

# Adapting to CLIMATE CHANGE in Coastal Areas: Six Steps Local Land Use Planners Can Take

by Amber Nicol

## Summary

*With recognition by the scientific and political community that the climate is warming, it is increasingly apparent that governments and landowners in coastal areas need to plan for change, since they will particularly be affected by climate change. Using a hazard mitigation lens, environmental planning principles, and coastal planning and climate change adaptation best practices, this article puts forward a six-step approach to help local land use planners prepare for coastal hazards in the context of a changing climate.*

## Résumé

*Maintenant que le réchauffement de la planète est reconnu tant par les scientifiques que par les politiciens, il est évident que les autorités et les habitants des régions côtières doivent planifier en fonction des changements climatiques. En se fondant sur l'atténuation des risques, les principes de planification environnementale et les pratiques optimales de planification côtière et d'adaptation aux changements climatiques, le présent exposé propose une approche en six étapes visant à aider les responsables locaux de l'aménagement du territoire à parer aux risques qui menacent les côtes dans un contexte de changements climatiques.*

**P**lanners in coastal areas need to take steps now to prepare for a warming climate. Climate change impacts specific to coastal areas include a rise in sea levels, a decrease in sea ice, and an increase in the frequency and intensity of storm surges. These impacts lead to increased rates of coastal erosion, coastal flooding, and wetland and beach loss. In this context, private property and public infrastructure are progressively more vulnerable to coastal erosion and flooding hazards.<sup>1</sup> Despite their vulnerability, coastal areas continue to experience high rates of development pressure throughout Canada.

Local governments and development authorities have a role to play in climate change adaptation in coastal areas through land use planning policy. Planning encourages communities to think long term about land use decisions and provides a framework to regulate land use in coastal areas. This article puts forward a six-step approach to help local land use planners prepare for coastal hazards in the context of a changing climate. This approach relies heavily on hazard mitigation and environmental planning principles and coastal planning and climate change adaptation best practices.

## Natural Hazard Mitigation

Applying a natural hazard mitigation lens is useful when developing climate change adaptation strategies for coastal areas. Natural hazard mitigation strategies seek a long-term reduction in damage, injury and death caused by natural hazards. Different decisions and actions can increase or reduce vulnerability.<sup>2</sup> The planning process provides opportunities to incorporate hazard mitigation strategies into land use decisions and to educate the public on hazard mitigation issues.<sup>3</sup>

## Environmental Planning Methods

Environmental planning methods can be used to help identify which areas of your region are vulnerable to coastal hazards. These methods are based on the study and analysis of landscape features, processes and systems to inform decisions and solve problems. When combined with land use planning policy, development is directed away from potentially hazardous and environmentally significant areas to more suitable ones.<sup>2</sup>

To make decisions on the varying degree of vulnerability in coastal areas, planners require knowledge of local geology,

soils, coastal features, topography, oceanography, and predicted climate change impacts. While few smaller municipalities and development authorities have this kind of knowledge, they can obtain it from other levels of government, local colleges and universities, and/or residents. Planners' skills in consultation and bringing together different fields of expertise are useful in this respect.

## Coastal Planning and Climate Change Adaptation Best Practices

A cornerstone principle for planning in coastal areas is recognizing the interface between land and sea is constantly changing and is, to varying degrees, sensitive to sea level rise and related impacts. Best practices in coastal planning and climate change adaptation are discussed here and raise awareness of some of the policy tools available.<sup>4</sup>

- Targeted zones, such as “Hazard Area”, “Environmentally Sensitive”, and “Floodplain”, can be used to prevent or restrict development in vulnerable areas and protect features such as beaches and wetlands which buffer coastal erosion and flooding impacts. Coastal location specific zones such as “Harbour”, “Marine Industrial”, “Shoreline District”, and “Coastal Tourism”, recognize the different uses of coastal land and consider the implications of developing in coastal areas.
- Horizontal setbacks target erosion hazards. These can be based on the rate of erosion per coastal feature, the rate of erosion based on an actual property, and/or the expected lifetime of a structure. Vertical setbacks target flood-risk hazards.
- Regulating development by building size, type, density, lot size, and location of onsite sewer systems is another option. This limits potential damage in vulnerable areas and prevents the need for erosion control structures.
- Voluntary tools such as Transfer of Development Rights (TRD) and Rolling Easements (RE) provide added flexibility. TRD uses a zoning overlay to determine areas for “sending” (no-build areas due to hazard risk/environmental sensitivity)

and “receiving” (areas safe for building) development rights. Rights are given up in a “sending” area but are used to intensify development in a “receiving” area. RE keeps land in private ownership but prohibits or restricts development in specific areas. (More information at: <http://coastalmanagement.noaa.gov/shoreline.html>)

- Existing development in vulnerable areas presents a particular challenge. Grandfathering existing uses but encouraging retrofitting is a common approach. Placing limits on rebuilding following major damage from a coastal hazard can be included in grandfathering policies.

sustainability and climate change adaptation to allow you to hire extra staff if needed. Thinking creatively at this stage will make a big difference in your end product.

### Step 2

Map applicable environmental features. Determine what features increase vulnerability to coastal erosion and flooding hazards. Some general principles: low-lying flat areas will flood, while areas with erodible soils, soft rock, or glacial deposits will erode (particularly when on steep slopes). Talking to local residents and emergency measure operations staff will help you identify areas already impacted.



*A bluff is an example of a coastal feature vulnerable to coastal erosion hazards.*

## Six Steps to Ensure Your Community is Prepared

Drawing on the fields of hazard mitigation, environmental planning, and coastal planning and climate change adaptation, a six-step approach was developed to help local planners prepare for coastal hazards in the context of a changing climate. Central to this approach is the need to build political commitment for climate change adaptation at the local level and to engage members of the public around individual and collective steps they can take.

### Step 1

Identify local resources and stakeholders with whom to work through this process, including local residents, political allies, experts with other government departments and agencies, and colleges/universities in the region. Take advantage of funding opportunities around

### Step 3

Complete an analysis based on your findings in Step 2 to identify (a) areas vulnerable to coastal flooding hazards, (b) areas vulnerable to coastal erosion hazards and (c) areas of environmental significance. Different approaches are used to adapt to different hazards. Maintaining ecosystem integrity strengthens the natural environment's ability to buffer climate change impacts.

### Step 4

Map built environment and land use information. Overlay this data on the coastal vulnerability and environmentally significant maps you created. Look for areas of overlap between these maps. Determine priorities by identifying areas containing vital infrastructure or institutional buildings, land uses posing a public health concern, or large numbers of built structures.



- **Step 4** – Built environment variables mapped included land use, zoning, infrastructure, and structures. Overlaying this data on the vulnerability maps identified 18 clusters of development in high-risk areas.
- **Step 5** – Gaps in local land use policy included limited planning in coastal areas, presence of broad rural development zones with little regulation along the coast, inconsistent application of some zones between different planning areas, and a weak history of environmentally-based planning policies. Opportunities included the use of limited watercourse setbacks and zones specific to islands, floodplains, and conservation areas.
- **Step 6** – Policy recommendations included: creating a Harbour zone; tightening up and uniformly applying existing environmentally-based zones; implementing horizontal and vertical setbacks; encouraging retrofitting of existing buildings in vulnerable areas; and pursuing public education and additional research options. Implementation should occur during the development of new plans and scheduled policy reviews.

### Step 5

Complete an analysis of local land use policy to identify gaps and opportunities for policy change. If you have questions about where your jurisdiction ends, consult with your provincial planning department.

### Step 6

Develop and implement land use policies using coastal planning and climate change adaptation best practices. Educate the public about steps individuals can take to ensure they are better prepared. Monitor the results and adapt policies as necessary.

### Case Study, Antigonish County, N.S.

A research study was completed in 2006 in Antigonish County to identify steps local governments in Nova Scotia can take to plan for climate change in coastal areas. Under current conditions, coastal areas of the County are facing erosion problems and localized flooding from storm surges and ice build-up. Losses from coastal hazards have considerable implications for property owners and government disaster assistance and infrastructure budgets. Climate change will only intensify these problems. Compounding this, coastal areas in the County are experiencing high development rates.

- **Step 1** – Relationships were established with the local university, community groups, residents knowledgeable on coastal issues, and regional staff with the provincial government and Natural Resources Canada.
- **Step 2** – Environmental features mapped included slope, relief, geology, soil erodability, and coastal features. Information was collected on the local coastal environment and climate change impacts.
- **Step 3** – Analysis maps were created. Indicators of high or moderate vulnerability to *coastal erosion hazards* were sedimentary rock, glacial deposits, erodible soils, steep slopes (with erodible material), and coastal features such as bluffs, wetlands, beaches, dunes, soft-bedrock slopes, and man-made structures. Indicators of high or moderate vulnerability to *coastal flooding hazards* were low relief, flat slopes adjacent to the coast, and low-lying coastal features such as wetlands, beaches, dunes, lagoons, flood-prone areas, and man-made structures. *Environmentally significant areas* mapped were important habitat regions, wetlands, dunes, beaches, steep slopes, and floodplains.

### Tools and Resources

Guidelines to help assess vulnerability are found in the 1998 Geological Survey of Canada report *Sensitivity of the Coasts of Canada to Sea-Level Rise*.<sup>5</sup> Environmental planning books provide analysis options and background on environmental variables. Geographic information systems (GIS) software can help map natural and built environment information and analyze data. Environment Canada provides digital information on coastal features for Atlantic Canada through its Environmental Emergencies mapping program and some provinces have mapped their coastlines. Access to LiDAR-based (Light Detection and Ranging) digital elevation models is particularly useful as they allow different flooding scenarios to be accurately represented. Contact local GIS/Remote sensing programs and Natural Resources Canada (NRCan) to find out whether this data is available for your region. NRCan has aerial video for some coastlines.

## Conclusion

The climate is changing and coastal areas will be affected. Planners, politicians, members of the public, and other stakeholders need to work together to develop adaptation strategies for their communities. When linked with natural hazard mitigation and environmental/coastal planning principles and best practices, land use planning is an effective tool to achieve this goal. The six-step process outlined here provides concrete steps land use planners can engage stakeholders around to ensure their communities are prepared for change. ■



The causeway to Delorey Island is vulnerable to flooding.

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### Rapid Identification of Vulnerable Areas

To identify vulnerable areas in your region, look to see where people hardened the coastline or installed a groyne to protect their investment.

### A Dynamic Environment

Coastal areas are always changing. Adaptation policies and zoning/vulnerability maps need to reflect this. Revisit policies and mapping during scheduled plan reviews to ensure these still match the actual situation of the coast.

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## References and Notes

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## For Further Reading

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