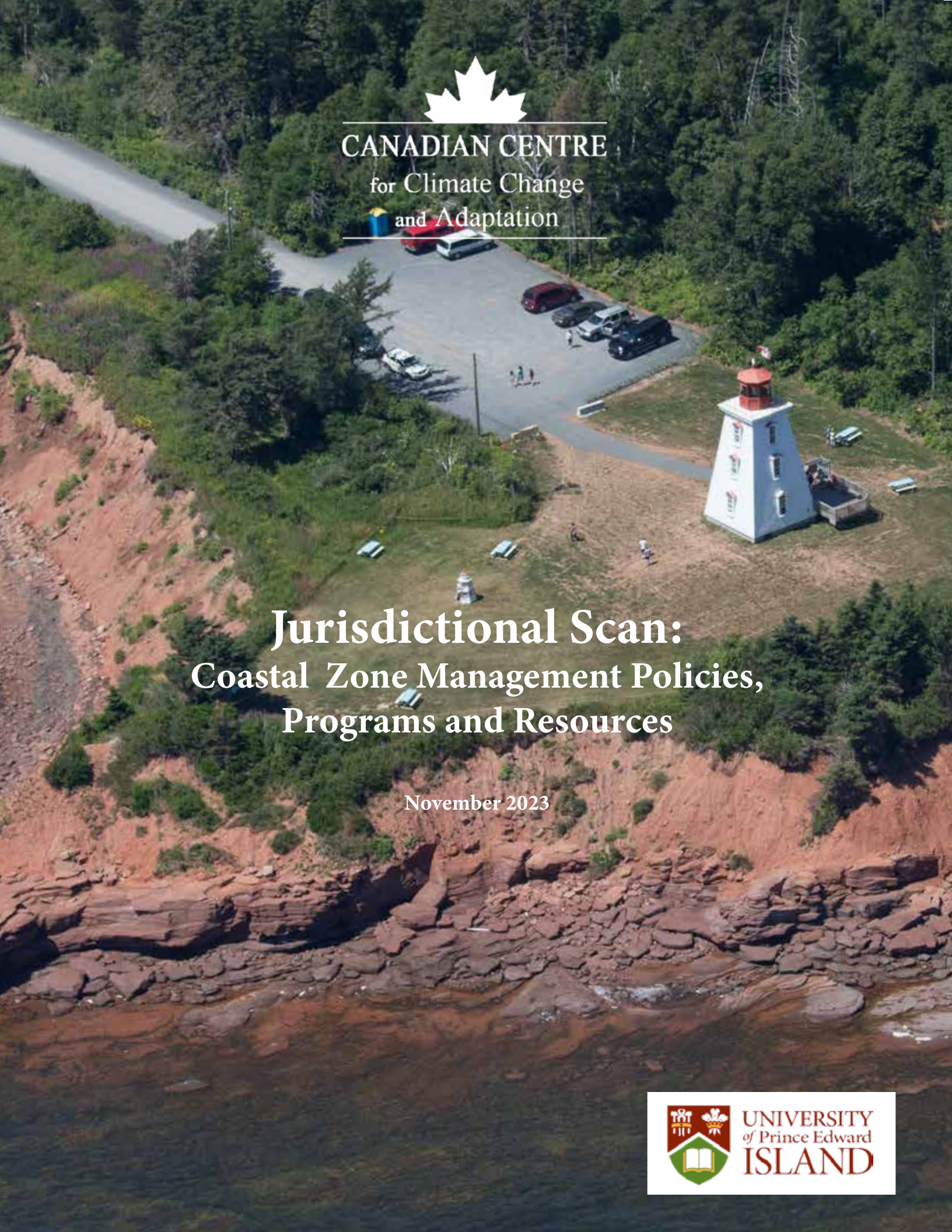

Jurisdictional Scan:
Coastal Zone Management Policies, Programs and Resources

November 2023

UNIVERSITY of Prince Edward ISLAND

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Contents

Acknowledgements

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The work was undertaken by the Canadian Centre for Climate Change and Adaptation (CCCCA), including staff and students with the UPEI School of Climate Change and Adaptation as listed below, and in collaboration with Hope Parnham, landscape architect and professional planner with DV8 Consulting.

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Introduction

In the preparation of the Prince Edward Island Interim Coastal Policy Recommendations Report a jurisdictional scan was completed for over 40 jurisdictions across the globe, including: 13 countries, six Canadian provinces and one territory; 20 US states; two Caribbean countries, eight countries in Europe, the Maldives in South Asia, Kenya in Africa, and New Zealand in Oceania.

Coastal impacts from our changing climate, with resulting sea level rise, and increased frequency of intense and high energy coastal storms are causing similar problems in countries and jurisdictions across the world. How these other jurisdictions frame their approach and response may help PEI evaluate the approaches and actions taken, to make more informed decisions to similar problems such as coastal flooding, coastal erosion, and geographic situations. Strategies, policies, legislation, planning tools, public education approaches, visualizations tools and other techniques used by others can provide valuable implementation considerations for PEI and can help eliminate approaches and techniques which have proven to be inefficient or have resulted in unintended consequences elsewhere.

The jurisdictional scan research team at UPEI used a variety of techniques to collect the information presented in this summary. The main technique used was internet keyword searches, such as "[Name of Jurisdiction], shoreline erosion", "shoreline enforcement", or "shoreline setback requirements", etc. In many cases, peer reviewed published publications provided science based or policy- based analysis of the approaches used. Third party evaluation is helpful to overcome bias which may creep into information provided on public websites created by the jurisdiction. In select examples, individual interviews were held to get more detailed and updated information, when it was difficult to determine if information on a website was up to date or if the information lacked details which were needed to understand the approach or methodology used.

Many of the jurisdictions provide data, maps, photos, permit records, fact sheets, guidebooks, and other instruments to help the public, professionals, decision makers, stakeholders and others access data to make more informed decisions. These educational resources can be critical for people considering purchasing land for their dream vacation home, for business and institutional investment, and other decisions related to development in coastal areas.

Where coastal data has been collected, compiled, and published using public funds, it is reasonable to expect this information should be made readily

available in a straightforward and understandable format.

To facilitate comparison of the information and approaches used, the summaries for each jurisdiction are presented under the following categories:

· Federal Jurisdiction

· Provincial/State Coastal Management Strategies

· Coastal Land Use Planning and Development Regulations (most often regulated at the local or municipal scale)

· Shoreline Erosion Mitigation Strategies / Armouring Regulations

· Data Availability / Education / Research / Outreach

· References / Links to Resources

For example, if someone wanted to find out the vertical or horizontal setbacks used by various jurisdictions one would look under the section on "Coastal Land Use Planning and Development Regulations".

The research conducted for this jurisdictional scan is based on the best information available at the time of writing of this report. Some information may not have been located.

The application and use of this document is the responsibility of the user and UPEI assumes no responsibility resulting from any application or use of the data in this document. Readers are encouraged to use the references/resource links provided to confirm the status of legislation, policies and programs as they may change from time to time.

The following table summarizes the trends and unique findings for each jurisdiction covered in this review on existing coastal zone management policies and regulations.

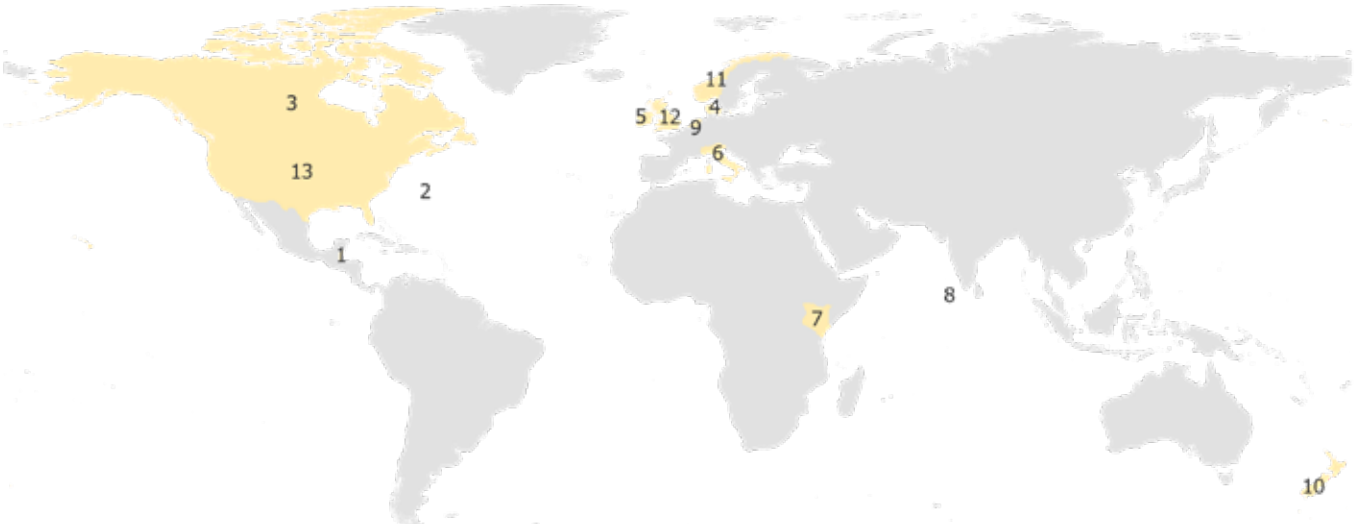

Figure 1. Jurisdictional scan coverage includes 13 countries. 1. Belize, 2. Bermuda, 3. Canada (6 Provinces and 1 Territory), 4. Denmark, 5. Ireland, 6. Italy, 7. Kenya, 8. Maldives, 9. Netherlands, 10. New Zealand, 11. Norway, 12. United Kingdom (England and Wales, and Scotland), and 13. United States (20 States)

Jurisdiction	Shoreline Management Plans or equivalent	Coastal Land Use Planning and/ or Development Regulations	Restrictions on Shoreline Armouring	Shoreline Protection Legislation	Adaptation/ Relocation Program	Ecosystem Services or Nature Based Solutions	Cap and/or Restrictions on Disaster Financial Relief Program	Disclosure Policies and/or Regulations
CANADA								
British Columbia	x	Mun	x	Mun	x	local	✓	x
New Brunswick	x	Mun	x	✓	x	local	✓ ✓	x
Newfoundland	x	Mun	x	✓	x	local	✓	x
Nova Scotia	x	Mun	x	✓	x	local	✓	x
Ontario	✓	✓	x	✓ ✓	x	local	✓	x
PEI	x	Mun	x	✓	x	local	✓	x
Quebec	✓	Mun	x	✓ ✓	x	✓	✓ ✓	x
Yukon	x	x	x	x	x	local	✓	x
UNITED STATES								
Alaska	x	local	x	x	✓	x	✓	✓
California	Local	✓	✓ ✓	✓	?	✓	?	✓
Connecticut	Local	✓	✓ ✓	✓	✓ ✓	✓	?	✓
Delware	x	✓	✓ ✓	✓	?	✓	?	✓
Florida	Local	✓	✓	✓	✓ ✓	✓	?	x
Georgia	✓	✓	✓ ✓	✓	x	✓	✓	x
Hawaii	Local	✓	✓	✓	?	local	✓	✓
Louisana	✓	✓ ✓	✓	✓	✓ ✓	✓	✓	✓
Maine	Local	✓	✓	✓	?	✓	?	x
Maryland	Local	✓ ✓	✓	✓	x	✓ ✓	?	✓
Massacheutts	Local	✓	✓	✓	x	✓ ✓	?	x
New Hampshire	Local	local	✓	✓	x	✓	?	x
New Jersey	x	local	✓	✓	x	✓	?	✓
New York	Local	local	✓ ✓	✓	x	✓	?	✓
North Carolina	✓	✓	✓ ✓	✓	x	✓	✓	✓
Oregon	Local	local	x	✓	✓	x	?	✓
Peurto Rico	Local	local	x	✓	✓	✓	✓	x
Rhode Island	Local	local	✓	✓	x	✓	x	x
South Carolina	Local	local	✓ ✓	✓	x	✓	x	✓
Texas	Local	local	✓	✓	✓ ✓	✓ ✓	✓	✓
Virginia	✓	✓	✓	✓	x	✓ ✓	x	x
Washington State	✓	✓	✓	✓	x	✓	x	✓
Wisconsin	x	local	x	✓	x	local	x	✓

Table 1. Summary of Jurisdictional Scan Findings in relation to select coastal policies (legislation, policy, plans and/or programs). See the following page for the table legend. For more information and references/resources on each jurisdiction, see the appropriate section in this report.

Jurisdiction	Shoreline Management Plans or equivalent	Coastal Land Use Planning and/ or Development Regulations	Restrictions on Shoreline Armouring	Shoreline Protection Legislation	Adaptation/ Relocation Program	Ecosystem Services or Nature Based Solutions	Cap and/or Restrictions on Disaster Financial Relief Program	Disclosure Policies and/or Regulations
INTERNATIONAL JURISDICTIONS								
Belize	x	Guidelines	x	x	x	x	x	x
Bermuda	x	Guidelines	x	x	x	x	x	x
Denmark	Local	Local	Review	x	x	✓	x	x
European Union	NA	NA	NA	NA	NA	✓ ✓	NA	NA
Ireland (Republic)	Local	Local	x	✓	x	✓ ✓	x	x
Italy	Local	Local	x	Local	x	✓	x	x
Kenya	x	x	x	x	x	x	x	x
Maldives	✓	✓	x	✓	✓	?	?	x
Mediterranean Coastal Region	NA	NA	NA	NA	NA	✓ ✓	NA	NA
Netherlands	Local	Local	Local	Local	✓	✓ ✓	x	x
New Zealand	Local	Local	✓	✓	✓	✓ ✓	x	x
Norway	x	Local	x	Local	x	x	x	x
UK: England & Wales	✓ ✓	✓ ✓	✓	✓	✓	✓	✓	x
UK: Scotland	✓	✓	x	✓	✓	✓	✓	x

x	program not available or information on program not found
✓	implemented for entire jurisdiction
✓ ✓	implemented with additional measures and strong supporting information
Mun	municipal implementation
Local	implemented by municipal, county or other local organization
Guidelines	not legislated but guidelines are provided
NA	not applicable (multi-national organization)
?	uncertain
Review	currently under review by the jurisdiction

Canada

Federal Jurisdiction

The federal role in helping Canada to adapt to climate change has been outlined in a recent Federal Adaptation Policy Framework for climate change announced early in 2023 at the Canadian School for Climate Change and Adaptation, on the UPEI campus at St. Peter's Bay, PEI. The key roles for the federal government include generating and sharing of knowledge, building adaptive capacity to respond, and helping Canadians take action, and integrating adaptation into federal policy and planning.

Coastal waters from the ordinary low watermark seaward to 370.4 km are controlled by the Government of Canada. The federal government also has authority over crown lands such as national parks, Canadian military facilities, land designated under The Indian Act such as reserves. Activities in the coastal zone such as navigation, seacoast, and offshore and inland fisheries.

In Canada the planning and managing of land development is often the responsibility of local municipal governments especially in developed areas. Federal jurisdictions are in control of development of activities on federally owned lands like National Parks or on activities in federally controlled water bodies such as the oceans and waterways. A unique aspect of aquaculture management on PEI is that the federal government is responsible for granting aquaculture leases. In some cases, the Canadian Environmental Assessment Act (CEAA) may be triggered resulting in a comprehensive review of a proposed development or modification of an existing development.

Natural Resources Canada (NRCan) is the lead federal agency in the assessment of the risks posed by climate change to Canada's coastline and the resulting impacts on communities, ecosystem, and economic sectors, associated vulnerabilities and opportunities for adaptation. NRCan has divided Canada's marine coasts into 3 large regions: East, North and West. A nationwide study assessed Canada's sensitivity to sea-level rise and found that one-third of our coastline is moderately or highly sensitive including 80% of the Nova Scotia, New Brunswick, and Prince Edward Island coasts (GSC Open File 8551, 2019). For much of Canada's coasts, the state of ecosystem health remains poorly documented or understood. The value of ecosystem services appears to be poorly recognized (Lemmen et al, 2016). The Geologic Survey of Canada (GSC) is an agency of NRCan and is the national organization for geoscientific information and research and conducts hazards risk management. The GSC also monitor climate change effects on sea levels

and have tools to inform adaptation strategies for coastal infrastructure and communities. Understanding the sensitivity of coastal regions to climate change (i.e., sea-level rise) and working with provinces and municipalities to help guide decision-making regarding coastal land use, building permits and the need for active mitigation strategies is another service provided by the GSC.

Due to the potential impact on fisheries in Canada the Federal Department of Fisheries and Oceans Canada (DFO) has management control over activities and developments which could be deleterious to fish or fish habitat. In conjunction with Environment and Climate Change Canada, DFO conducts scientific research and monitoring activities that inform decisions related to the management of fisheries, oceans and coastal infrastructure management, species conservation, and marine safety. For example, scientists are improving our ability to predict changing ocean conditions, increasing our understanding of the state and extent and biological impacts of ocean acidification on marine species, and determining the vulnerability of commercial fish species to climate change impacts. The hydrographic service branch of DFO also maintain and operate tide gauges in coastal regions of Canada which assist in providing long range monitoring of sea levels across the country.

Public Safety Canada provides financial assistance to provincial and territorial governments through the Disaster Financial Assistance Arrangements (DFAA). Since the DFAA program was established in 1970, the Government of Canada has contributed cover $7.9 billion in post-disaster assistance to help provinces and territories with the costs of response and of returning infrastructure and personal property to pre-disaster condition. 73 per cent of this total was paid out in the last 10 years. The program will provide support for impacts such as damage to primary dwellings, repairs to public infrastructure and buildings; restoration, replacement, and repairs to personal furnishings

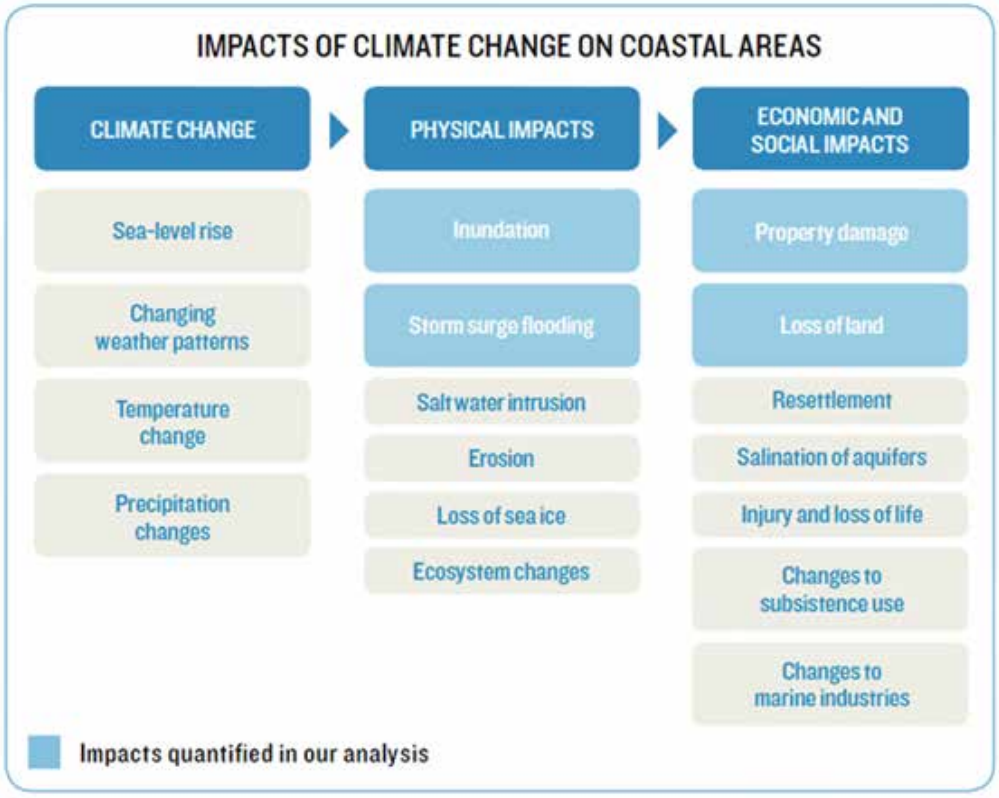

Figure 2. Coastal flood impacts from the National Round Table on the Environment and the Economy (Source: NRTee)

appliances and clothing; and costs of damage inspection, appraisal and clean up but will not cover repairs to a cottage (a property not registered as a primary residence), or repairs otherwise covered by insurance.

Parks Canada has jurisdiction over all activities and developments on the coastal area of the PEI National Park, which contains sand dunes, barrier islands, sandspits, beaches, cliffs, wetlands, and forests. Pursuant to the Canada National Parks Act critical habitat species of risk are protected and under the Species at Risk Act and the Migratory Birds Convention Act further protection against habitat destruction is provided. Species such as Piping Plover and Bank Swallows nest in the coastal zone and are very vulnerable to storm surge and wave action from more intense storms.

Under federal legislation (CEAA) offenses can be reported to an enforcement officer for an investigation of a reported illegal activity. Activities which may be detrimental to the coastline in the PEI National Park may be reported to a Parks Canada Warden. Developments which may be harmful to fish or fish habitat maybe reported to a Canada Fishery Officer appointed pursuant to the Fisheries Act.

References and Resources

Paying the Prince - Coastal Areas, National Round Table on the Environment and the Economy

Disaster Financial Assistance Arrangements. Public Safety Canada

East Coast Environmental Law, Summary Series Volume 4. Who Owns the Coast? Summer 2010

East Coast Environmental Law, Summary Series Volume 10. Who Owns the Coast? Summer 2018

East Coast Environmental Law, Summary Series Volume 5 Environmental Law for Land and Sea: PEI Autumn 2010.

British Columbia

Provincial Strategies

· No coastal management strategy and law is in place for the 25,000 km of shoreline in the province.

· The BC government recommends planning for a SLR of 1 m by 2100 and 2 m by 2200.

· BC Medical journal published an opinion on the health impacts of SLR on BC's coastal communities.

Coastal Land Use Planning and Development Regulations

· No overall Provincial Government requirement for land use plans in non-urban areas.

· Municipalities such as the City of Vancouver have adopted coastal adaptation plans for areas such as the Fraser River foreshore.

· The City of Vancouver proposes design attributes including.

- » Design for adaptability
- » Design for nature (nature-based solutions).
- » Design for safe to fail infrastructure systems.
- » Design for public safety.
- » Design for shoreline access.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Shoreline protection measures are not taken along large areas of the coast due to steep cliff and resistant bedrock composition.

· Shoreline sensitivity to SLR is available for the Squamish River estuary.

Data Availability, Education, Research and Outreach

· Shoreline erosion monitoring data is not available on a province wide basis.

· Nature based solutions are encouraged by the Stewardship Centre for BC's Green Shores program (pilot project).

References and Resources

Province of British Columbia, Land Use Planning for Provincial Public Land: Coastal and Marine Plans

Union of BC Muncipalities, Support for British Columbia Coastal Protection Strategy. 2020

West Coast Environmental Law. 5 reasons BC needs a law to protect the coast. 2019

BC lacks plans for rising seas and flooding, coastal adaptation researcher says. CBC 2020

New Brunswick

Provincial Strategies

· NB has a Coastal Areas Policy which is implemented through the Watercourse and Wetland Alteration Regulations. Some critics claim the policy is not strong enough and promotes the use of hard protection measures.

· There are 3 designations for coastal zones in NB.

» Zone A - Most sensitive and includes tidal watercourses, beaches, dunes, rock platforms, coastal marshes, and dyked lands between HHWLT and LLWLT.

» Zone B - lands adjacent to the coastal areas.

» Zone C – extends from Zone B inland and covers areas subject to storm surge. Includes areas where habitat may be impacted by storms.

Coastal Land Use Planning and Development Regulations

· NB uses regional planning commissions to implement land use control in all coastal areas.

· The Southeast Regional Service Commission have helped communities develop coastal planning tools for up to 10 areas which include.

» SLR zone with a requirement for 100-year design life.

» Habitable areas of residential and commercial buildings in the coastal zone must be designed for 4.3 m (CGVD28) above sea level. These must be accompanied by a plan showing how this requirement will be met along with a drainage plan for all infilling of lots.

» Extensions of existing buildings are not permitted unless this requirement is met.

» Buildings have to accommodate a 1:100-year storm event.

» All new coastal lots in Tantramar must provide a 30 m setback from the ordinary high-water mark.

» Tantramar has a policy requiring developers and property owners to a sign a waiver which acknowledges they accept the risk associated with storm surge and SLR.

» Design standards for flood walls and berms are available.

» Designs for dwellings on stilts are available.

» Promote the use of living shorelines to protect dunes and other natural areas.

Data Availability, Education, Research and Outreach

· NB has extensive shoreline erosion data from mapping, aerial photography and records from work conducted along the coast. Consultants doing any work along the coast are required to file a copy of any reports with the provincial Department of Natural Resources.

· NB will place a notice on the provincial government's land registry once a property has reached the $200,000 limit for disaster financial assistance.

References and Resources

Government of New Brunswick. A Coastal Areas Protection Policy for New Brunswick. 2019

Town of Shediac, Planning Commission.

Planning Areas | Land Planning | Southeast Regional Service Commission: Tantramar Unincorporated

Erosion experts caution N.B. against continued coastal development CBC 2021

Changes to disaster financial assistance program. Government of New Brunswick. February 2023

Newfoundland and Labrador

Provincial Strategies

· There is a Policy for Development in the Shore Water Zone in NL.

Coastal Land Use Planning and Development Regulations

· Development is controlled by the Lands Act and Rural Planning Act, 2000.

· Individual municipalities have municipal plans (Deer Lake, South River, etc.)

· At Deer Lake and South River areas below 2 m contour are considered highly vulnerable to coastal flooding.

· At South River a 30m setback is recommended for areas having unconsolidated materials. This is considered 2 times the annual erosion rate over a 100-year period.

· A 1:100 flood return period is used in the South River Municipal plan.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The province has identified 27 types of shoreline classes in the province.

· Shoreline erosion is prevalent in low lying areas and other highly sensitive locations.

· The average shoreline erosion rate is ~20 cm/yr with some areas experiencing up to 1 m/yr.

Data Availability, Education, Research and Outreach

· The province provides advice for development via "Coastal Change in NL A Handbook for Policy Makers and the Public, 2020 by Dr. Martin Batterson.

References and Resources

Government of Newfoundland and Labrador. Coastal and Ocean Management Strategy and Policy Framework for Newfoundland and Labrador: A Discussion Paper

Heritage Newfoundland and Labrador. Coastal Erosion

Town of Deer Lake Muncipal Plan 2019-2029, Prepared by Baird Planning Associates (September 2019)

Nova Scotia

Provincial Strategies

· NS prepared a state of the coast report in 2009 which was quite comprehensive.

· Municipalities had to prepare climate change action plans at that time which included coastal areas prone to SLR and erosion.

· NS conducted public and stakeholder consultation for the proposed Coastal Protection Act Regulations Part 2, 2021. This consultation has been completed and reports on the input received are available.

· One key finding is that different types of shorelines need to be addressed differently.

» Elevation was frequently mentioned as an important consideration due to the impacts from storm surges and coastal erosion.

» A minimum horizonal setback line of 80 to 100 m is proposed and will be required to meet an 80-year planning horizon.

» Modelling should be based on worst case scenario.

· There isn't a timetable for when the new regulations may be implemented.

· Landowners will be required to hire a designated professional to prepare a report for any development in the coastal zone. These reports will be valid for 10 years. Assessments from other professionals such as geotechnical engineer or geologist may also be required.

· The new regulations may impact the design and location of proposed structures.

· New shoreline structures will be restricted to cases where it is necessary to protect existing structures against erosion.

Coastal Land Use Planning and Development Regulations

· The HRM Land Use By-Law Mainland Area (edition 183), section 14QB states that no development permits can be issued for lots abutting the coast of the Atlantic Ocean within a 3.8 m elevation above CGVD28.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The Coastal Protection Act passed in April 2019 sets out clear rules to protect Nova Scotia's coastline from coastal flooding and erosion.

· Armour rock, breakwaters and seawalls have been used throughout the province for many years. And in recent years nature based solutions have been used to protect shorelines in some areas.

· Shoreline protection measures are not taken along large areas of the coast due to steep cliff and resistant bedrock composition.

· Shoreline sensitivity to SLR is available for the Squamish River estuary.

Data Availability, Education, Research and Outreach

· NS has extensive coastal erosion mapping and flood forecasting available for the province.

· NS has developed a new analytical tool to help with determining the required distance for horizontal setbacks called CERFA.

References and Resources

Government of Nova Scotia, Bill No. 106 Coastal Protection Act (2019)

Engineers Nova Scotia: Coastal Protection Act Information (2023)

Development of a Coastal Erosion Risk Factor Assessment Standard. Technical Background and Guidance. CBCL March 2021

Measuring coastal erosion in Nova Scotia, Canada. GeoNadir 2022

Municipal Climate Change Action Plan for POrt Hawkesbury, Victoria and Inverness County. CBCL 2012

Halifax Mainland Land Use Bylaw. Halifax Regional Municipality. 2016

Planning for Sea-level Rise in Halifax Harbour. Government of Canada, Natural Resources Canada. 2015

Ontario

Provincial Strategies

· Ontario has coastline in the Great Lakes Region and has international agreements in place between the Canadian and USA Governments and US states which share boundaries on the Great Lakes

· The province has established conservation authorities to manage shoreline and other environmental issues under the authority of the Conservation Authorities Act.

Coastal Land Use Planning and Development Regulations

· The Conservation Authorities Act (1990) gives Conservation Authorities the power to establish and undertake initiatives on private and public land to help achieve its objectives and can include:

» monitoring of areas affected by flooding, erosion, and or slope instability

» study and investigation of watersheds, and

» remediation of erosion and/or slope stability hazard.

· There are regulations under the Conservation Authorities Act including:

» Wetlands (42/06)

» Alterations to shorelines and water courses.

» Hazardous lands (97-04) Shoreline Management Plans are utilized in the province.

Shoreline management recommendations are grouped into the following four broad categories: Avoid, Retreat, Accommodate and Protect.

» The integration of SMPs and Municipal official plans needs to be explored.

» There is a Lake Ontario Shoreline Management Plan which was published on Nov. 5, 2020. The overarching principle guiding the plan is to promote sustainable coastal development in the future through integrated coastal zone management. The key objectives of the SMP are to increase the resilience of coastal communities, protect new development from coastal hazards, update existing hazard mapping using the best available information, incorporate nature-based solutions, protect, and enhance existing private and public amenities along the shoreline, and to integrate climate change impacts when considering the coastal hazards of the future.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Monitoring is critical to assess and quantify shoreline change over time and in the case of climate change, whether the risk profile is changing. For example, if global warming continues and shoreline ice coverage continues to decrease, it is possible that the long-term erosion rates will increase beyond those determined for this SMP and utilized in the updated shoreline hazard mapping.

Figure 3. Ontario Conservation Act Hierarchy of legislation and policies. (Source: CRCA)

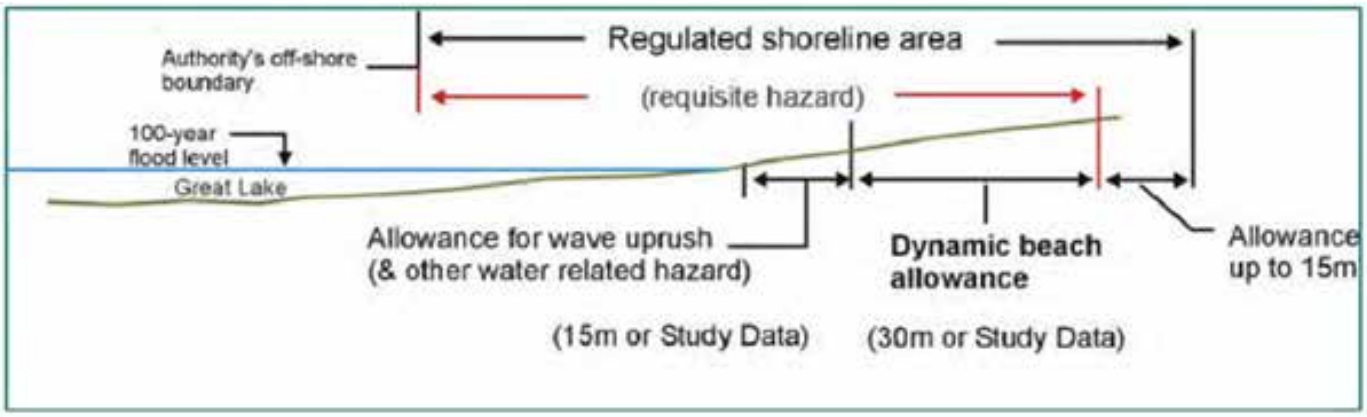

Figure 4. Regulated shoreline area as defined by the Cataraqui Region Conservation, Ontario (Source: CRCA)

· An erosion hazard setback is defined in the Guidelines for Developing Schedules of Regulated area (Conservation Ontario and MNR in 2005). For eroding beach shorelines, the limit of the erosion hazard was mapped in GIS using the following steps:

» Calculate the waterline erosion rate using shoreline change rates The waterline erosion rate is calculated as the Average Annualized Recession Rate (AARR) of the transects plus one standard deviation of the transect population (also annualized), times 100.

» From the 100-year flood elevation contour, a setback consisting of the 100-year erosion allowance for the beach was applied (using a buffer command).

» A dynamic beach hazard is also used to allow for "wave uprush", plus a 30 m allowance to account for the dynamic nature of the beach and dune system.

· In Kawartha County erosion control and shoreline protection techniques are outlined for shoreline property owners. The conservation zone authority recommends a no-mow zone along the shoreline at least 3 m back from the shoreline on at least 75% of the length of the shoreline.

· Consultation with Kawartha Conservation's Permitting department and Parks Canada's (Trent-Severn Waterway) policies for in-water and shoreline works and related activities is recommended before starting any activity along the shoreline to see if a permit is required.

· With respect to erosion control and remediation of erosion and/or slope instability prone areas, The Toronto Region Conservation Authority (TRCA) has a long-standing Erosion Risk Management Program that monitors and remediates hazards on a priority basis to the limit of available funding each year.

· TRCA's mission statement to protect, conserve, and restore natural resources and develop resilient communities through education, the application of science, community engagement, service excellence, and collaboration with our partners.

· The program is funded by the City of Toronto, Peel, York and Durham regions and the provincial and federal gov'ts on a project-by-project basis.

· Property owners must grant certain rights to the TRCA via a Design Contribution Agreement and pay a refundable design contribution deposit of $2,000. In some cases, land it conveyed to the TRCA for a permanent easement over access routes is granted. A restrictive covenant is registered to the land title to protect the structural integrity of the works completed.

· Guidance is provided for both private and public shoreline protection structures. It is generally based on regional design conditions with a 100-year planning horizon. The design of shore protection must be completed on a site or project-specific basis, as local shoreline conditions and wave exposure can vary significantly over short distances.

· Where a vertical or near-vertical structure is preferred over a sloping structure due to space

Property Type	Landowner Contribution	Example Scenario where total value of the work is $1,000,000 inc. HST
Single Residential Property	40% of the total value of the work	Benefitting landowner must contribute $400,000
Two (2) or more Residential Properties	50% of the total value of the work, divided equally between all benefitting landowners	Five (5) benefitting landowners, each must contribute $100,000
All Commercial, Institutional, or Industrial Properties (single or multiple)	60% of the total value of the work divided equally between all benefitting landowners	Total contributed by benefiting landowners must be $600,000

Table 2. Private landowner contribution schedule for erosion control works and public access, Ontario Conservation Authority (Adapted from: TRCA, 2017)

limitations or specific shoreline characteristics, stacked or stepped armour stone seawalls are recommended. Armour stone seawalls are particularly well suited for shorelines with flat, shallow bedrock. Vertical armour stone seawall structures must be carefully designed by a qualified individual.

Data Availability, Education, Research and Outreach

· In Nov. 2018, oblique aerial photography was obtained for 70km of shoreline using drones. The purpose of capturing the aerial photography was to develop a current, georeferenced photographic database of the shoreline, particularly in developed areas, ecologically sensitive areas, or areas otherwise identified as high-risk. This library of photographs was the primary source of information for the development of a high-resolution shoreline protection database.

· Historical aerial photos from 1953 and 1954 were georeferenced with GIS software.

· Emergency field visits along Lake Ontario were made in 2019 after record-high water levels in the lakes over a 50-day period. Erosion prone areas were also visited.

· Lake Ontario has a Wave information Study (WIS) database compiled by the US Army Corps of Engineers.

· Longshore sediment transport potential was calculated using the wave data.

· The impacts of climate change on future wave heights, and storm surges was evaluated for Lakes Erie and Ontario (Baird, 2019) as part of the NRCan supported study (Zuzek Inc., 2019). The wave height analysis was completed by selecting the top 15 wave height storms on Lake Ontario from 2000 to 2013, then comparing the predicted wave heights for the same storms for a late-century RCP8.5 emission scenario.

References and Resources

Parks Canada. Policies for In-water and Shoreline Works and Related Activities.

Toronto and Region Conservation Authority. Erosion Risk Management

Central Lake Ontario Conservation Authority. Lake Ontario Shoreline Hazard Management

Lakehead Region Conservation Authority. Shoreline Naturalization.

Cataraqui Region Conservation Authority, Guidelines for Implementing Ontario Regulations 148/06: Development, Interference with Wetlands, and Alterations to Shorelines and Watercourses

The Land Between. Design Your Own Shoreline Gardens.

Quebec

Provincial Strategies

· Under the Environmental Quality Act all structures and undertakings that encroach on the littoral zone must be authorised by permit before starting.

Coastal Land Use Planning and Development Regulations

· There is statute dealing with land-use planning and development and these are required for each municipality. These plans must identify areas that need restrictions to protect public safety and health and include flood and erosion zones.

· The implementation of land use planning and development laws and regulations in the 1980s was not able to limit the number of buildings at risk in the coastal zone. In fact, a 133% increase in buildings at risk was observed between 1980 and 2001.

· Use a GIS based coastal land-use planning tool for coastal erosion adaptation.

· This system will be used to characterize the coast and use data on the type of shoreline, coastal state, type of protection, state of coastal processes, building, infrastructure, etc.

· Zoning hazards are seen as excellent preventive measures in Gaspe.

· Structures on Cap aux Meules Island are being designed from 4.7 to 5.0 m above mean sea level.

· Ecosystem services are used to determine if projects make economic sense.

· Two municipalities in Magdalen Islands have municipal planning in place to protect the coast. A plan is currently being developed to protect the coast for the next 10 years with 40 locations being studied in greater detail. Particular attention is being given to eastern facing shorelines.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· A shoreline armouring study was conducted in Eastern Quebec which covered 21 coastal regional municipalities and 3300 km of coastline.

» In Eastern Quebec, 10% of the shoreline is armoured.

» 97.6% of these structures are reflective rigid structures.

» Consultations were held with 300 coastal managers, 494 coastal residents and 51 professionals.

» Soft structures were stated to be preferred by most, but rigid structures continued to be used. This is attributed to a lack of specialized knowledge, a lack of funding, a lack of collaboration, regulations which are too restrictive for innovation of coastal defence measures.

· Beach nourishment with gravel in Magdalene Islands withstood Fiona waves.

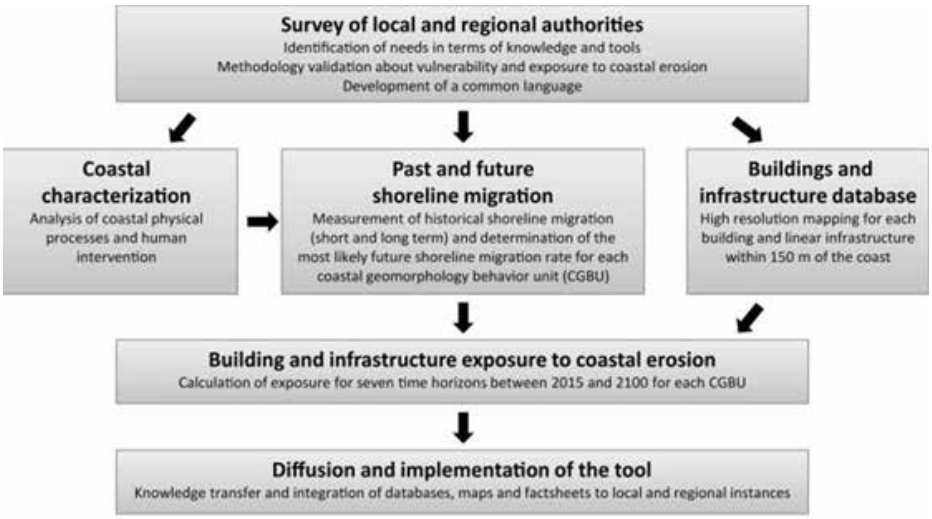

Figure 5. Key steps for GIS Coastal Land-Use Planning Tool in Quebec for coastal erosion adptation. (Source: Fraser et al. 2017)

Data Availability, Education, Research and Outreach

· The average rate of erosion on the Magdalene Islands between 2005 to 2021 was 53 cm based on 12,074 measurements. Shoreline erosion monitoring has been conducted on the Magdalen Islands since 2005 extensively by UQAR for over 10 years using drones, pegs, maps, solar cameras. UQAR has a satellite research centre, Cermim located in the Magdalen Islands, which investigates coastal erosion and coastal infrastructure.

· The relevance on psychosocial impacts such as stress, sleep disturbances, and economic stresses has been evaluated in one study.

· Groundwater impacts (saltwater intrusion) from rising sea level are being studied in Magdalene Islands but has had minor impact to date.

· Tourism impacts are important in Quebec.

· Conversation with Jean Hubert of Magdalen Islands on April 6th revealed that recent installation of a gravel beach proved effective against erosion from Fiona and they are looking at installing geotubes under the direction of Cermim.

· Quebec has a variable flood compensation rate depending on the level of water in a residence.

· Financial assistance can be granted in a the case of successive floods to abandon or to move the residence. Financial assistance may be provided to move to a safe lot in the same or adjoining municipality.

· The maximum amount of funding for repair of damages or for transfer of lot ownership to the municipality may not exceed $385,000.

· The above is an effort to nudge homeowners out of the flood zones with disaster relief program funding.

References and Resources

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Effectiveness of land managmenet measures to reduce coastal georisks, eastern Quebec, Canada. Drejza, et al. 2011

Quebec launches new disaster relief program with cap on flood compensation. Insurance-Canada.ca 2019

Flooding or other disaster related financial support for property owners and tenants. Quebec

Yukon

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Yukon has 210 km of coastline on the Beauford Sea and is very vulnerable to coastal erosion. About 2/3 of this coast is part of Ivvavik National Park.

· Mean shoreline erosion rates in the area west of Firth River are the highest with rates ranging from -0.9 to - 1.4 m/yr.

Data Availability, Education, Research and Outreach

· This area is extensively used by Inuvialuit, other indigenous peoples and non-indigenous peoples.

· The area contains 168 cultural sites and some rare artifacts; 44 cultural features have been lost in the past due to coastal erosion. Under SLR projections of up to 1 m by 2100, another 32 to 58 cultural sites could be lost.

· The area contains very little infrastructure along the coast with 2 landing strips in the area which are being shortened by coastal erosion.

References and Resources

Impacts of past and future coastal changes on the Yukon coast - threats for cultural sites, infrastructure, and travel routes. Irrgang et al, 2019

Coastal erosion on Yukon's only Arctic island exposes looming climate threat. The Narwhal. Gignac, J. 2020.

Researchers stunned by rapid rate of erosion on Herschel Island. CBC 2017

United States

Federal Jurisdiction

The Coastal Zone Management Act of 1972 provides the basis for comprehensive management of coastal issues in 34 coastal states and territories that participate in the voluntary program. State partners must follow basic requirements, but the Act provides flexibility for partners to design special programs that address their individual and unique challenges. The major provisions of the national program include federal consistency, program enhancements, nonpoint pollution control and coastal and estuarine land conservation. The national program is overseen by the NOAA Office of Coastal Management. The National program provides funding for several activities which totalled $72 Million in Fiscal year 2022 and this was matched by $63 Million from state and other partners. Some of the main activities funded include comprehensive planning for ocean and coastal waters, implementing state programs, protecting, and restoring coastal habitat, expanding public engagement, mitigating coastal hazards, promoting coastal community development, enhancing public access to the coast, protecting coastal water quality. The CoastSmart program in Maryland is an example of a funded program which addresses coastal vulnerability by connecting local governments and partners to relevant information, expertise, tools, training, and financial resources. Another example is the promotion of nature-based solutions in the state of Mississippi.

The Federal Emergency Management Agency (FEMA) is a federal agency which is active in helping to address coastal hazards as well as other emergencies across the country. This agency supports citizens and emergency personnel to build, sustain, and improve the nation's capacity and ability to respond to all types of disasters. To help achieve coastal resilience FEMA has initiated coastal flood hazard studies for 100% of the populated coastline in the USA. This is conducted via Risk mapping, assessment planning (Risk Map), National coastal flood insurance studies and flood insurance rate maps. FEMA also operates a National Flood Insurance Program (NFIP) which allows property owners in participating communities to purchase flood insurance to protect them against flood losses. This insurance program requires state and local governments to enforce floodplain management ordinances that are aimed to reduce flood damage from storms, storm surge and similar events. Flood insurance can be purchased for high-risk areas which are called Special Flood Hazard Areas (SFHAs) or 100-year floodplain if the local authority participates in SFHA program.

The USA Army Corps of Engineers, a federal agency of the Department of National Defence is mandated

to provide advice and services for both military and civil works in coastal regions. Some of the major roles of this agency includes protecting and restoring habitat, maintaining of navigable waters, conducting beach nourishment, undertaking flood control projects, and regulating coastal restoration projects. Over the years the Army Corps have produced several coastal engineering manuals and tools to provide reliable data for projects being planning in the coastal zone and guidance for the design of coastal infrastructure.

The US Geological Survey (USGS) another agency of the Government of the United States has a coastal and marine hazards and resources program which provides valuable data and information in support of efforts to protect and manage the coastal zone in the country. Historically this organization has funded field measurements of coastal erosion in many coastal areas. The USGS has also developed a Coastal Change Hazards Portal which provides data on extreme storms, shoreline change and SLR.

One of the tools used by the USGS is a nationwide network of coastal observing cameras, or CoastCams, to monitor coastal conditions in near real-time which helps support research being conducted by the organization. Images taken by these coast cams are made publicly available within minutes of collection.

The Digital Shoreline Analysis System (DSAS) is a software add-in to the Esri ArcGIS desktop system enabling a user to quickly calculate rate of change from historical shoreline positions. The USGS also use remote-sensing technologies such as aerial photography, satellite imagery, LiDAR, and others to measure coastal change over time. The USGS also examines physical processes at work prior to, during and post storm events, forecasting of coastal change on beaches to improve real-time and scenario-based predictions, geologic mapping of the sea floor, national assessment of coastal change hazards and many other initiatives.

References and Resources

FEMA Fact Sheet 5.4: Shorelines. Hurricane and Flood Mitigation Handbook for Public Facilities.

FEMA Coastal Flood Risk and Coastal Flood Insurance Maps

FEMA National Flood Insurance Program

United States Geological Survey (USGS) Coastal Change Hazards Portal

Alaska

State Strategies

· Alaska has the largest % of its population residing in coastal zone areas of all the states at 82.5%. The federal government owns or controls 60% of the land in the state.

· The State of Alaska withdrew from the National Coastal Management program under CZMA in 2011 after 32 years of active involvement. As a result, The Federal Consistency Provision, section 307 no longer applies in Alaska.

· There is a heavy dependency on resource extraction industries in Alaska and about 90% of the state government funding is from the oil and gas industry. Alaska has a Climate Change Impact Mitigation program which provides assistance to communities imminently threatened by climate hazards such as erosion, flooding, storm surge and thawing permafrost.

· In 2016 the Inupiat Eskimo village of Shishmaref, Alaska, voted in favor of relocating due to rising sea levels.

» The community had lost 2,500 to 3,000 ft of coastal land due to erosion over the previous 35 years. Several homes had to be moved over these years.

» Projections showed the village would be underwater within 3 decades.

» The community had voted to relocate in 2002 but it didn't happen due to lack of funding.

· Shishmaref had previously been located in May 1973 and again in July 2002 due to melting of permafrost.

Coastal Land Use Planning and Development Regulations

· The Community of Kotlik is on the north side of the Yukon Delta in western Alaska it has been identified as one of 13 highly vulnerable communities to climate change hazard threats.

» A community profile for the community has been prepared and this identifies the areas most vulnerable to climate change impacts such as aggressive erosion rates.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Alaska has one of the highest shoreline erosion rates in the world as determined by the USGS in a report issued in 2015. In this study 1650 km of shoreline was assessed. The average erosion rate for the entire study area was -1.4 m/yr with a range of -18.6 m/yr to +10.9 m/yr.

» Shoreline protection measures such as sandbags and rock-filled gabion revetments were the two main methods used in the past.

· It was estimated that there are 31 Native Villages in Alaska where erosion from climate change poses an imminent threat with 12 of them looking at the possibility of relocation.

» The cause of the extreme erosion is attributed to melting sea ice and loss of permafrost. (NPR story, August 2016)

Data Availability, Education, Research and Outreach

· In September 2015, the Alaska Shoreline Change Tool was launched by the state. This is an online mapping tool which shows past and future trends of coastal erosion.

· The Alaska Shorezone Coastal Inventory and Mapping Project has been flying helicopters along the entire Alaskan coast each summer since 2001.

· A new 2,375-foot-long sea wall was built by the US Army Corps of Engineers in 2005 at Shishmaref but this was considered a temporary measure. Two more phases of seawall extension were proposed at a total cost of over $22 million.

· The US Army Corps of Engineers costed out how much it would cost to relocate the community in 2004.

· It was estimated it would take 5 years to relocate the entire community to another location at a total cost ranging from $93 to $179 US million.

· The total estimated cost to stay at Shishmaref was estimated at $109 million with an annual erosion protection coast of $2.5 million.

· Sellers are required to disclose whether they are aware of any floods on the property, if so, of any damage to the property or structures from flooding. Sellers must also provide the flood zone designation.

References and Resources

Why did Alaska eliminate the Alaska Coastal Management Program? Wilson, R. 2018

Alaska Baseline Erosion ASsessment. U.S. Army Corps of Engineers, Alaska District.

Alaska Shoreline Change Tool. State of Alaska.

Alaska Risk Map Program. State of Alaska, Department of Commerce, Community and Economic Development. Division of Community and Regional Affairs

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

California

State Strategies

· Coastal Development in the State is controlled by the federal Coastal Development Act (1972) , California Public Resources Code, and the Federal Coastal Zone Management Act for 1972.

· The state defines the roles of the various state agencies involved in coastal development and management and each one is accountable to the California Coastal Commission.

· Development within the coastal zone is controlled by the California Coastal Commission which has legal authority to protect coastal areas.

» Six of the voting commissioners are locally elected and six are appointed by the public.

» The commission is a partnership between state and local government officials.

» Local coastal programs (LCPs) are required for each of 15 counties and 61 cities located in the coastal zone. These plans must all be approved by the Commission.

» The Commission has a preparedness and response program and a statewide Coastal Act enforcement program.

» The Commission operates a Coastal Access Program.

» The Commission has a program in place for removal of structures which have been placed without approval.

» Impacts of proposed developments on neighbouring properties, public beaches, wetlands. In some areas EIAs are required depending on sensitivity.

· The Coastal Act penalty section 30820 makes any violation of the Act a possible civil penalty. Fines range from $500 to $30,000.

· Section 30821 enables administrative penalties for access violations up to 75% of the maximum penalty assessed for each violation and can be assessed for each day of violation for a period of up to 5 years. The Commission can also place a lien on a property for failure to comply.

· The court is empowered to award attorney's fees to the prevailing party.

· Funds from violations are placed in a "Violation Remediation Account" of the Coastal Conservancy Fund.

Coastal Land Use Planning and Development Regulations

· The coastal zone generally extends 1000 yards inland from the mean high tide mark and extends offshore to the 3-mile limit for state waters.

· The state is planning for 3.5 ft of SLR in the next 50 years and 10 ft of SLR by 2100.

» Flood hazard mapping considers wave runup, splash and high velocity flow.

» At Pacifica, flood hazard mapping uses 4.6 ft of SLR for a 100-year event.

· A coastal zone permit is required for several activities.

» Construction, reconstruction, size alteration or demolition of a structure

» Grading, removing, placement, and extraction of any earth material,

» Subdivision and minor land division.

» Change in the density or intensity of land use,

» Harvesting of major vegetation, except for agriculture and timber harvesting.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The state has 1100 miles of shoreline and 10% of this is protected by coastal armouring.

· An analysis of the coastal armouring in the state was completed in 2015. Coastal armouring has diminished beaches, habitat, decreased recreation, and increased erosion on neighbouring properties. PEI could benefit from a similar study.

· A report (Guerry et al, 2022) on nature-based shoreline protection solutions providing benefits for urban dwellers due to habitat restoration in San Mateo County, California indicates benefits 8 times the benefits of traditional engineered structures plus improved habitat for shore dwelling organisms. A Nature Futures Framework lays out how this was implemented.

· At Daly City the long-term erosion rate is 1.3 to 1.6 ft /yr and in future they estimate it will increase to 1.8 to 4.5 ft/yr.

· California distinguishes between coastal bluff erosion and beach erosion.

Data Availability, Education, Research and Outreach

· The state has aerial photos, shoreline erosion data, flood inundation maps and SLR projections available. The USGS conducts the coastal erosion monitoring.

· The state has established a "Protect Our Coast and Oceans Fund" which is set up to give income tax deductions for contributors.

· A seller is required to disclose whether there are flood problems and whether there has been any major damage from floods in the past. Sellers are also required to complete a Natural Hazards Disclosure Report and identify whether the property is located within the floodplain designed by FEMA.

References and Resources

California Coastal Commission

Coastal Developoment Permit Applications and Appeal Forms. California Coastal Commission.

Enforcement: Coastal Act Violations. California Coastal Commission.

Coastal Zone Management Programs. NOAA Office for Coastal Management.

County of Santa Cruz. Planning Department. Coastal Zone Permits.

County of Santa Cruz. Coastal Zone Regulations.

Local Coastal Land Use Plan. Plan Pacifica 2040

State of California Sea-leve Rise Guidance: 2018 Update. City of Pacifica.

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USGS National Shoreline Change ESRI Story Map

Protection and restoration of coastal habitats yield multiple benefits for urban residents as sea levels rise. Guerry et al. 2022. npj Urban Sustainability

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Connecticut

State Strategies

· In Connecticut a large percentage of coastal properties are privately owned and 60% of the population resides in the coastal area of the state and is thus one of the most densely populated coastal zones in the USA.

· The Federal CZMA has been enforced in the state since 1980.

· Under the Tidal Wetlands Act, the State Department of Environmental Protection regulates activities such as building of structures, dredging, infilling waterward of the high tide line or in tidal wetlands.

· The shore zone in Connecticut is held in common law public trust and submerged land on the ocean side of the highwater line is held in trust for the public.

Coastal Land Use Planning and Development Regulations

· Development in the coastal zone is regulated by the Connecticut Coastal Management Act and this is administered at the local level through municipal planning, zoning boards and commissions.

· Municipalities regulate upland activities under local planning and zoning authority.

· The Town of Old Saybrook, Connecticut conducted a Coastal Resilience and Adaptation Study in 2018. The three main coastal resilience strategies were recommended for the town.

  » Protect

  » Accommodate

  » Managed Retreat

· The City of Milford with a population of 53,358 produced a Coastal Resilience Plan in 2016 as a toolbox to improve coastal resilience in the coming years. Here are some of the features of the plan.

  » Adopt freeboard that exceeds the state recommendation of 1 foot.

  » Partner with property owners to apply for FEMA mitigation grants to elevate homes.

  » Promote the Shore Up and similar home elevation loan programs.

  » Elevate sections of roads.

  » Restoration of dunes.

· Watershed management planning involves implementing land use practices and water management practices to improve and protect the quality of water.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The State has an Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures which was passed in 2012.

· This act introduced consideration of SLR, coastal flooding and erosion patterns for the first time into the planning process to help minimize damage and destruction of life and property.

· This act establishes a hierarchy or checklist of considerations that must be satisfied before a flood or erosion control structure can be authorised. This includes feasible, less environmentally damaging alternatives such as:

  » Move the house landward away from floodwaters or wave action.

  » Elevate the house vertically, preferably to the highest practical freeboard, or at least as high as FEMA standards require.

  » Restore or create a dune or vegetated slope between the house and the water to absorb storm waves and protect against erosion.

  » Create a living shoreline.

· Mitigation measures that can be considered are:

  » Provide a setback or rolling easement to enable upward migration of tidal wetlands.

  » Beach nourishment to replace the sand supply that may be adversely affected by a seawall or groin

  » Compensation for the hardening of one part of the shoreline by removing the equivalent extent of flood and erosion control structures from another part of the applicant's site or for another site. This is referred to as "No-net-increase in shoreline armouring."

Data Availability, Education, Research and Outreach

· A coastal public access awareness program has been established and a Connecticut Coastal Access Guide has been published.

· The state has a Coastal Management Manual which municipalities must follow for legislated activities in the coastal zone.

· Tools used by the state include:

  » Nature Conservancy's Coastal Resilience Mapping Portal and SLR and storm surge mapping tool.

  » Wave modelling software developed by FEMA and USACE including wave setup and runup models.

  » Shore Up Connecticut Loan Program (began in 2013).

  » A low interest loan program to provide financing to retrofit structures to be more resilient to flooding and extreme storms.

    · Loans up to $300,000 are available at 2.5% interest for up to 15 years.

    · Available for homes and small businesses.

    · Can be used to elevate homes to allow for reduced insurance rates.

· Sellers are required to disclose whether the property is in a flood hazard area but not required to disclose past flood damages.

References and Resources

State of Connecticut. Coastal Management Act Chapter 444.

State of Connecticut. Amendment to An Act Concerning the Costal Management Act and Shoreline Flood and Erosion Control Structures.

Connecticut Coastal Omnibus Bill - An Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures. Adaptation Clearinghouse. 2012

Shore Up Connecticut Loan Program. Adaptation Clearinghouse. 2013

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Delaware

State Strategies

· The federal CZMA controls development within the coastal zone.

· The Federal Water Resources Development Act of 2022 protects shorelines and improves waterways and is managed by the US Army Corps of Engineers.

» Under this Act the Army Corps have an updated emergency authority to provide greater support to Delaware's beaches after storms. The Corps will be able to enter contracts, cooperative agreements, grants and other transactions with the University of Delaware to conduct academic research.

· The state has a Coastal Zone Act which regulates new and existing manufacturing and heavy industry in the coastal zone.

· Criteria considered in a coastal zone act decision include:

» Environmental impacts

» Economic effects

» Aesthetic effects

» Number of similar facilities

» Neighbouring land uses including residential areas

» Consistency with county and municipal comprehensive planning

· Delaware has a Beach Preservation Act which declares that beaches are valuable natural features which furnish recreational opportunity and provide storm protection for persons and property, as well as an important economic resource for the people of the state.

· The 2021 Delaware climate action plan recommends creating a state-wide managed retreat plan.

· The state has requirements for disclosure during property sale transactions regarding coastal hazards such as flooding.

Coastal Land Use Planning and Development Regulations

· Rehoboth Bay and other areas have a comprehensive coastal inventory program which uses a 3- tiered approach.

» The immediate riparian zone which is evaluated for land use, tree fringe and canopy overhang.

» Shore bank, which is evaluated for height, stability, cover, natural protection.

» The shoreline, which describes the presence of shoreline structures for shore protection as well as recreational access.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· All coastal structures require a permit from the State Department of Natural Resources and Environmental Control.

· The state has a living shorelines initiative to assist with using them for stabilization.

· Motorized vehicles are prohibited on beaches except in designated areas.

Data Availability, Education, Research and Outreach

· The state has a mix of tidal wetlands and sandy beaches, similar to PEI.

· Most of the developed coastline is predominantly housing.

· A University of Delaware disaster researcher A.R. Siders promotes managed retreat to expand solutions to climate change. Retreat does not mean defeat but long-term adaptation will involve retreat.

» According to Siders, "Locally, Delaware is building faster inside the floodplain than outside of it. We are making plans for beach nourishment and where to build seawalls. We're making these decisions now, so we should be considering all the options on the table now, not just the ones that keep people in place."

· Seller is required to disclose whether a property has been damaged by a flood, whether any part of the property is within a flood zone, and whether there are any drainage or flood problems affecting the property.

References and Resources

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Delaware's Climate Action Plan

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Title 7: Conservation, Natural Resources. The Delaware Code Online.

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Striking a Balance. A Guide to Coastal Dynamics and Beach Management in Delaware. Delaware Department of Natural Resources and Environmental Control. 2004

Sediment Management Plan: Rehoboth Bay, Sussex County, Delaware. Moffatt & Nichol. 2007

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Florida

State Strategies

· CZMA, 15 CFR 923, 15 CFR 930, Chapter 380, Part II, Florida Statutes; Section 161.551, F.S

· Sea Level Impact Projection (SLIP) Study required before construction in coastal building zone.

· The State has a Coastal Management Program which is comprised of a network of agencies which implement 24 statutes which protect and enhance coastal resources in the state.

· On May 21, 2015, Governor Scott signed CS/CS/CS Senate Bill 1094 which focuses on flooding. Under this law SLR is listed as one of the causes of flood risk.

» This additional mention of SLR represents an important challenge to consider in the long-term resilience of Florida Communities.

» One example: "Policy 19.7.5. Broward County shall work with the Florida Division of Emergency Management and other agencies to incorporate SLR and increasing storm surge impacts into the remapping of potential hazard areas in coastal zones by 2015. Revised hazard area designations should better reflect the risks to communities associated with climate change and allow revaluation of suitability for development or redevelopment in these areas."

» Second example: "Policy 19.7.6. Broward County shall cooperatively develop model codes and policies to encourage post hazard redevelopment in areas with less vulnerability to storm surge, inundation, flooding, SLR and other impacts of climate change, and incentivize locally appropriate adaptation and adaptation strategies."

» In Neptune Beach, Florida the following is stated in their planning document. Page E-11: "The single greatest cause of beach erosion has been and will continue to be offshore sediment transport, which results from the rising sea level. Studies have shown that sea level has been rising at an average rate of 0.7 to 1.0 foot per century. For every foot in rise there is a loss of 30 ft of beach due to erosion. Therefore, a potential loss of 3.6 ft of beach per year exists solely from SLR."

» The Village of Pinecrest, Florida has Policy 9-1.2.2: Complete a Vulnerability Assessment for the Identification of Property and Infrastructure at Risk from SLR. The Village of Pinecrest shall complete a vulnerability assessment to further identify property, public investments, and infrastructure at risk from SLR, storm surge, groundwater contamination and other climate change related impacts by 2016 and shall update this assessment periodically as new SLR projections are published. Specifically, the Village shall complete a stormwater vulnerability assessment to further analyze vulnerability to facilities and services, including but not limited to: property; buildings; water and sewer lines; stormwater systems; roads, bridges, and all transportation infrastructure; electric sub stations; and municipal offices and facilities.

Coastal Land Use Planning and Development Regulations

· A systematic, interdisciplinary, and scientifically accepted approach in the natural sciences and construction design in conducting the study. An assessment of the flooding, inundation, and wave action damage risks relating to the coastal structure over its expected life or 50 years, whichever is less. Proponents are also required to present alternatives. Barrier Island Miami Beach has design standards that account of SLR during a 30-to-50-year time horizon. These standards include roads, stormwater outlets, seawall elevations and building finished floor elevations. The minimum base floor elevation was increased to 2.44 m NGVD. For seawalls the height requirement is now 2.21 m and for yard elevations it is 2.0 m NGVD.

· Coastal construction in the state is regulated by a variety of jurisdictions. The State of Florida has established Coastal Construction Control Lines (CCCL) on a county-by-county basis to define that portion of the beach-dune system which is subject to severe fluctuations following major storm events.

» Permits from the Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems are required for most structures constructed seaward of the established CCCL.

» Typically, a proposed residential structure must be located as far landward as possible, must not advance an existing line of construction, and must be elevated above the calculated storm surge and wind driven waves associated with a 100-year storm event. The structure must be constructed on pilings with ground level walls constructed of breakaway material. Under the Statewide Florida Building Code, the technical construction details applicable to structures to be constructed seaward of the CCCL are regulated through the building permits required by counties and municipalities.

» Structures to be constructed seaward of the established CCCL are required to be elevated upon piles. The piles are to be designed to be embedded deep enough to remain structurally sound after the predicted loss of several feet of soil during a hurricane event. The structure is required to be elevated to a height such that the water associated with a hurricane storm surge and wind-blown waves can pass safely below the first horizontal beam supporting the living floor of the structure. This elevation, called the "design storm elevation" or "100-year elevation" is measured from the bottom of the first horizontal structural member to mean sea level.

· City of Punta Gorda Adaptation Plan by SW Florida Regional Planning Council. Comprehensive plan of 2009 is a model for public engagement.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Florida has 825 miles of sandy coastline which are being impacted due to storms, natural events and SLR. More than 50% of this total are considered critically eroded. Critically eroded shoreline" is described as, "a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost.

· The state-financed constructor is solely responsible for ensuring that the study submitted to the Department meets the established standards. If a state-financed constructor begins construction of a coastal structure without first submitting a SLIP study as required, then the Department is authorized to institute a civil action, for injunctive relief to cease further construction of the coastal structure and recovery of all or a portion of state funds expended on the coastal structure.

· The state maintains a living shoreline database.

Data Availability, Education, Research and Outreach

· The State has an Adaptation Planning Guidebook (2018) which is comprehensive.

· A coral reef protection act fact sheet is available.

· Florida has no regulatory requirements for a seller to disclose a property's flood risks or past damage.

References and Resources

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How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Georgia

State Strategies

· Georgia has a Coastal Management Program (GCMP).

· The GCMP offers technical assistance to local governments, property owners, developers, and the public to provide expertise on coastal issues, minimize environmental impacts, clarify regulatory requirements, and identify agency contacts.

» Support and enhance public access with more than 100 locations in the coastal zone.

» Invested more than $2 million in coastal hazards planning.

» The state has an ecosystem report card.

· Georgia has a Coastal Regional Commission Planning Department which has produced a "Coastal Georgia Regional Plan 2022.

» One of the goals is to build an environmentally resilient region, equipped to confront the threats of climate change.

» Conserve the sense of place and identity and maintain a hub for visitors and residents to experience the unique character of coastal Georgia.

» There are 6 coastal counties in Georgia with storm surge values reaching nearly 30 ft in some low-lying areas during a category 5 hurricane. (College of Coastal Georgia building).

· The Georgia Coastal Marshlands Protection Act protects marshlands from development and 80% of the barrier islands' lands are protected by federal, state and land trust conservation.

» There is a development setback of at least 50 ft from coastal marshland.

Coastal Land Use Planning and Development Regulations

· The Georgia Planning Act requires all counties to complete a comprehensive land use plan.

» Coastal marshlands must have an established buffer of 25 ft measured horizontally from the coast marshland-upland interface.

» In Macintosh County areas are susceptible to Category 1 to 3 storm surges with 30% of developed areas at risk to a category 3 hurricane storm surge.

· The Georgia Farmland Conservation Fund Program works with farmers to voluntarily restrict their right to develop farmland with priority given to project proposals that protect agricultural lands susceptible to development, subdivision, and fragmentation.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The average erosion rates on the Georgia coastline are 1 to 2 ft per year. (Georgia Sea Grant)

· There are statutory requirements and policies for limiting hard structures, smaller stabilization projects are allowed without a permit.

· Non-structural approaches to shoreline stabilization are encouraged and it is required that no reasonable or viable alternative exists before permitting construction of shoreline stabilization structures.

· Groins and jetties are included as a 'first alternative' method of coastal armoring, along with beach nourishment.

· Following declared emergencies, the construction of coastal armoring can occur immediately and without a permit.

· Living shorelines and oyster reefs are promoted in the state.

Data Availability, Education, Research and Outreach

· The state has a living shoreline fact sheet.

· A study of recent home buyers in Glynn County, Georgia in 2018, found some interesting results about individual attitudes and perceptions of the need for flood insurance. (Landry and Turner, 2020).

» 62% of households had flood insurance policies with a mean annual premium of $1313 USD with a deductible of $1000 USD.

» 50% of the respondents indicated their household was their primary residence.

» 70% of the respondents properly identified their flood risk zone classification.

» The average respondent indicated that 33% of their wealth was represented by their coastal property.

» 41% of respondents were new coastal property owners.

» 15% had experienced some flooding damage.

» 3% had flood damage more than once.

» 61% agreed that coastal storms would be worse in the future.

» 54% expected that coastal armouring would be effective in mitigating future damage.

» Most residents believed that they would face more Category 3 hurricanes than predicted by NOAA.

» 46% of respondents were worried about the loss of their home due to a natural disaster.

· Georgia has no regulatory requirements for a seller to disclose a property's flood risks or past damage.

References and Resources

Georgia Coastal Management Program. Department of Natural Resources.

Coastal Management Program Online Mapping Tools. Georgia Department of Natural Resources.

Coastal Regional Plan. Coastal Regional Commission of Georgia.

Living Shorelines. ESRI Story Map. Georgia Department of Natural Resources.

State of Georgia, Storm Surge Inundation Map. ESRI

McIntosh Country Flood Risk. FEMA Flood Zones. Coastal Regional Commission GIS Department 2020.

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Hawaii

State Strategies

· The State Office of Planning and Sustainable Development manages the State CZM program.

  » Efforts are made to combine local expertise (Indigenous knowledge) with western science to create a balanced approach.

  » The restoration of natural resources for the coastal zone is a major policy initiative of the state.

  » All state and county agencies are required to enforce the CZM objectives and policies defined in the legislation.

· At the local level, counties are key partners and serve as authorities to administer and enforce special management area permitting and shoreline setback requirements.

  » The state and counties emphasize the use of place-based strategies to address shoreline management in the state.

Coastal Land Use Planning and Development Regulations

· No development is allowed within the special management area without obtained a SMA permit.

· Kauai County Government ordinance #863, "Shoreline Setback and Coastal Protection Ordinance"

· The shoreline environment is one of Kauai's most important economic and natural resources. Beaches and coastal area are part of the public trust and it is gov'ts fiduciary responsibility to protect beaches and coastal areas.

· The county is taking a proactive approach to managing coastal areas.

· The county is working with the University of Hawaii, Coastal Geology group to develop GIS layers such as:

  » Lot depth calculations

  » Shoreline changes

  » Erosion hazard zone with 3.2 ft SLR exposure

· This information will be used to help understand the management and regulation of vulnerable coastal areas.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Hawaii's coastal erosion rate ranges from 0.5 to 1.0 ft per year.

· The state has found that beaches are 50 to 75 % narrower in front of seawalls.

· The state maintains a coastal erosion website.

· Shoreline protection structures required permits beginning in 1970 with a setback requirements of 40 ft in most cases.

Data Availability, Education, Research and Outreach

· Hawaii shoreline study web shows shoreline change rate at a # of transects. The State of Hawaii enacted an update to the Mandatory Seller Disclosures in Real Estate Transactions Law in 2021, codified within Hawaii Revised Statutes §508D-15, requiring that real estate transactions within the State of Hawaii must disclose any risk of sea level rise to that property based on the 3.2-ft Sea Level Rise Exposure Area (SLR-XA).

· The state monitors coastal groundwater to identify SLR related infrastructure impacts.

  » Groundwater level changes can lead to coastal infrastructure damage thus simulations of sea level rise impact on groundwater may have on roads, drainage networks etc. Heavy rainfall impacts on groundwater levels is also being considered.

· Monitoring and modelling of shoreline change is also conducted.

· Wave run up forecasting is modelled using hydrodynamic models.

· Extreme tides are also being monitored with tide gauges in various harbours.

· Identification of costs and trade-offs in SLR response strategies.

  » Retreat scenarios are being assessed in a case study on the North Shore of O'ahu by the Institute for Sustainability and Resilience at the University of Hawaii at Manoa.

» Future work is going to include protect, accommodate, and retreat options.

· Sellers are required to disclose if a property is in a designated special flood hazard area, including whether the property lies within the Sea Level Rise Exposure Area. Sellers are not required to disclose information on whether there has been previous damage to the property.

References and Resources

Hawaii SMA Locator. Hawaii Statewide GIS Program, Office of Planning, State of Hawaii

Climate Resilience Collaborative. School of Ocean and Earth Science and Technology (SOEST). University of Hawaii.

State of Hawaii, Climate Change Portal

Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Ares in Hawai'i. Final Report. 2019

40% of O'ahu beaches could be lost by mid-century. University of Hawai'i at Manoa. M. Grabowski. 2020

Managing retreat for sandy beach areas under sea level rise. Setter et al. 2023

Shoreline Setback Ordinance. Ordinance No. 863. January 2008

Adapting Sea Level Rise and Coastal Erosion Hawaii. Climate Adaptation Knowledge Exchange. Kershner. 2021

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Sea Level Rise: STate of Hawai'i Sea Level Rise Viewer. NOAA 2016

Louisiana

State Strategies

· Louisiana has a comprehensive master plan for a sustainable coast. (2023).

» The coastal wetland and estuary geomorphology and ecosystem of Louisiana is similar to part of PEI coastline, which can provide mature experience for the management on these specific types of coasts.

· The Louisiana Comprehensive Master Plan for a Sustainable Coast provides recommendations of development control to help minimize the risk of damage from natural hazards, protect natural resources, and promote the long-term resilience of coastal communities. The recommendations include:

· Limiting development in areas at high risk of coastal erosion, flooding, and storm surge.

» Encouraging development in areas that are less vulnerable to coastal hazards, such as higher ground and areas with natural buffers like wetlands and barrier islands.

» Promoting sustainable development practices that reduce the environmental impact of development, such as the use of green infrastructure and the protection of natural habitats.

» Encouraging the use of elevation standards and building codes that can help reduce the risk of flood damage and other hazards.

» Working with local governments to update land use plans and zoning regulations to reflect the risks and challenges of coastal development.

» Promoting public education and outreach to help residents and businesses understand the risks and benefits of development in coastal areas.

» Green infrastructure: To use green infrastructure, such as vegetated swales, rain gardens, and bioswales, to manage stormwater runoff and reduce the impact of development on natural habitats.

» Building standards: To use building standards and codes that are designed to reduce the risk of damage from coastal hazards, such as hurricanes and flooding. This includes requirements for elevation, floodproofing, and wind-resistant construction.

» Coastal protection: To use natural and nature-based approaches to protect coastal areas from erosion and storm surge. This includes the restoration of wetlands, dunes, and barrier islands, as well as the use of living shorelines and other natural features.

» Transportation: To use transportation systems that are designed to be resilient in the face of coastal hazards. This includes the use of elevated roadways, bridges, and transit systems that are less vulnerable to flooding and storm surge.

» Sustainable development: Promoting sustainable development practices, such as the use of renewable energy, energy-efficient buildings, and sustainable agriculture. These practices can help reduce the impact of development on natural resources and promote long-term sustainability.

» The plan's decision-making processes are transparent, including the following elements:

· Open Meetings: The plan's decision-making processes are conducted through open meetings that are accessible to the public. This ensures that the plan's decisions are made in a transparent and inclusive manner.

· Public Comment: The plan provides opportunities for public comment on its proposals and recommendations. This allows the public to provide feedback on the plan's decisions and to raise any concerns or issues.

· Data Access: The plan makes its data and information publicly available through a variety of channels, including its website, reports, and other documents. This allows the public to access and review the data used in the plan's decision-making processes.

· Records Requests: The plan has a process in place for responding to public records requests. This ensures that members of the public can access relevant documents and information related to the plan's decision-making processes.

· Conflict of Interest: The plan has a conflict-of-interest policy in place to ensure that decision-makers do not have personal or financial interests that could influence their decision-making.

Coastal Land Use Planning and Development Regulations

· The Office of Coastal Management of the State Department of Natural Resources regulates development activities and manages the resources of the coastal zone in the state.

» The Office of Coastal Management has a permits/mitigation division which regulates development activities and manages the coastal resources of the Coastal Zone.

» The basic regulatory tool is a Coastal Use Permit which is required for many activities including.

· Dredge and fill work.

· Bulkhead construction.

· Shoreline maintenance.

· Other development projects.

» The purpose of the Coastal Use Permit is to make certain that any activity affecting the coastal zone is performed in accordance with established guidelines to prevent loss of wetlands and aquatic resources and to reduce conflicts of interest between coastal resource users.

· The Community of Isle de Jean Charles in Louisiana received $48.3M federal funding for relocation due to climate and manmade risks.

» This island was once 22,000 acres in area but in 2023 only 320 acres remain.

» The only road to the mainland, built in 1953 is frequently impassible due to high winds, tides, SLR or storm surge.

» A new Isle is a planned community of 500 homes, walking trails, commercial space, community center and other amenities.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Louisiana unveiled a 50-year, $50 billion plan to restore its eroding coastline in January 2023.

» The Coastal Protection and Restoration Authority must update its coastal master plan every 6 years guided by latest science available.

» The State has set a threshold of 14 ft or more of storm surge during a storm event (1:100-year event).

· The barrier islands in Louisiana are eroding at rates up to 20 m per year and the USGS expects some will disappear by the end of this century.

Data Availability, Education, Research and Outreach

· A coastal use permit database is available to the public.

· Data collection techniques: satellite observation, field sampling, modeling, surveys, monitoring, analysis of existing data.

· A seller is required to disclose the following: any flooding, water intrusion, accomulation or drainage problem on the land being sold; if the property is in a flood zone, and if yes, the flood zone classification; an elevation certificate; past damages to any structures; if there is flood insurance on the property; details on the history of federal disaster aid received for the property.

References and Resources

Louisiana Coastal Wetlands: A Resource At Risk. USGS Coastal and Marine Geology Program

Louisiana unveils update to 50-year, $50 billion plan to restore its eroding coastline. WWNO - New Orleans Public Radio. H. Parker 2023

Isle de Jean Charles Resettlement. Louisiana Office of Community Development. Louisiana Division of Administration

State of Louisiana. Department of Natural Resources. Office of Coastal Management: Permits/ Mitigation Division

A Coastal User's Guide to the Louisiana Coastal Resources Program. Louisiana Department of Natural Resources. Office of Coastal Management.

Flood Risk Disclosure. Model State Requirements for Disclosing Flood Risk During Real Estate Transactions. July 2022. FEMA

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Maine

State Strategies

· Maine like other states is required to follow the requirements of the federal Coastal Zone Management Act

» The Maine Coastal program is managed by the Department of Marine Resources. These plans are submitted to NOAA for approval and have to be updated in 5-year cycles.

» An Assessment and Strategy has been developed under Section 309 of this act.

Coastal Land Use Planning and Development Regulations

· Maine has a mandatory Shoreland Zoning Act (MSZA) which requires regulation of land use activities in the coastal zone

· The shoreland zone is comprised of all land areas within 250 ft, horizontal distance, of the

» normal high-water line of any great pond or river

» upland edge of a coastal wetland, including all areas affected by tidal action

» upland edge of defined freshwater wetlands

» all land areas within 75 ft, horizontal distance, of the normal high-water line of certain streams

· Protected areas are defined as 100-year flood zones, significant wetlands, steep slopes >20%.

· Developments excluding single family residences must be set back 250 ft from the highwater line.

· A 75-foot setback is required for residential development and 25 ft for general development.

· New structures must be placed on posts a minimum of 3 ft above grade.

· All proposed development within the sand dune system must show site stability over the next 100 years and allow for 3 ft of SLR.

· A permit is not required for maintenance or repair activities to a structure that has been destroyed by <50%.

· Shoreland zoning regulations are administered and enforced by each municipality through municipal specific ordinances, the local code enforcement officer is typically the first point of contact for shoreland zoning questions. Shoreland Zoning Staff at the MDEP assist municipalities with shoreland zoning related questions and issues, as well as provide technical assistance and training on the shoreland zoning rules.

· Municipalities which don't comply with this requirement can be ordered by the State Board of Environmental Protection to comply.

· The State has an information sheet on Guidelines for Restoration Plan for Shoreland Clearing Violations, issued in 2007. A buffer of trees is required under the act to protect water reduce overland flow. A qualified professional is required to design the restoration plan for sites in violation of this requirement.

» At least one tree must be planted for each tree cut in violation and should be replaced by trees of equal size and diameter.

» Saplings and shrubs must also be replaced to help prevent erosion and complement visual screening.

» Municipalities in Maine are required to adopt, administer and enforce ordinances which regulate land use activities within 250 ft of great ponds, rives, freshwater and coastal wetlands including all tidal waters; and within 75 ft of streams.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Maine has a guideline document for coastal property owners prepared by the Maine Geological Survey.

» Coastal property owners are encouraged to develop a short and long-term hazard management plan for their properties.

» The document provides background information on various hazards with explanations of the importance of knowing more about the facts of living in a coastal environment.

· Maine has a Natural Resource Protection Act which requires a permit for all shoreline stabilization activities.

· The Maine Geological Survey has a Living Shorelines Decision Support Tool in map format.

Project needs	Activities	Outputs	Outcomes	Impact
The following information is required to address community issues and mangaement decisions. 1. Erosion causes and effects 2. Land uses 3. BMPs 4. Priorities 5. Concerns Planned Work	If information needs are fulfilled then shoreline erosion management standards can be developed. 1. Organize working group(s) for information sharing 2. Report findings	If management standards are developed then policy changes can be made. 1. Staff prepares recommendations based on working group report 2. Town Council considers adoption	If standards are implemented then citizens, staff, and review entities will benefit from informed decision-making and predictable project reviews.	If informed decision-making, and predictable reviews are achieved then a positive response from stakeholders and the equitable protection of natural systems is expected. Intended Result

Table 3. Brunswick Maine, Logic Model for Shoreline Erosion Management. Source: Brunswick, Maine Shoreline Erosion Management 2023

· This provides information on the potential suitability for a living shoreline approach.

  · Areas not suitable for living shoreline includes areas susceptible to high energy waves with a rocky shoreline.

  · Highly suitable areas include low-energy coastal bluff or wetlands.

  · There aren't any best management practices for Living Shorelines in Maine.

» Brunswick, Maine requires consideration of projects for Shoreline erosion Management. The Town of Brunswick has a working group which is developing shoreline options for living shorelines.

» The Logic Model shown on Table 4 depicts the planned work and the intended results for shoreline erosion management in the town.

» Within the shoreland zone, including areas greater than 100 ft from the water, no more than 40% of the total basal area of trees four inches or more in diameter, measured at 4.5 ft above the ground level, may be removed in any ten-year period.

Data Availability, Education, Research and Outreach

· The University of Maine used mail outs to 7000 coastal property owners to inform and survey residents of climate variability and climate change as part of the development and testing of a national model of state-based outreach campaign,

· The state has state of the beach reports which cover topics like beach erosion.

· The state has collected data on coastal hazards, salt marshes (elevation/depth/vegetation), tidal restriction surveys, aquatic resources, rare plant populations, dune and beach changes, topographic data, dune/berm/beach volume, SLR, wave history.

· Maine has no regulatory requirements for a seller to disclose a property's flood risks or past damage.

References and Resources

Mandatory Shoreland Zoning. Maine Department of Environmental Protection.

Living Shorelines Decision Support Tool. Maine Department of Agriculture, Conservation and Forestry. Maine Geological Survey

Living shorelines: What they are and why they are great from Maine's Shorelines. Maine Lakes Youtube Video.

General Standards for Vegetation Clearing. Maine Land Use Planning Commission. Department of Agriculture, Conservation and Forestry.

Maine Coastal Property Owner's Guide to Erosion, Flooding and Other Hazards, 2nd Edition. Slovinsky, 2021

Use Caution When Clearing Vegetation in the Shoreland Zone. Andrew Hill Legal LLC. Brunswick Maine Legal Services. 2017

Building a Resilient Coast. Climate Variability and Coastal Community Resilience: Developing and Testing a National Model of State-based Outreach. White et al. 2010. Maine Sea Grant Publications. The University of Maine.

Clearing Vegetation in the Shoreland Zone (Issue Profile) Maine Department of Environmental Protection. 2018

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Maryland

State Strategies

· The Federal CZMA prescribes what activities require a federal license or permit and what stipulations must be met to obtain federal funding and insurance coverage for coastal developments.

· The Chesapeake & Coastal Service is responsible for maintaining and updating Maryland's enforceable coastal policies achieve consistency with federal requirements and vice versa.

· The state of Maryland has many enforceable coastal policies.

» Tidal wetlands act

» Habitat protection areas

» Critical area regulations

» Shoreline protection works regulations.

» Living Shoreline Protection Act

· Maryland has a Coast Smart Council which was formed in 2014 via House Bill 615. The scope of his council was expanded in 2018 to include "Sea Level Rise Inundation and Coastal Flooding - Construction, Adaptation, and Mitigation" via House Bill 1350.

· NOAA has conducted coastal zone assessments in Maryland.

· The state has conducted many programs and assessments for the coastal zone.

· The state has a shoreline similar to the south shore of PEI.

Coastal Land Use Planning and Development Regulations

· The Critical Areas Act has defined all land within 1000 ft of the mean highwater mark as sensitive.

» In a critical area a 100 ft vegetated buffer should be maintained landward of the mean highwater mark.

· Buffer management plans are required.

· Existing levels of coastal habitat must be maintained for all proposed redevelopments.

· Forest planting is required to maintain 15% forest cover in sensitive areas.

· Maryland State parks published some climate change and resiliency plans in 2022.

» Increased monitoring of water levels, erosion rates etc.

» Updates to buildings

» Land acquisition to allow relocation.

» Protect local species.

» Emphasis on beach nourishment, marsh regeneration and living shorelines.

· The Coast Smart program has a requirement that the lowest floor elevation above the base floor elevation of proposed structures located within a Special Flood Hazard Area be built at an elevation of at least 2 ft above the base flood elevation with some exemptions available.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Tidal erosion control measures are listed in order of preference.

» None or retreat

» Non-structural shoreline protection

» Stabilization designed to ensure long-term viability of non-structural stabilization projects

» Revetments

» Breakwaters

» Groynes

» Bulkheads

· Tidal erosion measures should not occur if

» There is no evidence of erosion

» Existing tidal wetlands are serving as a buffer

» Adjacent properties may be adversely affected (offsets are considered)

» Navigation may not be adversely affected (offsets are considered)

» Species are threatened or significant historical resources may be adversely impacted

» Natural oyster bars or private leases may be adversely affected

Data Availability, Education, Research and Outreach

· Maryland has a coastal atlas which includes many layers from geological survey, SLR vulnerability, storm surge, living resources etc.

· A regional online data portal (MARCO) is available and contains data layers pertaining to administration, fishing, maritime activity, recreation, renewable energy, security, marine life, oceanography and more.

· The State has a CoastSmart Communities program which is dedicated to assessing short- and long-term coastal hazards posed by flooding, storm surge and SLR.

· The state produces many guidance or educational pamphlets or documents.

» Shore erosion control guidelines for shorefront developers.

» Shore erosion control – the natural approach.

» Shoreline stabilization factsheet.

» A Citizen's Guide to the Critical Area program.

» Chesapeake Bay Shoreline Erosion in Maryland: A Management Guide.

· Sellers are required to disclose whether the property is located in a flood zone, conservation area, wetland or Chesapeake Bay critical area, but they are not required to disclose whether that has been flood damage.

References and Resources

Maryland Coastasl Zone Management Program Enforceable Policies

Building Resilience in the Maryland Coastal Bays, State of the Bays. Maryland Coastal Bays Program and University of maryland Center for Environmental Science. 2022

Maryland is Coast Smart with Climate Ready Action Boundary. FEMA Maryland. 2021

Maryland CoastSmart Council. Maryland Department of Natural Resources

Coast Smart. Infrastructure and Development. Maryland Department of Planning.

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Massachusetts

State Strategies

· Massachusetts Office of Coastal Zone Management (CZM) is the lead policy, planning and technical assistance agency for coastal zone issues for the Executive Office of Energy and Environmental Affairs (EEA) and implements the state's coastal program under the federal Coastal Zone Management Act. This office has a number of programs including:

· Coastal Habitat

  » Provides grants for many projects including development of habitat restoration plans, data collection and synthesis, natural resource assessments, restoration prioritization work.

  » Capacity building including training for municipal staff, bylaw development and case studies.

· Coastal Water Quality

· Federal consistency review

· Ocean Management

· Port and Harbour Planning

· Public Access and Coast Guide

  » Where to purchase native plants

  » Barrier Beach Management and inventory.

  » Guidelines for Barrier Beach Management in Massachusetts.

· Massachusetts Coastal Hazards Commission

  » Preparing for the storm Recommendations for Management of Risk from Coastal Hazards.

    · Including a rating system on the condition of coastal structures.

  » Inventory of Public Seawalls and other Structures. Oct 2009.

    · All coastal infrastructure data are available in the Massachusetts Ocean Resource Information System (MORIS). Massachusetts Coastal Erosion Viewer

Coastal Land Use Planning and Development Regulations

· The Massachusetts Office of Coastal Zone Management is the lead policy and planning agency on coastal and ocean issues within the state.

  » The state is divided into 5 coastal regions and includes 78 coastal communities.

  » The State has produced story map tours of these 5 regions.

· The State of Massachusetts has a Wetlands Protection Act (Chapter 131, Section 40), which protects wetlands and the public interests they serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fisheries, land containing shellfish, and wildlife habitat. These public interests are protected by requiring a careful review of proposed work that may alter wetlands. The law protects not only wetlands, but other resource areas, such as land subject to flooding (100-year floodplains), the riverfront area (added by the Rivers Protection Act), and land under water bodies, waterways, salt ponds, fish runs, and the ocean. The law regulates many types of work in resource areas, including vegetation removal, regrading, and construction of houses, additions, decks, driveways, and commercial or industrial buildings. If you want to work in a wetland resource area or within 100 ft of a wetland (an area called the buffer zone), persons must contact the local conservation commission before work is started. The commission visits every site to verify the boundaries of the wetland area. Public hearings are held prior to issuance of a permit.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The USGS Massachusetts Shoreline Change Project compiled a GIS compilation of Shoreline Change Rates using Digital Shoreline Analysis system up to 2021.

· Seafloor and Habitat Mapping

  » Coastal Resilience Grant program provides grants to municipalities and non-profit

organizations to advance innovative local efforts to address coastal flooding, erosion and SLR impacts via a number of methods.

» Shoreline Change Project to document erosion and accretion along the coast complete with interactive map back to the mid-1800s.

» Coastal landscaping project which provides many resources to maximize the success of shoreline projects.

- Benefits of coastal landscaping
- Landscaping a coastal bank
- Landscaping a coastal beach or dune
- Tips for planting, installation, and maintenance

» When do you need a permit? Areas with endangered species. Areas near wetlands. 100-foot buffer zone. Clearing or pruning naturally vegetated areas. Filling or grading within the 100-foot buffer zone. Cutting a path to the shoreline. Construction of buildings, sheds, septic systems, seawalls

- Plant list with images etc.
- Sample landscape plans.

· The Local Conservation Commission, Mass Dept of Environmental Protection oversees the regulation of Living Shorelines in the state.

» The document "Living Shorelines in New England: State of the Practice, 2017, Woods Hole Group for the Nature Conservancy" outlines the various types of living shorelines and provides some design information.

» Salem Sound Coastwatch project at Collins Cove Salt Marsh used natural approaches to mitigation of coastal erosion vs hardened techniques.

» Comparison of two shoreline stabilization projects in Boston Harbour (nature based vs grey hardening), 2021, Castagno et all, Wiley.

- 60% of Boston harbour protected by hard structures (first one built in 1784).
- Encore Boston Harbour (hotel) & Charlestown bus facility combined living shoreline and traditional grey infrastructure projects.
- The Charlestown project was on a 2:1 slope using geogrid fabric, 125,000 native plants above the MHHW. Below the MHHW mark the shoreline has riprap revetment. There are 3m tidal fluctuations in the area.
- This project required permits from 5 different agencies.
- The Encore project also planted plants in the salt marsh area and a coir-wrapped rock roll of 11-45 kg cobbles on the coastal bank.
- Outside groups influenced the decision to use the combined approaches for both projects.

Data Availability, Education, Research and Outreach

· Public Access and Coast Guide, Where to purchase native plants

· Barrier Beach Management and inventor, Guidelines for Barrier Beach Management in Massachusetts

· Massachusetts Coastal Hazards Commission

» Preparing for the storm Recommendations for Management of Risk from Coastal Hazards.

» Including a rating system on the condition of coastal structures.

» Inventory of Public Seawalls and other Structures. Oct 2009.

» All coastal infrastructure data are available in the Massachusetts Ocean Resource Information System (MORIS).

» Massachusetts Coastal Erosion Viewer

· StormSmart Coasts – Managing Erosion and Flooding

» StormSmart Properties provides tools for homeowners to reduce coastal erosion and storm damage and minimize damage to adjacent properties.

- » StormSmart Communities helps official prepare to and protect their communities from coastal storms and flooding.
  - · Home Builders Guide for Coastal Construction with 37 fact sheets. FEMA P-499.
  - · Coastal Construction manual. FEMA P-55, August 2011
  - · Free of Obstruction Requirements. FEMA NFIP Technical Bulletin 5, March 2020.
  - · How to elevate your home,
  - · National flood insurance program
  - · FEMA Mitigation reports on major hurricanes
- · Mapping and Data Management
  - » Shoreline change maps and data.
  - » SLR and Coastal Flooding viewer
    - · Assessment of coastal flooding vulnerability and risk for community facilities and infrastructure consistent with Executive Order 569 which establishes an integrated climate change strategy for the Commonwealth.
    - · Has a section of hurricane surge which provides 4 worst case scenarios of storm surge based on modelled combinations of hurricane intensity.
  - » CZM Grant viewer
  - » Seafloor and habitat mapping
  - » Coastal orthophotos (1:10,000 scale) using 1994 coastal aerial imagery.
- · MyCoast is a project of the Massachusetts Office of Coastal Zone Management where individuals can add photos and observations and the state computer servers retrieve weather and tidal info to add context to the photo. This provides additional information for coastal managers to assist them in making more informed decisions.
  - » There are MyCoast Tools which can be used to view and submit reports on King Tides, Storm Reports, Coastal Resilience and CoastSnap which is a tool to track coastal change.
- · Massachusetts has no regulatory requirements for a seller to disclose a property's flood risks or past damage.

References and Resources

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Massachusetts Office of Coastal Zone Management (CZM)

Massachusetts Coastal Zone Management Policy Guide 2011

Massachusetts Shoreline Change Project, 2021 Update: A GIS Compilation of Shoreline Change Rates Calculated Using Digital Shoreline Analysis System Version 5.1, With Supplementary Intersects and Baselines for Massachusetts

MyCoast. Massachusetts.

Protecting Wetlands in Massachusetts. Commonwealth of Massachusetts. Department of Environmental Protection

Living Shorelines in New England: State of the Practice, Woods Hole Group Inc. 2017

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

New Hampshire

State Strategies

· The New Hampshire Coastal Program under the federal Coastal Zone Management Act protects clean water, restores coastal habitats, and helps make communities more resilient to flooding.

» This program is administered by the New Hampshire Department of Environmental Services.

» The state is a member of the Coastal States Organization.

Coastal Land Use Planning and Development Regulations

· New Hampshire has a statewide standardized setback for all new coastal structures in the regulated coastal zone, which includes all the state's coastal municipalities.

· Shoreland Water Quality Protection Act Standards, a state shoreland permit is required for construction, excavation or filling activities not included in the exemptions detailed in the law, within 250 ft of the reference line. For coastal waters the reference line is the highest observable tide line.

· The protected shoreland are those lands located within 250 ft of the reference line of public waters; this 250 ft is measured from the reference line horizontally as measured from a bird's eye view. Public waters include:

» Lakes, ponds and impoundments greater than 10 acres;

» Year-round flowing waters (streams and rivers) of fourth order or higher;

» Designated rivers and river segments; and

» Coastal waters, being all waters subject to the ebb and flow of the tide, including the Great Bay Estuary and associated tidal rivers, tidal marshes, rivers, and estuaries.

· The woodland buffer is the area of the protected shoreland located within 150 ft of the reference line of public waters, measured horizontally. The woodland buffer includes the waterfront buffer, which is the area located within 50 ft of the reference line.

· New Hampshire's coastal waters were recently designated as a No Discharge Area. While boating in a No Discharge Area, marine sanitation devices must be secured to ensure overboard discharge is not occurring.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The waterfront buffer is the area of the protected shoreland located within 50 ft of the reference line elevation of public waters, measured horizontally.

· New Hampshire expanded its NOAA-approved coastal zone management area by 700% and increased wetland and shoreland enforcement personnel in the coastal zone by 25%.

Data Availability, Education, Research and Outreach

· 32.6% of the state population live in coastal areas with $10.5 billion in annual wages for coastal employment (42 coastal towns and cities)

· There have been 5 climate and weather disasters that affected the state between 2010 and 2018. (Hurricane Sandy was the worst in Oct. 2012)

· The University of New Hampshire has a coastal habitat restoration team engaged in dune restoration, public education, and outreach for the towns of Seabrook and Hampton in NH. These are grant funded.

· New Hampshire has a Living Shoreline Site Suitability Assessment Tool (L3SA) to help stakeholders identify suitable locations and creates an index of suitability on a scale of 1 to 6.

» A free Property Profile summarizing living shoreline suitability results is available from the NH Coastal Program.

» Great Bay Living Shoreline Project protects marshes and habitat from erosion, SLR and flooding.

» The State also has planting guide for shoreline landowners that can help landowners select species to manage erosion near a tidal shoreline.

» The state is working to advance understanding of living shoreline approaches in New England and is a member of the Northeast Regional

Ocean Council (NROC) and Nature Conservancy Massachusetts (TMC-MA)

- The state completed an inventory of completed hard shoreline stabilization structures in 2016.
  - » 12% of the state shoreline was armoured with structures such as seawalls, rip rap and revetments.
- New Hampshire has no regulatory requirements for a seller to disclose a property's flood risks or past damage.

References and Resources

Protected Shoreland FAQ. New Hampshire Department of Environmental Services.

New Hampshire Coastal Management Fact Sheet

Living Shorelines. Nature-based approaches for shoreline stabilization in tidal waters. New Hampshire Department of Environmental Services.

New Hampshire Coastal Viewer. 2023

Planting Guide for Tidal Shoreline Erosion Management in New Hampshire. New Hampshire Department of Environmental Services Coastal Program

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

New Jersey

State Strategies

· CZMA, Coastal Zone Management Rules, CARFA, Wetlands Act; Waterfront Development Act, FEMA Code, Municipal codes

» 17 of New Jersey's 21 counties are coastal and these counties are home to 80% of the state population.

» At Sea Isle, NJ, 200 homeowners summoned to court over not complying with FEMA flood vent requirements. Fines amounted to $500 per day.

Coastal Land Use Planning and Development Regulations

· New Jersey has a Shore Protection Program to protect life and property along the coast.

· 36 years of State regulation of the coastal zone has produced a large volume of policy designed to guide a safer development history especially along the inlet and oceanfront shorelines. Implemented by the Land Use Regulation Program (LURP) within the New Jersey Department of Environmental Protection (NJDEP), the shore protection aspect of the regulation has focused on building design, setbacks from the shoreline and the creation of a wider beach with a storm-resistant dune system built between the development and the beach.

· At Sea Isle, NJ, FEMA code requires 11-ft vertical setback in an "AE" zone and 14 ft in a "V" zone.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The Bureau of Coastal Engineering and Construction within the Dept of Environmental Protection Natural and Historic Resources group is responsible for administration of beach nourishment, shore protection, and coastal dredging throughout the state.

· The NJ Coastal Management Program is the lead agency related to coastal erosion in the state.

» Erosion and flooding are the primary coastal hazards and 43% of the coastline of New Jersey is armoured.

Data Availability, Education, Research and Outreach

· SLR since 1980 has increased the number of current homes at risk to flooding by about 110%. There are 27,000 more buildings worth a combined $15 Billion likely to flood at least once a year.

· The Richard Stockton College Coastal Research Center began studying how susceptible the New Jersey coastal communities were to storm damage from dune breaching and overwash during storms after 2004.

· Use a Stillwater elevation (SWEL) plus wave effect (BFE = SWEL + wave effect) resulting from a flood that has a 1% or greater chance of being equaled or exceeded in any given year. (Sea Isle Code)

· The state tracks beach volume and shoreline position changes in areas like Atlantic County.

· Have conducted a coastal resilience questionnaire to gauge public understanding of the issue.

· Base flood prevention for insurance purposes. Recent SLR has more than doubled tidal flooding risk in NJ. Sea levels are rising 2X the global average as subsidence is causing the land to sink.

· Use special tools such as MARCO Data portal; GIS Based Coastal Community Vulnerability Assessment Protocol.

· New Jersey adopted new laws relating to disclosure in 2023, and a seller must now disclose the following:

» if the property is wholly or partially within the 100-year or 500-year floodplain

» if the property is under federal law to obtain and maintain flood insurance and whether the property currently has flood insurance

» if there was ever been a claim for flood damage to an insurance provider including the National Flood Insurance Program

» history of disaster relief received from FEMA, or any other program

» if the property has experienced flood damage due to a natural flood event, including rainfall, storm surge, tidal inundation, or river overflow, and if yes, how many time.

References and Resources

New Jersey's Rising Coastal Risk. Rhodium Group

New Jersey Coastal Data. State of New Jersey Department of Environmental Protection Coastal Management Program.

Coastal Erosion and Sea Level Rise. NJOEM Hazard Mitigation Program. Section 5.2

NJ Shoreline Protection and Vulnerability. Stockton University

Jersey Shore. The Disappearing beach. NJ True Jersey 2023

Watershed and Land Management. Official Site of the State of New Jersey. Department of Environmental Protection

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

New York

State Strategies

· The State has a Coastal Erosion Hazard Areas (CEHA) law which seeks to protect the built and natural shoreline environment in the state. Beaches, bluffs, dunes, and nearshore areas are mapped and regulated by this law.

» The CEHA restricts the siting of shoreline structures in designated areas to maintain the integrity of natural protected features and to reduce risks to shoreline communities.

» The State preference under CEHA is to promote non-structural or natural based solutions versus structural measures. Permits are not issued for structures which have negative impacts including increased erosion.

» Non-structural solutions such as shoreline retreat, building elevation are preferred.

» Natural based solutions such as vegetative plantings, re-grading and geogrid are also acceptable.

» Hardened structures such as rock structures, concrete walls, sandbags are discouraged. These structures must have a reasonable probability of controlling erosion on the immediate site for at least 30 years.

· Motor vehicles are not permitted to travel on vegetation, primary dunes, or waterward of the toe of the primary dune or bluff.

» An administrator must grant approval for any emergency activity in these areas.

» The state has a "Coastal Erosion Hazard Board of Review" where appeals may be filed.

Coastal Land Use Planning and Development Regulations

· The NY State Department of State had prepared a collection of model laws that include consideration of future risk to SLR, storm surge and / or flooding as required by the 2014 NY State Community Risk and Resiliency Act. These model laws can be adopted and modified by local governments to address their individual issues.

· Municipalities who wish to regulate erosion hazard areas must adopt a law or ordinance the meets the requirements of the NY State Dept of Environmental Conservation (NYSDEC)

· Laws to reduce flood risks to people and property are also modelled.

» Town of Hamlin has a Shoreline Overlay District to guide development along water bodies. This could set boundaries or restrictions for development such as the landward boundary of the 100-year flood zone and require maintenance of a 100 ft natural vegetative buffer. The planning board could be prohibited from issuing a permit without a determination from a Waterfront Advisory Committee.

· Vertical and Horizontal setbacks can use different approaches. (Fixed, tiered, erosion based, or erosion and lot-depth based). An adaption tool kit, "SLR and Coastal Land Use by the Georgetown Climate Center in 2011 can be utilized.

» Setbacks are measured from the ordinary or mean highwater mark.

» A well-designed coastal setback is deemed to be one of the best tools available to increase long-term resilience of coastal communities.

» Setbacks for 40 to 100 ft from the HWM are considered minimum based on the depth of the lot (100 ft to over 200 ft)

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The state Dept of Environmental Conservation outline approaches which should be used to mitigate against erosion. Softer approaches are preferred by the state.

» Imitate Nature by using natural vegetation.

» Keep slopes gentle.

» Employ soft armouring whenever possible. (plants, logs, root wads, vegetation mats etc.

» Mix it up by using a wide diversity of approaches.

» Keep it small and simple.

Data Availability, Education, Research and Outreach

· Maintenance of a coastal vegetative buffer is considered essential along with limited disturbance of natural vegetation.

  » Clear cutting should not be allowed.

· The state provides help via Sea Grant funding to property owners on the Great Lakes who want to protect their shoreline using by using natural processes and materials. The state has provided a guide for property owners.

· New York adopted new laws relating to disclosure in 2023, and a seller must now disclose the following:

  » if the property is wholly or partially within the Special Flood Hazard Area (100 year floodplain) or a moderate risk flood hazard area (500 year floodplain)

  » if the property is under federal law to obtain and maintain flood insurance and whether the property currently has flood insurance

  » whether there is a FEMA elevation certificate available for the property

  » if there was ever been a claim for flood damage to an insurance provider including the National Flood Insurance Program

  » history of disaster relief received from FEMA, or any other program

  » if the property has experienced flood damage due to a natural flood event, including rainfall, storm surge, tidal inundation, or river overflow, and if yes, how many time.

· Prior to adopting disclosure regulations in 2023, sellers could previously pay a $500 to avoid disclosure.

References and Resources

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Coastal Management. New York State, Department of State

Erosion and Recession of New Yorks's Coastal Bluffs, Sea Grant. New York.

New York City's Risk Landscape. A Guide to Hazard Mitigation. Chapter 4.2 Coastal Erosion

Coastal Areas Regulated by the CEHA Permit Program. New York State

Guidelines for Design of Structures along NYS Coastlines. New York State

New York State REDI: Building Resilience in Recovery. Homeowner Program Guidance for Shoreline Management on the Great Lakes and St. Lawrence River. New York State

Coastal Shoreline Protection Measures. New York State. Department of State. 2020

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

North Carolina

State Strategies

· The coastline is managed by a number of statutes: CZMA (Federal), North Carolina Coastal Areas Management Act (CAMA), S.L. 2003-427, Article 7, Part 3 & 113A-115.1; Fisheries Reform Act

· The coastal management program in the state has evolved since 1974.

· A Coastal Resources Commission (CRC) was established by the CAMA. The CRC consists of 13 members appointed by the Governor, the Speaker of the House, and the Senate President Pro Tempore. Eleven of the 13 members must have experience in a particular area of expertise, including land development, coastal engineering, marine science, coastal-related business, local government, coastal agriculture, commercial fishing, coastal forestry, sports fishing, and wildlife. The commission has 3 goals:

  » Minimize loss of life and property resulting from storms and long-term erosion.

  » Prevent encroachment of permanent structures on public beaches.

  » Reduce public costs of inappropriately sited development.

· Federal Insurance and Mitigation Administration (FIMA) which has 3 goals: 1. New buildings to be protected from flooding, 2. guide development away from flood zones, 3. Transfer costs of flood losses onto property owners via premium.

Coastal Land Use Planning and Development Regulations

· The state adopted a statewide minimum ocean-front setback requirement for all new development in 1979. Effective in 1983, all coastal local governments have been required to include a hazard mitigation element in their mandatory land use plans.

  » Setback reference: vegetation line.

  » Planning Horizon: 30 years for small structures and 60 years for >4 units or >5,000 sq. ft.

  » Setback amount: the annual erosion rate x planning horizon.

  » Setback established at time of permitting.

· An Ocean Policy Steering Committee recommended incorporation of SLR component into CAMA land use plans. Local communities can write policies which must be approved by CRC.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The state has 320 miles of ocean shoreline and over half of this coastline experiences erosion rates of 2 ft per year or greater with 20% exceeding 6 ft per year.

· The State banned hardened structures along the ocean front in 1985. All sandbags were to be removed by May 1, 2008, but this is not enforced.

Data Availability, Education, Research and Outreach

· Economic values of coastal erosion management were determined from a survey of NC households on willingness to pay for coastal erosion management of beach visitors. There was a stronger preference for shoreline retreat by survey participants. (Landry et al, 2020)

· The CRC is working on updating a 2010 report on SLR in the state. Science panel meetings are open to the public.

· There is a North Carolina Coastal Federation (non-profit) which engages thousands of individuals and partners in a variety of activities to ensure a healthy, productive coast. One of their main goals is to increase awareness of the threats to the coast and advocate for access to clean coastal waters and restore thousands of acres of coastline. A number of living shoreline projects were overseen by this organization.

· One example is the Carteret Community College, Shoreline Restoration and Stormwater Runoff Reduction.

· North Carolina's disclosure laws currently require a seller to disclose whether they have "actual knowledge of the property being subject to a flood hazard or being located in a federally designated flood hazard area". The regulations lack specificity on what actual knowledge means. These regulations are currently under review.

References and Resources

Coastal Resources Commission. North Carolina Environmental Quality.

Coastal Erosion Study. Division of Coastal Management. North Carolina Department of Environmental Quality. 2016

Coastal Hazards. North Carolina Environmental Quality.

Coastal Erosion and the Ban on Hard Structures. Anchor. E. Jack

Protecting Oceanfront Property from Erosion. North Carolina Environmental Quality

North Carolina's Legislation on Hardened Structures REconsidered. Coastal Care. Pilkey. 2010

Oceanfront Construction Setback and Erosion Rates. NC Division of Coastal Management, Policy and Planning Section 2019

Shoreline Restoration and Stormwater Runoff Reduction. North Carolina Coastal Federation. Carteret Community College,

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Oregon

State Strategies

· Like other US coastal states, the federal government Coastal Zone Management Act of 1972 addresses coastal issues. There is a voluntary partnership between the state and NOAA.

» Oregon has a Coastal Management Program (OCMP) which implements the requirements of the federal act.

» There are 10 state agencies, 33 cities and 7 counties which have enforceable polices for implementation of the program. Four tribal nations are also partners in the program.

» Oregon has developed a toolkit for local governments and communities to assess and address the impacts of sea level rise This toolkit consists of 3 parts: 1. SLR impact explorer, 2. SLR impact assessment tool, 3. SLR Planning Guide for coastal Oregon.

· The latter tool has suggested adaptation strategies which could be adopted by local authorities. A toolkit outlines the steps required to implement adaptation strategies.

» Funding for the OCMP comes from the National Coastal Zone Management Program administered by the NOAA, Office for Coastal Management. Some grants have to matched 50:50 by the state (Section 306) and others don't require matching (Section 309)

· Oregon recommends a plan for post-disaster recovery through adoption of a recovery ordinance to provide overall guidance for local post-disaster facilitation and intervention including enabling of temporary repairs, debris management, stabilization of structures.

· The state strives to protect and expand public shoreline access as per the Oregon policy goal 17. These are important for economic, health and environmental wellbeing of coastal communities.

Coastal Land Use Planning and Development Regulations

· Estuary management plans need to incorporate SLR, and climate change impacts and the value of ecosystem services provided by estuaries to protect against impacts from a changing climate.

· The Statewide Planning Goal 18 states that "Beachfront protective structures may be permitted only where development existed on Jan. 1, 1977, unless an exception to Statewide Planning Goal 18, implementation requirement 5, has been adopted as part of the comprehensive plan. "

· The state uses a 1.5-foot SLR plus at 100-year flood event (1% chance yearly occurrence or a 26% chance over the course of a 30-year mortgage.

· In the Columbia River estuary, a 4.9 ft SLR is used which accounts for SLR plus total water level including tides, storms, and floods.

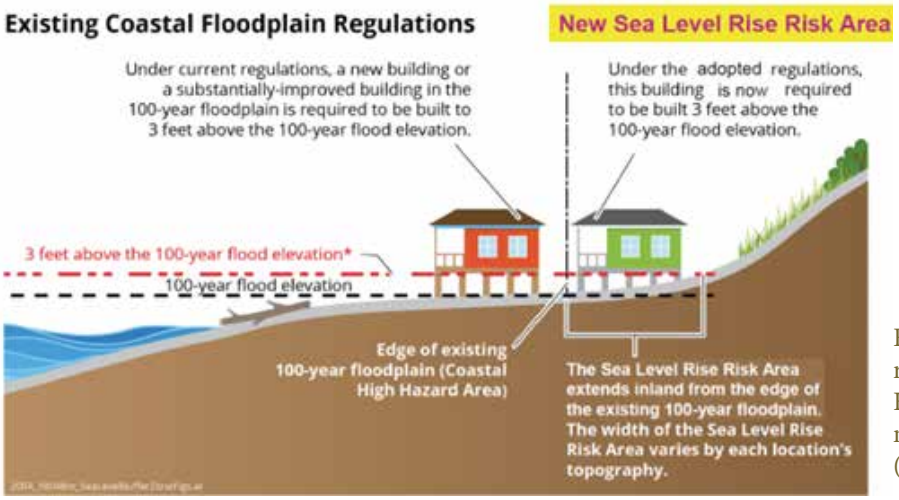

Figure 6. Oregon transition to new sea level rise regulations using an example from Kings County, WA Shows Structures must move landwards based on local topography. (Source: Coastal Atlas SLR Planning Guide)

· In the floodplain regulations a new building or a substantially improved building in the 100-year floodplain is required to be built to 3 ft above the 100-year flood elevation. A new SLR risk area extends inland from the edge of the existing 100-year floodplain. The width of the SLR risk area varies with the topography at each area.

· An exposure inventory was completed in 2017 which has determined the assets and geographies which are most likely to be impacted. This exposure inventory is considered the first step in adaptation planning.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Oregon requires the use of SLR and coastal erosion projections in the design of public projects such as roads, water supply & sewage treatment facilities, ports, beach accessway, trails, utility lines etc

Data Availability, Education, Research and Outreach

· Datasets compiled includes storm wave, flooding and coastal erosion zones from FEMA, DOGAMI, and the Lower Columbia Estuary Partnership.

· Oregon has a targeted communications and public outreach campaign for different audiences such as residents, property owners, realtors, surveyors, consultants, businesses, contractors, community staff, elected officials.

· There is a voluntary National Flood Insurance Program (NFIP) which provides communities with a framework to regulate development in flood hazard areas. This program is administered by FEMA. Flood insurance maps are available from counties in Oregon.

· Local communities can choose to participate in the National Flood Insurance Program (NFIP) and if they do, FEMA makes federal flood insurance available to residents and businesses in the community as long as the local government agrees to adopt a floodplain ordinance and manage all development in mapped floodplains in compliance with their local regulations.

· Sea Level Rise data for the Coasts of California, Oregon, and Washington is available.

· The USGS has determined historical shoreline erosion rates for the Pacific NW Coast from maps, aerial photos and Lidar. The average rate of erosion for the entire PNW coast is 0.9 m/yr.

· Some storms with high waves at high tide have cut back dunes in some coastal areas by 10s of metres within a week.

· Oregon recommends a Coastal Hazard Application for projects and developments in coastal areas such as schools, public infrastructure, subdivisions, etc. See Rhode Island Coastal Hazard App referenced in Oregon State website.

· Storm surge is not as significant on the Oregon coast and generally ranges from 10 to 15 cm above predicted tides. (Kumar et al, 1999)

· Sellers are reuqired to disclose whether there is any material damage to the property or structures due to flooding, and whether the property is in a designated floodplain.

References and Resources

Sea Level Rise Adaptation Planning. Oregon Coastal Atlas.

Sea Level Rise Planning Guide. Oregon Coastal Atlas.

Oregon Coastal Management Program. Department of Land Conservation and Development.

Guidebook on Erosion Control Practices of the Oregon Coast. Oregon Department of Land Conservation and Development. 2021

Storm Damage: Flood Insurance Oregon Division of Financial Regulation

Higher Regulatory Standards. Floodplain Management. FEMA Region 10. 2002

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

Puerto Rico

State Strategies

· Puerto Rico has a Coastal Management Program (PRCZMP)

· This US Territory has been hit by hurricanes over the past with Hurricane Maria (Category 4) causing severe coastal damage in 2017. As a result of the devastation from Maria officials recognized the need to rebuild their coastal communities to be more resilient to future hazards.

Coastal Land Use Planning and Development Regulations

· The coastal zone in the Commonwealth extends seaward up to 10.3 miles and includes islands and cays under its' jurisdiction.

· Puerto Rico has a voluntary relocation program for areas hit by storms and coastal damage. The program ensures active participation of residents in decision making, construction of new homes in resettlement areas and provision of mental health services to alleviate emotional distress.

· The area of Cano Martin Pena has developed a Comprehensive Development and Land Use Plan called ENLACE which relocates homes away from the floodplain and was developed via a public engagement process.

» A public corporation called ENLACE has been working with local communities on how to respond to climate risks and develop a comprehensive plan for making the 8 communities in the tidal channel El Cano Martin Pena more resilient to flooding and other risks.

» The corporation developed an inclusive, participatory-action planning process.

» ENLACE developed a plan to relocate 1,000 families for channel expansion process which was explained clearly at several public meetings.

» This project showed that in a changing climate, the responsibilities of designers and planners are shifting. Tools for conceptualizing the ways in which resilience projects are entangled with the rights and well-being of the local population has to considered. Design is not a mandate it is a conversation is one of the key learnings from this process.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The Territory Governor declared a state of emergency on April 11, 2023, to fight worsening coastal erosion across the territory. A sum of $105 Million has been set aside to implement over 2 dozen measures including relocating homes, creation of artificial reefs, planting trees and adding sand to beaches.

· The Puerto Rico Dept of Natural and Environmental Resources Developed a new coastal management strategy for 2023-2025 and addresses 3 priorities.

» Protecting wetlands

» Reducing coastal hazards

» Lessening cumulative and secondary impacts from storms.

· Natural and nature-based infrastructure is promoted and legislation is being amended to remove regulatory impediments to nature-based infrastructure.

Data Availability, Education, Research and Outreach

· Puerto Rico has a long history of displacement due to environmental risk.

· The NOAA Office for Coastal Management and Puerto Rico Sea Grant promoted the use of green infrastructure to improve resilience to coastal erosion and delivered NOAA's Green Infrastructure for Coastal Resilience training to interested communities.

References and Resources

Nature-based Solutions for Coastal Hazards (online course). NOAA Office for Coastal Management.

Puerto Rico Moves to Limit Coastal Damage from Hurricanes and Other Threats. Pew 2022.

Puerto Rico declares state of emergency on coastal erosion. CTV News 2023

Rhode Island

State Strategies

· Rhode Island has a Coastal Resources Management Council which has a mandate to preserve, protect, develop, and restore coastal resources for Rhode Islanders. This Council has a Coastal Zone Program.

» Setbacks of either 50 ft or 25 ft depending on position related the coastal buffer zone.

» In Critical erosion areas the minimum setback required is not less than 30 times the calculated average erosion rate for <4 dwelling units and not less than 60 times the calculated average erosion rate for >4 dwelling units.

» Natural vegetation is promoted to stabilize soil in coastal areas.

» All property abutting critical habitat areas must maintain a 200-ft-wide vegetated buffer zone.

» All property abutting Coastal Natural Areas must have a vegetated coastal buffer zone of 25 ft from the inland edge of the coastal feature.

Coastal Land Use Planning and Development Regulations

· The town of North Kingstown has an Adaptation Plan for natural hazards and climate change in the town.

» The purpose of "Adaptation to Natural Hazards and Climate Change in North Kingstown, Rhode Island" is to demonstrate the process and techniques for how to utilize spatial information and relevant exposure and vulnerability data addressing natural hazards, including coastal hazards such as flooding from projected sea level rise and storm surge events, in local planning to prepare implementable adaptation strategies. These strategies can then be used as a foundation for addressing adaptation in North Kingstown's comprehensive community plan, and to prioritize projects for inclusion in the municipal Capital Improvement Program (CIP), state Transportation Improvement Program (TIP). This pilot project in North Kingstown is intended to serve as a model for other municipalities in Rhode Island to address resilience to natural hazards in their local planning efforts.

· Coastal Resource Management Council policies prohibit new development on undeveloped and moderately developed barrier beaches. Data show that at least 65% of all barrier beaches have had no new permitted development or shoreline stabilizations since 1971.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· A policy prohibits the construction of new hardened structures on barriers, headlands, and other coastal features abutting type 1 waters and on any barriers or coastal wetlands anywhere in the state.

» Type 1 waters are defined as unsuitable for structures due to exposure to severe wave action.

» Shoreline armouring is prohibited on greater than 75% of the coast including most beach areas.

· On the dunes of barrier beaches, residential or non-water dependent structures destroyed by more than 50% may not be rebuilt regardless of insurance carrier coverage. Additions are allowed to structures designated for priority permissible uses.

Data Availability, Education, Research and Outreach

· Rhode Island has a how to guide on incorporating natural hazards planning and climate change adaptation into local comprehensive plans. "Resilient Communities Natural Hazard & Climate Change Adaptation." by University of Rhode Island.

· 100% of the population live in coastal areas.

· The state has had 8 climate and weather disasters from 2010 to 2018.

· Rhode Island has an online training program called PREP-RI to provide resilience education for planning in the state.

- This program consists of 7 training modules:
  - Climate Change in Rhode Island.
  - Adaptation to climate change.
  - Stormwater control.
  - Flooding
  - Infrastructure
  - Mapping Tools
  - Liability
- Rhode Island disclosure laws are vague but requires a disclosure statement to include information about floodplains. There is no requirement to disclose information on previous flood damage.

References and Resources

PREP-RI Providing Resilience Eduction for Planning in Rhode Island.

Adaptation to Natural Hazards and Climte Change in North Kingston, Rhode Island. US Department of Transportation. Federal Highway Administration. 2015

Science to Address Shoreline Change. Our Work. Coastal Resilience. Sea Grant Rhode Island.

Protecting Rhode Island's Shorelines from Flooding and Erosion. Rhode Island Shoreline Change Special Areas Management Plan. 2013

How will Erosion and sea-level rise impact the property and surrounding area? Rhode Island Coastal Property Guide.

Rhode Island - State of the Beach/State Reports. Beachapedia.

How States Stack Up on Flood Disclosure. Natural Resource Defense Council. August 2023

South Carolina

State Strategies

· South Carolina has a coastal zone management program established under the guidance of the CZMA (1972). This was authorized in 1977 under the state's Coastal Tidelands and Wetlands Act (CTWA). This Act has 21 regulations which control development in the coastal zone.

· The State also has a Beachfront Management Act with associated regulations.

» This act and regulations have significantly limited development and hard stabilization of the beachfront in many areas.

» Living shorelines are actively promoted in the state.

» A 40-year policy of retreat from eroding beaches was introduced.

» A setback line was established based on 40X the local annual rate of erosion.

» Limited construction within a 20 ft restricted zone seaward of the baseline.

» Within the setback area:

· No new erosion control devices allowed, and existing seawalls were to be replaced with sloping structures over time.

· New structures limited to a maximum of 5.000 sq. ft of heated space.

· Homes damaged beyond repair must be built farther landward.

» The State Department of Health and Environmental Control (DHEC) is responsible for administering this Act.

Coastal Land Use Planning and Development Regulations

· A Blue-Ribbon Committee on Beachfront Management was formed in 1987 by the South Carolina Coastal Council and complied a report in 2010 on how the state can adapt to shoreline change and to reinforce the goals and mechanisms of the state's "retreat" policy. The Committee laid out recommendations for reinforced management to reduce risks to beachfront communities.

· Prevent seaward expansion of beachfront development.

· Strengthen the State's Beachfront "Setback Area".

» Increase the minimum setback distance.

» Align setback regulations with statutes regarding size limitations.

» Evaluate all historical shorelines and short-term variability in non-stabilized inlet zones.

» Limit building in the most vulnerable beachfront areas, particularly seaward of the Baseline.

» Enhance protection of sensitive dune features that are outside the state's "beach/dune system.

· Eliminate inconsistent Public Subsidies.

· Strategically acquire Beachfront Lands and or Easements.

· Strengthen the role of local governments in beach management and planning.

· Develop and implement regional sediment management plans.

· Strengthen reviews of nearshore dredging and other alterations.

· Improve beach nourishment monitoring.

» Expansion of the SC Beach Restoration and Improvement Trust Fund to include structure relocation, land acquisition and planning proposal in addition to funding of beach nourishment projects and to support emergency response needs to repair beaches after storms.

· Refine criteria for emergency orders and sandbags.

· Improve guidelines for groins and breakwaters.

» Establish a technical committee to recommend siting and design.

» Leverage additional expertise in review of groin and breakwater proposals.

» Identify ownership and responsibility for all existing groins.

· Expand Beachfront real estate disclosure requirements.

· Manage erosion control in estuaries.

» Establish non-beachfront shoreline buffer zones.

» Establish a 25 ft. minimum buffer for all new developments along non-beachfront shorelines in the coastal zone.

» For previously developed properties, state tax incentives or credits could be considered buffers.

» Encourage local governments to establish or expand shoreline buffers.

· Special Area Management Plans are created in areas where coastal resources are not always mutually compatible and where conflicts of interest can occur.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The State has a "Beachfront Management Act" to combat coastal erosion and enhance beach and dune systems.

· Beaches and dunes are important in protecting life and property from storms.

· Unwise development sited too close to the shore has jeopardized the stability of beaches and dunes.

· The use of armouring in the form of hard erosion control devices has not proven effective and gives a false sense of security against wind and wave action and contributes to the loss of the dry sand beach.

· Inlet and harbour management practises such as construction of jetties have not been designed to accommodate longshore sand transport depriving downdrift beach/dune systems of their natural sand supply.

· Protection and preservation of public access to beaches is important for visitors and residents.

· A coordinated policy for post-storm management of the beaches and dunes is necessary.

Data Availability, Education, Research and Outreach

· There are 8 coastal counties in South Carolina.

· Long term coastal erosion rates are available for South Carolina's beaches.

· A Hazard vulnerability assessment tool (HVA) has been developed to assist with hazard planning and post-disaster redevelopment. The result is a vulnerability risk rating of 1 to 5 for coastal areas.

» The tool uses R software.

» The Department of Health and Environmental Control sought to make the process as transparent as possible for the public. Each full committee meeting was advertised by public notice and media release and widespread public coverage was sought.

» Over 60 pages of written comments were submitted by coastal engineers, property owners, stakeholders, town officials.

· A seller must disclose the following:

» if there were any flood problems with the property during ownership

» flood hazards, wetlands, flood hazard designations, flood zones, or flood risk affecting the property

» if the property is insured through public or private flood insurance

» if there was ever been a claim for flood damage to an insurance provider including the National Flood Insurance Program

» repairs made to the property as a result of flood events that were NOT filed with insurance

» history of disaster relief received from FEMA, or any other program

» if the property has been assessed for a beach nourishment project

References and Resources

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Texas

State Strategies

· The coastal zone in Texas is managed by the Texas General Land Office (GLO) and in 2017 it was decided that a piecemeal approach to coastal protection and management was not sufficient.

» Counties are delegated authority to adopt and enforce land use regulations in areas prone to flooding under the National Flood Insurance Act.

· Using 2013 FEMA data Texas had 641,653 Flood Insurance policies issued with at total coverage value of $162,213,731,200.00 with a total value of premiums paid of $368,060,396.00.

· The Biggert-Waters Act of 2012 tried to increase the cost of flood insurance to reflect true risk to all properties.

· The Texas Open Beaches Act stipulates that the state owns submerged lands to the line of the mean high tide or higher high tide. The public has an easement for access and use of a public beach from the mean low tide of the Gulf of Mexico landward to the natural line of vegetation. Structures that become seaward of the line of vegetation are subject to removal at the property owner's expense.

· There are several coastal programs managed by GLO including:

» The Texas Coastal Management Program

» The Coastal Erosion Planning and Response Act program (CEPRA)

» Community Development and Revitalization.

» Beach Monitoring and Maintenance program.

» The Texas Coastal Ocean Observation Network Program.

» The Beach Maintenance Reimbursement Fund Program.

» Adopt a Beach Program.

· Coastal Coordination in Texas was determined to be a collaborative effort by GLO and implementation of the coastal management plan involves many state department, US Army Corps of Engineers, USEPA, US Fish and Wildlife Service, US Geological Society, River Authorities, many coastal communities.

Coastal Land Use Planning and Development Regulations

· The state has 4 main coastal planning regions and 68 subregions and scored them to determine those which are highly vulnerable to coastal storms and related damage.

· The state planning methodology has identified several resiliency strategies such as:

» Restoration of Beaches and Dunes,

» Freshwater wetlands and coastal uplands conservation,

» Oyster reef creation and restoration,

» Plans, policies, and programs which provide a framework to address coastal resiliency priorities via legislation and administrative changes and coastal program enhancements.

· Texas has developed a coastal resiliency strategy framework to assist in understanding the complexity involved in coastal management. (See graphic next page)

· Living Shorelines and Beach nourishment are used to restore beaches and wetlands.

» Dredged materials are used for beach nourishment in Texas. Some projects such as one on Galveston Island involved improved coordination between federal and state agencies.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· The state Coastal Erosion and Response Act sets criteria for areas of "critical erosion".

» The average coastal erosion rate for Texas is 4 feet per year with some areas of the Gulf Coast eroding at rates of 5 to 10 feet per year with an average rate in the Gulf Coast of 6 feet per year.

» 64% of the Texas 369-mile Gulf Coast is critically eroding.

» On Galveston Island, erosion rates can reach 70 feet per year (storm occurrence) and the Island loses an average of 42 acres per year due to coastal erosion.

Figure 7. Texas Coastal resiliency strategy framework (Source: Texas Coastal Resiliency Master Plan)

· Texas uses a 3-step engineering approach for selection of an appropriate shoreline stabilization method from the list of alternatives.

» Site assessment and concept development.

» Alternative analysis and preliminary design.

» Final design and construction.

» The level of risk tolerance is considered in the selection process.

Data Availability, Education, Research and Outreach

· The coast of Texas is vulnerable to many coastal hazards such as coastal erosion, SLR, storm surge, habitat loss, water quality degradation etc.

· The Ecosystem services provided by coastal environments are recognized for their economic benefits they provide.

» The Texas Coastal Exchange (TCX) is a concept that aims to create a market for the buying and selling of ecological services. Oyster reefs, coastal marshes, bottomland forest systems are examples of systems that could be used in commercial transactions.

» A GIS database has been developed for use in 4 counties to track these systems

· The value of beaches and dunes for tourism is recognized as very important by the state.

· Oyster reefs are recognized for their economic value but also for value from sediment stabilization, shoreline protection, erosion control, water filtration etc.

· The state has conducted a technical assessment of previous coastal management projects and screened them to determine the most appropriate ones to be used.

· After Hurricane Harvey on August 25, 2017, which had 130 mph winds and 6-foot storm surge, Governor Greg Abbott created a Governor's Commission to Rebuild Texas headed by Texas A&M University.

» Governor Abbott called for "future-proofing our state".

» One recommendation was to improve emergency response procedures including existing radio infrastructure in the state for emergency situations.

» Drones were widely used to fly over affected areas in Texas after Harvey.

» FEMA to create improved Flood Insurance Rate Maps.

» More program coordination is needed between FEMA and GLO to speed up response efforts involving data sharing, contracting, agreements on actions.

» Conflicts in emergency funding policies between the state and federal governments need to be resolved.

» Improved planning and training for response efforts.

» It was recommended that state standards be established including best practises to elevate structures above base flood elevation in flood-prone areas.

· One technique would be to adopt freeboard standards in local flood zone ordinances.

· New structures under the National Flood Insurance Program (NFIP) must elevate new residential buildings in a 100-year flood plain up to or above the base flood elevation (BFE) but some communities have determined that this does not provide sufficient elevation.

· Harris County has the strictest regulation for freeboard requirements as it requires 2 ft of freeboard above the 500-year floodplain.

» The Association of State Floodplain Managers produced a table showing the cost of Freeboard Elevation for various foundation types (reproduced below). A study showed that building a 2000 sq ft house 2 ft above the BFE with fill underneath would reduce annual flood insurance premiums by an average of more than $1,400. The cost of elevation would be offset by just 3.3 years of premium savings and would yield $37,300 in savings over a 30-year mortgage period.

· Elevation of a structure may be more expensive in the short term but is generally far less expensive than demolition and relocation and the property continues to generate tax revenue.

» Buy outs are also practised in Texas mainly under the FEMA HMGP program. FEMA provides 75% of the funds and requires a 25% match from a local government. Land purchases under HMGP can't be re-developed.

» New developments should not cause flooding in adjacent or downstream areas.

» Use regulation and incentives to steer development away from high-risk areas.

· Texas has a Shoreline Stabilization and Resiliency Design Guide which provides concise guidance on how to plan for and design shoreline stabilization features, particularly under future rising sea level scenarios.

» The guide provides a comprehensive list of shoreline stabilization alternatives.

» The guide provides a range of construction costs for the various alternatives.

· Vegetation only $70 to $115 per lineal ft

· Hybrid (natural and structural): $120 to $600 per lineal ft.

· Oyster reef: $200 to $400 per lineal ft.

· Hardened shoreline: $450 to $1,000 per lineal ft

· Beach nourishment: $1.1 million per mile

· Dune restoration: $2,000 to $5,000 per lineal ft.

Foundation Type	Cost per foot (US$)
Concrete block piers	$890
Crawlspace with concrete block walls	$1,850
Crawlspace with poured concrete walls	$2,155
Stem wall with fill	$2,345
Fill only	$4,470

Table 4. Cost for various foundation types in the Coastal Zone of Texas. Adapted from Association of State Floodplain Mangers, www.floods.org.

	Permanence	Cost	Adaptability to Relative Sea Level Rise	Wave Energy Reduction	Technique Benefits and Drawbacks
Vegetation Only	low	low	mod	low	Benefits: stabilizes and captures sediment, assists in additional plant colonization, improves habitat for marine and benthic species, aesthetics Drawbacks: low permanence unless coupled with structures, susceptible to RSLR
Vegetated Crib Wall	mod	low	low	low	Benefits: anchors sediment, assists in plant colonization, small footprint, unobtrusive, aesthetics Drawbacks: requires periodic adjustment for maximum effect, may become a safety or debris concern once deteriorated
Oyster Reef	mod	low	mod	mod	Benefits: provides natural estuarine habitat, recreation opportunities, and water filtration Drawbacks: may be limited in the amount of vertical relief attained
Nearshore Berm	low	mod	mod	mod	Benefits: can create additional protected space for habitats, such as marsh grass, and estuarine species, berms can act sacrificially and add sediment to the nearshore system Drawbacks: low permanence unless coupled with structures, susceptible to RSLR, may become a safety or debris concern once deteriorated
Beach Nourishment	low	high	high	high	Benefits: provides recreational opportunities, able to adapt to wave climate and recover from losses Drawbacks: causes disruption to beach microbiome, turtle nesting, and beach recreation during construction; cyclical sand losses are expected
Horizontal Levee	high	high	mod	high	Benefits: provides transitional estuarine habitat area, adaptive to RSLR, reduces need for structure height and hardening when compared to a traditional levee Drawbacks: requires larger footprint than a traditional levee to construct, requires maintenance
Nearshore Engineered Reef	mod	mod	low	mod	Benefits: provides interstitial estuarine habitat Drawbacks: requires periodic adjustment for maximum effect, may become a safety or debris concern once deteriorated
Breakwater	high	high	mod	mod	Benefits: allows leeward sediment accretion, creates sheltered estuarine areas, can be coupled with natural features to create a living shoreline Drawbacks: downdrift & updrift erosion, may become a safety or debris concern once deteriorated
Revetment**	high	high	mod	mod	Benefits: anchors shoreline location, prevents upland erosion Drawbacks: downdrift erosion, disallows shoreline migration, vulnerable to flanking and scouring, difficult to permit
Bulkhead	mod	mod	low	mod	Benefits: anchors shoreline location, prevents upland erosion, small footprint Drawbacks: profile deflation; vulnerable to flanking, erosion, and overwash; disrupts aesthetics; cuts off upland habitat from water
Groin**	high	high	low	low	Benefits: updrift accumulation Drawbacks: downdrift erosion, vulnerable to flanking
Levee	high	high	low	high	Benefits: anchors shoreline location, flood and storm surge control Drawbacks: downdrift erosion, vulnerable to flanking and scouring, disruption to shoreline access during construction, requires maintenance, may require more armoring when compared with a horizontal levee
Seawall**	high	mod	low	high	Benefits: anchors shoreline location, prevents upland erosion, small footprint Drawbacks: profile deflation, downdrift & updrift erosion, vulnerable to flanking, vulnerable to destabilization from overwash, disrupts aesthetics, cuts off upland habitat from water, requires maintenance

Table 5. The benefits and drawbacks of gray and green techniques to stabilize and protect shorelines in Texas (Adapted from Shoreline Stabilization Resiliency Design Guide, Texas)

*Adaptability refers to the ability of the technique to respond to impacts due to relative sea level rise (RSLR) or to extend the lifetime of the project given RSLR.

**Can only be constructed by a subdivision of the state to protect public infrastructure (with extensive permitting requirements)

- Annual operations costs are also provided for the same options.
- Vegetation only: <$100 per lineal foot.
- Hybrid: <$100 per lineal foot.
- Oyster reef: none
- Hardened shoreline: $100 to $500+ per lineal foot.
- Beach nourishment varies over the project lifetime.
- Dune restoration: $100 to $500 per lineal foot.

» A listing of several gray and green techniques is provided with benefits and drawbacks is provided see table below.

· In one study (McLaughlin, Edwards and Ruppert, 2018) Beach nourishment and revetment are seen to be a stopgap versus a real solution to the protection of Surfside Beach for the Village of Surfside, Texas.

» Relocations back from the coast provide a much longer-term solution to SLR impacts but are extremely controversial measures in Texas.

» Brownwood subdivision in Baytown, Texas has initiated a relocation of threaten areas.

» After Hurricane Alicia on Aug. 18, 1983, the city of Baytown banned human habitation in Brownwood and forced the remaining residents to leave. Houses were purchased and bulldozed and the area became a Nature Centre.

» Organized relocation if initiated early could save millions of dollars in beach nourishment and shoreline protection efforts and could save human lives.

· Local hotel or room occupancy tax could be implemented for eligible coastal municipalities to implement actions to address or mitigate coastal erosion including living shorelines, beach nourishment, breakwaters, groins etc.

· Bond issues could be issued by municipalities to help protect coastal assets.

· Texas is not as advanced as Florida in preparing for SLR but some areas are starting to take the necessary steps.

· A seller must disclose the following:

» previous water damage due to a natural event

» previous floodind due to a natural event

» if the property is wholly or partly in a 100-year floodplain, 500-year floodplain or a reservoir.

» if there was ever been a claim for flood damage to an insurance provider including the National Flood Insurance Program

» if there is flood insurance on the property

» history of disaster relief received from FEMA, or any other program

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Virginia

State Strategies

· The coastal zone is administered under the federal CZMA, the Tidal Wetlands Act, The Coastal Primary Dunes and Beaches Act, the Chesapeake Bay Preservation Act and other state legislation.

» Shoreline management plans (SMPs) are produced by towns and cities like Accomack County

» Permits are required under the Wetlands Act.

· General permit #4 Emergency Situations

· Living Shorelines Group 1 permits for non-structural actions above mean highwater.

· Livings Shorelines Group 2 general for sand fill, fibre logs, fiber mats, shell bags, woven containment bags and temporary grazing protection in tidal wetlands, beaches, and submerged lands.

» Joint Permit Applications for proposed activities with impacts to tidal and non-tidal wetlands, dunes and beaches and subaqueous resources including construction, dredging, filling, or excavation.

· This permit is required for erosion control measures including revetments, marsh sill, bulkheads, etc.

· These applications require substantial information, sign offs, a living shoreline statement.

Coastal Land Use Planning and Development Regulations

· Virginia has a coastal resilience master plan which has been issued by the Governor's Office in 2021.

» This has initiated a public planning process for the state with extensive consultation and statistical analysis of climate and storm parameters.

» Coastal resilience is a key factor in the state's planning process.

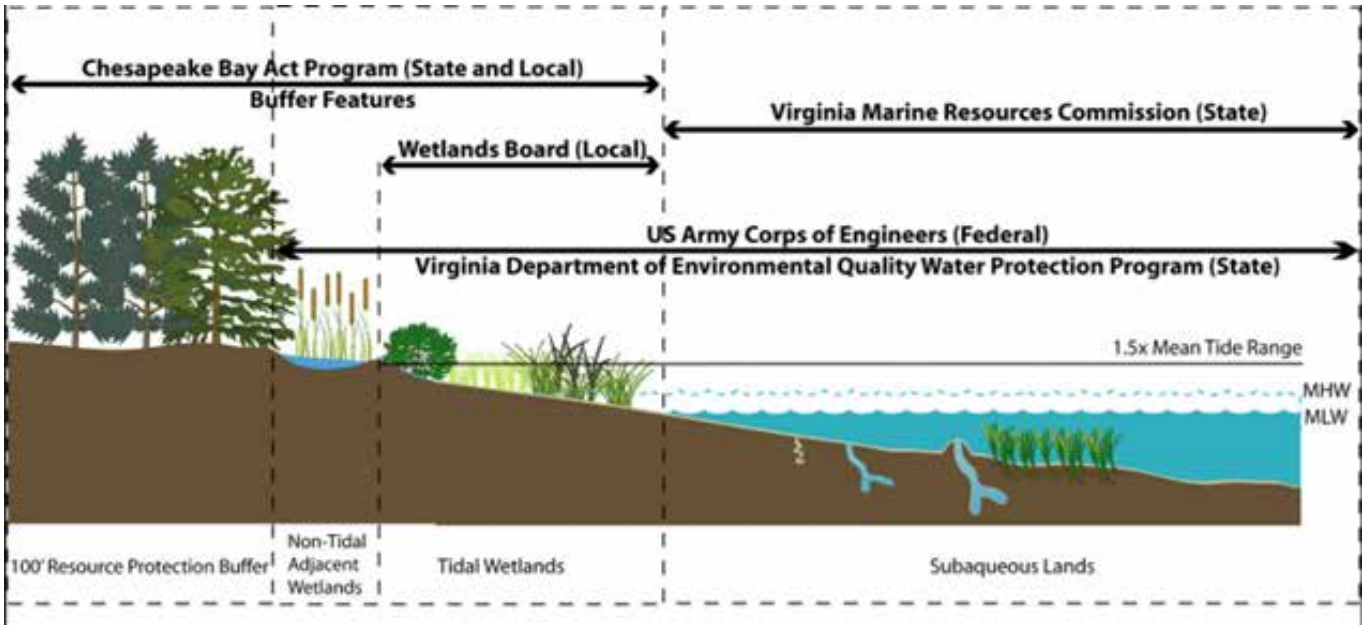

Figure 8. Virginia legally definied Shoreline Jurisdictions for various local, state and federal authorities.

Source: VIMS, Laws and Jurisdictions

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Living shorelines are used extensively in the state with substantial educational and training tools available. They are the preferred option for stabilizing tidal shorelines in the state.

» If a living shoreline approach is not suitable the Commission will still require applicants to incorporate living shorelines to the maximum extent possible.

Data Availability, Education, Research and Outreach

· The Virginia Institute of Marine Science has produced a "Shoreline Management Handbook" (see link in next section).

· The state has many self-guided decision tools available to assist with making decisions for developments in the coastal zone.

» Living shorelines Guidance

» Shoreline decision support tool

» Undefended shoreline and failed defense structures support tools / trees

· Undefended shoreline decision tool user manual – 2010

· Undefended shoreline decision tool diagram.

· A series of fact sheet giving definitions and descriptions of various types of protection structures.

· Virginia has no disclosure laws with respect to whether a property is located in a floodplain or on past flood damage, but a seller is required to disclose if there has been 2 or more claims of more than $1,000 paid by the National Flood Insurance Program within any rolling 10-year period since 1978.

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Shoreline Decision Support Tool. VIMS

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Washington State

State Strategies

· The US Coastal Zone Management Act sets the rules for management of activities in the coastal areas of the state.

» Some federal lands are excluded from control under the Act including tribal lands, military bases, national parks, national forest, and recreational lands.

· The State Department of Ecology administers the Coastal Zone Management for the state including the shorelines in Puget Sound under the authority of the Shoreline Management Act.

· The coastal area of the state includes 15 coastal counties and extends seaward a distance of 3.5 miles.

· The state uses a comprehensive approach to coastal resource management and have key priorities.

» Preventing or reducing threats from coastal hazards,

» Attaining increased opportunities for public access to the coast,

» Planning for use of ocean resources,

» Building resilience to SLR and other climate impacts,

» Mapping and monitoring the coastline to help communities to make informed decisions,

» Ensuring federal activities comply with state coastal policies.

· Washington has enacted a law to discourage armouring structures and promote living shorelines.

· The Hydraulics Code applies waterward of "ordinary high water" and the Shoreline Management Act applies waterward of ordinary high water and at least 200 ft landward of ordinary high water. Permits are required by the Department of Fish and Wildlife for any activity that will use, divert, obstruct, or change the bed or flow of state waters, including the construction of bulkheads and seawalls. There are provisions in the regulations for emergency projects. Removal of hardened shoreline structures has been required, but only by the authority of a local government under the state's Shoreline Management Act.

Coastal Land Use Planning and Development Regulations

· The state has a Shoreline Management Act which requires all counties and most towns and cities to develop and implement a Shoreline Masters Program (SMP) which has a goal to prevent the inherent harm of an uncoordinated and piecemeal

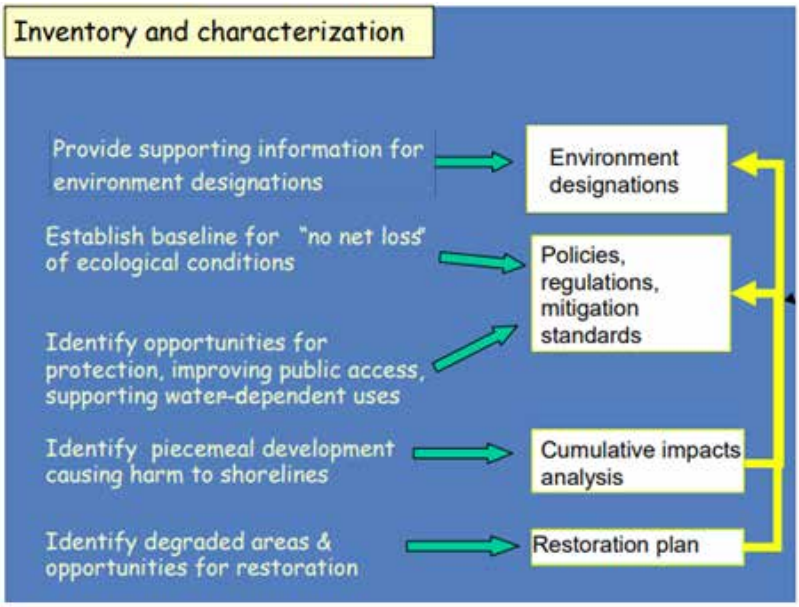

Figure 9. Washington State Shoreline Inventory and Characterization to provide foundation for the entire SMP update process. Source: SMP Handbook

development of the state's shorelines.

» The Shoreline Masters Program gives guidance for design of coastal structures and planning for coastal areas. Tools include Soft Shoreline Stabilization.

» The principal goal of the Shoreline Masters Program is to ensure no net loss of ecological functions. Soft shorelines are seen as a successful method of achieving this goal.

» The state checklist for shoreline developments is extensive and requires submission of detailed information for developments in coastal areas.

· There is a guidance document for developing or updating of SMPs in the state which has a 6-phase planning process.

» Preliminary shoreline jurisdiction and public participation plan.

» Shoreline inventory and shoreline analysis and characterization, including public access and use analysis.

» Shoreline environment designations, policy and regulation development, cumulative impacts analysis.

» Restoration plan, revisiting Phase 3 products as necessary.

» Local approval.

» State approval.

· SMPs require an inventory and characterization process.

· Permit requirements vary for a given site. Typically, a Joint Aquatic Resources Permit Application (JARPA) and a State Environmental Policy Act checklist needs to be filled out and submitted for approval.

» One of the first steps in the process is to compile an inventory and characterize the site under consideration.

· A list of potential ecological issues for shoreline developments is provided for applicants.

· Counties, cities, and towns can implement their own requirements for development in the coastal zone.

» Shoreline setbacks are defined in the City of Federal Way Revised Code (FWRC) 15.05.070 and are set as:

· 50 ft from Ordinary High-Water Mark (OHWM) for all developments and uses.

· 75 ft for office and commercial developments

· 50 ft or as required in critical areas for single family residential developments.

· 75 ft or as required in critical areas for multi-family developments.

» In Island County, Washington, shorelines include lands extending 200 ft from the OHWM. Island County generally required review and approval for regulated activity including:

· Land disturbing activities

· New construction, and exterior alteration of existing structures

Water flow/quantity	Water quality	Habitat
Flooding	Storm water runoff	Loss of riparian vegetation
Channel movement/migration	Sediment in water column	Loss of upland habitat
Potential flooding due to climate change and sea level rise	High temperature	Loss of eel grass, forage fish, shellfish, etc.
Upstream or local dams and levees	Nutrients and pathogens	Beach erosion

Table 6. Potential shoreline ecological issues, State of Washington. Adapted from: SMP Handbook

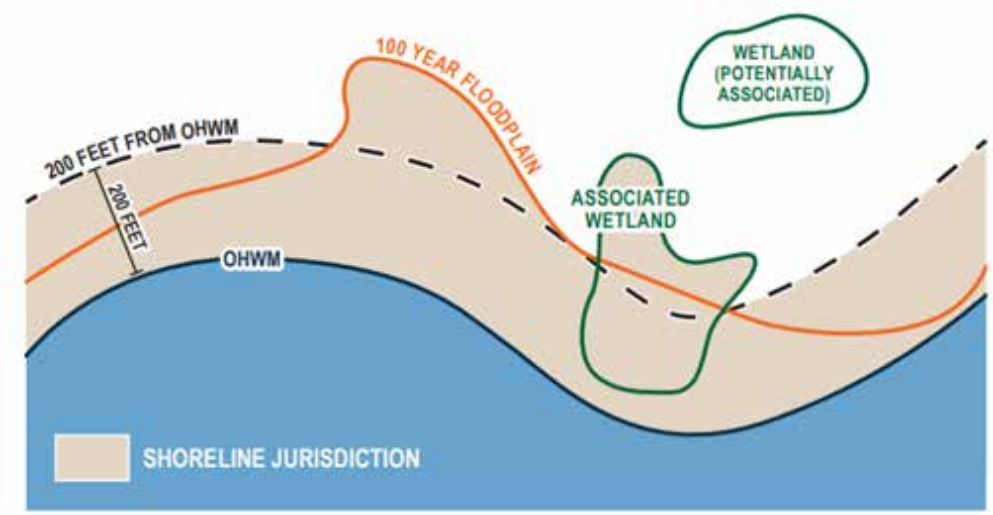

Figure 10 Determining Shoreline Jurisdiction. Island County, Washington State. Source: Island County

- Shoreline stabilization (bulkheads and soft shore)
- Vegetation removal and/or management
- Construction of piers and docks
- Placement of mooring buoys
- Dividing land
- Altering regulated critical areas
- Creating or replacing impervious surfaces
- Changing levels, temperatures, or chemical characteristics of wetlands or waterbodies.
- In King County the Critical Areas Regulations (Ch. 21A.24) require setbacks of 115 ft for urban growth areas and 165 ft for rural areas.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

- The potential impacts shoreline armoring may have at a particular site will depend upon shoreline type, shoreline condition, and the shoreline armoring design. Therefore, one or several impacts may occur.
- In Puget Sound, seawalls, bulkheads, and revetments have been installed on approx. 1/3 of the shoreline.
- Armouring is a controversial topic in Puget Sound as there are strongly held private interests in protecting shoreline property against broad public mandates to preserve shorelines for public uses and to protect environmental resources. (Shipman et al, 2010)
- Washington lawmakers have instituted civil penalties for illegal armouring structures. Property owners are prohibited from repairing or replacing seawall except as a last resort.
- A study by Shipman, 2010 provides a list of potential impacts shoreline armouring may have at a particular shoreline site in the state.
  - » Loss of upper beach and backshore.
  - » Reduces area of dry beach at high tide.
  - » Reduces amount of accumulated large wood and beach wrack.
  - » Reduces forage fish habitat.
  - » Reduces area availability for recreation.
  - » Modifies aquatic-terrestrial connectivity. Affects movements of materials and organics between aquatic and terrestrial systems. Reduces quality of riparian functions. Affects drainage patterns to the beach.
  - » Passive erosion. Does not allow for the natural retreat of the shoreline which narrows the remaining beach.

» Alters sediment delivery and transport. Reduces the delivery of sediment into the system and reduces the overall budget of the local littoral cell.

· Impedes alongshore transport and causes localized erosion downdrift.

· Altered wave action. Increases erosion and end scour through wave reflection.

Data Availability, Education, Research and Outreach

· The state has projected SLR assessment data for 2018 and has interactive SLR assessment tools completed by the University of Washington.

· Washaway Beach is the fastest eroding beach in the west with a claimed average of 100 ft of shoreline every year.

· For improved properties only (properties with a structure) a seller is required to disclose whether they have actual knowledge of:

· basement flooding

· flooding problems on the property that affect the property or access to the property

· any material damage to the property from floods and

· whether the property is located in a floodplain.

References and Resources

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Wisconsin

State Strategies

· Coastal shoreland is protected under State Chapter NR 115, Wisconsin Administrative Code, Wisconsin Shoreland Management Program

» Assures public rights to waters and owned by all citizens.

· The State has a Navigable Waters Protection Law

· The state experienced record-high water levels along the shores of Lake Michigan in 2020.

Coastal Land Use Planning and Development Regulations

· Zoning of Shorelands in County and Municipal Land Use Planning

» Have shoreline enforcement officers

» Have a shoreland permit process for development in the shore zone

» Limit direct cumulative impacts of shoreland development on water quality

· Walworth County Shoreland Ordinance

» Protects natural scenic beauty, fish and wildlife habitat, preservation and restoration of native vegetation, spawning grounds

» Protection of natural shrubbery and natural vegetation

» Protections of vegetation in within 35 ft of the ordinary high-water mark (no touch zone)

» Maintains a view and access corridor (VAC) and stairways, walkways, rails must be placed in the VAC

» Open sided structures must establish and maintain a buffer zone covering 75% of half of the shoreyard setback closest to the water.

» Require permits for vegetation removal (fee of $0 to $600)

» Permits required for stump grinding in the buffer zone. Fee of $25 per stump.

» Permits required for invasive species removal

» Removed trees must be replaced.

· Shoreline zoning rules apply to unincorporated land that is within 1000 ft of a navigable lake, flowage or pond or within 300 ft of a navigable stream or landward of a floodplain whichever is greater.

· All buildings and structures must be set back at least 75 ft from the ordinary high-water mark with exceptions for piers, boat hoists, fishing rafts, utilities, walkways, stairways, decks, gazebos and boathouses. Set back averaging based on an existing pattern of development may allow new homes to be built closer.

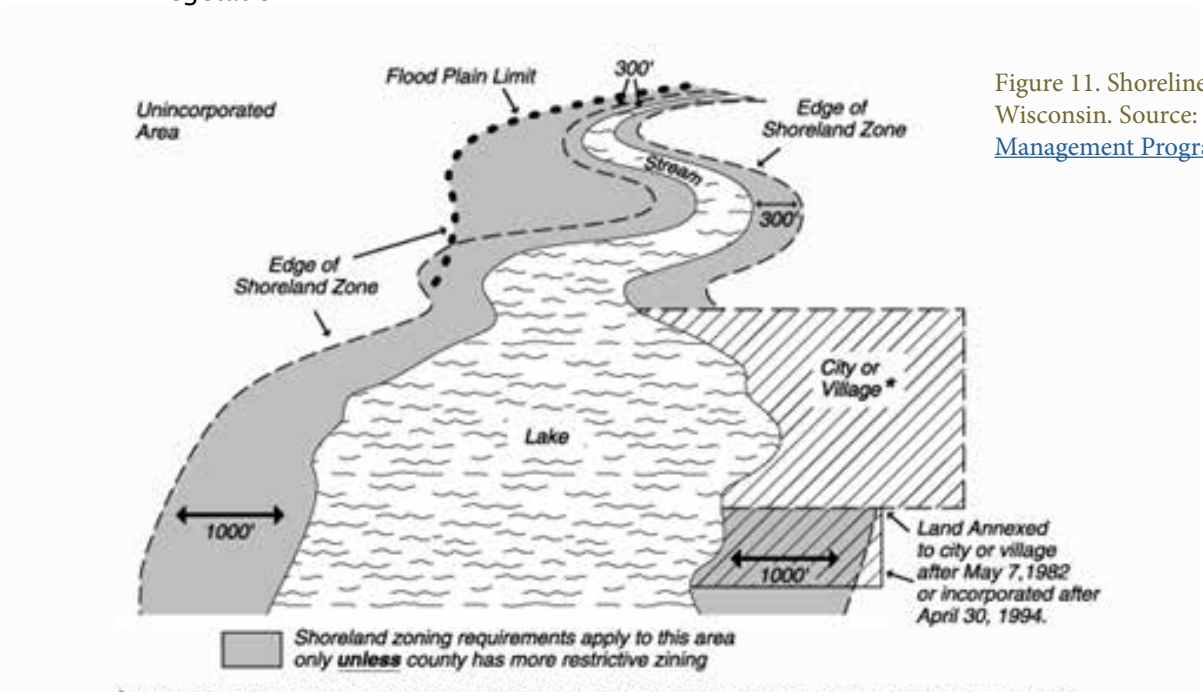

Figure 11. Shoreline and wetland Zoning Rules, Wisconsin. Source: Wisconsin's Shoreland Management Program.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Erosion control structures must go through a permitting process under the state Department of Natural Resources.

  » The cost of structures typically ranges from $100 to $500 per lineal foot.

· Vegetated armouring techniques are used in the state to combat shoreline erosion.

· Hard structural control measures such as riprap and seawalls are also used.

· The City of Green Bay promotes the use of "bio-engineering" techniques. Techniques such as joint planting, live fascine, brush mattress, vegetated geogrid are utilized.

Data Availability, Education, Research and Outreach

· Resources for property owners having coastal properties along the Great Lakes can access learning materials via a website funded by Sea Grant at the University of Wisconsin.

· Sellers are required to disclose whether they are aware that the property is located in a floodplain, however they are not required to disclose information on previous flood damages.

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International

Belize

Coastal Management Strategies

· The country has an integrated Coastal Zone Management Plan managed by the Belize Coastal Zone Management Authority and Institute (CZMAI).

» Describes the coastal zone including the barrier reef and associated habitat.

» Fisheries and tourism description

» Coastal issues such as urban expansion

» ID stakeholders and legislative authorities

» A vision for sustainable coast including adaptation and mitigation for climate change.

· Coastal zone management guidelines establish permitted and restricted uses for different areas.

· National sustainable tourism master plan is in place.

· The country has a number of marine protected areas. Coastal reefs are a major concern.

Coastal Land Use Planning and Development Regulations

· Has an integrated Coastal Zone Management System (ICZM)

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Sediment transport and erosion have been studied.

» Erosion rates at 4 municipalities revealed a maximum loss of -2.61 m per year to a total beach loss of 113 m over 50 years in one area. Some areas had beach growth up to 80.55 m.

» Causes of erosion include coastal roads, blockage of river sediment by dams and inadequate, coastal structures such as piers, and breakwaters.

» Studies of coastal dynamics were not conducted but it is known that in some cases the beach is protected but the problem is passed on to the neighbouring properties.

Data Availability, Education, Research and Outreach

· The rate of SLR in the Caribbean region is 2.7 mm/yr based on satellite measurements.

· A DEM for Belize has been developed to help understand the impacts on the country and 37 settlements are exposed to sea level rise

· Efforts to protect coral reefs, Sports Fishing and native species are being made due to treats from climate change.

References and Resources

Integrated Coastal Zone Management, Belize. Natural Capital Project. Stanford University.

Belize Integrated Coastal Zone Management Plan 2016. Coastal Zone Management Authority and Institute. Ministry of Agriculture, Forestry, Fisheries, the Environment and Sustainable Development.

Bermuda

Coastal Management Strategies

· The plan of 1992 refers to the Bermuda Image which aims to preserve the visual quality and character of development which is distinctively Bermudian. One of the components of this vision is.

» Natural coves, bays, beaches, the rocky coastline and islands, with views and glimpses of vividly coloured waters and the ocean.

Coastal Land Use Planning and Development Regulations

· The Bermuda Plan of 1992 is the guiding planning statement for the country.

· Bermuda has developed coastal protection and planning guidelines.

· Setbacks with consideration of inundation levels were considered.

» The amount of setback depends on the slope of the shoreline, the nearshore bathymetry, the rate of shoreline erosion and the geotechnical stability of the geological formations.

» Many existing buildings were located too close to the shoreline.

· Adoption of a community approach to shoreline defence and importance of functional integrity over aesthetics.

· Significant ecological features are considered.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· A coastal erosion vulnerability assessment provides wave modelling data to reveal areas of highest risk.

» The approach to armouring and development must be cognizant of the forces of nature acting in the area of study.

· Concrete or other seawalls to use Bermuda Stone Facing or stepped structures with vegetation at the top of the structure.

· Structures should be designed to handle a 1:50 year storm event.

· Concrete used should a developed strength of 5000 psi.

· Nearshore wave height, static storm surge and runup calculations are made for 50 year and 150 year storm events (Fabian was between a 100 to 150-year event.

· Importance of rim and boiler reefs for protect the shoreline are critical to reduce wave energy reaching the shores of the island.

· Hurricane Fabian in Sept. 2003 did considerable damage to seawalls, shore protection structures and beaches on the island. Many of these failed due to weak or no foundation or being built on sand.

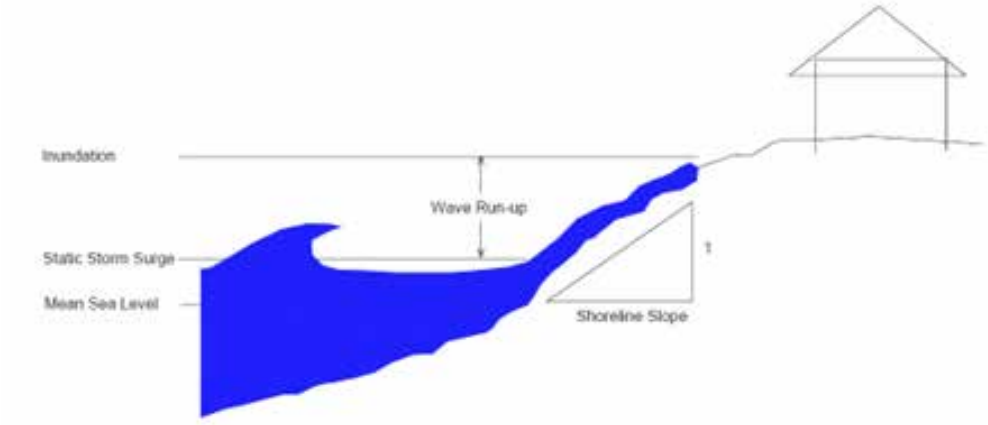

Figure 12. Sketch for calculation of Inundation Levels, Bermuda.

Source: Coastal Protection and Development Planning Guidelines for Bermuda.

· Cliff failures were also observed after the hurricane due to many factors.

· Wave attack at the toe of the cliff, leading to oversteepening and/or instability in the upper layers;

· Through wave attack, the outer weathered and hardened layers of the Aeolian limestone had been stripped away, leaving a soft, sandy core exposed. Once these soft areas became exposed, erosion of the rock proceeded at a rapid pace during the storm;

· High-pressure jets of water (from breaking waves) were shot up through narrow vents in the cliff face rock. These jets weakened blocks of cliff face that would not normally have been exposed to wave action during the storm, thereby leading to cliff failure in elevated sections of the cliff.

· Sand dunes were also cut back 20 to 30 m in some places.

· Dune restoration methods include;

· A mechanical method using fences or windbreaks

· A vegetative method involving planting of sand and salt tolerant species.

References and Resources

Coastal Protection and Development Planning Guidelines for Bermuda. Government of Bermuda, Ministry of the Environment.2004

Bermuda Plan 2016 - A Review of the Current Planning Statement.

Denmark

Coastal Management Strategies

· The Coastal Protection Act which is based on the first Dike Act of 1874 and Coastal Defences Act of 1922 regulates coastal protection.

» The Danish Coastal Authority is the official gov't agency in charge of coastal protections and oversees the regulation of coastal developments.

» The Danish Coastal Authority has a storm surge warning management system at Lemvig which is manned 24/7 year-round.

· In November of 2010 a large-scale storm surge warning system exercise was held which used a simulated 5 m above normal surge with high winds.

» Since September of 2018 administration of coastal protection belongs to local municipalities.

· In January 2018 Danish lawmakers agreed on regulating the Planning Act to prevent damage caused by flooding and erosion and provided municipalities the legal framework to begin combating SLR.

» The efforts by municipalities such as Guldborgsund was hindered by a lack of geospatial analysis of available data.

» Increases in tidal amplitude, mean water levels, storminess and increasing storm surges are contributing to the problems as designers of protection systems were not accounting for these changes.

· Generally, property owners in Denmark are responsible for protecting their land against the sea and they must request permission to establish coastal protection and pay the costs of construction, operation and maintenance.

· Denmark has a long history of coastal protection with 3 main principles: Protection, Accommodation, and Managed retreat

Coastal Land Use Planning and Development Regulations

· A nationwide risk assessment of coastal risks such as erosion and flooding called "Coastal Planner" has been conducted for the entire Danish coastline of 7300 kms. This included 3-time frames: today, 50 years and 100 years.

· Use a multi-criteria framework for the analysis and planning of coastal protection.

· Local municipalities develop regional plans based on their individual needs.

· Use the University of Copenhagen, Dept of Geography and Geology to provide advice.

· Have identified areas of special high risk.

· Areas under 5m above mean sea level considered highly vulnerable.

· Hope to achieve a safety level against flooding for a 100-year return period.

· The coastal municipality of Guldborgsund located on Falster Island in Southeastern Denmark is expected to have 19% of its landmass inundated with approximately 39% of the population directly experiencing a risk from SLR.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Similar coastline to PEI (Jutland area), particularly the sand dune areas with similar erosion rates

· Zero erosion is not achievable, but erosion can be slowed down.

· Hard protection measures such as groynes and sea walls have proven ineffective, and the country is trying to break the habit of using hard measures.

Data Availability, Education, Research and Outreach

· Denmark has 7000 kms of coastline.

· Use of satellite imagery is expected to assist in areas where data is lacking in quantity or quality.

· A combo of nourishment and detached breakwaters have reduced coastal retreat to 0.1 m/yr

· Denmark has shifted to mainly soft protection measures especially on dunes and beach areas.

References and Resources

Protected our Coastline. Coastal Management Plan Review. Your Denmark.

Coastal Planner. Climate Change Adaptation. Ministry of Environment of Denmark / Environmental Protection Agency

Coastal Protection on the West Coast of Jutland, Denmark. Case Study 02 World Bank Group.

Coastal protection technologies in a Danish context. Farago et al. 2018 DTU Library

Building with Nature. EcoShape. 2023

European Union (EU)

Coastal Management Strategies

There are 27 member states in the European Union and this organization has developed a number of directives for member states to help them prepare for and respond to severe impacts in the coastal zone due to climate change and to make the coastal adaptation process smarter. The EU strongly promotes the use of nature-based solutions to protect coastal areas and the organization also promotes the use of ecosystem services and the restoration of wetlands.

Some of the strategies and policies promoted by the EU include:

- Strategy on Adaptation to Climate Change adopted in 2021. The objectives of the strategy are to improve knowledge of climate impacts and adaptation solutions by stepping up adaptation planning and climate risk assessment with three main objectives.
  - Smarter adaptation: Improving knowledge and manage uncertainty; including:
    - Pushing the frontiers of adaptation knowledge;
    - More and better climate loss data; and
    - Enhancing and expanding Climate-ADAPT as the European platform for adaptation knowledge.
  - More systemic adaptation: Supporting policy development at all levels and all relevant policy fields; including three cross-cutting priorities to integrate adaptation into:
    - Macro-fiscal policy;
    - Nature-based solutions; and
    - Local adaptation actions.
  - Faster adaptation: Speed up adaptation implementation across the board.
- Integrated coastal zone management to handle cross-cutting issues
- Maritime Spatial Planning
  - Member States remain responsible and competent for designing and determining, within their marine waters, the format and content of such plans, including institutional arrangements and, where applicable, any apportionment of maritime space to different activities and uses respectively.
- Floods Directive 2007/60/EC. All EU countries are required to
  - assess all areas where significant floods could take place
  - map the flood extent and assets and humans at risk in these areas
  - take adequate and coordinated measures to reduce this flood risk
  - The rights of the public to access this information and to have a say in the planning process are also important elements of the Directive.
  - EU countries are required to create and update Flood Hazard Maps and Flood Risk Maps. Flood Hazard Maps should cover the geographical areas which could be flooded and Flood Risk Maps show the potential adverse consequences associated with these flood scenarios. These maps form the basis for the drafting of flood risk management plans.
- Marine Strategy Framework Directive 2014/89/EU. This includes promotion of Nature Based Solutions
  - Healthy marine ecosystems and their multiple services, if integrated in planning decisions, can deliver substantial benefits in terms of food production, recreation and tourism, climate change mitigation and adaptation, shoreline dynamics control and disaster prevention.
- Water Framework Directive for River Basin Management Plans.

References and Resources

Coastal Areas. Climate ADAPT. EU Adaptation Policy.

Floods. European Commission. Energy, Climate Change Environment.

Nature Based Solutions in Europe, European Environment Agency Report No. 01/2021

Ireland

Coastal Management Strategies

· Ireland is part of the EU and use European Adaptation Strategy to make adaptation smarter, faster, and more systematic.

· The Habitats Directive Article 6 92/43/EEC gives direction to protect habitats.

· The Republic of Ireland has three acts which control the coastal zone: The Planning and Development Act, the Foreshore Act and the Coastal Protection Act.

» The Planning and Development (Strategic Environmental Assessment) Regulations S.I. No. 436/2004.

Coastal Land Use Planning and Development Regulations

· Use County Action plans, county development plans and beach management plans with ICZM approach.

» The Fingal County Development Plan encourages an ICZM approach to coastal protection.

» A Strategic Flood Risk Assessment for the Fingal Development Plan 2023-2029 has just been completed by McCloy Consulting.

· Three flood zones have been established. When determining flood zones existing structures should be ignored.

· Use a sequential approach to coastal development. Avoid, substitute, justify, mitigate, proceed.

· Justification test outlined in Section 3.10 of the Plan.

Zone A	High probability of flooding (>0.5% or 1:200)	No development except for outdoor uses, docks, marinas. Required use of a justification test.
Zone B	Moderate probability of flooding (0.1% to 0.5%)	Highly vulnerable development such as hospitals, nursing homes, dwellings, other infrastructure considered inappropriate for this zone.
Zone C	Low probability of flooding (<0.1% or 1:1000)	Most development would be appropriate but would need proper planning and sustainable development considerations.

Table 7. Flood Zones from Rivers and Sea Fingal County, Ireland (Adapted from Strategic Flood Risk Assessment 2022)

· A report on coastal climate change adaptation for Ireland outlines a 6-step local coastal adaptation cycle process called CLAD.

» The CLAD Tool Kit was used at 5 coastal case study sites and involved many local stakeholders.

» Irish stakeholders at different levels of coastal governance were found to have a general understanding of the importance of climate change adaptation.

» Local authorities learn to adapt their daily management practices in reaction to changing conditions by introducing by-laws and measures for beach protection and coastal erosion.

» The process showed a need for an integrated approach to coastal management due to ongoing fragmentation of policies and plans and a lack of legal grounds for climate adaptation planning.

» Fragmentation of coastal governance into separated elements of governance (transport, tourism, environment, planning etc) does not lead to a uniform coastal governance approach.

· Historic tide gauge records proved helpful in combining synthesised data from the Irish Sea Surge Model, but the limited availability was a significant problem with flood assessment aspects and model calibration.

» The estimated accuracy of combined tide and surge levels was at 95% with confidence limits of +- 180 mm at OD Malin.

» Nine primary areas of potential coastal erosion risk were identified including Portraine, Skerries etc.

· Have by-laws for beaches and foreshores.

» Beach management plan for Burrow Beach near Dublin.

· The city of Dublin released a climate change action plan in 2019.

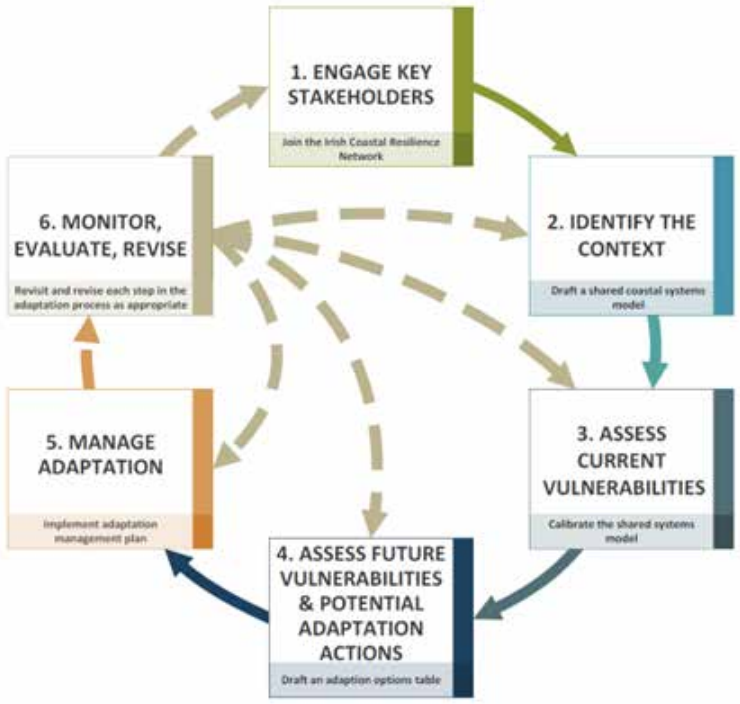

Figure 13. CLAD Toolkit Ireland, Local Coastal Adaptation Cycle. Source: EPA Climate Change Research Programme (CCRP)

» Increased use of nature-based solutions

» Sea level rose 6 to 7 mm per year from 2000 to 2016, which is about twice the annual rate.

» Record high tides of up to 2.9 m have been experienced.

» Storm surges up to 100 cm are expected to increase in frequency.

» Highest tide ever measured at Dublin was 3.014 m on Jan. 3, 2014. Highest tide in 400 years.

» The City of Dublin has a sea level risk matrix and a flooding risk matrix.

» Adaptation plans are required for areas which are at risk

· Areas of Dublin, Louth and Wexford are at highest risk to SLR. Under a projected SLR of 6 m close to 1200 km2 would be at risk.

· A minimum of 50 m setback for soft coasts and restrict vehicle access to beaches and dunes.

· A minimum of 4 m above present sea level is recommended for the east coast of Ireland which accounts for SLR of 0.5 m, storm surge of 2.95 m and a safety margin.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Approximately 20% of Ireland's coastline is eroding and these are areas made up of unconsolidated sediments.

· Coastal defences and other infrastructure are often old, and less than 4% of the coastline is protected by shoreline defences

· A coastal protection strategy study was completed in 2019.

· Limited use of hard engineering structures except in harbours, wharf areas. Use Seabee units.

· Collect a lot of data on various parameters and use a variety of collection techniques.

· Don't use managed realignment, detached breakwaters, sand motor or perched beach.

· In some areas a do-nothing approach used.

Data Availability, Education, Research and Outreach

· The Geological Survey of Ireland has developed a Coastal Vulnerability Index mapping system to evaluate the impacts of SLR.

· Storymaps are used to educate the public on national coastal climate adaptation policies in the country

· Eliminate invasive species.

· Frown upon short term solutions.

· Use signage and media to educate the public.

· Similar shoreline to many parts of PEI with many beaches and land use conflicts.

· The Climate Change Risk matrices for the City of Dublin may be of use to PEI.

References and Resources

Coastal Erosion Ireland. Climate Change Post 2023

National Coastal Climate Adaptation Policies in Ireland 2025-2021. CCAT Project 2021

Irish Coastal Protection Strateegy Study (ICPSS) 2020. Government of Ireland

Coastal Vulnerability Index (CVI) Geological Survey - Ireland.

Flood Maps. Commissioners of Public Works in Ireland.

High and dr: How Irish Rail is protecting its lines from coastal erosion in Dublin and Wicklow. The Irish Times, O. Kelly, 2022

Sea-level rise and storminess threaten Ireland's sandy beaches. The Irish Times, J. Gibbons, 2022

Ireland shrinks by 750 acres a year as sea eats shoreline. The Irish Times, D. Ahlstrom 2002.

Valuing Ireland's Blue Ecosystem Services. Socio-Economic Marine Research Unit (SEMRU)

Italy

Coastal Management Strategies

· Italy is a regionalized country where regions, provinces and municipalities may adopt their own statutes.

· Management of coastal areas is highly fragmented and suffers from considerable jurisdictional overlap.

· Legislation has introduced several key principles of effective water and flood risk management, later embraced when applying the EU Water Framework Directive (2000/60/EC) and the EU Floods Directive (2007/60/EC). The L. 183/89 adopts river basins as planning and management units and includes key principles for coastal flood and erosion risk planning and management.

Coastal Land Use Planning and Development Regulations

· In the Tuscany region a strong emphasis is placed on the importance of coastal tourism to the local economy.

· Coastal tourism has come into conflict with traditional coastal defence works. Detached breakwaters have been widened and lowered below sea level. Hardened structures reduce sediment yield.

· Long term strategies are required to resolve the problem with protection of the shoreline and this is incompatible with the life time of political officers. No coordination between local, regional and national authorities.

· Sustainable Development and Eco-tourism Program (PSSE in Italian), an economic-environmental planning tool.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· In the Marche region coastal erosion has been addressed in a number of ways mainly to protect beach areas.

» Beach nourishment

» Cliff stabilization, and

» Removal of artificial reef.

· Over 277 coastal protection measures have been implemented over 176 km of coast. These included

» New structural measures such as seawall and breakwaters

» Soft measures such as beach nourishment using sand and gravel.

· Materials used have to meet precise local requirements with an alluvial origin, similar mineral composition, colour and particle dimensions as per the original beach materials.

· Plans are being developed to create a sand bank using dredging materials to avoid disposal in landfills at sea.

· Beach nourishments have proven effective in increasing tourist activity.

Data Availability, Education, Research and Outreach

· Use of cost benefit analysis to strengthen project planning.

· Strong public planning, stakeholder consultation and cooperation with local communities (Marche region).

· 42% of Italy's beaches are already under erosion and these beaches are becoming increasingly narrower.

References and Resources

Italy - Governance Structures, laws, policies, plans and regulations for coastal protection and disaster risk reduction. RISC-KIT

Addressing coastal erosion in Marche region, Italy. Climate ADAPT.

Coastal Erosion Italy - Climate Change Post 2023

Kenya

Coastal Management Strategies

· The coast of Kenya is about 60 km long.

· Coastal erosion and saltwater intrusion already require substantial management interventions.

· Coastal management in Kenya needs improvement and have been divested to the county level.

Coastal Land Use Planning and Development Regulations

» Kenya has 6 coastal counties and these counites are responsible for planning and storm water management.

» Coastal counties in Kenya are already undertaking climate change adaptation in a poorly structured and non-integrated manner.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· In Kenya, seawall erosion protection has been a major issue in coastal development. Many coastal areas are vulnerable to coastal erosion due to high tides. In addition, local communities have traditionally treated the shoreline as a resource, thus destroying coastal forests and exposing unconsolidated soils. These developments have exacerbated shoreline instability and led to the relocation of hotels.

· Coastal flooding from sea-level rise is projected to affect 10,000–86,000 people a year as well as lead to coastal erosion and wetland loss at an annual cost of $7–58 million by 2030, rising to $31–313 million by 2050.

· Sand mining is a major issue and is impacting the status of the best beaches in Southern Kenya.

Data Availability, Education, Research and Outreach

· Climate change is threatening Kenya's historical sites in the coastal region.

· Coastal Kenya increasingly experiences rainfall induced flooding and droughts.

· In Kenya, various Digital Media Platforms and Social Networking Sites such as Twitter, Facebook, WhatsApp, Instagram, Telegram, Discord, LinkedIn, and YouTube are used to inform people about climate change information.

· Human activity has devastated a quarter of the seagrass beds along the coast of Kenya, resulting in the destruction of key habitats and contributing to climate change.

References and Resources

Integrated Coastal Zone Management in Kenya. Mwanguni et al. 2023 SEACAM

Assessment of Coastal Governance for Climate Change Adaptation in Kenya. Ojwang et al. 2017 Earth's Future.

Kenya South Coast Residents triumph as environmental tribunal blocks sand mining. Coastal Care: Kenya Sand Wars.

Maldives

Coastal Management Strategies

· The Maldives Government has an approval process for coastal development projects called a clearance process.

· The country uses a Coastal Zone Management Centre system to manage the coastal zone.

· Tourism projects require an additional process.

· Beaches are one of the most valuable economic and recreational assets for the Maldives.

Coastal Land Use Planning and Development Regulations

· Land-use planning has to be strengthened using environmental criteria to emphasize minimal impacts on geomorphological processes and periodic restoration of features when damage occurs

· Very low elevation group of islands which are very vulnerable to sea level rise and storm surge. The average height above mean sea level is 1.5m.

· For inhabited islands a recommended minimum of 100 ft between a building and the beach.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· One island is protected by a massive seawall and uses a tetra-pod design.

· Rising one island by an elevation of 1 m had been recommended in 2006.

Data Availability, Education, Research and Outreach

· The main driver of extreme coastal flooding in the Maldives is wind-waves.

· Global wave models are used to downscale large-scale fields which provides information along the coastline to a spatial resolution of 500m. This is combined with a set of mean sea-level changes using a scenario-independent approach. These were utilized to create risk maps up to 1 m above present day mean sea level using the RCP8.5 emissions scenario and produces a milestone for more informed adaptation policy by Maldivian decision-makers. The analysis advocates for improve monitoring systems and data collection to reduce uncertainties.

· The Coastal Zone Management Centre involves reps from gov't (federal, provincial and municipal), academic /scientific, planners, engineers, sectors (agriculture, fishery, tourism), etc.

· Terms of Reference for this centre:

  » ID organizations dealing with relevant coastal resource management issues.

  » Facilitate interaction amongst all stakeholders including funding agencies.

  » Promote coordination and cooperation on ICZM issues.

  » Collect, compile, and disseminate information via networking.

  » Assess and standardize the planning methodologies for integrated ICZM

  » Provide support for the promotion and development of ICZM concepts, methodologies, and tools.

  » Promote exchange of experiences, information, data and expertise in the ICZM.

  » Assist in institutional strengthening and HR development for capacity building in ICZM.

  » Conduct and coordinate research in the field of coastal zone management and facilitate technology transfer (workshops, seminars, training sessions/ courses, educational materials, technical meetings, etc)

  » Regular reporting (Quarterly, annual)

References and Resources

Building Climate Resilient Safer Islands in the Maldives. Green Climate Fund. 2021

Facing dire sea level rise threat, Maldives turns to climate change solutions to survive. ABCNews 2021

The Maldives are building a floating city to address rising sea levels and population. CBC Radio 2022

Coastal flooding in the Maldives Induced by Mean Sea-Level Rise and Wind-Waves: From Global to Local Coastal Modelling. Frontiers in Marine Science. Amores, et al. 2021

Mediterranean Coastal Region

Coastal Management Strategies

· The EU has a protocol on Integrated Coastal Zone Management Strategy in place for the Mediterranean since 1976.

· This protocol sets a 100m setback for developments along the coast under Article 8-2 with some exceptions for projects of public interest.

· Cost benefit analysis is used in the decision-making process.

Coastal Land Use Planning and Development Regulations

· Setback zones are used in many jurisdictions in Europe and worldwide.

· The key finding in a study by Lincke et al (2020) in Croatia is that economic impacts of sea-level rise can be significantly reduced by integrating setback zones into the adaptation strategy. If protection and construction restriction by setback zones are combined, the future cost of coastal flooding can be reduced by up to 39%. Combining protection and managed retreat by setback zones can reduce the future cost of coastal flooding by up to 93%.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

A five-step approach was used to make the calculations for coastal sensitivity to erosion:

Determine coastal sensitivity,

Land use obtained from official plan.

Sensitivity related to land use to enable determination of best mitigation strategies.

Info compiled on a regional scale.

Further studies and investigations to determine best options at a small spatial scale.

Data Availability, Education, Research and Outreach

· Lincke et al provide assessments of setback zones to assist with flooding and erosion problems in Croatia.

· Coastal management in Spain was in a failing state in 2003.

· Model for mitigation strategies and mapping coastal sensitivity in Spain using ERA5 dataset. Five classes of shoreline were identified from very low to very high.

· LIDAR maps widely used.

References and Resources

Integrated coastal zone management in the Mediterranean: From Vision to Action. PEGASO Project.

Netherlands

Coastal Management Strategies

· The Netherlands has been in the coastal protection business since the 1600s.

· In 2000 a national policy of ICZM was adopted with a focus on sustainable spatial quality and safety.

· The Dutch coastline is very similar to large sections of the PEI shoreline with sand dunes and low-lying lands which are vulnerable to SLR.

· Monitoring has been occurring since the late 1800s and since the 1960s it has been done systematically.

· Since 1963 measurements have been required via legislation to measure height/ depth values 800 metres seaward and up to 200 m landward from the first line of the dunes. Once every 3years a profile in each 1 km stretch is extended 2-3 kms seaward.

Coastal Land Use Planning and Development Regulations

· Integrated coastal management in the Netherlands has a strong focus on flood risk management and monitoring.

· The municipality of Rotterdam has installed floating homes in Nassau harbor that move with the tides, providing a sustainable waterfront view for homeowners while making room for public-friendly green space along the water.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· In the past engineered structures such as dikes and dams were used but erosion had destroyed most of these and a change in strategy to softer engineering options was introduced.

· Sandmotors are used to add sand to 13 km of coast adding some 3500 ac in some areas with extensive plantings of marram grass. System nourishment is used extensively.

Data Availability, Education, Research and Outreach

· The Dutch use a beach post system measuring perpendicular to the coast and these are placed 200 to 250 m apart in some areas.

· Measurements are recorded in a national database and an aircraft laser scanner has been used to acquire some of the measurements.

· Organization for policy development and implementation may be of some use for PEI.

· The strategic goal, tactical approach and operational objectives may be of assistance.

· The 1990 coastline is considered a basal coastline and is used as a standard for the policy of coastline management. The Dutch gov't tries to achieve the closest possible integration of sea defences, nature development, recreation and physical planning.

References and Resources

Coastal erosion - The Netherlands. Climate change Post 2023

The Sand Motor. ZandMotor Monitoring. De Zandmotor 2023

The Dutch coast is constantly under attack by the sea. World Water Atlas 2023

A Case Study Documenting Coastal Monitoring and Modelling Techniques in the Netherlands. Messina. Isle of Wight Council. 2005

Coastal Management in The Netherlands: Evolutionary best practices. Nauta, T. Deltares 2021

Ecosystem Services From Concept to Practice. PBL Netherlands Environmental Assessment Agency. 2015

How the Dutch are Building Coastal Protection for Less - with Nature's Help. 2020. Pulitzer Center.

New Zealand

Coastal Management Strategies

· New Zealand has a "New Zealand Coastal Policy Statement" (NZCPS) that is applied as required by the Resource Management Act 1991.

» Local authorities must amend regional policy statements, proposed regional policy statements, plans, proposed plans, and variations to give effect to NZCPS provisions that affect these documents as soon as practicable.

· Policy 24 in the NZCPS requires identification of coastal hazards. Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to:

» physical drivers and processes that cause coastal change including sea level rise;

» short-term and long-term natural dynamic fluctuations of erosion and accretion;

» geomorphological character;

» the potential for inundation of the coastal environment, taking into account potential sources, inundation pathways and overland extent;

» cumulative effects of sea level rise, storm surge and wave height under storm conditions;

» influences that humans have had or are having on the coast;

» the extent and permanence of built development; and

» the effects of climate change on:

· matters above;

· storm frequency, intensity and surges; and

· coastal sediment dynamics;

· taking into account national guidance and the best available information on the likely effects of climate change on the region or district.

Coastal Land Use Planning and Development Regulations

· Regional coastal plans are prepared by regional councils to achieve the sustainable management of their coastal environment.

» All regional councils and unitary authorities for the coastal marine area are required to prepare a coastal plan.

· Policy 25 for the NZCPS provides guidance for subdivision, use and development in areas of coastal hazard risk.

» In areas potentially affected by coastal hazards over at least the next 100 years:

· avoid increasing the risk of social, environmental and economic harm from coastal hazards;

» avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards;

» encourage redevelopment, or change in land use, where that would reduce the risk of adverse effects from coastal hazards, including managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances, and designing for relocateability or recoverability from hazard events;

» encourage the location of infrastructure away from areas of hazard risk where practicable;

» discourage hard protection structures and promote the use of alternatives to them, including natural defences; and

» consider the potential effects of tsunami and how to avoid or mitigate them.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

·Policy 26 of the NZCPS provides guidance on Natural Defences against Coastal Hazards,

» Provide where appropriate for the protection, restoration or enhancement of natural defences that protect coastal land uses, or sites of significant biodiversity, cultural or historic

heritage or geological value, from coastal hazards.

» Recognise that such natural defences include beaches, estuaries, wetlands, intertidal areas, coastal vegetation, dunes and barrier islands.

· Policy 27 of the NZCPS provides guidance on Strategies for protecting significant existing development from coastal hazard risk.

» In areas of significant existing development likely to be affected by coastal hazards, the range of options for reducing coastal hazard risk that should be assessed includes:

· promoting and identifying long-term sustainable risk reduction approaches including the relocation or removal of existing development or structures at risk;

· identifying the consequences of potential strategic options relative to the option of "do-nothing";

· recognising that hard protection structures may be the only practical means to protect existing infrastructure of national or regional importance, to sustain the potential of built physical resources to meet the reasonably foreseeable needs of future generations;

· recognising and considering the environmental and social costs of permitting hard protection structures to protect private property; and

· identifying and planning for transition mechanisms and timeframes for moving to more sustainable approaches.

» In evaluating options under the above:

· focus on approaches to risk management that reduce the need for hard protection structures and similar engineering interventions;

· take into account the nature of the coastal hazard risk and how it might change over at least a 100-year timeframe, including the expected effects of climate change; and

· evaluate the likely costs and benefits of any proposed coastal hazard risk reduction options.

» Where hard protection structures are considered to be necessary, ensure that the form and location of any structures are designed to minimise adverse effects on the coastal environment.

» Hard protection structures, where considered necessary to protect private assets, should not be located on public land if there is no significant public or environmental benefit in doing so.

· Policy 29 of the NZCPS does provide for restriction of certain coastal activities especially those which have been publicly notified.

· One suggestion from Belinda Storey, a climate change economist and expert in coastal insurance is to set up a "climate lease" system. This would put a time stamp on the property to say it can only be used for the next 20,40 or 100 years depending on the risk at the site. It will not just be government regulation that discourages development in the coming years, she said. First there will be insurance retreat, which will then lead to bank loan retreat, then there will be infrastructure retreat as the cost of repairs continues.

· In New Zealand as of 2019, about 72,000 people are exposed to coastal flooding and there are about 50,000 homes at a value of approximately $12.5 billion at risk of serious damage.

· New Zealand has a National Climate Plan which includes relocation of some houses announced in August 2022.

Data Availability, Education, Research and Outreach

· New Zealand has a Climate Resiliency Policy Indicator.

  » New Zealand has strengthened its commitment to climate change adaptation and resilience in recent years. The 2019 Climate Change Response (Zero Carbon) Amendment Act mandates that the Minister prepare an NCCRA every six years to detail the risks New Zealand faces from climate change, and that it formulate an accompanying National Adaptation Plan (NAP) within two years after.

· Observed, historical data is produced by the Climatic Research Unit (CRU) of University of East Anglia. Data is presented at a 0.5° x 0.5° (50km x 50km) resolution.

· New Zealand has identified coastal erosion hazard zones which includes coastal run-up hazard, coastal flood hazard and coastal erosion hazard.

· New Zealand has an open data site for a number of parameters.

  » Erosion protection structures

  » Historic Shorelines (2019)

  » Coastal erosion hazard zones

  » Coastal Erosion Hazard Zone 1 (50 years)

  » Coastal Erosion Hazard Zone 2 (100 years)

  » Coastal Hazard Zone 3 (100 years + rapid SLR scenario)

  » NZ Coastal Sensitivity Index CSI Erosion.

References and Resources

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New Zealand: Current Climate - Climatology. Climate Change Knowledge Portal.

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Rebuild or relocate? Climate crisis leaves New Zealand coastl communities facing tough choice. The Guardian. 2021

New Zealand's national climate plan includes possibly seeking higher ground. The Associated Press. 2022

Norway

Coastal Management Strategies

· Responsibility for coastal planning is shared between planning authorities at national, regional, and local levels.

· The Government of Norway has initiated a Coreplan project which addresses the need to manage the coastal zone by taking into consideration the different interest groups in an integrated and sustainable manner. Methods for assessing the value of the various benefits obtained from the natural environment – or ecosystem services – will be examined and the purpose is to find ways to integrate this into spatial planning.

  » Traditionally, the involvement of people in management and planning in the coastal zone has been via organized local interest groups such as farmers, fishers, landowners etc. Multinational corporations and international environmental organizations are also becoming more involved in these processes.

  » Private companies such as aquaculture farms, mining waste depots are acquiring exclusive rights to marine areas as well as exclusive rights to wild marine species (quotas).

· Use ecosystem services approach to coastal governance and improved coastal planning.

Coastal Land Use Planning and Development Regulations

· Norway uses a 1.58 m above High-water mark for the 200-year storm surge value in their planning to deal with future issues.

· Municipalities are the main planning authority in Norway and planning includes sea areas 1 nautical mile (1.85 km) outside baseline.

· Mapping plays a critical role in the planning process but is prone to variation in interpretation.

· Development in the coastal zone is generally prohibited.

Data Availability, Education, Research and Outreach

· Coastline is typically hilly and steep thus not that similar to PEI but there are some areas of low elevation and beaches which are similar.

· Use LIDAR mapping to assess vulnerability to coastal flooding.

· Have created inundation maps for about 80% of the coastline.

· Competing interests is an issue on PEI as it is in Norway. Aquaculture and fishery vs coastal development for tourism, summer residences etc.

References and Resources

Coastal zone management. Coreplan. The Research Council of Norway.

Integrated coastal zone planning. Directorate of Fisheries. 2016

Comparative study: Coastal zone planning in Hordaland, Norway. Interreg 3B: Coastatlantic. Atlantic Coast (Wester Ross) Project.

Maps and data. Mareano collecting marine knowledge.

United Kingdom - England and Wales

Coastal Management Strategies

· The UK has had a Coastal Protection Act since 1949. This act is overseen by the UK Department for Environment, Food and Rural Affairs (DEFRA). The Environment Agency of DEFRA oversees the following:

» Provide and operate flood warning systems.

» Carries out works to manage flood risk from the sea and main rivers.

» Issues consent for works on or near rivers, and works affecting watercourses, flood and sea defences and other structures.

» Advises planning authorities on the implications of development proposals on flood risk.

» Designates structures and features of the environment that affect flood or coastal erosion risk.

» Has the right to enter private land to carry out FCERM works. FCERM is the national Flood and Coastal Erosion Risk Management Strategy for England.

· Slide pack of this strategy is available.

· Shoreline management plans (SMPs) are non-statutory policy documents which have been used to protect shorelines since 1993. These stress the importance of research studies to identify the most successful and sustainable techniques and are based on sediment cells.

· Shoreline management policies considered in the UK include:

» Hold the line (It is recognised that the hold the line option may not last 100 years),

» Advance the line,

» Managed realignment,

» No active intervention.

· SMPs address approaches to manage risks over the next 100 years.

· Futurecast project assess shoreline evolution over a 100-year period.

· The UK is supporting a research program to help in decision making processes and this has 4 themes.

» Strategy and Policy Development,

» Modelling and risk,

» Sustainable asset management,

» Incident management and community engagement

· High priority areas receive funding from the federal government.

Coastal Land Use Planning and Development Regulations

Vol. 1 defines an SMP and outlines what it should include:

· These plans are a large-scale assessment of risks associated with coastal processes and aim to reduce the threat of flooding and erosion to people and property; and benefit the environment, society and the economy.

· An SMP should identify the best means of managing risks over the next 100 years from flooding and erosion.

· Shoreline management policies to manage risks should consider a range of responses.

· Remove risks by avoiding or moving inappropriate development in vulnerable areas;

· Reduce the likelihood of damaging events through management work that prevents damage (such as managing beaches, cliffs, dunes, saltmarshes, etc or using back-up and secondary defence systems.

· Reduce the consequences of risks by providing early warning systems;

· Reduce the risks associated with potentially damaging events through flood and coastal defence schemes or altering buildings to reduce the chance of flood damage.

· Shoreline management policies need to be supported by monitoring and must take into account existing health and safety legislation.

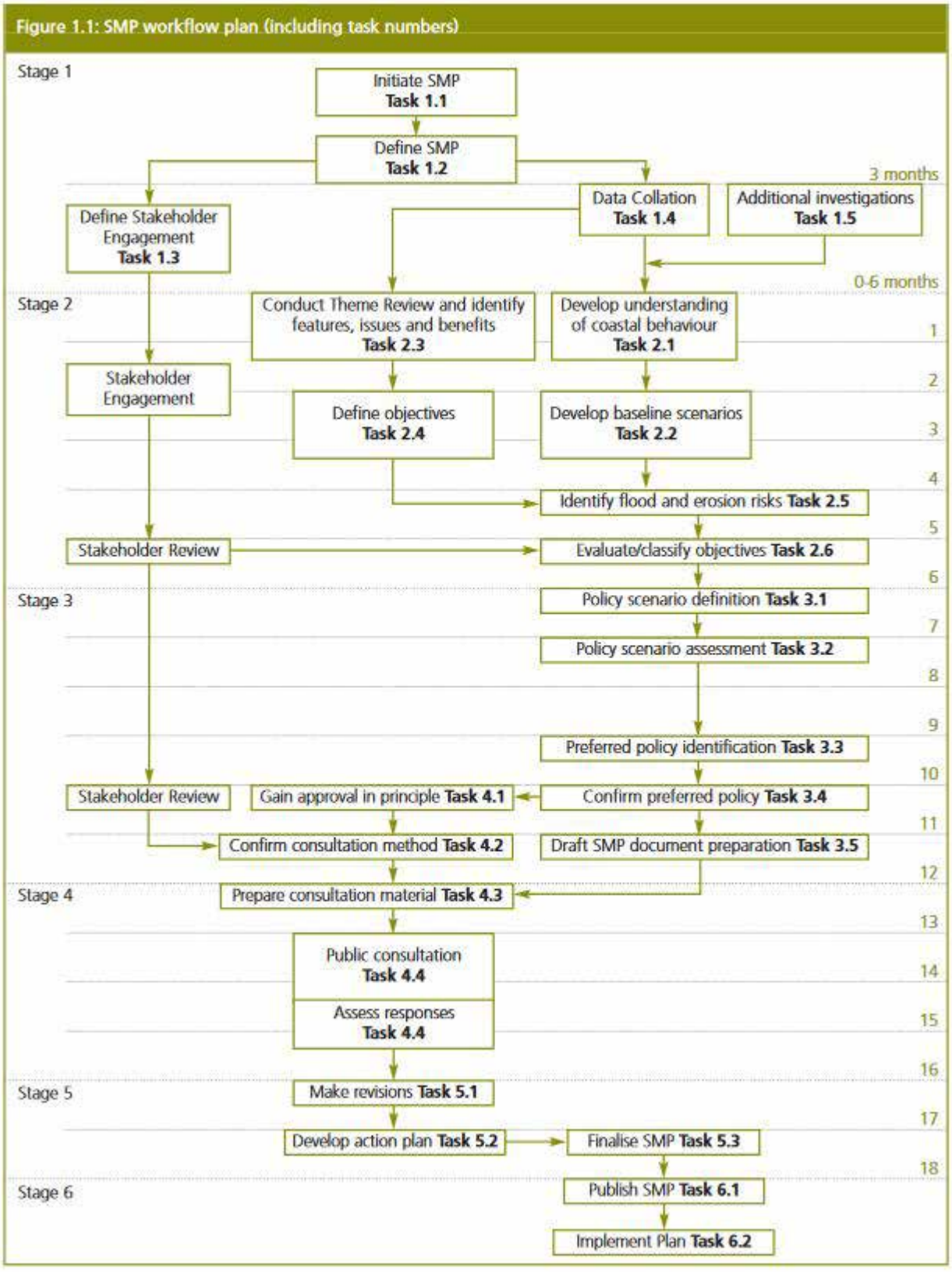

Figure 14. Shoreline Management Plan Workflow Plan (Source: Shoreline management plan guidance Volume 2: Procedures)

· It is essential that policies in an SMP are realistic, use existing legislation and consider likely future flooding potential.

· It is highly recommended that consultation of people is conducted during the main stages of SMP development.

· All stakeholders should be contacted.

· Stakeholders should be involved in the process.

· Councillors, regional flood committees, planner etc need to be involved and be willing to adopt the SMP into their plans.

· General public to be informed and advised how the planned actions are going to be implemented.

· Controlled development is a key component of the SMP process and before considering planning applications in defined coastal areas consultation between relevant engineering, local planning authorities are encouraged to reduce risk and amendments to proposed designs.

Volume 2 provided guidance on how to produce an SMP in line with the requirements in Vol. 1. It has been developed with industry wide expertise to find the most appropriate best management practices for delivering SMPs: Vol. 2 has 3 main parts.

- Guiding principles
- Summary of tasks and activities
- Guidance on delivering tasks and activities.

· The main tasks outlined in this volume include:

· Scope the SMP (sample of tasks to be completed.

- Assessments to support policy development. This includes assessment of existing coastal defence systems to evaluate their performance.
- Policy development.
- Public examination once draft plan has been developed.
- Finalise plan and obtain agreement on proposed changes and determine if the established standards have been met.
- Plan dissemination via publication and availability via websites and distribution to all local authorities.

· It takes time for coastal communities to adapt to climate change and to improve buy-in.

· The UK is supporting a research program to help in decision making processes and this has 4 themes.

» Strategy and Policy Development,

» Modelling and risk,

» Sustainable asset management,

» Incident management and community engagement

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· A national flood and coastal erosion risk management strategy for England has been developed nor the next 10 to 30 years. It seeks to better manage the risks and consequences of flooding from:

» Rivers

» The sea

» Groundwater

» Reservoirs

» Watercourses

» Surface water

» Sewers

» Coastal erosion

·All stakeholders are partners in implementation of the strategy.

» Individuals

» Communities

» The third sector

» Businesses

» Farmers

» Land managers

» Infrastructure providers

· Have a national database of flood and coastal defense systems.

· UK has a Coastal Transition Accelerator Programme (CTAP) which will explore how people can adapt to the effects of climate change on the coast. East Riding of Yorkshire and North Norfolk will receive fundings to work with communities that cannot be sustainably defended from coastal erosion.

Data Availability, Education, Research and Outreach

· Public education is a key component of any strategy development.

· Estuaries research program is in place.

· It takes time for coastal communities to adapt to climate change and to improve buy-in.

· Have developed a scoring system to direct money to the most cost-effective solutions.

· Most people in the UK who lose their assets, including land are not eligible for compensation.

· It is expected that England will seek increasing pressure to realign and many of the up to 160,000 people living in low lying coastal areas may have to relocate by the 2050's.

References and Resources

Policy paper. Shoreline Management plans (SMPs) Government of the United Kingdom. 2022

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Responding to climate change around England's coast - The scale of the transformational challenge. Ocean and Coastal Management. Sayers et al. 2022

UK Climate Projections (UKCP) MetOffice.

Coastal Transition Accelerator Programme (CTAP) Environment Agency.

The coastal handbook: A guide for all those working ont he coast. Environment Agency. 2010.

United Kingdom - Scotland

Coastal Management Strategies

· The Flood Risk Management (Scotland) Act, 2009 ensures long-term proactive planning and investment decision making to reduce the risk of flooding.

» Landowners are responsible for protecting their properties from coastal erosion and flooding.

» Local authorities have powers to protect land from the sea and can fund coast protection work from a capital grant from the Scottish Government.

» Dynamic Coast is Scotland's national coast assessment process has identified that ¾ of buildings and structures within 50 m of the shoreline are protected by natural defences such as sand dunes. The remainder are mainly protected by seawalls.

Coastal Land Use Planning and Development Regulations

· Coastal land use, resilience and adaptation planning must be based on latest provincial, regional and detailed evidence gathering data and assessments.

· Coastal planning and management need to be implemented in advance of climate change. Need to be sea level wise.

· Developed a work stream for 6 super sites within depth analysis for a range of shoreline types.

· Salt marsh areas require an alternate approach and track changes in the marsh system.

Shoreline Erosion Mitigation Strategies and Armouring Regulations

· Proposing a coastal erosion disadvantage mapping to assess what makes people more vulnerable to the coast.

· Average coastal erosion rate in Scotland is 0.43 m/yr.

· Promotes the recycling of dredged sediment to restore and nourish beach areas.

· Promotes Just Transition which ensures those at the most risk get more assistance.

Data Availability, Education, Research and Outreach

· Have established a coastal change and adaptation fund.

· Recognize the need for more data to use models effectively.

· Use a single page report card to provide "at-a-glance" summary.

References and Resources

Dynamic Coast. Scottish Government

Flood risk management plans in Scotland. Policy Paper. Government of the United Kingdom. 2022

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