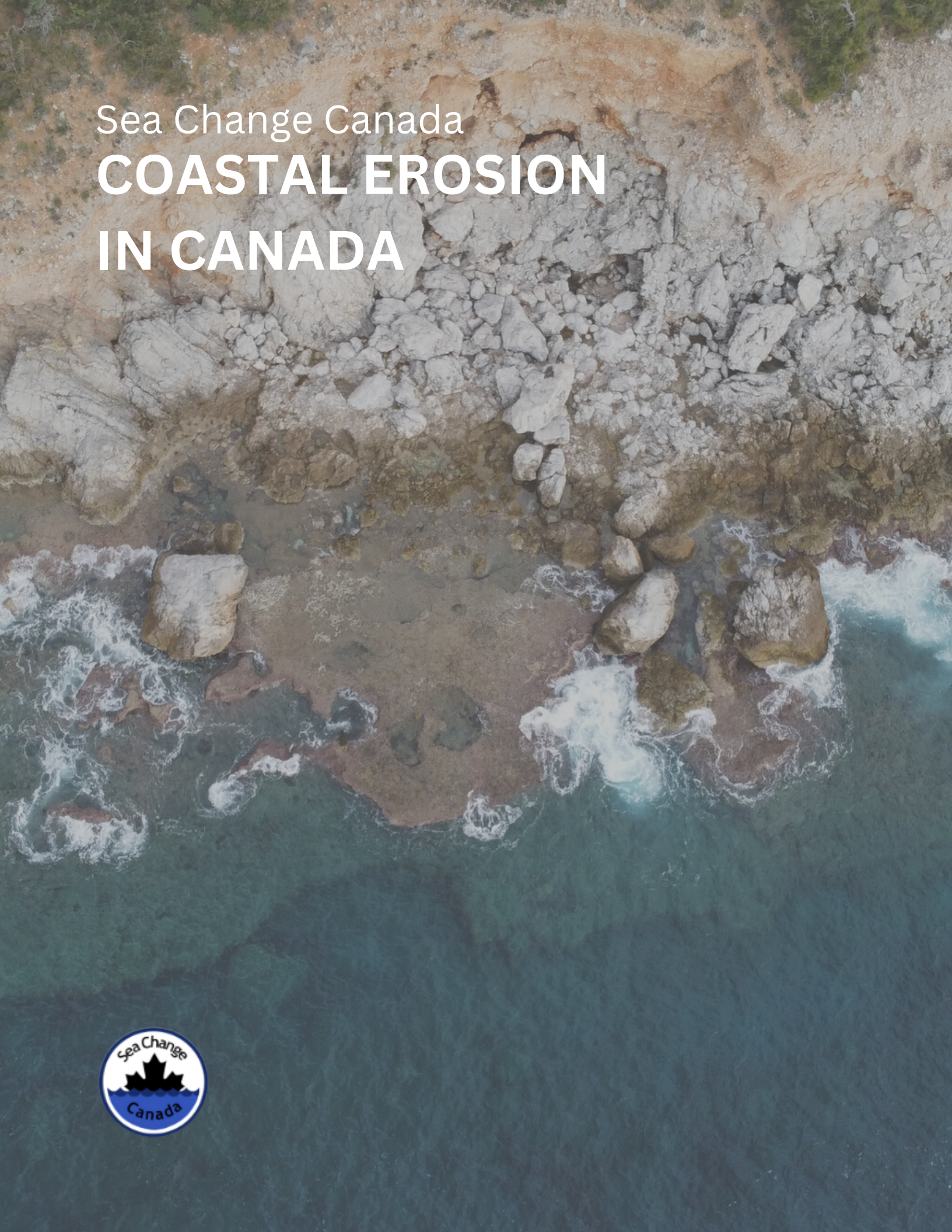

Sea Change Canada

COASTAL EROSION IN CANADA

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Last Updated: 10/12/2022

INTRODUCTION

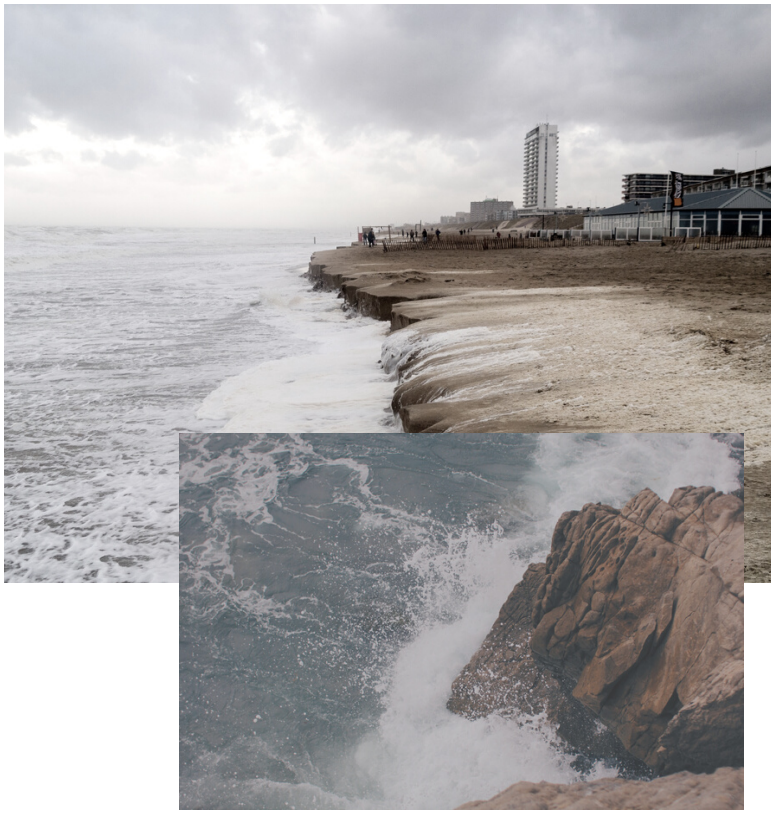
Eastern Canadian communities are directly influenced by the Atlantic Ocean (NRC, 2019). Cities in Eastern Canada have been built around harbours to facilitate shipping and national supply chains (Forward, 1982). Towns have been built up to the water's edge to allow for easy boat access for those who base their livelihoods around marine resources. Between the coasts are provincial roads that meander along to provide connectivity between all corners of the region (Lemmen et al., 2016). The provincial roads provide a link to the marine resources of the Atlantic Ocean, while also increasing the impacts of human activities on coastlines.

At 243,000 km, Canada has a longer coastline than any other country (Natural Resources Canada [NRC], 2019). Canada's East Coast is made up of the following provinces: Quebec, New Brunswick, Nova Scotia, Newfoundland and Labrador, and Prince Edward Island (NRC, 2019). Canada's East Coast has an approximate length of 42,000 km and its' coastal communities have an estimated population of approximately three million people (Lemmen et al., 2016). The East Coast is one of Canada's most threatened and vulnerable areas to the effects of climate change and coastal erosion (Russell, 2019).

It is important to investigate how coastal erosion is impacting coastal ecosystems since they provide ecological services including producing oxygen, absorbing carbon dioxide, regulating climate and providing a diverse habitat for many species (World Wildlife Fund [WWF], 2021). These ecosystem services occur in areas such as salt marshes, mangroves, coastal estuaries and the open ocean (Nature Conservancy of Canada [NCC], 2021). Coastal habitats also provide value through protection and barriers, such as coastal forests, sand dunes, flood plains and cliffs, which minimize damage caused by marginal flooding and tide changes (WWF, 2021). However, these coastal ecosystems are being threatened by an increased risk of coastal erosion.

The next section of this report will discuss what coastal erosion is, as well as the ecological and social impacts involved. Recommendations on potential solutions for coastal erosion issues in Canada will also be discussed at the reports end. These recommendations are based on the literature review completed for this report.

WHAT IS COASTAL EROSION?



Erosion is the process of movement and displacement of sediment caused by natural forces such as wind, rain, ice, waves, and storms (Evers, 2022). Coastal erosion refers to erosion specifically occurring in coastal ecosystems, often resulting in land recession and reshaping landforms like cliffs and dunes (Russell, 2019). Many ecosystems may be at a higher risk of erosion than others (**Figure 1**). Natural factors that are to be considered when assessing an area's sensitivity to coastal erosion is the geography, type of sediment, climate, and proximity to the Northern Coast (McClearn, 2021). Northern proximity is considered a risk factor due to the Arctic's high rates of ice melt, resulting in sea-level rise on the East Coast (Russell, 2019).

Erosion is typically a slow process, but with climate change, these factors have increased and accelerated coastal erosion rates, along with the threat of flooding coastal communities worldwide (Miller, 2020). Industrialization has vastly increased levels of carbon dioxide, resulting in higher temperatures on Earth and changes in the chemical makeup of land, water, and atmosphere (Climate Action Network [CAN], 2021). Warmer climates cause permafrost and glaciers within northern communities to melt, in turn raising our sea levels (Miller, 2020). As sea ice and permafrost melt, the ice and land movements create energy that releases into the ocean, causing higher tides and further escalating erosion rates (McClearn, 2021).

The continuing sea level rise is making Arctic coasts increasingly vulnerable to coastal erosion, however smaller provinces such as Prince Edward Island (PEI) are also at risk (Radosavljevic et al., 2016). PEI is slowly sinking due to its size, sedimentary makeup, rising sea-level, erosion, and high tides (Russell, 2019). The average erosion rate in this region is 30- 40cm per year, but in some parts of this island, they loose up to 2m annually. A number that is only expected to rise (Russell, 2019). For most of these communities, migration will be inevitable due to the threatening increase of coastal erosion rates.

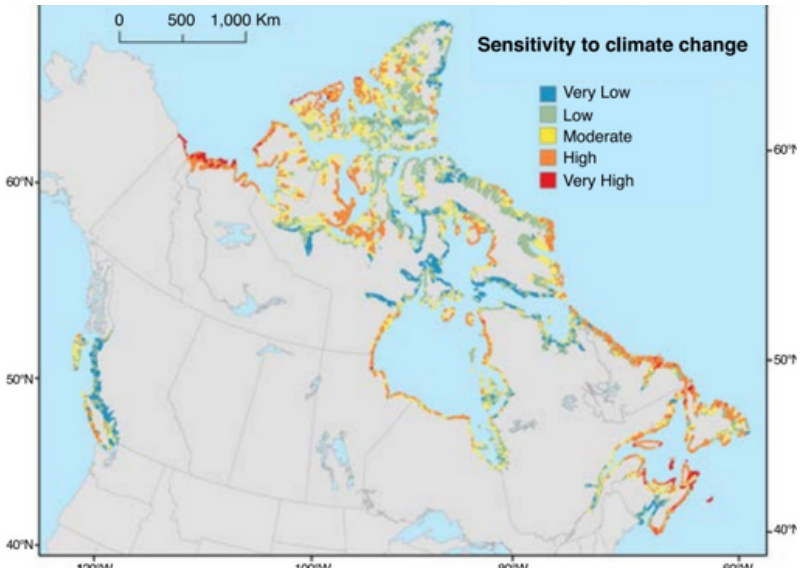


Figure 1. Preliminary map of coastal sensitivity to climate change in Canada developed using the CanCoast database. Sensitivity is based on present-day coastal materials, landforms, relief, ground ice, wave height and tidal range, as well as recent trends in total sea-ice concentration and projected changes in sea level to 2050. Note that some quite sensitive areas (e.g., the Fraser River delta) are not clearly visible at the resolution shown here.
(Manson, 2019).

ECOLOGICAL IMPACTS

Increased rates of erosion not only impact Canada's coastal dwelling populations, but they also have devastating ecological consequences. Coastal environments are areas that are between land and sea, including ecosystems such as estuaries, salt marshes, cliffs, banks, and dunes (NCC, 2021). Due to erosion and increased flooding, the health of these coastal ecosystems are declining (CAN, 2021). Many coastal environments, such as marshes and wetlands, act as natural barriers to protect the shoreline. Therefore their decline in health drastically endangers these coastlines.

Coastal environments in Canada (**Figure 2**) are highly sensitive ecosystems that are full of biodiversity, both aquatic and terrestrial. Coastal zones only make up about 10% of the total ocean environment but are home to over 90% of all marine species (WWF, 2021). During colonization, settlers drained natural salt marshes and wetlands, transforming them into agricultural land (CAN, 2021). The removal of these natural ecosystems has made Canada's coastlines more susceptible to the effects of coastal erosion and flooding.

Healthy coasts are essential to the overall productivity of the ocean, but due to coastal erosion and flooding there has been a decline in biodiversity and productivity throughout the entire ecosystem (NCC, 2021). Coastal protection, rehabilitation, and restoration are key to sustaining the ecological health of coastal ecosystems, as these diverse coastal environments are vital to all nature, including humans (WWF, 2021).

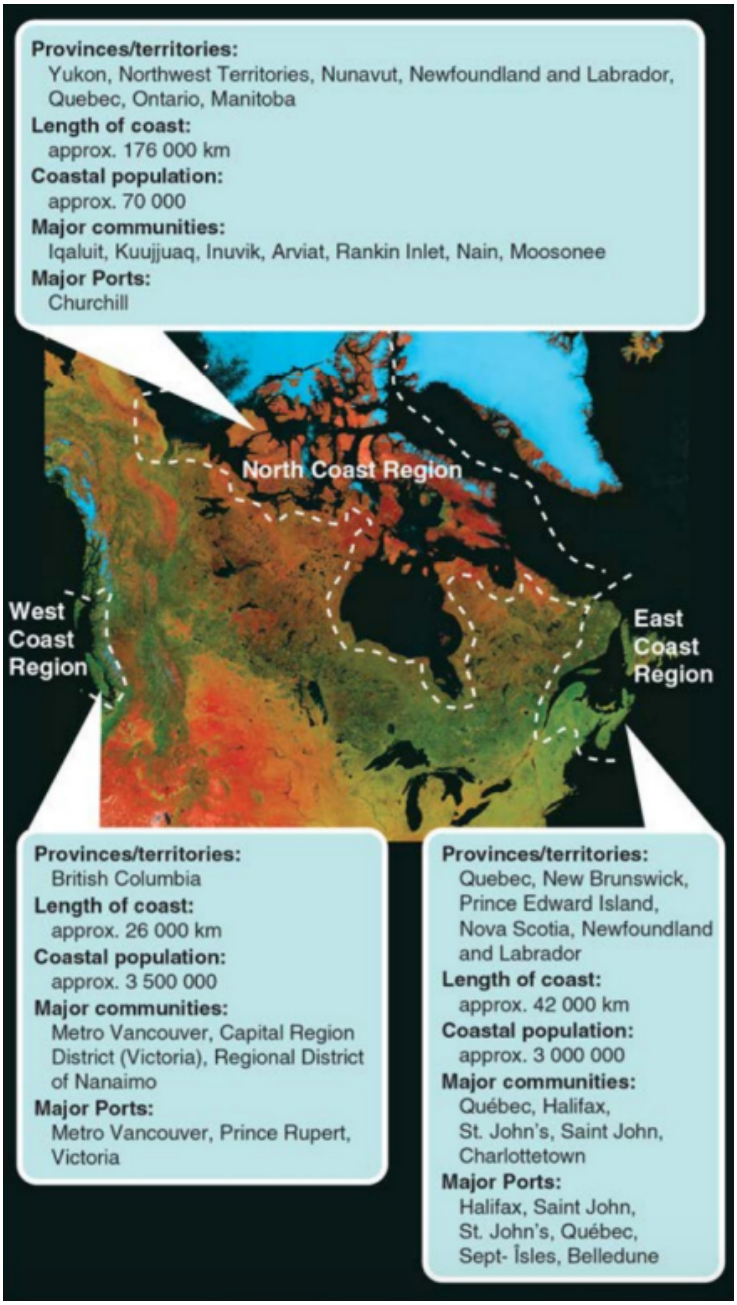


Figure 2. The three coastal regions discussed. Source: Canada's Marine Coasyts in a Changing Climate – Synthesis (nrcan.org).

SOCIAL IMPACTS

The ocean is the main source of protein for one billion people worldwide, and over 200 million people's income depends on the fishing industry (WWF, 2021). Fisheries are one of the main resources industries for communities on Canada's East Coast (NCC, 2021). Due to this direct dependence on oceanic resources, coastal erosion indirectly influences these East Coast communities.

Degrading coastlines due to coastal erosion will have negative consequences for the vital industries and infrastructure that support the socio-economic well-being of East Coast communities. As the nation's coastlines disappear, so will the dynamic coastal ecosystems that support aquatic and terrestrial life in these areas (McClearn, 2021).

The health and overall productivity of coastlines and ocean ecosystems are directly connected. If coastal habitats are altered by the effects of climate change; aquatic biodiversity, shoreline habitat, and land loss may also be observed (Lemmen et al., 2016). Losing healthy coastal ecosystems due to erosion and flooding would be especially devastating for Canadian communities that are known for their fresh seafood, beautiful beaches, scenic cliff and dune systems. Canadians are concerned about erosion impacts, which are currently being observed, as well as potential future coastal ecosystem changes resulting from increased erosion and flooding (Tran et al., 2021).

The following section will explain recommendations for coastal erosion solutions based on the literature review research completed for this report as well as concluding ideas on current coastal erosion management approaches.

CONCLUSION

Coastal communities that are at the highest risk of shoreline erosion and flooding must assess, monitor, and plan to reduce the effects of natural disasters and weather changes. There are a variety of potential approaches to these issues depending on the ecological and social factors involved. Some approaches might be largely passive and natural, such as renewing and preserving shoreline vegetation or adding sand to beaches. Other methods are more extreme and active, such as building walls or other barriers to prevent flooding.

When seeking solutions for coastline erosion and flooding risk, all environmental and human factors must be considered before choosing a particular method or combination of methods. You must consider the coast's sensitivity, hazards, and the area's natural ecosystems to determine the appropriate approach. There are four general approaches to managing erosion and flooding: no active intervention, avoidance and retreat, accommodation, and protection (Miller, 2020). The analysis of these approaches will be explained below.

No active intervention needs to be done when erosion and flooding risks aren't significant. As well as when avoidance and reduction procedures for the hazard can't be done, or when the potential threats outweigh the resources needed to intervene. Avoidance and retreat methods involve identifying erosion 'hotspots' and prohibiting any coastline developments in those areas. This approach is often used in areas with significant erosion and flooding hazard and helps preserve natural land and coastal ecosystems. Accommodation methods are used when the effects to the economy, environment and society outweigh the need for coastal protection, or when the protection methods would only be a short-term solution. There are different levels of protection intervention- ranging from hard methods like walls, dikes, and groynes, to soft approaches like reveg - etation and renourishing beaches with new sediment. Soft methods are preferred when planning, as they allow natural coastal processes to resume (Lemmen et al., 2016).

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