

# Coastal Climate Change Adaptation: An Opportunity for Nova Scotia's Towns & Municipalities

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*This fact sheet contains information about climate change adaptation strategies for Nova Scotia towns and municipalities. The information is based on a series of presentations developed by the Ecology Action Centre which are available on line from [www.ecologyaction.ca/content/coastal](http://www.ecologyaction.ca/content/coastal)*

## Nova Scotia's Coasts

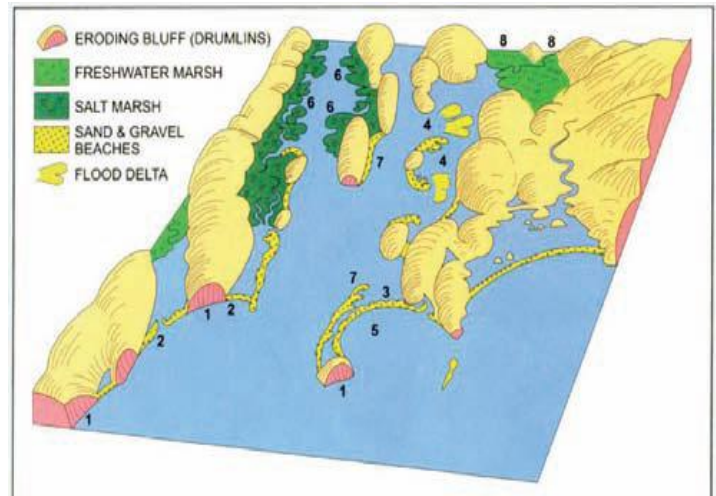
Nova Scotia has a rich variety of coastal ecosystems: beaches and dune systems, rocky shores, tidal marshes and estuaries. For more information on Nova Scotia's coastal ecosystems refer to *Nova Scotia State of the Coast Report*. Coastal wetlands in particular, are areas of high productivity, biodiversity and sensitivity. GPI Atlantic estimates wetlands provide \$7.9 billion worth of ecosystem services to Nova Scotia annually, and that salt marshes alone provide over \$400 million worth of ecosystem services to Nova Scotia communities each year including flood and erosion control and infrastructure protection from storm surges.

## Coastal Change

Shorelines are dynamic and always changing; constantly being eroded and built up again (see diagram below for an illustration of shoreline processes). Living shorelines need to be allowed to change in order to provide important services such as buffering from storms, flood control, improving water quality, and providing habitat for fish and shellfish. Historically a lot of energy has been used trying to stop the coast from changing by building shoreline protection structures such as sea walls and dykes. A significant consequence has been loss of coastal habitat, especially wetlands. The *Nova Scotia State of the Coast Report* states 80% of salt marshes along the Bay of Fundy and 65% province wide have been lost. GPI Atlantic estimates the consequences of wetland loss has cost \$2.3 billion yearly in lost ecological services like water purification, recharging drinking waters and enhancing fishery productivity.

## Traditional and Changing Uses

Longstanding uses of Nova Scotia's coast include residential and industrial development as well fishing, transportation and tourism. Recent trends include growing residential development and recreation. Negative consequences of increased activities in coastal watersheds include habitat loss, inappropriate development, degraded water quality, reduced public access, and property being put at risk.



**The role of shore cliffs in building other coastal features in Nova Scotia.** Shore cliffs (1) provide the anchor and sediment source for building barrier beaches (2), spits (3), tidal flats (4), and marshes (5, 6). *NRCAN 2007*

## Climate change

NRCAN (2007) refers to climate change as "a change in the 'average weather' that a given region experiences. Average weather includes all the features we associate with the weather such as temperature, wind patterns and precipitation. When we speak of climate change on a global scale, we are referring to changes in the climate of the Earth as a whole." For more information about climate change see: *From Impacts to Adaptation: Canada in a Changing Climate (NRCAN 2007)*.

Although there is uncertainty around specific local impacts, general effects of climate change include:

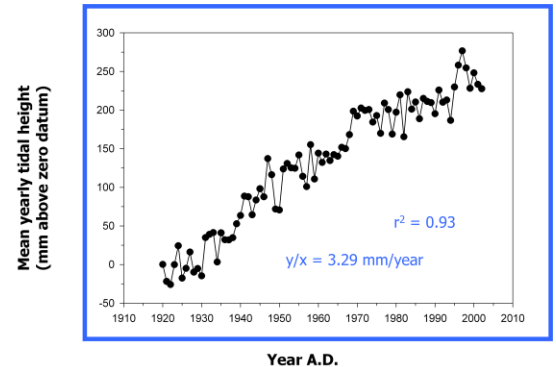
- Storm surges
- Changes in temperature & precipitation patterns
- Flooding
- Ocean acidification
- Changes in ocean circulation
- Accelerated erosion
- Salt water intrusion
- Sea ice changes

Climate Change poses the greatest risk to:

- Sensitive coastal ecosystems
- Areas of rapid coastal erosion
- Coastal infrastructure
- High storm surge
- Low lying properties

There is a scientific consensus that atmospheric warming is a result of increased greenhouse gas emissions. Average global temperature is expected to increase between 1 and 3.5°C by the end of the century, resulting in sea level rise from melting ice sheets and glaciers. In Nova Scotia, sea level rise is exacerbated by a gradual subsidence of its land mass by 1cm/year.

Consequently, an additional sea level rise of 70-140cm is expected over the next 100 years. Sea level rise can amplify the destructiveness of storms causing increased storm surge effects (erosion and flooding). Hurricane Juan cost municipal governments over \$100 million, many of the costs associated with damaged coastal infrastructure.



Sea-level change in Halifax 1910-2010

### What Towns and Municipalities can do!

Coastal towns and municipalities face many challenges: constantly changing coastlines and increasing human development pressures. Add the expected impacts of climate change, and there will be even more challenges in the future: rising costs of damaged infrastructure, protection and repair of property, public safety, water quality and sewage, liability, and increasing public expectations.

The Ecology Action Centre thinks a comprehensive Provincial Coastal Policy will help with planning and coastal guidelines and regulations for towns and municipalities, and provide a clearer understanding of what should be required to protect and manage the coast in a more sustainable way. Until such a policy is in place, there are many climate change adaptation options available to communities that can be undertaken easily and immediately to prepare for future change, reduce risks and save money.

**Climate Change Adaptation:** getting ready for the changes in our climate that are already happening: the slow cumulative changes, as well as the catastrophic events like major storms.

Although some adaptation measures have up-front costs, the cost of inaction may be greater in the long term. Many adaptations, like restoration of salt marshes, yield benefits independent of climate change. Ultimately efforts to protect and restore a healthy coastal ecosystem have ecological and economic benefits. The Geological Survey of Canada estimates damage to shorelines, roads and property from Hurricane Juan (2003) was less in areas with intact barrier beaches and salt marshes. Measures to be adopted will need to be prioritized in order to get the greatest public good with limited resources.

### Climate Change Adaptation Options

Vulnerability to climate change can be reduced through adaptation efforts that limit exposure, and through careful planning. Integrated Community

Sustainability Plans (ICSP) will require communities to include climate change adaptation measures by 2014. This fact sheet summarizes four core principles and specific measures relevant to Nova Scotia at this time from the climate change adaptation literature and measures being used in other communities.

## Adaptation Principles

Adaptation principles represent the goals to be achieved through climate change adaptation. Specific adaptation measures can be assessed against how well they achieve the principle. The Ecology Action Centre suggests the following principles as relevant for Nova Scotia municipalities and towns.

### 1. Public safety

*Make sure the risks to human health and safety are reduced by being prepared for the potential risks from climate change such as road wash outs, falling trees, storm surges, and power failures.*

### 2. Ensure Water Quality and Quantity

*Protect existing infrastructure (drinking water and waste water systems) and protective features (wetlands, recharge areas) to reduce to damage from intense rainfall and flooding.*

### 3. Protect Buildings, Roads and Jobs

*Ensure new development and existing coastal infrastructure are protected from the potential impacts of climate change; reducing the long term cost of maintenance and repair, and maintaining resource based jobs.*

### 4. Let the Coast do the Work

*Ensure natural coastal features like salt marshes and beaches, and shoreline processes (erosion and deposition) can continue to provide to cost effective coastal protection for inland areas.*

## Adaptation Measures

In the Ecology Action Centre presentation to municipalities each adaptation principle included three suggested adaptation measures, ranging from “low” to “high” in implementation cost and technical complexity. The table below provides an example of a range of adaptation options ranging from ‘low tech’ to ‘high tech’ measures to ensure public safety.

### Adaptation Principle: Public Safety

	Adaptation measure	Implementation & Relevance to Climate Change	Example
<b>Low</b>	<i>Identify known flood risk and erosion areas</i>	Use volunteers, local knowledge, topographic maps & basic climate projections to map flood hazard areas Reduces infrastructure losses and human safety risks of sea level rise, storm surge and flooding	Annapolis Royal, Antigonish
<b>Med</b>	<i>Develop emergency measures plans</i>	Proactive planning and capacity building addressing specific needs of community increases resilience and ability to respond to extreme climate events and flooding	Annapolis Royal, Colchester County
<b>High</b>	<i>LIDAR flood risk mapping</i>	Hire consultants to give detailed information about flood risk areas, and vulnerability assessments Reduces infrastructure losses and human safety risks of sea level rise, storm surge and flooding	Truro, HRM, PEI, NB

## Adaptation Measures:

There are many possible ways to prepare for climate change. The following table describes a few potential adaptation measures and how they can be implemented.

Measure	Implementation and Examples
Building standards	Specify minimum technical and safety regulations for designing buildings to reduce the effects of flooding, sea level rise and extreme storm events. i.e. Raising buildings on stilts.
Community emergency measures plans	Communities need to have plans that prevent, mitigate and prepare them for natural hazards and extreme climatic events. Everyone knows what they need to do (fire dept, ambulance) i.e. If the road washes out and cuts people off.
Development/ Construction setbacks	Restricts development a certain distance back from coast, creating barrier between development and the sea. Can prohibit or restrict the size/density of development, type of shore stabilization allowed, activities, removal/cutting of vegetation and require only temporary structures (boardwalks) be built. Setbacks can be vertical, horizontal, or both; vertical setbacks protect against flooding while horizontal setbacks protect against erosion. Benefits: can reduce infrastructure losses, mitigate erosion and flooding, and allow coast to change naturally.
Easements/ Rolling easements	Creates barrier similar to setbacks. Rolling easements do not restrict development but prevent landowners from holding back the sea (no shore hardening allowed) so help maintain shoreline processes. Owners are responsible for own repairs if coastline changes (rolls back) and there is damage. Have minimal impact on property values. Allows dry or intertidal land to always be available, preserving public access to the shore and water dependent uses. Can promote construction of small, more easily mobile structures near the shore. Appropriate where preventing development is not feasible and shore protection is unsustainable.
Hazard mapping (erosion and flooding)	Provides information to land owners, insurers, regulators on hazard areas so they can plan for and reduce impact on infrastructure and human safety from riverine and coastal flooding as a result of storm surges and heavy rains. i.e. Locate new development away from hazards (flooding, erosion zones).
Incentives and funding	Mandate or provide financial incentives: septic tank pump outs and repairs, water harvesting, rebates/ grants for water saving devices. Can minimize water runoff and pollution of coastal waters.
Increase green space/decrease hard surfaces	Reduce hard surfaces/imperviousness and increase green space to reduce flow rates (absorb/detain) to outfalls and minimize flooding and erosion i.e. Increase grassed areas and vegetation, create more wetlands. Also serves to protect wetlands and coastal habitats from land pollution.
Land acquisition	Purchase coastal lands to protect and preserve coastal lands, significant habitats, hazard lands (erosion), and areas susceptible to effects of climate change. Can reduce the need for shoreline stabilization and can protect and maintain natural shoreline processes.
Land exchange	Use individual negotiation to encourage owners to exchange property in coastal areas for municipality owned land away from shoreline. Frequently used where land is exchanged for hospital/school developments and similar to transfer of development rights used successfully in farmland preservation.
Natural shore line stabilization	Restore natural shoreline stabilization to better deal with erosion and natural storm surges. For example: stabilize beaches and dunes with vegetative plantings and, restore wetlands to act as natural buffers against erosion and storm surges - dampens wave energy.
Realignment of the coast	Remove/abandon hardening and restore natural coastline to allow it to migrate naturally and act as a natural buffer from rising sea level and storm surges. Replace undersized culverts, remove dykes, enhance and restore structural complexity and biodiversity of coastal wetlands which also act as water quality filters and refuges and nurseries for many species.
Relocation of structures	Relocate vulnerable and important infrastructure away from the coast. Reduces infrastructure losses & human safety risks i.e. Point de Chene, NB moved buildings away from shore.
Structural shore line stabilization/shoreline hardening	Use hardening or armouring techniques (seawalls, dykes, bulkheads) to protect critical infrastructure. Option of last response and although may provide immediate results, may not successfully protect coastal land in long term.
Water conservation measures	Mitigate and plan for potential salt water intrusion of shallow aquifers and freshwater shortages i.e. water harvesting, conservation, reclamation, grey water usage.
Zoning/ Zoning overlay districts	Zoning by-laws are effective for guiding development on vacant land. They can regulate how much and type of development that can occur, shoreline protection, landscaping, building materials, flood prevention, drainage, watercourse alteration and soil removal. Zoning overlays require further requirements to certain areas a community identifies as valuable and vulnerable (shoreline areas, erosion areas etc). Overlays sit on top of the existing zoning ordinances land use requirements. i.e. Town of Easthampton, NY developed coastal erosion overlay zones to regulate construction and alteration of shoreline protective structures.

## **Adaptation Measures Case Studies**

### ***Development/Construction Setbacks:***

Local governments have a variety of pre-emptive tools to manage development such as zoning, site design regulations and setbacks. Some examples of development setbacks in Nova Scotia include:

- Halifax Regional Municipality: 30m horizontal setback from water bodies and, 2.5m vertical setback from high water mark; within HRM Eastern Passage and Cow Bay: 61m horizontal setback from coastal waters

Some jurisdictions are choosing not to use fixed distances from the shore for setbacks:

- The Maui Planning Commission (Hawaii) require development be set back 50 times the annual erosion rate plus 20 feet; North Carolina requires new structures to be set back from the primary dune based on the current erosion rate times 30 years for easily moveable homes/60 years for large immovable structures.
- The Michigan Land Institute recommends using resource inventories (identifying steep slopes, sand dune crests, wetland areas, forested vegetation, and critical habitat) to determine setbacks. This ensures protection for fragile areas, while having no impact on land owners in less sensitive areas.

### ***Coastal Land Acquisition:***

The New Jersey Department of Environment set aside funding (*Blue Acres Funding Program*) for municipalities or counties to acquire important coastal lands for recreational and conservation purposes. The funding (50% grant/50% loan) is for land that must be undeveloped, in high risk erosion areas, serves important buffering roles, has been severely damaged by storms, or is threatened by future storms.

### ***Rolling Easements:***

Many US coastal states now restrict bulkheads and seawalls along the open ocean coast in order to protect beaches but Maine and Rhode Island have adopted rolling easements to protect wetlands, implementing it with prohibitions on future bulkhead construction. Texas common law recognizes rolling easements along its Gulf coast beaches, with the purpose of preserving public access to the shore. South Carolina amended its Beach Front Management Act to allow for rolling easements on lots seaward of the setback line. These lots can be developed but no hard shoreline stabilization structures can be used to protect the property. Soft erosion control methods can be used, but if homes are damaged or destroyed during a storm, they are allowed to rebuild only if high ground still exists.

### ***Incentives:***

The City of Guelph, Ontario offers rebates and grants for several water saving devices such as low flow toilets, rain barrels, and grey water systems. For example, if you install an approved rainwater harvesting system in your home, you receive a \$2,000 rebate. The Insurance Bureau of Canada and the Township of North Huron, Ontario have partnered for a pilot project to offer more than 1,000 free rain barrels to homeowners in order to determine whether the use of rain barrels is an effective way of keeping basements dry during intense rain storms. The Nova Scotia Environment Home Environment Assessment Program which ran from 2006-2010 offered rebates for pump outs, and grants for repair of septic systems.

### ***Habitat Restoration/Coastal Realignment:***

The salt marsh restoration project in Cheverie, NS (2003) where an undersized culvert was replaced restored 43 ha acres of salt marsh in the Minas Basin. A salt marsh restoration project underway in Aulac, NB will restore 40 acres of unused agricultural land back to saltwater marsh along the Bay of Fundy. Controlled breaching of sections of the seaward agricultural dikes on the Beauséjour marshland will help to re-established salt marsh providing a buffer protecting the new dikes that were built inland to protect the Trans-Canada highway, rail lines and private property.

## Selecting Measures

Each community has different risks, needs, and capacity, so each town and municipality needs to choose a variety of adaptation measures that suit their individual community's situation. Communities will need to select the best combination of measures based on: technical considerations, benefits, capacity, implementation considerations and the cost of doing something versus doing nothing.

## How to Get Started

- Create adaptation committee
- Start with your ICSP and MPS
- Gather information - what has been done?
- Risk assessment - what is vulnerable?
- Decide accepted level of information needed
- Do cost benefit analysis for adaptation
- Build partnerships, educate, and involve the community
- Make wise decisions about development now!



Road washed out at Western Head, NS after Hurricane Bill (2009). Photo taken by EAC

## Other Resources

- A Guide to Land Use Planning in Coastal Areas of the Maritime Provinces [www.dfo-mpo.gc.ca/Library/316491.pdf](http://www.dfo-mpo.gc.ca/Library/316491.pdf)
- A Guide to Sensitive Shoreline Development [http://www.mlui.org/pubs/specialreports/shoreline/shoreline\\_01.html](http://www.mlui.org/pubs/specialreports/shoreline/shoreline_01.html)
- Benefits of Coastal Landscaping [www.mass.gov/czm/coastal\\_landscaping/benefits.htm#pollutionbuffer](http://www.mass.gov/czm/coastal_landscaping/benefits.htm#pollutionbuffer)
- Canadian Federation of Municipalities (green grants/partners in climate change program) <http://www.sustainablecommunities.fcm.ca/partners-for-climate-protection/>
- Changing Climate, Changing Coast <http://ccns.chebucto.org/ChangingClimate.pdf>
- Coastal Climate Change Adaptation <http://community.csc.noaa.gov/climateadaptation/>
- Community Climate Change Adaptation Information Booklet [www.clean.ns.ca/files/01/59/CCAdaptBooklet.pdf](http://www.clean.ns.ca/files/01/59/CCAdaptBooklet.pdf)
- Climate Change Adaptations for Land Use Planners [http://adaptation.nrcan.gc.ca/projdb/pdf/178b\\_e.pdf](http://adaptation.nrcan.gc.ca/projdb/pdf/178b_e.pdf)
- Climate Ready Estuaries [www.epa.gov/CRE](http://www.epa.gov/CRE)
- ComCoast. The Future of Flood Risk Management <http://www.comcoast.org/>
- From Impacts to Adaptation: Canada in a Changing Climate <http://adaptation.nrcan.gc.ca/assess/2007>
- Halifax Regional Municipality Climate Change: Developer's Risk Management Guide [www.halifax.ca/Climate/documents/DevelopersGuidetoRiskManagment.pdf](http://www.halifax.ca/Climate/documents/DevelopersGuidetoRiskManagment.pdf)
- Maine Resources Guide for Land Use Planning <http://www.mainenemo.org/publication/mrg.pdf>
- New Jersey Coastal Blue Acres Program [www.nj.gov/dep/greenacres/blue.html](http://www.nj.gov/dep/greenacres/blue.html)
- Nova Scotia State of the Coast Report [www.gov.ns.ca/coast/state-of-the-coast.htm](http://www.gov.ns.ca/coast/state-of-the-coast.htm)
- On the Front Lines: Strategies for Healthy Beaches in Nova Scotia [www.ecologyaction.ca/files/images/file/Coastal/EAC\\_-\\_20NS%20Beaches\(1\).pdf](http://www.ecologyaction.ca/files/images/file/Coastal/EAC_-_20NS%20Beaches(1).pdf)
- On the Rocks. Our dysfunctional relationship with the coast [www.ecologyaction.ca/files/images/file/OnTheRocks\\_regular\\_fixed.pdf](http://www.ecologyaction.ca/files/images/file/OnTheRocks_regular_fixed.pdf)
- Protecting Florida's Communities. Land use Planning and Best Development Strategies for Minimizing Vulnerability to Flooding and Coastal Storms. <http://www.dca.state.fl.us/fdcp/dcp/publications/Files/hazmitbp.pdf>
- Safeguarding Coasts and Estuaries. Coastal Ecosystem Adaptation to Global Warming [http://ncseonline.org/CMS400Example/uploadedFiles/01\\_NEW\\_SITE/3\\_Solutions/WHPRP/Adaptation2009/NWF\\_coastal\\_adaptation.pdf](http://ncseonline.org/CMS400Example/uploadedFiles/01_NEW_SITE/3_Solutions/WHPRP/Adaptation2009/NWF_coastal_adaptation.pdf)
- USAID Adapting to Coastal Climate Change. A Guidebook for Development Planners [www.usaid.gov/our\\_work/cross-cutting\\_programs/water/docs/coastal\\_adaptation/adapting\\_to\\_coastal\\_climate\\_change.pdf](http://www.usaid.gov/our_work/cross-cutting_programs/water/docs/coastal_adaptation/adapting_to_coastal_climate_change.pdf)

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