/m^3	0.00509
Particulate Matter less than or equal to 2.5 microns (PM2.5)	5.089	kg/m^3	0.00509
Source: Diesel Fuel Generator - Fuel Usage Up To 600 Horespower. Based on NPRI toolbox provided by Environment Canada. Emission factors are from AP-42 (Chapter 3.3) and US-EPA WebFIRE (December 2005) database. See US EPA AP-42 for EF rating definitions.			

Vehicle - Critical Air Contaminants (by vehicle class)

Vehicle Class	Critical Air Contaminants	Gasoline (g/km)	Diesel (g/km)	Propane (g/km)	Natural Gas (g/km)	E85 (g/km)	Hybird (g/km)
Light duty Passenger Vehicles - Automobile	CO	10.9	0.662	6.54	6.54	7.2	7.57
	NOx	0.559	0.507	0.504	0.504	0.512	0.389
	SO2	0.0035	0.0216	0.0035	0.0035	0.0035	0.0025
	VOC	0.662	0.166	0.331	0.146	0.605	0.459
	TPM	0.0158	0.0683	0.0039	0.0032	0.0077	0.011
	PM10	0.0155	0.0682	0.0039	0.0031	0.0076	0.0108
	PM2.5	0.0071	0.0556	0.0018	0.0014	0.0035	0.0049
Light Duty Passenger Vehicles - Truck	CO	12.8	0.558	7.67	7.67	8.44	8.88
	NOx	0.701	0.572	0.631	0.631	0.641	0.487
	SO2	0.0045	0.0313	0.0045	0.0045	0.0045	0.0031
	VOC	0.709	0.268	0.354	0.156	0.648	0.492
	TPM	0.016	0.0942	0.004	0.0032	0.0079	0.0111
	PM10	0.0158	0.094	0.0039	0.0032	0.0077	0.011
	PM2.5	0.0073	0.0794	0.0018	0.0015	0.0036	0.0051
Heavy Duty Commercial Vehicle	CO	14.4	1.49	0.172	0.173	0	0
	NOx	2.86	7.01	4.03	4.07	0	0
	SO2	0.0092	0.0902	0.0902	0.0902	0	0
	VOC	0.959	0.267	0.921	0.932	0	0
	TPM	0.0584	0.192	0.0154	0.0448	0	0
	PM10	0.0569	0.192	0.0154	0.0448	0	0
	PM2.5	0.0406	0.163	0.0131	0.0381	0	0

Source: Transport Canada. Urban Transportation Emissions Calculator. Data presented is based on 2006 calculations. Available at http://www.tc.gc.ca/programs/environment/UTEC/CacEmissionFactors.aspx

Street and Area Lighting: Average kWh / Month

Cateogory of Street or Area Light	NSPI Division	NSPI: kWh / Month	NSPI: kWh / Year	Watt Range or Number of Bulbs
Incandescent	Low Watt	97.00	1164	300
	High Watt	154.00	1848	Greater than 300
Mercury Vapour	Low Watt	83.00	996	100 - 400
	High Watt	278.33	3340	700 - 1000
Fluorescent	Low Number of Bulbs	67.60	811.2	1 - 2
	High Number of Bulbs	194.00	2328	4
Fluorescent Crosswalk Continuous Burning	Low Number of Bulbs	160.00	1920	2
	High Number of Bulbs	487.67	5852	4
Flourescent Crosswalk Photocell Operation	Low Number of Bulbs	63.25	759	1 - 2
	High Number of Bulbs	222.67	2672	4
Low Pressure Sodium	Low Watt	52.50	630	90 - 135
	High Watt	80.00	960	180
High Pressure Sodium	Low Watt	60.25	723	70 - 150
	High Watt	125.00	1500	250 - 400
Metaillic Additive	Low Watt	72.33	868	100 - 250
	High Watt	255	3060	400 - 1000

SOURCE: NSPI Approved Tariffs, April 1, 2007 / Miscellaneous Tariffs: Street and Area Lighting. Averages based on Monthly kWh consumption / rate code in the Operating, Maintenance and Capital categories where full charges apply. *Note: Bulb length for fluorescent lights was not used as a determinant in these averages given the need for broad applicability of consumption factors, however, bulb length does impact energy consumption.

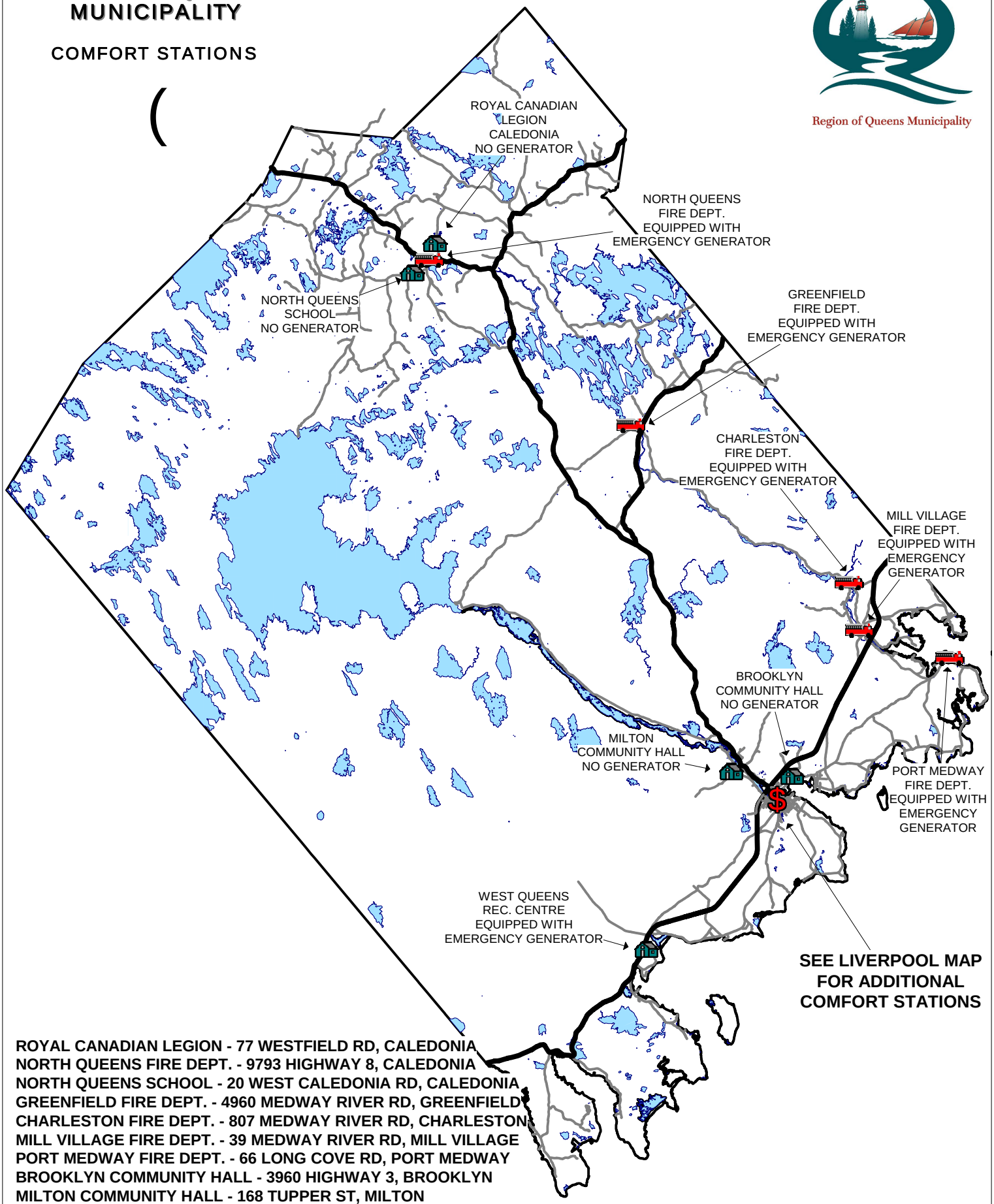
APPENDIX C

Emergency Shelter and Comfort Centre Locations

REGION OF QUEENS MUNICIPALITY

COMFORT STATIONS

Region of Queens Municipality



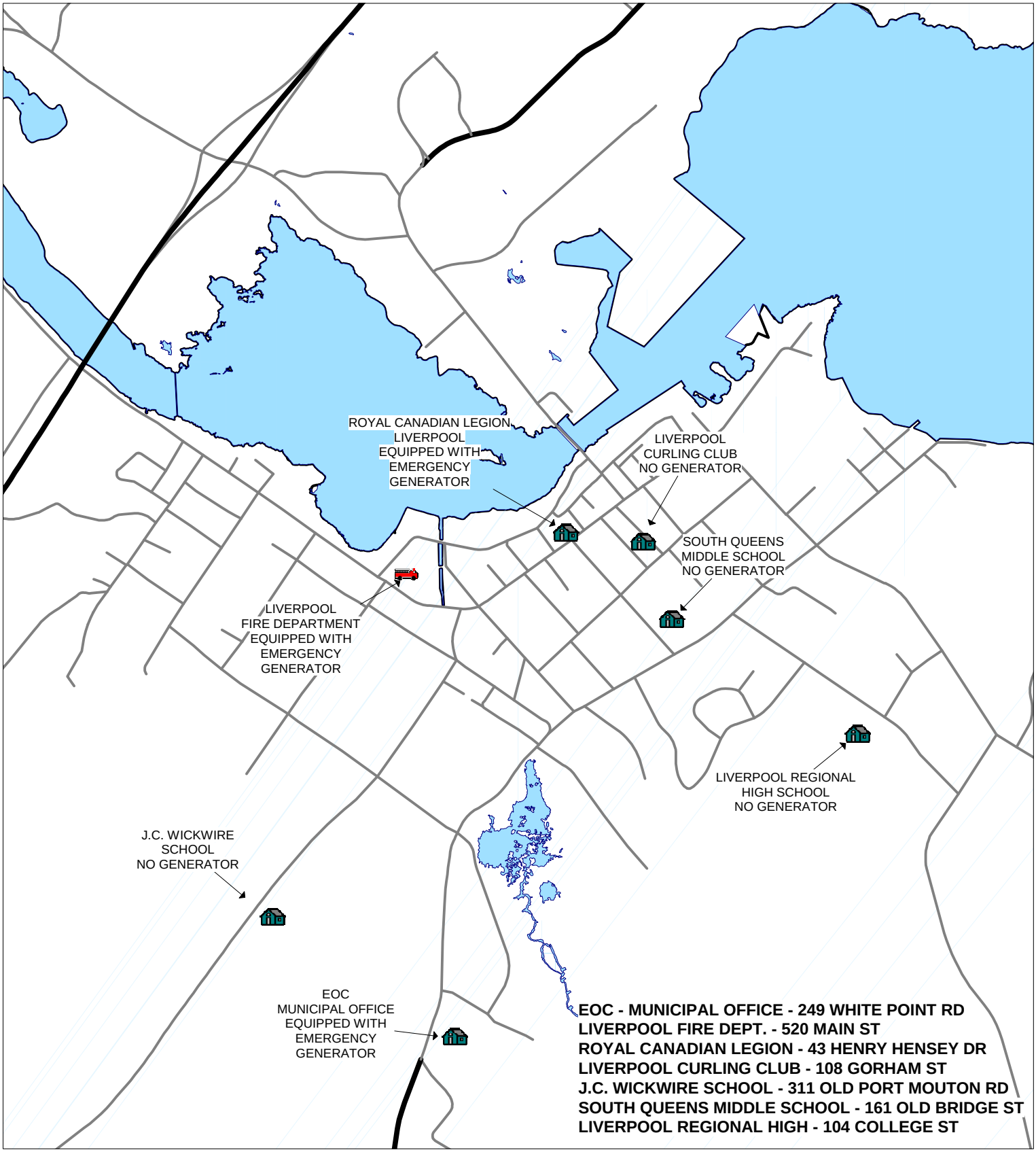
SEE LIVERPOOL MAP FOR ADDITIONAL COMFORT STATIONS

ROYAL CANADIAN LEGION - 77 WESTFIELD RD, CALEDONIA
NORTH QUEENS FIRE DEPT. - 9793 HIGHWAY 8, CALEDONIA
NORTH QUEENS SCHOOL - 20 WEST CALEDONIA RD, CALEDONIA
GREENFIELD FIRE DEPT. - 4960 MEDWAY RIVER RD, GREENFIELD
CHARLESTON FIRE DEPT. - 807 MEDWAY RIVER RD, CHARLESTON
MILL VILLAGE FIRE DEPT. - 39 MEDWAY RIVER RD, MILL VILLAGE
PORT MEDWAY FIRE DEPT. - 66 LONG COVE RD, PORT MEDWAY
BROOKLYN COMMUNITY HALL - 3960 HIGHWAY 3, BROOKLYN
MILTON COMMUNITY HALL - 168 TUPPER ST, MILTON
WEST QUEENS REC. CENTRE - 70 RIVER HEAD RD, PORT MOUTON

REGION OF QUEENS MUNICIPALITY

LIVERPOOL COMFORT STATIONS

Region of Queens Municipality

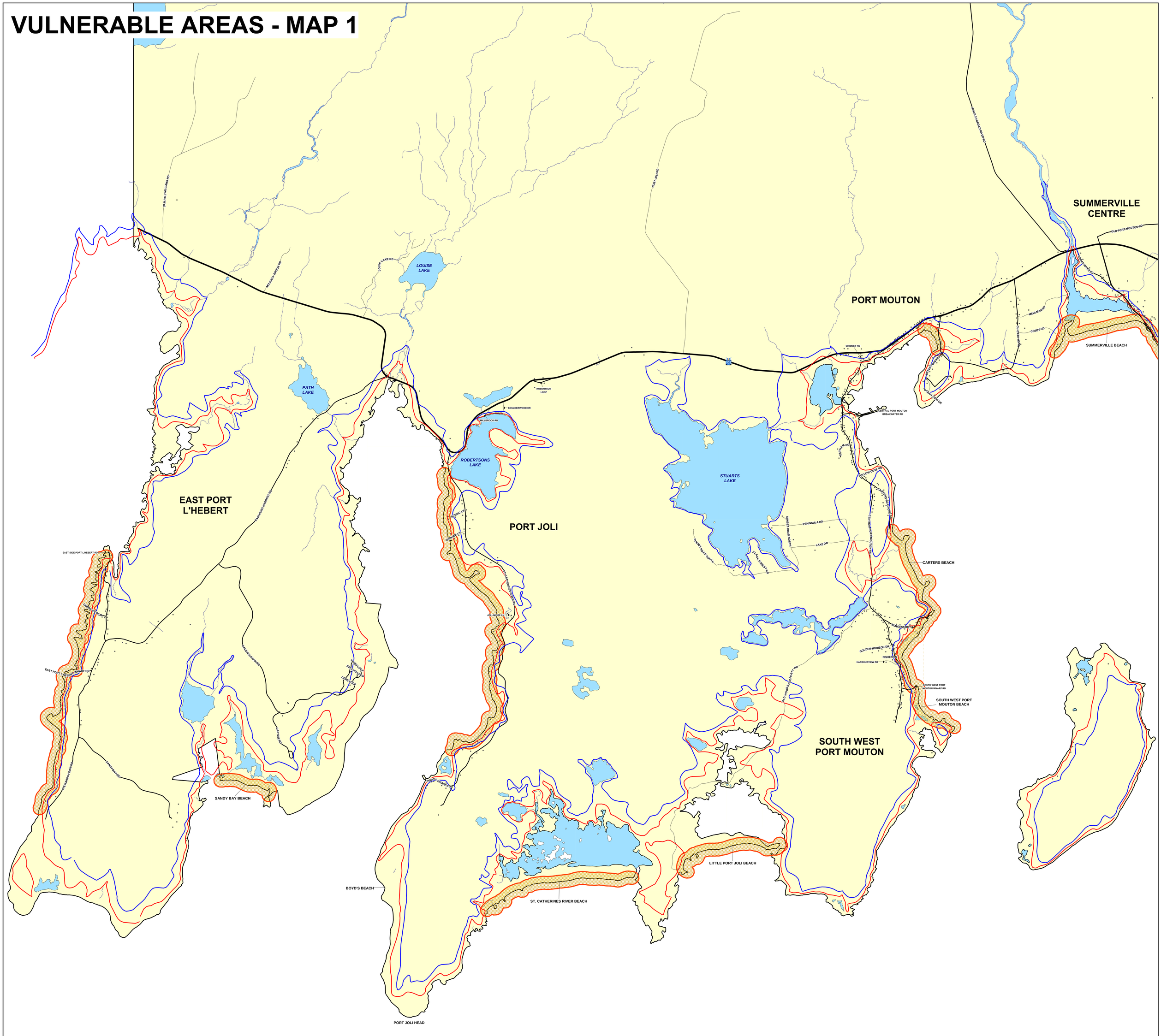


EOC - MUNICIPAL OFFICE - 249 WHITE POINT RD
LIVERPOOL FIRE DEPT. - 520 MAIN ST
ROYAL CANADIAN LEGION - 43 HENRY HENSEY DR
LIVERPOOL CURLING CLUB - 108 GORHAM ST
J.C. WICKWIRE SCHOOL - 311 OLD PORT MOUTON RD
SOUTH QUEENS MIDDLE SCHOOL - 161 OLD BRIDGE ST
LIVERPOOL REGIONAL HIGH - 104 COLLEGE ST

APPENDIX D

Vulnerable Areas Maps

VULNERABLE AREAS - MAP 1



0 1 2
kilometers

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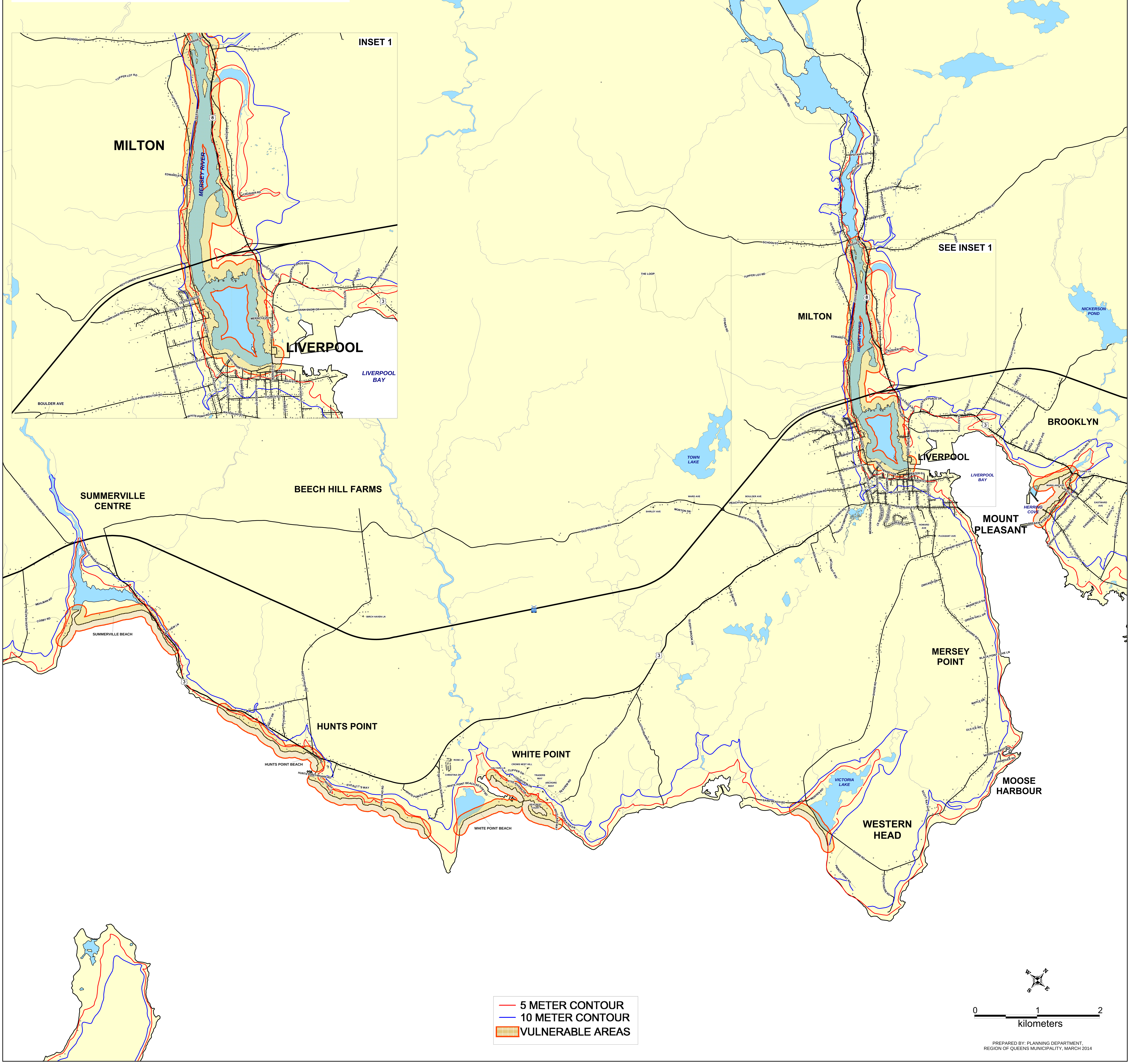
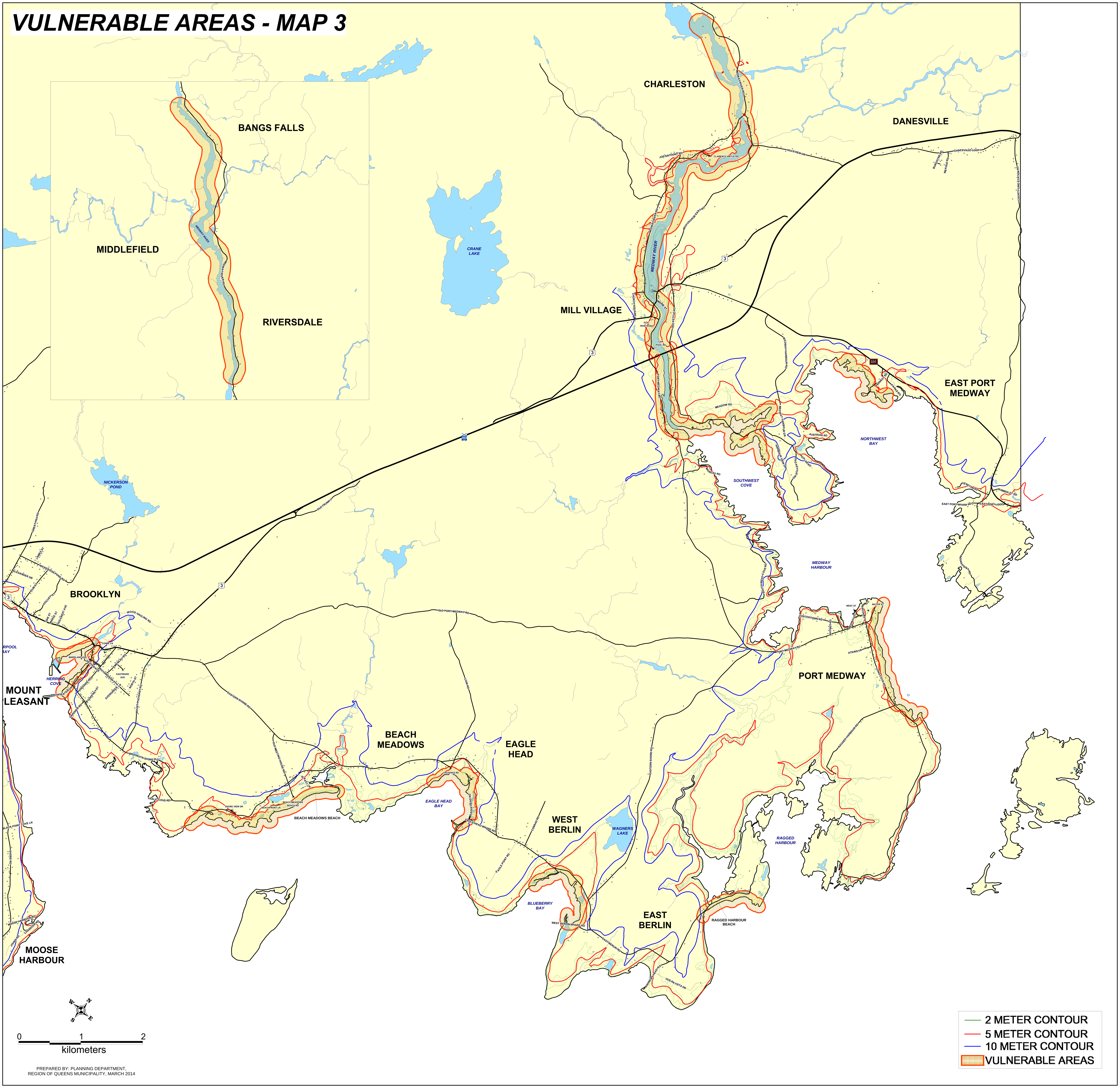
5 METER CONTOUR
10 METER CONTOUR
VULNERABLE AREAS

VULNERABLE AREAS - MAP 2



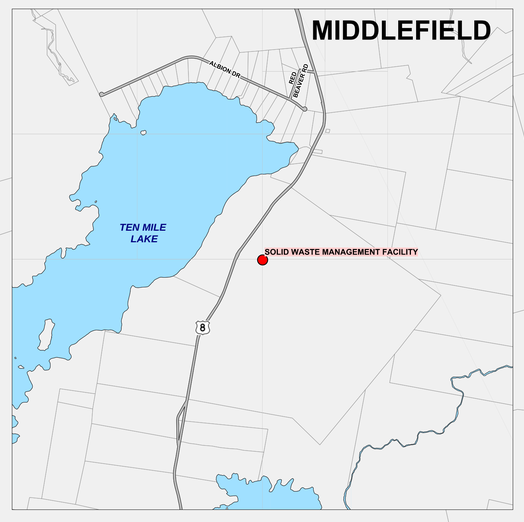
VULNERABLE AREAS - MAP 3



APPENDIX E

Municipal Facilities and Infrastructure Map

KEY MUNICIPAL FACILITIES AND INFRASTRUCTURE



WATER LINE
SEWER LINE

N W E S

0 0.5 1
kilometers

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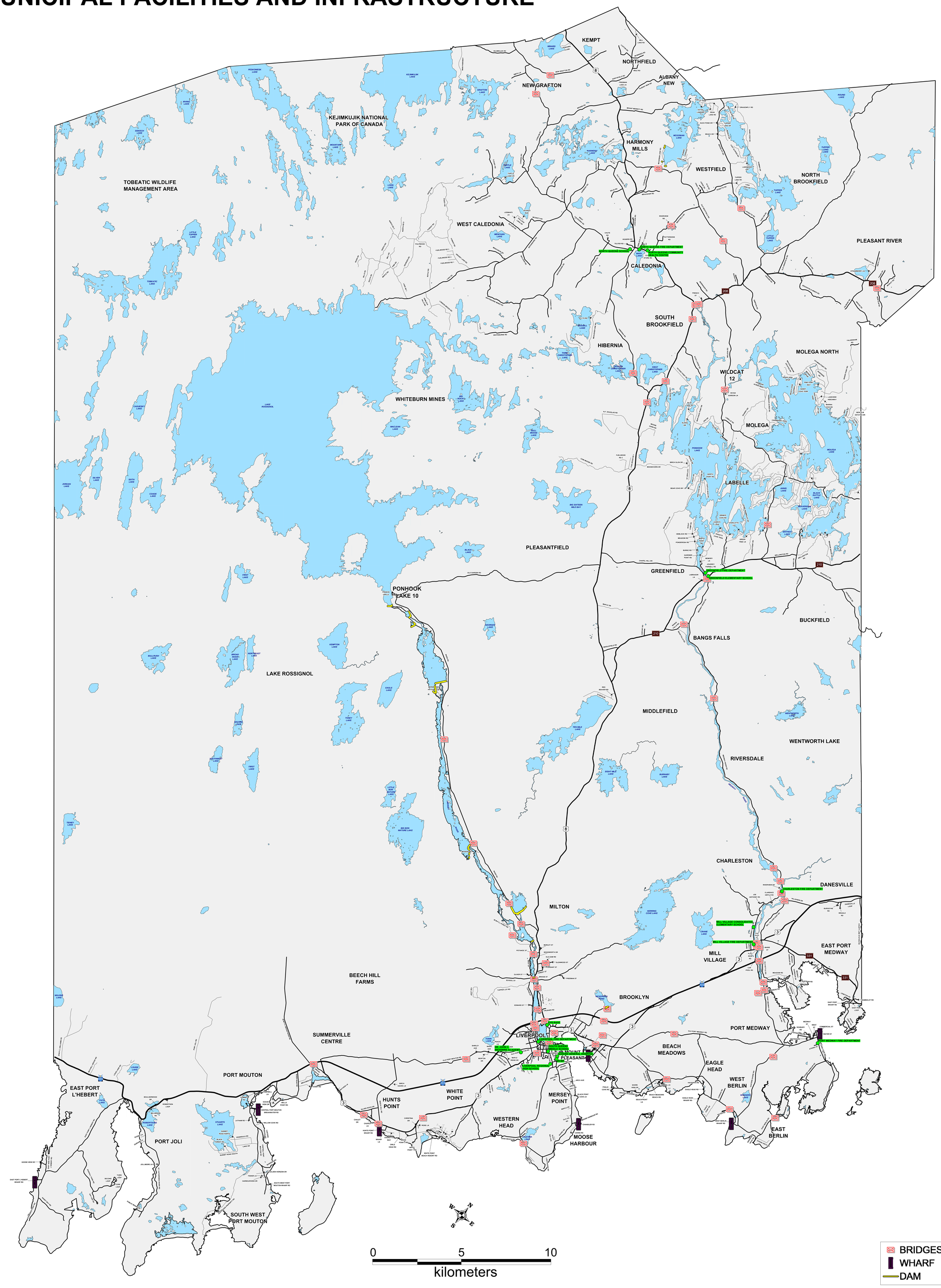
APPENDIX F

Non-Municipal Facilities and Infrastructure Map

KEY NON-MUNICIPAL FACILITIES AND INFRASTRUCTURE



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