MAINSTREAMING CLIMATE CHANGE TOOLS FOR THE PROFESSIONAL PLANNING COMMUNITY

CLIMATE CHANGE ADAPTATION ACTION PLAN FOR STRATFORD, P.E.I.

2010

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Part 1: About This Report

1.1 Report Background

This report is the result of a Canadian Institute of Planners (CIP) project funded by Natural Resources Canada (NRCan) called *MAINSTREAMING CLIMATE CHANGE TOOLS FOR THE PROFESSIONAL PLANNING COMMUNITY*. The Canadian Institute of Planners, in collaboration with Natural Resources Canada's Climate Change Impacts and Adaptation Program, is endeavouring to make scientific research and information on climate change impacts and adaptation a major consideration in planning practice across Canada. CIP and NRCan are natural partners to assist Canadian communities with adaptation to climate change. NRCan possesses and continues to amass a wealth of valuable information that provides the scientific foundation for climate change adaptation. Working with CIP, NRCan can transfer this information to professional planners across Canada, who are directly involved in decision-making and advising politicians at the community level. Further detail on this project can be found in **Appendix A**.

As part of the *MAINSTREAMING CLIMATE CHANGE TOOLS FOR THE PROFESSIONAL PLANNING COMMUNITY* project, climate change adaptation plans were initiated in four small communities in Atlantic Canada: Clair, New Brunswick; Glace Bay, Nova Scotia; Glenburnie – Birchy Head – Shoal Brook, Newfoudland; and Stratford, Prince Edward Island. The knowledge gained through this work, as well as adaptation plans completed in several Nunavut communities, will contribute to a Rural Workbook for use by rural communities across Canada.

This Climate Change Municipal Adaptation Plan (Climate Change MAP) was prepared for the Town of Stratford in Prince Edward Island.

1.1 Contributors

This Climate Change MAP for Stratford, Prince Edward Island, was prepared by Kate Greene, MCIP, LPP and Armand G. Robichaud, MCIP, RPP working collaboratively with the Town of Stratford, the Province of Prince Edward Island, the Atlantic Planners Institute (API) and the Canadian Institute of Planners (CIP). This work was done with the assistance of a local steering committee, a number of municipal and area committees, and with the participation of municipal and provincial officials and involvement of the community through public consultation.

Thanks and appreciation is extended to the residents, staff and Council of the Town of Stratford, for welcoming the project team into their community and working collaboratively on this project. In addition we would like to extend particular thanks to Vahid Ghomoshchi, Kevin Reynolds, Robert Hughes, Don Jardine, Erin Taylor, Brenda Penak, Gary Lines and Don Forbes for their support and contributions to the development of the project. Finally, Hailey Steiger provided resources over the course of the project and her valuable contributions to this project are duly noted.

Part 2: Climate Change Municipal Adaptation Plan Approach and Methodology

2.1 Project Approach

This report aims to integrate relevant existing scientific climate change data and adaptation processes with community knowledge of climate change, in order to develop new tools that incorporates climate change concerns in community planning initiatives. Community engagement is a central component of the project team's approach, and the project relies heavily on existing community knowledge and understanding of climate related events.

To determine an approach, the project team analyzed a variety of planning models and assessed their applicability to the climate change adaptation process. **Table 2.1** provides an overview of all the models reviewed. After consideration, elements from a variety of planning models were combined to develop the project methodology, which brought together a combination of Community Planning, Strategic Planning, Vulnerability Assessment and Risk Management Planning Approaches. For additional references and information on planning processes, please see **Appendix B**.

Table 2.1 Examples of Planning Models Related to Climate Change Adaptation

Examples of Planning Models Related to Climate Change Adaptation									
	Urban Planning[i]	**Community Planning**[ii]	**Strategic Planning Example 1**[iii]	**Strategic Planning Example 2**[iv]	**Vulnerability Assessment**[v]	**Risk Assessment Example 1**[vi]	**Risk Assessment Example 2**[vii]	**Risk Assessment Example 3**[viii]	**Smart Growth**[ix]
1	Land Use Design – Desirable alternatives for future land use	Data Gathering	Identify Your Purpose	Mission	Engage Affected Parties	Strategic Objectives	Initiate the Process	Getting Started	Guiding Principles
2	Guidance System – Formulating a course of action	Data Analysis	Select the Goals to be Reached	Objectives	Assess Current Vulnerability	Risk Assessment	Perform Preliminary Analysis	Preliminary Analysis	Inclusive Process
3	Projection of Consequences	Policymaking	Identify Specific Approaches or Strategies	Situation Analysis	Estimate Future Conditions	Risk Reporting	Evaluating the Risk	Risk Estimation	Design Charrette
4	Evaluation of Consequences	Implementation	Identify Specific Action Plans	Strategy Formulation	Estimate Future Vulnerability and Identify Adaptation Strategies	Decision	Control the Risk	Risk Evaluation	Practical Research
5	Coordination, Adjustment and Synthesis	Monitoring	Monitor and Update the Plan	Implementation	Decisions and Implementation	Risk Treatment	Take Action	Risk Control	Follow-through
6				Control		Residual Risk Reporting	Monitor Impacts / Follow Up	Action and Monitoring	
7						Monitoring			

The process to prepare a plan under each of the planning models identified in **Table 2.1** is expressed in numerous ways, for example, the names, the order and the number of steps varies. Despite this, the general process remains essentially the same. We establish a vision (purpose or objectives), we assess the current situation, we establish strategies, we develop an action plan and we monitor our success. This project followed a similar planning process, which is explored in greater detail in the following section.

2.2 Project Methodology

The project was organized into four key phases following the project requirements as defined by CIP and NRCan, which outlined that four community visits would be required for each community adaptation plan. Phases for the Town of Stratford Climate Change MAP were as follows:

2.2.1 Phase 1 Getting to Know the Community

The aim of Phase 1 was to develop a project and research framework that would enable a community-centred plan that included the aspirations of the Town of Stratford (Town, Stratford, Municipality) and key stakeholders. To accomplish this, the project team established a core working group to oversee the project planning process, which consisted of a representative from the Town of Stratford, a representative from the Province of PEI, and the two CIP project team members. To begin the project, the team generated objectives and expectations for the adaptation planning process. The following questions were used to guide this discussion and establish the project focus:

- What initial ideas does everyone have? What would you like to see included in the process?
- How will the Climate Change Adaptation Plan be used? How can we create a useful document?
- What is the vision for the plan? At the end of the day, what do we want to end up with?

Figure 1: In Stratford, PEI, heritage buildings and sites, such as historic homes and the Hazard Point lighthouse, are threatened by coastal erosion.

Following this, the working group established the overall project work plan.

Phase 1 included a series of initial interviews and meetings held with local and provincial officials, including a presentation to the Town of Stratford Council. These meetings allowed the project team to meet key stakeholders, communicate project objectives, receive input regarding objectives, and perceptions of climate change and adaptation. During each of the meetings, participants were provided a survey to complete, which can be found in **Appendix C**.

The team also initiated research to identify key climate change impacts and scenarios, working with the Province of Prince Edward Island, Environment Canada, and the Bedford Institute of Oceanography. A half day community tour of existing climate change impacts allowed the project team to observe and document perceived climate change impacts throughout the Town. Finally, the project team began their own research of climate change planning and adaptation processes, including identification of Town infrastructure, the environmental and social landscape, and land use framework.

In summary, key Phase 1 actions included the following:

- Establishment of Climate Change MAP Working Group;
- Meetings with key municipal staff and steering committee members;
- Meeting with Town Council;
- Meeting with PEI Provincial Climate Change Group;
- Meetings with key community stakeholders (including Watershed Improvement Group members) ;
- Site visits, photography of vulnerable areas;
- SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) questionnaire; and
- Obtained data on Climate Change from the province, Town and other scientific resources including Environment Canada and the Bedford Institute of Oceanography.

2.2.2 Phase 2 Establishing Current and Future Vulnerability

During Phase 2, the project team worked closely with the community to compare existing and perceived climate change impacts to estimated future climate change scenarios. This Phase consisted of a series of meetings with the community to present the results of the project team's research of key climate change impacts and scenarios. These impacts were mapped using existing scientific research and the community's own knowledge of climate change related events. The highlight of Phase 2 was a community meeting held at the Town of Stratford. During this public meeting, participants were asked to provide their knowledge of climate related events and interpret existing scientific climate change scenarios. Participants were provided with a survey to complete a survey to complete which be found in **Appendix C.**

In summary, key Phase 2 actions included the following:

- Meeting with key municipal staff and the Climate Change MAP Working Group members;
- Meeting with Town Council;

- Public meeting during which the project team
    - presented research to date
    - presented scenarios mapping
    - undertook community mapping exercise to compare community knowledge of impacts to potential future impacts
- Conducted site visits, photography of vulnerable areas; and
- SWOT (Strengths, Weaknesses, Opportunities, Threats) questionnaire.

2.2.3 Phase 3 Developing an Adaptation Strategy

During Phase 3, the project team was tasked to incorporate into a strategy for responding and adapting to climate change. To do this, the team adapted a risk management matrix, which ranked climate change impacts to key community infrastructure based on the relative importance of infrastructure to the community, and the likelihood of the climate change impact occurring (scientific probability). This evaluation process resulted in a table ranking key infrastructure and potential climate change impacts to this infrastructure, and in doing so highlighted potential areas for future adaptation. The table and method was presented to the working group and community stakeholders, so as to receive feedback and identify information gaps. A working draft of the Climate Change Municipal Adaptation Plan was also presented for feedback. The working draft identified core areas of analysis, the Climate Change MAP framework, and potential policies and regulatory tools that could be used to enable implementation of the climate change adaptation priorities.

Figure 2: Public utilities: such as streets, bridges, water and sewer systems, have been damaged by extreme weather events in Stratford, PEI.

In summary, Phase 3 key actions included the following:

- Meeting with the Climate Change MAP Working Group;
    - Discussed information gaps
    - Reviewed Draft Adaptation Plan and receive feedback
    - Discussed Approach to determining areas of climate vulnerability
- Meeting with Safety Service and Environment Committee;
    - Presented key highlights of Draft Adaptation Plan and received feedback
    - Reviewed process and next steps
- Meeting with Town Managers, CAO and Climate Change MAP Working Group Members;

- Discussed information gaps
- Reviewed Draft Adaptation Plan and received feedback
- Discussed Approach to determining areas of climate vulnerability and review vulnerability matrix and key infrastructure, reviewed risk management structure

- Site visit, photography of vulnerable areas.

2.2.4 Phase 4 Finalizing the Adaptation Plan

During Phase 4 the project team finalized the elements of the Climate Change MAP, including implementation tools and an action strategy to be used to address climate change impacts. The plan incorporated recommendations for identified adaptation priorities and general methods for incorporating adaptation planning into existing Town regulatory and planning processes. Key elements of the Draft Adaptation Plan were presented during a public meeting held at the Town, followed by submission of the Climate Change Municipal Adaptation Plan.

In summary, Phase 4 key actions included the following:

- Conducted public meeting to review Draft Climate Change MAP; and
- Submission of Climate Change MAP.

2.3 Report Limitations

There were several limitations related to the study that affected the scope and analysis of the report. Time and resources provided under the contract were limited given the overall objectives of the project. The project team relied heavily on existing information available within and to the Town, and did not invest in resources to develop new research, mapping or data. The team did this with the understanding that the process used in this adaptation plan could easily be tailored to another community with limited resources.

The potential climate change scenarios developed in the report were based on the best available scientific data. With a few exceptions, this study relied on existing regional information and knowledge of the study area through information provided by stakeholders. Some of this existing data had been downscaled to the City of Charlottetown or Town of Stratford Area, and other data was regional, representing either the Province of Prince Edward Island or Atlantic Canada.

The climate change mapping used over the course of the project is based on existing mapping provided by the Province of Prince Edward Island and the Town of Stratford and has not been verified for accuracy, and therefore should only be interpreted as providing high level, general, geospatial information. In addition, the climate change scenarios and emissions scenarios as depicted in this report are based on the best available scientific data. Climate change scenarios are based on modelling that provides a guide reflecting potential future climate change impacts, but this information is generalized and developed from a complex web of

meteorological factors. Therefore it should only be interpreted as conceptual in nature and inconclusive.

Specialized studies and further investigation as outlined are necessary to more fully understand potential climate change scenarios and the biophysical context. As a result, this report provides a series of high level recommendations for climate change adaptation, management and land development strategies. This Climate Change Adaptation Plan should be updated as more detailed and accurate climate data and modelling becomes available.

Part 3: About the Town of Stratford

3. 1 Community Introduction

The Town of Stratford is the third largest and fastest-growing municipality in Prince Edward Island with a population of more than 7000 persons. The Town is situated on a peninsula just south of the provincial capital Charlottetown. It is bounded by Fullerton's Marsh, the Hillsborough River, Charlottetown Harbour and the Hillsborough Bay and covers a land area of 22.1 square Km. Stratford's shoreline boundaries are typical of Prince Edward Island's south shore, low red sandstone cliffs, coves and beaches. The topography is diverse with a ridge running east west affording dramatic views to the south across the straits. The Town is well known for its magnificent water views, desirable and peaceful neighbourhoods, rich rural heritage and quality of life.

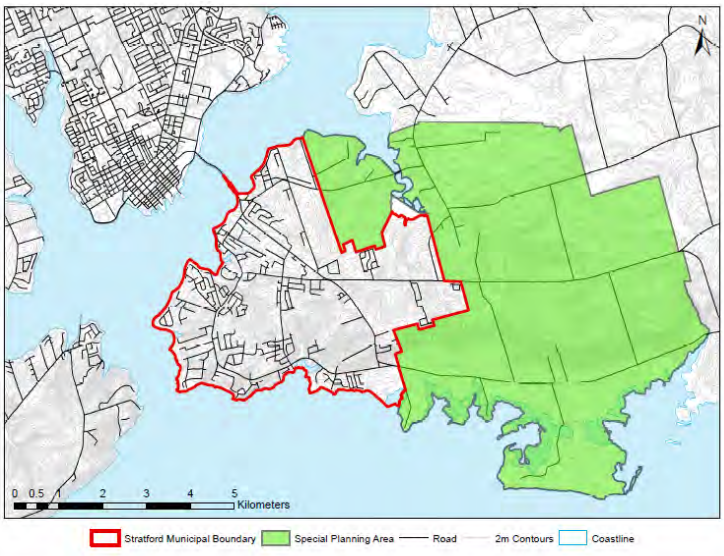


Figure 3: Town of Stratford municipal boundaries are shown in red.

The Mi'kmaq name for the area around today's Stratford was Adoosak. The first European settlers to the area were Acadians in the 1750s whose activities included agriculture, shipbuilding and brickworks. In the nineteenth and for much of the twentieth century, Stratford was primarily agricultural. It also became a choice location for summer cottages for Charlottetown residents. In the 1960's with the construction of a new bridge across the Hillsborough River a new wave of residential development gained momentum. The Town of Stratford was formed in 1995 from the former communities of Bunbury, Southport, Crossroads and Keppoch-Kinlock and the unincorporated area of Battery Point. Today, the Town is a predominantly residential community with higher-than-average quality housing stock and higher-than-average income levels.

Recently, a new commercial core has begun to emerge to make the Town a full service community. The quality of life in the Town is enhanced by the pride that residents take in their properties, the abundance and accessibility of recreation programs, the proliferation of municipal parks, the beautiful views of water and pasture land, the number and variety of trees in the community and the community spirit that is evidenced by the high level of volunteerism.

3.1.1 Demographic Profile

The population of the Town of Stratford increased from 6314 in the 2001 census to 7089 in the 2006 census representing a 12.2% increase in 5 years which is, by far, the largest population increase in Prince Edward Island. By comparison, for the same period, the population of the Province increased by 0.4% and the population in the City of Charlottetown declined by 0.2%.

The population growth does not tell the whole story of growth for Stratford because the number of persons per dwelling unit continues to decline, reflecting the trend across Canada of an aging population and smaller families. The real growth can be seen in the number of dwelling units in Stratford; from the 2001 to 2006 census, the number of dwellings increased in Stratford from 2402 to 2898, a 20.6% increase. This compares to a 12.1% increase in the Province and a 5.8% increase in the City of Charlottetown over the same time period.

3.1.2 Location

Stratford is located just 59 Km from the Confederation Bridge to New Brunswick and just 58 Km from the Wood Islands Ferry to Nova Scotia. It takes less than 10 minutes to drive to the regional Airport on the periphery of Charlottetown and only 5 minutes to drive to the regional hospital or to downtown Charlottetown. The Town is connected to Charlottetown by the Hillsborough Bridge and Stratford has the highest annual average traffic volume in the Province with over 31,000 vehicles per day crossing the bridge.

3.1.3 Residential Land Use

As identified previously, Stratford is the fastest growing municipality in the Province of Prince Edward Island and one of the fastest growing municipalities in the Maritimes. The housing market is very strong in Stratford with the majority of land use being residential, and the Town is approaching 3000 dwelling units. Residential housing lots vary in price from low prices in the $25,000 to $35,000 range to more than $150,000 for some waterfront lots.

3.1.4 Commercial Land Use

Stratford enjoys the services provided by a full service grocery store, wholesale cash-and-carry outlet, full service building supply store, a number of medical and dental clinics, a pharmacy, liquor store, motel/rv park, restaurants and other commercial enterprises. As part of the Town's effort to increase employment and the commercial tax base of the Town, a new business park was constructed adjacent to the existing industrial area of the community. The first phase of the business park was completed in 2000. Services include water, fire-rated water, sewer, three-phase power and fibre-optic cable access.

3.1.5 Town Services

The central portion of the Town is serviced by a municipal sewer system and a central water system is now being developed. The Stratford Business Park and the newly emerging commercial area around the Kinlock Road and Trans Canada Highway intersection are serviced with municipal water and sewer. Fire-rated water is also available in these areas for building sprinkler systems due to a recent investment in a water tower.

The Town of Stratford has an abundance of recreational parks and green spaces including four major community parks and 25 neighbourhood parks. There is a new outdoor recreational trail system in development and public access to the shore at various locations throughout the Town including the public beaches at Tea Hill Park and Kinlock Beach Park. Town recreation facilities include 4 ball fields, 6 soccer fields, 4 tennis courts, an outdoor rink, a youth/seniors centre, several other community centres and access to additional sport fields at Glen Stewart School. The Town provides police protection, fire protection, street lighting, sidewalks, animal control, planning and inspection, and a number of other services. The street network is owned and maintained by the province.

Figure 4: Aerial Photo of the Town of Stratford showing street layout, lot fabric and Town boundaries.

Part 4: About Climate Change Adaptation Planning

4.1 Climate Change Adaptation Overview

Scientific research and analysis suggest that over time, Canada will experience significant shifts in climate and weather patterns; evidence of our changing climate is already being realized in our communities.[x] It is anticipated that this change in climate will continue for decades, if not centuries, regardless of the success of efforts to reduce green house gas emission. [xi] To respond to this changing climate, all Canadian communities will need, in various ways, to adjust to the effects of climate change and incorporate new and innovative policies and tools into their day-to-day decision-making. Climate change adaptation planning is one such method through which a community can consider the potential current and future impacts of climate, and establish a response to decrease potential risks resulting from a changing climate.

For the purposes of this project, the team used a simple definition for climate change, as compiled from the study *Adapting to Climate Change – An introduction for Canadian Municipalities,* produced by the Canadian Climate Impacts and Adaptation Research Network. In this study, climate change adaptation is identified as *"…. any action that reduces the negative impact of climate….enabling municipalities to plan and respond effectively to the challenges of climate related events*." As our climate changes over time, it is anticipated that even small shifts in climate normals could have significant impacts on existing municipal infrastructure, including built systems (i.e.: roads and bridges), natural systems (i.e.: watersheds and forest) and human systems (i.e.: health and emergency services). [xii] Municipalities will need to incorporate the most recent scientific information regarding climate change, along with current community knowledge, and understand how current climate and potential future climate change scenarios might make their community vulnerable to changing weather patterns and related impacts. At the same time communities will need to plan to adapt using this new knowledge, integrating it into daily decision-making and developing strategies to lessen the impacts of climate change, and minimize future vulnerabilities.

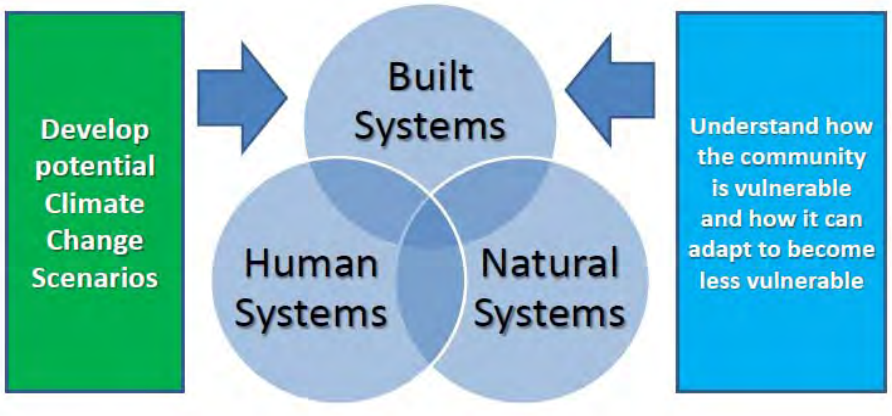


Figure 5: Diagram depicting climate change vulnerability assessment process.

Part 5: Community Thoughts on Climate Change Adaptation and Priorities

Climate Change Municipal Adaptation Plans help a municipality to understand the range of potential climate change impacts, interpret scientific study, evaluate future vulnerabilities, identify areas for more detailed future study, develop strategies to mitigate or minimize any adverse impacts, as well as to maximize any potential positive return. In working with the Town of Stratford, a variety of methods were used to establish the community's vulnerability and priorities for climate change adaptation. These methods are outlined below.

5.1 Objectives for the Climate Change MAP Process

To begin the project, the project team worked with key representatives from the Town of Stratford and the Province of Prince Edward Island to establish a series of objectives and expectations for the Climate Change Municipal Adaptation Plan process. The following questions and responses were used to guide this discussion and establish the project focus.

1. *What initial ideas does everyone have for this project? What would you like to see included in the process?*
    - impact of more frequent and higher intensity storms on our storm sewer and sanitary sewer system;
    - impact of sea level rise on existing and future development;
    - impact of more frequent and higher intensity storms and sea level rise/storm surges on civil infrastructure;
    - any other significant impacts of climate change that we have yet identified; and
    - In general, "How vulnerable is our community"? And in which areas?

2. *How will the Climate Change Adaptation Plan be used? How can we create a useful document?*
    - to amend our design assumptions regarding storm-water;
    - to amend our planning documents as required to avoid future development in flood plains or storm surge areas;
    - to educate and notify people who may be affected by storms or sea level rise;
    - to guide future plans for civil infrastructure like the sewer treatment plant, lift stations etc.; and
    - to review our emergency plan to ensure we are ready for what may come.

3. *What is vision for the plan? At the end of the day, what do we want to end up with?*
    - A document, which includes the following:
        - mapping of the areas that will be affected by flooding and/or storm surges;
        - potential impacts on infrastructure and new assumptions to be used for future planning and design; and

- Increased public awareness of the potential impacts of climate change during the process would be desirable also.

This information was also shared with senior level staff at the Town of Stratford, the Town of Stratford Council, the Province of Prince Edward Island Climate Change Working Group, the Town of Stratford Watershed Area Improvement Group for review and further input. Based on this, the project team engaged key representatives from the Province of Prince Edward Island Environment Canada and Bedford Institute of Oceanography to develop a deeper understanding of future climate change scenarios, in particular scenarios for sea level rise and increased precipitation. The project team also undertook a site visit of the entire Town to develop a deeper appreciation of the community landscape, infrastructure, and land use, and to observe areas currently vulnerable to climate.

5.2 Community and Stakeholder Priorities and Concerns

To identify priorities and concerns for adaptation, the project team used a survey to gather information from a variety of individuals. Surveys were provided to provincial government representatives, Town Staff, Town Councillors, and community members to ensure a wide range of input, and were distributed at different meetings over the course of the project. The survey used SWOT analysis, which is a strategic planning process that identifies Strengths, Weaknesses, Threats and Opportunities. Particular survey results for the different consultation events can be found in **Appendix C.** A summary of all surveys is provided in **Table 5.1**

Table 5.1 Summary of Strength, Weaknesses, Opportunities and Threats Survey Results

Vision:	• Stratford is prepared and protected for climate change impacts	
Community Strengths:	• Increasing population and tax base • Higher education level and revenue • Visionary, caring and green community • Good management and planning	• Relatively new infrastructure and amenities • Watershed Management Plan • Close proximity to provincial capital • Sustainable reputation
Community Weaknesses:	• Vulnerable, surrounded by water on three sides • Lack of data and expertise • Limited municipal resources	• Supply of drinking water close to capacity • Pro development • Resistance to change
Opportunities:	• Collaborative and proactive planning • Improved codes and procedures • Attract climate change adapted development	• Enhanced reputation – model or pilot project • Room for sustainable development • Educate public
Threats:	• Climate change impacts • Increasing insurance rates & more difficult claim approval • Being too restrictive on future development	• Difficulty in engaging other partners • Changing government policies and priorities • Extra cost of sustainable development • Being cut off from regional and provincial services in Charlottetown (Hillsborough Bridge)
Issues:	• Storm water management system overflow (inland flooding) • Coastal soil erosion • Salt-water intrusion in groundwater • Protect coastal properties from sea	• Protect infrastructure from sea level rise and tidal surges • Training for Council & Staff • Inadequate procedures and codes • Changes in wildlife habitats (foxes)

	level rise and tidal surges	• Public awareness, participation • Bridge access to Charlottetown (hospital, …)
Strategies :	• Dedicate municipal resources to Climate Change MAP (Municipal Adaptation Plan) • Emergency Measures Plan • Council and staff awareness and training	• Public education program • Review municipal procedures and codes • Creation of collection ponds to absorb sediments • Increased trees and shrubs planting

5.3 Existing Climate Change Research

To identify current knowledge of climate change impacts, the project team reviewed research documents regarding climate change. The team focused on information that described changing weather patterns that will affect the Town of Stratford community in the future. Information was obtained for various geographical areas, including Atlantic Canada, Prince Edward Island and the Town of Stratford. A summary of this information is included in **Table 5.2**.

Table 5.2 Highlights of Existing Climate Change Research

From Impacts to Adaptation: Canada in a Change Climate, *Atlantic Region* 2007 [xiii]	• Atlantic Canada will experience more storm events, increasing storm intensity, rising sea level, storm surges, coastal erosion and flooding. • Water resources will come under pressure as conditions shift and needs change. • For marine fisheries, impacts will extend beyond fish species to include numerous aspects of fisheries operations, including transportation, marketing, occupational health and safety and community health. • Although higher temperatures and longer growing seasons could benefit agriculture and forestry, associated increases in disturbances and moisture stress pose concerns. • Vulnerability to climate change in the Atlantic region can be reduced through adaptation efforts focused on limiting exposure and through careful planning. (Key Findings)
Coastal Impact of Climate Changes and Sea-Level Rise in Prince Edward Island, *Executive Summary* [xiv]	• Charlottetown o Private and public property in both the residential and commercial sectors in Charlottetown are at a risk of damage from flooding events. o Many of the 335 heritage properties in Charlottetown are at risk. o Storm water systems, sewage waste treatment systems, streets and sidewalks, including several recent upgrades, in Charlottetown are at risk. o Electric generating facilities are also vulnerable. o Flooding will bring costs and loss of productivity for lost wages and health care. o The Queen Elizabeth Hospital and the Hillsborough Hospital and Special Care Unit could be affected. • North Shore o Severe erosion damage and rapid coastal change. o 50% of coastal properties on the North Shore will be lost in the next 100 years. o Several wetlands and dunes will be lost. • Sea-level Rise o Even in the absence of climate change the present rate of sea-level rise will pose a challenge. • Storm Surges o Storm surges are frequent in Charlottetown (8 times a year, compared to 2 times a year in Halifax). • Wind o Small increases in wind speed can have a significant impact on flooding risk.

	○ During the 1990's the frequency of northeasterly winds increased whereas that of northwesterly winds decreased. ○ The storms that most often cause surges follow a preferred northeast track. • Waves ○ Waves are one of the most widely recognized indicators in storm activity and constitute a significant natural hazard for shoreline erosion and infrastructure damage. ○ On October 29-31 2000, 14 metre waves were recorded on the North Shore of Prince Edward Island. • Ice-cover ○ The presence of sea ice in the Gulf of St Lawrence inhibits wave development, thereby reducing winter storm erosion. By 2045, the Gulf of St Lawrence may be free of ice.
Coastal Erosion and Shoreline Classification Project, ***Town of Stratford (PEI)***[xv]	• The height of the coast varies from 0 to 9 metres in Stratford • Three historical data sources are available for Stratford • 15 erosion rates values were compiled • Erosion in till bluffs varies from 0 .20 to 0.31 metres per year • Erosion in sandstone cliffs varies from 0.15 to 0.46 metres per year • No data is available on erosion of salt marshes in Stratford • Erosion of coastal marches varies from 0.31 to 1.52 metres per year generally in the Northumberland Strait

5.4 Current Climate Change Impacts

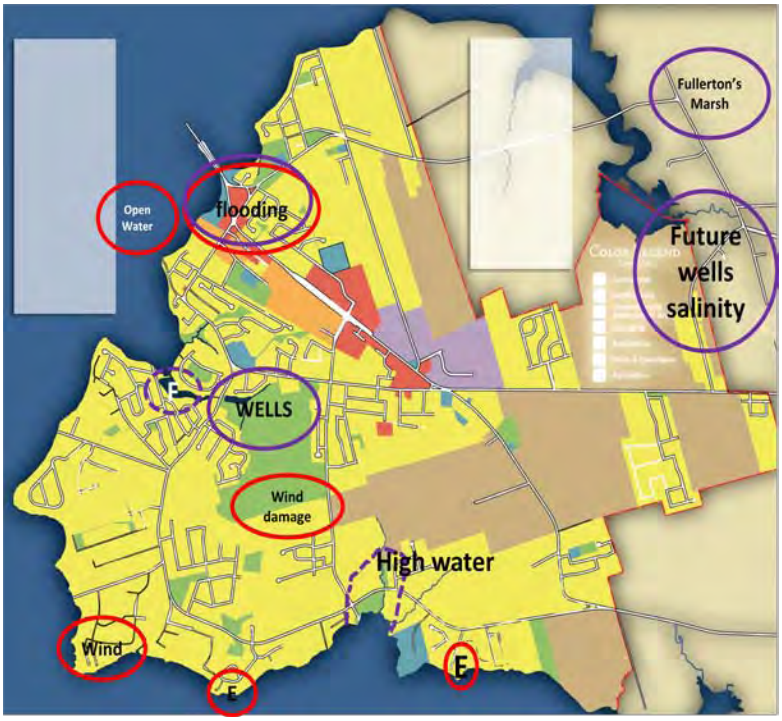
In addition to compiling climate change research, the project team worked with the community to record the community's observations of current changes in climate. Municipal staff, and the community have observed a variety of different weather related impacts in the Town of Stratford. Significant erosion has occurred in numerous places along the shoreline. In many areas housing is set very close to the shoreline, and is vulnerable due to proximity to the water's edge. On private properties seawalls and other forms of physical barriers used to protect property and prevent the shoreline from eroding have been erected. These are also viewed to have caused a higher rate of erosion to other properties in the near vicinity which have not developed protective measures. Many significant pieces of infrastructure, such as pumping stations and the sewage treatment lagoon, are also located in close proximity to the shore. Intense storm and precipitation events have resulted in significant flooding in the Keppoch Road/Pondside and Horton Park area. The Keppoch Road/Pondside area houses a municipal water well, along with an important pumping station, and a significant roadway. Flooding in the Horton Park has the potential to significantly impact multi-family housing, along with an important park, the Robert L. Cotton Park. Winter weather patterns have also resulted in significant climate related impacts within the Town, for example, changing and more frequent freeze thaw cycles, is viewed to exacerbate erosion along the coastline. In addition, storm surges have resulted in ice deposits on private land, and caused property damage in some instances. The community has indicated that occurrences of saltwater intrusion have also been observed in wells within the Town. A summary of these observations is included in **Table 5.3**.

Table 5.3 Observations of Current Climate Change Impacts in the Town of Stratford	
Summary of Project Observations of Current Climate Change Impacts, *Town of Stratford (PEI)*[xvi]	• *More frequent and more severe weather events* • *Coastal soil erosion* • *Threats to well water supply and quality, including salt-water intrusion in groundwater* • *Being cut off from regional and provincial services in Charlottetown (Hillsborough Bridge)* • *Storm water management system overflow (inland flooding)* • *Damage to coastal properties from sea level rise and tidal surges* • *Damage to infrastructure from sea level rise and tidal surges* • *Changes in wildlife habitats*

5.5 Establishing Current and Future Vulnerability

Once an initial understanding of current vulnerability and climate change research was obtained, this information was reviewed at a community meeting. The meeting began with a community mapping exercise that asked participants to map perceived *current vulnerabilities* to climate change. After this a presentation was delivered outlining the most recent scientific research regarding potential climate change impacts in the Town of Stratford, Charlottetown area, Prince Edward Island, and Atlantic Canada. The community was then asked to identify *future vulnerabilities* to climate change impacts, using this new knowledge. Mapping depicting the results of this mapping exercise is shown on subsequent pages.

Community Mapping Exercise: Results Group 1



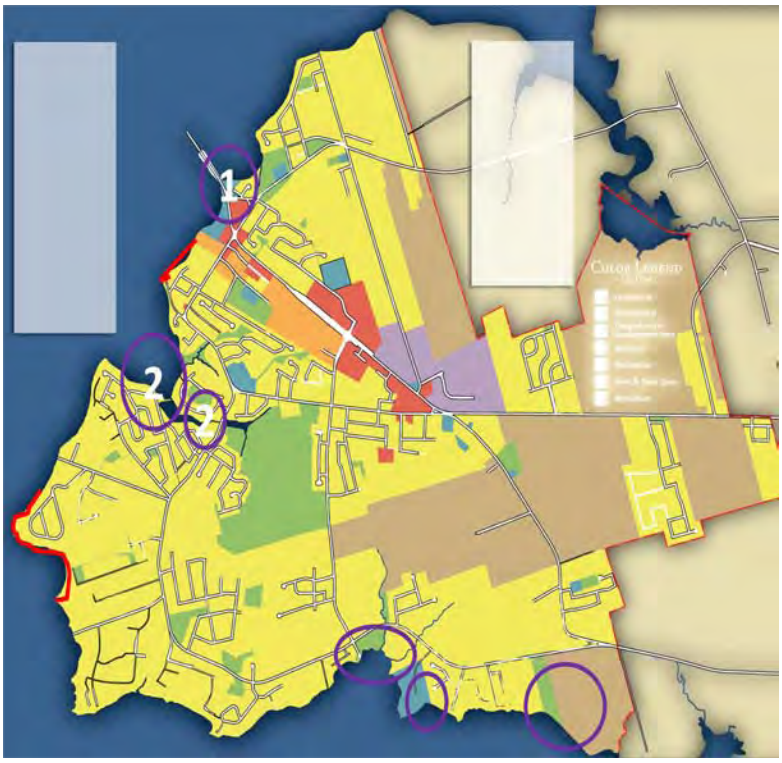
Current Vulnerability: Red

1. Open water
2. Flooding (F)
3. Wind damage
4. Wind
5. Erosion (E)
6. More species of birds year round

Future Vulnerability: Purple

7. Wells
8. Flooding (F)
9. High water
10. Future wells / salinity
11. Fullerton's March

Community Mapping Exercise: Results Group 2



Current Vulnerability: Red

1. Erosion; Shoreline armored

Future Vulnerability: Purple

1. Erosion; Shoreline Armored
2. Storm Surge / Flooding/ Wells

Community Mapping Exercise: Results Group 3

Current Vulnerability: Red

1. Erosion
2. Erosion by humans
3. Erosion of Park
4. Flooding storm water
5. General hurricane damage
6. Salt water in wells
7. Rapid growth of invasive species

Future Vulnerability: Blue

1. Erosion; Shoreline Armored
2. Storm Surge / Flooding/ Wells

Community Mapping Exercise: Results Group 4

Current Vulnerability: Red

1. Erosion
2. Less ice in winter
3. Air temperature increase
4. Flooding
5. High ice
6. Concern about loss of land
7. Animal are come out
8. Water wells deeper, water table contaminated
9. Decrease in snow (not site specific)

Future Vulnerability: Blue

1. How much of Teahill Park will be left?
2. Flooding or
3. Run off silt
4. Land loss
5. Loss of light houses
6. Water tables
7. Damage from people trying to protect their land

5.6 Summary of Observations

Present day impacts of climate change, in Stratford, Prince Edward Island, are visible and real to the community. Local residents currently see their properties being gradually eroded away, fearing that their houses or accessory buildings will eventually be washed away. There is anticipation that storm surges resulting from sea level rise and more extreme weather events will result in more devastating effects to property. The municipality has public infrastructure, streets, water wells, wastewater and water pipes, a municipal sewage treatment lagoon and pumping stations many of which are close to the water's edge and could be damaged by severe future events. More intense rain events are causing flooding events in low areas throughout the inland of Town of Stratford. Water wells are being abandoned due to saltwater intrusion. Most agree that business as usual is no longer acceptable, new standards and guidelines are needed to guide future growth. Existing climate change research indicates that future climate change scenarios and impacts will only exacerbate existing conditions. The Municipality wants to find new ways of dealing with new climate change related issues. Climate change issues need to become paramount within all municipal planning initiatives.

Part 6: Potential Climate Change Scenarios

Based on observations of current climate impacts, project objectives, community priorities and available scientific data, scenarios for climate change were developed. As is the case with many communities in Atlantic Canada and in Prince Edward Island, Stratford is anticipated to be significantly affected as climate change related events become more frequent and more intense. Three key climate change impacts were researched, namely, Coastal Erosion, Coastal Sea Level Rise, Storm Surge and Flooding and changes in precipitation events.

6.1 Coastal Erosion

Coastal erosion rates in Stratford are not expected to be as significant as what has occurred in the north shore of PEI, which is expected to lose 50% of coastal properties in the next 100 years. This being said, Stratford presently experiences a significant range of erosion, with recent studies suggesting some areas retreat approximately 0.2 m–0.31m a year (till bluffs), whereas erosion in sandstone cliffs tends to be higher ranging from 0.15 m to 0.46 m per year. The height of the coast also varies significantly in Stratford, ranging from 0 m to 9m. Residents have explained that several owners of coastal properties have seen significant erosion rates. Some coastal property owners have erected sea walls of rocks, concrete or wood to stop erosion.

Figure 6: In Stratford PEI, the height at the coast along the sandstone cliffs facing the Northumberland Strait varies between 1.5 and 9 m.

6.2 Coastal Sea Level Rise, Storm Surge and Flooding

Public and private infrastructure in Stratford is vulnerable to storm surge and flooding, in particular near low lying areas, along with areas adjacent to stream or waterways. Nearby Charlottetown is extremely vulnerable, and a significant part of the Downtown area could be flooded as sea level rises and storm surges become more intense and more frequent. This could impact emergency services, the power utility and wastewater facilities, all of which are located along the shoreline in the City of Charlottetown. A study completed in 2002, called the *Coastal Impact of Climate Changes and Sea-Level Rise in Prince Edward Island,* outlines these impacts in greater detail.

Storm surges, coastal erosion, coastal flooding, inland flooding and severe weather events can all require emergency measure responses. However, Stratford is in a unique situation since it

relies on the nearby City of Charlottetown for several emergency services: hospital, supplementary fire protection and police support. Given the most direct access to Charlottetown across the Hillsborough Bridge, this could have significant impact for the provision. If a storm surge cut off access to this bridge, the residents of Stratford would be in a very vulnerable situation. Further, given that key infrastructure such as the Charlottetown Hospital are located in close proximity to the shoreline, future adaptation strategies should consider these vulnerabilities.

To develop a deeper understanding of the potential impacts of sea level rise, a digital elevation model (DEM) incorporating sea level rise and storm surge was developed. Hailey Steiger, planner, who is acting as coordinator of this Atlantic Canada climate change project developed the DEM. The DEM confirms the concerns expressed by residents, several low lying coastal areas in Stratford may be subject to more severe coastal flooding events, under different climate change scenarios. Copies of the scenarios mapping can be found in **Appendix D.** Climate change scenarios are based on modelling that developed from a complex web of meteorological factors. This information has been generalized and interpreted to apply it to this climate change adaptation planning exercise and should be treated as illustrative and conceptual in nature.

Figure 7: Residents of Stratford, PEI are seeing ice walls pushed closer and closer to their homes.

In **Appendix D** two versions of the mapping are presented. The first versions incorporate a storm surge of 255cm, as provided by the Environment Canada and Bedford Institute of Oceanography. At the request of the Town of Stratford, additional mapping was developed to show a potential storm surge of 470cm, to reflect Town understanding of the highest existing storm surge recorded in the area. The accuracy of this assumption was not confirmed by the Project Team. Mapping also does not take into account coastal erosion.

All mapping was prepared with very general inputs and assumptions, and thus should be considered illustrative but inaccurate from a scientific standpoint. More detailed study and modeling is required to develop a more accurate projection of potential future impacts. All mapping should only act as a conceptual illustration of vulnerable areas to help the Town assess potential weaknesses and identify future areas of study.

6.3 Changes in Precipitation Events

General climate change scenarios for this region predict more rain and more severe, intense precipitation, such as flash flood events. The Town of Stratford was interested in developing a deeper understanding of potential changes in precipitation, both to understand the impacts for stormwater management systems and key streams and watercourses. Most storm water systems are designed on past rain occurrences are likely to fail, causing inland flooding in unexpected areas. The Province of Prince Edward Island provided climate change scenario data regarding maximum and minimum temperatures, as was developed by Environment Canada. Projections for the Charlottetown area are based on the B2 emissions scenario, which is now considered to be a conservative emissions scenario. Potential projections for two climate change models are presented below in **Table 6.1**.

Figure 8: Sedimentation ponds are used in drainage systems as means to alleviate flash floods, in Stratford, PEI.

Table 6.1 Projections for Extreme Precipitation (millimetres)

Based on CGCM2			
PERIOD	**10 YEARS**	**50 YEARS**	**100 YEARS**
HISTORICAL	74	94.2	102.7
2020's	120.7	168.4	188.6
2050's	107.7	144.8	160.6
2080's	99.8	128.6	140.7

Based on HadCM3			
PERIOD	**10 YEARS**	**50 YEARS**	**100 YEARS**
HISTORICAL	74	94.2	102.7
2020's	86.4	110.3	120.4
2050's	93.7	121.1	132.7
2080's	79.1	97.2	104.8

Part 7: Assessing Vulnerability, Risk and Priorities for Adaptation

After developing a series of climate change scenarios based on the best available scientific data, and analyzing the community's current perceptions of climate change and areas of future vulnerability, the project team developed a framework through which areas of vulnerability within the Town of Stratford could be estimated. Primarily, the team wanted to establish a systematic way through which vulnerability of community systems could be estimated. Analysis would also need to take into account the relative importance of any particular system, as well as the scientific probability of any given climate change impact.

Figure 9: Residents of Stratford, PEI, are concerned about climate change. Meetings for the Climate Change Municipal Adaptation Plan project were well attended.

7.1 Estimating Vulnerability and Risk

The project team analyzed each climate change scenario by asking a series of questions which assisted the team in thinking about potential Town of Stratford vulnerability to climate change. These questions were as follows:

- **Where will this climate scenario have impacts?**
  - Identify potential impact areas for each the scenarios.
  - This could include physical impacts on built systems, human systems or environmental systems.

- **How likely is it that this climate scenario will occur?**
  - Determine the scientific probability of the scenario.
  - Also consider whether or not the community is already observing changes or conditions resulting from changes in climate.

- **What systems or infrastructure might be impacted? What is most critical and most vulnerable?**
  - Identify key individual facilities or resources within impact areas.
  - Identify which infrastructure is most critical.
  - Identify scenarios and impacts which pose the greatest risk to systems.

In estimating vulnerability, the project team was most concerned with classifying risk so as to prioritize future adaptation methods. Given municipal resources are constrained, it is extremely important to identify those potential impacts which pose the greatest threat to municipal systems. **Table 7.1**, adapted from the report, *Elaborer un plan d'adaptation aux changements climatiques*, produced by Ouranos, Fondsvert, and the Province of Quebec, was used to classify potential risk.

Table 7.1 Classification of Risk

Probability of Occurrence	Significance of Climate Change Impact on a system or activity *				
	Insignificant (INS)	Minor (MIN)	Moderate (MOD)	Major (MAJ)	Catastrophic (CAT)
Almost Certain (AC)	Medium	Medium	High	Extreme	Extreme
Probable (PB)	Low	Medium	High	High	Extreme
Possible (PS)	Low	Medium	Medium	High	High
Unlikely (U)	Low	Low	Medium	Medium	Medium
Rare (R)	Low	Low	Low	Low	Medium

In this matrix, the level of risk is established by considering the probability that a climate scenario or event will occur in conjunction with the significance of such an event on any given system or activity. By weighting these two categories against one another, a priority ranking system is established. In this ranking system, the impacts to any given system or infrastructure potential climate change will either be ranked as a low, medium, high or an extreme risk to the Town of Stratford.

In order to classify risks in the Town of Stratford, the team needed to examine each of the potential climate change scenarios and consider the likelihood of occurrence for each scenario. An overview of each potential climate change impact and scenario along with the project team's reasoning in establishing a probability of occurrence in **Table 7.2** below.

Table 7.2 Probability of Occurrence

Climate Change Impact	Climate Change Scenario	Probability of Occurrence	Project Team Observations
Coastal Sea Level Rise and Storm Surge Flooding	Low Emission Scenario	Almost Certain	The Low Emission Scenario developed for the Town of Stratford establishes a rate of sea level rise which assumes that ozone depleting gas emissions will be low. This would mean that the sea level rise would be significantly lower than current scientific predictions and that there would be less storm surges as compared to the most generally acceptable projections regarding the number and magnitude of storm surges. This scenario would have the least impact on the community of

			Stratford, however these climate change impacts are almost certain to occur.
	Current Emission Scenario	Probable	This scenario projects that greenhouse gas emissions will be similar to currently acceptable scientific predictions. If this scenario occurs the sea level will rise higher and there will be stronger and more frequent storm surges as compared to the previous scenario. This scenario will probably occur and the effects predicted for Stratford will most likely be seen. However it is generally accepted that the scientific community predictions are conservative.
	High Emission Scenario	Possible	If the cumulative effects of greenhouse gases is higher than expected or if countries around the world do not take the expected required steps to reduce the emissions of ozone depleting gases, it is possible that more intense climate changes impacts will occur in Stratford. Higher sea level rises and more frequent high intensity storm surges will cause an increase in coastal erosion rates, and more frequent coastal and inland floods in Stratford. It is possible that this scenario will occur.
Inland Flooding	Areas that are already experiencing flooding	Almost Certain	Changes in precipitation caused by more frequent or intense events are likely to exacerbate problems in areas that are already experiencing flooding. Conservative models developed for the Charlottetown area show changes in precipitation that cause changes within the next 10 years to the 10, 50 and 100 year flood events. Given the community already perceives that key systems and infrastructure are already vulnerable to inland flooding occurrences, areas that already have experienced flooding have been categorized as *almost certain* to experience impact or pressure under future scenarios.
	Areas along key watercourses or the marsh system	Possible	Many of the potential climate change impacts are related to changes in precipitation events, which will put increasing pressure on hydrological systems and units, including watersheds, watercourse and marsh systems. Emissions modeling for coastal sea level rise and storm surge shows that some of the areas of greatest vulnerability are those low lying areas where key watercourses and marshlands discharge into the ocean. Therefore, it is categorized that it is *possible* that areas along major watercourses or marshlands will experience impact or pressure under future climate scenarios.
Coastal Erosion	Areas along coastline	Almost Certain	Within PEI and the Town of Stratford, the physical composition of lands along the coast already causes the coastline to be susceptible erosion. While additional study on the historical rate of erosion establishes a variable rate of erosion depending on geological makeup, there was insufficient scientific information to project a rate of erosion to specific areas of the coastline. Given the community's observations that coastal erosion is already an area where the community is feeling climate change impacts, the historical rate of erosion, and potential future impacts resulting from changes in storm surge resulting from more intense and frequent storm events, along with the established frequency of storm surge for Charlottetown , the

			project team determined to categorize it to be *almost certain* that the Town of Stratford will experience impact or pressures resulting from future climate change scenarios on coastal erosion.
Salt-water Intrusion of Groundwater	All potable water	Possible	While there is little available research on salt-water intrusion in groundwater supplies, the community did establish that wells in low lying areas have already experienced some ground water intrusion. Given that the Town of Stratford is entirely dependent on groundwater for potable water, and the importance of drinking water to the Town, the project team has categorized salt-water intrusion as having a *possible* occurrence under future climate change scenarios.

After establishing the probability of occurrence for each potential climate change impact, the project team needed to further define the significance of any particular climate change impact, and determine whether it would cause insignificant, minor, moderate, major or catastrophic impacts. These definitions are important in assessing the how critical or important of any given piece of infrastructure or system is within the overall health and functioning of the community. The definitions created by the project team for the purposes of this study are described in **Table 7.3.**

Table 7.3 Descriptions for Significance of Climate Change Impact

*Significance of Climate Change Impact	Description of Impact on Infrastructure/System
Insignificant	Loss of infrastructure system/service can be tolerated but not desirable
Minor	An important but non-essential infrastructure services/system is threatened
Moderate	Critical Infrastructure/System for Neighbourhood or Localized Area is threatened.
Major	Critical Infrastructure/System to Town or Overall System is threatened
Catastrophic	Critical Infrastructure/System; if compromised could result in loss of human life

7.2 Classifying Risk and Priorities for Adaptation

Once the team established the scientific probability of each climate change impact and the relative significance of any given piece of infrastructure, the project team was able to classify risk using **Table 7.1.** Key elements of Town systems were identified. The team worked closely with the Town of Stratford senior staff and representatives from the Province, as well as the Safety Service and Environment Committee to establish the system or infrastructure elements. One of the benefits of working in a community the size of Stratford is that it was relatively easy to identify these elements. In a larger municipality, this could be a more time consuming task. This being said, geographic information systems (GIS) would be a useful tool in developing a ranking system to establish the relative probability of occurrence and risk classification of key

community elements, particularly in instances where there is a broader geographic area to be analyzed, or more involved system of infrastructure etc.

The key system elements identified for risk classification were the waste water treatment system and supporting pumping stations, water system components, private properties, road system, stormwater system, park and recreation infrastructure, heritage properties, watershed units or areas and emergency services. Mapping showing key wastewater treatment infrastructure and water system components, stormwater management system, park and recreation and heritage properties and watershed drainage areas is shown in **Appendix E**. To evaluate the vulnerability of key systems and infrastructure to sea-level rise, storm surge and flooding, the emissions scenario mapping was over-laid.

The results of the risk classification exercise, is shown in detail in **Table 7.4**.

Figure 10 a and b: Property owners in Stratford, PEI, use cement blocks, wood beams, rocks and recycled build materials to build sea walls, in attempts to protect their lands from erosion.

Table 7.4 Risk Classification of Key Town of Stratford Systems

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
Wastewater Treatment Plant	Sewage Lagoon	Major	Y								
	Charlottetown	Major	Y								
Pumping Stations	Mason Road	Moderate									Mapping showing approximate Pumping Station locations is included in **Appendix E**
	Carriage Lane	Moderate									
	Horton Park	Moderate									
	Bunbury	Major									
	Harbourview	Moderate									
	Bayside	Major									
	Pondside	Major	Y				(AC)			Some flooding has already occurred along this river system	
	Zakems	Moderate									
	Aptos	Moderate	Y				(AC)			Some flooding has already occurred along this river system	
	Battery Point	Moderate									
	Red Rock	Moderate									
	Schurmans	Moderate									
	Sky Lane	Moderate									
	Calloway Close	Moderate									
	Maclaughlin	Moderate									
	Eastern Realties	Moderate									
	Spinnaker Street	Moderate									
	East Keppoch Road	Moderate									
	Corish	Major	Y				(AC)			Some flooding has already occurred along this river system	
	Clearview	Moderate									
	TransCanada	Moderate									

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
	Reeves Estate	Moderate									
	Mount Herbert	Moderate									
Water Infrastructure	**Pondside**	Major	Y				(AC)				Saltwater Intrusion has been identified as possible in all wellfields, however more scientific study is required to determine actual vulnerability to saltwater intrusion.
	Cable Heights	Major									
	New Well field	Major								Location of New Wellfield Still Unknown	
	Beacon Hill	Major									
	Langley	Major									
Private Properties	**Area A**	Moderate	Yes				(AC)				Areas A-H are part of a classification system developed by the Town, which divide the Town into subdivision areas. This was used because it is an established system that breaks down residential areas, however the Town may wish to develop a new classification system based on climate scenarios or watershed drainage areas.
	Area B	Moderate					(AC)				
	Area C	Moderate									
	Area D	Moderate									
	Area E	Moderate									
	Area F	Moderate									
	Area G	Moderate									
	Area H	Moderate									
Road Infrastructure	**Hillsborough Bridge**	Catastrophic								Height of bridge not factored in to analysis.	

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
Stormwater Infrastructure	Culvert 201	Moderate					(AC)				Culverts are those Major Culverts identified in the Town of Stratford Stormwater Management Plan. This study identified that many of these culverts are unable to handle a 1 in 5 year event. Build up of sedimentation is a noted issue in many instances.
	Culvert 301	Moderate					(AC)				
	Culvert 302	Moderate									
	Culvert 401	Moderate					(AC)			Downstream Channel is Tidal	
	Culvert 601	Moderate					(AC)				
	Culvert 602	Moderate					(AC)				
	Culvert 603	Moderate					(AC)				
	Culvert 604	Moderate									
	Culvert 605	Moderate					(AC)				
	Culvert 606	Moderate					(AC)				
	Culvert 607	Moderate					(AC)				
	Culvert 701	Moderate	Y				(AC)			Pondside Culvert	
	Culvert 702	Moderate					(AC)				
	Culvert 703	Moderate					(AC)				
	Culvert 801	Moderate					(AC)			Downstream of outlet is tidal shoreline with no defined channel	
	Culvert 802	Moderate					(AC)			Downstream of outlet is tidal shoreline with no defined channel	
	Culvert 1001	Moderate					(AC)				
	Culvert 1002	Moderate					(AC)				
	Culvert 1003	Moderate					(AC)				
	Culvert 1004	Moderate					(AC)				
	Culvert 1101	Moderate					(AC)				
	Culvert 12B01	Moderate					(AC)				
	Culvert 1201	Moderate					(AC)				
	Culvert 1202	Moderate					(AC)				
	Culvert 1401	Moderate					(AC)				

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
	Culvert 1402	Moderate					(AC)				
	Culvert 1501	Moderate					(AC)				
	Culvert 1502	Moderate					(AC)				
	Culvert 1601	Moderate					(AC)				
	Culvert 1602	Moderate					(AC)				
	Culvert 1603	Moderate					(AC)				
	Culvert 1701	Moderate					(AC)				
	Culvert 1702	Moderate					(AC)				
	Culvert 1801	Moderate					(AC)				
	Culvert 1802	Moderate					(AC)				
Park and Recreation Infrastructure	Robert L Cotton Park	Moderate	Y				(PS)				
	Kenny Park	Minor									
	Keppoch Park	Minor									
	Sundance Park	Minor									
	Kinlock Park	Minor									
	Pondside Park	Minor	Y				(PS)				
	Lantz Park	Minor					(PS)				
	Reddin Park	Minor	Y				(PS)				
	Spruce Grove Park	Minor									
	Rankin Park	Minor									
	Bunbury Park	Minor									
	Sprucehill Park	Minor									
	Bellevue Park	Minor									
	Tea Hill Park	Moderate	Y								
	MacNeill Field	Minor									
	Burnbury Rink	Minor									

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
	Starling Park	Minor									
	Reeves Park	Minor									
	Clearview Park	Minor									
	Zakem Park	Minor									
	Partridge Park	Minor									
	Town Centre Park	Minor									
	Stratford Soccer Complex	Minor									
	Glen Stewart School Park	Minor									
	Emmalee Park	Minor									
Heritage Properties	Clinton United Church	Moderate									
	Bayfield Jaynes Property	Moderate									
	John Farquharson Farm	Moderate									
	Clifton Farm House	Moderate									
	Dewar House	Moderate									
	The Tannery	Moderate									
	Duncan House	Moderate									
	Cross Roads Christian Church	Moderate									
	The Brick House	Moderate									
	Balahan House	Moderate									
	Mill Brook Farm	Moderate									

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
	Cahill House	Moderate									
	Lighthouse Haszard Pt	Moderate	Y								
	Lighthouse Sprindrift Ln	Moderate									
Watershed Units	Area 1 Duffy Road System	Moderate								Majority of watershed located outside of Town Boundaries	
	Area 2 Bunbury System	Moderate									
	Area 3 Rankin Park System	Moderate	Y							Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 4 Hillsborough System	Moderate									
	Area 5 Southport System	Moderate									
	Area 6 Stratford Road System	Moderate								Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 7 Pondside System	Moderate	Y							Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 8 Rosebank Heights System	Moderate	Y							Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 9 Langley System	Moderate									
	Area 10 Battery Point System	Moderate								Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	

Infrastructure or System		Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes	
				Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion		
				Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)		
	Area 11 Keppoch Heights System	Moderate								Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 12 a Eastern Reality System	Moderate									
	Area 12 b Lower Gate System	Moderate									
	Area 13 Spinnaker System	Moderate									
	Area 14 Sundance System	Moderate								Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 15 Corish System	Moderate	Y							Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 16 Bellevue System	Moderate								Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 17 Tea Hill System	Moderate	Y								
	Area 18 Fullerton's Marsh System	Moderate	Y							Low Lying Drainage with 1 in 100 year floodlines upstream of major culverts	
	Area 19 Bouyer Creek System	Moderate								Watershed located outside of Town Boundaries	
Emergency Services	Fire Department	Catastrophic									
	Police Department	Catastrophic									
	New Police Station	Catastrophic								Location Not Known Yet	

Infrastructure or System	Significance Infrastructure or System	Seeing Impacts Already Yes (Y) – No (N)	Potential Climate Change Impact/Scenario and Probability of Occurrence						Notes
			Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 1 *	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 2*	Coastal Sea Level Rise and Storm Surge Flooding Emissions Scenario 3 *	Inland Flooding	Coastal Erosion **	Saltwater Intrusion	
			Almost Certain (AC)	Probable (PB)	Possible (PS)	Ares with Existing Flooding – Almost Certain (AC) Along River/ Marsh Systems – Possible (PS)	Along Coastline – Almost Certain (AC)	Possible (PS)	

* Assumed Storm Surge of 4.7m at the request of the Town of Stratford, where there is anecdotal evidence that storm surge has been recorded as high as 4.7m in previous storm events. Modeling does not incorporate rate of coastal erosion. Fullerton's marsh has been treated similar to coastline, however it is recognized that this system is unique and more study is required to understand impacts specific to this particular system. Mapping depicting coastal sea level rise and storm surge is general, based on best available data at the time of said project, and should be interpreted as inconclusive. More detailed study and modeling is required.

** Height of coastline or rate of erosion was not factored into estimation of impacts resulting from coastline erosion. Proximity to the coast of infrastructure or system was the only determining factor.

Part 8: Developing a Climate Change Adaptation Strategy

Classifying levels of risk helps highlight how the Municipality might be vulnerable to future climate change impacts. By incorporating both scientific probability and the relative significance of each community system, the project team is able to estimate potential exposure and susceptibility to environmental climate change impacts. While the climate change scenarios are based on a basic interpretation of scientific study and analysis, the project team was still able to assess how the municipality might be vulnerable to future changes in climate.

> The vulnerability of a community or ecosystem to climate change is a function of its exposure and susceptibility to environmental change and its inherent of managed adaptive capacity (resilience, ability to cope) in the face of such change. Adaptations are actions taken in response to a projected or actual change in the climate or other change in the environment. They aim to maximize any positive effects and to minimize adverse impacts, thereby reducing vulnerability. Adaptation may be spontaneous (autonomous) or planned, and may take place on local, national and international scales.
>
> *Coastal Impacts of climate Change and Sea-Level Rise on Prince Edward Island, Synthesis Report*

Climate change scenarios are typically estimations of a long-term evolution of climate conditions; projections sometimes look 100 years into the future. Communities have valuable information to contribute to the climate change adaptation process, since they are often the most familiar with the local environment, and often are able to identify more immediate changes in climate. While these are based on short-to-medium term subjective observations, and are not validated by scientific research, observation and analysis, this information is still of value, and can help point towards areas of pressing concern. Using current observations of changing climate in conjunction with long-term climate scenario development helps to establish a conceptual understanding of how the community is vulnerable. For the purposes of this project, current and future projections both played a role in the assessment of risk. Where the community was already observing impacts in key areas of future vulnerability, it was assumed that these areas would likely experience increased pressure under future climate change scenarios.

8.1 Developing Recommendations for Adaptation Planning

The risk classification process (results as detailed in **Table 7.4**) allows the Municipality to ascertain areas that may be under increased pressure in future climate scenarios, and to focus in on critical infrastructure which if threatened, may result in undesirable or negative consequences for the municipality. Key observations and recommendations emerging from the risk classification results are provided in **Table 8.1**.

Table 8.1 Observations and Recommendations for Climate Change Adaptation Planning

System or Infrastructure	Observations	Recommendations
Wastewater Treatment System	The Town is currently considering upgrading their existing sewage lagoon. They are also considering developing a new system that would see wastewater sent to the City of Charlottetown for treatment. A report developed in 2002 called *Coastal Impacts of Sea-Level Rise on Prince Edward Island* identified the City of Charlottetown primary treatment plant and lift stations as vulnerable to sea-level rise and storm surge.	• Request the City of Charlottetown's long-term plans for adapting/improving resiliency of the wastewater treatment system/plant to respond to potential changes in sea level rise and other climate change impacts. • Request the City of Charlottetown's long-term plans to separate stormwater and wastewater treatment systems. • Work with the Province of Prince Edward Island to connect with the Insurance Bureau of Canada, who in partnership with NRCan, are developing and testing a surface water and waste water infrastructure vulnerability assessment tool for communities of a variety of sizes and types. The Town of Stratford and City of Charlottetown should be engaged in the application of this tool. • Undertake a detailed analysis of the long-term environmental costs, benefits and resiliency of either system both in terms of capacity to accept and treat Town of Stratford wastewater as well as resiliency to impacts of climate change. • Determine if the existing sewage treatment lagoon could act as a backup treatment facility should the Charlottetown wastewater treatment fail.

Pumping Stations	When evaluating wastewater pumping stations, the project team differentiated between those that were important or critical to the functioning of the entire system, and those that were important to a localized area. Of the major pumping stations, most have been identified as being vulnerable to sea level rise and storm surge. Those in close proximity to the shoreline, such as Coorish, Bayside and Bunbury have been highlighted. Pondside has also been identified as susceptible to storm surge flooding, and it also has already been subject to localized flooding. Although this flooding did not impact the functioning of the pumping station, staff are aware that this pumping station might be vulnerable should more severe flooding occur.	• Evaluate the relative importance of each pump station to the system, and determine the impacts to the overall community and wastewater treatment system should one pump station or multiple pump stations fail. The evaluations should include economic, environmental and social costs. • If required, determined if there is a method for safeguarding against pump station failure, whether through improving design of overall system, or upgrades of individual stations. • Evaluate the benefits of any changes to the system, comparing long-term cost of upgrades with costs resulting from future impacts. • If pump failure will result in significant damages or threats to the community, determine if changes to the emergency response plan is required.
Potable Water Infrastructure	The Town is entirely dependent on groundwater for potable water. At present, the Town is searching for a new well field site. The dependence on groundwater as the source for potable water is common across all communities in Prince Edward Island. The vulnerability of the water table to impacts such as saltwater intrusion, or changes to the hydrologic cycle resulting from changing temperatures could have important implications for groundwater quality and quantity. Further changes in the nature of precipitation events could influence a range of features, from groundwater recharge to surface water quality. Understanding the impacts to water resources is important not only to the Town of Stratford but also the Province of PEI.	• Determine if climate change impacts are a consideration in the assessment of the new well field site. • Work with the Province of Prince Edward Island to evaluate and study the impacts of climate change on groundwater. • Research best management practices that the Town can employ to ensure that land management activities are not detrimental to the protection of groundwater resources. • Determine if there is any interest in the academic or scientific community to study the climate change impacts or scenarios reflecting groundwater resources in Stratford, in particular, salt-water intrusion. • Work with the Province to determine how the Groundwater Quality and Quantity Assessment Project proposed through the Regional Adaptation Collaborative will be testing a salt-water intrusion model in the City of Summerside PEI. The Town should

		determine if the model being developed can be applied to Stratford in the future.
Road Infrastructure	The Hillsborough Bridge is a critical link between the Town of Stratford and the City of Charlottetown. Stratford is in a peculiar situation since it relies on the nearby City of Charlottetown for several emergency services: hospital, supplementary fire protection and police support. While there is another route that could be used as a secondary access, this route would add considerable time to the length of any vehicle trip should the Hillsborough Bridge be inaccessible. This becomes extremely problematic in emergency response situations. If storm surge cut off access to this bridge, the residents of Stratford could be in a very vulnerable situation. While climate change scenario mapping developed for this study does show that bridge might be vulnerable to future changes in climate, the height of the bridge was not factored into the DEM.	• Work with the City of Charlottetown and Province of Prince Edward Island to develop more detailed and accurate climate change scenario modeling to determine how changes in sea level rise and storm surge might impact the Hillsborough Bridge. • Evaluate the Town of Stratford's emergency response plan to determine if the plan considers alternatives should the Hillsborough Bridge be rendered inaccessible.
Stormwater Infrastructure	The *Town of Stratford Stormwater Management Plan* prepared by CBCL identifies that many of the key elements of the stormwater management system, such as major culverts, are already subject to flows that exceed culvert capacity. A quote from the report states "*It can be seen that very few of the major system culverts have capacity to convey the 1 in 100 year peak flow without surcharging the inlet. Several systems have capacity to convey the flows without overtopping the road but they flood upstream areas. Many do not have capacity to convey the existing peak flow from a 1 in 5 year design storm.*" The study does identify with a series of measures and actions to undertake to improve the overall system.	• Continue to implement the recommendations of the stormwater management plan. • Review engineering standards to determine how to incorporate new standards responding to climate change. • Develop relationship with Engineers Canada and research work of Public Infrastructure Engineering Vulnerability Committee, a committee dedicated to formal reviews of infrastructure design, operation and maintenance codes, standards and engineering practices in four infrastructure categories: buildings; storm water and wastewater systems; roads and associated structures; and water resource systems. • Ensure the Inland Flooding Risk and Vulnerability Assessment proposed

		through the Regional Adaptation Collaborative process focuses on improvements to stormwater management system. These improvements should also be linked to the protection and recharge of groundwater.
Watershed Areas	Integrated Watershed Management Planning is a critical tool that can assist the Town in responding to the identified climate change impacts. The Town is fortunate to have a willing group of citizens who have engaged in community-based watershed management. This group has developed a *Stratford Area Watershed Management Plan (working)* which can help to strengthen the Town's knowledge of the relationship between the land management and the environmental characteristics of the landscape, including protection, remediation and restoration of water resources. Risk classification has identified that the majority of the Watershed Areas delineated in the *Town of Stratford Stormwater Management Plan* are vulnerable to climate change impacts.	• Work with the Stratford Area Watershed Improvement Group (SAWIG) to incorporate potential climate change impacts into the watershed management strategy. • Use the *Town of Stratford Stormwater Management Plan* research to inform watershed delineation in the Watershed Management Plan to allow the Improvement group to focus in on key drainage areas. • Continue to support and provide resources to the Stratford Area Watershed Improvement Group in the development of the Watershed Management Plan.
Private Properties	The study team did not identify individual properties that might be threatened by climate change impacts. However residential coastal development is one of the most predominant forms of housing in Stratford and many properties are situated extremely close to the water's edge, whether on cliffs vulnerable to erosion or in low lying areas vulnerable to storm surge, flooding and ice flow. The Town of Stratford should consider developing proactive stance in managing this development to mitigate future impacts.	• Evaluate the socio-economic implications of sea-level rise and storm surge on private property. The study titled *Impacts of Sea-Level Rise and Climate Change on the Coastal Zone of Southeastern New Brunswick* identified socio-economic implications of risks to property by calculating the assessed value of properties that might be subject to future flooding. Undertaking a similar exercise might prove a valuable education and evaluation tool in Stratford. • Consider developing setbacks from coastal and low lying areas. • Work with the Province to develop a policy for managing seawall construction and maintenance.

		• Examine the Zoning Map and determine if there are opportunities to work with landowners and rezone residential or commercial properties for conservation if it appears they will be significantly threatened by coastal erosion or sea level rise and storm surge. It is important that this is a balanced approach, as this is a significant change in land rights. Incentives such as compensation or land swap should be considered. • Establish a working partnership with the Province of Prince Edward Island to develop a deeper understanding of the impacts of coastal erosion.
Park and Recreation Infrastructure	Most of the Town's key parks and recreation infrastructure, such as the Robert L. Cotton Park, Ponside Park and Tea Hill Park, are vulnerable to climate change impacts. Currently, there is already some planning underway for these key parks, as identified in the *Stratford Area Watershed Management Plan (working copy)*.	• Work with the Stratford Area Watershed Improvement Group to incorporate potential impacts from climate change scenarios by developing an adaptation strategy as part of planning for key parks. • Any of the park adaptation strategy should focus on the full range of potential adaptation methods, as indicated in **Appendix G**.
Heritage Properties	A few of the Town's key Heritage Properties and features are potentially vulnerable to climate change impacts, primarily because of their location along the coast, or in close proximity to areas prone to storm surge flooding or coastal erosion. These include, The Tannery, Cahill House, Haszard Pt Lighthouse, and the Bayfield Janes Property.	• Develop an adaptation strategy for key heritage property which considers a range of potential adaptation methods, as indicated in **Appendix G**. • In particular, the project team has observed that the Haszard Pt Lighthouse is immediately vulnerable, and the community should take steps to reduce vulnerability of this piece of infrastructure, which could become a health and safety hazard if the base becomes unstable.
Emergency Services	Emergency Services is currently considering a new location for the Police Station. In addition, the community has developed emergency response plan. The Coastal *Impacts of Cliamte Change and Sea-Level Rise on Prince Edward Island* identifies that the causeway and road that provide access to the hospital facilities could be	• Work with emergency services to ensure the Emergency Response Plan has adequately considered the long-term implications of potential climate change. • The emergency response plan should give careful consideration to the vulnerability of key emergency services, such as the Queen Elizabeth Hospital,

	affected in the event of storm surge flooding.	and work with the City of Charlottetown and the Province of Prince Edward Island to address any concerns.
OVERALL SYSTEM/ COMMUNITY OF STRATFORD	Each of these different climate change scenarios point us towards elements of the hydrologic cycle. From changes in ice cover resulting in sea level rise, to changes in freeze thaw cycles resulting in increased erosion, to changes in precipitation events changing the flow and retention of water on the surface, and changes to the composition and storage of groundwater, all impacts relate closely to one another and are part of an overall cycle. Further, these changes can cause cumulative effects, for example, changes in sea level rise resulting in more flooding from storm surge, could also be exacerbated by a higher rate of coastal erosion.	• Gain a deeper understanding of how changes in the hydrologic cycle are influenced by land use and management of infrastructure and municipal services. The Municipality should consider changing the frame of reference from land management, to a broader perspective that considers environmental and ecological analysis as a basis for decision-making. One of the key available planning tools that can assist in developing this understanding is integrated watershed management planning. • The Town should work closely with the Stratford Area Watershed Improvement Group to consider how watershed management tools and concepts might play a larger role in land management, including municipal planning and engineering.

8.2 Developing a Climate Change Adaptation Framework

Research involving climate change science and projections is changing regularly, and adaptation strategies must also recognize that our understanding and awareness of climate change mitigation, adaptation and future climate is continually changing. Our knowledge of how municipalities might adapt must evolve in response to changes in this area of scientific research. It is important for climate change considerations to become a part of everyday decision-making, and for planning and municipal practitioners to stay connected to those government representatives, scientists and academics studying climate change, to stay abreast of the most recent knowledge.

In a municipality such as the Town of Stratford, that already perceives it is experiencing significant climate change impacts, it is easier for the community to understand and appreciate how more intense changes in climate might exacerbate existing conditions. Key initiatives already underway in the Municipality such as the relocation of the existing wastewater treatment facility, recommendations of the Stormwater Management Plan and activities of groups like the Stratford Area Watershed Improvement Group, show how critical climate

change scenario considerations are in long-term planning. In particular, it is important for the municipality to think of climate change implications when making strategic decisions involving key elements of the built environment, which typically involve significant investment with a 50 to 100 year lifespan.

To ensure that climate change adaptation is incorporated into daily decision-making, the Climate Change MAP should outline a framework for adaptation that emphasizes adjustments to existing tools and resources. It should also outline a clear plan for implementation and monitoring to ensure that new and emerging research is incorporated.

8.2.1 Changes to Municipal Policy in Support of Climate Change Adaptation

One of the first steps in improving existing tools is for the Municipality to update land use policies and the supporting regulatory framework to address climate change issues. Comprehensive policies should be designed that will include all affected departments of the Town. These policies should be added to the Town's Official Plan, which can direct the creation of more specific policies, regulations and standards in supporting and related bylaws, guidelines or similar process documents. **Table 8.2** outlines some simple policies that could be added to the Official Plan.

Table 8.2 Suggestions for Official Plan Policy	
General Climate Change Policies	*It is a policy of the Town of Stratford to recognize climate change as a legitimate concern.* *It is a policy of the Town of Stratford to be proactive in order to mitigate likely impacts of climate change.* *It is a policy of the Town of Stratford to monitor the progress of climate change impacts.*
Setbacks from Coastal and Low Lying Areas Policy	*It is a policy of the Town of Stratford to establish proper setback requirements in pertinent bylaws so that public and private infrastructure is out of harm's way, as climate change impacts affect coastal and low lying areas.*
Building and Maintenance of Sea Walls Policies	*It is a policy of the Town of Stratford to allow the construction of sea walls when vital community infrastructure it at risk.* *It is a policy of the Town of Stratford to allow for the maintenance of existing sea walls provided all pertinent bylaws and regulations are respected.*
Subdivision Policies	*It is a policy of the Town of Stratford to not approve subdivisions that could be negatively affected by climate change impacts.*
Storm Water Management Policies	*It is a policy of the Town of Stratford to recognize that present storm water standards needs to be revised to recognize the impacts that increased coastal erosion, coastal flooding and inland flooding will have on the Town's storm water management system.*
Sanitary Sewer Management Policies and Standards	*It is a policy of the Town of Stratford to recognize that present sewer management standards needs to be revised to recognize the impacts that increased coastal erosion, coastal flooding and inland flooding will have on the Town's sewer management system.*
Potable Water Supply Policies and	*It is a policy of the Town of Stratford to recognize that present water supply standards needs to be revised to recognize the impacts that increased coastal erosion, coastal*

Standards	*flooding and inland flooding will have on the Town's water supply management system.*
Emergency Measures Plan	*It is a policy of the Town of Stratford to recognize that the present Emergency Measures Plan needs to be revised to recognize the impacts that increased coastal erosion, coastal flooding and inland flooding will have on the Town's emergency measures.*
Street Design Policies and Standards for roads and bridges	*It is a policy of the Town of Stratford to recognize that present standards for the construction of roads and bridges needs to be revised to recognize the impacts that increased coastal erosion, coastal flooding and inland flooding will have on the Town's roads and bridges system.*
Climate Change Monitoring Program	*It is a policy of the Town of Stratford to monitor coastal erosion, changes in precipitation patterns and other climate change events.*
Public Education and Awareness Program	*It is a policy of the Town of Stratford to organize conferences & meetings, put out pamphlets and web sites on climate change related issues.*
Staff & Council Awareness & Training Program	*It is a policy of the Town of Stratford to send delegates to conferences on climate change. It is also the policy of the Town of Stratford, to invite climate change researchers and lecturers in the community.*

8.2.2 Climate Change MAP Implementation Schedule

This action plan is proposed to implement the identified priorities, taking into consideration present day Town of Stratford resources, policies and administrative by-laws.

8.3 Climate Change Municipal Adaptation Plan Implementation					
What		**Who**	**When**	**Where**	**Why**
Land Use Management	General Climate Change Policies	Stratford Planning & Development Department	2010	Stratford Official Plan	Recognize that climate change is real and that it will impact the Town of Stratford.
	Setbacks from Coastal and Low Lying Areas	Stratford Planning & Development Department	2010	Stratford Zoning Bylaw	Allow sufficient setback to allow the shores and wetlands to migrate inland as coastal erosion occurs.
	Building and Maintenance of Sea Walls	Stratford Planning & Development Department	2010	Stratford Zoning Bylaw	Allow sea walls only as temporary solutions in situations where vital community infrastructure are at risk.
	Revised Subdivision Standards	Stratford Planning & Development Department	2010	Stratford Subdivision Bylaw	Deeper lots are needed for developments near costal and wetlands area.
Storm Water Management	Policies and Standards	Stratford Public Works & Utility Department	2010	Revised Policies & Standards	Recognize that more frequent and more severe storms are likely to occur in the future and design storm water infrastructure accordingly.

Wastewater Management	Policies and Standards	Stratford Public Works & Utility Department	2010	Revised Policies & Standards	Redesign the sanitary sewer system taking into consideration a receding coast line and more inland flooding.
Potable Water Supply	Policies and Standards	Stratford Public Works & Utility Department	2010	Revised Policies & Standards	Redesign the water system taking into consideration a receding coast line and more inland flooding.
Emergency Measures	Plan	Chief Administrative Officer	2010	Revised Plan	Review the emergency measures plan with climate change scenarios in mind.
Street Design	Policies and Standards- roads and bridges	Stratford Public Works & Utility Department	2010	Revised Policies & Standards	Assure that streets have proper setback from areas where coastal erosion is likely to occur. Design culverts and bridges considering anticipated heavier volumes of rain and flash floods.
Strategic Planning	Sustainability Checklist	Chief Administrative Officer	2010	Revised Policies	Revise the Sustainability Checklist to include consideration of climate change impacts as part of evaluation tool.
Monitoring Program	Monitoring Program	Chief Administrative Officer	2010	New Program	Monitor coastal erosion, changes in precipitation patterns and other climate change events.
Public Education and Awareness	Community Awareness	Chief Administrative Officer	2010	New Program	Organize conferences & meetings, put out pamphlets and web sites on the subject.
	Staff and Council Training	Chief Administrative Officer	2010	New Program	Send delegates to conferences on the subject. Invite researchers and lecturers in the community.

Part 9: Conclusions

Present day impacts of climate change in Stratford Prince Edward Island are visible and real to the community. Town of Stratford infrastructure is vulnerable to impacts of climate, and it is anticipated that this vulnerability will increase as climate change impacts become more pronounced.

The Climate Change Municipal Adaptation Plan aimed to integrate relevant climate change data, research and adaptation processes with community knowledge of climate change. Areas that may be under increased pressure in present and future climate scenarios have been identified. The risk classification process used narrows in on key infrastructure that is threatened by this future climate change. If no adaptation measures are taken, it is possible that the climate change impacts identified in the Municipal Adaptation Plan will result in undesirable or negative consequences for the community.

The Town of Stratford has the authority to develop and implement strategy, planning, policies, bylaws and standards that incorporate adaptation methods to minimize the impacts of climate change. Established vulnerabilities should be examined in further detail in order to minimize future damage to public and private properties, infrastructure and to minimize impacts to human health and safety. Further research should focus on establishing partnerships with key government and academic researchers, and should include developing methods to enhance the resilience and adaptive capacity of the community. The Town of Stratford should continue to act as a leader in the development of sustainable, forward thinking planning, in order to ensure proactive changes to community management, in the face of future climate change.

Part 10: References

[i] CHAPIN, F. Stuart, Jr., KAISER, Edward J., *Urban Land Use Planning*, University of Illinois Press, third Edition, 1985, p. 354.

[ii] KELLY, Eric Damian, *Community Planning: An Introduction to the Comprehensive Plan*, Island Press, Washington, DC, 2009. 29-31.

[iii] Strategic Planning, http://managementhelp.org/plan_dec/str_plan/str_plan.htm

[iv] The Strategic Planning Process, http://www.netmba.com/strategy/process

[v] Canadian Climate Impacts and Adaptation Research Network, Adapting to Climate Change, and Introduction for Canadian Municipalities, 2006 http://www.c-ciarn.ca/pdf/adaptations_e.pdf

[vi] Treasury Board of Canada, Integrated Risk Management Framework, http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=12254

[vii] Transport Canada, Risk Management, Type 2A (Short Process) (TP 13905), http://www.tc.gc.ca/civilaviation/systemsafety/pubs/tp13905/menu.htm

[viii] Natural Resources Canada, From Impacts to Adaptation: Canada in a Changing Climate 2007, http://adaptation.nrcan.gc.ca/assess/2007/index_e.php

[ix] Similar to sustainable development, smart gowth is more about principles than process. http://www.sgog.bc.ca

[x] Adapting to Climate Change, An Introduction for Canadian Municipalities, Canadian Climate Impacts and Adaptation Research Network, February 2006 and Lemmen, D.S., Warrend, F.J. and Lacrois, J. (2008):From Impacts to Adaptation: Canada in a Changing Climate 2007 Synthesis Report, Government of Canada

[xi] Ibid.

xii Ibid.

xiii VASSEUR, Liette, CATTO, Norman, From Impacts to Adaptation: Canada in a Changing Climate, Atlantic Region, Chapter 4, National Resources Canada, 2007, p. 119-170. http://adaptation.nrcan.gc.ca/assess/2007/index_e.php

[xiv] McCULLOCH, Martha, FORBES, Donald L., SHAW, Roderick W., Coastal Impact of Climate Changes and Sea-Level Rise in Prince Edward Island, Executive Summary, Geological Survey of Canada, 2002, 28 p. adaptation.nrcan.gc.ca/projdb/pdf/56b_e.pdf

xv O'CARROLL, S. 2010. Coastal Erosion and Shoreline Classification Project, Town of Stratford (PEI). Final Report submitted to the Town of Stratford, Prince Edward Island, by Géo Littoral Consultants: 90 p. + CD-ROM (containing raw data and shapefiles).

[xvi] Results of SWOT Analysis, Stratford PEI, Provincial Climate Change Committee, Public meetings (2010)

Appendix A

CANADIAN INSTITUTE OF PLANNERS | INSTITUT CANADIEN DES URBANISTES

Shaping our Communities Sustaining Canada's Future | *Bâtir nos communautés Pour un Canada viable*

MAINSTREAMING CLIMATE CHANGE TOOLS FOR THE PROFESSIONAL PLANNING COMMUNITY

A CIP Project Funded by Natural Resources Canada,
Climate Change Impacts and Adaptation Program
March 2009 – March 2011

BACKGROUND:

Scientific research and analysis suggest that all Canadian communities will need, in various ways, to adjust to the effects of climate change and incorporate new and innovative policies and tools into their day-to-day decision-making. Natural Resources Canada (NRCan), through its programs and activities, has conducted extensive research on climate change impacts and is developing tools to assist communities in adapting to climate change by collaborating with a number of professional organizations across Canada.

The Canadian Institute of Planners (CIP), in collaboration with Natural Resources Canada's Climate Change Impacts and Adaptation Program, is endeavouring to make this and other scientific research and information on climate change impacts and adaptation a major consideration in planning practice across Canada. In 2007 NRCan and CIP successfully collaborated in Phase I of this groundbreaking project and produced, among other things, a policy position for Canadian planners on climate change adaptation as well as a draft two-day module for continuous professional learning . All of the Phase I work was showcased at a multi-disciplinary symposium on the science and planning of climate change in Iqaluit, Nunavut, in July 2008.

PHASE II COLLABORATION:

The goal of the next phase of the project is to continue to build awareness and expertise on climate change within the Canadian planning profession and develop tools and resources that will assist planners in their day-to-day work. Phase II has the following components:

- Completion of the roll-out of CIP's national policy framework for climate change adaptation for use by planners across Canada[1];

[1] CIP Climate Change Policy is available on the CIP website (www.cip-icu.ca)

- An assessment of existing planning tools and benchmarking and monitoring of planners' knowledge of climate change through surveys and focus groups across the country;
- Development of a "Model" Standard of Practice that can be adapted for use by CIP Affiliates;
- Climate Change planning case studies that may be helpful to the profession;
- Development and testing for three learning modules: a 2-hour primer on climate change adaptation planning, to be tested at all Affiliate conferences, for future use by Affiliates; a 2-Day climate change adaptation planning seminar to be refined at a workshop with Affiliate representatives and through a "Train-the-Trainers" workshop; and two to four lecture modules for inclusion in introductory planning courses in Canadian planning programs. Phase II of the project also has resources to begin converting various learning modules to a web format;
- Development of climate change adaptation plans in four communities in Atlantic Canada, working collaboratively with the Atlantic Planners Institute (API); based on this work, as well as adaptation plans completed in several Nunavut communities, a Rural Workbook will be created for use by communities elsewhere in Canada;
- Organizing an international climate change conference in Montreal, October 2-5, 2010 at which the NRCan/CIP partnership and other Canadian achievements will be showcased, as well as those of other scientific and planning organizations from across Canada and around the world[2].

NRCan and CIP are in a unique position and are natural partners to assist Canadian communities with adaptation to climate change. NRCan possesses and continues to amass a wealth of valuable information that provides the scientific foundation.

Working with CIP, NRCan can transfer this information to professional planners across Canada, who are directly involved in decision-making and advising politicians at the community level. In the process, CIP will engage its members directly, as well as work with the seven provincial/regional Affiliates, the Association of Canadian University Planning Programs (ACUPP), and the Canadian Association of Planning Students (CAPS). Nor does it end there. CIP's outreach will include a wide and growing list of national and international stakeholders, including other members of the Global Planners Network.

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[2] For information on the Conference visit: http://www.planningforclimatechange.ca/

Appendix B

Main Movements / Models / Tools / Buzzwords in Planning
Principaux mouvements / modèles / outils en urbanisme

HISTORY / HISTOIRE

Définition - Urban Planning / Urbanisme -
http://en.wikipedia.org/wiki/Urban_planning
http://fr.wikipedia.org/wiki/Urbanisme

History of City Planning -
http://www.lib.berkeley.edu/ENVI/histplan.html

1893 - City Beautiful Movement – Chicago, Frederic Law Olmstead, Daniel Burnham, ...
http://xroads.virginia.edu/~cap/CITYBEAUTIFUL/city.html

1898 - Garden City Concept (villes nouvelles) -Angleterre, Ebenezer Howard
http://www.library.cornell.edu/Reps/DOCS/howard.htm

1911 - Société Française des Urbanistes -
http://www.urbanistes.com/page-4.html

1914 - Thomas Adams, Adviser, Canada Commission of Conservation / Commission canadienne de la conservation
www.cip-icu.ca/_CMS/Files/ThomasAdams_75article.pdf
http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=f1ARTF0000039

1933 – Charte d'Athènes -
http://fr.wikipedia.org/wiki/Charte_d%27Ath%C3%A8nes

STRATEGIC PLANNING / PLANIFICATION STRATÉGIQUE

Strategic Planning (in nonprofit or for-profit organizations) -
http://www.mapnp.org/library/plan_dec/str_plan/str_plan.htm

Strategic Planning Models -
http://www.managementhelp.org/plan_dec/str_plan/models.htm

La planification stratrégique – est-ce pour vous? http://www.omafra.gov.on.ca/french/rural/facts/93-042.htm

Virtual Planning Inc. Model / Le modèle de Planification virtuelle Inc. -

http://www.virtualplanning.ca/english/home/index.cfm?id=6
http://www.virtualplanning.ca/Francais/home/index.cfm?id=6

COST BENEFIT ANALYSIS / L'ANALYSE COÛT-BÉNÉFICE

The Tools / Outils –
http://www.mindtools.com/pages/article/newTED_08.htm
http://fr.solutionmatrix.com/analyse-cout-benefice.html

The National Council for Science and the Environment -
http://www.ncseonline.org/NLE/CRSreports/Risk/rsk-4.cfm?&CFID=9002318&CFTOKEN=91088194

Environmental Economics -
http://www.env-econ.net/2005/07/costbenefit_ana.html

TOTAL QUALITY MANAGEMENT / QUALITÉ TOTALE (Certification ISO)

Tools / Outils –
http://managementhelp.org/quality/tqm/tqm.htp
http://www.manager-go.com/qualite-totale.htm

La qualité aujourd'hui (France) -
http://perso.wanadoo.fr/chris.giron/qualit1.htm

Total Quality Management Web Resources (ISO 9000) -
http://www.gslis.utexas.edu/~rpollock/tqm.html#tools

ADVOCACY PLANNING / URBANISME ENGAGÉ

Pratt Institute Center for Community Development -
http://www.picced.org/

Citizen's Housing and Planning Council -
http://www.chpcny.org/

National Trust for Historic Preservation -
http://www.preservationnation.org/

Sprawl -

http://www.sierraclub.org/sprawl/factsheet.asp

Society Created to Reduce Urban Blight (SCRUB) -
http://publicvoiceforpublicspace.org/

Americans Against Traffic Calming -
www.motorists.org/trafficcalm/

SUSTAINABLE PLANNING / DÉVELOPPEMENT DURABLE

Sustainable Development Timeline -
http://iisd1.iisd.ca/timeline/

Introduction au développement durable (SDGateway) -
http://sdgateway.net/introsd/fr_default.htm

HEALTHY COMMUNUTIES / COMMUNAUTÉS EN SANTÉ

Healthy Cities - Healthy Communities (Joe Flower) -
http://www.well.com/user/bbear/healthy_communities.html

Healthy Communities Programs (National Civic League) -
http://www.ncl.org/cs/services/healthycommunities.html

Ontario Healthy Communities Coalition –
http://www.healthycommunities.on.ca/

Réseau québécois de Villes et Villages en santé -
http://www.rqvvs.qc.ca/

Mouvement acadien des communautés en santé -
http://www.macsnb.ca/

GROWTH MANAGEMENT / GESTION DE LA CROISSANCE

Growth Management -
http://en.wikipedia.org/wiki/Growth_management

Growth Management Toolbox -
www.mass.gov/dcr/.../growthmanagementtools.pdf

SMART GROWTH / DÉVELOPPEMENT INTELLIGENT (Croissance réfléchie)

Smart Growth Network -
http://www.smartgrowth.org/

Smart Growth America -
http://www.smartgrowthamerica.org/

North Carolina Smart Growth Alliance -
http://www.ncsmartgrowth.org/

Smart Growth Canada / Réseau Canadien du Développement Intelligent
–
http://www.smartgrowth.ca/home_e.html
http://www.smartgrowth.ca/home_f.html

Smart Growth British Columbia -
http://www.smartgrowth.bc.ca/

INTELLIGENT COMMUNITIES / VILLES INTELLIGENTES

http://www.intelligentcommunity.org/
www.acturban.org/biennial/DOC_planners/intelligentCities.pdf
http://www.culturemobile.net/innovations/c-est-pour-demain/dossier-smart-city-villes-intelligentes-01.html

RISK MANAGEMENT / GESTION DES RISQUES

http://www.ibc.ca/en/Business_Insurance/Risk_Management/
http://fr.wikipedia.org/wiki/Gestion_du_risque
http://www.tbs-sct.gc.ca/pubs_pol/dcgpubs/RiskManagement/rmf-cgr_e.asp
http://www.promosciences.com/seminaire-risques-urbains/charte1.html

GOVERNANCE BY POLICY / GOUVERNANCE PAR POLITIQUES (Carver)

http://www.carvergovernance.com/

Iowa City School Board -
http://www.uiowa.edu/~cyberlaw/governance/

URBAN DESIGN / DESIGN URBAIN

Resources for Urban Design Information (RUDI)
http://www.rudi.net/

Urban Desighn Portal –
http://www.weburbandesign.com/pages/bluerings_index.html

Ahwahnee Principles -
http://www.lgc.org/ahwahnee/

NEW URBANISM / NOUVEL URBANISME

Congress for the New Urbanism -
http://www.cnu.org/

Principes du nouvel urbanisme -
http://www.cnu.org/node/693

Disney's Celebration, Florida -
http://www.americansc.org.uk/Online/Celebration.htm

LIVABLE COMMUNITIES / COMMUNAUTÉS VIVABLES

Partners for Livable Communities -
http://www.livable.com/

Planning Livable Communities -
http://www.pedestrianfriendly.com/

CREATIVE COMMUNITIES / COMMUNAUTÉS CRÉATRICES

Creative Class- Richard Florida
http://www.washingtonmonthly.com/features/2001/0205.florida.html

Creative City Network of Canada / Réseau des villes créatrices du Canada -
http://www.creativecity.ca/

Canada - Vancouver
http://www.creativecommunities.ca/

USA -
http://www.creativecommunitiesonline.org/

CLIMATE CHANGE ADAPTATION / S'ADAPTER AUX CHANGEMENTS CLIMATIQUES

Natural Resources Canada / Ressources naturelles Canada -
http://adaptation.nrcan.gc.ca/

Plan d'adaptation aux changements climatiques – Québec
www.eauquebec.com/programmes/climat-municipalites/Plan-adaptation.pdf

Climate Smart Halifax HRM
http://www.halifax.ca/Climate/

Municipal Adaptation Plan (MAP) - Cape Town, South Africa
http://eau.sagepub.com/cgi/content/abstract/19/1/143

PLANNING ASSOCIATIONS / URBANISME PROFESSIONNEL

Canadian Institute of Planners / Institut canadien des urbanistes -
http://www.cip-icu.ca/

Atlantic Planners Institute / Institut des urbanistes de l'Atlantique -
http://www.atlanticplanners.org/

American Planning Association -
http://www.planning.org/

l'Ordre des urbanistes du Québec -
http://www.ouq.qc.ca/

Association des aménagistes régionaux du Québec -
http://aarq.qc.ca/

Intergovernmental Committee on Urban and Regional Research (ICURR).
Le Comité intergouvernemental de recherches urbaines et régionales (CIRUR)
http://www.icurr.org/

Cyburbia, the Urban Planning Portal -
http://www.cyburbia.org/

la Société Française des Urbanistes -
http://www.urbanistes.com/

Planning Commissioners Journal -
http://pcj.typepad.com/

New Zealand Planning Institute
http://www.nzplanning.co.nz/

Planning Institute of Australia
http://www.planning.org.au/

PLEASE NOTE - Web site addresses are subject to change.
VEUILLEZ NOTER - Les addresses web peuvent changer.

Appendix C

Participants
Public Meeting March 15, 2010
Stratford Climate Change Adaptation Plan

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9	Erin Taylor	taylorer@maritimeelectric.com	629-3822
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14	Catherine Miller	catherine@eramosa.pe.ca	628-8544
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17	Kelley Arnold	stratfordwater@gmail.com	367-3605 (w)
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21	Irené Novaczek	inovaczek@upei.ca	566-0386
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25	Norman Dewar	ndewar@gmail.com	569-9115
26	Jeff Karn	jkarn@hotmail.com	626-7141
27	Wally Walsh	15 Wal-Dale Est Charlottetown RR 5	569-5491
28	Malcolm Mac ???		569-2678

29	Phil Wood	phil@peisland.com	368-1942

- Some names and numbers were difficult to read and could have been misread.

Armand G. Robichaud
Virtiual Planning Inc.

Town of Stratford Climate Change MAP (Municipal Adaptation Plan)
SUMMARY STRATEGIC STATEMENT

VISION: Stratford is prepared and protected for climate change impacts.

Strengths:

- Increasing population and tax base
- Higher education level and revenue
- Visionary, caring and green community
- Good management and planning
- Relatively new infrastructure and amenities
- Watershed Management Plan
- Close proximity to provincial capital
- Sustainable reputation
-

Weaknesses:

- Vulnerable, surrounded by water on three sides
- Lack of data and expertise
- Limited municipal resources
- Supply of drinking water close to capacity
- Pro development
- Resistance to change
-

Opportunities:

- Collaborative and proactive planning
- Improved codes and procedures
- Attract climate change adapted development
- Enhanced reputation – model or pilot project
- Room for sustainable development
- Educate public
-

Threats:

- Climate change impacts
- Increasing insurance rates & more difficult claim approval
- Being too restrictive on future development
- Difficulty in engaging other partners
- Changing government policies and priorities

- Extra cost of sustainable development
- Being cut off from regional and provincial services in Charlottetown (Hillsborough Bridge)

Issues:

- Storm water management system overflow (inland flooding)
- Coastal soil erosion
- Salt-water intrusion in groundwater
- Protect coastal properties from sea level rise and tidal surges
- Protect infrastructure from sea level rise and tidal surges
- Training for Council & staff
- Inadequate procedures and codes
- Changes in wildlife habitats (foxes)
- Public awareness, participation
- Bridge access to Charlottetown (hospital, …)

Strategies :

- Dedicate municipal resources to Climate Change MAP (Municipal Adaptation Plan)
- Emergency Measures Plan
- Council and staff awareness and training
- Public education program
- Review municipal procedures and codes
- Creation of collection ponds to absorb sediments
- Increased trees and shrubs planting

Summary of SWOT Questionnaire prepared by:
Armand G. ROBICHAUD, MCIP
Kate GREENE, MCIP
December 9, 2010

SWOT Analysis – Provincial Climate Change Working Group
Meeting of January 19, 2010

Stratford, Prince Edward Island
Climate Change Adaptation - Canadian Institute of Planners Project

VISION

- A community that has sustainable civil infrastructure (including sustainable funding) and whose future growth is not construed by adverse implications of climate change.
- In 20 years, if current growth trends continue, Stratford is going to continue to experience population growth. In an environment that is going to be characterized by climate changes, there will be added pressure that the community is going to experience. Climate change impacts that Stratford will face: risk to groundwater, risks to sewage facilities, property infrastructure damages to private and public areas. Hillsborough Bridge? What would happen if Hillsborough Bridge was put out of use for a significant time period?
- A community prepared and protected from climate change impacts for public safety and security of infrastructure.
- A vibrant and progressive municipality within central PEI that has developed resilience and adaptive capabilities with respect to the planet's changing climate and natural hazards.
- Voters act to change policy for a more adaptable (and hopefully sustainable) Stratford.
- To be able to adapt to the various threats from climate change.
-

Strengths:

- Generally well educated public and progressive administration.
- Public infrastructure somewhat new – not fully developed – time to adapt without re-designing too much.
- Progressive council.
- Adequate resources (financial and human) to tackle the issues.
- Likely many of the community members are quite knowledgeable.
- Young community with no heritage or limited heritage buildings along shoreline making changes in infrastructure easier.
- Appears to be a high degree of interest in being "green" but also being proactive with challenges they may face.
- Strength in community leadership level, mayor and council have publicly displayed their desire to create a green community.
- More funding available due to the popularity of this issue right now.
- Public appetite for change.
- Professional staff – planners, engineers, etc. who know the town and have developed significant corporate history that is passed to new staff (with respect to climate change).
- Educated and informed citizens who understand climate change.

- Infrastructure that has the ability to withstand impacts.
- Only community in PEI with clear population growth.
- Close proximity to Charlottetown may offer some partnership abilities.
- Strong community involvement over changes/impacts to the community.
- Vibrant, growing community.
- Several attractive amenities i.e. new town hall / recreation facilities.
- Close to schools shopping centers, employment.
-

Weaknesses:

- From an outsider's perspective –has had more interest in rapid development than supporting infrastructure.
- In close proximity / competition with Charlottetown.
- If Stratford implements land use restriction and Charlottetown does not, development may be redirected elsewhere.
- Financial resources.
- What are the appropriate actions to take, not knowing exactly what will be the climate change outcome.
- Technical expertise.
- Need for support for council /government (both local / provincial) to make decisions (perhaps taxation or public policy related).
- Lack of data / expertise.
- Lack of knowledge, proven examples, to learn from / follow / feed off of.
- Rollover amongst municipal staff.
- Elections cycle brings challenges in educating leadership to climate change.
- Exposure of citizens and municipality to energy prices.
- Restricted in size.
- Any further development may come at the expense of green space, agricultural land, etc. that may increase the impacts of climate change.
- Some scattered development.
- Requires extensive infrastructure build out to service all residents.
- Require investment (provincial) for schools and other infrastructure.
-

Opportunities:

- Being progressive and showing organizations and businesses that the community is concerned about their safety and investment could be a selling feature.
- Relating to wastewater, regional approach to wastewater treatment.
- Review storm water design in light of other RAC design.
- Funding opportunity through RAC.
- UPEI is looking at doing adaptation studies.
- Partnership of NGO's and other levels of government.

- Education through local information dissemination using council, chamber (business), schools.
- Tap into available expertise and bring to local level.
- Green leadership.
- Residents who feel secure, less crime, …
- Building codes that reflects threats could lead to lower emergency costs.
- To be a model community in terms of sustainable development.
-

Threats:

- Impacts of evolving regulatory regime with respect to wastewater effluent management – see CCME Municipal Waste Water Effluent Strategy (MWWE).
- I am not aware of Stratford's municipal boundaries, but need to take into consideration areas (unincorporated) outside municipal boundaries.
- Climate change.
- Community resisting actions or changes.
- Changing climate – weather/storm events – the very issues we are trying to have addressed.
- Changing policies.
- Changing priorities (i.e. competition with Health/Education).
- Energy prices.
- Groundwater supply.
- Disaster claims increasingly difficult to get approved.
- Sky rocketing insurance rates for property.
- Restrictive policies or covenants may cause developers to seek other communities.
- Increase to tax rate will often dictate public perception. Good ideas often look bad if they cost too much.
- Flooding from tidal surges.
- Groundwater issues, including salt-water intrusions.

ISSUES:

- Managing storm water and effect of extreme events on sanitary sewer overflow/discharges.
- Subdivision planning in coastal sections, with respect to erosion rates, especially for lot sizes, servicing options (i.e. central versus on-site water supply) and setback distances.
- Public uptake, participation.
- Adaptability on a community/municipal level and sustainability on a global level are interdependent. One cannot be considered and adequately addressed without consideration toward the other.

STRATEGIES:

- Simply support development broader coastal issues and inland water issues.

- Investigate regional water and wastewater collaborative issues with Charlottetown and Cornwall.
- Education.
- Awareness.
- Strategy for engaging the community.
- Impactful and informational pamphlets on climate change (or data sheet or any other form of informal education).
- Increase the scientific literacy of Stratford residents so they understand the issues at hand through presentations to the community or even workshops.
- Empowerment - Citizens are the defacto policy makers in a democratic society. It is important for a community to be educated that they can make an impact and take personal responsibility. Show them success stories (take AerØ, Denmark for example) etc.

Compiled by:
Armand G. Robichaud, MCIP
Virtual Planning Inc.

SWOT Analysis - Members of Council and Staff

Stratford, Prince Edward Island
Climate Change Adaptation Project

Vision:

Stratford will be a resilient community that has developed and implemented a plan to mitigate the potential negative consequences of climate change in the short term, that has taken action to lessen our contribution to climate change in the medium to long term and that has taken advantage of the opportunities presented by the new economy that is driven by climate change.

To be prepared for climate change and proactive in the planning process and development approvals to ensure a safe, healthy and vibrant community.

Strengths:
1. Stratford has a long term vision of a more sustainable future.
2. Stratford is a growing community with growing resources and an increasing ability to inspire change within and beyond its' borders.
3. Stratford has a visionary Council and well qualified staff.
4. Size …. We are small enough to be able to quickly respond and adapt.
5.Visionary … we are not afraid to be out in front.
6. Reputation … we have a sustainable reputation …. Let's capitalize on it!
7. Educated & caring community that wishes to reduce carbon footprint – i.e. transit, sustainability initiatives.
8. Establishment of watershed management plan.
9. Need to continue with more trees and shrubs planting to improve flora and fauna and help with extreme sun exposure.

Weaknesses:
1. Stratford is surrounded on three sides by water and is therefore vulnerable to coastal erosion, sea level rise and inland flooding.
2. Stratford is a small organization with limited staff resources.
3. Stratford's waterfront property that is most vulnerable to the effect of climate change is also the most valuable and is largely developed.
4.Change is difficult! We must be unified in our commitment.
5.The field of knowledge may not exist in-house to adequately deal with issues .... it is a relatively new science, and rather specialized!
6. Coastal erosion will increase if no action is taken.

7. Supply of quality drinking water may be close to capacity due to rapid development.

Opportunities:
1. Stratford can reduce the potential impact of climate change on residents, businesses and property owners through collaborative and proactive planning.
2. Stratford can enhance its' reputation as a forward thinking, sustainable community in leading by example on climate adaptation, potentially attracting economic development to the Town
3. Stratford can assist other communities in mitigating the impact of climate change by being a pilot community for this project and by being willing to share what we have learned.
4.There is an opportunity to be on the forefront of planning for climate change and capture those developers and prospective residents who are very interested/committed.
5.We have a large amount of undeveloped land … opportunity!
6. Creation of collection ponds to absorb sediment so that streams and ponds will thrive & provide enjoyment for residents & flora & flora.
7. Increase tree planting in streams, buffer zones, parks and costal regions.
8. Update stormwater and buffer zone regulations & better enforcement of these regulations.

Threats:
1. The availability of information, or lack thereof, about the impact of climate on Stratford may result in a less than adequate climate adaptation plan
2. The ability to engage residents to develop and implement the plan with them, particularly property owners of vulnerable waterfront land, who may not want to face the issue.
3. The ability to engage other partners, particularly the agencies of the Province, who are stretched from a fiscal and staffing perspective.
4.Some developers may not be open to long-term planning ..... focused on short term profits.
5.Extra costs for developing with climate change in mind ... may deter some developers/ landowners.
6. Extremes in weather have resulted in Pondside overflowing and show that infrastructure need to be updated and maintained.
7. Changes in birds & wildlife with coyotes pushing foxes in residential areas.
8. Water levels will continue to rise and we need to ?? CO^2 into atmosphere so that we might reduce severity of weather effects – immediate need for stream enhancement & tree planting of native Acadian species.

Issues:
1. The potential impact of climate change on the coastline from coastal erosion.
2. The potential impact of climate change on existing properties and future development from sea level rise and storm surges.
3. The potential impact of climate change on municipal and provincial infrastructure from sea level rise and storm surges.
4. The potential impact of climate change on private, municipal and provincial infrastructure from the increased frequency and intensity of storm events.
5. The potential impact of climate change on infrastructure design using outdated design parameters.
6. How to deal with planning issues (sea level, stormwater, vegetation, etc).

Strategies:
1. I think it best to first hear from everyone and then develop strategies together.
2. Participate in as many forums as possible to gain knowledge.
3. Be proactive in raising residents' knowledge levels.
4. Encourage staff to learn and stay abreast of issues.
5. Ensure Development Bylaw is as relevant as possible thru constant review/revision.

STRATFORD CLIMATE CHANGE ADAPTATION PLAN

If predictions are correct and temperatures become milder resulting in increased sea levels and more storms and more severe storms then establishing a plan for these events would lessen the impact on Stratford residents.

The current study should therefore focus on the impact of climate change on a number of areas including:

SOIL EROSION: What areas of the Town would be impacted by soil erosion due to higher water levels and increased storm activity? What if anything can be done to mitigate the damage? What changes to Town bylaws are required if any? Particular emphasis should be given to setbacks from coastal water banks with particular attention to low land areas.

STORM WATER MANAGEMENT: Are the present storm water management systems adequate to handle substantially increased amount of rain over short periods of time? If not what are the options?

SALT WATER INTRUSION INTO TOWN WELLS: Are any of the present wells operated by the Town at risk of salt water intrusion? If so, plans should be established to reduce or eliminate this risk.

TOWN SEWER AND WATER INFRASTRUCTURE: An analysis of present sewer and water infrastructure to determine what effect climate change would have. Identify options to rectify deficiencies and establish plans for future infrastructure projects. During the study to replace and/or modify the lagoon consideration should be given to the impact of climate change.

Stratford has many strengths when it comes to climate change. Being a relatively new community, planning, zoning and other community supported policies can be developed that would minimize the impact of climate change. A new set of guidelines can be developed in such a way that new housing in the area close to estuaries and shorelines can be eliminated.

One of the biggest weaknesses in our community I see is the universal plan to provide central sewer and water to all residents. This, I think, is a catastrophe waiting to happen. Global warming and the resulting tidal surges will cause salt water intrusion in some of the wells and it only takes one to become contaminated to contaminate the system. Many subdivisions that have larger lots, some of which have central sewer now, do not need a central water system. It would be much better to leave these individual residents on their own water systems so that at least some residents have water in the event of tidal surges causing salt water intrusion. The development of central well fields and a

central water system should be limited to those areas below a certain contour line, particularly in the costal and estuary regions.

Planning for climate change should include an emergency plan in the event that access to central services i.e. Queen Elizabeth II Hospital, are protected. While the Hospital itself is probably at risk of being influenced by a major tidal surge, the town should have an emergency plan in place to be able to access the Hospital if a tidal surge prevents the use of the Hillsborough Bridge.

These are my initial thoughts on climate change as it may impact the Town of Stratford, if I have others before the 12th, I will send them in a separate email.

SWOT Analysis – Participants of March 15, 2010 Public Meeting
(8 of approximately 30 participants responded)

Stratford, Prince Edward Island
Climate Change Adaptation Project

Vision:
1. Community development approach to bringing policy, people, together with government, planners, etc. with a goal of managing climate changes.
2. To have a town with future vision for sustainable growth planning for the distant future.
3. I would like to see the town develop with a modern look at all the services and development with a close watch to the climate and environment, focusing on quality of life.
4. Reduced (?) developable land maps. Compromised wells. Access from and to town in jeopardy.
5. Plan controlled development with emphasis on water availability.

Strengths:
1. Interested concerned citizens.
2. Beginning development of climate control measures, ie bus, walking/biking routes.
3. A young community.
4. Has potential, if the will and foresight are there.
5. Space to grow.
6. Emerging town / city.
7. Space with many beautiful places.
8. Involved council.
9. We do have high areas – hilly terrains.
10. Watershed committee is in place.
11. Strong community interest in the problem, in many cases for selfish reasons (property values, water quality).
12. Very progressive Council.
13. Professional planning staff.

Weaknesses:
1. Need for more education of public regarding climate change and risks for land, water, roads, homes, people.
2. Giving up on what should be, in favor of revenue.
3. Pushing development too quickly.
4. Too many high density ideas.
5. Lack of financial resources.
6. Public buy in lags.
7. Too much pressure from developers.

8. A poorly informed public about the vulnerability of our water source.
9. Inertia, unwillingness to change.
10. OK to make smaller lots, denser settlement, but not in my subdivision.
11. Lack of understanding.

Opportunities:

1. Need for more planners / sustainable experts.
2. People are concerned as they begin to see negative effects on personal lands.
3. New growth with proper planning.
4. Young families to stay and grow in the town.
5. Capitalize on a test town and have company and government use as a model.
6. Young town / city.
7. Federal funding for planning initiatives such as this one.
8. Tree planting throughout the community helps in many ways.
9. Increase density of subdivisions, leave more green space.

Threats:

1. Planning without vision, example filling in ditches and piping away water, vs.
2. Over population, particularly in vulnerable areas. (Too dense population – example Stratford Road / Southport.)
3. Developers with $ in their mind and no thought for the future.
4. Coastal erosion.
5. Drinking water.

Issues:

1. Well water.
2. Access.
3. Planning issues related to buffer zones near watercourses.

Strategies:

1. Establish municipal wells in areas not expected to be impacted. – No private wells.
2. Storm water management that retains water as best as possible on site.

Armand G. Robichaud
Virtual Planning Inc.

Stratford Climate Change Adaptation Plan
VISION AND SWOT ANALYSIS

VISION: What will be the future of the Town of Stratford with predicted climate changes? How do you see the community adapting? Dare imagine what is possible with proper resources!

Vision:

Strengths (internal):

1.

2.

3.

Weaknesses (internal):

1.

2.

3.

Opportunities (external):

1.

2.

3.

Threats *(external):*

1.

2.

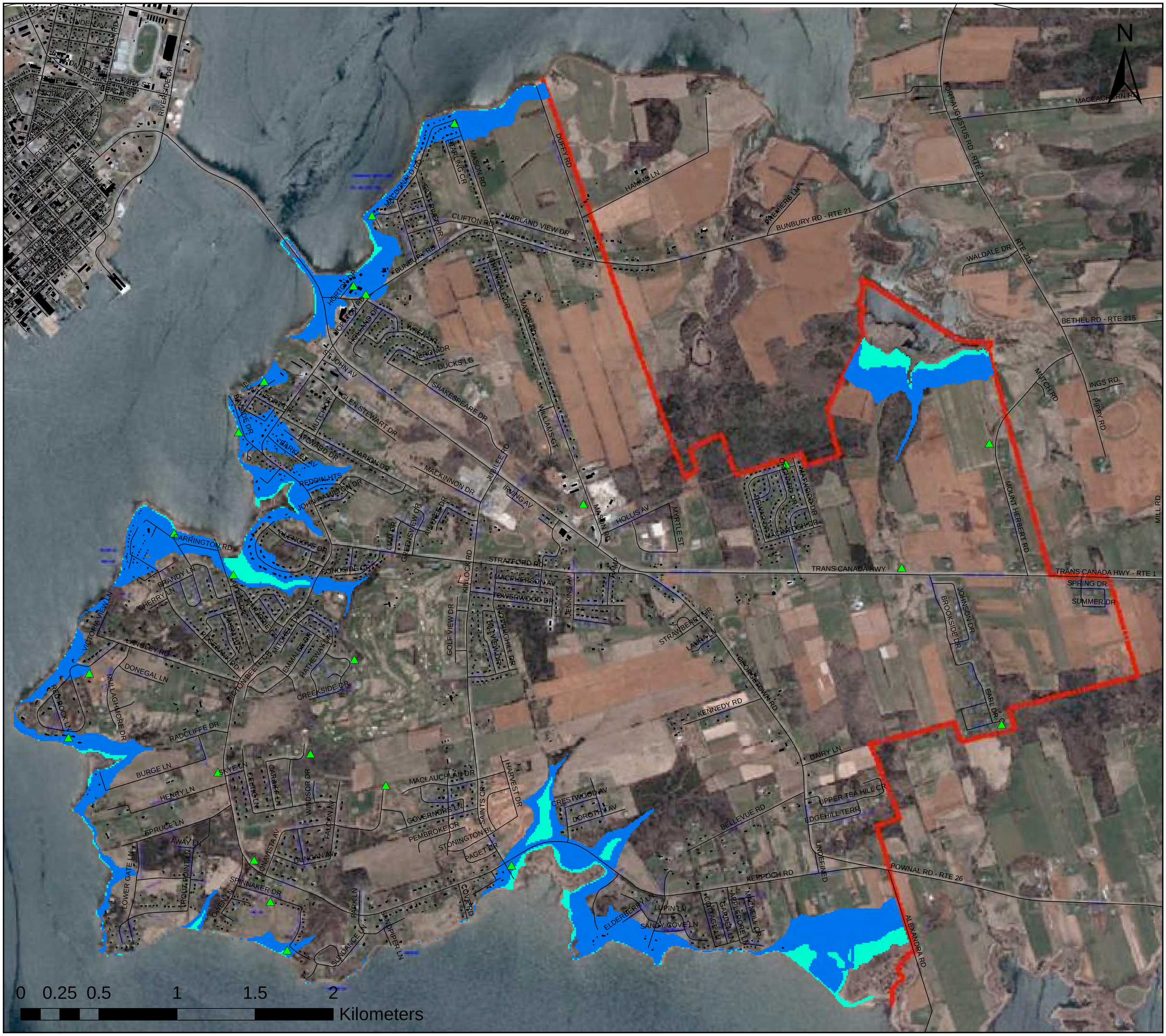
3.

ISSUES:

STRATEGIES:

Appendix D

Town of Stratford - 120 centimetre Sea Level Rise (High Emissions Scenario)



Stratford Municipal Boundary

Buildings

Roads

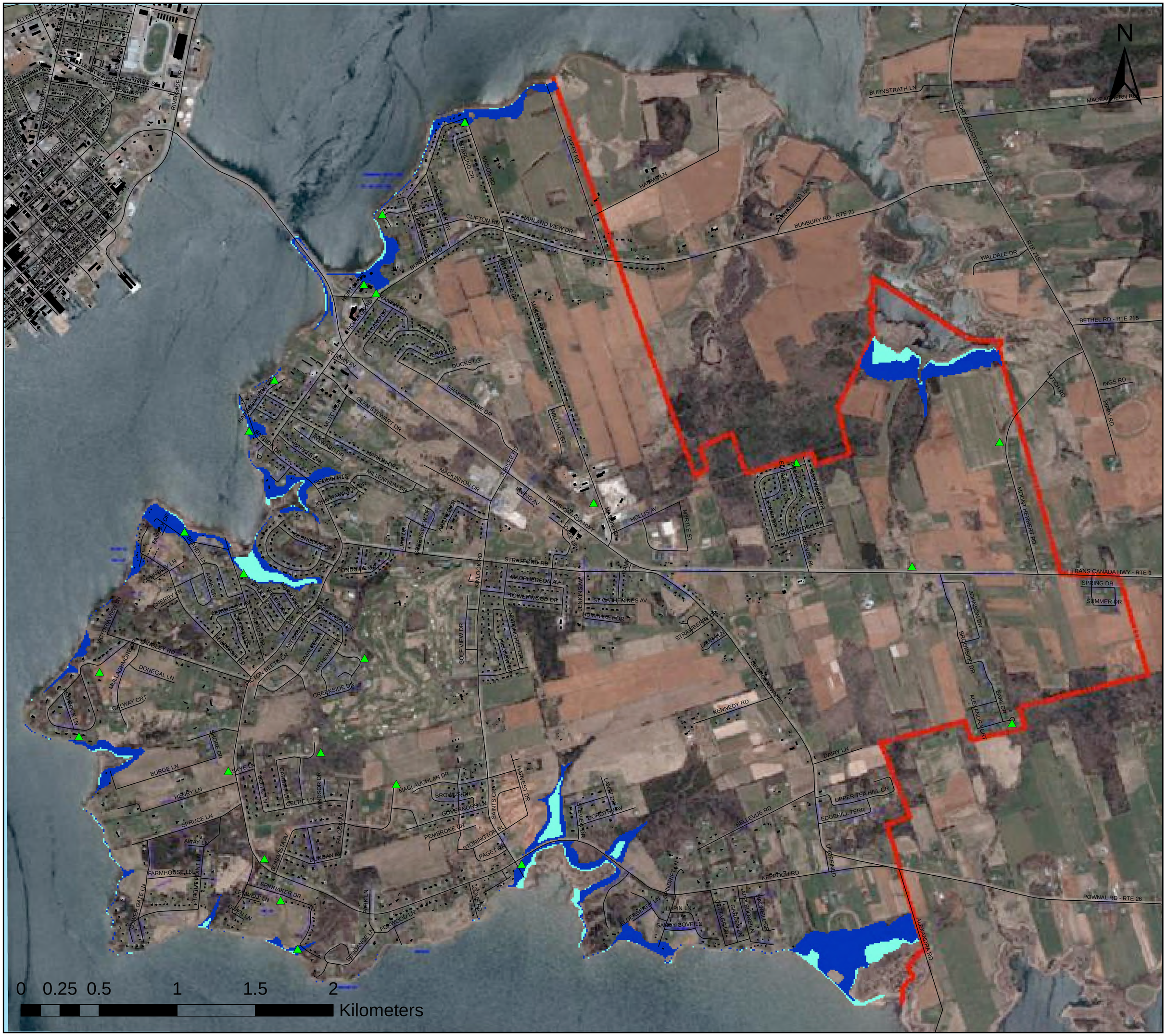
Municipal Stations

120 cm Sea Level Rise

+ 470 cm storm surge

Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

Town of Stratford - 90 centimetre Sea Level Rise (Current Emissions Scenario)



Stratford Municipal Boundary

Buildings

Roads

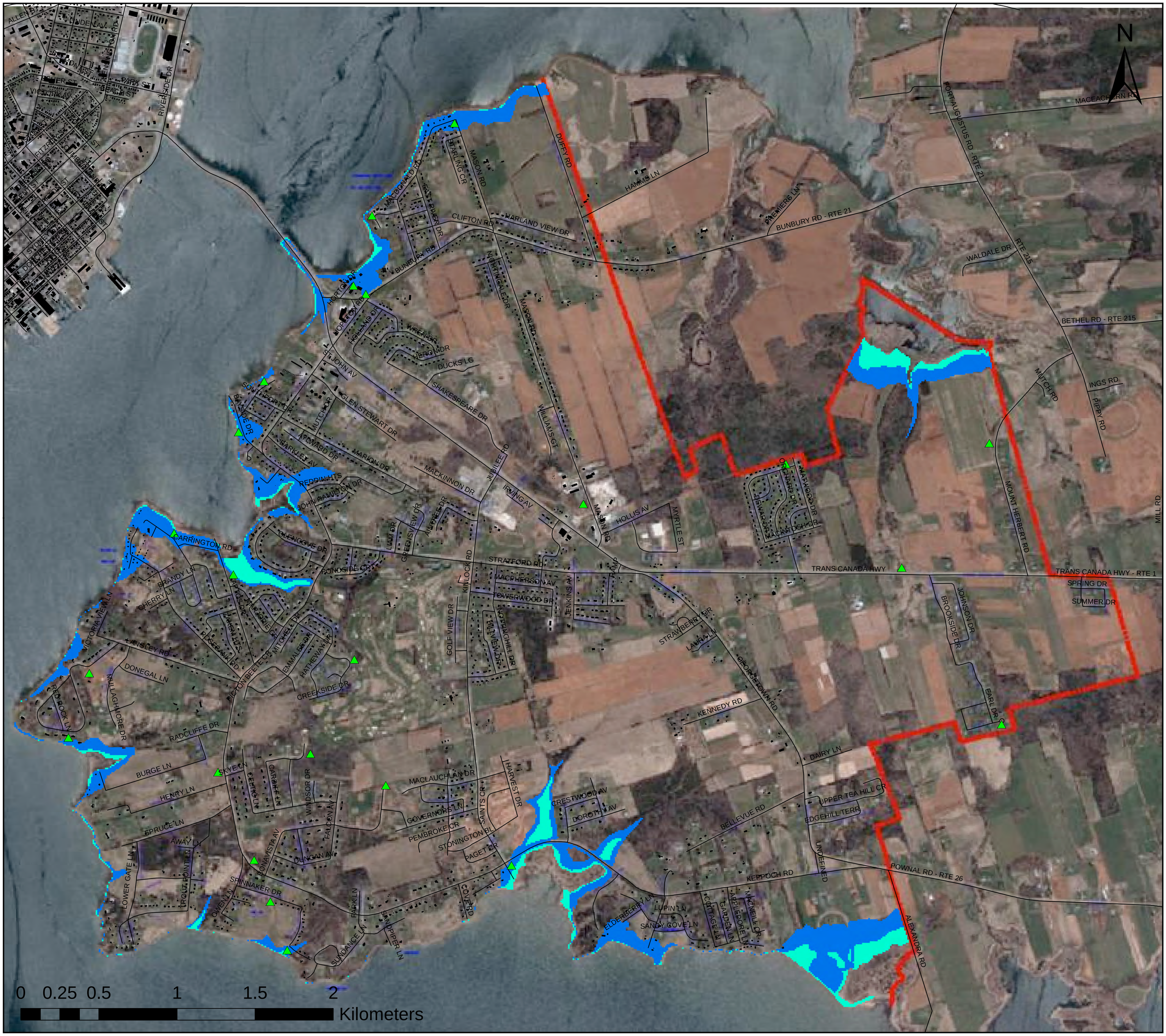
Municipal Stations

90 cm Sea Level Rise (Emission Scenario A2)

+ 255 cm Storm Surge

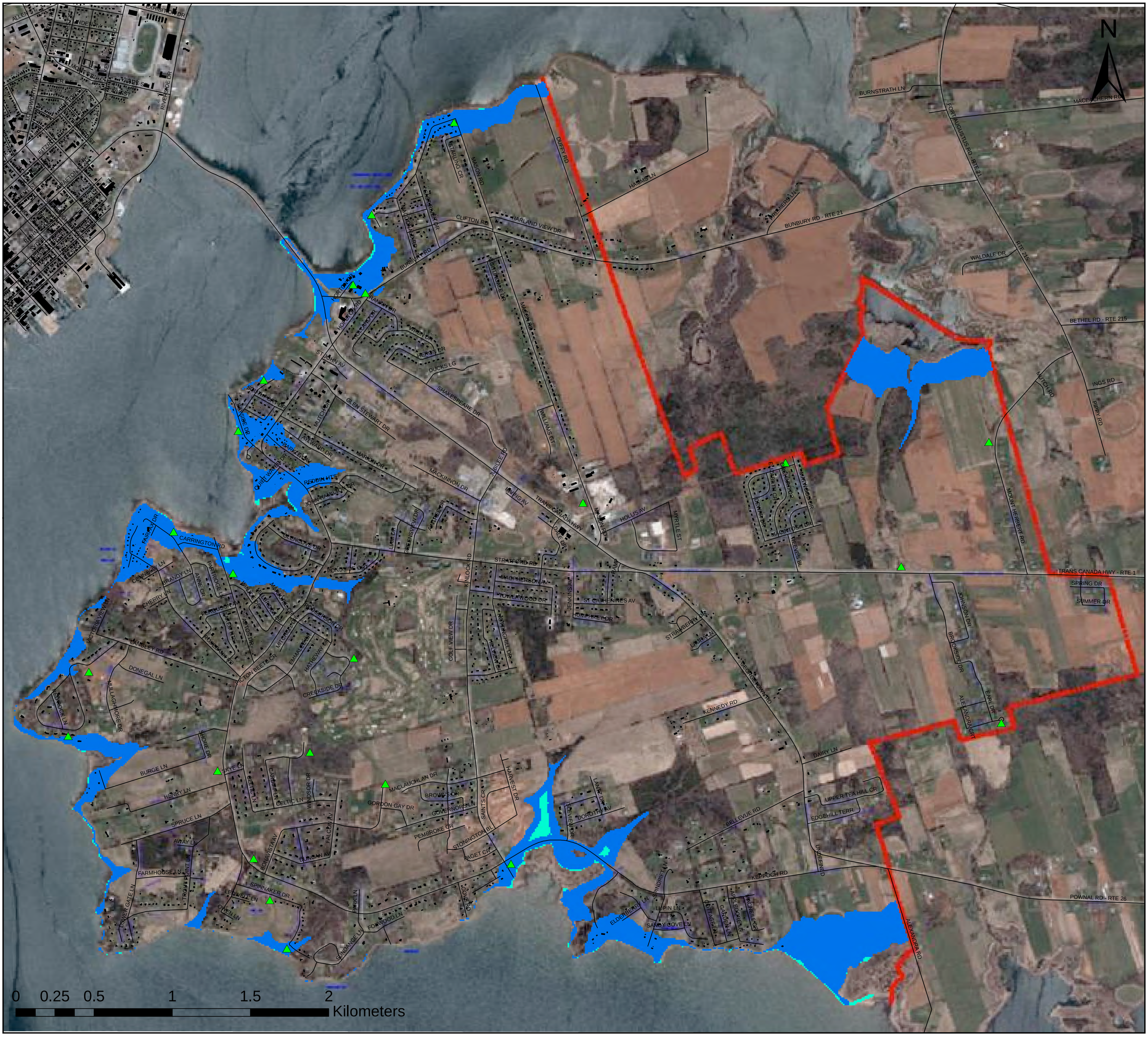
Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

Town of Stratford - 120 centimetre Sea Level Rise (High Emissions Scenario)



Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

Town of Stratford - 50 centimetre Sea Level Rise (Low Emission Scenario)



Stratford Municipal Boundary

Buildings

Roads

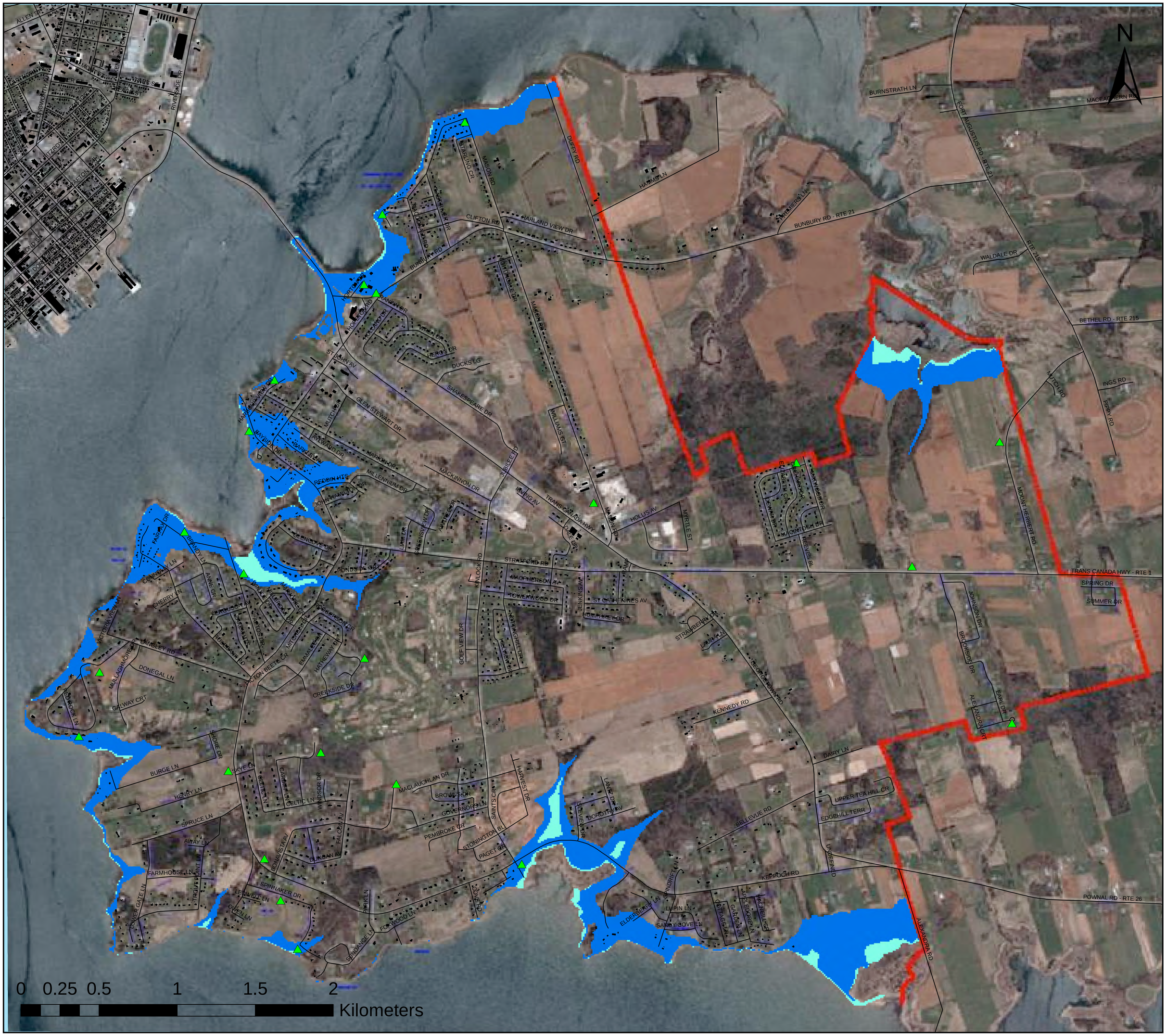
Municipal Stations

50 cm Sea Level Rise (Emission Scenarios B1 to A1F1)

+ 470 cm storm surge

Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

Town of Stratford - 90 centimetre Sea Level Rise (Current Emissions Scenario)



Stratford Municipal Boundary

Buildings

Roads

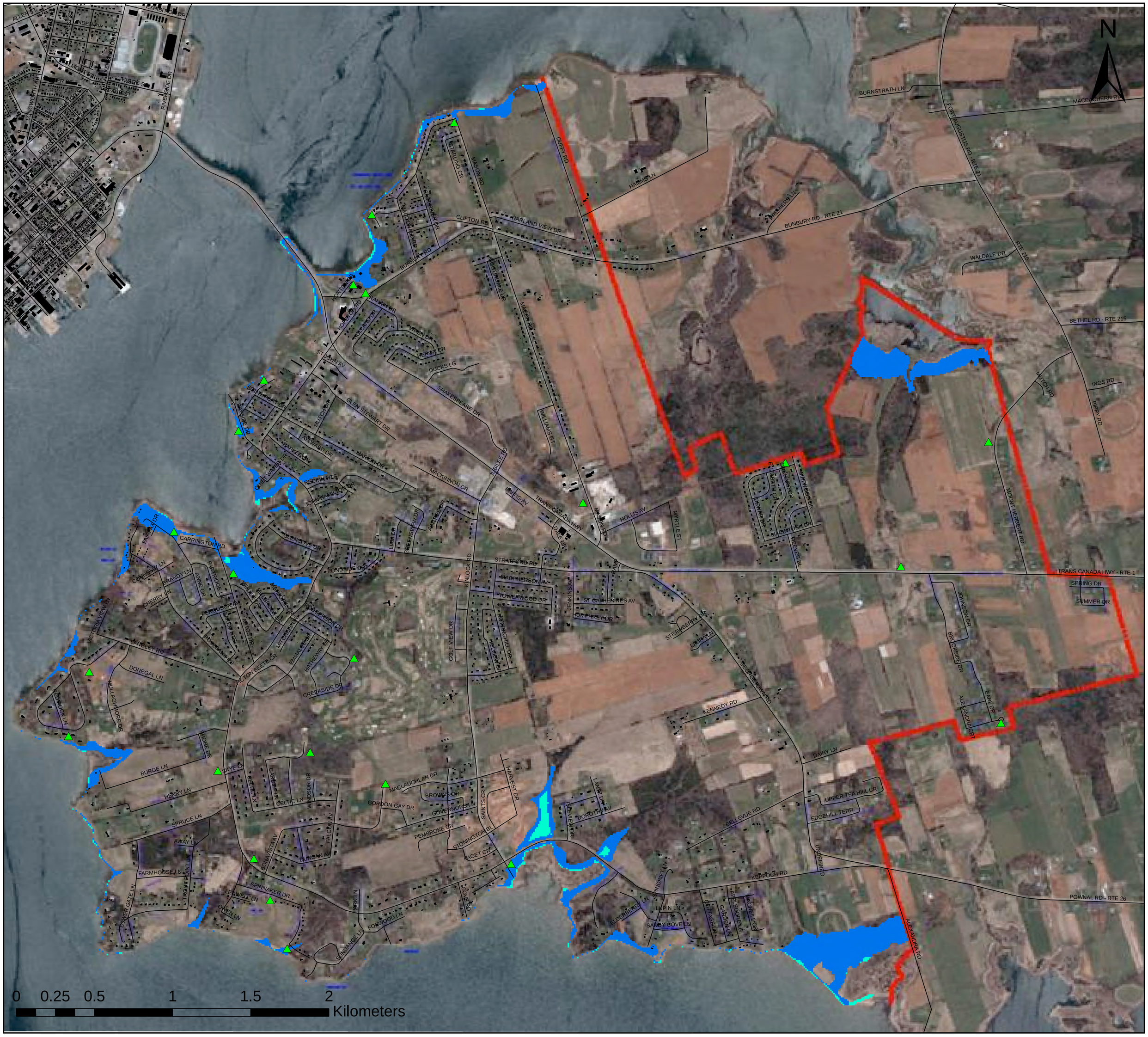
Municipal Stations

90 cm Sea Level Rise (Emission Scenario A2)

+ 470 cm storm surge

Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

Town of Stratford - 50 centimetre Sea Level Rise (Low Emission Scenario)



Stratford Municipal Boundary

Buildings

Roads

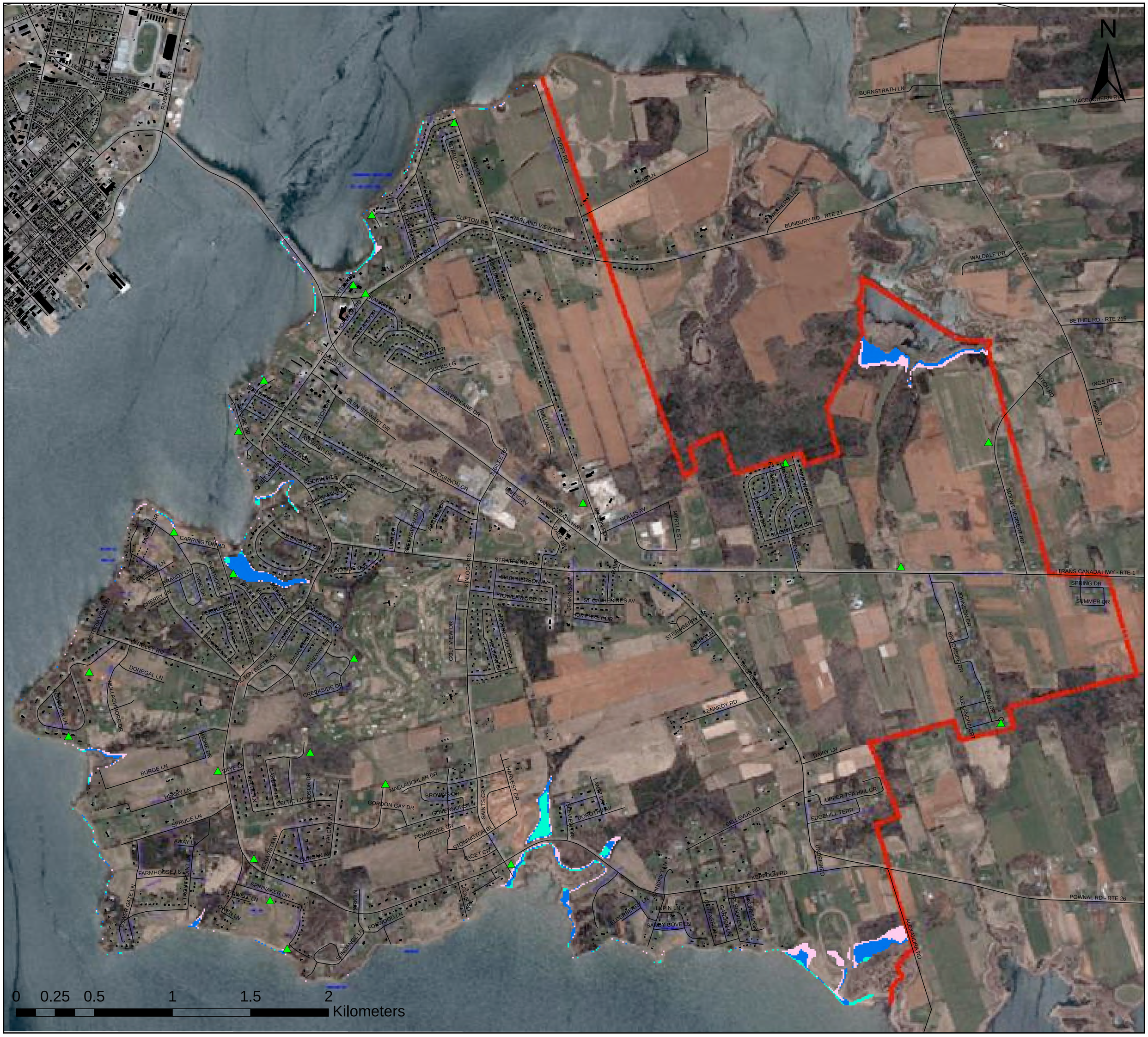
Municipal Stations

50 cm Sea Level Rise (Emission Scenarios B1 to A1F1)

+ 255 cm storm surge

Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

Town of Stratford - SLR Scenarios (Low to High)



Stratford Municipal Boundary

Buildings

Roads

Municipal Stations

50 cm Sea Level Rise (Emission Scenarios B1 to A1F1)

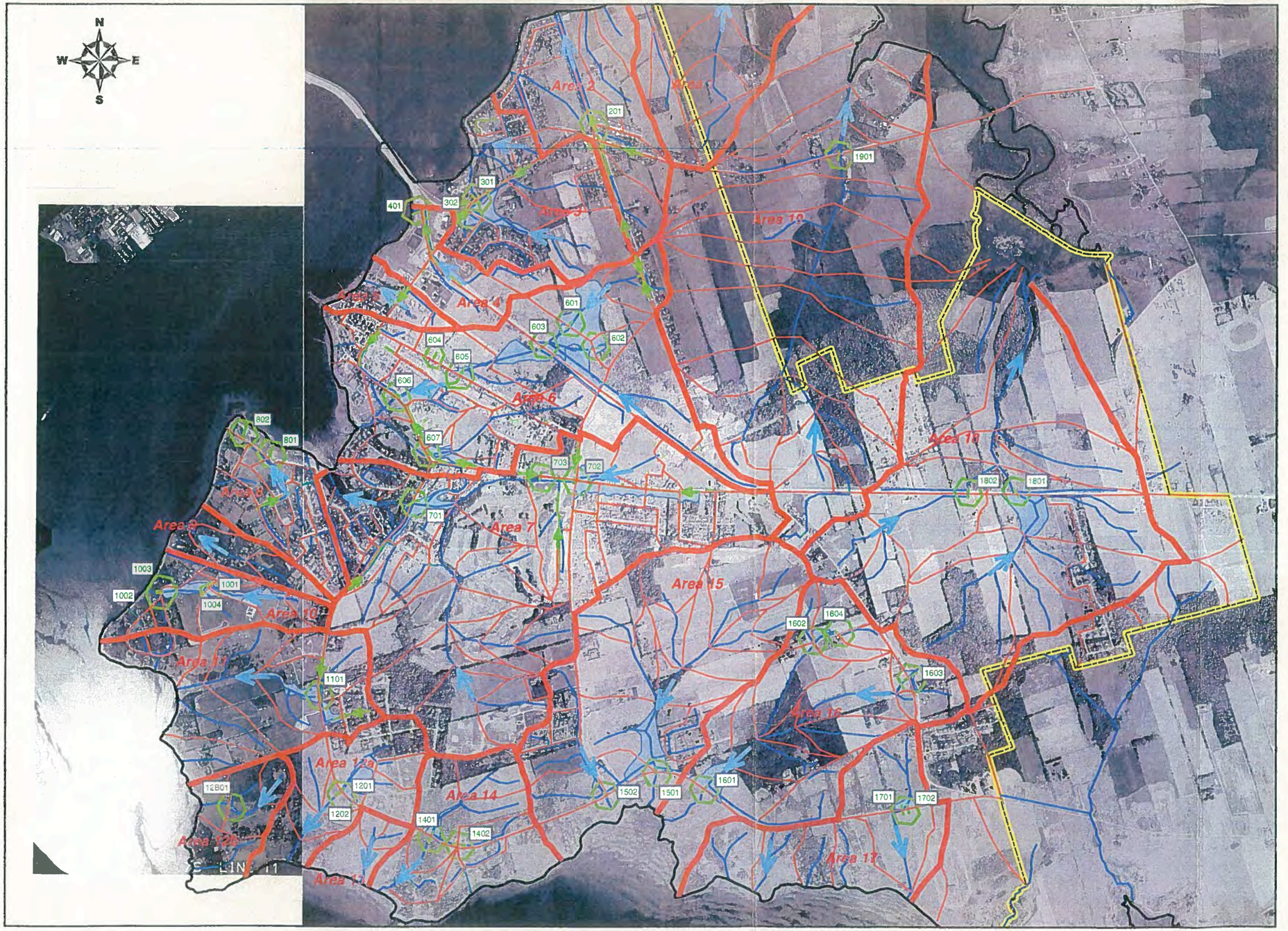
90 cm Sea Level Rise (Emission Scenario A2)

120 cm Sea Level Rise

Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

TOWN OF STRATFORD - STORMWATER MANAGEMENT PLAN

DRAINAGE SYSTEM WITH FLOODLINES AND CULVERTS



LEGEND

- Town Boundary
- Drainage Paths
- Major Watersheds
- Stream Flow Direction
- Major Culvert Location
- 606 — Culvert Name
- Existing Storm Sewer/Culvert
- Storm Sewer Flow Direction
- Existing 1 in 100 Year Floodline (upstream of major culverts)

Project Number:	032629
Date :	March 2004
Data Source:	Government of PEI

CBCL LIMITED
Consulting Engineers

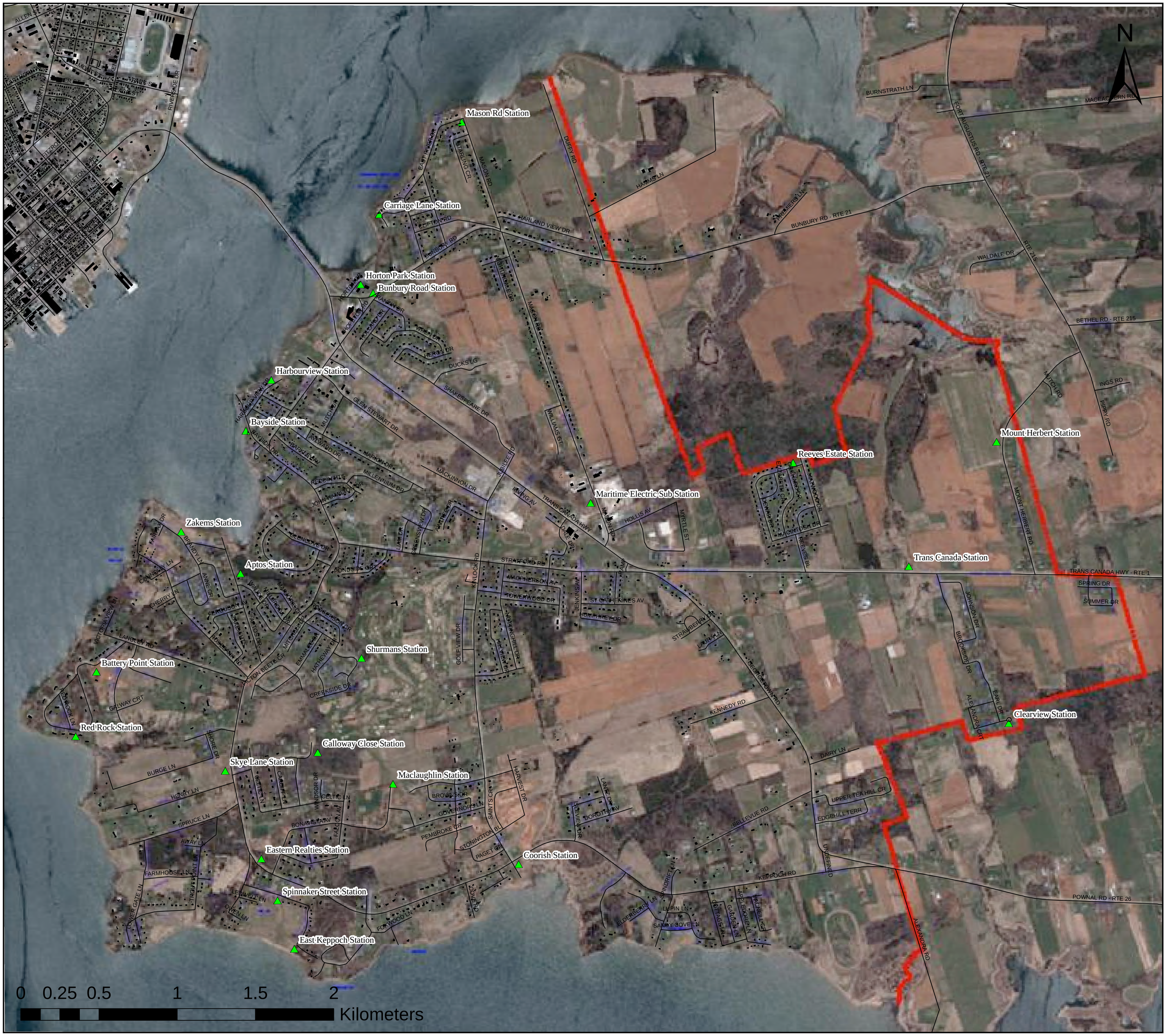
0 0.25 0.5 1 Km

Scale 1:25,000

FIGURE 2.1

Appendix E

Town of Stratford - Community Infrastructure



Stratford Municipal Boundary

Buildings

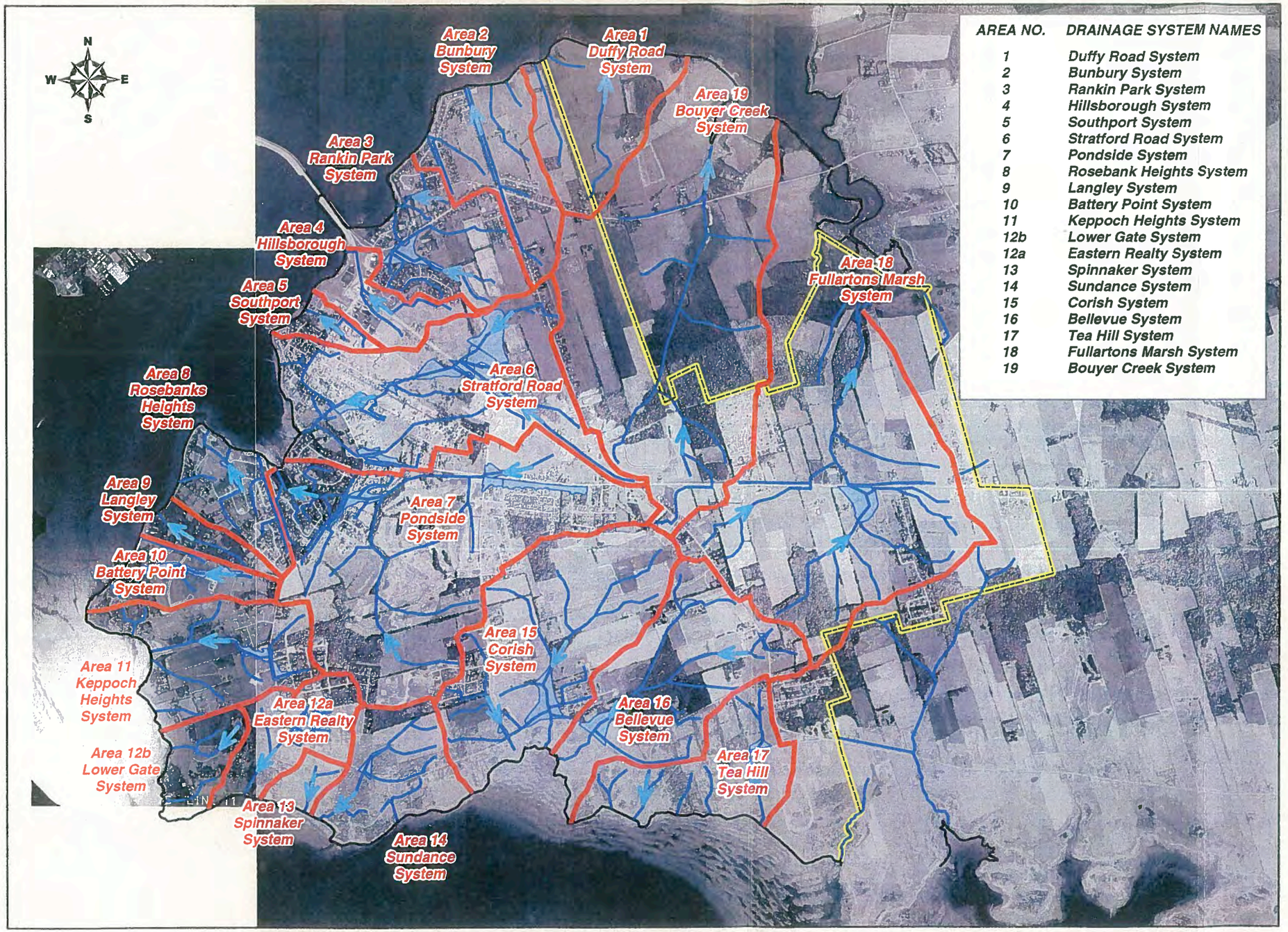
Roads

Infrastructure

Data Source:
The Government of PEI:
Department of Finance & Municipal Affairs;
Environment, Energy and Forestry;
Transportation & Infrastructure Renewal.
By: Hailey Steiger

TOWN OF STRATFORD - STORMWATER MANAGEMENT PLAN

MAJOR WATERSHEDS



AREA NO.	DRAINAGE SYSTEM NAMES
1	Duffy Road System
2	Bunbury System
3	Rankin Park System
4	Hillsborough System
5	Southport System
6	Stratford Road System
7	Pondside System
8	Rosebank Heights System
9	Langley System
10	Battery Point System
11	Keppoch Heights System
12b	Lower Gate System
12a	Eastern Realty System
13	Spinnaker System
14	Sundance System
15	Corish System
16	Bellevue System
17	Tea Hill System
18	Fullartons Marsh System
19	Bouyer Creek System

LEGEND

- Town Boundary
- Drainage Paths
- Major Watersheds
- Flow Direction
- Existing 1 in 100 Year Floodlines (upstream of major culverts)

Project Number:	032629
Date :	March 2004
Data Source:	Government of PEI

CBCL LIMITED
Consulting Engineers

0 0.25 0.5 1 Km

Scale 1:30,000

FIGURE 1.1

Appendix F

Red Foxes and Coyotes

European settlers found coyotes on the plains, prairies and deserts of central and western North America. The first coyotes appeared in New England in the 1930's. They crossed the Canadian border in Atlantic Canada and appeared in New Brunswick in 1958. In Prince Edward Island the first coyote was snared in 1983. Coyotes probably arrived a few years earlier crossing the Northumberland over ice from New Brunswick or Nova Scotia. The reason for the eastern coyotes expansion are not fully understood but probable include several conditions created by people: the clearing of forests, the provision of dead animal flesh from domestic livestock and the removal of the wolf.[1]

Does climate change have an impact on animals? Do animals migrate as climate conditions become more temperate? Scientists generally agree that significant changes in animal behavior are occurring as the weather becomes warmer. Trees, plants and insects are also affected and migrate with climate change. The red fox and coyotes are both spreading northward, in response to a warmer climate, scientists say.[2]

Stratford residents have seen in recent years changes in habits of red foxes, which have always been common in Prince Edward Island. Foxes habitat is usually woodlots, farmlands, marshes, sand dunes and other open country. It is believed that the arrival of the eastern coyote has had a significant impact on red foxes behavior. Coyotes do not tolerate red foxes within their home range. Foxes are now forced into areas unoccupied by coyotes, including residential neighborhoods in cities, towns and suburbs. While red foxes have become more visible for humans in Prince Edward Island, their population is actually declining. In Stratford red foxes are regular occurrences on golf courses, in parks and in back yards. They use damaged culverts as dens and residential yards as their playgrounds. Municipalities should monitor changes occurring in the natural environment. Municipalities and residents will have to adjust their management of properties to cope with changes in wildlife behaviors.[3]

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[1] http://www.hww.ca/hww2.asp?id=88>http://www.hww.ca/hww2.asp?id=88

[2] http://www.livescience.com/environment/050621_warming_changes.html>http://www.livescience.com/environment/050621_warming_changes.html

[3] http://www.gov.pe.ca/photos/original/eef_redfoxes.pdf>http://www.gov.pe.ca/photos/original/eef_redfoxes.pdf

Appendix G

Potential adaptation methods can be categorized as outlined in **the chart below:**

Adaptation Methods		
Adaptation Method	**Description**	**Example**
Bear the costs	Do nothing to reduce vulnerability and absorb losses	Allow household lawns and gardens to wither
Prevent the loss	Adopt measures to reduce vulnerability	Protect coastal communities with seawalls
Spread or share the loss	Spread burden of losses across different systems or populations	Crop insurance
Change the activity	Stop activities that are not sustainable under the new climate, and substitute with other activities	Make ski resort a four-season facility to attract tourists year round
Change the location	Move the activity or system	Move ice fishing operations farther north
Enhance the adaptive capacity	Enhance the resiliency of the system to improve	Reduce non-climatic stresses, such as pollution its ability to deal with stress

Source: Natural Resource Canada, Climate Change Impacts and Adaptation Program

WARMING OF THE CLIMATE SYSTEM IS UNEQUIVOCAL, AS IS NOW EVIDENT FROM OBSERVATIONS OF INCREASES IN GLOBAL AVERAGE AIR AND OCEAN TEMPERATURES, WIDESPREAD MELTING OF SNOW AND ICE, AND RISING GLOBAL AVERAGE SEA LEVEL.

IPPC Fourth Assessment Report