Municipality of
the District
of Chester

Municipal **CLIMATE CHANGE** Action Plan

Effective: October 30, 2013
Adopted: October 30, 2013
Version: 8

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Adaptation Committee

COUNCIL

- Warden Allen Webber
- Deputy Warden Floyd Shatford
- Councillor Andre Veinotte
- Councillor Brad Armstrong
- Councillor Robert Myra
- Councillor Tina Connors
- Councillor Sharon Church-Cornelius

COMMITTEE MEMBERS

- Erin Beaudin, CAO
- Steve Graham, Director of Finance
- Pam Myra, Municipal Clerk
- Tara Maguire, Director of Community Development
- Matt Davidson, Director of Public Works
- Bruce Forest, Director of Solid Waste
- Chad Haughn, Director of Recreation and Parks
- Cliff Gall, Director of Information Services

STAKEHOLDERS

- Geoff MacDonald, Planner and MCCAP Process Lead
- Dan Pittman, Records Management Coordinator
- Bruce Blackwood, Fire Services Coordinator
- Arden Weagle, EMO Coordinator
- Jami Fay, Planning Technician
- Nick Zinck, GIS Technologist

Mandate

The Municipal Climate Change Action Plan Adaptation Committee's mandate is to:

- *Form an Adaptation Committee;*
- *Identify climate change issues and hazards;*
- *Identify affected locations;*
- *Identify affected facilities and infrastructure;*
- *Identify who is affected, the economic implications, and environmental issues;*
- *Complete the greenhouse gas emissions template for municipal operations;*
- *Work together with Council to identify the priorities for adaptation; and*
- *Submit a complete draft of the Climate Change Action Plan to Council for consultation and approval.*

Accountability

The Adaptation Committee is accountable to Council for the completion of the Draft Municipal Climate Change Action Plan.

Assumptions

Using reference materials, we have assembled some basic assumptions used to develop this Plan:

- *Sea level rise at the Mean High Water Level might approach 1.85 metres by the year 2100;*
- *We have no estimates on the **rate** of sea level rise, only on the possible **amounts**;*
- *When combined with extreme high tides, which recur regularly, and the storm surge expected from an intense storm, the plausible water level achieved during an emergency event at the present time is about 2 metres above the current Mean High Water Mark; and*
- *Under the same circumstances, the plausible water level in the year 2100 is about 5 metres above the current Mean High Water Mark.*

REMO Process

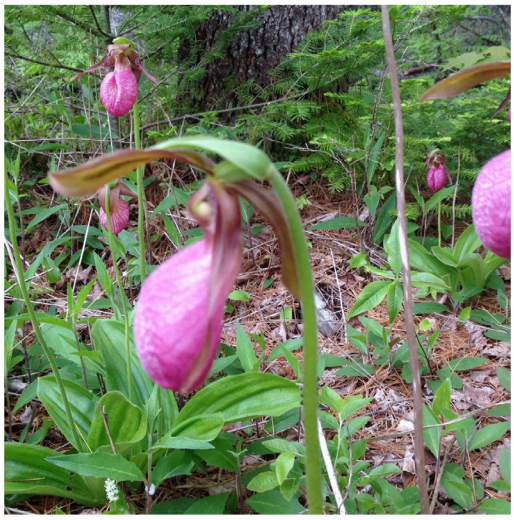
In 2012, the Lunenburg County Regional Emergency Measures Organization (REMO) developed a hazard, risk and vulnerability assessment for each potential hazard identified in Lunenburg County as a result of climate change.

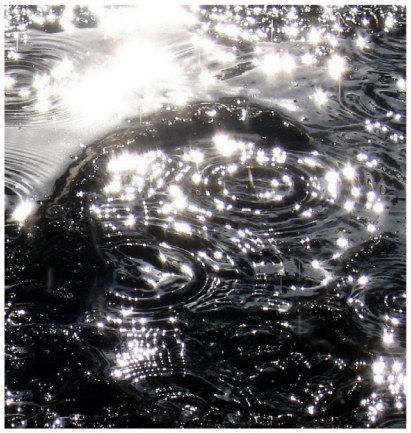
REMO partnered with staff from:

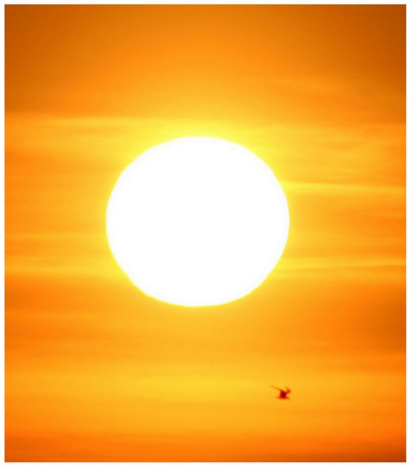
- *Municipality of the District of Chester;*
- *Municipality of the District of Lunenburg;*
- *Town of Bridgewater; and*
- *Town of Mahone Bay.*

The hazards identified in the REMO assessment related to the Municipality of the District of Chester are used in our Plan.

The complete REMO Assessment is located in Volume II, Appendix C

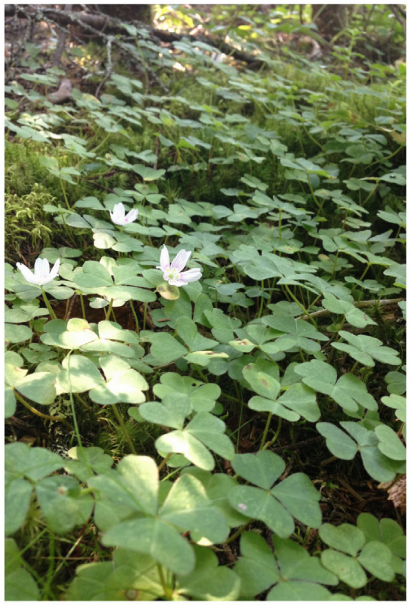


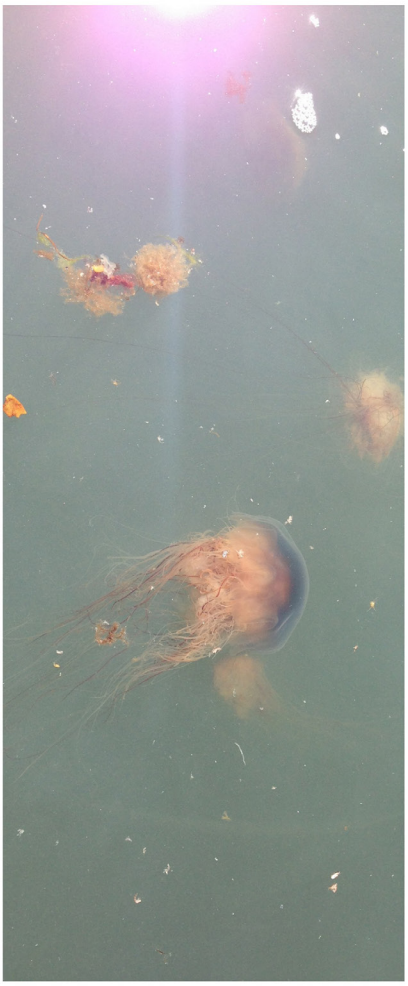




The MCCAP Team identified thirteen climate change issues and hazards.

- *Coastal flooding;*
- *Inland flooding;*
- *Hurricane;*
- *Extreme weather event;*
- *Winter storm/blizzard;*
- *Hot days/heat wave;*
- *Forest fire;*
- *Drought;*
- *Animal disease;*
- *Plant disease;*
- *Forest cover changes;*
- *Agricultural crop changes; and*
- *Sea temperature rise, acidification, and invasive species.*





COASTAL FLOODING

The flooding of coastal lands by sea water affects most of the Municipality's population given that settlement is concentrated in coastal areas. Rising sea levels are exacerbated when storms affected by low atmospheric pressure hit the coast, creating storm surge.

Hazards

Flooding and storm surge could worsen because of rising sea level and more frequent storms that are noticeably more intense.

Affected Areas, Facilities, and Infrastructure

Areas most affected are those within two metres of the high water mark; however, there is potential for effects up to four metres depending on future sea level rise. For example, by 2100, areas up to five or six metres of the existing high water mark could be affected.

Private and public infrastructure that could be physically vulnerable:

- Provincial infrastructure, specifically bridges in Martins River and East River, Highway 3 in Western Shore, Highway 329, and the Tancook Ferry Wharf;
- Municipal infrastructure, such as sewage treatment plants and pumping stations near the coast, streetlights, sidewalks, Wild Rose Park and other parks, storm sewers, wharves and boat launches. As a result, Kaizer Meadow Landfill may have to accept large amounts of waste on short notice; and
- Causeways at Marvins Island, Shaws Island, and Oak Island.

COASTAL FLOODING

Who can be Affected and the Environmental Effects

Residents and businesses located up to six metres of the high water mark could experience:

- salt water saturation in their wells;
- disabled service of central sewer in Chester, Chester Basin, Otter Point, and Western Shore or potential for release of raw sewage;
- blocked or damaged roads;
- possible chemical contamination from industrial sources within hazard area; and
- shorts in electrical systems.

Economic Impacts

Outside of the costs resulting from physical damage, coastal flooding will have a potential economic impact on:

- aquaculture and inshore fishery facilities;
- the Tancook Ferry Service;
- banking and insurance industries;
- loss of property value; and
- loss of regular economic activity and tourism.

INLAND FLOODING

Residents of the Municipality who live inland can escape coastal flooding, but they may still be affected by the overflow from rivers, streams and lakes caused by intense precipitation. In winter, ice jams and spring melt can contribute to inland flooding.

Hazards

Flooding caused by overflowing rivers, streams, lakes, etc. as a result of intense precipitation (which is predicted to increase in frequency) and/or snow melt and ice jams. Flooding could intensify if combined with a storm surge on the coast.

Affected Areas, Facilities, and Infrastructure

Areas most affected in the Municipality are likely to be:

- New Ross
- Martins River
- East River

Private and public infrastructure that could be physically vulnerable:

- Municipal infrastructure, such as the New Ross and Western Shore sewage treatment plants, the pumping station in Chester, the Kaizer Meadow leachate and storm water treatment plants, and various culverts and bridge abutments on the Chester Connection and Aspotogan Trails;
- Provincial infrastructure, such as the bridges on Highway #3 over East River and Martins River, and the bridge across Middle River on the Chester Grant Road.

INLAND FLOODING

Who can be Affected and the Environmental Effects

There are no major flood locations identified in the Municipality, but residents and businesses could experience:

- localized, minor flooding;
- contamination of dug wells;
- sewage treatment failures, which could cause release of raw sewage;
- closure of key highway bridges;
- power outages;
- increased mosquito and blackfly hatches; and
- manure washing into streams because of pasture land flooding.

Economic Impacts

Outside of the costs resulting from physical damage, inland flooding will have a potential economic impact on:

- transportation if highway bridges are affected;
- the forestry industry if woods roads bridges are affected;
- LP Canexel plant if East River pumping station is affected;
- the aquaculture industry because of sedimentation;
- tourism;
- damage and relocation costs related to the Western Shore and New Ross sewage treatment plants; and
- disruption of communications would be costly to the Province.

HURRICANE

A hurricane is a cyclonic tropical storm with exceptionally strong winds and heavy rain. Formed offshore in the equatorial Atlantic, they affect the Caribbean and the coastal United States and, with increasing frequency, Canada's Atlantic region.

Hazards

Both coastal and inland flooding are a risk, plus large waves could make coastal flooding worse.

Also, strong winds could cause damage to wood land and infrastructure.

Affected Areas, Facilities, and Infrastructure

Areas affected by coastal and inland flooding should be included.

In addition to all of the infrastructure vulnerable in a flood event, we can also add:

- structures damaged by high winds, causing increased mixed waste at Kaizer Meadow;
- electrical distribution system; and
- Municipal infrastructure, such as sewage treatment plants and pumping stations affected by power outages.

HURRICANE

Who can be Affected and the Environmental Effects

Residents and businesses could experience:

- coastal and inland flooding;
- closure of highway bridges;
- tree damage caused by wind;
- blowing debris;
- power outages and downed electrical wires caused by wind;
- home heating oil tank leakage/spillage;
- raw sewage released due to power outages; and
- devasation to sensitive habitats, like saltwater marshes, Bayswater and East River beaches and stream estuaries.

Especially vulnerable to power outages are the elderly and infirm residing in nursing homes, which are located in Chester, New Ross and Western Shore.

Economic Impacts

Outside of the costs resulting from physical damage, hurricanes have a potential economic impact on:

- the forestry industry;
- the fishery; and
- tourism.

EXTREME WEATHER EVENT

Hurricanes can be forecasted; not so with most sudden weather events. The frequency and intensity of severe storms is expected to increase in the coming years. Heavy rain, thunderstorms, hail storms, and tornadoes can cause major damage to houses, boats and infrastructure.

Hazards

We are expecting an increase in the frequency and intensity of severe storms, such as thunderstorms, tornadoes, and hail storms.

Affected Areas, Facilities, and Infrastructure

The entire Municipality is susceptible to extreme weather.

Infrastructure and services that are especially vulnerable include:

- Municipal sewage treatment plants and pumping stations, Kaizer Meadow landfill because on an increase in waste, and building inspection services; and
- Potentially Nova Scotia Power, who could have PCBs in storage.

EXTREME WEATHER EVENT

Who can be Affected and the Environmental Effects

Residents and businesses in all parts of the Municipality can expect:

- extensive flooding;
- frequent lightning strikes on the electrical distribution system;
- sudden rises in stream and river levels;
- power outages; and
- inadequate fire services as resources run low.

Economic Impacts

Similar to a hurricane, a potential economic impact could be felt by:

- the forestry industry;
- the fishery; and
- tourism.

WINTER STORM/ BLIZZARD

Severe winter storms can come in the form of snow, freezing rain, rain or any combination of these. They are expected to occur more often in the future. While a few centimetres of snow can be managed, major storms impact municipal infrastructure and the effectiveness of emergency management.

Hazards

Severe winter storms pose hazards such as strong winds and heavy precipitation (snow, rain, freezing rain, etc.) It is anticipated that severe winter storms will occur more often.

Affected Areas, Facilities, and Infrastructure

The entire Municipality is vulnerable to a severe winter storm, particularly low-lying areas.

Infrastructure particularly vulnerable includes:

- highways;
- wharves;
- sewage treatment plants and pumping stations;
- sidewalks;
- municipal roads;
- Landfill operations; and
- electrical distribution system.

WINTER STORM/ BLIZZARD

Who can be Affected and the Environmental Effects

During a severe winter storm, residents and businesses can expect to experience:

- limited access to structures and infrastructure;
- road blockages because of snow, downed power lines, ice and/or wind;
- inland flooding because of snow melt or rain; and
- power outages.

Especially vulnerable are the very young, elderly and infirm.

Economic Impacts

Potential economic impact could be felt by:

- winter operations related to the fishery, forestry, and tourism;
- retail trade; and
- service industries.

HOT DAYS/ HEAT WAVE

A heat wave means there have been at least three consecutive days where temperatures have exceeded 30 degrees. Temperature extremes such as this can be expected to occur more frequently and for longer periods in the future.

Hazards

Exposure to prolonged heat during hot days or a heat wave can be dangerous. Hot days are expected to occur more often, which means a drier, hotter summer.

Affected Areas, Facilities, and Infrastructure

All areas in the Municipality are open to the effects of increasing hot days.

Private and public infrastructure that could be affected are:

- Electrical distribution system as people use more power;
- groundwater resources as use/need increases;
- comfort stations as they establish themselves as “cooling centres”; and
- public green spaces as maintenance becomes more difficult in hotter weather.

HOT DAYS/ HEAT WAVE

Who can be Affected and the Environmental Effects

All residents and businesses can be affected by prolonged heat. Especially vulnerable are the very young, elderly and sick people.

Economic Impacts

The potential economic impact will affect all sectors, but specifically:

- crops that like warmer temperatures will thrive;
- pressure will increase to change waste collection to weekly as well as to provide Chester a central water supply;
- forestry because of woods travel closures; and
- brownouts will occur caused by pressure on power supplies for air conditioning.

FOREST FIRE

Although naturally occurring forest fires are a reality, about 97% of all forest fire and wildfires in Nova Scotia are caused by human activity. These events are likely to increase in frequency with drier and hotter summers.

Hazards

Clear hazard of a fire in the forest is that it becomes uncontrollable and could threaten residential areas.

Affected Areas, Facilities, and Infrastructure

All woodland has the potential for fire. Residential areas in proximity to the fire could also be affected.

Private and public infrastructure that could be affected:

- Municipal infrastructure, such as sewage treatment plants and pumping stations as well as public open spaces;
- residential structures;
- lands protected by the Province; and
- productive forests, both private and public.

FOREST FIRE

Who can be Affected and the Environmental Effects

Most of the Municipality's population lives in or near forested land. In the event of a forest fire, residents and businesses could experience:

- smoke inhalation; and
- destruction of property/structures.

Economic Impacts

The area that would sustain the biggest impact economically is the forestry industry by destroying large amounts of valuable forest land.

Other areas threatened by forest fire are residential and commercial structures and property.

DROUGHT

Water resources are essential for irrigation and domestic use. Just as more frequent and heavy rains can be expected, so too can we expect to see prolonged periods of abnormally dry weather.

Hazards

An extended drought can seriously deplete water sources.

Affected Areas, Facilities, and Infrastructure

The entire Municipality would be touched by drought. Specifically,

- parks and public spaces as maintenance would be limited;
- wetlands, lakes and streams.

DROUGHT

Who can be Affected and the Environmental Effects

Residents and businesses experiencing a drought could see:

- a reduction in water supply to wells, especially to dug wells;
- those in the core of Chester Village;
- the potential for salt water intrusion along the coast;
- an impact on agricultural crops from lack of water;

Economic Impacts

Drought will have a potential economic impact on:

- the Municipality as residents of Chester would increase pressure for a central water supply;
- local businesses and small farms; and
- the tourism industry with a possible increase in boating and outdoor recreation.

ANIMAL DISEASE

Changes in mean temperature and warmer waters, where certain pests can thrive where they could not before, mean that diseases affecting agricultural animals, wildlife, and our human population that have been historically rare, are likely to become more prevalent in the future.

Hazards

- Diseases affecting agricultural animals
- Diseases affecting wildlife
- Animal diseases affecting humans

Affected Areas, Facilities, and Infrastructure

Literally every area in the Municipality could be subject to disease and pests.

The Kaizer Meadow Environmental Management Centre was identified as the primary municipal facility affected by animal disease, pests and invasive species. This is because of the large number of carcasses that could potentially be disposed of on short notice.

ANIMAL DISEASE

Who can be Affected and the Environmental Effects

When agricultural hazards are identified, workers associated with the industry are at higher risk for disease cross-over.

Besides that, residents and businesses should be wary of:

- consumption of contaminated foods;
- importation of new diseases; and
- the possibility of health threats if an outbreak of animal disease results in large number of carcasses that are not disposed of quickly or in a sanitary way.

Economic Impacts

Animal disease, pests and invasive species could have a significant economic impact on:

- agricultural industry in the destruction of contaminated foods and livestock; and
- food supplies as they could be interrupted.

PLANT DISEASE

Just as changes in mean temperature can bring animal diseases and pests that we haven't seen before, so too can they bring new plant diseases and pests, and new invasive species. Plants can easily be stressed by increased heat and drought.

Hazards

There are two considerable hazards: disease affecting agricultural plants as well as forest plants.

Affected Areas, Facilities, and Infrastructure

The whole Municipality can be affected by plant disease.

Specifically,

- parkland and other municipal land;
- woodland;
- farmland; and
- agricultural crops.

PLANT DISEASE

Who can be Affected and the Environmental Effects

In particular, agricultural and forestry workers are most likely to see the effects of plant disease.

In a broad sense, residents and businesses could experience:

- an increase in the use of poisonous pesticides and herbicides; and
- the potential to consume contaminated foods.

Economic Impacts

The greatest economic implications will affect the agricultural and forestry industries, as a result of:

- the large-scale destruction of contaminated foods; and
- crop failure.

FOREST COVER CHANGES

Forests naturally evolve with changes in mean temperature and other weather-related phenomena. But when the pace of climate change is more rapid, forest plant populations will not be able to adapt as quickly, causing some species to die out over the next 100 years.

Hazards

The potential for susceptible species to die over the next 100 years as the climate changes more quickly than forests can adapt poses a hazard to our woodland. Transversely, some species may grow more rapidly in warmer climates.

Affected Areas, Facilities, and Infrastructure

Private and public land that could be physically affected:

- all woodland and parkland; and
- Municipal lands, such as parks, landfill property; and islands.

FOREST COVER CHANGES

Who can be Affected and the Environmental Effects

Residents and businesses located near or in forested areas could notice a change in forest species due to warmer winters and drier, hotter summers.

Economic Impacts

An economic impact will be especially felt by the forestry industry, including Christmas tree growing and harvesting.

AGRICULTURAL CROPS CHANGES

As with changes affecting forest cover, the pace of change on our local climate will affect the survivability of certain crops that we have traditionally depended on to thrive. We can expect to have to adapt by cultivating other crops that are more viable in warmer, drier growing seasons.

Hazards

The rapidity of climate change could jeopardize certain crops. On the other hand, there could be opportunity for different crops to thrive.

Affected Areas, Facilities, and Infrastructure

The areas most affected are agricultural operations.

AGRICULTURAL CROPS CHANGES

Who can be Affected and the Environmental Effects

Obviously, those working in the agricultural industry will be most vulnerable.

Economic Impacts

Economic impacts of an agricultural crop change can be mitigated by growing different crop types.

RISE IN SEA TEMPERATURE, ACIDIFICATION INVASIVE SPECIES

Climate change doesn't just affect forest cover and agriculture. It also affects the mix of plant and animal species in our waters. Rising sea temperature means that certain species not native to our shores will thrive and threaten the local ecology. Moreover, species we have depended on for our survival may not flourish.

Hazards

- Traditional fisheries may collapse.
- Opportunity for unfamiliar pests and diseases to flourish.
- Invasive species from warmer climates may populate our waters.
- Potential for an increase in the frequency of storms and a change to the course of the Gulf Stream.
- Acification can hamper the growth of many organisms.

Affected Areas, Facilities, and Infrastructure

The entire coast has been, and will likely continue to be, affected by invasive species.

The main municipal infrastructure category to be affected physically is our wharves.

RISE IN SEA TEMPERATURE, ACIDIFICATION INVASIVE SPECIES

Who can be Affected and the Environmental Effects

Effects will mainly be experienced by aquaculture and fisheries.

Environmentally, the pace of change is expected to increase, affecting all salt water fish and plants. Specifically, invasive species are having a serious effect on sea urchins, seaweeds, and mussels.

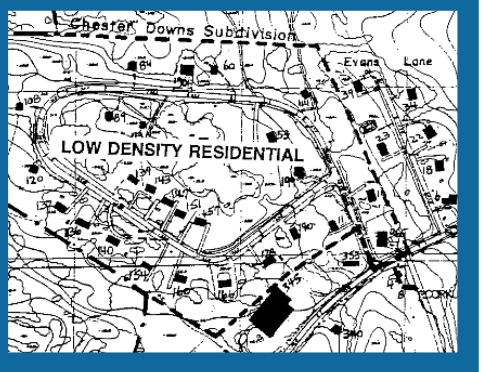
Economic Impacts

The potential economic impact will most likely be felt by the aquaculture sector and fisheries, including fishing tourism.

Priorities

Chester Municipality has established priorities for adaptation over the short term (0-5 years), medium term (5 to 20 years) and long term (over 20 years).

They include priorities for managing our infrastructure, our outreach requirements (how we work with the community), and policy and planning priorities, that is, how we update our planning and policy documents to meet the climate change challenge.



Infrastructure... in the short-term

Our short-term priorities for municipal infrastructure are divided into two groups: top priority and second priority.

TOP PRIORITY

- Acquire, store and manage data on infrastructure and mapping;
- Finish asset mapping for the sewer systems, sidewalks, storm systems, and street lighting; and
- Identify and map vulnerable emergency response, cultural and heritage resources, such as wharves and slipways, schools, beaches, fire halls, etc.
- SEWER SYSTEM PRIORITIES:
    - Review inflow/infiltration effect on capacity and develop mitigation plans;
    - Review emergency power options and develop mitigation plans;
    - Review the vulnerability to coastal and inland flooding and develop a mitigation plan;
    - Review options for expansion and replacement;
    - Review power outage options for lift stations, based on vulnerability and function and develop a mitigation plan;
    - Review installation standards for force mains that could potentially be affected by tide and coastal flooding; and
    - Monitor and record all river flood events near the sewer treatment plants in New Ross and Western Shore.

SECOND PRIORITY

- Review all park and recreation land for vulnerability and long-term adaptation plans;
- Monitor and identify potential drainage problems on the Chester Connection and Aspotogan Trails;
- Review and assess all bridges on the Chester Connection and Aspotogan Trails and develop an upgrade schedule;
- Review vulnerability of municipal wharves to sea level rise and storm surges, inspect regularly, repair and maintain against increasing storm damage;
- Adapt Landfill operations and the leachate treament/stormwater treatment systems to accommodate increased rainfall.

Infrastructure... up to the long-term

Our medium- to long-term priorities for municipal infrastructure are:

MEDIUM-TERM

- **Keep asset mapping up to date;**
- **Gradually implement mitigation plans for central sewer systems;**
- **Upgrade installation of force mains whenever they are replaced;**
- **Develop mitigation plans based on recorded observations at the New Ross and Western Shore sewer treatment plants;**
- **Develop mitigation or abandonment plans for municipal parks;**
- **Gradually upgrade drainage and bridges on Chester Connection and Aspotogan Trails; and**
- **Plan to re-locate or abandon wharves and slipways.**

LONG-TERM

- **Re-evaluate Municipal Climate Change Action Plan; and**
- **Re-locate or abandon wharves and slipways.**

Outreach...

Our priorities for outreach are:

SHORT-TERM

- **Publish the Municipal Climate Change Action Plan throughout the Municipality, including the website, regular mention in newsletters, and presentations to community groups. Include and publicize legible maps showing vulnerable areas;**
- **Refer bridge, highway, and storm drainage infrastructure issues to the NS Department of Transportation and Infrastructure Renewal (TIR);**
- **Develop agreements with TIR on the maintenance of storm drainage that affects municipal infrasructure; and**
- **Refer this Plan to development agencies and to the Regional Emergency Measures Organization.**

MEDIUM-TERM

- **Continue to promote the Municipal Climate Change Action Plan and its review processes.**

LONG-TERM

- **Re-evaluate the Municipal Climate Change Action Plan.**

Policy & Planning... in the short-term

Our short-term priorities for policy and planning are:

- **Review the Municipal Planning Strategy, Subdivision By-Law, Land Use By-Law, and the Building Code By-Law to develop policy and regulation on development near vulnerable areas, including forested areas;**
- **Update Municipal Specifications, with emphasis on storm water and on sewage treatment;**
- **Consult with REMO and Fire Departments to develop pre-planning for the expected emergency events and with Nova Scotia Emergency Measures Office to coordinate emergency services;**
- **Examine the findings of the Intergovernmental Panel on Climate Change fifth Assessment Report (September 2013), and review this Plan accordingly; and**
- **Continue to monitor and protect the watershed of Spectacle Lake.**

Policy & Planning... up to the long-term

Our medium- to long-term priorities for policy and planning are:

MEDIUM-TERM

- **Monitor Municipal Specifications and all planning documents for accommodation to climate change;**
- **Continue monitoring and updating pre-plans; and**
- **Review Climate Change Action Plan periodically and update as required in light of observed changes and updated predictions.**

LONG-TERM

- **Monitor Municipal Specifications and all planning documents for accommodation to climate change;**
- **Continue monitoring and updating pre-plans; and**
- **Periodically review the Plan.**

Climate Change Mitigation

By "climate change mitigation" we mean the interventions needed in policy and procedure to reduce the use of greenhouse gas resources and emissions. Mitigation is successful when these interventions, whether technological or economic, result in the reduction of greenhouse gas resources and emissions, and enhance greenhouse gas sinks.

The Municipality completed an inventory of its corporate energy use (Appendix D). It then completed a Municipal Energy Audit Report (Appendix E) which provides an analysis of corporate energy consumption of various assets. The Municipality has been working to implement the report's recommendations.

Corporate Energy Use

The Municipality measured its energy use to determine our greenhouse gas emissions (Appendix D). The Top 4 "consumers" are:

1. *Kaizer Meadow Environmental Management Centre because of the leachate treatment facility and amount of diesel fuel consumed.*

2. *The fleet of heavy vehicles used for solid waste collection and transfer to Kaizer Meadow Landfill.*

3. *Wastewater collection and treatment systems operated by the Municipality in various communities.*

4. *Streetlights, including those owned by the Municipality and those leased from Nova Scotia Power.*

Reducing Energy Consumption

As a result of an Energy Audit done in 2009 (Appendix E), the recommendations to deal with the Top 4 consumers are:

- *Install new high-efficiency equipment at the Kaizer Meadow leachate treatment facility;*
- *Review vehicle size for fuel efficiency and improve performance through routine maintenance and monitoring (a new vehicle log and monitoring system has already been established);*
- *Reduce running times for aeration blowers and utilize high efficiency equipment and parts in the wastewater system; and*
- *Review street lighting usage and consider strategic location of new streetlights to service areas where most needed.*

In addition, we are incrementally reducing our energy consumption by upgrading office lighting and heating controls.

MUNICIPAL CLIMATE CHANGE ACTION PLAN

MUNICIPALITY OF THE DISTRICT OF CHESTER

APPENDIX A

CLIMATE CHANGE TABLES, PRIORITIES, AND MITIGATION

(STEPS TWO, THREE, FOUR, FIVE, SIX)

INTRODUCTION TO APPENDIX A

The Municipal Climate Change Action Plan for the Municipality of the District of Chester was developed using the ***Municipal Climate Change Action Plan Guidebook*** issued in 2011 by the Service Nova Scotia & Municipal Relations, a Department of the Government of Nova Scotia. The guidebook sets out the mandatory content of Municipal Climate Change Action Plans as a series of steps.

STEP ONE: Assemble an Adaptation Team/Committee
STEP TWO: Identify Climate Change Issues and Hazards
STEP THREE: Identify Affected Locations
STEP FOUR: Identify Affected Facilities and Infrastructure
STEP FIVE: Identify affected Populations, Economic Sectors, and Environmental Issues
STEP SIX: Set Priorities for Action

Appendix A contains detailed analysis related to STEPS TWO, THREE, FOUR, FIVE and SIX in a series of tables.

ASSUMPTIONS AND PROCESS

The tables were developed using a set of references and assumptions, as follows:

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Climate Change in Atlantic Canada Multi-media Project, Mount Allison University, retrieved February 2013 from www.climatechangeatlantic.com.

Assumptions

a) Sea Level Rise at the Mean High Water Level might approach 1.85 metres by the year 2100.

b) We have no estimates on the rate of sea level rise, only on the possible amounts of sea level rise.

c) When combined with the extreme high tides which recur regularly and the storm surge expected from an

intense storm, the plausible water level achieved during an emergency event at the present time is about 2 metres above the current Mean High Water Mark.

d) When combined with extreme high tides which recur regularly and with the storm surge expected from more intense storms, the plausible water level achieved during an emergency event in the year 2100 is about five metres above the current Mean High Water Mark. The mapping which accompanies this report shows the 2, 4, and 6 metre contours above the current high water mark for guidance in assessing the current and future hazards resulting from sea level rise and storm surges.

e) Intense rainfall events are expected to give up to 16% more rain in each event and these events are expected to recur more often.

f) Summer weather is expected to be drier and hotter as the next century progresses. Fall, winter and spring are expected to be warmer and wetter.

R.E.M.O. Process input

Throughout the late winter and spring of 2012, the Lunenburg County Regional Emergency Measures Co-ordinator met with planning and engineering staff from the Town of Bridgewater, the Town of Mahone Bay, the Municipality of Chester and the Municipality of Lunenburg to develop a united identification of the hazards and risks of climate change that are likely to affect Lunenburg County. That analysis led the Regional Emergency Measures Organization to develop a Hazard, Risk and Vulnerability Assessment for each of the identified hazards, which was completed in July 2012. The complete text of the final document is attached as **Appendix C**.

For the purposes of this Climate Change Action Plan, the identified hazards related to the Municipality of Chester are described in the following pages.

Analysis (STEPS TWO, THREE, FOUR AND FIVE)

The MCCAP team reviewed that information and expanded it to reflect the specifics of the Municipality of Chester. That analysis is presented in the following tables, dealing with the thirteen climate change issues and hazards identified by the team plus additional issues the team identified:

- Coastal Flooding;
- Inland Flooding;
- Hurricane;
- Extreme Weather Event;
- Winter Storm/Blizzard;
- Hot Days/Heat Wave;
- Forest Fire/WildFire;
- Drought;
- Animal Disease.
- Plant Disease;
- Changes in Forest Cover;
- Changes in Agricultural Crops.
- Sea temperature rise, acidification, and Invasive Species.

Other Hazards

Other hazards were discussed by the team which felt they were better addressed by being included in the twelve major categories listed above. Those secondary categories included erosion, landslides, public water supply contamination, raw sewage releases.

Priorities for Action (STEP SIX)

The Adaptation Committee worked with Council on Step Six, which lists priorities for adaptation in the short,

medium and long term. These priorities are listed in the relevant table as

- Infrastructure priorities
- Outreach priorities
- Policy and Planning priorities

1.0 CLIMATE CHANGE HAZARDS, AFFECTED AREAS, AFFECTED INFRASTRUCTURE

3.1 Coastal Flooding

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Flooding of coastal lands by sea water. (Includes Storm Surge – elevated sea level caused by atmospheric low pressure area associated with a large storm).	**Climate Issues** Sea level rise resulting from the increase in ocean volume. The increase in the frequency of intense storms.	**Anticipated Future Effects** When combined with the on-going land subsidence, these effects will significantly increase the number of significant flooding events .	**Level of Preparedness** Low	**Maps** Map 1, Coastal Flooding, shows areas vulnerable to coastal flooding. Maps 1A to 1E show most vulnerable areas with Municipal Infrastructure.	**Information Gaps** Estimates of the rate of sea level rise due to increase in ocean volumes vary widely, introducing uncertainty about the urgency of adaptation measures	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Places historically affected** Generally NSTIR infrastructure within 1–2 metres of the high water mark, specifically at Martins River Bridge, Western Shore Highway 3, East River Bridge, Highway 329, Tancook ferry wharf in Chester. Some private causeways such as at Marvins Island, Shaws Island, or Oak Island are also vulnerable.	**Expected Places Affected** Immediate concern is all places within 2 Metres of High Water, based on storm surges experienced in Halifax and on the predicted basic sea level rise. However, areas within 4 metres are vulnerable in the longer term, based on estimates of sea level rise, and the storm surge experienced by New York in 2012. The total sea level rise and storm effects by the year 2100 are expected to be in the range of 5 to 6 metres above the current high water mark, Long term concern is land mass reduction of Mahone Bay islands	**Degree of Impact** High	**Maps of Affected Locations** Map 1, Coastal Flooding shows the areas of immediate concern (2 metre contour), medium term concern (4 metre contour) and long term concern (6 metre contour).	**Information Gaps** There has been no systematic record of storm damage locations or repair costs. There is no tide gauge in Lunenburg County to record actual storm surge heights. The nearest tide gauges are in Halifax and Yarmouth. We have no mapping of storm sewers associated with our sidewalks within the areas of concern identified on Maps 1A to 1D. Sewer System Asset mapping is about 80% complete. Sewage plant treatment capacity needs study.	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Sewage treatment systems near the coast, and in particular the pumping stations at low points in those systems. Western Shore pumping stations and treatment plant, Chester Basin treatment system, Chester Village pumping stations, Otter Point System. Some street lighting, sidewalks, and parks are also vulnerable. Wharves and boat launches. Storm sewers associated with sidewalks.	**Municipal F & I Affected** Primarily sewer pumping stations and sewage treatment plants, although some sidewalks, storm sewers and street lighting are also vulnerable. Western Shore Wild Rose Park is extremely vulnerable. Western Shore Sewage Treatment plant is vulnerable at the 6 metre elevation. Kaizer Meadow Landfill may have to accept large amounts of mixed debris for disposal at short notice.	**Specific Issues Anticipated** Disabling the control systems on pumping stations, whether from submergence, or from concentrated salt water spray. Erosion of the seawall and landscaping at Wild Rose Park. Shorting of electrical supply to decorative street lighting. Wharf and boat launch damage. May need a temporary or emergency landfill location at Kaizer Meadow.	**F & I Important to Emergencies** Streets and highways not owned by the Municipality as well as the fire stations at Western Shore and Blandford, also not owned by the Municipality. Electric distribution system, not owned by the Municipality.	**Maps of Affected Municipal Infrastructure** Map 1A Western Shore Sewer. Map 1B Chester Basin Sewer Map 1C Chester Village Sewer Map 1D Otter Point Sewer	**Information Spreadsheets** Analysis of the efficiency of existing infrastructure is shown in the spreadsheets attached as an appendix to this Plan.	

Coastal Flooding

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Short-term – Residents and businesses below the 2 metre elevation at the seacoast Medium term – people between the 2 metre and the 4 metre elevation. Long-term – people between the 4 metre and the 6 metre elevation. All persons on central sewer in Chester, Western Shore, Otter Point, Chester Basin, because disabling one pumping station by flooding may disable the entire system. All persons within the flooded area may experience salt water intrusion into water supply wells, especially shallow dug wells.	**EMO Integration** REMO has done an HRVA.	**Maps** Map 1 Coastal flooding Map 1A Western shore Map 1B Chester Basin Map 1C Chester Village Map 1D Otter Point Map 1E Blandford	**Hazards which Affect Health and Safety** Flooding will damage or destroy businesses and homes, and block or damage roads, restricting emergency response and affecting longer-term access. Flooding of pumping stations will result in the release of raw sewage. Flooding Western Shore treatment plant will result in long-term releases of raw sewage. Vulnerable fire stations are Western Shore and Blandford Salt water contamination of private wells.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors.
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Tancook Ferry service, all public wharves, and boat launches. All marinas. Aquaculture and inshore fishery shore facilities. Public Sector – repair and recovery costs for Municipal and Provincial infrastructure, as well as loss of assessment value, and sales taxes from economic activity. Tourism – from destruction of shoreline infrastructure, marinas, retail shops and restaurants. Banking and insurance industry, private homeowners.	**Options for dealing with threats to the economy** Short-term: Raise or strengthen key facilities. Long-term: abandon some locations, retreat to higher ground or more adaptable locations. Diversify the economy.	**Beneficial Effects** None		**Economic Effects of Emergencies** Sea Level rise will increase the frequency of coastal flooding events, which are expensive to recover from. Construction of new facilities is very expensive, both private and public sector Modifying public sector infrastructure to prepare for increased emergencies is expensive
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Well contamination by salt water. Some coastal erosion, particularly of coastal roads.	**Expected Change in Environmental Problems** More salt water intrusion into coastal wells. More erosion problems. Home heating oil or sewage contamination of private wells.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Beaches – Piping Plovers Islands – Roseate Terns Saltwater marshes and wetlands Bayswater Beach and East River Beach. Salt marshes and stream estuaries.	**Dangerous or Hazardous Materials** PCBs – NSP Chester depot is above 6 metre contour. Sewer Plant – Chlorine and wastewater. Marinas – Lubricating oils, fuel, paints. Furnace Oil Mixed debris from demolished homes and other structures.	**Emergency Preparedness Plan** Business continuity plan for the Municipal office needs upgrading. REMO is developing emergency preparedness plans from their HRVA assessments.

3.2 Inland Flooding

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Flooding caused by overflow of river, stream, lake or similar water body. Usually caused by intense precipitation events, but may be combined with snow melt and ice jams in the spring. May combine at the coast with storm surge.	**Climate Issues** Intense storms are predicted to increase in frequency	**Anticipated Future Effects** Increase in the number of flood events	**Level of Preparedness** Low	**Maps** Map 2 – Low-Lying Areas	**Information Gaps** No central record of flooding issues although anecdotal evidence indicates that highway bridges are the most affected infrastructure. No analysis of rivers to identify likely future flood areas. Upgrade municipal specifications for storm drainage standards.	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Places Historically Affected** Inland: Gold River at New Ross East River and Martins River at the Highway 3 bridges. Chester Grant Road - Middle River bridge. Pumping Station in Chester Village	**Expected Places Affected** New Ross, Martins River, East River. Urbanised areas may experience localized minor flooding, including public parks Western Shore Sewage Treatment Plant Chester Connection Trail – culvert washouts, bridge abutments. Pumping Station 2 at Cheater Village. Western Shore treatment plant at Vaughns Brook. New Ross treatment system. Kaizer Meadow Landfill leachate treatment and storm water treatment.	**Degree of Impact** high	**Maps of Affected Locations** Map 2, Low-lying areas	**Information Gaps** No analysis of rivers to identify likely future flood areas. There is no mapping of heritage, cultural or archeological resources, which may be threatened.	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** New Ross sewage treatment	**Municipal F & I Affected** New Ross Sewage treatment site. Western Shore Sewer Plant Chester Connection and Aspotogan Trail culverts at various locations.	**Specific Issues Anticipated** Worst-case scenario of ice jam, river flood and storm surge could flood the Western Shore Sewer Plant or the New Ross treatment system.	**F & I Important to Emergencies** Highway Bridges.	**Maps of Affected Municipal Infrastructure** Map 1A Western Shore Sewer Map 1B Chester Village Pumping Station 2	**Information Spreadsheets** Attached	

Inland Flooding

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** No major flood locations identified in Chester Municipality. Many local flooding issues which may each affect small number of people.	**EMO Integration** None	**Maps** Map 2, Low-lying Areas	**Hazards which Affect Health and Safety** Closure of key highway bridges, power outages. Contamination of dug wells. Disease associated with sewage treatment failures, both public infrastructure and private systems. Inconvenience and disease caused by mosquito and black fly hatches in spring and summer floods.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Local transportation and community connections if highway bridges are affected. Forestry industry if woods road bridges are affected. LP Canexcel hardboard plant may be affected if pumping station at East River disabled. Aquaculture – sedimentation. Tourism – recreational fishery. Municipal – damage to western Shore or New Ross treatment systems. Costs of re-locating these systems.	**Options for dealing with threats to the economy** Upgrade Municipal Specifications to require higher capacity in future storm drainage systems.	**Beneficial Effects** None		**Economic Effects of Emergencies** Temporary disruption of communications, large costs to the NS Dept of Transportation. Disruption of forest harvesting.
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Flooding of pasture land washing manure into streams. Highway Bridges and cross-culverts threatened	**Expected Change in Environmental Problems** More frequent flood events.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** None	**Dangerous or Hazardous Materials** On site sewage disposal systems. Raw sewage release – Western Shore treatment plant, New Ross treatment system.	**Emergency Preparedness Plan** In conjunction with REMO.

3.3 Hurricane

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Hurricane – a tropical storm with strong winds and heavy rain. Coastal and inland flooding are both likely, and may combine at the mouths of rivers. Large waves may intensify the effects of coastal flooding. Strong winds cause damage to forest land, electricity infrastructure, other structures.	**Climate Issues** Rise in sea temperatures in temperate latitudes. Increase in the frequency of Intense storms	**Anticipated Future Effects** As sea temperatures increase at temperate latitudes, more tropical storms are expected to arrive as hurricanes in Nova Scotia waters.	**Level of Preparedness** Medium	**Maps** Map 1 Coastal Flooding Map 2 Inland Flooding.	**Information Gaps** Areas subject to inland flooding are not well identified.	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** See: Coastal flooding and Inland Flooding	**Expected Places Affected** See: Coastal Flooding and Inland Flooding	**Degree of Impact** High	**Maps of Affected Locations** Map 1 Coastal Flooding Map 2 Inland Flooding.	**Information Gaps** There has been no systematic record of storm damage locations or repair costs. There is no tide gauge in Lunenburg County to record actual storm surge heights. No analysis of rivers to identify likely future flood areas.	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** See: Coastal Flooding and Inland Flooding	**Municipal F & I Affected** See: Coastal Flooding and Inland Flooding. Note that high winds may cause destruction of buildings, which will produce large amounts of mixed waste to be processed at the Kaizer Meadow landfill.	**Specific Issues Anticipated** See: Coastal Flooding and Inland Flooding. Interruption of electricity supply. Sewage pumping stations and treatment plants affected by flooding and power outages causing sewage backups into basements and sewage overflows. Municipal office is a Secondary Emergency Operations Centre, which might be activated. There will be a need for emergency debris disposal site at Kaizer Meadow Landfill.	**F & I Important to Emergencies** See: Coastal Flooding and Inland Flooding. High winds threaten the electrical distribution system. High winds might affect wind turbine installations.	**Maps of Affected Municipal Infrastructure** Map 1A Western Shore Sewer. Map 1B Chester Basin Sewer Map 1C Chester Village Sewer Map 1D Otter Point Sewer Map 1E Blandford	**Information Spreadsheets** Attached	

Hurricane

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** As for Coastal Flooding and Inland Flooding. Elderly and infirm are particularly vulnerable to power outages caused by wind. This includes the nursing homes in Chester, Western Shore, and New Ross in particular	**EMO Integration** REMO hurricane hazard plan.	**Maps** Map 1 Coastal flooding Map 1A Western shore Map 1B Chester Basin Map 1C Chester Village Map 1D Otter Point Map 1E Blandford Map 2, Low-lying Areas	**Hazards which Affect Health and Safety** Closure of key highway bridges Flooding of coastal highways. Tree damage due to wind. Blowing debris may damage buildings. Power outage resulting in the release of raw sewage from pumping stations or treatment plants. Flooding causing release of raw sewage from manholes. Downed electrical wires.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** As for coastal flooding and inland flooding. Forestry can be greatly affected by wind damage.	**Options for dealing with threats to the economy** None identified	**Beneficial Effects** None identified		**Economic Effects of Emergencies** Damage to shore facilities can cripple the fishery. Damage to accommodations such as hotels can affect Tourism. Other related damage to private and public facilities can have very high cost for recovery.
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Hurricane Juan at Halifax. Hurricane Sandy at New York.	**Expected Change in Environmental Problems** More frequent and more intense storms are expected.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Bayswater Beach and East River Beach. Salt marshes and stream estuaries.	**Dangerous or Hazardous Materials** Home heating oil tanks Mixed debris, including animal carcasses which must be handled at the Kaizer Meadow Landfill.	**Emergency Preparedness Plan** Developed with REMO

3.4 Extreme Sudden Weather Event

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Extreme sudden weather events such as thunderstorms, tornadoes, and hail storms.	**Climate Issues** Frequency and intensity of severe storms are expected to increase.	**Anticipated Future Effects** As the frequency of severe storms increases, the frequency of damage from extreme sudden weather events will increase.	**Level of Preparedness** Medium	**Maps** None	**Information Gaps** Rate of change in frequency and intensity of storms	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**	Entire Municipality is vulnerable,	**Historical Places Affected** Entire Municipality.	**Expected Places Affected** More extensive local flooding, possible stream flooding (see: inland flooding). More frequent lightning strikes on electrical distribution system.	**Degree of Impact** Medium	**Maps of Affected Locations** Map 2, Inland Flooding	**Information Gaps** None identified	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Sewage pumping and treatment	**Municipal F & I Affected** Power outage – sewage pumping and treatment. Landfill – power outages and increases in Construction and Demolition waste. Building Inspection – building damage assessment.	**Specific Issues Anticipated** Power outage Fast response by fire departments. Fire department resources may be inadequate for large events.	**F & I Important to Emergencies** Fire Departments	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** Attached	

Extreme Sudden Weather Event

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Elderly, very young.	**EMO Integration** REMO all hazards plan.	**Maps** None	**Hazards which Affect Health and Safety** Power outages due to lightning strikes or wind damage.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Similar to hurricane.	**Options for dealing with threats to the economy** None identified	**Beneficial Effects** None identified		**Economic Effects of Emergencies** Potentially high, depending on the track of the storm.
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Sudden rises in stream and river levels.	**Expected Change in Environmental Problems** More frequent occurrence of thunderstorms, tornados, hailstorms	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** None identified	**Dangerous or Hazardous Materials** Nova Scotia Power – Possible PCBs in storage.	**Emergency Preparedness Plan** In conjunction with REMO

3.5 Winter Storm/Blizzard

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Severe winter storm with strong winds and heavy precipitation which may be in form of snow, freezing rain, rain, or any combination of these.	**Climate Issues** Predicted increase in the frequency of severe storms.	**Anticipated Future Effects** Severe winter storms will occur more often	**Level of Preparedness** High	**Maps** Map 1 – Coastal Flooding Map 2 – Inland Flooding.	**Information Gaps** Rate of change in frequency and intensity of storms	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**	Entire Municipality is vulnerable	**Historical Places Affected** All highways. Wharves. All low-lying areas	**Expected Places Affected** All Highways and wharves. Low-lying areas Electrical distribution system.	**Degree of Impact** High	**Maps of Affected Locations** Map 2, Low-lying Areas	**Information Gaps** None identifies.	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Sewage pumping and treatment Municipal sidewalks Two Municipal roads.	**Municipal F & I Affected** Access to Sewage Treatment Plants and pumping stations. Municipal sidewalks. Both Municipal roads. Landfill operation.	**Specific Issues Anticipated** See: inland flooding for snowmelt and rain events. Access to all Facilities and infrastructure is compromised.	**F & I Important to Emergencies** Fire Departments,Emergency Operations Centre.	**Maps of Affected Municipal Infrastructure** Map 2, Low-lying areas	**Information Spreadsheets** Attached	

Winter Storm/Blizzard

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** The very young, elderly and infirm are particularly vulnerable.	**EMO Integration** REMO all hazards plan	**Maps** Map 1 – Coastal Flooding Map 2 – Inland Flooding.	**Hazards which Affect Health and Safety** Road blockage due to snow, power outage due to wet snow, ice, and wind.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** All sectors of the economy.	**Options for dealing with threats to the economy** None identified	**Beneficial Effects** None		**Economic Effects of Emergencies** High
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Winter storms are common occurrence	**Expected Change in Environmental Problems** More frequent intense storms are predicted.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** None identified	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** Developed with REMO

3.6 Hot Days/Heat Wave

Step Two CLIMATE CHANGE ISSUES & HAZARDS	**Hazard** Heat wave: three consecutive days with temperatures over 30 degrees Celsius	**Climate Issues** Climate projections indicate drier, hotter summers with an increase in mean temperatures	**Anticipated Future Effects** Increase in the number of hot days and the likelihood of heat waves. Increased electricity use, need for medical help. Mean temperature increase may lead to outdoor work inefficiencies.	**Level of Preparedness** Low	**Maps** None	**Information Gaps** Rate of increase in mean temperatures is unknown.	**Climate Change Benefits** Increase in summer temperatures will favour heat-loving crops.
Step Three AFFECTED LOCATIONS		**Historical Places Affected** Entire Municipality	**Expected Places Affected** Entire Municipality	**Degree of Impact** High	**Maps of Affected Locations** Map 3, Emergency Response	**Information Gaps** As above	
Step Four FACILITIES & INFRASTRUCTURE	**Key Municipal Facilities & Infrastructure** None	**Municipal F & I Affected** Outside maintenance of parks, sewers becomes more difficult in extended heat wave.	**Specific Issues Anticipated** Increased pressure on groundwater resources Increased pressure for central water supply in Chester Village Increased pressure for weekly garbage collection.	**F & I Important to Emergencies** Municipality will co-operate with community groups to set up comfort stations (cooling centres).	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** Attached	

Hot Days/Heat Wave

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** The very young, elderly and sick people are particularly vulnerable.	**EMO Integration** REMO all hazards plan	**Maps** None	**Hazards which Affect Health and Safety** Prolonged heat is itself a hazard .to health.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** All sectors Forestry is particularly vulnerable to woods travel closures. All sectors are vulnerable to brownouts caused by pressure on power supplies for air conditioning.	**Options for dealing with threats to the economy** Review Nova Scotia Power ability to generate sufficient power to meet demand.	**Beneficial Effects** None		**Economic Effects of Emergencies** Medium
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Relatively small number of occurrences.	**Expected Change in Environmental Problems** Increase in the number of occurrences.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Water loss in wetland areas	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** Developed with REMO

3.7 Forest Fire/ Wildfire

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Uncontrolled fire in forest land. May threaten residential areas. About 97% of wildfires in Nova Scotia are caused by human activities.	**Climate Issues** Drier hotter summers are predicted	**Anticipated Future Effects** Increased difficulty in controlling wildfires	**Level of Preparedness** High	**Maps** None	**Information Gaps** Rate of change in mean temperatures	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** All woodlands	**Expected Places Affected** All woodlands and natural open areas Most residential areas	**Degree of Impact** High	**Maps of Affected Locations** Map 4, Forested Areas	**Information Gaps**	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Sewage treatment plants and sewage pumping stations.	**Municipal F & I Affected** Sewage treatment plants and sewage pumping stations.	**Specific Issues Anticipated** Destruction of productive forest land, destruction of residential areas. Damage to parklands and to sewage systems. Continued education of the public on fire safety. Land Use – the urban/forest interface may need regulation to protect houses from wildfires. The municipality may need to further restrict open burning.	**F & I Important to Emergencies** Fire Departments. None are owned or operated by the Municipality. Provincial forest fire fighting resources.	**Maps of Affected Municipal Infrastructure** Map 3, Emergency Response	**Information Spreadsheets** Attached	

Forest Fire/Wildfire

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Most of the population lives in or near forested land.	**EMO Integration** In REMO all hazards plan	**Maps** Map 4 Forest Areas	**Hazards which Affect Health and Safety** Uncontrolled fire Inhalation of smoke from extensive wildfire.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Forestry	**Options for dealing with threats to the economy** See previous page – Land use may require regulation to protect housing from wildfires.	**Beneficial Effects** None identified		**Economic Effects of Emergencies** Large wildfires may destroy large amounts of valuable forest land. Uncontrolled wildfires may destroy housing.
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Extensive damage to NS forests before forest fire fighting became practical.	**Expected Change in Environmental Problems** More hot dry summers will likely increase the risk of forest fire.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Provincial protected lands (12%).	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** Developed with REMO

3.8 Drought

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Prolonged period of abnormally dry weather that depletes water resources.	**Climate Issues** Higher temperatures and decreased precipitation during summer months	**Anticipated Future Effects** Increased risk of drought.	**Level of Preparedness** Low	**Maps** None	**Information Gaps** Global Climate models leave some uncertainty about the effects in Atlantic Canada.	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** Entire Municipality	**Expected Places Affected** Entire Municipality. Reduction of private water supply from wells. Potential for salt water intrusion along the coast. Impact on some agricultural crops from lack of irrigation water.	**Degree of Impact** Medium to high	**Maps of Affected Locations** None	**Information Gaps** Affected agricultural crops.	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** None affected directly. Municipal office and Kaizer Meadow Landfill office have drilled wells.	**Municipal F & I Affected** Parks and grounds	**Specific Issues Anticipated** Maintenance of parks and grounds will be affected. Increased pressure for water supply in Chester Village.	**F & I Important to Emergencies** None	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** Attached	

Drought

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** People on dug wells are especially vulnerable. The core of Chester Village is known to be particularly vulnerable. Some agricultural operations are vulnerable.	**EMO Integration** In REMO all hazards plan	**Maps** None	**Hazards which Affect Health and Safety** Reduced drinking water supply	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Chester Village businesses. Local small farms	**Options for dealing with threats to the economy** Central water supply for Chester Village	**Beneficial Effects** Possible increase in tourism, boating and outdoor recreation.		**Economic Effects of Emergencies** None identified
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Drought is infrequent in Chester Municipality.	**Expected Change in Environmental Problems** Drier, hotter summers will produce more frequent drought conditions.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Wetlands, lakes and streams.	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** Developed with REMO

3.9 Animal Disease, Pests, and Invasive Species

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** 1. Diseases affecting agricultural animals 2. Diseases affecting wildlife 3. Animal diseases affecting humans	**Climate Issues** Changes in mean temperature and precipitation create favourable conditions for diseases which have been historically rare or unknown in the Atlantic Region	**Anticipated Future Effects** Diseases and pests adapted to warmer climates will be introduced and thrive in Atlantic Canada. Recent examples include the black-legged tick which carries Lyme Disease and white nose syndrome which affects bats.	**Level of Preparedness** 1. High for agricultural animals 2. Medium for Wildlife 3. High for humans	**Maps** Map 5 Agriculture Areas	**Information Gaps** The identity of likely diseases	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** Entire Municipality	**Expected Places Affected** Entire Municipality	**Degree of Impact** Medium	**Maps of Affected Locations** None	**Information Gaps** Future threats are unknown	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Kaizer Meadow Environmental Management Centre	**Municipal F & I Affected** KMEMC Landfill	**Specific Issues Anticipated** Disposal of large numbers of animal carcasses at short notice.	**F & I Important to Emergencies** Landfill	**Maps of Affected Municipal Infrastructure** Map 5 Agricultural Areas	**Information Spreadsheets** None	

Animal Disease, Pests, and Invasive Species

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Agricultural workers are vulnerable to any animal/human disease cross-over.	**EMO Integration** In REMO all hazards plan	**Maps** Map 5 Agricultural Areas.	**Hazards which Affect Health and Safety** Bites/stings by disease vectors Consumption of contaminated foods.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Agricultural Sector	**Options for dealing with threats to the economy** Agriculture Canada maintains a surveillance and reporting system.	**Beneficial Effects** None		**Economic Effects of Emergencies** Interruption of food supplies Destruction of contaminated foods/livestock
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Increased range of disease vectors, including the dog tick and the black-legged tick (Lyme disease)	**Expected Change in Environmental Problems** Continued change in the range of disease vectors such as ticks, resulting in the importation of new diseases	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Wetlands	**Dangerous or Hazardous Materials** In animal disease outbreaks, there may be large numbers of animal carcasses to be dealt with quickly and in a sanitary way to avoid human health threats.	**Emergency Preparedness Plan** Developed with REMO

3.10 Plant Disease, Pests, and Invasive Species

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** 1. Diseases affecting agricultural plants. 2. Diseases affecting forest plants.	**Climate Issues** Changes in mean temperature and precipitation create favourable conditions for diseases which have been historically rare or unknown in the Atlantic Region.	**Anticipated Future Effects** Diseases and pests adapted to warmer climates will be introduced and thrive in Atlantic Canada. Heat and drought stress will make some plants more susceptible to disease.	**Level of Preparedness** 1.High for agricultural plants 2. Medium for forest plants.	**Maps** Map 5 Agriculture Areas	**Information Gaps** Identity of likely diseases and pests.	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** Entire Municipality	**Expected Places Affected** Entire Municipality	**Degree of Impact** 1.High for agricultural plants 2. Medium for forest plants.	**Maps of Affected Locations** Map 4, Forest Areas Map 5, Agricultural Areas	**Information Gaps**	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** None	**Municipal F & I Affected** Parkland and other Municipal lands.	**Specific Issues Anticipated** Loss of woodland. Loss of agricultural crops Need for a Municipal land Management Policy. Need for forest management plan at Kaizer Meadow landfill.	**F & I Important to Emergencies** None	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** None	

Plant Disease, Pests, and Invasive Species

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Agricultural and forestry workers.	**EMO Integration** In REMO all hazards plan	**Maps** Map 5 Agriculture Areas	**Hazards which Affect on Health and Safety** Consumption of contaminated foods.	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Agriculture and Forestry	**Options for dealing with threats to the economy** None identified	**Beneficial Effects** None identified		**Economic Effects of Emergencies** Destruction of contaminated foods. Failure of diseased/infested crops
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** None identified	**Expected Change in Environmental Problems** Continued change in the range of disease vectors, resulting in the importation of new diseases	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** Farmland	**Dangerous or Hazardous Materials** Pesticides and herbicides	**Emergency Preparedness Plan** Developed with REMO

3.11 Forest Cover Changes

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** The pace of climate change is expected to be more rapid than any previous change shown in the geological record, and is expected to be proceed more quickly than forest plant populations can move	**Climate Issues** Rapid changes in mean temperature and precipitation	**Anticipated Future Effects** Changes in forest composition, with susceptible species dying out relatively quickly over the next 100 years.	**Level of Preparedness** Low	**Maps** Map 4 Forest Areas	**Information Gaps** The pace of climate change is yet unknown.	**Climate Change Benefits** Some native species may grow more rapidly in some parts of the Province in warmer conditions.
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** Unprecedented change	**Expected Places Affected** Entire Municipality	**Degree of Impact** Medium	**Maps of Affected Locations** Map 4, Forested Areas	**Information Gaps** The pace of climate change is yet unknown.	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Parklands, Landfill property, Municipal Islands.	**Municipal F & I Affected** Parklands, Landfill property, Municipal Islands.	**Specific Issues Anticipated** Change in forest species mix will change the economy of forest operations, including Christmas trees.	**F & I Important to Emergencies** None	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** None	

Forest Cover Changes

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Forestry workers, all residents.	**EMO Integration** Not addressed – no emergencies foreseen	**Maps** Map 4 Forest Areas	**Hazards which Affect on Health and Safety** None identified	**Emergency Resources** REMO plans list resources, including REMO, police, fire, Red Cross, local contractors
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Forestry and related industries.	**Options for dealing with threats to the economy** When planting cut-over areas, use species adapted to warmer conditions.	**Beneficial Effects** None		**Economic Effects of Emergencies** No emergencies forseen.
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Human-induced changes to the forest have been faster than climate-related changes.	**Expected Change in Environmental Problems** As climate changes to warmer winters and hotter, drier summers, the mix of forest species will change.	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** All forested lands, all species.	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** None

3.12 Agricultural Crop Changes

Step Two CLIMATE CHANGE ISSUES & HAZARDS	**Hazard** The pace of climate change is expected to be more rapid than any previous change shown in the geological record. Traditional agricultural crops may not thrive, other crops may become economically viable.	**Climate Issues** Rapid changes in mean temperature and precipitation	**Anticipated Future Effects** Some current crops may not thrive in the new conditions, but there is an opportunity to introduce new crops.	**Level of Preparedness** None	**Maps** Map 5 Agriculture Areas	**Information Gaps** The pace of climate change is yet unknown.	**Climate Change Benefits** There may be an opportunity for new crops.
Step Three AFFECTED LOCATIONS		**Historical Places Affected** Unprecedented change	**Expected Places Affected** Agricultural operations.	**Degree of Impact** Medium	**Maps of Affected Locations** Map 5, Agricultural Areas	**Information Gaps** The pace of climate change is yet unknown.	
Step Four FACILITIES & INFRASTRUCTURE	**Key Municipal Facilities & Infrastructure** None	**Municipal F & I Affected** None	**Specific Issues Anticipated** None	**F & I Important to Emergencies** None	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** None	

Agricultural Crop Changes

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Agricultural workers	**EMO Integration** No emergency foreseen	**Maps** Map 5 Agriculture Areas	**Hazards which Affect on Health and Safety** None identified	**Emergency Resources** N/A
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Agriculture	**Options for dealing with threats to the economy** Gradual adaptation of commercial crops to changing growing conditions.	**Beneficial Effects** Farmers may be able to switch to new crops.		**Economic Effects of Emergencies** None identified
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Unprecedented Change	**Expected Change in Environmental Problems** N/A	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** All farmlands	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** N/A

3.13 Sea Temperature Rise, Acidification, and Invasive Species

Step Two **CLIMATE CHANGE ISSUES & HAZARDS**	**Hazard** Climate change results in warmer waters along the Atlantic coast of Nova Scotia, changing the mix of plant and animal species in our waters. Traditional fisheries may collapse. Unfamiliar diseases and pests may thrive. Invasive species from further south may thrive	**Climate Issues** Sea temperatures in this area may continue to warm, changing local climate and changing the plant and animal populations in the sea. Increased input of carbon acidifies sea water, interfering with the growth of shells by m a great many organisms, from plankton to coral, shellfish, crabs and lobsters. Invasive species supplant native species and change the local ecology.	**Anticipated Future Effects** Warmer sea temperatures also allow storms such as hurricanes to retain greater strength as they enter Nova Scotia waters.. Changes in animal and plant populations will increase. Increased general warming may change the course of the Gulf Stream, which could lead a sudden cooling of the waters off Nova Scotia.	**Level of Preparedness** Low	**Maps** None	**Information Gaps** The future pace of sea temperature rise and acidification are unknown	**Climate Change Benefits** None
Step Three **AFFECTED LOCATIONS**		**Historical Places Affected** Entire coast has been affected by invasive species such as tunicates and green crabs.	**Expected Places Affected** Entire coastline	**Degree of Impact** High	**Maps of Affected Locations** None	**Information Gaps** The future pace of sea temperature rise and acidification are unknown	
Step Four **FACILITIES & INFRASTRUCTURE**	**Key Municipal Facilities & Infrastructure** Wharves	**Municipal F & I Affected** Wharves	**Specific Issues Anticipated** None identified .	**F & I Important to Emergencies** None identified	**Maps of Affected Municipal Infrastructure** None	**Information Spreadsheets** Appendix A	

Sea Temperature Rise, Acidification, Invasive Species

Step 5(a) **WHO WILL BE AFFECTED**	**Who is Vulnerable?** Aquaculture and fisheries	**EMO Integration** No emergency foreseen	**Maps** None	**Hazards which Affect on Health and Safety** None	**Emergency Resources** N/A
Step 5(b) **ECONOMIC IMPLICATIONS**	**Vulnerable Economic Areas** Aquaculture and fisheries, including fishing tourism. Lobster and crab fisheries.	**Options for dealing with threats to the economy** Reduce greenhouse gas emissions.	**Beneficial Effects** None identified		**Economic Effects of Emergencies** N/A
Step 5(c) **ENVIRONMENTAL ISSUES**	**Historical Environmental Problems related to weather or climate change.** Green crabs are having a serious effect on sea urchins and thus on seaweeds. Tunicates are smothering mussel farms	**Expected Change in Environmental Problems** Pace of change is expected to increase	**Sensitive Habitats, Ecosystems, Wildlife, Endangered species** All salt water populations of fish and plants.	**Dangerous or Hazardous Materials** None identified	**Emergency Preparedness Plan** None

PRIORITIES FOR ADAPTATION

	SHORT-TERM: 0 TO 5 YEARS	RESPONSIBILTY	MEDIUM-TERM: 5 TO 20 YEARS	LONG-TERM: OVER 20 YEARS.
INFRASTRUCTURE	**TOP PRIORITY** Develop the Information Services Department capacity to acquire, store, and manage data on infrastructure and mapping.	Information Services	Keep Asset mapping up to date.	Re-evaluate Municipal Climate Change Action Plan.
	Finish the asset mapping for sewer systems, sidewalks, storm systems, street lighting.			
	Identify and map vulnerable emergency response, cultural and heritage resources. (Includes wharves, slipways, beaches, fire halls, schools, etc.)			
	SEWAGE TREATMENT PLANTS - Review inflow and infiltration effect on capacity and develop mitigation plans - review emergency power options and develop mitigation plan - Review vulnerability to coastal flooding and inland flooding and develop mitigation plan - Review expansion options and replacement options and identify preferred options.	Public Works	Implement mitigation plans incrementally each year.	
	SEWAGE LIFT STATIONS - Review Power outage options for all, based on vulnerability and function and develop mitigation plan.			
	FORCE MAINS - review installation standards for those potentially affected by tide and coastal flooding		Implement mitigation plans incrementally each year	
	NEW ROSS AND WESTERN SHORE STP - monitor and record all river flood events.		Upgrade installation whenever force mains are replaced.	
	SECOND PRIORITY PARKS -Review all park and recreation land for vulnerability and long-term adaptation plans.	Recreation and Parks	Develop mitigation plans based on recorded observations.	
	TRAILS - Monitor and identify potential drainage problems on the Chester Connection and Aspotogan Trails.			
	- Review and assess all bridges on the Chester Connection and Aspotogan Trails and develop upgrade schedule.		Develop mitigation or abandonment plans.	
	WHARVES AND SLIPWAYS - Review vulnerability to sea level rise and storm surges, inspect regularly, repair, and maintain against increasing storm damage.	Public Works	Upgrade drainage incrementally each year. Upgrade bridges incrementally each year.	
	KAIZER MEADOW LANDFILL - Adapt landfill operation, leachate treatment and stormwater treatment systems to manage increased rainfall	Kaiser Meadow	Plan for re-location or abandonment of wharves and slipways	Re-locate or abandon wharves and slipways.
OUTREACH	Publish this climate Change Action Plan throughout the Municipality, including website, regular mention in newsletters, presentations to community groups. Include and publicise legible maps showing vulnerable areas.	Info Services; Community Development	Continue to promote Climate Change Action Plan and its review processes.	Re-evaluate Municipal Climate Change Action Plan
	Refer bridge, highway and storm drainage infrastructure issues to the NS Dept. of Transportation and Infrastructure Renewal.	Public works		
	Develop agreements with TIR on maintenance of storm drainage which affects Municipal Infrastructure.			
	Refer this Climate Change Action Plan to Development Agencies and the Regional Emergency Measures Organisation.	Community Development		

POLICY AND PLANNING	Review Municipal Planning Strategy, Subdivision By-law, Land Use By--law and Building Code By-law to develop policy and regulation on development near vulnerable areas, including forested areas.	Community Development	Monitor Municipal Specifications and all planning documents for accommodation to climate changes.	Monitor Municipal Specifications and all planning documents for accommodation to climate changes
	Update Municipal Specifications, with emphasis on storm water and on sewage treatment.	Public Works		
	Consult with REMO and Fire Departments to develop pre-planning for the expected emergency events and with Nova Scotia emergency Measures Office to co-ordinate emergency services.	Community Development	Continue monitoring and updating pre-plans	Continue monitoring and updating pre-plans
	Include Climate Change issues in all infrastructure investment and planning	Public Works		
	Examine the findings of the Intergovernmental Panel on Climate Change Fifth Assessment Report (September 2013), and review this Plan accordingly.	Community Development	Review Climate Change Action Plan periodically and update as required in light of observed changes and updated predictions.	Periodic review of Climate Change Action Plan.
	Continue to monitor and to protect the watershed of Spectacle Lake	Public Works		

MITIGATION

The Municipality completed an inventory of all its corporate energy use using the base year of 2006, in order to determine its corporate greenhouse gas emissions (see Appendix D). This showed that the largest total energy consumer for the Municipality is the Kaizer Meadow Environmental Management Centre, due to the leachate treatment facility, as well as the large amount of diesel fuel consumed by the mobile equipment on the site. The second largest consumer is the heavy vehicles fleet used for solid waste collection and transfer to Kaizer Meadow. The third largest consumer is the category of wastewater collection and treatment systems operated by the Municipality in various communities. The fourth largest consumer of energy is the category of streetlights, including those owned by the Municipality, and those leased by the Municipality from Nova Scotia Power. The energy consumed by the corporate buildings is, in total, less than any of the other categories.

Following this inventory the Municipality completed in 2009 a Municipal Energy Audit Report (see Appendix E), which provided an analysis of the corporate energy consumption of the various assets of the Municipality. This audit also provided a list of measures and opportunities to reduce energy consumption and the corresponding greenhouse gas emissions for each of these assets. Recommendations to address the four highest energy consumers are:

- Install new high efficiency equipment at the Kaiser Meadow leachate treatment facility;
- Review vehicle size, especially vehicles servicing Kaiser Meadow, for fuel efficiency, and improve vehicle performance through routine maintenance and monitoring;
- Reduce running times for aeration blowers and other equipment in the wastewater system, and utilize high efficiency equipment and parts in the system; and
- Review street lighting usage and consider the strategic location of new streetlights to service areas where they are most needed.

The Municipality has been working at implementing the recommendations of the report. Work done to date includes:

- All overhead light fixtures in the Chester Office and the Annex buildings changed to high efficiency fixtures.
- All building heating controls upgraded to programmable controls.
- All exit lights upgraded to LED fixtures.
- Floor space at Zoe Valle Library insulated
- Complete vehicle log and monitoring system established

The Municipality intends to continue implementing the recommendations of the energy audit year by year. The Municipality is now reviewing the details of its streetlight leases with Nova Scotia Power, and the usage of the streetlights it owns in several communities.

MUNICIPAL CLIMATE CHANGE ACTION PLAN

MUNICIPALITY OF THE DISTRICT OF CHESTER

APPENDIX B

INFRASTRUCTURE RISK ASSESSMENT TABLE

INTRODUCTION TO APPENDIX B

The following spreadsheet pages were developed in February 2013 by Matthew Davidson, Director of Public Works, and Geoff Macdonald, Planner, by inserting data into a pre-formatted Appendix B spreadsheet in the Microsoft Excel program supplied by Service Nova Scotia and Municipal Relations.

The risk evaluation was based on the perceived risk over the next 10 to 20 years, as low, medium, or high.

The pre-formatted spreadsheet calculates on each page a total risk assessment based on numerical values as follows:

L = Low Risk = 1
M = Medium Risk = 2
H = High Risk = 3

If the spreadsheet calculates a total numerical value on any line as ‘high’, a secondary spreadsheet opens, with detailed explanations of the nature of the risk and the steps required to mitigate the risk.

In the case of Chester’s municipal infrastructure, no assets were calculated to have high risk, so there are no secondary sheets completed.

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	L	1	L	1	L	1	L	1	L	1	N	0	L	1	**8**	**L**
Water Treatment Plant	N	0	L	1	L	1	L	1	L	1	L	1	L	1	N	0	L	1	**7**	**L**
Water Storage Facilities	N	0	L	1	L	1	L	1	L	1	L	1	L	1	N	0	L	1	**7**	**L**
Water Pumping Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Distribution System	N	0	L	1	L	1	L	1	L	1	L	1	L	1	N	0	L	1	**7**	**L**
Individual Water Service Lines	N	0	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	**8**	**L**
Total	**1**		**5**		**5**		**5**		**5**		**5**		**5**		**1**		**5**		**37**	
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	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Wastewater Gravity Sewer	M	2	L	1	M	2	N	0	M	2	L	1	L	1	L	1	L	1	**11**	**M**
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**		**4**		**7**		**2**		**7**		**4**		**4**		**4**		**4**		**43**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Storm Sewer System																				
Catchbasins	L	1	L	1	L	1	N	0	L	1	N	0	L	1	N	0	L	1	**6**	**L**
Manholes	L	1	L	1	L	1	N	0	L	1	N	0	N	0	N	0	L	1	**5**	**L**
Pipes	L	1	N	0	L	1	N	0	L	1	N	0	N	0	N	0	L	1	**4**	**L**
Total	**3**		**2**		**3**		**0**		**3**		**0**		**1**		**0**		**3**		**15**	
Municipal Buildings																				
Buildings	N	0	L	1	L	1	L	1	N	0	L	1	L	1	N	0	L	1	**6**	**L**
Total	**0**		**1**		**1**		**1**		**0**		**1**		**1**		**0**		**1**		**6**	
Landfills/Solid Waste Facilities																				
Flooding	N	0	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	**8**	**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	N	0	N	0	N	0	L	1	**6**	**L**
Leachate Treatment	N	0	L	1	M	2	L	1	N	0	N	0	L	1	L	1	L	1	**7**	**L**
Buildings	N	0	L	1	L	1	L	1	N	0	L	1	L	1	N	0	L	1	**6**	**L**
Total	**0**		**5**		**7**		**5**		**3**		**3**		**4**		**3**		**5**		**35**	
Dams																				
Flooding	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Control Gates	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Access Road	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Fish Passage	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	

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	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Street Lighting	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	L	1	**1**	**L**
Signs	N	0	N	0	N	0	L	1	N	0	N	0	N	0	N	0	L	1	**2**	**L**
Culverts	N	0	L	1	M	2	L	1	M	2	N	0	L	1	N	0	L	1	**8**	**L**
Sidewalks	L	1	L	1	L	1	L	1	M	2	N	0	L	1	N	0	L	1	**8**	**L**
Local Roads	L	1	L	1	L	1	N	0	L	1	N	0	L	1	N	0	N	0	**5**	**L**
Collectors	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**2**		**3**		**4**		**3**		**5**		**0**		**3**		**0**		**4**		**24**	

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

MUNICIPAL CLIMATE CHANGE ACTION PLAN

MUNICIPALITY OF THE DISTRICT OF CHESTER

APPENDIX C

HAZARD, RISK, VULNERABILITY ASSESSMENT

REGIONAL EMERGENCY MANAGEMENT ORGANIZATION

MCCAP and HRVA Workshop Summary

Project Background (MCCAP *and REMO Collaborative Work Project*)

Each Municipality in Nova Scotia is tasked with completing a Municipal Climate Change Adaptation Plan (MCCAP) by December 2013.

During preliminary work it became obvious there is clear cross-over between the information needed to complete the MCCAP and the information gathered to complete the REMO Hazard Risk Vulnerability Assessment (HRVA) model. REMO uses completed HRVA models to assess the impacts of identified threats and direct Emergency Planning efforts at all levels of mitigation, preparedness, response and recovery. There are 9 hazards identified that have some linkage to Climate Change. It was determined that completion of the HRVA for each of these 9 related hazards will not only provide hazard analysis for responding to emergencies within REMO, it will also gather the information required for much of Steps 2, 3, and part of Step 5 out of the 6 Steps necessary to complete the MCCAP.

By contributing concentrated effort to completing 9 HRVAs in the shared REMO capacity, each municipality will have information available to them that can extrapolated from the HRVAs directly into their MCCAP. Each of the REMO municipalities committed to this project.

Project Process

For the first step of this process, the REMC completed a draft version of each of the following hazards:

-Flood Inland
-Hurricane
-Storm Surge (later changed to Coastal Flooding)
-Drought
-Forest/Wildland Fire
-Hot Days/Heat Wave
-Thunderstorm/Tornado/Hail
-Animal Disease
-Winter Storm/Blizzard

The nine draft HRVAs were then circulated to each Municipal unit for familiarization and review through the Planning Officer or person responsible for MCCAP completion and Assistant Emergency Coordinator (AEC). Each Municipal unit reviewed the documents for the purpose of indentifying information available to enhance completion of the HRVA and to identify internal sources for this information. During this step in the process maps were also generated to support analysis.

Each municipal unit established a committee consisting of the REMC, AEC's, Planning Officers and any other pertinent staff members identified as having crucial information for the HRVA. Representatives from these individual committees participated in a 2 day workshop, facilitated by the REMC, for the purpose of completing the 9 HRVAs as regional documents inclusive of each units findings.

Workshop Goal and Objectives

Goal: To have completed a Regional HRVA for each of the 9 threats with an assigned ranking number indicating priority for planning.

Workshop Objectives/Format (completed for each of the 9 threats)

1. Review basic impact of each threat with consideration for Climate Change predictions (REMC)
2. Review individual unit HRVA with emphasis on infrastructure and vulnerabilities for each impact area identified on maps provided by units. (Unit Lead)
3. Complete any information gaps for each HRVA required for overall analysis (group + assistance from outside sources via phone calls, internet etc. as required)
4. Compile all information into one Regional HRVA (REMC)
5. Assign overall regional ranking of threat (group consensus)

Review Process for Capturing Information outside Workshop Scope

It was identified that the detailed analysis of risk would likely identify issues of concern in all areas of prevention, mitigation, adaptation, preparedness, response and recovery. It was recognized these issues might be specific to a particular unit or regional in scope. In order to remain focused on analysis only without losing valuable information for later use, a flagging system was utilized during the workshop.

Issues outside the scope of analysis, as well as issues, questions or concerns that could not be answered during the workshop with the gathered resources and personnel were documented within three categories:

1. White flag of surrender- any item that was a long-standing issue, considered political in nature, or involved personnel not within the committee or unit jurisdictions (ex. Provincial, or municipal leadership)
2. Red Stop for REMO- any item that should be addressed by the REMO group during response, future planning or analysis
3. Green Go to MCCAP- any item that should be addressed through further MCCAP work.

All items are documented in Appendix A.

Workshop Conclusions

Each of the nine HRVAs was completed. Final scores and hazard ranking are as per Table 1.1 below.

Table 1.1. HRVA/MCCAP Threat Analysis

Threat	Hazard Risk Vulnerability Ranking	Hazard Risk Vulnerability Actual Rating Score (1-25)
Hurricane	**High**	**25**
Coastal Flooding	**High**	**20**
Flood Inland	**High**	**20**
Winter Storm/Blizzard	**High**	**15**
Wildland Fire	**High**	**14**
Hot Days	**High**	**12**
Drought	**Moderate**	**10**
Animal Disease Outbreak	**Moderate**	**9**
Thunderstorm/Tornado/Hailstorm	**Moderate**	**6**

Workshop Recommendations

1. The REMC will compile the 9 detailed HRVAs with the workshop summary and forward to AEC's for distribution throughout their committees.

2. It is recommended the completed HRVAs be utilized by each unit in completing their MCCAP. It is suggested the HRVAs be included as an Appendix to the final document to fulfill requirements for Steps 2 through 6 of the MCCAP.

3. The HRVAs should be compiled in a cleaner format/word processed document for inclusion in the MCCAP. In particular, the environment and property damage cost section of the Impacts table could be extracted and presented in a more user friendly/readable format. MODL (Douglas Reid) has a partial template that could be used for this. One of the four units with resources to do this would then share the formatted versions with REMO and the other three units.

4. A revised template of the HRVA as per # 3 above would be adopted for future REMO use.

5. REMO should complete or revise existing Contingency Plans for the hazards as analyzed in priority sequence.

6. The list of maps required as per *Appendix B* should be acquired for each municipal unit and compiled by a lead mapping specialist for REMO use (MODL agreed to take the lead on this). A comprehensive map book (hard and electronic format) should be compiled for REMO, MCCAP, and additional municipal use.

7. The electronic versions of the map book as per #6 above should be uploaded to the REMO website for access during an emergency or for planning stages.

8. All items identified in ***Appendix A*** should be assigned to responsible parties with timelines for completion. It is recommended for items within "White Flag" section of Appendix A, CAO's from Municipal units determine responsible parties for completion.

Appendix A

The following includes all items documented during the workshop process that were deemed outside the scope of the workshop but pertinent for future consideration and effort.

White Flags (surrender)

- Political Leadership can more properly assess Risk Tolerance
- Do units have complete BCP's for infrastructure loss?
- Get drought definition from NS Agriculture
- DNR response and capacity needs to be re-evaluated provincially
- Need inspection teams for post evacuation to allow for return of residents (resources)
- Determine what temperature are set points for pumps etc. vulnerable to hot days
- Need NS TIR information (operational) on vulnerable infrastructure to inland flooding and coastal flooding
- Need a better list of industrial, agricultural, hazardous material sites
- Can we define Severe/Major Thunderstorm?
- Need Base mapping for location of culverts (main) and bridges for all TIR roads

Red Stops (Items for REMO)

- Storm Surge plan should deal with wells (salt water intrusion) as public information to be disseminated
- Public Service Announcements should include:
    - To inform public of insurance coverage
    - To inform public that current insurance doesn't cover inland flooding (vertical)
- Need to include testing for Municipal Water supplies post flooding in plans
- Look at adding a "How to Communicate with " in the "Susceptible Persons" column for effective EM planning
- Need maps for Telecommunication Towers
- Consider "Inn From the Cold" for Comfort Station in Bridgewater
- Need contact information for private campgrounds in Resource Inventory

Green Stops (Items for MCCAP)

- Track response costs for Heat Days in local Fire Departments
- Flood mapping for Bridgewater Watershed (talk to Public Service Commission)
- MCCAP to identify flood plains and land use by-law to regulate land use in the Flood Plain
- Chester analysis for vulnerable populations to coastal flooding
- Connections with Lead Agencies on Animal-Related Diseases (vector mapping) incidence of disease mapping (rabies, lyme, white nose, EEE, etc.)
- Registered farm/agricultural operations (mapping)

Appendix B

The following maps are required for each municipal unit:

Coastal Flooding

Layers to include:

- Coastal dwellings/areas of population
- Businesses
- Senior's/long term care complexes
- Farm/livestock
- Pet owners
- Mobile home parks
- Campgrounds
- Sewage plants
- Lift stations
- Industrial sites
- Gas stations
- NSP infrastructure (lines, substations, regional office)
- Roadways
- Bridges
- Wharves and boat launches
- Ferry terminals (Chester, Tancook(s); LaHave)
- Water treatment facilities
- Fire departments
- EHS stations
- Police stations
- Wells and on-site systems

All coastline (specific areas identified as vulnerable as below)

- Mahone Bay (maps from Dalhousie report- Edgewater and Main St.)
- Bridgewater (2-7m surge; Shipyard's Landing; Mall and area along low side of River front)
- MODL(Kingsburg, Petite; Riverport; Green Bay, Big and Little Tancook; other areas of coastline)
- MODC (Highway 3; Highway 329; Western Shore/Gold River; Village of Chester; Blanford; Hubbards)

Flood Inland

Layers to include:

- Dwellings/areas of population
- Pet owners

- Livestock/farms
- Bridges along river (Bridgewater, New Germany, Petite) LaHave, Gold River at New Ross
- East River, Martin's River)
- Roadways
- Culverts
- Water or Waste Water Treatment Facilities and Systems (New Germany; Conquerall Bank; Hebbville; Western Shore; Bridgewater; Vaughan's Brook; New Ross)
- Water and Waste Water lines under LaHave River (Town of Bridgewater and New Germany)
- NS Power Substations
- Dams (Bridgewater Watershed as mapped and Morgan Falls in New Germany)
- Source Water / water supply lakes (Oakland)
- Cemeteries
- On site septic and wells;
- Industrial and agricultural sites with potential hazardous waste and or goods

All low lying/ flood prone areas mapped for:

- Town of Bridgewater
- MODL- LaHave River North of Bridgewater to County Line (Meisner's section)
- MODL- LaHave River Watershed flood risk analysis based on slope

Specific Impact Areas identified as:

- Fancy Lake subdivisions; New Germany/Barss Corner; Petite Rivere along river Fancy Lake downriver
- Lake Lawson (New Ross)
- Mahone Bay- (Clearway to Edgewater St.; Ernst Brook)
- Martin's River; East River

Winter Storm/Blizzard

Each municipal unit boundaries with layers to include:

- Farm/livestock owners
- Pet owners
- Mobile Home Dwellers
- Hospital
- Emergency Infrastructure (EHS Stations; Fire Dept., Police Stations, REOC's
- Evacuation centers and Comfort Stations (including NSCC)
- Roads and Bridges
- Ferry Terminal (Chester and Tancook Islands and LaHave)
- Dams (Hebbs Lake System)
- Water and Waste Water Treatment plants (due to power issues)
- Telecommunications Equipment
- Power substations and transmission lines
- Public Works garage (Bridgewater, TIR Hebbville; Marriott's Cove)

Wildland Fire

Each municipal unit boundaries showing areas where property densities encroach on wildlands

Layers to include:

- Restricted access areas (ex. Kingsburg; Big Tancook)
- Pet/Livestock owners
- School populations (including day cares)
- Campground/seasonal residents/cottage developments
- Hospital
- Municipal Water Supply (Hebbs Lake System and Oakland and Dares Lake)
- Roads
- NSP transmission lines and substations
- Water and waste water treatment plants
- Fire Stations
- Police
- EHS
- Landfills (Kaiser Meadows; Whynott Settlement)
- Telecommunication towers
- DND Radio (Federal Asset) Mill Cove)

Drought

Maps identifying the following boundaries:

- Town of Bridgewater (Hebbs Lake Water supply area)
- Town of Mahone Bay (Oakland Water supply area)
- Dares Lake Water Supply Area
- MODL- inland (well water decreased supply: New Germany)
- Coastal (risk of salt water intrusion)
- MODC- all residents on well systems (Village of Chester; Western Shore)

Layers to include:

- Farm/livestock owners
- Residents on dug wells
- Fire Suppression services (fire ponds, dry hydrants)

Animal Disease

Mapping for each unit of areas with registered agricultural use (Farmers and Livestock owners)

- Layers to include:
- Exhibition grounds
- New Ross Fairground
- Farm Supply Operators (Shur-gain; Co-op)
- Farmers Market Sites
- Pet owners/Hobby farms
- Veterinarian clinics
- Kennels /Animal Shelters

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Coastal Flooding

Background Information

Analysis Completed For: ____REMO Lunenburg Co._____

Analysis Completed By: ____Planning Committee & MCCAP Planning Project___

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: _____ Coastal Flooding ___

Coastal flooding occurs when sea water inundates coastal land forms. This can be influenced by sea level rise, storm surge, wind, waves, and tidal variations.

Storm surge = temporary increase at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place. Negative storm surges also occur and can present significant problems for navigation. (MCCAP guidebook pg. 4)

The two main atmospheric components that contribute to a storm surge are air pressure and wind. Deep low pressure systems can create a dome of water under the storm (much like the low pressure in a vacuum on a carpet). High winds, lunar influences and sea level rise along a coastline can also elevate the water levels at the shore, depending on the direction of the wind with respect to the coast. (Environment Canada)

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
October	none	Nor'easter occurred causing Storm Surge to reach levels only 15cm less than the

30, 2011		storm surge of Hurricane Juan
January 2-3 2010	unknown	Baie-Verte and Port Elgin NB Peak water levels lasted for approx. 2 hours, no gauges to identify height but greater than recorded 5 feet at closest gauge; winter storm event; $627,673 damage costs
October 29, 2009	unknown	Eastern and Northern Coastline NB Severe storm surge with winds in excess of 130km/hr. Private property, businesses & public infrastructure damaged. Emergency shellfish aquaculture industry (mussels, oysters & clams) was greatly affected.
December 27, 2004	unknown	Kings County PE Winter storm, winds & surge. Person rescue by firefighters from flooded residence
September 2003		Hurricane Juan 1.63M surge at Halifax
January 21, 2000	unknown	1.36 m surge occurred as intense storm passed 55km east of Charlottetown bringing 70km/h sustained winds. Peak surge coincided with high tide resulting in water level of 4.23m above chart datum. 460 properties inundated including gas stations, power generating plant and damaging wharves
1996		Hurricane Hortense- 1M storm surge
October 25, 1983	unknown	Cape Breton Island Eastern shores of Cape Breton Island;

		water levels rose to 0.761.5m above normal high water mark. Flood highways and destroyed 30 fishing boats and thousands of lobster traps.
February 2, 1975	unknown	Western, Central and Northern NS & Saint John NB "Groundhog Day Storm", produced 188km/h winds & 12m waves with swells 10m high. NB- $8,005,500 damage; transportation & utilities stopped for a week, 550m sea wall caved in; damaged docks, buildings, boats, mobile homes, lobster traps & nets; hydro poles & trees NS- $ 4,137,800 damage; roofs, windows, trees, power and telephone lines, sea wall damage; biggest impacts due to storm surge; fishing industry greatly affected by damage to shoreline as a result of extremely high tides

Predicted Events without Historical Evidence

Predicting Authority	**Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)**	**Mitigation Strategies in Place**	**Comments**
Intergovernmental Climate Change Panel 2007	50	Climate Change Adaptation Plans to be created by December 31,	ICCP reports projects increase in global average surface temperatures will result in global sea level rise of a meter

		2013.	or more by the end of this century. This will occur due to thermal expansion of seawater and melting glaciers and ice caps. Predictions suggest with climate change, Halifax could experience an increase in sea level by 80cm by the year 2100. (MCCAP guidebook pg. 7) As sea level rises, the risk of storm surge inundation increases. "Increased erosion and flooding will likely mean significant impacts on coastal communities with damage to houses, buildings, roads, bridges and other types of infrastructure, as well as the risk of contamination to fresh water supplies, damage to drainage systems and sewage treatment facilities. " (Guidebook pg.7)
Daigle Report	50		Total sea level rise estimated 0.43m on Lunenburg County will increase the impact of storm surge
REMO HRVA - Hurricane	5		HRVA completed March 2012 for Hurricanes predicts high probability of storm event within 5 years or less; Hurricane event increases risk of Storm Surge

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- X 5 Highly Probable within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area (geographical; map reference)

___All coastal areas:

Mahone Bay (maps from Dalhousie report- Edgewater & Main streets)

Bridgewater (mapping available for 2-7 m surge; Shipyard's Landing; Mall & area along low side River front)

MODL- (maps available: Kingsburg, Petite, Riverport; Green Bay, Big & Little Tancook Islands other areas long coastline)

MODC-(maps available: Highway 3; Highway 329: Western Shore/Gold River; Village of Chester; Blandford; Hubbards)

Identify Population number in Impact Area

____275 + direct impact Mahone Bay; 200+ Tancook Islands; MODL (1200 households with a contour of 5m of sea level) MODC ; Bridgewater (less than 50 households; 60 business estimated)

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

Homeowners in coastal dwellings/areas (identified above)

Person's with Mobility issues

Senior's complexes (Mahone Bay Nursing Home)

Farm/livestock owners (Springoff Farm (First South))

Pet owners

Mobile Home Park (Tanner's Settlement)

Drug-dependent individuals

Medical Dependent individuals

Tourists

Campground residents Campgrounds (Risser's; Grave's Island; Rayport;)

Senior Citizen Homes (Mahone Bay; Riverport)

Identify critical Infrastructure in Impact Area

Sewage plant (Western Shore), Lift stations; Conquerall Bank; Bridgewater plant & multiple lift stations; Village of Chester lift stations; Mahone Bay lift stations; Chester Basin Lift station; Otter Point Treatment Plant

Industrial sites (fuel, chemicals) Gas Stations (Mahone Bay Irving; Chester Basin; 200 non-residential sites within MODL; Bridgewater 60 business;

NSP Regional Office in Bridgewater (poles; service trucks, supplies, personnel)

Roadways

Bridges

Wharves and Boat Launches

Ferry Terminal (Chester & Tancook (Big & Little)

Power Lines

Water Treatment Facilities

Emergency Infrastructure (First Responder Facilities (MODL (as mapped) MODC (Blandford; Western Shore)

Wells and on-site systems

Typical Impacts	# of potential Deaths or Injuries	# of persons displaced or isolated & timeframe	Environment & Property Damage Cost estimate*	Resources required to respond	Comments
Fatalities/injuries	Less than 10	N/A	N/A	EHS; Pre-evacuation would require Police Personnel	Within normal operating procedures; may have to use alternate routes for transport; pre-evacuations may be required if persons isolated from EHS
Displacement	Less than 10 (greater potential if not done prior to event)	1500+ if all areas affected; 300+ could be out for 1 week or more	Low	Red Cross; REOC; RCMP; EHS; Fire; DART-NS; Livestock Evacuation Teams;	Evacuation plans; Some cases may require Shelter –In-Place plans due to road closures
Erosion of headlands/shorelines	Less than 10 (greater potential if public not warned of unsafe conditions)	unknown	High	DNR- (parks & campgrounds)TIR; Municipal units	Evacuation in areas where property affected

Impassable/unsafe roads	Less than 10 (greater potential if no pre-evacuations and warnings issues	1500	Potentially High is permanent damage	TIR; RCMP; Red Cross; Muni Units	As per flood & evacuation plans
Drinking water contamination	(Salt Water Contamination might cause illness in more)	On-site well systems (dug wells)	Low	EHS; South Shore Health;	PSA for testing
Public property damage	N/A	N/A	High	Municipal units; provincial costs	
Private property damage	N/A	N/A	High	Individual property-owner insurance; provincial/federal assistance programs	Need PSA's to inform public
Fishing & Aquaculture Industry Disruption	None	None	High +	DF0; Environment & Labor	Long term impacts more than emergency response; issue for recovery
Economic & Ecological Disruption	None	None	Unknown	Unknown	Long term impacts more than emergency response; issue for recovery

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- ☐ 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- X 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- ☐ 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
- ☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
- ☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public		X(Political bodies may be better able to measure at time of event)	
Media		X may depend on other areas affected & pre-warnings/evacuations	

HAZARD RISK VULNERABILITY RATING

Probability score ___5__ x Overall Impact Score ___4___ = Number assigned to this hazard ____20__(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

- ☐ Low (1-5)
- ☐ Moderate (6-10)
- X High (11-25)
- ☐ Requires further analysis due to Risk tolerance rating

- Long-term planning & mitigation strategies greatly impact this risk, response and recovery. Threat predicted to increase incrementally over time due to sea level rise
- This hazard may not need separate REMO Contingency plan but could be combined with others (Flood Inland, hurricane & winter storm)
- Flag for political bodies regarding risk tolerance issues

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Flood Inland

Background Information

Analysis Completed For:__ REMO- Lunenburg Co.

Analysis Completed By: __Planning Committee (Revised May 2012 by MCCAP Planning Project)

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ___Inland Flooding ___

A Flood can be defined as "an overflow or inundation that comes from a river or other body of water and causes or threatens damage".

This may occur as a result of weather phenomena and events that deliver more precipitation to a drainage basin than can be readily absorbed or stored within the basin over time or as a Flash Flood, the result of heavy or excessive amounts of rainfall within a short period of time, usually less than 6 hours, causing water to rise and fall quite rapidly.

*Historically a 100-year flood occurs **on average** once every 100 years and thus has a 1-percent chance of occurring in a given year. (Williams & Daigle)*

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
2005-2010	Some of these bridges have been repaired since, but not all	Bridge closures due to significant events during the past 5 years New Ross Bridge (replaced), Vaughan's Brook (replaced since), East River (repaired), Chester Grant Road (repaired),

		Ernst Brook (trail bridge replaced- MAB)
February 2010	Revised REMO protocols; small-scale evacuation procedure created and distributed to first responders	1 family voluntarily evacuated (New Germany/MODL area); numerous road closures; New Germany bridge/School st. closed for few weeks, sewage treatment plant flooded; pump station overflows
May 2005	Assessment of dam-improvements implemented	100 evacuated(Fancy Lake Hebbville/MODL) ; EOC operational for several days
Feb. 2003	Work done on bridge to include ice protection	2 Deaths due to driving past barricades, car submerged in river (Pinehurst/MODL)

Predicted Events without Historical Evidence

Predicting Authority	**Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)**	**Mitigation Strategies in Place**	**Comments**
Environment Canada	5	Protocols; coordination with first responder groups for response	Flooding situation likely to continue and increase due to increased building and rising sea and water levels
Climate Change Data (N.S. Infrastructure Secretariat)	100 year floods could increase to every 10 years	As above; efforts underway to increase LIDAR mapping to indentify low-lying areas	More frequent & intense storms predicted (Daigle Report Table A-18); increasing sea level rise; wetter warmer winters; drought periods followed by heavy rainfall increasing run-off

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- X 5 Highly Probable within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- ☐ 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area (geographical; map reference)

As mapped for:

- Town of Bridgewater
- MODL- LaHave River North of Bridgewater to County Line (Meisner's section)
- MODL- LaHave River Watershed flood risk analysis based on slope

Other Impact Areas Include:

Fancy Lake subdivisions; New Germany/Barss Corner; Petite Rivere along river Fancy Lake downriver

Lake Lawson (New Ross)

Mahone Bay- (Clearway to Edgewater St.; Ernst Brook)

MODC- (Martin's River; East River)

Identify Population number in Impact Area

Approximately 100 people in heaviest density areas

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

Persons with mobility issues

Pet owners

Livestock/farms

Uninformed/unprepared residents

Identify critical Infrastructure in Impact Area

As per mapping

Bridges along river area (Bridgewater, New Germany, Petite) LaHave, Gold River at New Ross; East River, Martin's River) *s per mapping*

Roadways

Culverts

Water or Waste Water Treatment Facilities & Systems (New Germany; Conquerall Bank; Hebbville; Western Shore; Bridgewater (sites mapped); Vaughan's Brook; New Ross)

Water & Waste Water lines under LaHave River (Town of Bridgewater & New Germany)

NS Power Substations

Dams (Bridgewater Watershed as mapped; Morgan Falls in New Germany)

Water Supply Lakes (Oakland)

Cemeteries (Brookside; as per mapping)

On site septic & wells

Industrial & Agricultural Sites with potential hazardous goods

Typical Impacts	**# of potential Deaths or Injuries**	**# of persons displaced or isolated & timeframe**	**Environment & Property Damage Cost estimate***	**Resources required to respond**	**Comments**
Fatalities/injuries	Less than 10	N/A	none	EHS	Within normal operating procedures
Displacement	Less than 10	300 max within total area,	None	REMO RCMP/Police/GSR	Evacuation plans

		may be evacuated for 1 week or less		Red Cross Fire Depts TIR	
Isolation	Less than 10	100	N/A	TIR with barricades to block roads	Evacuation may be required if unable to access emergency services
Hazardous Goods & Waste Contamination of Environment (including drinking water)	Less than 10	N/A	Potentially High	Impact and resources to respond unknown; Biomonitoring could be useful; Dept. of environment	Recommendations for planning (water testing) & long term planning/land use flood plans
Bacterial Drinking Water Contamination	Illness may be experienced less than 100	N/A	Medium	Water testing kits & lab results (SSRHA) Potable Water supplies	Individual home owner concerns for those on wells; public service announcements
Bridge/Road damage	Less than 10	N/A	High	TIR with barricades	Alternative routes for all major roads; private roads may restrict access & require evacuation
Transportation disruption	None	N/A	Medium (cost of road repair)	TIR; municipalities for muni owned roads	As above

Public property damage	N/A	N/A	High	Municipal units; provincial costs	
Private property damage	N/A	N/A	High	Individual property-owner insurance; provincial/federal assistance programs	Need PSA's to inform public
Economic & Ecological Disruption	None	Unknown	Low	Unknown	Municipalties need to measure this impact for long-range planning
Erosion	Less than 10	100	High	Unknown	As above (long-range impacts)
Dam Breech	100 +	500+	High	First Responders; outside scope of mutual aid partners; would require provincial assistance	Recent upgrades, monitoring, and maintenance to dam structures (Bridgewater Water Supply maps) make a sudden breech unlikely
Ice Jams	Less than 10	100	High	First Responders	

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support

X 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable

☐ 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements

☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;

☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X		
Media		X	
Other (Resident groups in flood-prone areas ex. Hebbville; Pine Grove			X

HAZARD RISK VULNERABILITY RATING

Probability score ___5__ x Overall Impact Score __4___ = Number assigned to this hazard __20__(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

☐ Low (1-5)
☐ Moderate (6-10)
X High (11-25)
☐ Requires further analysis due to Risk tolerance rating

* Have a REMO Contingency Plan for Flood that should be reviewed after HRVA changes

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Hurricane

Background Information

Analysis Completed For: REMO- Lunenburg Co.

Analysis Completed By: __Planning Committee __ (revised May 2012 by MCCAP Planning Project)

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ___Hurricane ___

When disorganized clusters of showers and thunderstorms become organized so that a definite rotation develops and winds become strong, the system is upgraded to a tropical depression. If winds continue to increase to 63 kilometres per hour the system becomes a tropical storm and is given a name. The system becomes more organized and the circulation around the center of the storm intensifies. As surface pressures continue to drop, the storm becomes a hurricane when wind speed reaches 118 kilometres per hour. An eye develops near the center of the storm, with spiral rain bands rotating around it.

Once a tropical cyclone reaches hurricane strength it is given a rating from 1 to 5 on the Saffir-Simpson Hurricane Intensity Scale. A category 1 storm has the lowest wind speeds, while a Category 5 has the highest.

Category 1= minimal damage; primarily to shrubs, foliage and unanchored homes or structures

Category 2- moderate damage; damaged to exposed mobile homes; poorly constructed signs; some roofing; window and door damage; rising water in roads 2-3 hours before arrival of the center; marinas flooded; small craft torn from moorings; **Evacuation of some shoreline residences and low-lying areas required**. Hurricane Juan made landfall as a Category 2.

Category 3- extensive damage; large trees blown down; signs, roofing, window and door damage; structural damage to small buildings; mobile homes destroyed; serious flooding at coast; larger structures near coast damaged by waves and debris; low lying escape routes flooded with water 3-5 hours before hurricane arrives; flat terrain of 1.5 metres or less above sea level flooded inland 1.3km or more. **Evacuation of low-lying residences within shoreline area required**.

Category 4- extreme; trees, signs blown down; extensive damage to residences; complete destruction of mobile homes; flat terrain of 3 metres or less above sea level flooded inland as far as 9.5km.Low-lying escape routes cut by rising water 3 to 5 hours before hurricane center arrives. **Major evacuation required of all residences within 50 metres of shore and single-story residences within 3km of shore likely required**.

Category 5- catastrophic; unlikely in Canada

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
2011	BITERA on Tancook Island integrated into REMO warning/situational awareness	Multiple warnings and "near misses" during very active 2011 season; Irene downgraded to extratropical when landfall; Hurricane Maria landfall in Nfld.; Ophelia landfall in Nfld.
Sept. 21, 2010	No Changes	Warnings in place for Hurricane Igor, landfall occurred as Cat. 1 in NFld. – extensive damage to roads/infrastructure in Nfld
Sept. 3, 2010	No changes	Hurricane Earl made landfall at Western Head, no requests for resources, minimal damage & storm surges; meetings held in warning phase
Aug. 23, 2009	No changes	Hurricane Bill made landfall at Western Head; power outages throughout region; pre-event REOC situational awareness mtg. – no resource requests
November 3, 2007		Storm Noel. Heaviest impact in Halifax & Lunenburg. $2,772,554 total damage recorded provincially.
2003 Hurricane	Warning Systems more advanced; greater public awareness of probability,	Although predicted to hit the South Shore, Juan veered off course and made landfall between Shad Bay and Prospect

Juan	impact and need to prepare	as a Category 2 hurricane. Storm surge in Halifax was 1.63m. Rainfall was approx. 40mm, storm surge in Mahone Bay was 1.0m, Longest power outages were 2 weeks. 8 deaths
1996	Changes to public awareness, warnings, information	Hurricane Hortense hit Mahone Bay. Storm surge measured approximately 1 meter in height. Surge in Halifax 1.63 m(Dalhousie Mahone bay Sea-Level Rise Final Report 2011)
October 25, 1991		"Halloween Storm" of 1991, preceded by two hurricanes: Grace and an unnamed storm off the north Atlantic; highest wave in the world ever recorded by an instrument was measured as 30.7metres on the Scotian Slope
August 1, 1950		Hurricane-like storm hit Nova Scotia and caused flooding throughout the province
1953		Hurricane Edna through New Brunswick
1893	Major improvements in prediction/warning systems and response systems	Category 3 landfall in St. Margaret's Bay; sank 2 vessels

Predicted Events without Historical Evidence

Predicting Authority	**Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)**	**Mitigation Strategies in Place**	**Comments**
Environment	5	Warning Systems	Hurricane season predictions

Canada		(responders and public); 72 hour Preparedness Program; Protocols; coordination with first responder groups for response	made every year for June-November season; number and impact of hurricanes predicted to continue to increase
Canada- Nova Scotia Infrastructure Secretariat "Municipal Climate Change Action Plan Guidebook" 2011	5	Increased public warning for predicted storms via Environment Canada	"Research indicates the Atlantic Region will experience an increase in extreme weather events and all climate models suggest that storm activity will worsen". (pg. 6)
Intergovernmental Panel on Climate Change (IPCC) 2007	5	As above	Globally there has been a 75% increase in the number of Category 4 or 5 hurricanes since 1970; Warmer climates are experiencing more frequent and intense storms

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- X 5 Highly Probable within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- ☐ 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area (geographical; map reference)

Entire region could feel impacts of rain and heavy rainfall; worst hits along the coast for storm surges and flooding; off-shore Islands

Mapping (cross reference with Coastal Flooding maps & Inland Flood maps)

Identify Population number in Impact Area

50,000

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

Homeowners in coastal dwellings/areas
Mobility issues (evacuation)ex. Senior's complexes (Mahone Bay; Riverport)
Farm/livestock owners (evacuation: Springoff Farm First South)
Drug-dependent individuals
Medical equipment dependent
Tourists
Campground residents (maps to be made)
Mobile Home Parks (Front Center; Wileville; Dayspring; Eisenhouer; LaHave Heights; Eisner's; Tanner's Settlement)
Summer Camps (Kadiamah; Long Lake; Mush Mush; Wahelo; Sherbrook Lake)
Homeless (Inn From the Cold Program 30)
Homeowners in coastal dwellings/areas (identified above)

Identify critical Infrastructure in Impact Area

Industrial sites (fuel, chemicals)-Petroleum & Gas Storage Centers (3Hebbville; Cookville; Wilveille)
Roadways; Bridges (as per Coastal & Inland)
Wharves (Working Waterfronts)
Ferry Terminal (Chester & Tancook (Big & Little) LaHave Ferry)
Electrical Substation & Main Transmission Lines (as per mapping)
Water Treatment & Waste Water Facilities (as per mapping)
Telecommunication (Cell Towers, Switching Stations; Radio Communications/TMR; Scotia Business: mapping required)
Dams (as per Flood Inland)
Emergency Infrastructure (Hospital; First Responder Facilities., Municipal buildings)

Typical Impacts	# of potential Deaths or Injuries	# of persons displaced or isolated & timeframe	Environment & Property Damage Cost estimate	Resources required to respond	Comments
Fatalities/injuries	Less than 10	N/A	NA	EHS; First Responders	Within normal operating procedures; may be unable to respond for period of time during storm
Displacement	Less than 10 fatalities; injuries could be increased 11-51	200+ on Tancook Islands, 1500+Mobile Homes; may be evacuated for 1 week or less	High	REMO RCMP/Police/GSR Red Cross Fire Depts TIR	Evacuation plans
Isolation	Less than 10	300	Low	TIR with barricades to block roads Red Cross RCMP/GS&R Fire Depts. REMO radio volunteers	Evacuation may be required if unable to access emergency services
Public Property Damage	Less than 10	None	High ++		Wharves Bridges, Roads, treatment /waste facilities, recreation

					facilities;
Private Property Damage	Less than 10	1500+	High +	Assessment teams required to identify safety of structures	Long term evacuations
Power Disruption	Less than 10	Possible after 72 hour shortage	Potentially High Increased with length of outage	NS-Power EHS Red Cross	NS-Power contingency plans for restoration based on priorities
Telecommunication Disruption	Less than 10	N/A	High	TMR as per Telecommunication plan	Communication providers require contingency plans
Inland Flooding	Less than 10	300+	High	TIR Red Cross	Alternate routes available unlikely for entire community to be cut off; Inland Flooding HRVA & plan
Community Lifeline Damage	Less than 100	100 or more	High	Pre-deployment of service providers during warning phase Outside assistance may be required	Hospital could be on decreased capacity; First Responders unable to respond or limited response
Food & fuel	Less than	None	None	Could require outside resources	Grocery stores and fuel

shortages	10			to add with food and fuel delivery	delivery dependent on daily deliveries
Economic Disruption	Less than 10	None	High	Federal/Provincial Government	Fishing Vessels & wharfs in port vulnerable; Units require BCP's for infrastructure loss

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- X 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- ☐ 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- ☐ 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
- ☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
- ☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X (may not be an asset if public becomes sensitized to number of warnings failing to take precautions		
Media	X		
Other (identify)			

HAZARD RISK VULNERABILITY RATING

Probability score ___5__ x Overall Impact Score __5___ = Number assigned to this hazard __25__(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

- ☐ Low (1-5)
- ☐ Moderate (6-10)
- X High (11-25)
- ☐ Requires further analysis due to Risk tolerance rating

Have Hurricane Contingency Plan; needs review after May 2012 HRVA changes

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Extreme Sudden Weather Event
(Thunderstorm/Tornado/Hailstorm)

Background Information

Analysis Completed For: ___REMO Lunenburg Co._____

Analysis Completed By: ___Planning Committee + MCCAP Planning Project_____

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ____Extreme Sudden Weather Events (ex. Thunderstorms/Tornados/Hail Storms)__

Environment Canada issues Severe Thunderstorm warnings when conditions are favourable for the development of severe thunderstorms with one or more of the following conditions:

- Wind gusts of 90 km/h or greater, which could cause structural wind damage;
- Hail of two centimeters (cm) or larger in diameter; or
- Heavy rainfall, as per rainfall criteria

Hail is large, layered ice particles, often spherical in shape, that form within an unusually unstable air mass. Hail is often a product of thunderstorms or tornado activity. For this reason, the hazard analysis will include all three weather phenomenon (thunderstorms, tornados, hail storms).

Tornadoes are referred to as funnel clouds until they touch the ground. They are spawned by severe thunderstorms, and are violent, funnel-shaped wind vortexes in the lower atmosphere, with upward spiralling winds of high speeds.

The tornado usually appears from a bulge in the base of a cumulonimbus cloud. It can be tens to hundreds of metres wide and have a lifespan of minutes or hours. In terms of size and area, it is one of the least extensive of all storms, but in terms of how violent storms can be, it is the world's most severe.

More tornadoes occur in the United States than in any other country. In Canada, tornadoes occur mostly on the Prairies and in Southern Ontario.

The Fujita scale (F0-F5) is used to rate the severity of tornadoes as a measure of the damage they cause.

F0 light (winds of 64 - 116 km/hr; some damage to chimneys, TV antennas, roof shingles, trees, signs, and windows), accounts for about 28% of all tornadoes.

F1 moderate (winds of 117 -180 km/hr; automobiles overturned, carports destroyed, and trees uprooted), accounts for about 39% of all tornadoes.

F2 considerable (winds of 181 -252 km/hr; roofs blown off homes, sheds and outbuildings demolished, and mobile homes overturned), accounts for about 24% of all tornadoes.

F3 severe (winds of 253 -330 km/hr; exterior walls and roofs blown off homes, metal buildings collapsed or severely damaged, and forests and farmland flattened), accounts for about 6% of all tornadoes.

F4 devastating (winds of 331 - 417 km/hr; few walls, if any, left standing in well-built homes; large steel and concrete objects thrown great distances), accounts for about 2% of all tornadoes.

F5 incredible (winds of 418 -509 km/hr; strong frame houses lifted off foundations and carried considerable distances; automobile sized objects fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged), accounts for about 0.1% of all tornadoes. Until the June 2007 Elie tornado, no F5 had been officially recorded in Canada. Regardless, F5 tornadoes are possible in parts of Canada every summer.

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
Nov. 8, 2010		Yarmouth Co. Severe thunderstorm produced rainfall ranging from 140-250mm. 100 people evacuated, 20 roads closed- all due to flooding.
Oct. 26, 2009		NS & NB. 2000 customers without power after thunderstorm; sewer backups in NB; flooded basements; rainfall & flooding caused biggest impacts

Aug. 29, 2008		Thunderstorms brought heavy rains within 3 day period; caused flooding
Nov. 3, 2007		Thunderstorms (Noel). Heaviest impacts in Halifax and Lunenburg. Estimated provincial cost = $ 2,772,554
June 17, 1973	marine warnings	Sudden severe thunderstorm struck Atlantic provinces causing extensive damage to fishermen's gear. Estimated overall cost = $5,330,000
Jan. 30, 1954	Weather monitoring/warning systems upgraded	Tornado producing hail and lightning hit the Coast of Nova Scotia near Liverpool at White Point Beach.

Predicted Events without Historical Evidence

Predicting Authority	Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)	Mitigation Strategies in Place	Comments
Canada-Nova Scotia Infrastructure Secretariat	50		"Research indicates the Atlantic Region will experience an increase in extreme weather events and all climate models suggest that storm activity will worsen" Guidebook pg. 6

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- ☐ 5 Highly Probably within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- X 3 Might occur once every 20 years *
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

* Extreme sudden weather event might occur; not necessarily accompanied by hail, unlikely to cause tornado

Impacts

Identify most likely Impact Area (geographical; map reference)

Entire REMO area

Identify Population number in Impact Area

50,000

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

As per Hurricane HRVA

Identify critical Infrastructure in Impact Area

As per Hurricane

Typical Impacts	# of potential Deaths or Injuries	# of persons displaced or isolated & timeframe	Environment & Property Damage Cost estimate	Resources required to respond	Comments
Fatalities	Less than 10	None	None	First Responders	Within Standard operating
Property Damage	As per Hurricane	(as per flooding or	unknown	EHS, Red Cross; Fire	Within standard operating

		hurricane)			
Transportation disruptions	As per Hurricane				
Crop Damage	As per Hurricane HRVA				
Flooding	As per Flooding HRVA				
Power/Utility Disruptions	As per Hurricane			NS-Power; telecommunications	Lightning strikes pose biggest threat to NS Power causing outages; telecommunications due to lightening or hail (Western Shore)

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements

X 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;

☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X		
Media	X		

HAZARD RISK VULNERABILITY RATING

Probability score ___3___ x Overall Impact Score ___2___ = Number assigned to this hazard __6____(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

☐ Low (1-5)
X Moderate (6-10)
☐ High (11-25)
☐ Requires further analysis due to Risk tolerance rating

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Winter Storm/Blizzard

Background Information

Analysis Completed For: ____REMO Lunenburg Co.____

Analysis Completed By: _____Planning Committee & MCCAP Planning Project___

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ___Winter Storm (blizzard/freezing rain)__

Blizzard is "a severe weather condition characterized by reduced visibility from falling and/or blowing snow and strong winds that may be accompanied by low temperatures." (Environment Canada)

Blizzard warnings are issued by Environment Canada's Meteorological Service (MSC) for hazardous weather conditions characterized by high winds, and a widespread reduction in visibility due to falling and/or blowing snow. Blizzard conditions may persist for a period of time on their own or be part of an intense winter storm in which case a blizzard warning is issued instead of a winter storm or snowfall warning. Blizzard conditions may be accompanied by a severe wind chill making it even more dangerous.

Freezing rain is defined by Environment Canada as rain that freezes on impact to form a coating of clear ice (glaze) on the ground and on exposed objects. If freezing rain is predicted a warning is issued by Environment Canada.

Freezing spray occurs when a combination of below freezing temperatures and strong winds, causes a wind-generated spray to freeze and accumulate (or build-up) on any marine infrastructure located in or near the vicinity of the water. A warning is issued by Environment Canada's Meteorological Service (MSC) if freezing spray is forecast or observed to be moderate or severe. Freezing spray is termed moderate if the ice accumulation or build-up rate on marine infrastructure is between 0.7 and 2 cm per hour. It is termed severe if the ice accumulation or build-up rate on marine infrastructure is greater than 2 cm per hour.

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
December 4, 2007	Increased public awareness of 72-hour preparedness	40cm wet, heavy snow knocked out power to approx. 50,000 people across the 4 Atlantic provinces
Feb. 18-19, 2004	Warnings systems via environment Canada, NS Power and NS-EMO established	"White Juan", 4 day Provincial State of Emergency; storm surges caused flooding in NB& Nfld.; 50-70 cm snow; winds 60-80km/hr with gusts up to 120km/hr; $5,600,000 provincial cost
January 2001	Reinforcement done to bridge	Ice jam effect on LaHave river in Bridgewater- upriver from Bridgewater, moved steel bridge
Jan. 17-22 2000	None known	Storm lasted for 6 days; 70cm of snow, temperatures dropped to minus 40 C with the windchill; 216 people evacuated in N.S. (none in Lunenburg co.) $6, 621,462 Provincial cost
March 15, 1993	Changes to emergency management structures federally & provincially	Caused by mid-latitude cyclone; 3 million people without electricity at one point; Liberian freighter left Halifax despite warnings of hurricane winds and sank 200km off Cape Sable Island in waves up to 20m. Crew of 33- no survivors $19,866, 000 Eastern Canada costs
February 1971	Built second bridge	Bridgewater: Bridge collapsed/moved due to heavy rains and sudden thaw with ice jamming

Predicted Events without Historical Evidence

Predicting Authority	Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)	Mitigation Strategies in Place	Comments
Intergovernmental Climate Change Panel 2007	50	Climate change Adaptation Plans to be created by December 31, 2012	Future warming of 1.5 to 6 degree Celsius is predicted to occur over the next 50 years due to Climate Change (Table SPM.1). Although this may decrease the amount of snow fall, NS may experience more freezing rain/ rain/snow mix events.
From Impacts to Adaptation, NR Canada 2007	50		"Atlantic Canada will experience more storm events, increasing storm intensity..." (Key Findings)
Daigle Report Climate Scenario Development for Communities in Nova Scotia; 2011	30		Scenario Model predicts and increase in precipitation in winter over next century; coupled with warmer weather can lead to possible mix of blizzard/rain-snow conditions (Table A18)
REMO-HRVA (hurricane; Coastal Flooding)	50		Hazard Analysis indicates increased probability of more frequent storms; those occurring during fall or spring (October & March) may be mix of winter blizzard type

			conditions

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- X 5 Highly Probable within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- ☐ 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area (coastal & Inland flooding mapping)

____Entire REMO region (for additional impacts refer HRVA Coastal Flooding & Inland Flooding)__

Identify Population number in Impact Area

_____50,000 + _____

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

___ Homeowners in coastal dwellings/areas (storm surge)

___ Person's with mobility issues

___Farm/livestock owners

__ Pet owners (evacuation)

__ Drug-dependent individuals

__Medical equipment dependent

__ Residents without 72 hour preparedness/shelter-in-place ability/plans

__ Public works personnel

__ Mobile Home Dwellers

__ Marginalized populations (ex. homeless)

Identify critical Infrastructure in Impact Area

__Hospital

__Emergency Infrastructure (EHS Stations; Fire Dept., Police Stations, REOC's; NSCC (evacuation center), Comfort Stations)

__ Roads & Bridges (Provincial, municipal, private)

__ Ferry Terminal (Chester & Tancook Islands & LaHave)

__ Dams (Hebbs Lake System)

__ Water & Waste Water Treatment plants (power issues)

__ Telecommunications Equipment

___Power substations and transmission lines

__ Public Works garage (Bridgewater, TIR Hebbville; Marriott's Cove)

Typical Impacts	**# of potential Deaths or Injuries**	**# of persons displaced or isolated & timeframe**	**Environment & Property Damage Cost estimate**	**Resources required to respond**	**Comments**
Fatalities/injuries	Less than 10	N/a	N/A	May require road clearing equipment for response; EHS may be unable to respond during storm	EHS-storm protocols;
Displacement/evacuation	Less than 10	May require evac. (300+) as per Coastal	Medium	First Responders; Red Cross; Insurance	Comfort Centre protocols may mitigate evacuation for

		Flooding & Inland Flooding HRVA		Industry;	events exclusive of flooding
Isolation	Less than 10	N/A	None	Basic supplies (food, water, generator fuel, medications)	Red Cross/First Responders to deliver supplies to areas (comfort centers) for distribution
Private Property Damage	Less than 10	1500+	High +	Red Cross, First Responders for evacuation; Engineer teams in recovery	Cross Referenced with Hurricane, Coastal & Inland Flooding HRVA's
Public Property	Less than 10	None	High ++		Wharves Bridges, Roads, Water Treatment & waste facilities (as per Hurricane and Flood HRVA's)
Crop & Livestock Damage	N/A	N/A	Unknown	NS Dept. of Agri.	No links with these organizations
Power/Utility Disruption	Less than 10	300+ concern for long term	High	Red Cross; Comfort Stations; Radio	Links to service provider(NSP) plans ; Mitigation

				Operators	may be required after 72 hour
Transportation Disruption	Greater than 10; less than 100	100+	High	TIR; EHS; Police; Provincial support	Unable to get supplies in; unable to transport critical hospital patients;
Supply Shortage	Less than 10	N/A	High	Provincial support	Will require provincial support if major arteries (103) cut off more than 72 hours or if NB border cut off
Flooding	Less than 10	1500 if all areas affected; 300+ could be out for 1 week or more	High	Red Cross; RCMP; Fire; DART-NS; Livestock Evacuation	See Flooding HRVA 's
Ice Jams	Less than 10	100	High	First Responders;	See Flooding HRVA's

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to

environment; serious infrastructure disruption; community unable to function without significant support

- ☐ 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- X 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
- ☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
- ☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X for first 72 hours		
Media	X as above		

HAZARD RISK VULNERABILITY RATING

Probability score ___5__ x Overall Impact Score ___3___ = Number assigned to this hazard __15____(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

- ☐ Low (1-5)
- ☐ Moderate (6-10)
- X High (11-25)
- ☐ Requires further analysis due to Risk tolerance rating

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Hot Days/Heat Wave

Background Information

Analysis Completed For: _____REMO Lunenburg Co._____

Analysis Completed By: _____Planning Committee & MCCAP Planning Project____

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ___Hot Days/Heat Wave_____

*For purposes of this analysis, a heat wave is defined as three consecutive days in which the temperature reaches 30 C or higher**

**Definitions vary according to the source*

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
2000-21st C	Warnings available from Environment Canada	Over the last 20 years, although no records are present to support, there has been an increase in number of hot days throughout the region
July 26- 28, 1963	Significant changes to health care & emergency response structures, warning systems, and building temperature	Temperatures of 33-34 Celsius; greater traffic volume in Halifax caused minor accidents; increased hospitalizations; 4 drownings

	controls	
July 5-17, 1936		Two –week heat wave, greater than 32 degrees Celsius across Canada; 1180 fatalities, severe drought reported as well, increased forest fires Temperature & Impacts felt West of New Brunswick
July 8, 1912	Significant changes as above	July 8-10; temperature of greater than 32 from Ontario to Atlantic Ocean; 3 heat-related deaths in adults; more infant deaths believed to have occurred in poor areas; homicides reported; crop damage

Predicted Events without Historical Evidence

Predicting Authority	**Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)**	**Mitigation Strategies in Place**	**Comments**
W. Daigle & Daigle	50	None	2011 report, "Scenarios & Guideance for Adaptation to Climate Change & Sea Level Rise- Nova Scotia Municipalities; Table A-18 Increase to 31 hot days in BW by 2080
Impacts to Adaptation: Canada in a Changing Climate, 2007)	50	None	Climate projections indicate that Atlantic Canada will experience drier, hotter summers with an increase in mean temperature. By 2050, trends indicate a 2 to 4 degree Celsius increase in summer temperature.

			This may increase the risk of extreme heat days as well.
Health Canada 2005	50	None	Predicts more frequent and severe heat waves could cause heat-related illnesses and death; particularly for respiratory & cardiovascular disorders

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- ☐ 5 Highly Probable within 5 years or less
- X 4 Likely to occur every 5-7 years
- 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area (geographical; map reference)

Inland areas more affected & densely populated

Town of Bridgewater & periphery (much hotter, 12,000 pop.) Cookville, Dayspring; Oakhill, Conquerall Bank, Wileville

New Germany (300), Barass Corner, Farmington, North of 103 (less than 100 per community)

New Ross, New Russell, Forties (500 all three communities)

Mahone Bay (1000)

Identify Population number in Impact Area

As above

50,000

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

Persons with pre-existing health conditions (respiratory & cardiovascular)

Infants/very young children

Elderly

Outside workers (construction, roads)

Marginalized (homeless, isolated, mobility challenged, low income)

Identify critical Infrastructure in Impact Area

None identified (municipalities may need to research what temperatures are set-points for infrastructure (pumps etc.) vulnerable to heat)

Typical Impacts	**# of potential Deaths or Injuries**	**# of persons displaced or isolated & timeframe**	**Environment & Property Damage Cost estimate***	**Resources required to respond**	**Comments**
Fatalities	Less than 10	None	None	Fire Depart/Police/EHS, SSH	Within standard operations
Increased need for health care/hospitalization First Responders	Less than 10	None	None	Fire Depart/EHS; SSH	Within standard operating procedures
Crop/Livestock Damage	None	None	unknown	Agriculture; CFIA	No links to plans, resources or impacts
Increased electricity use (air	None	None	Unknown	NS-Power	Discussions with NSP 2012 highlighted

conditioners/fans)					no anticipated problem with meeting demand
Work slow down/stoppages for workers	None	None	unknown	Local departments/business (NS labor laws)	Could be impacts at /industry levels; not EM response
Animal Distress/Death	none	none	unknown	SPCA; By-law officers	Standard operations
Economic & Ecological Disruption	Less than 10	None	unknown	unknown	This impact may require long-range planning by municpalities

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- ☐ 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- ☐ 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- X 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements

- 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
  1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Considering the area of impact, community events, and past experience, identify the level of tolerance to the hazard identified.

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public	X		
Media	X		

HAZARD RISK VULNERABILITY RATING

Probability score __4___ x Overall Impact Score __3= Number assigned to this hazard __12___(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

Low (1-5)
- Moderate (6-10)

X High (11-25)

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Forest/Wildland Fire

Background Information

Analysis Completed For: _REMO Lunenburg Co.

Analysis Completed By: __REMC & Planning Committee + MCCAP Planning Project

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ___Forest/Wildland Fire

"In many provinces a large number of forest fires are caused by lightning. In Nova Scotia only an average 3 % of fires start this way. The remaining 97% are caused by the activities of people, mostly accidental but sometimes deliberate. About one-third of person-caused fires are classed as "residential". These fires are caused by people engaged in activities- like debris and grass burning- on and around their property. Another major cause is arson, which accounts for about one quarter of the person-caused fires in this province in an average year. "(DNR; Media Guide to Forest Fires May 2009 pg.2)

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
Heat Wave March 20-22, 2012	N/A	Record temperatures and official heat wave (28degree weather) created grass and wood fires throughout the region; no evacuations or property damage noted. DNR crews not on standby until April 1, could create lack of resources
2011		Beech Hill; 7 Dept. & DNR; no evacuations, no resources required from

		REMO
Slave Lake Alberta May 1, 2011	N/A	Towns of Slave Lake, High Prairie, Little Buffalo, Lesser Slave Lake, and multiple municipal districts affected. 12055 evacuated (1300 under immediate, emergency conditions including hospital and town services) Oil drilling in region halted; CN rail halted Estimated Cost = $700, 000,000
B.C 2009	N/A	Fire Season 2009 had 3049 fires, 213 were wildland-urban interface fires. Increased lightning storms, record high temp. and decreased precipitation were factors. 100 notable fires causing 27 evacuation orders, 20, 000 people evacuated in total. One fatality (within fire service personnel) Estimated Cost = $ 75,000,000
Halifax May 2009	N/A	Purcells Cove Halifax, brush fire spread quickly due to wind gusts & dry debris as a result of previous hurricane (Juan 2003) 1200 people evacuated from 427 homes. 10 homes damaged, 2 homes destroyed
Halifax June 13, 2008	N/A	Brush fire in wooded area east of Halifax (Lake Echo & Porter's Lake). Fire destroyed 2 homes, 5000 residents evacuated
Wallace Lake Shelburne Co. May 20, 2003	N/A	795 ha; 600 ha of which was Tobeatic Wilderness Area (TWA) of ecological and environment concern

Western Shore July 10, 2003	N/A	18 acres private woodland near Vaughans Lake. DNR crews (including helicopter) and 10 Fire Departments; No evacuations; 2 minor injuries
New Ross August 10 2001	N/A	10 acres privately owned land ; DNR & 24 Departments involved & 150 firefighters; Dozens of firefighters treated for heat exhaustion by paramedics on scene Evacuations of Maple Glen Park & cottages on New Russell Road (approx. 36 homes)
Porcupine Lake Trafalgar, Guysborough Co. June 4, 1976	N/A	13000 ha burned; fire burned for six days; boy scout troop in area was protected by water bomber drops until evacuation could occur
1950s Bridgewater		Fire started in Chelsea burned through Bridgewater to Hebbville. Burned for 5 days brought in military and fire departments from throughout the province. Residential area of Bridgewater sustained most damage. Liverpool and Shelburne had big fires at the same time.

Predicted Events without Historical Evidence

Predicting Authority	**Evidence to support prediction with timeframe (5, 7, 20, 100, or 500**	**Mitigation Strategies in Place**	**Comments**

	years)		
Environment Canada	5		Climate Change Predictions indicate increased temperatures; hotter summers; less snowfall; incidence of greater variance in rainfall (drought followed by heavy rain); increased hurricanes leaving deadfall; all these factors increasing the risk of wildfires (MCCAP Guidebook)
DNR	Issued on an annual basis, no projected forecast	Public warnings issued via media & bans throughout parks ; permits required for residents during fire season (April-Oct.) Fire Behavior is predicted according to the Canadian Forest Fire Danger Rating System Fire Behaviour Prediction model on any given outbreak to help guide evacuation response Nova Scotia has a relatively wet climate, thus the number of fires	DNR issues Fire Index and puts out fire bans and alerts based on successive days of increased risk. Tracked from April 1-Oct. 15th DNR crews on stand-by for provincial response from April 1 to Oct. 15th only

		that typically occur in an average season is low compared to drier provinces (NS Wildfire Science)	
Daigle Report	30		As per environment prediction above

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- ☐ 5 Highly Probable within 5 years or less
- X 4 Likely to occur every 5-7 years*
- ☐ 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

*Based on probability of fire requiring evacuation

Impacts

Identify most likely Impact Area (mapping available)

__ need to compile some maps showing areas when property densities encroach on wildlands for each municipal unit;(MODC & MODL- all populations; Town of Bridgewater: Oakhill; Dayspring; Hebbville; Wileville ; Town of Mahone Bay:

Identify Population number in Impact Area

__approx. 300 people max in most evacuation areas; extreme situations up to or over 1500+

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

___Persons with Respiratory Conditions

___Mobility Issues

___Restricted access (ex. Kingsburg; Big Tancook)

___Pet/Livestock owners

___School populations (including day cares)

___ Tourists

___ Campground/seasonal residents/cottage developments

Identify critical Infrastructure in Impact Area (mapping available during response)

__Hospital

__ Municipal Water Supply (Hebbs Lake System & Oakland & Dares Lake)- maps available

_ Roads

-NSP transmission lines and substations

- Schools

- Water & waste water treatment plants

-Fire Stations; Police; EHS

-Landfills (Kaiser Meadows; Whynott Settlement)

_ Telecommunication towers

__ DND Radio (Federal Asset)- Mill Cove

Typical Impacts	**# of potential Deaths or Injuries**	**# of persons displaced or isolated & timeframe**	**Environment & Property Damage Cost estimate**	**Resources required to respond**	**Comments**
Fatalities & Injuries	Less than 10	None	None	First Responders	Standard Operating
Displacement (evacuation)	Less than 10; larger impact if Hospital evacuation	300 persons;	None	Fire Dept.; DNR; Red Cross; Police	Evacuation Centres (NSCC)

	required				
Private Property	Less than 10	300 persons	High	First Responders; Assessment Teams; Insurance Industry	
Public Property Damage	None	Long-term multiple numbers	High++	Fire Dept.(s); DNR	Would include Province/Federal partners
Transportation Disruption	Less than 10	Short term 300+	Low	Police; TIR;	May need extra personnel for manned barricades
Long-term Environmental Impacts	Potential contamination water supply causing illness	N/A	Potentially High ++	Water testing; DNR;	Waters supply areas, Hazardous Material areas with long-term clean-ups
Animal displacement/death	Livestock deaths 100+	None	unknown	Agri-Canada; CFIA; DART-NS;	Lack of formal arrangements with resources that could be required
Crop Damage	None	None	unknown	Agri-Canada; NS Department of Agriculture; Agriculture Groups	No contact with these groups to provide info in planning or response

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

- ☐ 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- ☐ 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- X 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
- ☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
- ☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Considering the area of impact, community events, and past experience, identify the level of tolerance to the hazard identified.

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public		X	
Media		X	
Other (identify)		X	

HAZARD RISK VULNERABILITY RATING

Probability score __4____ x Overall Impact Score ___3.5___ = Number assigned to this hazard __14____(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

- ☐ Low (1-5)
- ☐ Moderate (6-10)
- X High (11-25)
- ☐ Requires further analysis due to Risk tolerance rating

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Drought

Background Information

Analysis Completed For: _____REMO Lunenburg Co._____

Analysis Completed By: _____Planning Committee & MCCAP Planning Project_____

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: _____Drought_____

"Droughts are complex phenomena with no standard definition. Simply stated, drought is a prolonged period of abnormally dry weather that depletes water resources for human and environmental needs" (AES Drought Study Group, 1986). Environment Canada- Science & Technology

For the REMO region we do not have a prediction for what atmospheric conditions will constitute a drought situation.

May be correlation with increased hot days HRVA/plans

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
2002-2001	Agriculture & Agri-Food Canada (AAFC) expanded Drought Watch to monitor status of drought over all major agricultural regions of	Canada-wide drought from Spring 2001 to Fall 2002. Repercussions included agricultural production, employment, crop and livestock production, and the Gross Domestic Product. Atlantic Canada

	the country.	sought advice from Prairie Farm Rehabilitation Administration (PFRA) on procedures to augment on-site water supplies for agricultural communities. Appears to have been little local affect within Lunenburg County.

Predicted Events without Historical Evidence

Predicting Authority	Evidence to support prediction with timeframe (5, 7, 20, 100, or 500 years)	Mitigation Strategies in Place	Comments
Nova Scotia Department of Agriculture & Fisheries	100	None	Droughts in Atlantic Provinces occur rarely but reduced occurrence results in lower adaptive capacity making the region more susceptible to drought impacts.
Environment Canada-Science & Technology	100	None	All Global Climate Models project future increases in summer continental interior drying and associated risk of droughts due to increased temperature and evaporation not balanced by precipitation. Uncertainly exists on a regional basis of any impacts to Atlantic region.
Daigle Report Table A-18	50		Predicts higher temperatures & decreased precipitation during the summer months;
DNR	0n-going	None	DNR measures and releases daily during fire season, a Provincial Drought (DC) on a

			range of 0-unlimited. Measures dryness of the largest sized surface fuels and deep duff layers (10+cm depth) Derived from the previous (day before) DC, the local noon temperature, and 24 hour precipitation. Coded as Low, Moderate, High and Extreme

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- ☐ 5 Highly Probable within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- X 3 Might occur once every 20 years
- 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area (geographical; map reference)

Town of Bridgewater (Hebbs Lake Water supply area)

Town of Mahone Bay (Oakland Water supply area)

Dares Lake Water Supply Area

MODL- inland (well water decreased supply: New Germany); Coastal (risk of salt water intrusion)

MODC- all residents on well systems (Village of Chester; Western Shore)

Identify Population number in Impact Area

___50, 0000 ____

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

Farm/livestock owners

Residents on dug wells

Identify critical Infrastructure in Impact Area

___Hebbs Lake Water Supply System ___

___Oakland Lake Water Supply System ___

__ Fire Suppression services (fire ponds, dry hydrants)

Typical Impacts	**# of potential Deaths or Injuries**	**# of persons displaced or isolated & timeframe**	**Environment & Property Damage Cost estimate**	**Resources required to respond**	**Comments**
Decreased Water Supply (watershed & wells)	Less than 10	N/A would have to supply alternative sources to prevent evacuation	High +++	Alternative Water supplies- none identified	As per Water Contamination Contingency Plan Estimated at $5000.00 per day for Town of Mahone Bay alone
Crop/Livestock Damage	None	As above	Unknown	Agri-culture industry	No links to agri-response
Animal disease/death	None	None	Unknown	Agri-culture; CFIA;	No links to agri-response
Increased Wildland Fires	Less than 10	300+	High	DNR, Fire Departments; Mutual Aid water Supplies	Within normal operating procedures unless water supplies unavailable to combat

					(see Wildland Fire HRVA)
Economic Disruption	None	None	High	Unknown Resources	Damage to tourism; resource industries
Ecological Disruption	None	None	High	DNR, DOE; DFO & unknown	Loss of habitat, endangered species (20) (whitefish); Reduced biodiversity

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- ☐ 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- X 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- ☐ 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
- ☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
- ☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public			X
Media			X
Other (Residents on Municipal Water systems)			X expect water supply to be constant with little historical evidence of lack

HAZARD RISK VULNERABILITY RATING

Probability score ___2.5___ x Overall Impact Score __4____ = Number assigned to this hazard ___10___(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

- ☐ Low (1-5)
- X Moderate (6-10)
- ☐ High (11-25)
- ☐ Requires further analysis due to Risk tolerance rating

Nova Scotia Emergency Management Organization
Hazard Risk Vulnerability Model
Animal Disease Outbreak

Background Information

Analysis Completed For: _____REMO Lunenburg Co.____

Analysis Completed By: _____Planning Committee + MCCAP Planning Project____

Category of Hazard

- X Natural
- ☐ Technological
- ☐ Industrial
- ☐ Human-Induced

Identify Specific Hazard: ___Animal Disease Outbreak__

A foreign animal disease (FAD) is a disease caused by a transmissible infectious agent, currently exotic to Canada, with the potential for rapid spread, the introduction of which would seriously affect access of Canadian animals and animal products to foreign markets. The primary focus of the current response policy if a disease, such as foot and mouth disease (FMD) or classical swine fever (CSF), were identified in the region is eradication by stamping out. The primary tools of stamping out a disease include early detection of disease when introduced, rapid killing of all known infected animals, tracing of all high risk contacts, application of herd quarantine, testing of populations at risk, and, in some instances, the application of pre-emptive slaughter or strategic vaccination. Crucial to the success of stamping out is the early placing of high risk premises and geographic production areas under animal movement restriction. (CFIA)

Animal disease outbreak in Wildlife is less monitored and regulated. Backyard flocks, hobby farms, organic operations may not undergo the same control/surveillance measures as animals within the food chain.

Many animal disease causing agents have possibility for mutation and cross-over to humans.

PROBABILITY

Historical Events

Date (most recent first)	Changes made since	Comments
On-going	Increased surveillance programs in place	Vector population mapping and indices of disease suggest increased prevalence of lyme, rabies, white nose syndrome in

		bats, EEE
2009		Low pathogenic Avian Influenza, B.C
2007	Emergency Management Act came into effect; linked CFIA to coordinate emergency management falling within their mandate	High pathogenic Avian Influenza, Sask.
Sacramento California 2005		West Nile Virus 163 human cases; pesticide spray operation; Total cost of health care & spraying costs = 2.98 Million
2005		Low pathogenic Avian Influenza, B.C.
2005		Bovine spongiform encephalopathy (BSE, or Mad Cow disease) Alberta
2004		High pathogenic Avian Influenza, B.C.; over 13 million domestic birds depopulated
1999	Surveillance & reporting of bird die-offs (CFIA)	West Nile Virus outbreak started in New York Zoo birds; 125 human cases, 4 deaths, Transmission from birds to mosquitoes to people; City-wide pesticide spraying program initiated; DEET-distributed to residents through fire halls (300,000 cans)

Predicted Events without Historical Evidence

Predicting Authority	**Evidence to support prediction with timeframe (5, 7, 20, 100, or 500**	**Mitigation Strategies in Place**	**Comments**

	years)		
Canadian Food Inspection Agency (CFIA)	20	Federal EM plans & programs	"Animal disease emergencies have been happening more often in recent (since 2004) years. The Agency expects this to continue because international trade and travel is growing and new diseases are emerging". (CFIA; 2010)
Canadian Medical Association "Climate change and infectious diseases in North America: the road ahead" by Amy Greer PhD, Victoria Ng BS, And David Fisman MD MPH (CMAJ, 2008)	20		Climate change may affect infectious diseases of animal origin that may be transmitted to humans) in 3 ways: it may increase the range or abundance of animal reservoirs or insect vectors, prolong transmission cycles, or increase the importation of vectors or animal reservoirs (e.g., by boat or air) to new regions, which may cause the establishment of diseases in those regions. Lyme disease (a tick-borne borreliosis) is likely to change substantially in North America and Europe. Temperature determines the northernmost extent of tick populations. Mathematical models suggest that tick abundance may greatly increase in southern Canada, with a northern expansion of about 200 km by the year 2020.

Probability Score

(Considering historical and predicted probability rate the likelihood of occurrence in years)

- ☐ 5 Highly Probable within 5 years or less
- ☐ 4 Likely to occur every 5-7 years
- X 3 Might occur once every 20 years
- ☐ 2 Not expected; could occur once every 100 years
- ☐ 1 Rare chance of occurrence every 500 or more years

Impacts

Identify most likely Impact Area

__ Entire REMO area for human cross over disease—

Animal Disease in Food Supply Chain:

MODL & MODC & Town of Bridgewater (Mapping of areas with registered agricultural)

Bridgewater- map of exhibition grounds & 3km radius

New Ross Fairground

Identify Population number in Impact Area

50,000

Identify numbers of Susceptible Persons in Impact Area (Identify groups)

Farmers/Livestock owners

Farm Supply Operators (ex.Shur-gain; Co-op)

Farmers Market Vendors

Pet owners/Hobby farms

4-H groups

Veterinarians

First Responders

Health Care Workers

Kennel/Animal Care Workers

Wildlife workers

Animal Control & By-Law Enforcement Officials

Identify critical Infrastructure in Impact Area

As per Epidemic/Pandemic HRVA & Plan

Veterinarians & Vet Clinics

Typical Impacts	**# of potential Deaths or Injuries**	**# of persons displaced or isolated & timeframe**	**Environment & Property Damage Cost estimate**	**Resources required to respond**	**Comments**
Illness (transmission to humans)	Unknown- could be long term illness/disabilities for certain diseases	None	Potentially High	EHS; Hlth Canada; SSH; DNR; CFIA	Provincial and Federal plans and procedures in place 2005- 163 humans cases WNV in California est. Cost of 2.98M (EID Journal Volume 16, Number 3- March 2010 CDC)
Increased need for health care (humans)	Unknown	As above	None	As above	As above
Increased need for veterinary	None	None	unknown	Veterinary support; transportation	No links to these agencies

care				of animals; CFIA if Foreign Animal Disease Livestock	
Transportation disruption	None	None	Unknown	Police (barricades); CFIA	No links to quarantine restricting authorities
Carcass Disposal	None	None	Unknown	No resources to dispose of large numbers	No links to agencies
Media Focus	None	None	None	REOC; Media Liaison; Mayors/Council	Clear procedures & guidelines on authority, lead agency,
Public disorder	Less than 10	None	unknown	Police/RCMP;	Organized groups could arrive in area if slaughter/animal welfare in question
Economic Disruption	None	None	Unknown	No links to agriculture groups	Could shut down Farmer's markets; exhibition; animal shows; Decreased /recreation use in park areas & facilities Economic consequences from loss of agricultural production

					could be high
Ecological Disruption	None	None	Unknown	No links	Unknown information

* Used Low, medium and high scores for environmental & property costs assuming Low= thousands of dollars; Medium= 10, 000 + and High = 100,000+

Overall Impact Score

(Considering each of the impacts identified and the guidelines below, select an overall impact score for the hazard event)

- ☐ 5 Catastrophic, over 100 people affected; multiple fatalities; injuries, long term health effects; prolonged displacement; extensive environment & property damage; long term effects to environment; serious infrastructure disruption; community unable to function without significant support
- ☐ 4 Significant; 51-100 people affected; multiple serious injuries; long-term hospitalization required; displacement for 6-24 hours; significant impact to environment- medium to long term effects; external resources required; community only partially functioning, some services unavailable
- X 3 Moderate; 11-50 people affected; no fatalities, some hospitalization and treatment required; localized small numbers displaced for 6-24 hours; no long term environmental or property damage; localized damage rectified by routine arrangements; normal community functioning with some inconvenience, no resources required outside of mutual aid agreements
- ☐ 2 Minor; less than 10 people affected; no fatalities, small number of injuries requiring first aid only; small numbers displaced for less than 6 hours; no external resources required; minor localized disruption to community services for less than 6 hours;
- ☐ 1 Insignificant; no fatalities, injuries or impact on health; no persons displaced; no damage to properties or environment; no disruption to community services or infrastructure; no mutual aid resources required

RISK TOLERANCE

Group	High Tolerance	Medium Tolerance	Low Tolerance
Public			X low tolerance to mass slaughter; fears of transmission
Media			X

Other (Animal Rights groups; Anti-pesticide groups)			X mobilize to area to oversee animal welfare; Anti-pesticide groups not tolerant of certain eradication techniques

HAZARD RISK VULNERABILITY RATING

Probability score __3__ x Overall Impact Score __3__ = Number assigned to this hazard __9__(1-25)

Final Hazard Assignment in consideration of Risk Tolerance for Priority Planning

- ☐ Low (1-5)
- X Moderate (6-10)
- ☐ High (11-25)
- X Requires further analysis due to Risk tolerance rating

* Requires input from agriculture/animal/livestock groups for accurate assessment
* Provincial health care/agriculture/DNR assessment & direction
* May require municipal planning for tick control/eradication/pesticide spraying
* Highlights need for Agri input into REMO response planning
* Have Human Disease/Pandemic Contingency Plan- sections may apply

MUNICIPAL CLIMATE CHANGE ACTION PLAN

MUNICIPALITY OF THE DISTRICT OF CHESTER

APPENDIX D

ENERGY INVENTORY OF THE MUNICIPALITY:
Corporate Energy and Emissions Spreadsheets

Name of Municipal Government:	Mun. of the District of Chester
Province or Territory:	Nova Scotia
Corporate Inventory Year:	2006
Completed by:	Lyle Russell

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

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 following up with Nova Scotia Power each year.

kWh Coefficient	0.868

Instructions: If you are selecting a base year other than the default 2006 base year, please select from the table above and enter the corresponding emission coefficients in the cells to the left. For example, if you chose 2000 as your base year, enter the value 0.937 into cell B24.

Buildings **Mun. of the District of Chester**
Corporate Inventory

A) Energy Consumption - Buildings

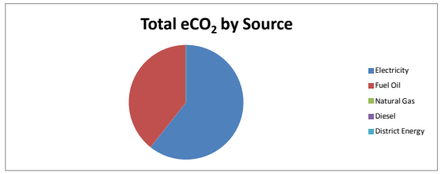
				Emissions Coefficients											
				Type Selected Coefficient			AP	2.68 kg eCO2/L			AP	50.79 kg eCO_2/GJ			AP
	1. Indicators			2. Electricity (kWh)				3. Fuel Oil (L)				4. Natural Gas			
Building or Building Group Name	Occupants	Operating Hours	Total Floor Area (m^2)	Total Use (kWh)	Cost ($)	Total 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 $NO_{x\ (KG)}$
Main Office (151 King St)				104920.00		91.07	188.86	9147.20		62.20	77.93			0.00	0.00
Planning Office (186 Central St.)				21900.00		19.01	39.42	8960.80		60.93	76.35			0.00	0.00
Bandstand				270.00		0.23	0.49	0.00		0.00	0.00			0.00	0.00
Landfill (450 Kaizer Meadow Rd)				161514.00		140.19	290.73	0.00		0.00	0.00			0.00	0.00
Boat Pumpout (South St)				1.00		0.00	0.00	0.00		0.00	0.00			0.00	0.00
Zoe Valley Library (63 Regent St)				8998.00		7.81	16.20	6529.70		44.40	55.63			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	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			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	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			0.00	0.00
						0.00	0.00			0.00	0.00			0.00	0.00
Totals	0	0	0	297603.00	0.00	258.32	535.69	24637.70	0.00	167.54		0.00	0.00	0.00	

	2.63 kg eCO2/L			AP	50.79 kg eCO2/GJ											
	5. Diesel				6. District Energy			TOTALS								
Building or Building Group Name	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
Main Office (151 King St)			0.00	0.00			0.00	0.00	153.27	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Planning Office (186 Central St.)			0.00	0.00			0.00	0.00	79.94	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Bandstand			0.00	0.00			0.00	0.00	0.23	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Landfill (450 Kaizer Meadow Rd)			0.00	0.00			0.00	0.00	140.19	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Boat Pumpout (South St)			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Zoe Valley Library (63 Regent St)			0.00	0.00			0.00	0.00	52.21	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			0.00	0.00			0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Totals	0.00	0.00	0.00		0.00	0.00	0.00	0.00	425.86	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

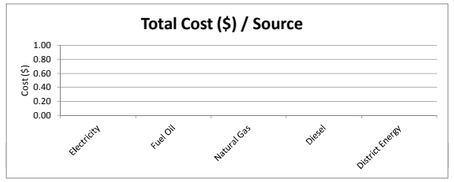
B) Air Pollutants

	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)	297603.00	N/A	N/A	24637.70	0.000600	14.782620	0.00	0.035368	0.000000	0.00	0.015595	0.000000
Sulphur Dioxide (SO2)		0.001800	535.685400		0.008520	209.913204		0.000253	0.000000		0.004761	0.000000
Oxides of Nitrogen, expressed as NO2 (NOx)		0.000750	223.202250		0.002400	59.130480		0.042105	0.000000		0.072396	0.000000
Volatile Organic Compounds (VOCs)		N/A	N/A		0.000024	0.591305		N/A	N/A		0.005910	0.000000
Total Particulate Matter (TPM)		N/A	N/A		0.000240	5.913048		0.000800	0.000000		0.005089	0.000000
Particulate Matter less than or equal to 10 microns (PM10)		N/A	N/A		0.000120	2.956524		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	0.739131		0.000800	0.000000		0.005089	0.000000

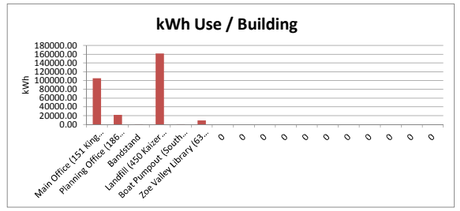
Total eCO_2 by source	
Electricity	258.32
Fuel Oil	167.54
Natural Gas	0.00
Diesel	0.00
District Energy	0.00



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



kWh Use / Building	
Main Office (151 King St)	104920.00
Planning Office (186 Central St.)	21900.00
Bandstand	270.00
Landfill (450 Kaizer Meadow Rd)	161514.00
Boat Pumpout (South St)	1.00
Zoe Valley Library (63 Regent St)	8998.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



Insert comments here:

Vehicle Emissions
Corporate Inventory

Mun. of the District of Chester

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
Landfill Heavy Equiptment					0.00	98935.50		260.20			0.00			0.00			0.00	0.00	260.20	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Public Works Trucks			11457.40		26.81	66.50		0.17			0.00			0.00			0.00	0.00	26.99	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Garbage Collection Fleet					0.00	74466.72		195.85			0.00			0.00			0.00	0.00	195.85	#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!
					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	0	11,457	0	27	173,469	0	456	0	0	0	0	0	0	0	0	0	0	483	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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.

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

Insert Comments here:

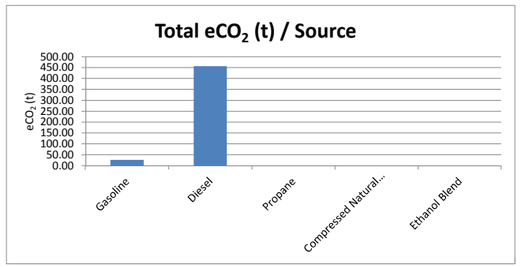
Representative Vehicle Selected											
Make/Model	Class	Eng Size/ # Cyl	Trans #gears	Fuel			Consumption L/100km		Rank		CO_2 kg per year
				Type	$/yr	L/yr	City	Hwy	Class	All	
Chevrolet C1500 Avalanche	PU	5.3 / 8	E4E	X	$1,960	2839	16.4	11.5	88	864	6814

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

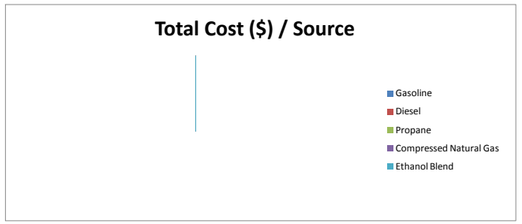
Vehicle Efficiency for Different Fuels (L/100km)

Fuel Type	Heavy Truck	Bus
Gasoline	43.5	35.7
Diesel	39	32

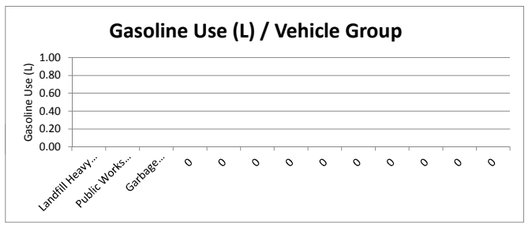
Total eCO2 (t) / Source	
Gasoline	26.81
Diesel	456.22
Propane	0.00
Compressed Natural Gas	0.00
Ethanol Blend	0.00



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



Total Gasoline Use (L) / Vehicle Group	
Landfill Heavy Equiptment	0.00
Public Works Trucks	#REF!
Garbage Collection Fleet	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
0	0.00
0	0.00



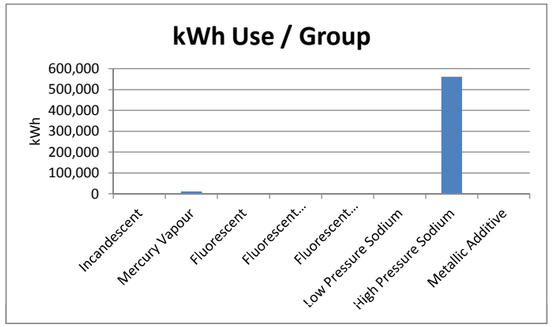
Streetlights **Mun. of the District of Chester**
Corporate Inventory

		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:		11	10,956		10	0.864528
HIGH WATT:			0		0	#DIV/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:			0		0	#DIV/0!
High Pressure Sodium						
LOW WATT:		772	558,156		484	0.627564
HIGH WATT:		2	3,000		3	1.302
Metallic Additive						
LOW WATT:			0		0	#DIV/0!
HIGH WATT:		1	3,060		3	2.65608
Totals		786	575,172	0	499	0.635177221

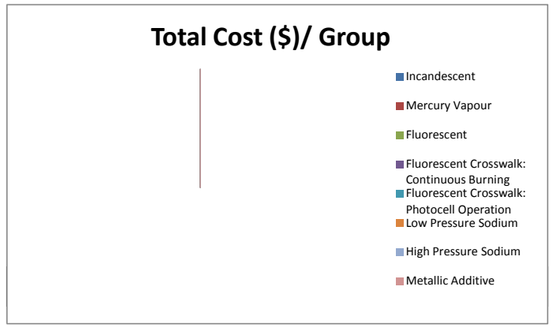
B) Air Pollutants

	2. Electricity - Air Pollutants		
	Total Use (kWH)	AP Coefficient	Total AP (KG)
Carbon Monoxide (CO)	575172.00	N/A	N/A
Sulphur Dioxide (SO2)		0.001800	1035.309600
Oxides of Nitrogen, expressed as NO2 (NOx)		0.000750	431.379000
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

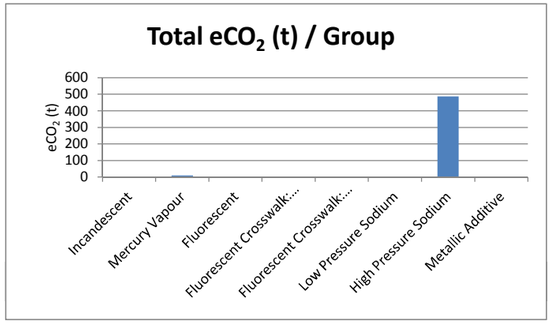
kWh Use / Group	
Incandescent	0
Mercury Vapour	10,956
Fluorescent	0
Fluorescent Crosswalk: Continuous Burning	0
Fluorescent Crosswalk: Photocell Operation	0
Low Pressure Sodium	0
High Pressure Sodium	561,156
Metallic Additive	3,060



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	0
Metallic Additive	0



Total $eCO_{2\,(t)}$ / Group	
Incandescent	0
Mercury Vapour	10
Fluorescent	0
Fluorescent Crosswalk: Continuous Burning	0
Fluorescent Crosswalk: Photocell Operation	0
Low Pressure Sodium	0
High Pressure Sodium	487
Metallic Additive	3



Insert Comments Here:

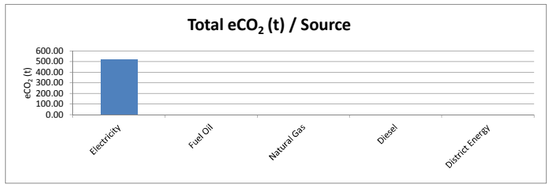
Water and Sewage
Corporate Inventory

Mun. of the District of Chester

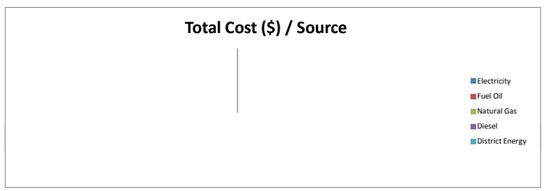
		Emissions Coefficients																						
		Type Selected Coefficient			AP	2.68 kg eCO2/L			AP	50.79 kg eCO_2/GJ			AP	2.63 kg eCO2/L			AP	50.79 kg eCO2/GJ						
	Indicators	Electricty (kWh)				3. Fuel Oil (L)				4. Natural Gas				5. Diesel				6. District Energy			TOTALS			
Facility or Facility Group 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)
Chester WWTP		354775.00		307.94	638.60			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	307.94	#DIV/0!	#DIV/0!
Western Shore WWTP		97315.00		84.47	175.17			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	84.47	#DIV/0!	#DIV/0!
Chester Baisn WWTP		2665.00		2.31	4.80			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	2.31	#DIV/0!	#DIV/0!
New Ross WWTP		2980.00		2.59	5.36			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	2.59	#DIV/0!	#DIV/0!
Chester Acres WWTP		1785.00		1.55	3.21			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	1.55	#DIV/0!	#DIV/0!
Mill Cove WWTP		48280.00		41.91	86.90			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	41.91	#DIV/0!	#DIV/0!
Mill Cove WTP		93550.00		81.20	168.39			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	81.20	#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!
Totals	0.00	601350.00	0.00	521.97		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	521.97	#DIV/0!	#DIV/0!

	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)		N/A	N/A		0.000600	0.000000		0.035368	0.000000		0.015595	0.000000
Sulphur Dioxide (SO2)		0.001800	1082.430000		0.008520	0.000000		0.000253	0.000000		0.004761	0.000000
Oxides of Nitrogen, expressed as NO2 (NOx)		0.000750	451.012500		0.002400	0.000000		0.042105	0.000000		0.072396	0.000000
Volatile Organic Compounds (VOCs)	601350.00	N/A	N/A	0.00	0.000024	0.000000	0.00	N/A	N/A	0.00	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

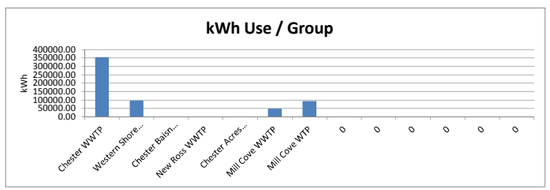
Total eCO_2 / Source	
Electricity	521.97
Fuel Oil	0.00
Natural Gas	0.00
Diesel	0.00
District Energy	0.00



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



kWh Use / Group	
Chester WWTP	354775.00
Western Shore WWTP	97315.00
Chester Baisn WWTP	2665.00
New Ross WWTP	2980.00
Chester Acres WWTP	1785.00
Mill Cove WWTP	48280.00
Mill Cove WTP	93550.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



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Waste **Mun. of the District of Chester**
Corporate Inventory

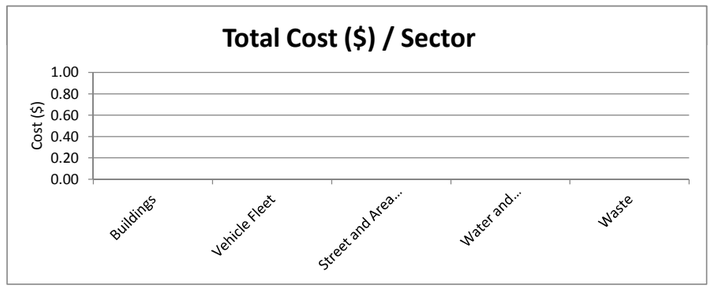
		3. Landfill Without CH4 Recovery			4. Landfill With CH4 Recovery (Landfill gas flared or used for energy generation)							
		Emissions Coefficient (tonne eCO2 / tonne waste)			Emissions Coefficient (tonne eCO2 / tonne waste)							
		Paper - 0.58	Trimmings - 0.238	Food - 0.400	Paper - 0.114	Trimmings - 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		11.7		5.85			0			#DIV/0!	#DIV/0!	

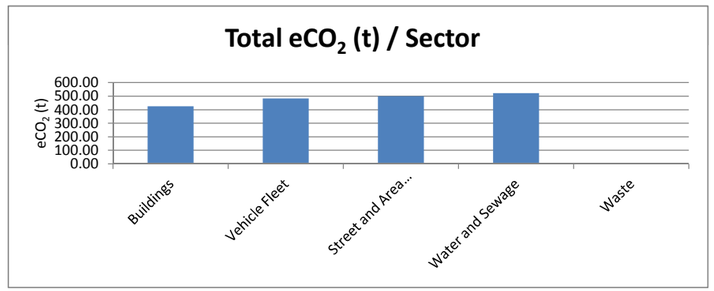
Insert Comments Here:

Summary **Mun. of the District of Chester**
Corporate Inventory

Cost and Tonnes of eCO2 / Sector

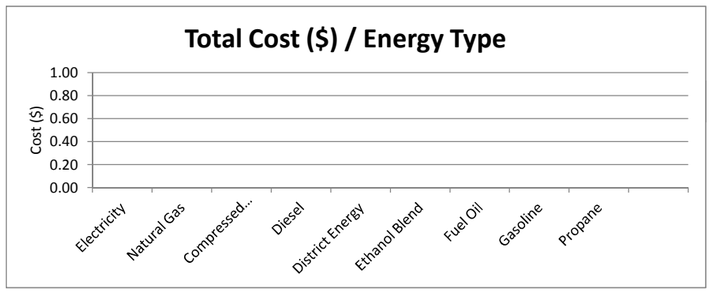
Sector	Total Cost	Total eCO2
Buildings	0.00	425.86
Vehicle Fleet	0.00	483.03
Street and Area Lights	0.00	499.25
Water and Sewage	0.00	521.97
Waste	0.00	5.85
Totals:	0.00	1935.96

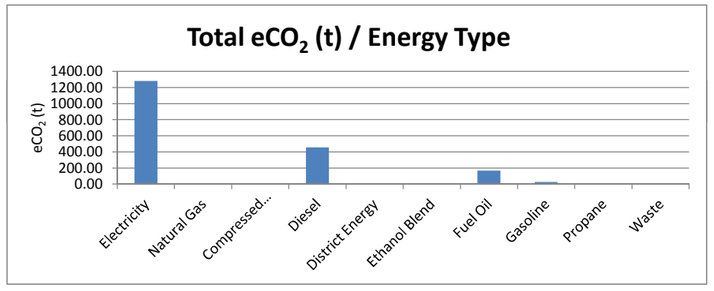




Cost and Tonnes of eCO2 / Energy Type

Energy Type	Total Cost	Total eCO2
Electricity	0.00	1279.54
Natural Gas	0.00	0.00
Compressed Natural Gas	0.00	0.00
Diesel	0.00	456.22
District Energy	0.00	0.00
Ethanol Blend	0.00	0.00
Fuel Oil	0.00	167.54
Gasoline	0.00	26.81
Propane	0.00	0.00
Waste	-	0.00
Totals	0.00	1930.11





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	To convert from kg to metric tons, multiply by:	0.001
Giga	1,000,000,000		
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 Coefficient:

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 foloowing 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 builds.			

Fuel Oil Consumption - Facilities

Substance Name	Emission Factor	Units	kg/L
Carbon Monoxide (CO)	0.6	kg/m³	0.0006
Sulphur Dioxide (SO2)	8.52	kg/m³	0.00852
Oxides of Nitrogen, expressed as NO2 (NOx)	2.40	kg/m³	0.0024
Volatile Organic Compounds (VOCs)	0.024	kg/m³	0.000024
Total Particulate Matter (TPM)	0.24	kg/m³	0.00024
Particulate Matter less than or equal to 10 microns (PM10)	0.12	kg/m³	0.00012
Particulate Matter less than or equal to 2.5 microns (PM2.5)	0.03	kg/m³	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)	EBS (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/CalcEmissionFactors.aspx

Street and Area Lighting: Average kWh / Month

Catecgory 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
Metallic 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.

MUNICIPAL CLIMATE CHANGE ACTION PLAN

MUNICIPALITY OF THE DISTRICT OF CHESTER

APPENDIX E

EcoNOVA SCOTIA MUNICIPAL ENERGY AUDIT REPORT

The Municipality
Of The District of Chester

ecoNova Scotia – Municipal Energy Audit Report

Date Prepared: March 16, 2009

Prepared For: The Municipality of the District of Chester
151 King Street
Chester, Nova Scotia, B0J 1J0

Attn: Lyle Russel, Public Works
Darrel Hiltz, CAO

Prepared By: Mike Jenkins, P. Eng.
Nova Dynamics Limited

Table of Contents

1. Introduction

This Eco-Trust "Basic Energy Audit Report" provides an analysis of the energy consumed by the various assets of The Municipality of The District of Chester, Nova Scotia. This report also provides a list of measures and opportunities to reduce energy consumption and corresponding greenhouse gases for each of these assets. The analysis and list of opportunities are based on findings from a walkthrough energy audit of The Municipality of the District of Chester's assets and a completed GHG inventory list.

Each of the opportunities identified during the walkthrough audit and analysis are listed in the corresponding asset section of this report. The rational and measures to implement each opportunity are also described along with an estimated value of savings, installed costs, and a calculation of simple payback. Each of the opportunities described are also summarized in spreadsheets in the appendix of the report according to their pay back and priority. This report also provides recommendations for future feasibility study and potential implementation under the ecoNova Scotia (Eco-Trust) program.

2. Executive Summary

This "Municipal Energy Audit" report is based on an analysis of a separate ecoNova Scotia (Eco-Trust) greenhouse gas inventory list prepared by the District of Chester as well as notes made during a site visit at each town asset. This report describes the existing energy consumption and current conditions for each asset reviewed along with a comparative energy analysis with similar regional assets. The site visits and walk-through energy audit resulted in over 75 energy saving opportunities identified and described in this report.

Overview of Energy Usage For The District of Chester's Corporate Assets

The information listed in Table 2.1 below, provides an overview of the energy usage by the municipality's various asset categories. The greenhouse gas inventory report previously prepared also includes this information along with a detailed calculation of the equivalent greenhouse gases for each asset class.

Analysis of the data show that the largest, total energy, consumer for the Municipality of the District of Chester is the landfill site. This is due to the leachate wastewater treatment facility as well as the large amount of diesel fuel consumed by mobile equipment at the site. The second largest consumer for the District is the heavy vehicles used primarily for solid waste collection. The third largest consumer of energy is the District's wastewater treatment and water supply assets. Streetlights represent the fourth largest consumer of energy. The energy consumed by the corporate buildings is, in total, less than any of the other selections.

Table 2.1 – Corporate Asset Annual Average Energy Consumption in GJ, (2006-2007) Sorted By Total Consumption

Asset Description	Liquid/Gas Fuel Consumption GJ	Electrical Energy Consumption GJ	Total Energy Consumption GJ
Landfill (450 Kaizer Meadow Rd)	3,826.83	581.61	4,408.44
Vehicles (Without landfill Vehicles)	3,293.98	0.00	3,293.98
Street Lights	0.00	2,071.20	2,071.20
Water - Waste/Water	0.00	1,828.59	1,828.59
Main Office (151 King St)	353.81	377.82	731.63
Planning Office (186 Central St.)	346.60	78.86	425.47
Zoe Valley Library (63 Regent St)	252.57	32.40	284.97
Bandstand	0.00	0.97	0.97
Boat Pump out (South St)	0.00	0.00	0.00
Total Energy Used GJ	**8,073.79**	**4,971.46**	**13,045.25**

General Building Assets

The majority of the opportunities described in this report are in the building asset section due to the quantity of buildings, their relative age and their usage. Energy reduction strategies favour reduction of heat loss first and then consideration of alternative or replacement energy sources. The main heat loss reduction strategies for typical building assets are: improved insulation in ceiling and basement spaces, improved space heating boiler/furnace efficiency, and improved space heating distribution controls. Electrical energy loss reduction opportunities and strategies typically involve an upgrade to more efficient lighting systems and replacement of electric hot water storage heaters with on demand tank-less water heaters. A replacement energy strategy for fuel oil space heating is via the use of a heat pump.

Street Lighting

Street lighting is provided by Nova Scotia Power and is the third largest consumer of energy for the Municipality. This report includes the following key opportunities and strategies to optimize energy use for streetlights:

- Street light usage study
- Optimize area lighting for town assets

Vehicles

The vehicle fleet fuel savings have more general recommendations but the key recommendations are as follows:

- Track individual vehicle costs to assist with decisions on usage, maintenance and replacement.

- Participate in NRC "fleet smart program" with operational and management training for vehicle fleets.

Wastewater and Water Treatment Systems
This report outlines opportunities to optimize the use of electrical energy for water treatment plants and water supply facilities. The use of instruments to measure the dissolved oxygen in wastewater can be used to control the aeration blowers to provide the right amount of air without providing more than is needed.

Landfill Site Energy Usage
The landfill site includes buildings, leachate treatment processes, and heavy vehicle assets, which in total is the largest energy consumer for the District. The heavy vehicle consumption is the largest component at this site. Electrical motors used for blowers compressors and pumps in the leachate treatment process are also large consumers of energy since they operate over long periods of time. These assets provide several energy reduction opportunities; including increased equipment efficiency and adding advanced controls.

General Report Recommendations
The "Opportunity list" spreadsheet found in the appendix of this report summarizes and sorts the opportunities in each category by the order arranged in the report, then again by payback and finally by priority. It is recommended that the District implement opportunities with a payback of under four years as a good investment on their own. There are several opportunities in the higher cost "Retrofit" category with a longer payback that can benefit from the 50% cost sharing of the second phase of the ecoNova Scotia (Eco-Trust) program.

The summary spreadsheet totals the potential cost savings of all projects at $85,000 per year, however some opportunities are mutually exclusive where perhaps only one alternative of several may be chosen. The total green house gases saved from all of the opportunities listed, is calculated as 355.9 metric tonnes per year. The total capital cost of all the projects is estimated to be $213,000.

3. Methods Used to Identify and Analyze Opportunities

The assets of the Municipality of the District of Chester, are divided into the following categories:

1. Building Assets:
    a. Main Office Municipal Administration Building
    b. Planning Office
    c. Zoe Valle Library Building

   d. Landfill Site Office & Maintenance Buildings
   e. Other small periodically used buildings including the bandstand and boat pump out station

2. Vehicle Fleet (including light and heavy vehicles or diesel and gasoline consumers respectfully).

3. Street and Area Lights

4. Water Treatment Facilities and Wastewater Handling assets

5. Solid Waste Handling Facility

This report outlines the findings of the energy consumption and an energy analysis of each asset, followed by a description of green house reduction opportunities determined for each asset.

The green house gas reduction opportunities described for each asset, are arranged into sub-categories of: "**Housekeeping**", "**Minor Maintenance**", and larger capital or "**Retrofit**" opportunities.

Housekeeping opportunities are those measures that can be implemented through current operational procedures, and/or maintenance practices. **Minor Maintenance** or low cost capital measures include the upgrade, or replacement of existing equipment, using internal staff with assistance from maintenance or service contractors. **Retrofit** opportunities are those measures that require larger capital costs, outside contractors and coordination with other building activities.

Each of the opportunities described in this report are also summarized in a spreadsheet located in the appendix of the report. This spreadsheet summary provides for each opportunity; an estimated installed cost where available, the anticipated energy cost savings, and the GHG equivalent emission reductions for each asset. The spreadsheet also indicates payback results and a proposed priority for implementation. The opportunities listed in the spreadsheet are then sorted according to proposed implementation priority based on category and payback.

The data collected in this report, for the energy consumption used by the Municipality of the District of Chester, is from the District's GHG inventory report. This Inventory report utilizes the 2006 annual consumption records. The current (February 2009) average price of energy is equal to $0.13 per kWhr for electricity, and $0.85 per liter for fuel oil. Electricity rates have increased from 2006 due to a 9.3% increased as of January 2009. Fuel oil prices have however, recently trended down from $1.25 per liter in September of 2008 to below $0.70 per liter in January 2009. The long-term price for furnace oil is expected to average about $1.00 per liter in future years. Therefore, for analysis and calculations used in this report, the average cost used for furnace oil is $0.85

per liter and the cost of electrical consumption is $0.13 per kWhr. Where sensitivity to fuel oil or electricity prices is warranted, other pricing will be highlighted.

The units used for quantities in this report are generally the SI or metric system. In some cases, existing equipment specifications indicate other units. Typical conversion values for energy units used in this report are as follows:

- 1 GJ of energy is the equivalent of 277.8 kWhr electrical.
- 1 GJ of energy is the approx equivalent of 0.9478 million BTUs (1 Million)
- 1 GJ of energy is 1,000 MJ of energy.
- 1 liter of fuel oil is .03868 GJ
- 1 liter of propane is .0266 GJ
- Insulation resistance value of 1 (RSI) = 5.67 (R)

4. Building Asset Energy Audit

4.1 Municipality of The District Of Chester - Administration Building

Description of District Administration Building

The District of Chester's administration building is located at 151 King Street in the Village of Chester. This building is approximately 35 years old and was built in 1974. The complete building is used for the municipality's administrative, public works, recreation, council chambers and Warden's offices. The administrative offices are typically used during regular offices hours of 8:00 am to 4:30 pm. The council chambers and committee rooms are used periodically at various times outside of office hours.

The building is a two-story structure generally rectangular in shape, with a canopy over a concrete outdoor area in the rear or west side of the building. The front of

the building is aligned with King Street and is oriented facing and east. The administration building's floor area is approximately 350 m^2 all on each level with a total area of 700 m^2. The main level of the building contains the main administrative offices including the CAO's office, accounting and tax offices as well at the IT and records storage area. The main electrical room, boiler room, and mechanical service room are all on this level. The upper floor contains the Council Chamber's Warden's office and meeting room as well as Public Works and recreation offices.

The building is of wood frame construction. Interior walls are generally wood frame with interior finish of gyprock except where the concrete block is used for fire resistance such as archive storage room. The ground floor is on a concrete slab and is exposed to outdoor ambient air on 3 sides, and a portion of the rear of the building. The building's wall envelope appears to be constructed with 150mm (6") walls and is therefore assumed to be insulated with minimum RSI 2 (R12) walls with exterior painted wooded shingle finish with a light grey color.

The roof is a low slope peaked roof with overhangs. The ceiling membrane is dark coloured asphalt shingles. The roof space is assumed to be insulated with fiberglass batts of RSI 3.5 (R20) insulation value. The ceiling spaces for both upper and lower floors have suspended T-bar ceiling and ceiling tiles. There are 4 skylights at the top of the central stairwell and over the upper floor corridor. The upper and lower floor are separated by interior doors and glassed in central stairwell space.

The building's walls have 22 windows sized approximately (900mm h x 600mm w) and approximately 11 windows (sized 600 mm h x 900 mm wide) wood and non-metallic frames with double glazed glass in the building's envelope. There is a set of double doors at the main entrance in front and rear each with a second set in the foyer. There are two steel insulated man doors, one upstairs and one downstairs, on the south end of the building.

Administration Building Mechanical Systems

A hot water boiler provides the main administrative building space heating. There is a New York Thermal model NT 282 with gross output of 279,000 BTU/hour. The boiler is controlled with a "Teckmar" 260, a single stage boiler controller with DHW and potential outdoor reset control. There is an internal domestic hot water coil in the boiler and an electric hot water storage tank that serves as a supplemental or summer season hot water source. Water supply is via a well pump system.

The space heating water is distributed in an insulated single pipe loop via a circulating pump. It is assumed that the controller is set up for outdoor air reset and mixing control with the circulating pump to reduce loop temperature. The space-heating terminal units (heaters) used in the building are typically convection type, hot water, baseboard heaters. There are two forced air

convectors at the entrance foyers. One unit is located upstairs and one unit is located at the downstairs entry, thermostats control each.

Several small split system air conditioning units and heat pumps provide space cooling. The split system's indoor fan coil is typically a wall-mounted unit and is tubed to an outdoor condenser/evaporator located at ground level. Each unit is provided with its own internal control system. There are approximately 8 of these air conditioning systems installed in the building.

A "Nu–Air" heat recovery ventilator is installed in the main administrative area in a ground floor mechanical room space. The fresh air is tempered with both a hot water heating coil as well as a 10 kW eclectic duct heater. The ventilation system is also provided with a humidity control system. The ventilation air is controlled via a humidistat.

Administration Building Electrical Systems

The building is supplied from a single 200 amp, 240/120-volt, single phase, overhead, and electrical service. The main electrical service panel is located in the mechanical room, on the ground floor in the south side of the building. The main fused switch feeds a 200 amp; circuit breaker distribution panel. This panel supplies the building, loads on the ground floor as well as two other distribution panels. The main power supply is supplied via a 200-amp automatic transfer switch to a remotely installed backup generator installed in a separate building on the west side of the building.

The building's lighting system is comprised mainly of fluorescent lighting fixtures. The fixtures are typically two types 2' x 2' U tube, 4 x 4 tube fixtures in suspended ceilings. The upstairs corridors and entry foyer as well as the council chambers are illuminated with incandescent pot lights. Other offices have on-ground floor have combination of 2' x 2' and 4' tubes. There are several incandescent lamp exit lights. The estimated total lighting load is 8.4 kW.

The main electrical loads in the building are as follows:

1.	Space heating	1,000 watts
2.	Lighting	8,400 watts
3.	Kitchenette Stove	4,000 watts
4.	Water heater	3,000 watts
5.	Refrigerator	1,200 watts
6.	Air conditioner	6,000 watts
7.	Office Copier	600 watts
8.	Servers computers	2,400 watts
9.	Ventilation system	12,000 watts
	Total	38,600 watts

Town Hall/ Administration Building Energy Analysis

The energy inventory report indicates that the electrical energy consumption for 2006 year was 104,920 kWhr. This represents an annual electrical energy consumption of 353.81 GJ. The average electrical cost over this period of 2006 is estimated to be $12,000 assuming the average cost per kWhr was $0.11 per kWhr. The space heating fuel consumption is reported as 9,147 Liters for 2006 or equivalent energy consumption of 353.8 GJ. Assuming the average cost of furnace oil was $0.85 in 2006 the estimated fuel cost was $7,774.95.

The total energy consumed by the District's administration building is therefore 731.63 GJ. An overall energy intensity factor based on an operational area of 700 m^2 is therefore calculated to be 1.05 GJ/m^2. The average energy intensity factor (consumption of energy) for a similar office building in Atlantic Canada is 1.60 GJ/m^2. Relative to the average building of this type, this compares very well considering that this building has air conditioning and a separate mechanical ventilation system. The energy consumption intensity level for space heating is calculated as 0.505 GJ/ m^2 including fuel oil plus electrical consumption for heat pumps and electrical space heating costs. The average space heating requirements for office buildings of this size in Atlantic Canada consume 0.652 GJ/m^2, this also compares favourably.

The total cost of energy for this building on an annual basis is estimated to be $19,775 and therefore the building energy cost index is calculated as $28/$m^2$. The total calculated annual greenhouse gas emissions for this building are 91 tonnes of CO_2e.

Opportunities for Energy Savings

The following energy-saving opportunities for the "Municipal Administration Building" have been determined by an initial priority of reducing energy consumption by reducing losses, secondly by considering means of recovering any of the losses present and finally by use of alternative fuels or more efficient systems to utilize energy.

Municipal Administration Building Housekeeping Opportunities

1. Cleaning & Re-lamping Light Fixtures: Original lighting levels of new fixtures and lamps depreciate over time. Cleaning fixture reflective surfaces and re-lamping, when necessary, of existing lighting systems can improve lighting output 10-25%. Where more light is needed this will be an immediate improvement and where more lighting is not needed fixtures may be switched off or individual lamps removed to save energy. The estimated cost of cleaning fixtures and replacing lamps in the administration building is estimated to be $300. Assuming a 15% improvement in light of the resulting savings 1.26 kW of lighting in operation for 2,000 hours per year equals about $327 annual in electrical cost savings. This measure represents a 1-year payback.

Municipal Administration Building Minor Maintenance Opportunities

2. Reduce Lighting Load: Upgrading lighting controls from switches to occupancy sensors for areas such as washrooms, hallways, meeting rooms or spaces infrequently used can reduce the amount of time lights are left on in un occupied spaces. Outdoor lights can also have timers and/or daylight sensing controls added. These types of lighting controls can provide savings of 10-30% of lighting costs, in their respective areas. Assuming there is the potential to control 3,000 watts (or 3kW) of lighting, this represents a potential savings of $156 per year. The cost of installing advanced lighting controls is approximately $100 for each light switch. Assuming there are 6 locations the installed project cost is $600. Therefore the simple payback for this project is about 3.85 years.

3. Heating Controls Upgrade: The energy used for space heating of spaces such as the council chambers, entry foyers, Wardens office, utility spaces and administrative space that is not used, can be reduced when they are not occupied. The council chambers room has a programmable thermostat but it appears to be for the air conditioning /heat pump system only rather than space heating. There appear to be at least four potential zoned, non-programmable thermostats in the building that could benefit from an upgrade. Replacing these manual thermostats with programmable thermostats can save approximately 5% -15% of space heating costs. The cost of programmable thermostats is $150 installed therefore for 4 installations the estimated project cost is $ 600. The estimated fuel oil savings, based on energy savings at 10% consumption reduction, is 914 liters per year or calculated as $777 per year cost savings. This is calculated as a 0.8-year project payback.

4. Boiler Burner and Heating Surface Efficiency: Service of the existing space heating boiler's burner, boiler-heating surfaces should be completed annually. A build up of soot on the boilers fireside heat transfer surfaces reduces the efficiency of the furnace. A buildup of scale and minerals in the boiler's distribution water also reduces the heat transfer and the efficiency of the heating system. Periodic furnace and heating distribution system maintenance such as periodic water side de-scaling, blow down and inspection of water side components can improve boiler efficiency by up to 3%. Also, the oil burner nozzle and fuel burner adjustments for correct airflow should be checked and adjusted for a further 2-3% efficiency improvement.

   Assuming an average efficiency improvement of 5%, this represents a savings of approximately 450-500 liters of oil or approximately $388 in savings. The cost for this periodic service may be $300. The calculated payback therefore is 8 months; however this service should be repeated annually.

Municipal Administration Building - Retrofit Opportunities

5. More Efficient Lighting. The existing lighting system in the building is original and can be upgraded to more efficient lighting fixtures, thereby reducing electrical losses and reducing heat gain in the cooling season. The proposed project is to change all existing T12 fluorescent fixtures to more efficient T8 or T5 fluorescent fixtures with electronic ballasts. There are several pot lights (incandescent lamps) on both floors that can easily be changed to compact fluorescent fixtures. Electronic ballasts have the capability to be dimmable and may be suitable in the council chambers or meeting rooms or potentially for offices upstairs such as public works where daylight harvesting features can be added.

   The anticipated energy savings of new fixtures are 30% better than the original fixtures. The total savings are therefore 2.5 kW kilowatts of the 8.4 kW) over an average of 2,000 hours. The savings are $655.00 dollars. The retrofit cost of a light fixture is approximately $100-150 per fixture for a fluorescent fixture, and $5 for a compact fluorescent. The total installed cost of replacement fixtures is estimated to be $7,700. The expected payback for this type of upgrade is therefore about 12 years. NSPI and Conserve Nova Scotia have a current "Small Business Direct Install lighting Program" retrofit program underway that will improve this payback to about 2-4 years.

6. Exit Light Upgrades: Replacement of exit light lamps with newer, low power LED style lamps. The estimated replacement cost for each exit light lamp installed is $50 each. There are approximately 10 fixtures installed for a total cost of $500. Exit light fixtures are normally constantly energized and although they are small electrical loads, their energy costs accumulate over the entire year. The typical existing 50-watt incandescent lamp consumes 8,760 hours x 60 watts or approximately $683 per year of electrical costs. Therefore, a 10-watt LCD type lamp will save approximately $546 per year. The calculated pay back is therefore 1.1 years. Refer to Conserve Nova Scotia's lighting upgrade program, which provide incentives for these types of upgrades as well.

7. Reduce Domestic Water Heater Losses: Due to infrequent but periodic demand for domestic hot water, consider a demand type (tank-less electric) water heater rather than an electric storage or indirect storage tank water heater. An "on-demand" water heater can save up to 3%-5% of hot water storage tank radiation heat losses as well as the pipe distribution losses. Large quantities of hot water storage such as for shower use are not often required in this building. The savings in hot water heating cost for a 3 kW water heater is approximately 3 kW x 3% x 8,670 hours x $.13 /kWhr = $102

per year. The cost of an on-demand heater is $600 therefore the payback is 6.00 years.

8. Verify Boiler Outdoor Reset Controls: Boilers and distribution systems operating over short cycles are not as efficient as boilers operating at or near capacity over a longer period of time. Advanced boiler controls may be used to control the distribution temperature of water based on the outdoor temperature (outdoor reset) and the building's actual heating requirements. The existing boiler has a "Teckmar" 260 controller used for DHW control as well as a potential outdoor reset control. The outdoor reset control should take precedence over the DHW control now that the hot water is on a demand heater. It is more important for the boiler to reduce the primary loop temperature via a mixing system according to outdoor temperature. This type of advanced control can dramatically increase the efficiency of the boiler by preventing short operating cycles to satisfy hot water demand or mild weather heating requirements. The cost to implement this system, if not already present, is $1000. An efficiency improvement of 10-15% will provide savings in the annual cost of oil of $1,166, therefore the potential payback is about 1 year.

9. Install An Automatic Damper Vent in Chimney: The chimney and boiler stack vent will continue to remove warm air from a heated space as long as the vent damper is open. This is especially true after a boiler has been firing and then shuts off. An automatic damper vent closes the boiler's exhaust vent when the boiler is not operating and opens it before the boiler operates. This device can save about 5-7% of the cost of the heating season fuel, approximately 1176 liters or a saving of $1,000 per year. The cost per vent and installation is approximately $600. Therefore, the estimated payback is 1.5 years.

Municipal Administration Building - Alternative Fuel Retrofit Opportunity

10. Heat Pump System - Air Source Heat Pump: Several of the spaces have an air source heat pump as well as split system air conditioners. An air source heat pump which costs only 10-15% more than an air conditioner can also provide up to 75% -80% of the same area's seasonal heating requirements. Therefore, ideally all split or unit system air conditioners should be heat pumps. However, a standard heat pump is still not able to efficiently obtain heat from outdoor air at less than -8 degrees C. Therefore, the existing oil fired hot water system is needed as a reliable backup system for extremely cold days and for periods of time when a heat pump may be defrosting. The typical COP (coefficient of performance) for an air source heat pump is approximately 2.5:1 (One unit of electrical energy in will provide 2.5 times the heat energy out). The HSPF (heating season performance factor) for southern Nova Scotia, for air source heat pump, is approximately 6.5-6.9.

This provides an approximate seasonal coefficient of performance (SCOP) of 2.3 for the Chester area.

The suggested total size of a heat pump primarily sized for cooling conditions in the administration building is a total of 20 tons. This may be best achieved as existing systems several 2-3 ton split systems. It is estimated that approximately 50% of the existing air conditioning systems could be upgraded when due for replacement to heat pumps. This size of heat pump will provide for 70 % of the space heating requirements during the year. The estimated installed cost of 50 % more air source heat pumps is therefore $20,000 and the estimated savings during the heating season are $2,400 per year. Therefore, the payback is expected to be 8 years.

11. Solar Lighting /Daylight Harvesting: The municipal administrative building is typically occupied during daylight hours and the roof slope does face east and west but visible to 30 deg. of true south for a large part of the day. This provides an opportunity to utilize a solar powered "Sun Tracker" light fixture to provide natural day lighting during office hours. Perhaps the existing skylights can be replaced with a solar tracker. This light source in combination with new automatically controlled (daylight harvesting) lighting fixtures is a beneficial combination. The sun tracker device uses a motorized solar powered, reflective surface inside a sealed skylight to direct diffused natural light into a building interior space. The reflector optimizes the amount of light by following the angle of the sun. This fixture has the capacity of replacing up to 8 –10 regular light fixtures. When the daylight is unavailable the electronically controlled fixtures automatically sense this and brighten. The public works and upper hallway area of the administration building are a good application for this fixture. The estimated cost of the fixture including installation is $3,000 and the estimated electrical savings is calculated as 2,000 hours x 80% x 800 w = $166 annually. Therefore, with a 25% solar rebate, the expected payback is 14.5 years.

12. Reduce Heat Loss Through Ceilings: The Administration building envelope insulation and ceiling insulation should be inspected for consistent coverage and quantity. An effective means of doing this is with a thermal imaging scanner. The administration building's roof is a low peaked roof with potential room for adding additional layers of fiberglass batt or blown in insulation in areas with suspended ceiling. A minimum of insulation value of RSI 6 (R 34) should be present in the ceiling insulation. Assuming the existing ceiling space is insulated to an RSI value of 3 (R15), adding a 100% increase or a value of RSI 3 over an area of 200 square meters of roof could save a maximum 9,120 KJ of energy per hour. Over a period of a year, this heat loss represents an electrical energy savings of 593 liters of fuel oil per year and provides a cost savings of $504 per year. The cost of installing insulation is typically $25 per square meter in ceiling space or $ 5,000, when done with easy access to a roof or ceiling space. Therefore this opportunity

has a 9-year payback. If the existing insulation is less than an RSI value of 3, the payback will be much sooner.

4.2 Municipal Planning Office Building

Description of Municipal Planning Office Building

The planning office building is located behind the administration building with its main entrance at 186 Central Street, Chester. The building was formerly a school building with two floors, each floor containing two classrooms upstairs and down. The building is currently used to house the District of Chester's planning offices in the upper floor as well as a food bank and storage space in the lower floor. The bottom floor is not regularly occupied. The building is a rectangular shape; approximately 18m long by 12 m wide. The building is oriented with the main entrance on the south side. The approximate floor area of the building is 180m on the top floor and similar area is used for the basement.

The original building is approximately 50 years old and has gone through a few minor renovations over its life span and retains its exterior façade as an historic building. The ceiling spaces in the lower as well as the upper floor, 3.0m and 3.6m heights respectively, allowed the use of suspended tiled ceiling throughout most of the space. The building's structure is wood framed with a concrete basement set into the side of a hill. There are 6 small basement windows assumed to be single glassed the furnace room walls are concrete block walls. Therefore, the ground floor is exposed to one north wall and 50% of its sides to ambient air and 1m of the south wall. The wall envelope in the basement is assumed to be insulated with a minimum of (2") 50mm fiberglass batt insulation; the ceiling space in the basement appears to also have 2" fiberglass batt.

The roof is a single pitched roof oriented north and south with dark coloured asphalt singles. The entrance lobby is insulated with 150mm of fiberglass insulation, viewed when a wall panel was removed for inspection. The walls are finished in gyprock wall panel relatively recently installed in some areas.

The ceiling in the upper floor is reported to have to be insulated to a minimum of 6" (150mm) fiberglass batt insulation.

The lower floor is concrete tiled flooring. The outside walls in service space are poured concrete walls and not insulated. The lower floor has a large wooden un-insulated, double door with visible gaps around some of its edges. There are also single pane older windows in contact with ambient outdoor temperature. On the north and south sides of the building there is a single entry door. On the top floor of the building there is also a corresponding single man door at the northeast and southeast corners respectively. The main entry into the center of the building is located on the top floor. This is a set of double doors; insulated steel doors with an upper window panel in each.

On the upper floor there is one window each located on the north and south side plus a door window each. In addition, there are 4 windows located on the west side plus the entryway windows. These windows are approximately 1,500 mm high x 500mm wide. On the back or east side of the building, there are 12 windows approximately1800mm high x 900mm wide. These windows are single glazed and fitted with an outside storm window. The east side has 6 lower windows of 1500mm h x 600mm wide. The windows upstairs and most of the lower floor windows are wood frame with double glassed glass panels. They are older (25-30 years), but not original wood sash windows. They are slider type and fitted with an exterior storm window.

Planning Building Space Heating

A single oil fired hot water boiler provides space heating for this building. This boiler is a Kerr "Saturn" model with a Reillo model F20 burner. The boiler is installed on the lower floor in a boiler room. The boiler hot water distribution piping is 1-1/4' black iron without insulation. There are three-zone pumps used for the heat distribution system, two heating zone distribution systems to the upper floor's north and south sections and a single zone downstairs. A 2,300-liter oil tank is located in the lower section of the building. The heating terminal units downstairs are cast iron convectors along the outside wall. The upper floor heating units are fin tube hot water convectors. The flue is a single indoor chimney that penetrates the building roof.

There is a split system air conditioner located at the north end of the building with an air duct distribution in the upper floor's ceiling space with supply and return air ducts above the suspended ceiling for the upper floor planning office space.

There is a single "Giant" 40 gallon 120 liter hot water storage tank located in the furnace room in the basement. There are two vertical branches on the outlet without heat loops. Space heating and domestic hot water piping is un-insulated.

Planning Building Electrical Systems

The electrical service for this building is located in an electrical room in the basement adjacent to the boiler room. There is a minimum or a 200-amp main beaker panel with underground service single-phase 240 /120 volt 3 wire system.

The main electrical loads in the building are listed below:

Lighting	5,000 watt
Furnace	1,000 watt
3 Circulating pumps	900 watt
1 Air conditioner	2,000 watt
1 Stove	5,000 watt
2 Freezers	2,000 watt
1 Refrigerator	1,000 watt
10 Office computers	4,000 watt
3 Office Copiers	2,000 watt
Water Pump	1,000 watt
Hot water heater	3,000 watt
Total loads	25,900 watts

Lighting System

The lighting system consists mainly of 2 tube surface mounted fluorescent fixtures. These fixtures are magnetic ballasts with T-12 lamps. There are approximately 25 fluorescent fixtures. There are fixtures upstairs and approximately 16 fixtures down stairs. There are 2-3 incandescent lights in service rooms as well as the exit lights and 2 outdoor incandescent lamps in red glass fixtures. The total lighting load is 5 kW.

Planning office Energy Analysis

This building was reported to have consumed 21,900-kWhr or 78.86GJ of electrical energy during the 2006 annual period. The total quantity of furnace oil consumed (used for space heating) in the building in the 2006 periods was 8,960 liters. The total energy content of the oil, based on 0.0386 GJ/liter, is 346 GJ.

The total consumption of energy for this building is therefore calculated as 425.47 GJ. The total area inside the building is 250 m^2. Therefore, the planning office building has an average energy intensity level of 1.7 GJ/m^2. This compares closely with the average of similar facilities in Atlantic Canada of 1.6 GJ/m^2 . The space heating intensity at 1.38 GJ/m^2 is high relative to the average of other buildings this size at 0.652 GJ/m^2.

The average cost per kWhr was assumed to be $0.12 over this period. Therefore, the cost of electrical energy is $2,628. Assuming an average cost of furnace oil

was $0.85 per liter for this period and that the cost of fuel oil is $7,616 before taxes. The total cost of energy on an annual basis is $10,244 and the building energy cost index based on area is calculated as $40.98/$m^2$.

The total calculated green house gas annual emissions for this building is reported from the inventory to be 43.0 tonnes of eCO_2.

Opportunities for Energy Savings

The following energy saving opportunities for the Municipal Planning Building have been determined by an initial priority of reducing energy consumption by reducing losses. Secondly, it has been done by considering means of recovering any of the losses present and finally by the use of alternative fuels or more efficient systems to utilize energy.

Municipal Planning Building Housekeeping Opportunities

1. Cleaning & Re-lamping Light Fixtures: The original lighting levels of fixtures depreciate over time cleaning and re-lamping when necessary, of existing lighting systems can improve lighting output 10-20%. Where more light is needed this will be an immediate improvement and where more lighting is not needed fixtures may be switched off or individual lamps may be removed. The estimated cost of cleaning reflective surfaces and replacing lamps in the planning building fixtures is $200. This work should be done every 2 years. The resulting potential savings, assuming 15% of 5.0 kW of lighting in operation for 2,000 hours per year equals about $195 annual in electrical cost savings and therefore represents a 1-year payback

Planning Building Minor Maintenance Opportunities

2. Reduce Lighting Load: Upgrading lighting controls from switches to occupancy sensors for areas such as washrooms, entry areas, service spaces in the basement or spaces infrequently used with occupancy sensors can reduce the amount of time lights are on. Outdoor lights can also have timers and/or daylight sensing controls. These types of controls can provide savings of 10-30% of lighting costs in their respective areas. Assuming there is the potential to control 1500 watts (or 1.5 kW) of lighting, this represents a potential savings of $78 per year. The cost of installing advanced lighting controls is approximately $100 for each light switch. Assuming 4 locations, costs are $400. Therefore the simple payback is about 5 years.

3. Heating Controls Upgrade: The energy used for space heating of spaces such as entry foyers, the office area, utility spaces, and administrative space that is not used can be reduced when they are not occupied. The existing controls for the planning building consist of three zones. Potentially three, but practically 2 thermostats, may be installed. Replacing these manual thermostats with programmable thermostats may save approximately 5% -15% of space heating

costs over the heating season. The cost of programmable thermostats is $150 installed therefore for 2 installations the estimated cost is $ 300. The estimated energy savings at 10% consumption reduction is calculated as $761 or approximately a 0.4-year payback.

4. Boiler Burner and Heating Surface Efficiency: Service of the boiler's burner, boiler-heating surfaces should be completed annually. A build up of soot on the boilers fireside heat transfer surfaces reduces the efficiency of the furnace. A buildup of scale and minerals in the boilers distribution water also reduces the heat transfer and the efficiency of the heating system. Periodic furnace and heating distribution system maintenance can improve boiler efficiency by up to 3%. Also, the oil burner nozzle and fuel burner adjustments for correct airflow should be checked and adjusted for a further 2-3% efficiency improvement.

   Assuming an average efficiency improvement of 5%, this represents a savings of approximately 450-500 liters of oil or approximately $380 in savings. The cost for this periodic service may be $300. The calculated payback therefore is 8 months, however this service should be repeated annually.

Planning Office Retrofit Opportunities

5. More Efficient Lighting. The existing lighting system can be upgraded to more efficient lighting fixtures thereby reducing electrical losses and reducing heat gain in the cooling season. The proposed project is to change out all existing T12 fluorescent fixtures, especially those on the top floor to more efficient T8 or T5 fluorescent fixtures with electronic ballasts. There are a few incandescent several pot lights on both floors that can easily be changed to compact fluorescent fixtures. Electronic ballasts have the capability to be dimmable and may be suitable in the council chambers or meeting rooms or potential for upstairs offices such as public works where daylight harvesting features can be added.

   The anticipated savings are 30% of the existing 5,000 watts currently consumed by the existing lighting system. The total savings are therefore 1.5 kW kilowatts over an average of 2,000 hours. The savings are $390.00 dollars. The retrofit cost of a light fixture is approximately $100-150 per fixture for a fluorescent fixture and $5 for a compact fluorescent. The total installed cost of replacement fixtures is therefore estimated to be $5,000. The expected payback for this type of upgrade is therefore about 12.7 years. NSPI and Conserve Nova Scotia have a current lighting "Small Business Direct Install lighting Program" retrofit program underway that will improve this payback to about 2-4 years.

6. Exit Light Upgrades: Replacement of exit light lamps with newer, low power LED style lamps. Estimated replacement cost for each exit light lamp

installed is $50 each. There are approximately 4 fixtures installed for a total cost of $200. These light fixtures are normally constantly energized. The typical existing 50-watt incandescent lamp consumes 8,760 hours x 60 watts or approximately $227 per year. Therefore a 10-watt LCD type lamp will save approximately $180 per year. The calculated payback is therefore 1.1 years. Refer to Conserve Nova Scotia's lighting upgrade program, which provide incentives for these types of upgrades as well.

7. Reduce Domestic Water Heater Losses: Due to infrequent, but periodic, demand for domestic hot water, consider a demand type (tank-less electric) rather than an electric or indirect storage tank water heater. An "on-demand" water heater can save up to 3%-5% of hot water storage tank radiation heat losses as well as the copper pipe distribution losses. Large quantities of hot water such as showers are not often required in this building. The savings in hot water heating costs for a 3 kW water heater is approximately 3 kW x 3% x 8,670 hours x $.13 /kWhr = $102 per year. The cost of an on-demand heater is $600. Therefore, the payback is 6.00 years.

8. Add Boiler Outdoor Reset Controls: Lower temperature hot water distribution will have reduced heat loss. Advanced boiler controls may be used to control the distribution temperature of water based on the outdoor temperature (outdoor reset) and the building's actual heating requirements. Along with this, a lower distribution temperature for the hot water during shoulder seasons will allow more regulated heating rather than frequent cycling of hot and cold. The existing boiler has three circulating pumps for zone control. A new primary circulating loop with return water mixing will allow an outdoor temperature-sensing controller to provide the correct temperature distribution water. This type of advanced control can dramatically increase the efficiency of the boiler by preventing short operating cycles. The costs to implement the system are estimated at $2,000. An efficiency improvement of 10-15% will provide savings in the annual cost of oil of $1,142. Therefore, the potential payback is about 2 years.

9. Install An Automatic Damper Vent in Chimney: The chimney and boiler stack vent will continue to remove warm air from a heated space as long as the vent damper is open. This is especially true after a boiler has been firing and then shuts off. An automatic damper closes the boiler's exhaust vent when the boiler is not operating and opens it before the boiler operates. This device can save about 5-7% of the cost of heating saving which amounts to $1,000 per year. The cost per vent and installation is approximately $600. Therefore the estimated payback is 1.5 years.

10. Insulate Hot Water Heat Distribution Lines: The existing hot water zone distribution line's supply and return as well as the boiler supply and return header should be insulated. These are 1-1/4" black iron pipes. The estimated length of pipe in the distribution zones is 100 m; the estimated cost of pipe

insulation is $10 per meter for a project cost of $1,000. The expected cost of oil savings is therefore 929 liters and the total cost is $800 per year. Therefore, the payback is 1.2 years.

11. Reduce Heat Loss Through Ceilings: The Planning-building envelope insulation and ceiling insulation should be inspected for consistent coverage and quantity. An effective means of doing this is with a thermal imaging scanner. The Planning-building roof is a peaked roof, with potential room for adding additional layers of fiberglass batt or blown in insulation in attic spaces or batts areas with suspended ceiling. A minimum insulation value of RSI 6 (R 34) should be present in the ceiling insulation. Assuming the existing ceiling space is insulated to an RSI value of 3 (R15), adding a 100% increase or a value of RSI 3 over an area of 200 square meters of roof could save a maximum of 9,120 KJ of energy per hour. Over a period of a year, this heat loss represents an electrical energy savings of 522 liters of fuel oil each year and provides a cost savings of $444 per year. The cost of installing insulation is typically $25 per square meter in ceiling space or $ 4,400 when done with easy access to a roof or ceiling space. Therefore, this opportunity has a 9-year payback. If the existing insulation is less than an RSI value of 3, the payback is proportionally sooner.

Town Hall Alternative Fuel Retrofit Opportunity

12. Heat Pump System - Air Source Heat Pump: The upper floor has an air conditioning system and an air distribution system installed in the ceiling space. An air source heat pump, which costs approximately 10-15% more than an air conditioner, can also provide up to 75% - 80% of a buildings heating requirements seasonally. The existing air conditioner appears to use outdoor air in the ceiling space to reject heat to and therefore is not as efficient. An outdoor mounted ground or wall stand split system heat pump can be concealed at the edge of the building. A heat pump is however still not able to efficiently obtain heat from outdoor air at less than -8 degrees C. Therefore the existing oil fired hot water system is needed as a reliable back up system for extremely cold days and for periods of time when the heat pump may be defrosting. The typical COP (coefficient of performance) for an air source heat pump is approximately 2.5:1 (One unit of electrical energy in will provide 2.5 times the heat energy out). The HSPF (heating season performance factor) for southern Nova Scotia, for air source heat pump, is approximately 6.5-6.9. This provides an approximate seasonal coefficient of performance (SCOP) of 2.3 for the Chester area.

    The suggested total size of a heat pump primarily sized for cooling conditions in the upper floor of the planning building is a total of 5–7 tons. This may be best achieved as existing systems two 3 ton split systems. The estimated cost

of heat pumps is $15,000. The existing air conditioning systems could also be upgraded when due for replacement to new heat pumps. This size of heat pump will provide for 70 % of the space heating requirements during the year. The estimated savings during the heating season, is $2,400 per year. Therefore, the payback is expected to be 6.5 years.

13. Solar Lighting /Daylight Harvesting: The municipal planning building is typically occupied during daylight hours. The roof is oriented north and south, however, a roof monitor in the form of a dormer may be used to capture natural daylight and have it be diffused through diffuser panels for a large part of the day. Another opportunity is to utilize a solar powered "Sun Tracker" light fixture or light pipes to provide natural day lighting during office hours. Perhaps the existing skylights can be replaced with a solar tracker. This light source in combination with new automatically controlled (daylight harvesting) lighting fixtures is a beneficial combination. The sun tracker device uses a motorized solar powered, reflective surface inside a sealed skylight to direct diffused natural light into a building's interior space. The reflector optimizes the amount of light by following the angle of the sun. This fixture has the capacity of replacing up to 8 –10 regular light fixtures. When the daylight is unavailable, the electronically controlled fixtures automatically sense this and brighten. The upper foyer area of the administration building is a good application for this fixture. The estimated cost of the fixture including installation is $3,000 the estimated electrical savings is 2,000 hours x 80% x 800 w = $166 annual in savings. Therefore with a 25% solar rebate the expected payback is 14.5 years.

14. Upgrade windows on east side of the building. The east side of the planning building has a large amount of area in n since it was used as a school building. The windows are dated and not as efficient as current windows. The calculated heat loss through these windows is approximately 475 liters of oil. Windows with a film and ½" air space could reduce heat loss by approximately 100 liters of oil a year however the cost of replacement windows would make this a long payback (more than 25years). The quantity of the windows can be reduced by 50% and therefore heat loss would be reduced by 50% providing a savings of 250 liters of oil per year. Assuming the costs to remove and refinish window space are approximately $3,000, this project would have a payback of 12 years. If windows in this area are to be replaced, the most efficient available windows are recommended.

15. Improve Windows and Doors In Lower Level: The windows and equipment doors into the food bank area are poorly fitted not very efficient. There is some air space around the equipment door and the windows are only single glazed without storm covers. Assuming a total window and door area of 12 m^2 per door, the heat loss calculated can be reduced by improving windows and doors to double-glazed and insulated doors. The reduced heat loss is calculated as the equivalent of 370 liters of fuel oil per year or a cost savings

of $313 annually. The project cost to upgrade windows and doors is estimated to be $4,500; therefore payback is 14 years.

16. Reduce Basement Heat Loss: The basement walls in the ground floor are not insulated on the west side and also do not appear to be insulated on the north and south sides. There is some insulation above the ceiling space in the basement (approximately 50mm fiberglass batt). This project is to insulate basement walls in bottom floor. The floor to wall headers and bare concrete exterior basement walls should be insulated. The estimated savings in fuel oil for this work is 1,942 liters of fuel or cost savings of $1,651 per year. The estimated cost of insulating these walls and the header space is $6,100. Therefore, the overall payback is approximately 4 years.

4.3 Zoe Valle Library Building

Description of Zoe Valle Library Building

The Zoe Valle Library building is located at, 63 Regent Street, in the Village of Chester. This is a historic building built approximately 150 years ago. The building is rectangular in shape with two floors plus a basement. The main floor contains two rooms containing the library's book collection, which is open to the public on a periodic basis. The remainder of the building is a residential space.

The front of the building faces Regent Street or the north direction. Its outside dimensions are approximately 12 m long by 9 m wide. The total occupied floor area including both floors is reported to be 150 m^2. The building envelope is a wood frame building consistent with building construction at the time. It is assumed that there is minimum insulation in the wall spaces. The interior walls are finished in plaster surfaces and with wooden shingles sheathing on the outside walls. A central stair well in the center of the building leads from the entry way to the upper floor.

The building's roof system is a conventional peaked roof with black asphalt shingles on top of a wood structure. The center portion of the roof provides an attic space. An inspection of the attic shows approximately 150mm of fiberglass insulation in the ceiling space and appears to continue down in the ceiling spaces to the eaves of the building. There are two brick chimneys as well as a separate furnace vent penetrating through the building out the roof of the building.

The basement is a full height basement in the main part of the building with a crawl space under the lower kitchen section of the building. The basement floor is concrete and the basement walls are mortared stone walls. The basement contains the furnace and water pump equipment. The headers above the basement walls and basement entry way are insulated with fiberglass batts.

There are approximately 12 windows in the building envelope. The approximate size is 750mm wide x 1000mm high. The windows in both floors of the building are older (50-60 year old) style wooden sash, vertical type. The glazing is made up of 12 smaller panes of single pane glass. Most windows are fitted with single metal-framed storm windows on the exterior. The main entry way has several individual panes of glass forming a light transit and sidelights surrounding the main wooden entry door. There is a second door on the rear, or south side of the building and a former door on the east side of the building.

Library Mechanical Systems

The library space heating is provided by a relatively new (less than 10-year-old) oil fired, hot air furnace. This furnace is a Kerr Gemini model KDFE 140 with a Reillo F40 burner. The burner is configured with a 1.22 gph rate nozzle for a gross heating capacity of 140,000 BTU per hour. Heat is distributed via hot air ducts and floor registers. There is only one zone in the building, regulated by a single thermostat.

An assumed electric hot water tank located on the main floor of the building provides the domestic hot water.

Library Electrical Systems

The electrical service is a 100 amp, 240/120 single-phase overhead system. The typical electrical loads in the building are listed below:

Lighting	1,600 watt
Furnace	1,000 watt
1 Blower	1,000 watt
1 Electric Stove	4,000 watt
1 Refrigerator	1,000 watt
1 computers	800 watt
Domestic appliances	3,000 watt
Water Pump	1,000 watt
Hot water Heater	3,000 watt
Total loads	16,400 watts

Library Lighting System

The ground floor generally has incandescent light fixtures. The two library rooms each have two florescent, 2-tube 48" lamps, fixtures with T12 lamps. The second floor is illuminated with incandescent fixtures. The assumed lighting load is 1.6 kW.

Library Energy Analysis

The electrical consumption for the library building, for the 2006 period was 8,998 kWhr or 32.4GJ of energy per year. The reported furnace oil used for space heating during the 2006 year was 6,529 liters or 252.57 GJ of space heating energy. The total energy used by the library is therefore 284.97 GJ and the total floor area of the building is estimated at 204 m^2 therefore the energy intensity is calculated at 1.9 GJ/ m^2. This is higher than an average office building in Atlantic region but difficult to compare to a small historic building. The building's space heating energy intensity is calculated as 1.8 GJ/m2 and is considered to be high compared to office buildings of this size in Atlantic Canada, which on average consume 0.652 GJ/m^2 for space heating.

The cost for electrical energy in 2006 was $0.12 kWhr and the estimated cost of electrical energy was $1,079 for the year. The fuel oil cost during the 2006 reporting period is assumed to be $.85 per liter. The estimated cost for space heating was therefore estimated to be $6,630. The building's energy cost index estimate is therefore $44.20 per m^2.

The total green house gases for the library building annually are 25.3 Tonnes of CO2e.

Opportunities for Energy Savings

The following energy saving opportunities for the Zoe Valle Library Building have been determined by an initial priority of reducing energy consumption by reducing losses, secondly by considering means of recovering any of the losses present and finally by use of alternative fuels or more efficient systems to utilize energy.

Library Building Housekeeping Opportunities

1. Cleaning & Re-lamping Light Fixtures: The original lighting levels of all lighting fixture types and lamps depreciate over time. Cleaning fixture reflective surfaces and re-lamping when necessary, can improve lighting output 10-25%. Where more light is needed this will be an immediate improvement and where more lighting is not needed fixtures may be switched off or individual lamps removed. The estimated cost of cleaning reflective surfaces and replacing lamps in the library building is estimated to cost $100 and should be done every 2 years. The resulting potential savings assuming 15% of 1.26 kW of lighting in operation for 2,000 hours per year equals about $62 annual in electrical cost savings and therefore represents a 1-year payback.

Library Building Minor Maintenance Opportunities

2. Heating Controls Upgrade: The building has only one thermostat and one common distribution system. Replacing the manual thermostat with a programmable thermostat to implement night time set back or other features may save approximately 5% -15% of space heating costs over the heating season. The cost of programmable thermostats is $150 installed. The estimated energy savings at 10% consumption reduction is calculated as $551, or approximately a 0.5-year payback.

3. Boiler Burner and Heating Surface Efficiency: Service of the furnace burner, heating surfaces should be completed annually. A build up of soot on the fireside heat transfer surfaces reduces the efficiency of the furnace. A buildup of dust and dirt on the fan and heat exchanger reduces the heat transfer and the efficiency of the heating system. Periodic furnace and heating distribution system maintenance can improve boiler efficiency by up to 3%. In addition, the oil burner nozzle and fuel burner adjustments for correct airflow should be checked and adjusted for a further 2-3% efficiency improvement.

   Assuming an average efficiency improvement of 3%, this represents a savings of approximately 200 liters of oil or approximately $166 in savings. The cost for this periodic service may be $200. The calculated payback is therefore 1.2 years, however this service should be repeated annually as part of a preventative maintenance program.

Library Building Retrofit Opportunities

4. More Efficient Lighting. The existing lighting system can be upgraded to more efficient lighting fixtures thereby reducing electrical losses and reducing heat gain in the cooling season. The proposed project is to change out the existing T12 fluorescent fixtures in the library rooms, especially those on the top floor to more efficient T8 or T5 fluorescent fixtures with electronic ballasts. There are a few incandescent several pot lights on both floors that can easily be changed to compact fluorescent fixtures. Electronic ballasts have the capability to be dimmable and may be suitable for use in reading rooms or public areas where daylight harvesting features can be added.

   The anticipated savings are 30% of the existing 1,600 watts currently consumed by the existing lighting system. The total savings are therefore 0.5 kW over an average of 2,000 hours. The savings are $120.00 dollars per year. The retrofit cost of a light fixture is approximately $100-150 per fixture for a fluorescent fixture and $5 for a compact fluorescent. The total installed cost of replacement fixtures is therefore estimated to be $1,000. The expected payback for this type of upgrade is therefore about 7 years. NSPI and Conserve Nova Scotia have a current lighting “Small Business Direct Install

lighting Program" retrofit program underway that will improve this payback to about 2-4 years.

5. Reduce Domestic Water Heater Losses: Due to infrequent but periodic demand for domestic hot water, consider a demand type (tank-less electric) rather than an electric or indirect storage tank water heater. An "on-demand" water heater can save up to 3%-5% of hot water storage tank radiation heat losses as well as the pipe distribution losses. The savings in hot water heating costs for a 3 kW water heater are approximately 3 kW x 3% x 8,670 hours x $.13 /kWhr = $102 per year. The cost of an on-demand heater is $600 therefore the payback is 6.00 years.

6. Install An Automatic Damper Vent in Chimney: The chimney and boiler stack vent will continue to remove warm air from a heated space as long as the vent damper is open. This is especially true after a boiler has been firing and then shuts off. An automatic damper closes the boiler's exhaust vent when the boiler is not operating and opens it before the boiler operates. This device can save about 5-7% of the cost of heating savings, totaling $277 per year. The cost for a small vent and installation is approximately $500. Therefore, the estimated payback is 1.8 years.

7. Reduce Heat Loss Through Ceiling: The library building envelope insulation and ceiling insulation should be inspected for consistent coverage and quantity. An effective means of doing this is with a thermal imaging scanner. The roof is a peaked roof, with about 50% of its area accessible in an attic space. There appears to be about 150 mm (6") of insulation with potential room for adding an additional 150 mm layer of fiberglass batt or blown in insulation. A minimum insulation value of RSI 6 (R 34) should be present in the ceiling insulation. Assuming the existing ceiling space is insulated to an RSI value of 3 (R15), adding a 100% increase, or a value of RSI 6, over an area of square meters of roof could save 6,840 KJ of energy per hour. Over a period of a heating season, this heat loss represents an electrical energy savings of 356 liters of fuel oil per year and provides a cost savings of $378.50 per year. The cost of installing insulation is typically $20 per square meter in ceiling space or $ 3,000 when done with easy access to a roof or ceiling space. Therefore, this opportunity has an 8-year payback.

8. Reduce Basement Heat Loss: The basement walls are generally mortared stonewalls with little direct exposure to ambient air. The floor header spaces over top of the stone are insulated with fiberglass batts. The basement wall heat loss therefore acts in a single direction; typically to the earth. The assumed temperature differential through the winter season is 10 deg. C. Installing a rigid foam or a framed and batt insulation system can reduce the heat loss from the basement and from the floor space above through the walls. The estimated savings in fuel oil for this work is 1,444 liters of fuel or cost savings of $1,227 per year. The estimated cost of insulating these walls and

the header space is estimated to be $2,800. Therefore, the overall payback is approximately 2.28 years.

9. Insulating Floor Space: Insulating the floor space below the kitchen and areas non-insulated or heated basement spaces will reduce heat loss to a cooler basement space or ambient outdoor areas. The estimated savings in fuel oil for this work is 1,125 liters of fuel or cost savings of $957 per year. The estimated cost of insulating below the floor space and the header space is estimated to be $2,000. Therefore, the overall payback is approximately 2 years.

Library Alternative Fuel Retrofit Opportunity

10. Heat Pump System - Air Source Heat Pump: An air source heat pump can provide up to 75% -80% of a building's heating requirements seasonally as well as provide cooling for the summer period. The existing library building uses a hot air furnace with distribution ducting already in place therefore a heat pump air coil could be added to the existing system. A split system heat pump installed outside of the building could be configured to blend in with its historical setting. A standard heat pump is however still not able to efficiently obtain heat from outdoor air at less than -8 degrees C. Therefore, the existing oil fired hot air system is needed as a reliable backup system for extremely cold days and for periods of time when the heat pump may be defrosting. The typical COP (coefficient of performance) for an air source heat pump is approximately 2.5:1 (One unit of electrical energy in will provide 2.5 times the heat energy out). The HSPF (heating season performance factor) for southern Nova Scotia, for an air source heat pump, is approximately 6.5-6.9. This provides an approximate seasonal coefficient of performance (SCOP) of 2.3 for the Chester area.

    The suggested total size of a heat pump primarily sized for cooling conditions in the main floor of the library building is a total of 3.75 tons. This size of heat pump will provide for 75 % of the space heating requirements during the year however it will consume more expensive electrical energy while achieving the COP efficiency. The payback for heat pumps is sensitive to the relative costs between oil and electricity. If oil prices increase, the payback period will become shorter or as oil prices go lower the payback will increase. The estimated savings in oil costs less the additional electrical costs, during the heating season is therefore calculated to be $1,783 per year. The estimated installed cost of heat pumps is $11,000. Therefore the payback is expected to be 6.17 years for oil at $0.85 per liter or 4.37 years for oil at $1.00 per liter years.

4.4 Kaiser Meadows Solid Waste Site Buildings – Administration Building

Description of Solid Waste Administration Building

The Kaiser Meadow landfill office is a new (1-2 years old), single story plus basement rectangular building located at the landfill site entrance across from the scale house. The upper floor contains reception area office, meeting room, and lunchroom facility. The basement of the building contains a shower and locker room as well as storage space. The occupied area of the building is approximately 70m^2 upstairs and similar area in the basement.

The electric service for this is an overhead, single-phase 240/120 volt 200 amp service. The lighting system is typically via ceiling surface mounted fluorescent fixtures. The typical fixture is a 2 tube, 48" fixture with T-12 lamps. Exit lights are incandescent amps. The estimated lighting load is 2,000 watts for both floors.

Space heating for the building is via electric baseboard heaters and air conditioning is provided via four wall-mounted, split style air conditioner systems. The building has a "Venmar" heat recovery ventilator system. The basement walls are un-insulated. An electric hot water storage tank provides domestic hot water.

The scale house is a single story building with a 1 m crawl space. The building is approximately 6m x 4.5m and is also electrically heated and has an air conditioning system split unit. The lights are surface mounted 2 tube fixtures with t-12 lamps. The approximate lighting load is 500 watts. The scale house has a 15-gallon DHW heater.

Landfill Office Building Housekeeping Opportunities

1. Cleaning & Re-lamping Light Fixtures: Original light fixture lighting levels depreciate over time. Cleaning and re-lamping when necessary of existing lighting systems can improve lighting output 10-20%. Where more light is needed, this will be an immediate improvement and where more lighting is not needed, fixtures may be switched off or individual lamps can be removed. The estimated cost of cleaning reflective surfaces and replacing lamps in the landfill office building is $100 and should be done every 2 years. The resulting in potential savings assuming 15% of 2.0 kW of lighting in operation for 2,000 hours per year equals about $70 annual in electrical cost savings and therefore represents a 2-year payback

Municipal Administration Building Minor Maintenance Opportunities

2. Reduce Lighting Load: Upgrading lighting controls from switches to occupancy sensors for areas such as washrooms, entry areas, service spaces in the basement or spaces infrequently used with occupancy sensors can reduce the amount of time lights are on. Outdoor lights can also have timers and/or daylight sensing controls. These types of controls can provide savings of 10-30% of lighting costs in their respective areas. Assuming there is the potential to control 1000 watts (or 1.0 kW) of lighting, this represents a potential savings of $52 per year. The cost of installing advanced lighting controls is approximately $400 for each light switch. Assuming 4 locations, costs are $400. Therefore the simple payback is about 7 years.

3. Heating Controls Upgrade: The energy used for space heating of spaces such entry foyers, office area, utility spaces administrative space that is not used, can be reduced when they are not occupied. The existing controls for the building consist of several individual electrical line thermostats, assuming potentially two or more programmable thermostats may be installed. Replacing these manual thermostats with programmable thermostats and contactors may save approximately 5% -15% of space heating costs over the heating season. The cost of programmable thermostats is $150 installed. Therefore, for 2 installations the estimated cost is $300. The estimated energy savings at 10% consumption reduction is calculated as $338 per year or approximately a 0.8 -year payback.

Solid Waste Office Building Retrofit Opportunities

4. More Efficient Lighting. The existing lighting system can be upgraded to more efficient lighting fixtures thereby reducing electrical losses and reducing heat gain in the cooling season. The proposed project is to change out all existing T12 fluorescent fixtures, to more efficient T8 or T5 fluorescent

fixtures with electronic ballasts. There are a few incandescent fixtures on both floors that can easily be changed to compact fluorescent fixtures. Electronic ballasts have the capability to be dimmable and may be suitable in the council chambers or meeting rooms or potentially for upstairs offices such as public works where daylight harvesting features can be added.

The anticipated savings are 30% of the existing 2000 watts currently consumed by the existing lighting system. The total savings are therefore 0.6 kW over an average of 2,000 hours. The savings are $156.00 dollars per year. The retrofit cost of a light fixture is approximately $100-150 per fixture for a fluorescent fixture and $5 for a compact fluorescent. The total installed cost of replacement fixtures is estimated to be $2,700. The expected payback for this type of upgrade is therefore about 17 years. NSPI and Conserve Nova Scotia have a current lighting "Small Business Direct Install lighting Program" retrofit program underway that will improve this payback to about 2-4 years.

5. Exit Light Upgrades: Replacement of exit light lamps with newer, low power LED style lamps. Estimated replacement cost for each exit light lamp installed is $50 each. Exit lights may not be required for this building and could be removed. There are approximately 4 fixtures installed for a total cost of $200. These light fixtures are normally constantly energized. The typical existing 50-watt incandescent lamp consumes 8,760 hours x 60 watts or approximately $227 per year. Therefore, a 10-watt LCD type lamp will save approximately $180 per year. The calculated pay back is therefore 1.1 years. Refer to Conserve Nova Scotia's lighting upgrade program, which provides incentives for these types of upgrades as well.

6. Reduce Domestic Water Heater Losses: Due to infrequent, but periodic, demand for domestic hot water, consider a demand type (tank-less electric) rather than an electric or indirect storage tank water heater. An "on-demand" water heater can save up to 3%-5% of hot water storage tank radiation heat losses as well as the copper pipe distribution losses particularly in a basement location. The savings in hot water heating cost for a 3 kW water heater are approximately 3 kW x 3% x 8,670 hours x $.13 /kWhr = $102 per year. The cost of an on-demand heater is $600. Therefore, the payback is 6.00 years.

Landfill Office Alternative Fuel Retrofit Opportunity

7. Heat Pump System - Air Source Heat Pump: The upper floor has several split system air conditioners. An air source heat pump which costs only 10-15% more than an air conditioner can also provide up to 75% -80% of a building's heating requirements seasonally. A standard heat pump is however still not able to efficiently obtain heat from outdoor air at less than -8 degrees C. Therefore, the existing baseboard electric space heating system is needed as a reliable back up system for extremely cold days and for periods of time when

the heat pump may be defrosting. The typical COP (coefficient of performance) for an air source heat pump is approximately 2.5:1 (One unit of electrical energy in will provide 2.5 times the heat energy out). The HSPF (heating season performance factor) for southern Nova Scotia, for air source heat pump, is approximately 6.5-6.9. This provides an approximate seasonal coefficient of performance (SCOP) of 2.3 for the Chester area.

The suggested total size of a heat pump primarily sized for cooling conditions in the upper floor of the landfill administration building is a total of 4-6 tons. This may be best achieved as existing systems; three 1 –2 ton split systems. The estimated cost of heat pumps is $9,000. The existing air conditioning systems could also be upgraded when due for replacement to new heat pumps. This size of heat pump will provide for 75 % of the space heating requirements during the year. The estimated savings during the heating season are therefore $2,149 per year. Therefore, the payback is expected to be 4.6 years.

8. Solar Lighting /Daylight Harvesting: The municipal planning building is typically occupied during daylight hours. The roof is oriented north and south. A roof monitor in the form of a dormer may be used to capture natural daylight and have it be diffused through diffuser panels for a large part of the day. Another opportunity is to utilize a solar powered “Sun Tracker” light fixture or light pipes to provide natural day lighting during office hours. Perhaps the existing skylights can be replaced with a solar tracker. This light source in combination with new automatically controlled (daylight harvesting) lighting fixtures is a beneficial combination. The sun tracker device uses a motorized solar powered, reflective surface inside a sealed skylight to direct diffused natural light into a building interior space. The reflector optimizes the amount of light by following the angle of the sun. This fixture has the capacity of replacing up to 8 –10 regular light fixtures. When the daylight is unavailable, the electronically controlled fixtures automatically sense this and brighten. The upper foyer area of the administration building is a good application for this fixture. The estimated cost of the fixture including installation is $3,000. The estimated electrical savings is 2,000 hours x 80% x 800 w = $166 annually in savings. Therefore, with a 25% solar rebate, the expected payback is 12 years.

9. Reduce Basement Heat Loss: The basement walls in the ground floor are not insulated except for a portion used as a locker room. There is some insulation in the header space above concrete walls. The ceiling space in the basement is not insulated. Therefore, the temperature differential between basement and ground is assumed to be 15 degrees C. Installing 150mm of foam or fiberglass batt along the basement walls will reduce the heat loss by 29,000 MJ or a cost savings of $1,000 annually. The estimated cost to insulate basement walls is $2,500; therefore the overall payback is approximately 2.5 years.

4.5 Kaiser Meadows Solid Waste Site Buildings - Maintenance Building

Description of Solid Waste Landfill Maintenance Building

The existing landfill maintenance shop building was enclosed with a new building, built completely around it. The new structure is now approximately 25m x 25m or total enclosed area 625 m^2. This building has a 6 m high ceiling. It is a single story steel frame structure on a concrete slab. The walls and roof panels are steel insulated double layer (inner and outer steel with internal insulation) walls and roof. The roof is low slope, with open web steel roof joists; the roof panels have internal (4'') 100 mm insulation. The three new and one original, overhead equipment doors into the shop area, are insulated doors. Two rows of natural lighting translucent panels are installed approximately 4m high along the two side walls of the building.

The building's electrical system is a 200 amp, single-phase 240/120-volt system. The building lighting is via high bay HID metal halide 250-watt lights. There are approximately 28 fixtures. Other building electrical loads are shown in the following table:

Table 6-1 maintenance building loads

Electrical Load Calculation

Description of Load	**Quantity**	**Watts**	**Subtotal**
Lighting System	28	300.00	8,400.00
Water heater	1	3,000.00	3,000.00
Kitchen Equipment	1	6,000.00	6,000.00
Oil heater	3	400.00	1,200.00
Welder	1	3,000.00	3,000.00
Air compressor	1	5,000.00	5,000.00
Water pump	1	600.00	600.00
Misc lights	1	1,200.00	1,200.00
Door operators	3	600.00	1,800.00
	Total	Watts	**30,200.00**
	Total	kW	**30.20**

The building's space heating is provided by three overhead linear horizontal tube, oil fired linear radiant heaters. A 4,000-liter outdoor oil tank provides fuel for the space heating. A single electric water heater storage tank provides hot water.

Solid Waste Landfill Maintenance Building Housekeeping Opportunities

1. Cleaning & Re-lamping Light Fixtures: Original light fixture lighting levels depreciate over time. Cleaning and re-lamping when necessary of existing

lighting systems can improve lighting output 10-20%. Where more light is needed, this will be an immediate improvement and where more lighting is not needed, fixtures may be switched off or lamps removed. The estimated cost of cleaning reflective surfaces and replacing lamps in the landfill maintenance building is fixtures is $400 and should be done every 2 years. The resulting improvement in lighting provides potential savings assuming 15% of 7 kW of lighting in operation for 2,000 hours per year equals about $273 annually in electrical cost savings and therefore represents a 1.5-year payback

Solid Waste Landfill Maintenance Building Minor Maintenance Opportunities

2. Reduce Lighting Load: Upgrading lighting controls from switches to occupancy sensors for areas such as washrooms, entry areas, shop service spaces or spaces infrequently used with occupancy sensors can reduce the amount of time lights are on. Outdoor lights can also have timers and/or daylight sensing controls. These types of controls can provide savings of 10-30% of lighting costs in their respective areas. Assuming there is the potential to control 7000 watts (or 7.0 kW) of lighting, this represents a potential savings of $364 per year. The cost of installing advanced lighting controls is approximately $400 for each light switch, assuming 4 locations costs are $400. Therefore the simple payback is about 1 year.

3. Heating Controls Upgrade: The energy used for space heating of spaces such shop bays, office areas, utility spaces, and administrative space that is not used, can automatically be reduced when they are not occupied. The existing controls for the maintenance building consist of several individual thermostats. Assume that three thermostats are installed. Replacing these manual thermostats with a programmable thermostat configured to automatically reduce heating requirements during nights and weekends save approximately 5% -15% of space heating costs over the heating season. The cost of programmable thermostats is $150 installed therefore for 3 installations the estimated cost is $450. The estimated energy savings at 10% consumption reduction is calculated as $1,071 per year for approximately a 0.4-year payback.

Solid Waste Landfill Maintenance Building Retrofit Opportunities

4. Reduce Domestic Water Heater Losses: Due to infrequent but periodic demand for domestic hot water, consider a demand type (tank-less electric) rather than an electric or indirect storage tank water heater. An “on-demand” water heater can save up to 3%-5% of hot water storage tank radiation heat losses as well as the copper pipe distribution losses particularly in a basement location. The savings in hot water heating cost for a 3 kW water heater are approximately 3 kW x 3% x 8,670 hours x $.13 /kWhr = $102 per year. The cost of an on-demand heater is $600. Therefore, the payback is 6.00 years.

5. More Efficient Lighting. The existing high bay HID lighting system is new, however it can be improved in efficiency with high bay fluorescent fixtures with electronic ballasts. The proposed project is to change out all existing T12 fluorescent fixtures, to more efficient T8 or T5 fluorescent fixtures with electronic ballasts. Electronic ballasts have the capability to be dimmable and may be suitable where daylight harvesting features can be added.

   The anticipated savings are 20% of the existing 8,400 watts currently consumed by the existing lighting system. The total savings are therefore 1.68 kW over an average of 2,000 hours. The savings are $436 dollars per year. The retrofit cost of a light fixture is approximately $250 per fixture for a fluorescent fixture and $5 for a compact fluorescent. The total installed cost of replacement fixtures is estimated to be $7,000. The expected payback for this type of upgrade is therefore about 16 years. NSPI and Conserve Nova Scotia have a current lighting retrofit program ("Small Business Direct Install lighting Program") underway that will improve this payback to about 2-4 years.

6. Solar Lighting /Daylight Harvesting: The maintenance building is typically occupied during daylight hours only. The roof has a low slope and is oriented north and south. A roof monitor in the form of a dormer may be used to capture natural daylight and diffused through diffuser panels for a large part of the day. Another opportunity is to utilize a solar powered "Sun Tracker" light fixture or light pipes to provide natural day lighting during office hours. Perhaps the existing skylights can be replaced with a solar tracker. This light source, in combination with new automatically controlled (daylight harvesting) lighting fixtures, is a beneficial combination. The sun tracker device uses a motorized solar powered, reflective surface inside a sealed skylight to direct diffused natural light into a building interior space. The reflector optimizes the amount of light by following the angle of the sun. This fixture has the capacity of replacing up to 8 –10 regular light fixtures. When the daylight is unavailable the electronically controlled fixtures automatically sense this and brighten. The estimated cost of the fixture including installation is $3,000. The estimated electrical savings is 2,000 hours x 80% x 800 w = $166 annually. Therefore with a 25% solar rebate the expected payback is 12 years.

7. Add Destratification Fans To Ceiling: The temperature at the ceiling of the shop is 3-5 degrees warmer than the working level due to the height of the shop. Adding destratification fans will save 5% of the heating costs. In summer these fans can be reversed providing cooler air at working levels. The estimated cost of installing 4 fans is $6,000 the savings of is 535 liters of oil or a cost of $455 per year and therefore simple payback is 11 years.

5. Vehicles & Fleet Systems

The Municipality of the District of Chester's vehicle fleet is made up of heavy vehicles used for solid waste collection and landfill operation. Public Works and Administration departments also use light utility and passenger vehicles. The heavy-duty vehicles generally consume diesel fuel while the light vehicles consume gasoline fuel.

The heavy vehicle fuel supply for the landfill is via bulk diesel fuel, from a 4,000-liter tank located at the landfill site. Light vehicle fuel is typically supplied via commercial gasoline sales sites and billed to the Municipality. Individual vehicle fuel consumption and distance traveled or hours operated per vehicle are not currently recorded. The total diesel and gasoline fuels consumed have been reported in the GHG inventory report.

The solid waste collection transportation is sub-contracted to G.E. trucking out of Bridgewater. The recyclables are sorted at the source and, at a designated area within the solid waste-handling site at Kaiser Meadow Road, it is collected and transported at Kentville for further processing. The majority of the diesel fuel (98,935 liters) is used by the landfill site's heavy equipment and the solid waste collection trucks use an additional 74,466 liters. The public works trucks used 11,457 liters of gasoline.

Fleet Energy Analysis

The energy inventory report spreadsheet indicates total diesel consumption mainly by the heavy vehicles in was 74533 liters for solid waste collection and 98,935 liters at the land fill site for a total of 173,469 liters of diesel fuel over the 2006 period. The energy consumption is therefore equal to 3,826 GJ for the landfill equipment and 2,879 GJ for the solid waste collection vehicles. The consumption of gasoline for light vehicles over the same period was reported to be 11,457 liters, or an equivalent energy value of 414.76 GJ.

This annual vehicle fuel consumption represents a total of 7,120 GJ of energy. The total green house gases produced by heavy and light vehicles are calculated as 495.6 Tonnes of CO_2e.

Fleet and Transportation Opportunities

Rationalization of vehicle use continues to be important now with future anticipated fuel cost increases. Opportunities to rationalize transportation and fleet assets may be achieved by utilizing one or more of the following approaches.

1. The first approach is to consider reduction in travel of discretionary vehicles travel by: incorporating a travel plan, providing a logistical review of transportation requirements, tracking of transportation metrics, optimize service delivery with less travel, use remote communications, incorporate tele-working and telecommuting where possible, and use modern communications devices and remote sensing devices to reduce the frequency of inspections.

2. The second approach is to improve fuel efficiency of existing or future planned vehicles by optimizing the vehicle size to anticipated use. Purchase new vehicles with fuel saving options. Consider options for existing vehicles.

3. A third approach is to improve performance of existing vehicles and drivers with training and equipment to optimize fuel-efficient practices. Implement a reduced idling policy.

4. Utilize alternative fuels other than gasoline or diesel for transportation.

5. Recover waste fuels and vehicle liquid and solid wastes.

Fleet Housekeeping Opportunities

1. Routine Maintenance: Regular routine maintenance on vehicles has a direct impact on vehicle fuel and operational efficiency. Oil changes, filter replacement, tire inflation all have a measurable impact on fuel efficiency. The total annual cost of both diesel and gasoline fuel is approximately $81,000. Literature indicates that up to10% efficiency improvement may be obtained by regular maintenance of fleet vehicles. Assuming 5% efficiency improvement with regular maintenance and savings of $4,075 per year. This project also requires continuous investment for the long-term condition of vehicle fleet. A specific payback is difficult to calculate based on other vehicle servicing requirements. The annual investment is however assumed to be $5000 or 1 year payback. The recently improved maintenance shop at the landfill site will help with providing regular maintenance.

2. Measure and Monitor Transportation Data: Monitor and measure transportation statistics noting those measurements that are trending outside of set targets. Particularly the heavy fuel consuming vehicles such as at the landfill site. Individual vehicle fuel consumption, mileage or operating hours and maintenance records provide indication of trends and deviations from trends. It can be assumed that the tracking individual fleet vehicle usage, maintenance and operating costs' usage patterns will help select the correct vehicles for the job and help to decide on future maintenance. If the actual cost to collect this information annually is $2,000 per year and can provide a

savings of 3 % of the operating cost, the savings are $2,500 per year. This project has an equivalent 1-year payback but requires annual investment.

3. Rationalize Travel: Consider if travel is necessary for routine trips or if other means be used to obtain information or provide the service. Can telephone, email, faxing be used for information delivery. For employees, consider telecommuting, remote communication, and remote monitoring systems such as SCADA systems to reduce the amount of discretionary travel.

4. Rationalize the Correct Vehicle Is Used For The Job: Are more fuel-efficient vehicles suitable for the task rather than a heavy, less fuel-efficient vehicle? Are the vehicles configured correctly with the lightest acceptable equipment for the job?

Fleet Minor Maintenance Or Operational Opportunities

5. No Idling Policy: Implement a no-idling policy for both light and heavy-duty vehicles. Idling vehicles just to maintain cab comfort of engine oil temperature may be done by more efficient means.

6. Vehicle Cab Heating: For heavy vehicles, provide a separate electric or alternative fuel cab heaters rather than using vehicle engine idling to maintain cab comfort and engine starting temperature. Ensure that during cold weather use sufficient block heaters and receptacles are available to avoid warm-up and idling during breaks or lunch hours.

7. Block Heaters: For light vehicles, during cold weather, rather than running the vehicle's engine, provide electrical receptacles for vehicle block heaters and cab heaters control equipment operating times.

8. Smart Fleet Program: Implement programs such as NRC's (Natural Resources Canada's) "Fleet –Smart" program for awareness of transportation issues as well as a source of driver/operator training programs where impacts of vehicle speed, braking and operations are considered.

Fleet Retrofit Opportunities

9. Remote Monitoring with Camera: Modern internet and wireless internet cameras can allow an operator to view and control a pan, tilt and zoom camera via the internet that will allow site inspection and general monitoring of remote indoor or outdoor assets. This type of technology can save travel time and costs. The cost of a single fully featured camera is approximately $2,500. The anticipated savings of reducing travel to a particular site such as a well pumping station or park security for monitoring or information gathering purposes by 50% is estimated at 50 trips x $10 in fuel = $500 annually. The

simple payback on a single site is 5 years. For example, web or cellular based cameras may be installed at pumping stations or remote facilities along with data to retrieve status of remote sited. The estimated cost of a remote site station is $ 6,000. The annual cost to travel to a site on a period basis assuming the cost of travel is $25 is listed below:

Daily visit	$ 9,125.00
Weekly visit	$ 1,300.00
Monthly visit	$ 300.00

Assuming weekly visits can be eliminated by remote monitoring, the payback is approximately 4.6 years.

10. Alternative Fuel: When natural gas becomes available to the Municipality of the District of Chester, the gas may be compressed into fuel ready bottles for use on gasoline or diesel vehicles. The cost to convert a current vehicle is about $3,000. Natural gas fuel creates less GHG emissions when consumed and cost quite competitive with gasoline. For vehicles that travel only within a limited area and can return for regular refueling, compressed natural gas may be worth considering.

11. Compactor or Baler: Solid waste collection trucks are likely equipped with compacting equipment to provide more volume for solid waste materials. Similarly recyclable materials collected at a transfer station can be compacted or baled to provide for more efficient transportation from landfill site to Kentville. The estimated cost of a baler is $20,000 and can reduce frequency of travel by 50%. The savings are estimated to be about $15,000 per year or an annual payback of 1.33 years.

6. Street & Area Lights

The Municipality of the District of Chester has several non-metered streetlight accounts. NSPI installs and maintains the fixtures as well as provides energy for the lights within this rate and bills on a fixed monthly rate. Approximately 50-60% of the NSPI un-metered cost is for rental of the streetlights. The balance of the monthly cost is for the consumed energy.

The main type of streetlight installed and reported by the GHG inventory for 2006 are low wattage high-pressure sodium fixtures. There are 772 of these fixtures installed by NSPI and billed under a non-metered rate. High-pressure sodium fixtures are among the most efficient fixtures however they provide an amber coloured monochrome light. There is one metal additive fixture installed, as well as 11 low wattage mercury vapor, and 2 high wattage high-pressure sodium area lights fixtures. The calculated energy consumed for these fixtures over the 2006-year period was 575,172 kWhr or an equivalent energy consumption of 2,071 GJ.

There are no areas in the Municipality of the District of Chester where streetlights are intended to be on constantly during the day or where high colour rendition (ability to distinguish colour) is required. Therefore, high-efficiency, high or low pressure sodium (yellow) lights each with a photo eye controller should typically be used.

The assumed electrical energy and maintenance costs over the 2006 period were $170,700 and the average annual energy cost is $57,517. A portion of the non-metered rate cost is used for the rental and maintenance fee of the fixtures.

The total green house gases produced annually by street light energy use are calculated as 499 Tonnes of CO2e.

Street Lighting Opportunities

1. Review of Street Light Usage: Complete a review or study on street light applications to determine the following analysis to help rationalize existing or future street light use.

    a. Are any lights required for high color rendition? If not remain with existing efficient high-pressure sodium or more efficient low-pressure sodium fixtures.
    b. Ensure that all fixtures are working despite the fact that it is NSPI's responsibility that they are not on during day and photo controls are working.
    c. Ensure that the fixtures are all used for town purposes such as security and traffic safety rather than individual property users.
    d. Have the lighting needs changed as roads and building facilities been added or removed?
    e. Traffic safety review, can fewer lights are used?

    It is assumed that optimizing streetlights can save approximately 10% of the energy and operating cost of streetlights, or $17,700 per year. The cost of a street light study is estimated to be approximately $12,000 this opportunity has a payback of 0.7 years.

2. Install Area Lights on Buildings Rather Than Poles (Non-Metered Accounts): For street light fixtures that are within 50 meters (150 feet) of an existing building with an electrical service, install a fixture on the building rather than on an un-metered service rather than non-meters service. For example, at the landfill site near the newly expanded maintenance building there is a non-metered 400-watt fixture illuminating the building and area. These fixtures could be fed from the building's power supply and controlled to meet the building requirements such as security lighting. The installed cost of a typical fixture is approximately $500. The energy cost is approximately $150 per

year. The rental cost of the fixture is approximately twice the energy rate. Therefore, savings in the rental rate equate to a payback of approximately 3.5 years plus a maintenance overhead cost.

3. Reduced Energy Use for Area Lights: For building or security lighting applications owned by the municipality, occupancy sensors or timers should be installed used to illuminate areas only while there is activity or occupancy. For example, lighting for parks and parking lots can be placed on a timer controller or contactor and turned off after a certain time. Some lights are seasonal and may be turned off during the off-season. These fixtures can be installed at the building and placed on the buildings meter. For example a 400-watt floodlight at the maintenance building is placed on an occupancy sensor. The cost of operating this fixture is $75 per year and the cost to add a controller to the fixture is approximately $200 assuming that the fixture is on the building's power supply. The savings are approximately $75 per year. This provides a payback of 2.6 years.

7. Water Supply & Waste Water Treatment System

Water Supply Systems

The Municipality of the District of Chester has only a single water treatment plant and supply system considered in this report, which it operates at Mill Cove, a former Military site. It also services the users at that site. The Mill cove water source is from wells using submersible pumps to a storage tank. Water from the storage tank is treated with Sodium Hypochlorite and pressure boosted with two 7.5 HP pumps. The pressure is controlled via a pressure control valve bypassing back to the supply.

See table 7.1 for the energy consumption and analysis of the Mill Cove water treatment plant.

Waste Water Treatment Systems

A wastewater treatment plant (WWTP) is also located at Mill Cove. This plant includes an extended aerated chamber. There are two blowers; one 7.0 HP Aerazen model and a 5.0 HP roots blower. The blowers are operated manually. The treatment building contains electric heat. See table 7.1 for the energy consumption and analysis by Mill Cove's plant. The Mill Cove wastewater treatment plant consumed 48,280 kWhr of energy plant.

The largest wastewater treatment plant is the village of Chester's STP plant. This plant is located in the village of Chester adjacent to Nauss's Point Road. The facility is an aerated channel with filter and sludge removal and a dewatering tank. Dewatered sludge is removed from the plant and further processed at the landfill site.

The electrical system for the process is a 3 phase 100 amp, 600-volt service, and a 15 KVA transformer. A maintenance and storage building is located on site with approximate area of 50 m^2 upstairs and similar downstairs. The downstairs is used as a shop.

There are two rotary lobe blowers, assumed to be 10 Hp as well as four propeller aerators 5 hp each and two submersible pumps at the site.

The waster water treatment plant is supplied by a series of sewage lift stations. Smaller wastewater treatment plants and sewage lift stations are located in Western Shore, Chester Basin, New Ross and Chester Acres.

The water supply pumps and the water treatment plant consume the following quantity kWhr of electrical power. See table 7.1 below for breakdown among assets:

Table 7.1: Water &Wastewater Energy Consumption

Facility or Facility Group Name	Total Use (kWh)	Cost ($) at $0.11 per kWhr	Total Energy (GJ)	Total eCO_2 (tonne)
Mill Cove WTP	93,550.00	$ 9,355.00	336.87	81.39
Chester WWTP	354,775.00	$ 35,477.50	1,277.55	308.65
Western Shore WWTP	97,315.00	$ 9,731.50	350.43	84.66
Chester Basin WWTP	2,665.00	$ 266.50	9.60	2.32
New Ross WWTP	2,980.00	$ 298.00	10.73	2.59
Chester Acres WWTP	1,785.00	$ 178.50	6.43	1.55
Mill Cove WWTP	48,280.00	$ 4,828.00	173.86	42.00
Totals	**507,800.00**	**$ 50,780.00**	**1,828.59**	**441.79**

Water and Waste Water System Energy Analysis

The total cost of energy for the water treatment plant is therefore calculated to be $39,862 and the treatment plant represents $36,807 of that amount. The total cost of energy for the wastewater system is $28, 348 and the waste treatment plants represent $21,283 of that amount. The total green house gases produced annually by energy use by water and wastewater systems are calculated as 441.07 Tonnes of eCO2.

Water and Waste Water System Opportunities

1. General Power Factor Correction: The water and the wastewater treatment plants with larger integral (5hp and up) electrical motors typically have an electrical service, with 3 phase, 600 volt power. The electrical service billing for these sites is typically on a general electrical rate code with a demand component in the electrical power bill. The demand component of the electrical billing includes KVA demand, which increases (increases electrical cost) as the power factor decreases. A suitably sized power factor correction capacitor can be installed for each integral hp (5hp and larger) motor to provide the reactive or magnetic power currently supplied from the utility, and therefore reduces the demand billing factor cost. The typical power factor of a motor is .85 and changes with motor loading and motor style.

   This demand control opportunity does reduce electrical billing costs, but does not reduce overall consumption or green house gas emissions. Capacitors are best applied to motors that operate over longer periods of time (greater than 4,000 hours per year). Table 7.2 lists potential motors for consideration.

Table 7.2 Power factor Correction Motors

Plant	Motor QTY	Hp	Total Cap Kvar
Mill Cove WTP	2.00	15.00	6.00
Chester WWTP	8.00	50.00	20.00
Western Shore WWTP	2.00	10.00	4.00
Chester Basin WWTP	N/A		
New Ross WWTP	N/A		
Chester Acres WWTP	N/A		
Mill Cove WWTP	2.00	20.00	8.00
Total	**14.00**	**95.00**	**38.00**

   The estimated cost of capacitors proposed in table 7.2 is $10,000 installed at the motor starter with a disconnect switch. The estimated savings are approximately 5% of the consumed power. The savings are therefore $2,500 annually. This represents approximately a 4-year pay back.

2. Electric Motor Efficiency: In general, electrical motors have a standard efficiency of between 87-91%: premium efficiency motors if available in a suitable configuration can achieve efficiency of 93-96%. Rewound motors typically have an efficiency rating of 85-88 %. An efficiency improvement of 3% of a motor that runs for more than 50% of the time or more than 4,000 hours per year will have an attractive payback of less than 5 years. The efficiency of the existing motors should be compared to the premium style of replacement when new motors are considered for replacement or repair. The estimated cost of replacing an existing pump with a premium efficiency pump is typically 150% of the standard cost. For motors under 10 HP, it is not considered cost effective to rewind them. Where a rewound motor is used on an application that runs more than 4,000 hours per year (50% of the time), the payback to replace this motor is less than 5 years. Assuming that 50% of the water and wastewater treatment plant motors are eventually upgraded to high efficiency, the typical savings are 1.5 percent of electrical operating costs or $761 per year. The anticipated high efficiency option upgrade cost for 50% of the motors (when replacement is necessary) is estimated to be $4,000. The payback for this type of project is therefore 5.25 years.

Wastewater System Opportunities

3. Reduce Blower Operation in WWT Plant: The largest energy usage in sewage treatment plants is the operation of the aeration blowers. In the Chester sewage treatment plant at least one 10HP blower is operating continuously to provide oxygen to the lagoon. By monitoring the O2 level in the lagoon, the correct amount of air can be added with out excessive running of the aeration blowers. Assuming the costs of a DO monitoring system, a control system, and a variable speed drive are approximately $7,000, it is expected that the blower speed can be reduced 10-15%, reducing the energy cost of the blower motors by 25%. Therefore savings result in $1,950 per year. Therefore, the payback is 3.6 years.

4. Utilize High Efficiency Drive Belts: The drive belts for each of the blowers appear to be a solid belt. Utilizing a notched higher efficiency drive belt can save approximately 5 % of the motor capacity. The cost of the belts and sheaves is approximately $400 each. Assume $1200 for all plants and the savings expected is $800 per year. Therefore, the payback for this project is less than 1.5 years.

5. Install VSD for WTP Pressure Control. The Mill Cove water supply station is reported to have two 7 HP pumps that alternate and provide water pressure to the distribution system. The pumps are fixed speed and a control valve maintains downstream pressure at a set point via throttling a pressure control valve as well as a bypass control valve. A variable speed drive on the pumps can provide the pressure control and save pump motor energy. A 15%

reduction in pump speed can save 40% of the pumps motor power. The calculated savings in electrical cost are $1,900 annually. The cost of a variable speed drive is estimated to be $3,000 and the payback is 1.5 years.

8. Solid Waste Handling Systems

Solid Waste Collection

The Municipality of the District of Chester collects corporate and serviced community solid waste via a sub contractor. Solid wastes are transported to the solid waste facility located at Kaizer Meadow Road. Recyclables and compostable material are also collected by the contractor or may be delivered to the site.

For energy analysis, the site consists of the three buildings and two process areas. The buildings are described in the building asset sections 4.4 and 4.5 of this report.

Leachate Treatment Process

The leachate collection system blower building and treatment system has a blower building for the aeration lagoons. Two "Aerazen" blowers are located in a small building. The building electrical power service is a 200-amp phase 600-volt system. Also located inside is a 30 KVA transformer. The two blower motors are STD efficiency 20 hp motors each driving an Airmen Blower. A variable speed drive system is alternated in for each blower's control system. It is understood that the blower control system is sequences via a timing control circuit. Lighting in the building uses newer T-8 fluorescent fixtures. There is a 600-volt, 3-phase unit heater.

The leachate treatment plant consists of a small building containing process equipment including an electrical room, 60 H air compressor leachate discharge pump and pressure control system as well as a leachate disinfection UV system, additive tanks and a small control room. A 5HP instrument air compressor and instrument air dryer are also located in theist building. The lighting in this building is via fluorescent T-8 fixtures.

The leachate process building takes treated leachate and pumps effluent to the spray tower along with atomizing air and spread on the surface. The leachate process building uses fluorescent lighting. The power supply is a 3-phase 600 volt 400 amp system. Large loads include:

Field Pump	40 kW
Air Compressor	50 kW
Instrument air	5 kW
Instrument dryer	3 kW

UV Disinfection System	5 kW
Lighting	1 kW
Transformer	30 KVA
Chemical Pumps	1 kW
Water heater	3 kW
Total Electrical Load	**138 kW**

8.1 Energy Opportunities for Waste

1. Typical opportunities for solid wastes are to capture methane produced from the landfill and use the methane to produce heat and electrical power generation. This is only practical in a large waste facility such as the Guysborough facility.

2. The transport of recyclables can be reduced by compacting paper and plastic waste into bales and transporting less frequently.

3. An energy recovery analysis and opportunities to reduce consumption study should be done for the landfill site.

Solid Waste Buildings

The solid waste site, administration building, scale house, and maintenance buildings are described in the buildings section of this report.

8.2 Leachate treatment Plant Opportunities

1. Install VSD Rather than Re-Circulation Valve and Pressure Control Valve. The Leachate discharge pump is a 40 HP pump which pumps leachate to a spray tower under pressure control. The pressure is controlled via the throttling of a pressure control valve as well as a bypass control valve. A variable speed drive on the pump can provide the pressure control and save pump motor energy a 10% reduction in pump speed can save 20% of the pump's motor power. The calculated savings in electrical costs are $7,000 annually. The cost of a variable speed drive is estimated to be $12,000 and the payback is 1.7 years.

2. Review Use of Instrument Air Compressor: The control valve and a few other actuators utilize instrument air. The use of electric actuators in lace of compressed air for the few devices will eliminate the compressor and the air dryer. Other necessary air loads could utilize compressor air with correct filter regulator. The energy consumed by the instrument air compressor and dryer assuming they run 30% of the time is equal to 2,000 kWhr. The cost savings is therefore calculated as $2,049 per year. The estimated cost of replacement actuators is $2,000. Therefore, the estimated payback is 1 year.

3. High Efficiency Pump and Blower Motors: The leachate pump runs constantly and the aeration blower motors each run for periods greater than 4,000 hours per year. The drive motors are standard efficiency and can be replaced with high efficiency motors gaining about 3 % efficiency. The electrical savings are 1,000 and the cost to upgrade the motors is typical 150% of the existing motor. For the leachate pump, this is $2,000. Therefore, the savings are calculated as $1,060 and the calculated payback is 2.0 years. Rewound motors should not be used for this service where motors are expected to run more than 4,000 hours per year.

4. High efficiency Belt Drives: The existing blower motors are belt driven using conventional v-belts. Improving the belt dive efficiency by installing v-notch belts or new-toothed belt sheaves and belts can increase efficiency by 4%. The anticipated run time for each 20 HP blower is 60% of the year. Therefore, the cost of savings is $300 and the cost of the belt replacement is $800 and the calculated payback is 3 years.

9. Recommendations

The overall objective of the ecoNova Scotia (Eco-Trust) Program is to reduce greenhouse gases. There are over 77 opportunities or measures to reduce green house gases and save energy described in this report. These measures are listed in three spreadsheets in the Appendix. The first spreadsheet is a summary of the opportunities arranged as they are described in this report. The second spreadsheet lists the opportunities sorted according to “category” and to “payback”. This helps to select the implementation priority of the opportunities. The third spreadsheet is sorted by the selected priority of measures.

In general, it is recommended that all opportunities regardless of category, with a payback of less than 3 years, be considered as a suitable investment for implementation in the short or long term. These projects are highlighted with the “Cyan blue” colour in the reports opportunity spreadsheets.

Project opportunities with larger cost savings and slightly longer payback of 4-8 years are ideal for the second “implementation” phase of the ecoNova Scotia Program. The cost sharing of this program will improve the project payback, by 50%, and placing the project into a good investment range. These projects are highlighted with a yellow background in the opportunities list spreadsheet located in the appendix of this report. Typical recommended projects for the ecoNova Scotia Program are listed in Table “EcoNova Scotia Program Retrofit Opportunities” 9-1 below.

Those opportunities identified as **“Retrofit”** opportunities, are longer term and are typically larger cost opportunities. All projects with a payback of four years

and less should be considered as good investment for implementation. The actual life cycle cost of each of these opportunities should however be analyzed before starting implementation. Opportunities with a longer payback may be considered for cost sharing or, if due to special circumstances, where a related activity can assist with costs, this project should be undertaken. Examples of Retrofit projects are shown in table 9-2.

Those opportunities under the category of **"Minor Maintenance"** will require outside services and have larger budget requirements. Each opportunity in this category with a payback of less than 4 years is also considered to be a good investment and should be budgeted for current or future years. The estimated cost of outside services for this category should be confirmed by quotations prior to implementation of these projects. Typical minor maintenance projects are listed below in table 9-3.

Those opportunities identified as **"Housekeeping"** category opportunities are easier to implement by current municipal staff since there are minimal materials or contracted service requirements. Some of these opportunities are periodic and can be incorporated into operations and maintenance procedures or plans. The relatively low cost and risk of housekeeping opportunities should not require any further detailed analysis prior to implementing these measures. See table 9-4 for typical short-term Housekeeping opportunities.

Table 9-1 ecoNova Scotia Program Typical Projects Recommended For Phase 2 Implementation

Description of Eco-Trust Retrofit Opportunity	Report Item	Capital Cost	Annual Savings	Pay-back (Years)
Municipal Planning Office – Insulating Basement Walls	4.2-16	$6,100	$1,650	4
Land Fill Office-Replace Air Conditioner with Heat Pump	4.4-7	$9,000	$2,149	4.2
Waste Water Plant - Upgrade Motor to High Efficiency	7-2	$4,000	$761	5.2

Table 9-2 Typical Retrofit Projects Recommended

Description of Retrofit Opportunity	Report Item	Capital Cost	Annual Savings	Pay-back (Years)
Street Light Usage & Requirements Study	6-1	$12,000	$17,700	0.7
Waste Water – Upgrade Drive Belt Efficiency	7-4	$100	$124	0.8
Municipal Administration Building – Boiler Controls	4.1-8	$1,000	$1,166	0.8

Table 9-3 Typical Minor Maintenance Projects Recommended

Description of Recommended Minor Maintenance Opportunity	Report Item	Capital Cost	Annual Savings	Pay-back (Years)
Library -Programmable Thermostats	4.3-2	150	550	0.3
Municipal Administration – Boiler maintenance	4.1-3	600	700	.77
Landfill maintenance – Lighting Controls Occupancy Sensors	4.5-2	400	400	1

Table 9-4 Typical Housekeeping Projects Recommended

Description of Recommended Minor Maintenance Opportunity	Report Item	Capital Cost	Annual Savings	Pay-back (Years)
Vehicles - Measure and Monitor Fuel Data -Landfill	5-2	2,000	2500	.8
Municipal Administration Light Fixture Cleaning Re-lamping	4.1-2	$300	$327	1
Vehicles – Rationalize Travel	5-3	N/A	N/A	N/A

General Recommendations

The opportunity spreadsheet totals the potential cost savings of all projects at $85,000 per year. However, some of these projects are mutually exclusive where perhaps only one alternative of several may be chosen. The total green house gases saved from the opportunities are calculated as 355.9 metric tonnes per year. The total capital cost of all the projects is $ 213,000.

Vehicles, particularly those that are related with the landfill site, are the highest energy consumers for the District. Monitoring and logging fuel usage and operation of each of these vehicles or equipment may lead to optimizing the use of fuel and reducing costs. Even a 2% improvement in this area annually represents $4,000 in savings. For the vehicle category, the recommended opportunity is to consider the NRC fleet smart program and to log the costs of each vehicle.

Streetlights are the third largest operating cost for the town and it is estimated that a detailed review of their use and application may reduce the quantity of lights by 10 %. This opportunity has a relatively quick payback.

Similar multiple site items such as upgrading electric hot water storage tanks to on–demand electric heaters, and light fixture cleaning and re-lamping services are identified at several building sites. A group purchase of materials and service contracts may provide a more cost effective project.

The Nova Scotia Provincial organization “Conserve Nova Scotia” in conjunction with NSPI has a very attractive program for commercial lighting upgrades. This program improved the relative payback from a typical 8 years to 2 years for fluorescent lighting upgrades. The direct install lighting program is recommended for all building assets and may be accessed by contacting Nova Scotia Power.

10. Appendix

1. See Opportunity List Spreadsheet arranged as follows:
    a. By report section
    b. Arranged by category and payback.
    c. Arranged by priority

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