

Adapting to Climate Change: Infrastructure at Risk

Tantramar Marshlands



Figure 1:
Location of Sackville and the Tantramar Marshes

The Area

The Tantramar River drains into the Cumberland Basin of the Bay of Fundy in southeastern New Brunswick, near the border with Nova Scotia. Its tidal marshlands – known as the Tantramar – are a rich cultural and ecological feature of the region. A system of historic dykes protects farmland and properties in the area, including the Town of Sackville (population 5,500 in 2011). The earliest of the dykes were developed by Acadian colonists between 1671 and their expulsion from the region in 1755.

Sackville is the largest community within the Tantramar marshlands. In 1762, the Town of Sackville held its first local government meeting. The community got off to a slow start due to a huge storm that breached the dykes and temporarily prevented the resettlement of the land formerly owned by the Acadians. However, settlers from New England soon occupied the former Acadian farms; by 1815, the English had constructed a new canal to drain additional marshlands for hay growing.

In 1843, Mount Allison University was established in Sackville. The university has grown to become a major local employer. The area is also known for the international radio towers the Canadian Broadcasting Corporation has operated in the marshlands since 1943. While agricultural land use has been declining in this part of Westmorland County since the 1970s, the remaining cultivated and pasture lands occupy a substantial portion of the Tantramar marshes.

Climate Change and Community Vulnerability

Projected regional climate change impacts include relative sea level rise, changing precipitation patterns, increasing temperatures and an increase in the frequency of extreme weather events. Researchers expect climate change to impact agricultural production in the area. While increased temperatures might lengthen growing seasons, farm animals and crops may not respond well to altered temperature ranges and there are concerns over the spread of invasive species and unfamiliar pests and diseases.

The Tantramar – like many parts of New Brunswick – was hit by the historic Saxby Gale in October 1869; while the area's flood mapping has referred to the extraordinarily high water levels that resulted at the time, development has continued to occur in the Saxby Gale floodplain. There have been several serious storm events over the last decade, including two in 2010 that extensively damaged coastal infrastructure and terrain in the nearby Port Elgin area. There is growing public awareness and concern about the potential impacts of climate change on the Tantramar.

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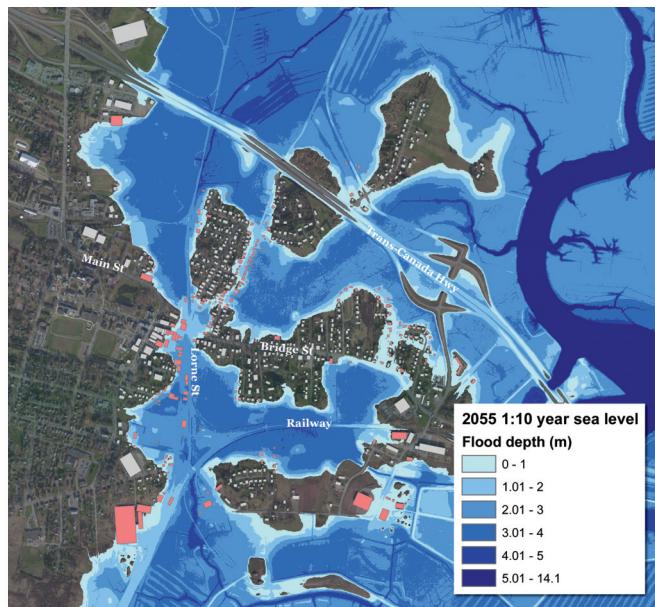


Figure 2: 1 in 10 year storm flood scenario in 2055.

J. Bornemann, TPDC

The combination of rising sea levels and increasingly frequent and more powerful storm surges is expected to substantially increase the extent of coastal floodplains throughout the province. Currently, one in ten-year storm water levels would be expected to overtop existing dykes and cause extensive flooding in the Tantramar (Figure 2)¹. Researchers expect a 1-metre sea level rise to affect much of the region by 2100: if this happens, the flooding levels reached at the height of a record storm-surge event in January 2000 (then considered a 100-year return period event) could occur every three to five years².

Climate change could also impact regional transportation systems. There are two ground transportation routes on the isthmus between New Brunswick and Nova Scotia, but the Tantramar route is by far the busier. Traffic volume on the Trans-Canada Highway reaches 13,500 vehicles per day;³ substantial flows of passengers and freight move through the same corridor by rail. Serious flooding of the Tantramar marshlands could lead to transportation disruptions, with economic consequences affecting multiple sectors across the entire Atlantic region.

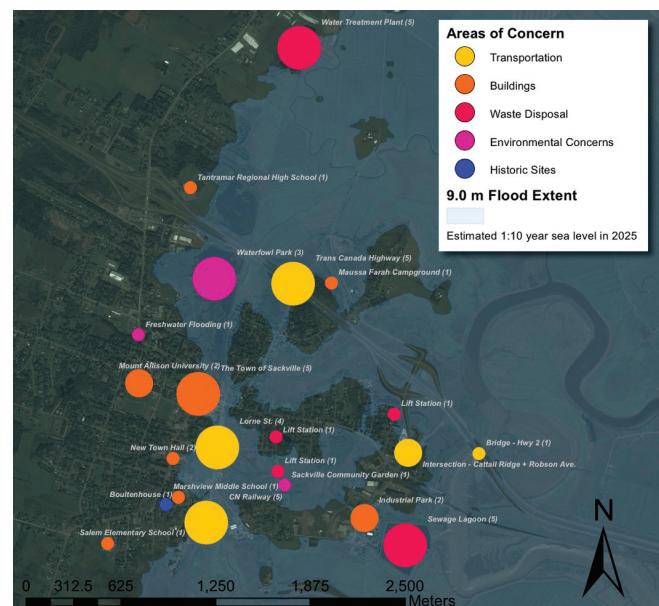
Local Climate Change Adaptation to Date

The New Brunswick Department of Agriculture, Aquaculture and Fisheries currently maintains the Tantramar area dykes. Historically, dykes helped

control lowland flooding, making it possible to bring more land into productive use. Over time, the function of the dykes has expanded. Today they protect not only the agricultural lands, but also the Town of Sackville and the essential transport corridors between Nova Scotia and the rest of Canada (both CN Rail and the Trans-Canada Highway). In fact, the rail line sits on top of the dykes in some sections along the bay (Figure 3).

In October 2011, researchers from Mount Allison University and the University of New Brunswick reported on a series of climate change related projects at a meeting in Sackville, New Brunswick. Residents were particularly concerned about the findings regarding the potential impact of climate change on the area's historic dykes. Researchers expect rising sea levels and increasingly frequent and more powerful storm surges to cause both greater dyke erosion and a heightened risk of failure, resulting in more flooding. Researchers found that 89% of the area's existing dykes, which range in elevation between 7 and 12 metres above sea-level (averaging 8.6 metres) would be overtapped in a current one-in-ten year storm surge event. The erosion rates would be greatest in dykes closest to the coast and in those bare of vegetation.

The researchers recommended some short-term adaptation options including updating emergency response plan scenarios to include dyke system



Areas of concern in case of flooding in Sackville, NB. Feature labels are followed by number of groups concerned.

Geospatial Modelling Lab, Mount Allison University

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Figure 3:
The CN Rail line runs on top of some of the dykes in the Tantramar.

R. Chiasson

breaches; making improvements to the dykes, especially by vegetating exposed sections; and conducting public outreach to raise awareness of the potential risks. Suggested longer-term adaptations would build on these efforts by: using regulations to prevent further development of areas at risk of flooding; relocating or replacing vulnerable infrastructure; and by identifying which dykes to raise in order to better protect critical infrastructure that cannot be moved. Researchers proposed restoring salt marshes as a means of introducing a natural buffer zone to absorb the most powerful and erosive storm waves⁴.

Researchers from the University of New Brunswick have prepared Wet Areas Mapping (WAM) for many flood zones in the Maritime region. Working with finely-textured LiDAR (Light Detection and Ranging) base map data, they generated a variety of potential inland flood scenarios for the Tantramar area: these were presented at the Sackville meeting (Figure 4). The researchers set up flooding scenarios of varying severity and identified the potential network of stream channels that could result, along with the associated flows into existing drainage infrastructure; they also looked at the potential impact on critical utilities such as powerlines and pipelines in the area. The researchers also assessed the degree of potential terrain saturation or ‘wetness’ that could lead to further damage from erosion and slumping. Their modeling identified locations where breaches would likely appear in residential and agricultural ditches, as

well as in several culverted stream crossings along the length of the Trans-Canada Highway.

Next Steps and Opportunities

Staff from the Town of Sackville and provincial and federal government departments are reviewing the outcomes of the Wet Area Mapping (WAM) and flood modeling done for the area. It will take the various levels of government some time to make the appropriate adjustments to land use plans and regulations, public education campaigns, capital works and maintenance processes, and other operations that could be affected by the increased flooding scenarios.

After better understanding the extent of the flood risk to agricultural lands in the Sackville area, researchers recognized the need for further investigation of the climate change impact on agricultural production in the Tantramar region. The research findings could be used to evaluate the merits of saving agricultural lands experiencing flooding versus allowing them to revert to salt-marsh. More information would also help planners assess the relative costs and benefits of engineered adaptations in upland and lowland settings. The development of an agricultural adaptation strategy for the Tantramar Region is underway, taking these questions into account. Researchers also plan to interview local farmers to gain a better understanding of what they

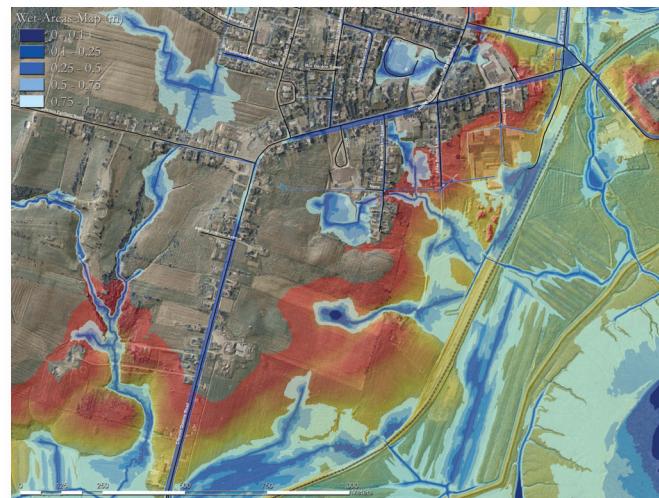


Figure 4:
Inland flooding potential, sea level rise, for Sackville, NB illustrated using wet areas map and flow network (blue channels).

M. Castonguay, J. Ogilvie, and P. Arp. Faculty of Forestry and Environmental Management, University of New Brunswick, 2011

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are already experiencing and how they are adapting, or planning to adapt to climate change.

Mount Allison University is also conducting further research to study the public perception of risk, and assess the social and economic vulnerability of the Tantramar community to coastal flooding. The vulnerability assessment will involve a preliminary analysis of the costs and benefits associated with a number of community adaptation strategies – factors that also commonly inform decision-making. The use of visualization tools – for example those based on LiDAR modeling – to illustrate flooding scenarios appears to be very helpful in enabling people to understand the seriousness of the projected climate change impacts⁵.

In order to improve transportation sector planning, researchers are constructing an interactive model of the New Brunswick-Nova Scotia transportation corridor. By providing researchers with a better understanding all the economic consequences of climate change impacts over time, the model will make it possible to measure and compare the long term costs and benefits of various adaptation options.

For More Information

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- 1 D.J. Lieske. and J. Bornemann, Coastal Dykelands in the Tantramar Area: Impacts of Climate Change on Dyke Erosion and Flood Risk. (Sackville, NB: Department of Geography and Environment, Mount Allison University, 2011).
- 2 R.J. Daigle Enviro, Sea-level Rise Estimates for NB Municipalities (Atlantic Climate Adaptations Solutions Associations, 2011) Retrieved 08 April 2012 at http://atlanticadaptation.ca/sites/discoveryspace.upei.ca.acasa/files/Sea%20Level%20Rise%20Estimates%20for%20NB%20Municipalities_March%202011.pdf
- 3 Y. Yevdokimov, Economic Evaluation of Climate Change Impacts on New Brunswick-Nova Scotia Transport Corridor. Environmental Trust Fund Project Report No. 110128. (Fredericton, NB: University of New Brunswick, 2012).
- 4 D.J. Lieske and J. Bornemann, Coastal Dykelands in the Tantramar Area
- 5 D.J. Lieske, Assessing and Visualizing Community Vulnerability in the Face of Sea Level Rise, Presentation, (Department of Geography and Environment, Mount Allison University, Sackville, NB, 2011).

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Solutions d'adaptation aux changements climatiques pour l'Atlantique
Atlantic Climate Adaptation Solutions Association



Natural Resources Canada
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