

ADAPTING TO CLIMATE CHANGE

Planners and decision-makers must to adapt to climate change in order to make most efficient use of resources when establishing coastal trails and boardwalks. Typically, there are three ways in which climate change impacts can be mitigated. Protection reduces the risk to infrastructure and human activities from hazards of erosion or flooding by building up and defending the shoreline with artificial structures. Accommodation involves modification of existing practices to minimize the impacts of coastal hazards and increase coping ability. Finally, retreat attempts to eliminate the hazard by simply avoiding it and not developing in the hazard zone. In some areas, local priorities will lead to the implementation of one or more of these adaptation methods.



10. Martinique Beach, N.S.

In Nova Scotia for example, there has recently been a change in philosophy with regards to development and management of provincial parks and trail systems, including those in coastal areas. Conservation of coastal environments has taken priority over visitor use and the idea is to reduce the impact of visitors on the natural environment and thus conserve or improve natural resilience. Options that may be explored to achieve this new approach include using more appropriate site specific trail design, better siting of facilities, controlling or directing access away from high risk areas, and conservation or rehabilitation of natural features.

There is no one option that provides the best or most effective approach for adaptation. It becomes very important to identify, evaluate, analyze and monitor conditions at potential trail sites. This includes understanding shore type, geology, rates of shoreline change and the natural environment, as well as the driving forces impacting the area such as winds, waves, currents, ice conditions, precipitation and storms. The implications of climate change on the local conditions need to be considered and could lead to adaptation options that incorporate a combination of approaches. Continual changes in vulnerability, knowledge, technology, and coastal dynamics will require adaptation options to be reassessed and adjusted accordingly.



11. Change Islands, N.L.



12. Signal Trail, N.L.

Further Reading:

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2. Intergovernmental Panel on Climate Change, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. [online: <http://www.ipcc.ch/>]
3. Shaw, J., Taylor, R.B., Forbes, D.L., Ruz, M-H. and Solomon, S. 1998. Sensitivity of the coasts of Canada to sea-level rise. Geological Survey of Canada Bulletin 505. 79p.
4. Parlee, K. 2004. Reducing the Vulnerability of Coastal Trails and Boardwalks to Storm Surge, Flooding, Erosion and Sea Ice. C-CIARN Coastal Zone Report 04-3

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The national, regional and sectoral C-CIARN offices are building a network of researchers and stakeholders, facilitating research and helping to provide voice and visibility to climate change impact and adaptation issues.

ATLANTIC COASTAL TRAILS AND BOARDWALKS & CLIMATE CHANGE

1. Cape Breton, N.S.



INTRODUCTION

Many Atlantic Canadians live, work or play near the coast, and coastal areas are an integral aspect of our culture. Sadly, evidence suggests that many coastal areas may be impacted by climate change. Powerful waves from storms that pass through the region increase the risk of erosion, and storm surges may put low-lying coastal areas at risk of sudden flooding. Such storms can also cause significant damage to coastal infrastructure, including trails and boardwalks.

The sensitivity of Atlantic shores to flooding, erosion and accretion also depend on its local relief, geology, type of coastal landform involved, and its exposure to marine processes. Given that the frequency and intensity of coastal storms may increase, we must be careful how we adapt our coastal infrastructure to meet the challenges of a changing shoreline.

IMPACTS

Computer models suggest that human-induced climate change could cause an increase in global mean sea-level of 18-59 cm by 2100. Expansion of warming seawater and the melting of glaciers and ice caps will primarily be responsible for these expected sea-level changes. In Atlantic Canada, sea-level rise from regional subsidence and climate change will be cumulative and increase the vulnerability of the region's coasts to impacts from increased water levels. One report suggests that approximately 80% of the Atlantic Region's coast is considered to be highly sensitive to sea-level rise.

When planning coastal trails and boardwalks it will be critical to incorporate information on rates of projected sea level rise and the magnitude and frequency of storm surges into the design and modification of infrastructure, as well as for introducing appropriate adaptation strategies. Trail groups, planners and developers may find studying tide gauge records useful in helping to determine the local rate of historical sea-level changes. Aerial photographs, satellite imagery or other remotely sensed data can also be used to identify areas of significant historic coastal change, as well as indicate areas of current and future vulnerability to coastal erosion and storm surges.



2. Cornerbrook, N.L.

BEACH TRAILS

Beaches and dunes provide habitat for a variety of marine and terrestrial species, such as the piping plover and are also popular tourist destinations in Atlantic Canada. As such, it is common to find boardwalks stretching across dunes to allow visitors a peak into the natural dune ecosystem with minimal impact to the dunes from foot traffic. One example is the 2km raised wooden boardwalk at La Dune de Bouctouche located along the Northumberland Strait near the town of Bouctouche, New Brunswick.

While spits and dunes are naturally dynamic and continually respond to waves, currents and winds, in recent years numerous storms have had significant impacts on many of these systems in the region. These coastal landforms can be particularly susceptible to rising sea-level and subsequent increases in the storm surge range resulting from climate change. For relief from increased summer temperatures more people will travel to coastal areas. Increased public use can put increased pressure on these systems and leave them more susceptible to damage from more frequent and severe extreme weather events. This means that coastal trails and boardwalks located in these areas could experience substantial damage during storms and other extreme events.

At La Dune de Bouctouche, recent storms have resulted in considerable shoreline erosion, over-wash of the dunes and significant damage to the boardwalks. Portions of the dune are currently eroding at rates as high as 0.7 m per year and the northern end of the beach has experienced rapid landward migration, with the sand being replaced by cobble.

3. La Dune de Bouctouche - 1999, N.B.



4. La Dune de Bouctouche - 2004, N.B.



5. Lawrencetown Beach, N.S.

URBAN WATERFRONT BOARDWALKS

Many communities along the Atlantic coast were established as resource-based economies, which, in recent years have begun to shift towards tourism as an important contributor to the local economy. In the case of Charlottetown, Prince Edward Island, a waterfront boardwalk was built to promote tourism, commercial development, and recreation in the downtown is now one of the city's most used public facilities.

6. Halifax, N.S.



Unfortunately, like many other waterfront areas, these structures are susceptible to flooding and sea ice forced shoreward, which result in significant damage to boardwalks, pilings, and piers. In September 2003, the storm surge and waves from Hurricane Juan severely damaged the waterfront in Charlottetown and caused major erosion and undermining of the shoreline, torn geotextile, and damage to the boardwalk surface and structures. An increase in the occurrence and intensity of storm surges will put urban waterfront boardwalks at risk to more frequent flooding, as well as increased erosion. Relative sea-level rise and the increase in sea-level associated with climate change will also mean smaller storm surges will have a larger impact.

To address the present damage and future concerns about climate change in Charlottetown, several design options were considered, including a new concrete seawall, gabion basket seawall, 'native' sandstone riprap shore protection, and 'imported' quarried rock shore protection. In the end, significant effort was placed into locating a more resistant rock that would be aesthetically consistent with the red sandstone commonly found on Prince Edward Island.

7. Charlottetown, P.E.I.



SALT MARSH TRAILS

The Cole Harbour Salt Marsh Trail, located near Dartmouth, Nova Scotia was built on an abandoned section of the old Canadian National (CN) Upper Musquodoboit Railway. Historically, the harbour was dyked and the local salt marshes converted into cropland, but when the dyke was removed, tides flooded back and the area was allowed to revert back to marsh. This marsh provides important habitat for many songbirds, waterfowl and other forms of terrestrial and aquatic wildlife.



8. Salt Marsh Trail, Cole Harbour, N.S.

Because of increased frequency of strong winter storms, with high winds, waves and associated storm surge, the trail has been overtopped on several occasions during the past few years. With the arrival of Hurricane Juan in September 2003, the trail was reduced to rubble, with spots eroded down to the original rail bed. Along several portions of the trail the elevation was reduced to water level. The repair work has been extensive and included cleaning fallen and damaged trees, repairing the bridges, rebuilding the trail surface, and re-installing benches, interpretative panels and information kiosks.

9. The Arches Provincial Park, N.L.



Climate change is a concern for salt marsh trails because the associated impacts will likely include an increase in storm surge levels, as well as an increase in the frequency of intense storms. As a result, there is an increased likelihood of overtopping and erosion damage. There is also concern about damage to marsh environments and how this may impact the local song bird and waterfowl populations, as well as the other wildlife.