Island County, WA

Sea Level Rise Strategy Study

Prepared for Island County and the Washington Coastal Resilience Project

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The Washington Coastal Resilience Project (WCRP) is a three-year effort to rapidly increase the state's capacity to prepare for coastal hazards, such as flooding and erosion, that are related to sea level rise. The project will improve risk projections, provide better guidance for land use planners and strengthen capital investment programs for coastal restoration and infrastructure.

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Preface

As discussions about sea level rise become increasingly commonplace and shoreline management regulations begin to consider its projected impacts, adaptation planning at the community level will be necessary to ensure coastal community assets and values endure. This study is intended to demonstrate the necessity and feasibility of coastal resilience planning, and to provide Island County, WA shoreline communities with a sense of the tools and resources at their disposal to carry it out and ensure a resilient future.

Research presented in this report was conducted by University of Washington (UW) Master of Urban Planning students in partnership with the Washington Sea Grant and Island County Department of Planning and Community Development. Staff within each partner organization were key contributors to this effort, and provided countless hours of interviews, interim draft reviews, and guidance to ensure project success. While a debt of gratitude is owed to all involved, specific recognition is due to Island County project sponsors Meredith Penny and Jonathan Lange for their commitment to ensuring this product meets the needs of shoreline residents and County government alike and provides useful tools for adaptation strategy development; to Nicole Faghin of Washington Sea Grant for her professional guidance throughout the development of this study and connection with the most recent and relevant Washington State sea level rise and coastal resilience information available; and to University of Washington professors Bob Freitag and Dan Abramson for providing academic review and input, ensuring the research and study outcomes are in keeping with the high standards of the UW Department of Urban Design and Planning. Thanks in no small part to the support of these individuals this report presents a current, useful baseline for community-level coastal resilience and sea level rise adaptation planning which incorporates best available science and is tailored to the specific needs of Island County coastal communities.

It is the authors' sincere hope that this report is leveraged and improved upon as a resource for the development of coastal community resilience and sea level rise adaptation strategies in communities throughout Island County and beyond.

Study Overview and Organization

Sea level rise of 1-3 feet is projected as likely for coastal areas of Island County, Washington by the year 2100 (Miller et al., 2018). In an effort to incorporate considerations of the potential impacts of sea level rise into County planning processes including an ongoing update to the Island County Shoreline Master Program (SMP), the Island County Department of Planning and Community Development embarked on an initiative to research and develop guidance related to community-based coastal resilience planning, identify sea level rise adaptation best practices applicable to Island County shoreline communities, and develop a monitoring program to track sea level data and inform future planning decisions. This study captures the research process and outcomes associated with community-based planning and adaptation best practices elements of this initiative.

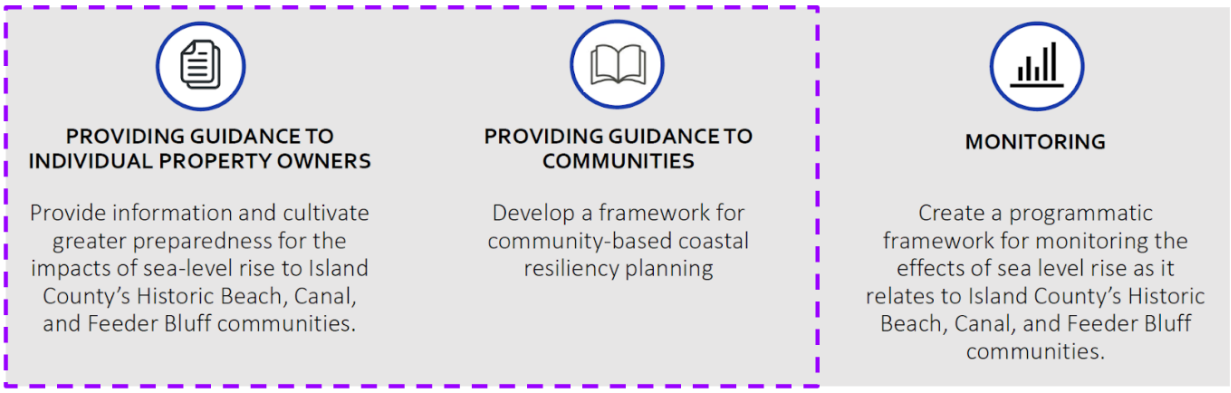

Figure 1: Island County Shoreline Master Program Update Sea-Level Rise Considerations

Source: Island County Department of Planning and Community Development (2019)

Through a series of site visits, County staff interviews, literature review, and data analysis the research process resulted in a baseline understanding of Island County shoreline management practices, coastal flooding issues, and consideration of extreme high tides and projected sea-level rise in current plans, policies, and regulations. From this baseline, viable adaptation alternatives representing accommodation, protection, and retreat strategies were identified, and a framework for community-based coastal resilience planning was developed as a means of mobilizing local property owners and resources to proactively address future challenges associated with sea level rise. This study presents the research process and outcomes related to each of these focus areas and delivers a set of recommendations intended to support Island County communities in planning and implementing adaptation strategies to improve coastal resilience and prepare for projected sea level rise.

This report is organized in three volumes:

Volume 1: Existing Conditions Report

This report profiles Island County Coastal characteristics, identifies County and community experience and concerns related to coastal flooding and projected sea level rise, and establishes planning objectives considered as fundamental for the development of adaptation strategy recommendations and community-based planning guidance.

Volume 2: Sea Level Rise Adaptation Best Practice Report

Volume 2 contains background research and case study analysis related to coastal adaptation measures in place along U.S. shorelines and abroad. This body of research ultimately informs a set of Island County-specific sea level rise adaptation recommendations applicable in the short, medium, and long term across the County's various coastal community types.

Volume 3: Community-Based Planning Report

This report includes background research related to community-based planning drivers and best practices and presents a community-based planning framework and associated guidebook intended to support local community efforts to plan for coastal resilience now and in the future. These volumes collectively comprise the 2020 Island County Sea Level Rise Strategy Study and provide a baseline toolkit for individual shoreline property owners and coastal communities alike to employ as they work toward a resilient future.

Each volume contains appendices and references specific to its content. The study concludes with a glossary of terms commonly referenced throughout the reports.

Volume 1

Existing Conditions Report

Island County Sea Level Rise Strategy Study
Volume 1: Existing Conditions Report

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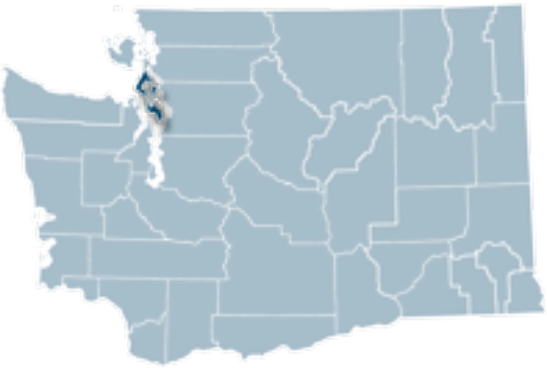
1. Introduction

This report documents conditions influencing shoreline planning in Island County, Washington at the outset of a 2019-2020 Sea Level Rise Strategy Study conducted in support of the County's 2020 Shoreline Master Program (SMP) update. Information presented in this report is foundational to the development of recommendations for shoreline property sea level rise adaptation strategies and community-led coastal resilience planning, also included in the study. The report is organized to orient readers to Island County's location, demographics, and economic profile; characterize the County's shoreline ecosystems and development patterns; document County and community coastal flooding concerns; review potential shoreline impacts associated with projected sea level rise; highlight current sea level rise policy considerations; and present sea level rise considerations planned for inclusion in future updates to plans, policies, and regulations.

1.1 Orientation

Island County, located in Northwest Washington, consists of Camano and Whidbey Islands as well as seven small, mostly uninhabited islands: Smith, Deception, Ben Ure (15 residential properties), Smith, Minor, Strawberry, and Baby islands. Island County cities and towns include Oak Harbor, Coupeville, Langley, and unincorporated Freeland, of which Coupeville is the County seat.



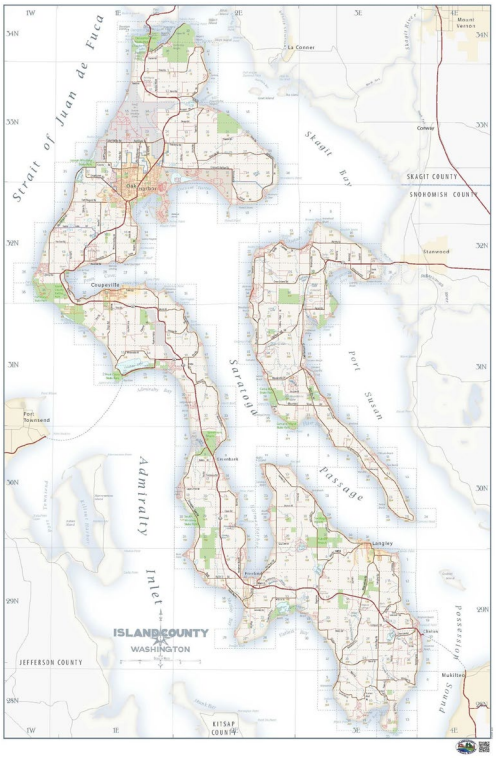


Figure 1.1: Island County, WA Area and Vicinity Maps

Sources: WA Employment Security Department; Island County Mapping Center

1.2 History

The areas now known as Whidbey and Camano Islands are the original home to the Coast Salish people including members of the Lower Skagit, Swinomish, Suquamish, Snohomish, and Kikalos tribes. (Whidbey Island US, 2019; McClary, 2005). European settlement of Whidbey and Camano Islands began in 1848 and 1855, respectively, as early settlers sought success in the timber industry. Shortly after initial settlement, Island County was formally established in 1853 by the Oregon Territorial Legislature. The county originally encompassed what are now Snohomish, Skagit, Whatcom, and San Juan Counties. Today, the county encompasses approximately 517 square miles, 309 of which are open water and 208 of which are land (McClary, 2005).

1.3 Island County Demographic Profile

Island County is the eighth oldest and second smallest county in Washington State by landmass (McClary, 2005). U.S. Census Bureau 2018 American Community Survey estimates the county population at 81,636, of which approximately 23% are age 65 or older and 85% are white (US Census Bureau, 2018). Median household income in the County is $64,809, under the state median of $74,073, and the County poverty rate is slightly lower than the state average at approximately 9% (U.S. Census Bureau, 2018). Washington State Office of Financial Management (OFM) Growth Management population projections indicate the Island County population may increase to 94,463 (11.8%) by 2040, with the percentage of the population 65 and older projected to increase to approximately 28% (OFM, 2017). Of note, a significant majority (69%) of the Island County population lives in unincorporated areas (Community Attributes, 2019).

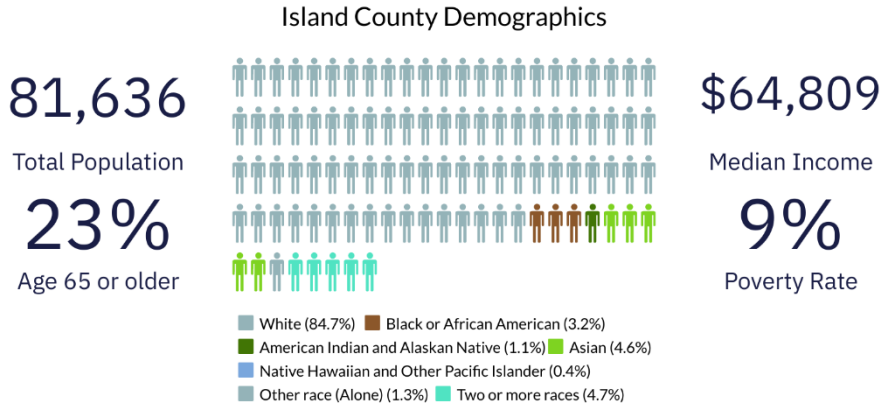


Figure 1.2: Island County Demographics
Data Sources: WA ESD (2019); U.S. Census Bureau (2018)

1.4 Island County Economic Profile

Island County's largest employer is Naval Air Station Whidbey Island, which employs 7,050 military personnel and 2,400 civilian employees and contractors and has an economic impact of approximately $1.04 billion across Island and Skagit Counties combined (Community Attributes, 2019). Aside from Navy employment, the majority of Island County jobs are in local government, health care, education, arts, entertainment, and hospitality (Community Attributes, 2019). Though not as significant a sector in terms of employment, agriculture is also a staple of the Island County economy and is a major contributor to the county's rural character and facilitates rural-dependent sectors and tourism (Community Attributes, 2019).

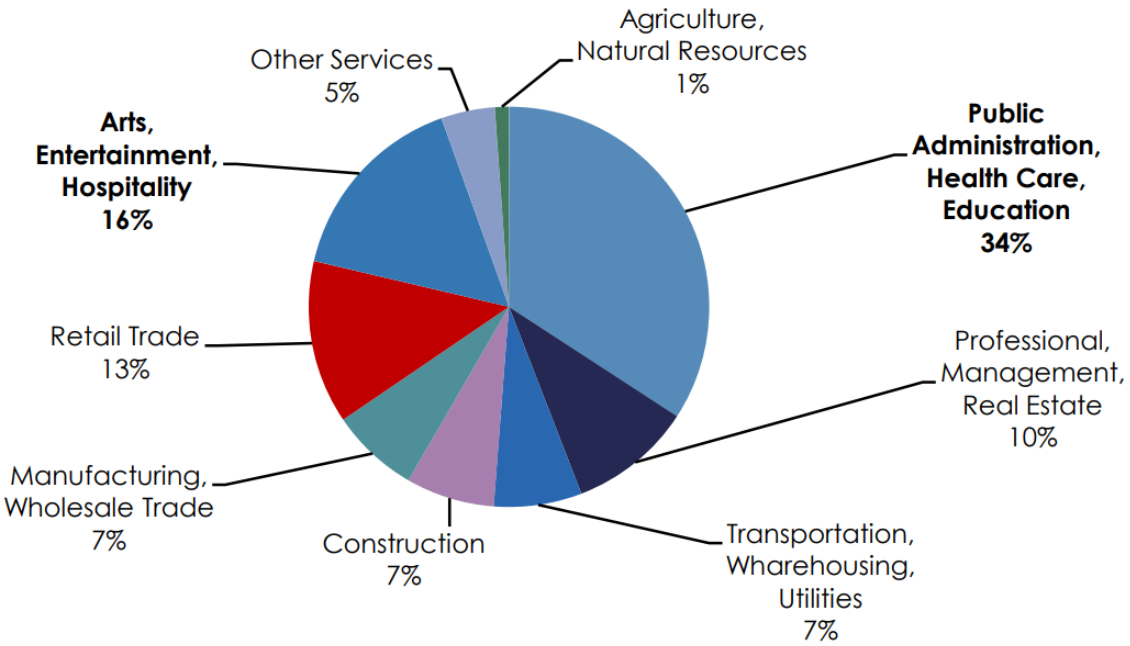


Figure 1.3: Island County Civilian Employment by Job Sector, 2018

Source: Island County Economic Trends and Conditions Summary Report, 2019

Though the above industries are broadly represented in Island County, over 50% of residents commute out of the county for work, and wages in the county are well below state averages (U.S. Census Bureau, 2018). Growth in Island County is characterized both by rural inflow of older populations with higher incomes who are able to take advantage of a lower cost of living on Whidbey and Camano Islands and capable of commuting to surrounding cities and counties

for needs which are not met locally; and by the attraction of younger, lower-income households to cities and towns, where the need for mobility is less, but wages and growth opportunity are limited. This dynamic challenges Island County's economic growth potential by constraining business activity through limited ability to attract and retain working-age adults (Community Attributes, 2019).

This report will focus on the population residing in Island County's shoreline areas, which are generally characterized by residential or undeveloped space and an older, more affluent population with limited constraints on mobility. That said, the Island County shoreline does support limited economic activity primarily centered on transportation, tourism, and aquaculture facilitated by Washington State Ferry terminals in South and Central Whidbey Island; recreational trails and beaches; tribal and commercial shellfish harvest beds; public and private moorage and marinas; and waterfront-dependent businesses including the County's fifth-largest employer, Nichols Brothers Boat Builders Inc. (Community Attributes, 2019). Though waterfront industry and employment centers comprise only a small portion of the County's economy, they serve as community assets with potential to affect the larger economy if negatively impacted.

2. Shoreline Characterization

Island County includes over 196 miles of shoreline, characterized by low-lying beaches and spits, dredged canals, wetlands, and high unstable bluffs. Countywide, coastal shoreline landforms are predominantly characterized as bluff back beaches (58%) and barrier beaches (25%), with the remaining 17% comprised of artificial development, barrier estuaries, barrier lagoons, closed lagoons and marshes, deltas, open coastal inlets, pocket beaches, plunging rock shorelines, and rocky platform beaches (Island County, 2012). These landforms play integral roles in Island County ecosystem processes such as sediment input, transport, erosion and accretion. These processes result in a continuously changing shoreline which, when left undisturbed by development and human influence, provide valuable habitat and ecosystem services (Island County, 2012).

2.1 Ecosystem Processes

The natural movement of water, sediment, and aquatic organisms and their effect on local ecosystems is perhaps best characterized by the concept of drift cells. Drift cells are coastline areas for which wind, wave action, and surface and groundwater runoff and freeze/thaw cycles

generate and transport sediment from beaches and coastal bluffs to other low-lying coastal areas. This process results in the gradual erosion of sediment sources, such as bluffs, and accretion of low-lying beaches and creation of spits in other areas of the cell (Shore Friendly, 2019). This constant beach replenishment supports ecosystem health through habitat establishment, protection, and nutrient supply. The vast majority of the Island County shoreline is associated with a series of drift cells, including one of the Puget Sound's largest cells located in Western Whidbey Island (Shore Friendly, 2019).

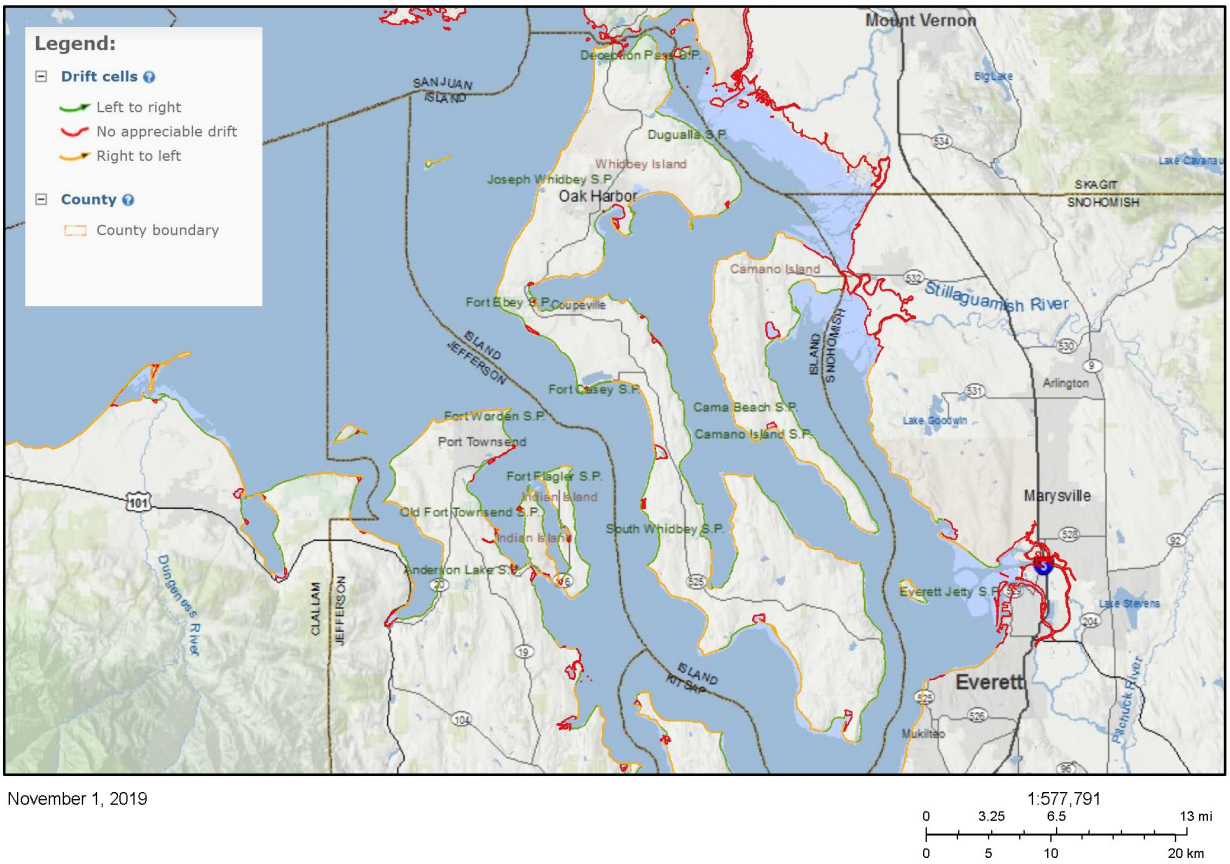


Figure 2.1: Island County Drift Cells

Source: Washington State Coastal Atlas Map

Over time, human activities including land development and associated physical property protections such as floodplain diking and shoreline armoring have interrupted these naturally occurring ecosystem processes, thereby degrading the County's natural fish and wildlife habitat and supported functions (Island County, 2012).

2.2 Climate

Precipitation and wind are primary areas of climate influence along Island County shorelines. Annual precipitation between 17-40 inches per year is the primary source of recharge for freshwater aquifers, which provide the majority of the County's potable water. Maintaining adequate water supply of potable quality is a key function of these aquifers, and their ability to perform this function is largely dependent on precipitation and managed water consumption. Wind contributes significantly to coastal erosion along Whidbey Island's western shoreline and wave action throughout the County. Changing dominant winds from the south-southwest in the fall through winter months, and from the north in the late spring and summer influence the coastal landscape and activities throughout the County (Island County, 2012).

2.3 Geology and Shore Landforms

Island County's shoreline natural landforms, or "shoreforms," consist primarily of beaches and bluffs created from glacial deposits and barrier beaches fed by sediment from eroding bluffs (Island County, 2012). Bluff erosion is a natural and continuous process which results in varying rates of gradual shoreline retreat and volume loss throughout the County. In many cases, the erosion process increases the risk of coastal landslides, most recently and vividly exemplified by the 2013 Ledgewood/Bonair landslide on Whidbey Island's western shoreline (Island County, 2013).

Figure 2.2: Ledgewood/Bonair Slide (Whidbey Island)

Source: Island County Department of Emergency Management

Artificial shoreforms such as bulkheads and dredged channels comprise approximately 4.5% of the overall county shoreline, with a significantly higher occurrence on West Whidbey Island (11.8%) than East Whidbey (3.7%) or Camano Island (0.3%). Despite seemingly high percentages on Whidbey Island, the county's overall artificial shoreline is considered low in comparison with other Puget Sound shorelines (Island County, 2012).

2.4 Surface and Groundwater

Island County's surface water features include a series of small lakes and streams which collect and convey surface storm water runoff from multiple, relatively small drainage basins. Though much of the precipitation which falls throughout the county is infiltrated into surrounding soils, heavy rainfall events result in excess runoff which eventually reaches the shoreline, contributing to coastal erosion. Island County aquifers provide potable water for 72% of Island County residents and vary in depth and composition. Approximately 20-34% of annual rainfall, or 22 billion gallons of water, are estimated available for aquifer recharge, significantly exceeding current consumer demand. Despite this abundance, issues such as seawater intrusion and introduction of surface contaminants in high permeability soils are primary concerns related to quantity and quality of groundwater available in coastal aquifers (Island County, 2012).

2.5 Fish & Wildlife Habitat

The Island County shoreline boasts diversity in terms of habitat type and supported species, the success of which is largely influenced by the amount of human disturbance. Island County coastal fish, invertebrate, amphibian, bird, and mammal habitat identified in the 2012 Shoreline Master Program includes: beaches, tidal flats, kelp and eelgrass, marshes, freshwater wetlands, marine riparian zones, and streams (Island County, 2012). Many of these areas support fish and wildlife species listed as threatened or endangered under federal, state, or both designations. Descriptions of each habitat type and examples of supported species are detailed in the SMP and summarized below.

Pocket and barrier beach habitat consists of unconsolidated sediment which moves with tidal action. This habitat supports shorebirds and mammals including Black Turnstone and River Otter; shellfish such as the Geoduck Clam; and forage fish such as the Sandlance.

Tidal flats consist of unconsolidated sand and/or mud in intertidal and subtidal areas. This habitat supports shellfish and invertebrates such as little-neck clams and Dungeness crabs; shorebirds and wading birds including Dunlin and Great-Blue Heron; and mammals and birds such as raccoon, bald eagle, and glaucous-winged gulls.

Kelp forests and eelgrass meadows form in lower intertidal and subtidal zones and provide habitat for invertebrates which serve as a primary food source for various fish species, including salmonids. Sea birds such as the Red-throated Loon, Western Grebe, and Marbled Murrelet rely on these areas as foraging grounds as well.

Salt and brackish marshes occur in areas of tidal inundation, and provide juvenile salmonid habitat, as well as support for multiple species of songbirds, mammals, and predatory birds such as bald eagles and ospreys.

Freshwater wetlands often lie in depressions adjacent to coastal areas and provide nesting and foraging habitat for waterfowl such as Green-Winged Teal; amphibians including the Pacific Tree Frog; and birds and mammals transitioning the area such as black-tailed deer, barred owls, and raccoons.

Marine riparian forests along coastal bluffs consist primarily of western hemlock, Douglas fir, western red cedar, shore pine, and grand fir. These forests provide year-round nesting and foraging habitat and movement corridors for bird species such as the black-capped chickadee. Adjacent bluff faces provide nesting and foraging habitat for other bird species including Bank Swallow, Belted Kingfisher, and Peregrine Falcons.

Streams that drain to the Island County shoreline are often surrounded by riparian and wetland habitats which support numerous bird, mammal, and amphibian species. The streams themselves directly support various salmonids and other fish, as well as invertebrates such as crawfish.

2.6 Shoreline Land Use and Residential Development

Predominant land uses along the Island County shoreline include residential development, designated tidelands, and agriculture (Island County, 2012). Other uses include parks and open space, limited commercial development, and forest or timber. The Island County Shoreline

Master Program categorizes allowable land use into a series of Shoreline Environmental Designations, presented in the figure below.

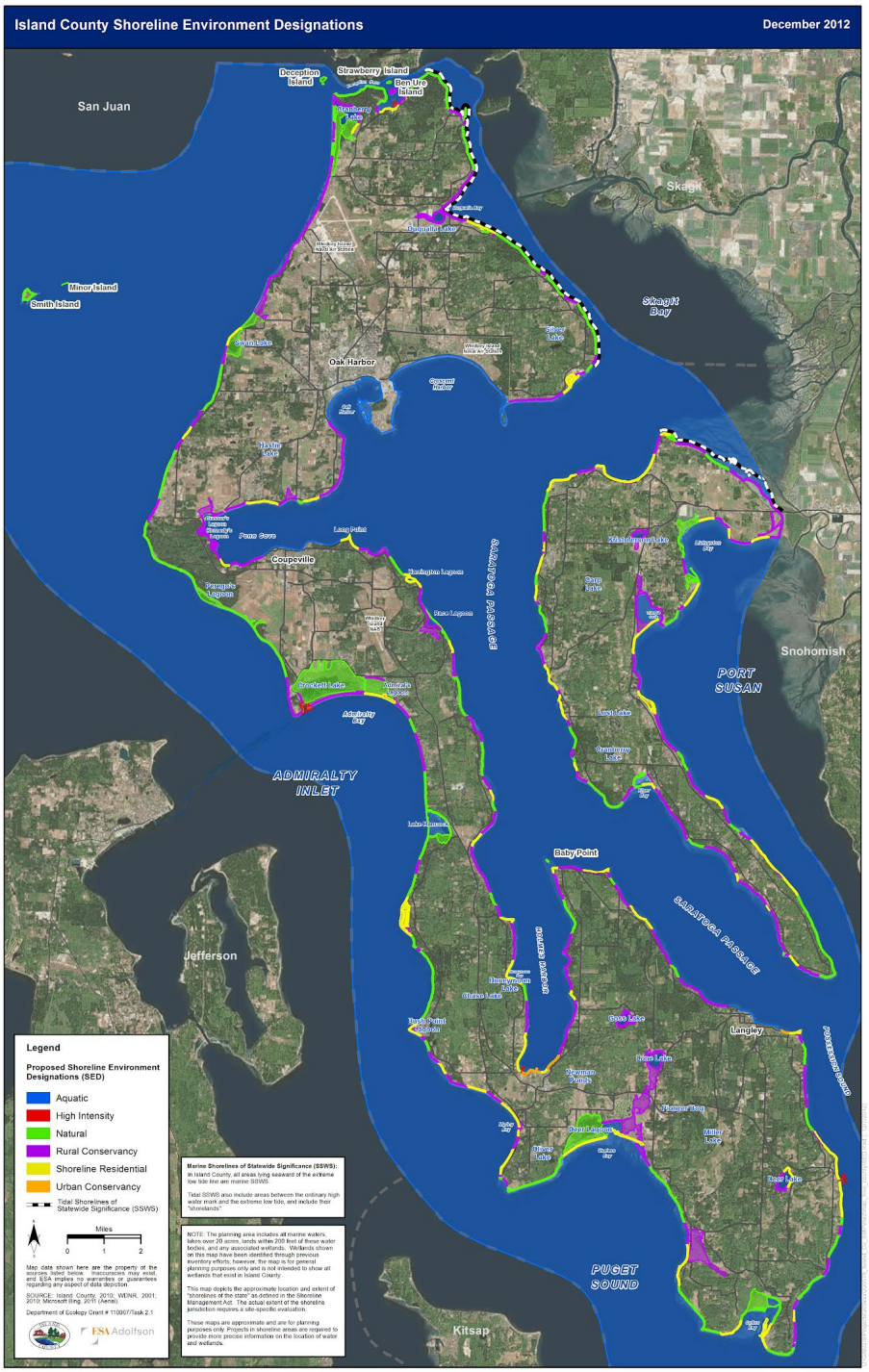


Figure 2.3: Island County Shoreline Environmental Designation Map

Source: Island County Shoreline Master Program, 2012

Approximately 63% of the Island County shoreline is designated for residential land use and presented above as Rural Conservancy or Shoreline Residential environmental designations. The Rural Conservancy designation includes areas zoned as “Rural,” which accounts for 49% of the shoreline and allows 5-acre minimum residential lots. The Shoreline Residential designation includes areas zoned as “Rural Residential,” which comprise 14% of the shoreline and allow for smaller (0.3-2.5 acre) residential lot development. The remaining shoreline land uses primarily fall under Natural or Aquatic environmental designations. Exceptions include limited high intensity and urban conservancy environments at and immediately adjacent to Central and South Whidbey Island ferry terminals and shipbuilding businesses.

Island County Shoreline Residential development is the focus of this report and is most commonly encountered in the form of historic beach communities, canal communities, and coastal (feeder) bluff communities. These communities are characterized by their physical relationship to the shoreline and predominant development patterns. In each case, specific regulations governing future development apply. These regulations include designation of marine buffers which preclude most development and support critical species habitat and ecosystem process restoration; and shoreline setbacks which limit allowable development directly adjacent to the shoreline. Specific characteristics of these three community types and applicable development limitations are detailed in this section.

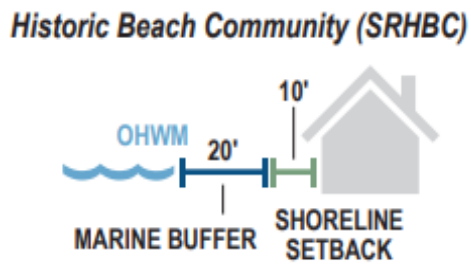
2.6.1 Historic Beach Communities

Historic Beach Communities consist of densely platted small lots with residential structures constructed thirty feet or less from the ordinary high water mark. These properties were established prior to Washington State’s adoption of the Shoreline Management Act (SMA) in 1972. According to Island County Shoreline Master Program guidance for homeowners, Historic Beach Community designations allow for residential development and moderate-to high-impact recreational uses which reflect historic development patterns and consider normal shoreline ecosystem functions in appropriate areas of the shoreline. These communities are located primarily along beaches and spits formed by sediment accretion over time.

Figure 2.4: Historic Beach Community Example

Source: Island County SMP Guidance

Historic Beach Community development standards include a minimum 20-foot marine buffer from the ordinary high water mark and an additional 10-foot shoreline setback. Landscaping and development within these buffers and setbacks are regulated under provisions of the Island County Shoreline Master Program.



Marine Buffer and Setback Requirements

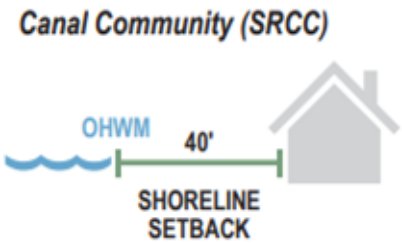
2.6.2 Canal Communities

Canal Communities consist of discrete residential communities developed along engineered canals. These communities are typified by residential structures constructed above the ordinary high water mark with dedicated waterfront access. Canal Communities are primarily located in

areas formed by sediment accretion in which lagoons were dredged to form canals and dredged material was used to create adjacent developable land.

Figure 2.5: Canal Community Example
Source: Island County SMP Guidance

Island County development regulations require a 40-foot shoreline setback from the ordinary high water mark. Landscaping and development within these buffers and setbacks are regulated under provisions of the Island County Shoreline Master Program.



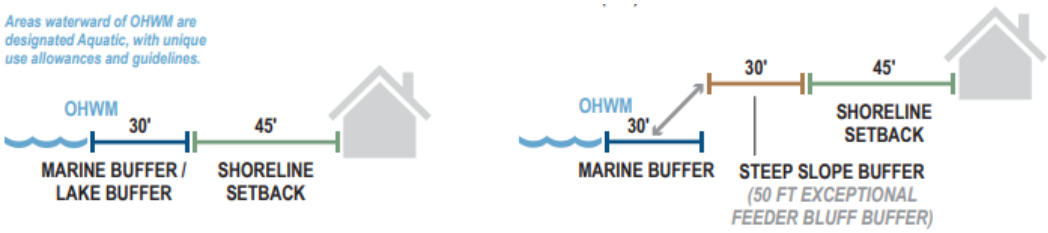
Marine Buffer and Setback Requirements

2.6.3 Coastal (Feeder) Bluff Communities

Coastal (Feeder) Bluff communities, consist of residential development both atop and at the base of steep or unstable slopes. Bluffs adjacent to these communities are identified as drift cell sediment sources, which are subject to erosion as part of natural coastal ecosystem processes.

Figure 2.6: Coastal (Feeder) Bluff Community Example
Source: Washington State Coastal Atlas Map

These communities generally fall under the Shoreline Residential designation, though they may overlap with Rural Conservancy shoreline environmental designation. Steep unstable slopes also exist throughout Natural shoreline environmental designations; however, development in these areas is typically sparse and not characteristic of communities evaluated in this report. Regulations applicable to Shoreline Residential development include a 30-foot marine buffer and additional 45-foot shoreline setback at the base of bluffs; and an additional 50-foot steep slope buffer for development on the top of bluffs.



Community Marine Buffer and Setback Requirements
Source: SMP Guidance for Island County Homeowners

3. Community Coastal Flooding Concerns

Since 1990, Island County has experienced eight extreme flooding events resulting in disaster declarations (Island County, 2015). In coastal areas, extreme flooding events typically occur as a result of combined severe winter storms and tidal surge. Island County coastal communities are particularly vulnerable during these events, as they are often impacted by both erosion resulting from surface water runoff, and the effects of tidal surge. County staff review of damage associated with historical flooding events, community input gathered during recent countywide projected sea level rise forums, and Island County staff input collected through interviews highlight the following community concerns related to extreme coastal flooding events:

3.1 Private Property Impacts

Historic Beach, Canal, and Coastal Bluff communities are particularly susceptible to private property damage during extreme flooding events. Reported damages from previous flooding events include overtopping of bulkheads, inundation and failure of onsite septic systems and/or groundwater wells, residential ground floor flooding, restricted private beach access, and protracted site drainage precluding timely repair. These issues lead to costly and time-consuming repairs and, in some cases, temporary displacement of community members.

County and community input indicate shared concern that existing regulatory mechanisms such as development permitting and flood insurance guidelines do not adequately mitigate hazards associated with these events, and instead may lead property owners to pursue individual protections rather than whole community resilience. Island County residential development permitting for homes built in frequently flooded areas reflect the minimum elevation and flood protection measures necessary to remain eligible for federal flood insurance coverage. Nature-based adaptation strategies are advocated for in shoreline development guidance; however, limited incentive for homeowner selection of alternatives to hard protection measures such as bulkheads exists. Further, an expedited emergency repair permitting process exists for homeowners who sustained damage from coastal flooding events which, while beneficial in terms of addressing immediate needs, do not necessarily encourage or facilitate long-term resilience planning. Though additional permitting requirements apply to shoreline projects exceeding the “substantial development” threshold of $7,047, without substantial incentive for nature-based adaptation homeowners may seek to leverage expedited emergency permitting to re-establish a baseline property flood risk, rather than working toward mitigation and improved

resilience. County records of emergency repair permit applications and community feedback during sea level rise forums indicate many private property owners pursue emergency repairs and improved physical protection of their existing properties through such actions as bulkhead extensions or dike improvements in response to extreme flooding events; though nature-based alternatives to shoreline protection including bulkhead removal and natural shore restoration are gaining popularity.

3.2 Public Property Impacts

Impacts of extreme coastal flooding events extend beyond privately owned property, affecting public property and natural resources. Island County staff input indicates past flooding events have contributed to natural resource degradation through release of contaminants into public waterways and fish and wildlife habitat; interrupted natural ecosystem processes through diversion of floodwater and associated wave energy to unprotected shorelines; and negatively impacted public access to shoreline recreation opportunities.

County concerns associated with continuation of existing levels of natural resource degradation and interruption of ecological processes include the potential for contaminant releases from onsite septic systems, creosote soaked piles in tidal areas, and household hazardous waste at a level significant enough to cause long term, irreversible damage to the surrounding ecosystem and its ability to support regional fish and wildlife; reduction in groundwater supply due to seawater intrusion and/or flooding of well sites; unnatural erosion patterns with potential to disproportionately damage public lands; and reduction of fish and wildlife habitat, particularly for threatened or endangered species. Further, County staff and private property owners alike expressed concern over potential impacts to public spaces in low-lying coastal areas; both from the perspective of resource reduction and concern over increased trespassing on private beach property which may be associated with loss of public amenity.

4. Projected Sea Level Rise Impacts

Sea level rise is one of the most observable impacts of climate change. Two main factors contribute to global sea level rise. “A warming climate causes global sea level to rise principally by (1) warming the oceans, which causes seawater to expand, increasing ocean volume, and (2) melting land ice, which transfers water to the ocean.” (National Research Council, 2012) From studying Earth’s history, scientists have projected levels rising “another 1 to 4 feet by

2100." (NASA, 2019) Those numbers alone are enough to inundate "many cities along the U.S. East Coast." (Nunez, 2019)

Current projections indicate sea level rise between 1-3 ft. along the Island County shoreline by 2100 (Miller et al., 2018). Potential impacts to shoreline properties and surrounding ecosystems include increased coastal flooding, habitat loss, surface and groundwater salinity changes, and altered coastal erosion and sediment deposition patterns (Miller et al., 2018). How these impacts might affect Island County is detailed in this section.

4.1 Coastal Flooding

Current flooding problems will only be exacerbated with increases in sea level rise compounded by storm surge and wave run-up (Miller et al., 2019). The impacts of sea level rise in Washington State will likely be experienced initially as changes in the magnitude and frequency of extreme coastal water level events. New areas will be flooded during the most extreme events, and coastal areas already exposed to flooding will be impacted more frequently (Vitousek et al., 2017). The combination of sea level rise and extreme storm events will continue to result in more consistent and severe coastal flooding causing damage to infrastructure and potential loss of life.

4.2 Habitat Loss

As sea level increases, intertidal habitats like wetlands, mudflats, and marshes are in danger of disappearing. Human development regularly takes place along the coast and will block intertidal habitats from their natural response to this phenomenon; expanding inland. Estuaries and wetlands provide many essential services to communities and will be heavily impacted by sea level rise. Estuaries, mudflats, and marshes provide "refuge and forage for wildlife, fish, and invertebrates" and vegetation in these areas "provide overwintering habitat for millions of migratory waterfowl." (National Research Council, 2012). These wetland zones buffer sediment from waterways and streams from moving into the ocean and also protect communities by storing floodwaters and limiting storm surge. In many cases, sea level rise will submerge these habitats.

4.3 Salinity Changes

Higher sea levels will cause an increase in groundwater levels which impacts freshwater resources. This causes saltwater intrusion in wells, septic system leaching and harms vegetation. In addition to sea level rise, “groundwater in coastal regions of the US is particularly at risk due to a combination of changes in precipitation, withdrawal rates. As sea level rises, the amount of saltwater infiltrating the groundwater aquifer will increase, which can make the water too salty for human consumption.” (Bradford, 2019) The overall impact is a reduction in water quality and soil stability. As of late 2019, many Island County residents rely on well water and septic systems for their freshwater and waste disposal needs.

4.4 Coastal Erosion & Deposition

Finally, rising sea levels will erode land in some areas and grow land through sediment deposition in others. Beaches and soft cliffs will be most vulnerable to erosion, but this process will also contribute to habitat loss in estuaries and wetlands. Many Island County residents live along the coast. Erosion and sea level rise could result in damage to their homes and properties. On a larger scale, community infrastructure will most likely be impacted including roads, ports, and industry.

The erosion of cliffs and bluffs is not reversible. Although cliff and bluff erosion is a natural process it has sped up due to sea level rise. The principal forces catalyzing cliff and bluff erosion include “marine processes—primarily wave energy and impact, but also tidal range or sea level variations—and terrestrial processes, such as rainfall and runoff, groundwater seepage, and mass movements such as landslides and rockfalls.” (National Research Council, 2012) Increased water levels mean increased wave heights and more wave energy eroding coastlines. This means an increased rate of cliff retreat.

Beaches naturally grow and shrink seasonally depending on wave climates. “These fluctuations in beach width are predictable and temporary, and the losses of sand experienced each winter are normally recovered the following summer… [however] over the long term, rising sea level will cause landward migration or retreat of beaches.” (National Research Council, 2012) Beaches will be submerged by rising sea levels and will also be transported offshore through the deposition process.

5. Current Sea Level Rise Policy Considerations

Current plans, policies, programs, and processes related to Island County coastal development include limited consideration of projected sea level rise. Though many plans and programs acknowledge the need to address projected climate change impacts, and some provide mechanisms for addressing challenges related to extreme coastal flooding and sea level rise, current coastal development regulations provide limited enforceable adaptation requirements. These regulations are largely based on flood zones established by the U.S. Federal Emergency Management Agency (FEMA) for flood insurance purposes, which are heavily reliant on historical data and do not include consideration of projected future conditions, including those associated with sea level rise. This section highlights plans, policies, regulations and programs which govern and support shoreline development in Island County, and the extent to which sea level rise is considered in each.

5.1 FEMA National Flood Insurance Program (NFIP)

As part of the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) provides and periodically updates Flood Insurance Rate Maps (FIRMs) for jurisdictions located within the 100-year, or 1% annual chance floodplain. Island County FIRMs were last updated in 2017 and provide a relatively clear and current picture of established flood zone boundaries and base flood elevations. This data is used by FEMA to develop flood insurance rates as part of the National Flood Insurance Program. Additionally, Island County uses FEMA flood zones and base flood elevations as the basis for development regulations related to structural ground floor elevations and flood protections within established floodplains. It should be noted the FEMA flood maps are based on historical flooding and do not account for tidal surge, extreme high tides or projected sea level rise. Communities have the opportunity to address potential flood impacts exceeding established flood zone boundaries and elevations through adoption of higher regulatory standards and participation in the Community Rating System (CRS). CRS participation also provides an opportunity for discounted private property owner flood insurance rates. Island County does not currently take part in the CRS, and current development regulations within flood zones are consistent with minimum NFIP eligibility requirements. Also of note, as of 2019 the County and incorporated areas on Whidbey and Camano Islands had a combined 988 active NFIP policies relative to approximately 8,250 parcels zoned to allow residential development within the established floodplain (FEMA, 2019;

Island County, 2020). This low percentage of homeowners covered by NFIP policies indicates increased risk of property loss without certainty of redevelopment in the future.

5.2 Island County Comprehensive Plan

Though Island County's current comprehensive plan, *Island County 2036*, identifies frequently flooded areas as subject to critical areas ordinances and includes a land use policy (LU 6.4) which requires consideration of flood hazards when establishing density; the plan does not account for sea level rise projections. Instead, flood hazard areas identified in the plan are consistent with the FEMA 100-year, or 1% annual chance floodplain.

5.3 Island County Shoreline Master Program (SMP)

The current Island County SMP adopted in 2016 includes climate change and projected sea level rise considerations in policies related to shoreline use, conservation, and development. These policies call for accounting for projected sea level rise when evaluating shoreline uses; monitoring effects of climate change on the marine environment through regular sea level and pH measurements; and adjusting development standards to increase setbacks and minimum elevations in areas that could be affected by sea level rise (Island County, 2012). Shoreline permitting processes and guidance identify location-specific marine buffers and shoreline setbacks detailed in section 3 of this report which are applicable to coastal properties and communities and generally consistent with SMP considerations; however, these regulations are based on existing conditions and do not directly account for projected sea level rise. Further, regulations identified in the SMP favor natural shoreline protections by requiring new development to "minimize or prevent the need for shoreline defense and stabilization measures and flood protection works" (17.05A.090.A.13); limiting structural flood reduction measures (dikes, levees, bulkheads, etc.) to areas where non-structural methods are infeasible (17.05A.090.L.2); and prohibiting solid waste storage and new or expanding development or use which would "likely require structural flood control works" (17.05A.090.L.7); among other significant shoreline protections intended to limit armoring, incompatible shoreline development, and shoreline ecosystem damage.

5.4 Hazard Mitigation Plan (HMP)

The Island County Multi-Jurisdictional Hazard Mitigation Plan (HMP) identifies hazards and mitigation opportunities and recommendations related to coastal erosion, dam failure, drought,

earthquake, flood, landslide, tsunami, volcano, severe weather, and wildfire hazards each specifically address potential climate change impacts and considerations. The plan includes an extensive section related to coastal flood hazards which includes critical asset inventories, vulnerable population identification, and a history of extreme flooding events. According to the plan, approximately $590 million in private property assets and 11 critical infrastructure systems are located within the Island County 100-year floodplain. Vulnerable populations within the floodplain are identified as those over the age of 65 and the economically disadvantaged. This population totaled 4,168 at the time of the 2015 HMP update.

In terms of coastal resilience considerations, the HMP includes a series of hazard mitigation recommendations which could support sea level rise adaptation including seeking emergency management grant funding for acquisition of properties within high-hazard areas and implementing cost-effective measures to address vulnerability of facilities at risk to sea level rise, extreme high tides and storm surges as they relate to potential inflow of saltwater (Island County, 2015). Additionally, the plan calls for improved forecasting, monitoring, and floodplain management planning to prepare coastal communities for future flood events. Specifically the plan states: “Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted;” and “as hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels, and levees, as well as the design of local sewers and storm drains” (Island County, 2015).

Though many recommended policies and actions identified in the HMP indicate consideration of projected sea level rise and intensified coastal flooding events, the plan bases potential flood impacts on FEMA 100 and 500-year floodplain data which does not account for climate change-related factors and stops short of recommending specific climate change or sea level rise adaptation strategies for shoreline properties.

5.5 Island County Development Regulations

The Island County Code of Ordinances includes a chapter which specifically addresses development in flood hazard areas. Chapter 14.02 *Flood Damage Prevention Ordinance* includes general and specific code requirements applicable new development, repair of

substantial damage, and substantial improvements to structures located within special flood hazard areas (SFHAs). SFHA development regulations include elevation of the lowest floor of residential structures to at least the established base flood elevation (BFE), at least three feet above BFE for critical facilities, and at least one foot above BFE in high hazard areas subject to high-velocity floodwaters. Base flood elevations are derived from the FEMA flood insurance rate maps (FIRMs), which, as noted above, are based on periodically updated 100-year floodplain data and do not account for tidal surge, extreme high tides, or projected sea level rise.

Individual property onsite sewer (septic) system and individual and two-party well permitting processes are managed by the Island County Department of Environmental Health. Larger systems require permitting through the Washington Department of Health. County processes begin with site registration, followed by design submission and permit application, and ultimately submission of as-built drawings for public record (Island County, 2019). Site approval criteria accounts for the separation of proposed septic systems from the ordinary high water mark and viability of well production and groundwater quality at the time of application, but do not specifically address requirements related to projected sea level rise such as a variable ordinary high water mark and seawater intrusion into groundwater aquifers. Regular system inspections are required to ensure compliance with permit criteria and, per feedback from the Department of Environmental Health, identification of non-compliance may result in a requirement to relocate septic systems and wells at the homeowner's cost.

5.6 Natural Resource Conservation and Restoration Programs

The Island County Department of Natural Resources (DNR), in partnership with the Washington State Department of Natural Resources, Department of Ecology, and Department of Fish and Wildlife, administers multiple programs designed to address climate change, sea level rise adaptation, and habitat restoration through community action. Though DNR does not have permitting authority, programs administered by the Department may benefit development supportive of conservation efforts. The Island County salmon recovery program is one such endeavor which seeks to restore and preserve salmon habitat through promotion of "projects that respect the rights of property owners and create a sustainable environment for people and fish" (Island County DNR, 2005). Through the salmon recovery program, private property owners and communities may have access to permitting and funding support for projects which provide "shore friendly" protection from extreme flooding events and projected sea level rise,

and result in shoreline and habitat restoration or preservation. To take part in the program and access this support, private property owners must coordinate applications for grant funding with Island County DNR submission schedules, and ultimately receive approval through the Washington State Recreation and Conservation Office Salmon Recovery Funding Board. The grant process occurs on an annual basis, and landowner application submission criteria and timelines are managed at the county level (WA Recreation and Conservation Office, 2020).

Another DNR managed program, "Shore Friendly," is a public education program intended to "influence Island County shoreline residents who have natural shorelines in place or those who have armored shoreline and are considering repair/replacement to adopt a 'shore friendly protection' approach" (Shore Friendly, 2019). Recommended "shore friendly protection" includes replacement of hard armoring such as structural bulkheads with more natural protections including a combination of increased setbacks, elevated structures; beach nourishment; use of logs, berms and soft shore material to absorb wave energy; and re-grading of waterfront slopes, drainage improvements, and planting of resilient native vegetation to reduce erosion potential. These techniques are consistent with Washington State Department of Ecology soft shore stabilization guidance as well as recommendations presented in a Washington Department of Fish and Wildlife 2016 publication, *Your Marine Waterfront: A guide to protecting your property while promoting healthy shorelines* (WA Department of Fish and Wildlife, 2016). Implementation of shore friendly stabilization projects is ultimately governed by provisions of the Island County SMP and Municipal Code, which the DNR Shore Friendly program seeks to assist interested property owners in navigating to ensure more resilient communities and nearshore ecosystems.

6. Future Sea Level Rise Policy Considerations

Though the majority of existing Island County plans, policies, and processes do not specifically address potential impacts of projected sea level rise, ongoing and planned updates indicate that will change. Examples of ongoing and potential State and Island County efforts to account for projected climate change and sea level rise in future planning, policy and regulation development processes are summarized below:

- Forthcoming guidance from the Washington State Department of Commerce recommends comprehensive plan revisions to more specifically incorporate climate

change and sea level rise adaptation into pertinent elements (WA Department of Commerce, 2020).

- Island County's Shoreline Master Program update, which is currently in progress, will explicitly address sea level rise adaptation best management practices, community-based coastal resiliency planning, and county-wide monitoring programs (Island County, 2019).
- A 2020 revision to the Island County Hazard Mitigation Plan is underway and will include updated sea level rise projections as well as specific guidance related to incorporation of climate change and sea level rise considerations into mitigation strategies.
- Island County may pursue involvement in the FEMA Community Rating System (CRS), which could reduce shoreline property owner flood insurance rates through strengthening of development regulations to more adequately address potential impacts of projected sea level rise.
- Continued development of Department of Natural Resources initiatives such as Salmon Recovery and Shore Friendly programs may improve permitting processes and access to financial incentives sufficient to restore Island County natural shorelines while simultaneously increasing community resilience through the actions of private property owners and collective communities.

Of these opportunities for incorporation of sea level rise considerations into future Island County plans, policies, and processes, this report will focus on addressing projected sea level rise as part of Island County's 2020 Shoreline Master Program update through identification of adaptation best management practices and community based coastal resiliency planning.

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Volume 2

Best Practices for Sea Level Rise Adaptation Report

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Executive Summary

This study examines available strategies and makes recommendations for three types of coastal areas in Island County, Washington that are characterized as historic beach, bluff, and canal communities. The objective of this report is to empower homeowners and neighborhoods in these communities to know their options when preparing for sea level rise in the future so they may make choices according to their level of risk tolerance. The literature review contained in this report acts as a broad overview by evaluating sea level rise adaptation strategies and practices applicable to individual homeowners and neighborhoods. This information is used in a cross-comparison analysis of available strategies to those which would be appropriate for Island County residents to form recommendations. Products of this report include a recommendation table and analysis matrix which may be informative for Island County coastal homeowners.

1. Introduction

Current projections indicate sea level rise between 1-3 ft. along the Island County shoreline by 2100 (Miller et al., 2018). Potential impacts to shoreline properties and surrounding ecosystems include increased coastal flooding, habitat loss, surface, and groundwater salinity changes, and altered coastal erosion and sediment deposition patterns (Miller, 2019). In light of the upcoming challenges, Island County would like to provide information and recommendations to property owners who will be impacted by the effects of sea level rise.

1.1 Purpose Statement

The purpose of this study is to pinpoint best practices for property owners to use as they recognize and identify the vulnerabilities of their properties with increased storm and flood events, determine what might be the options for appropriate adaptation, and choose how to manage their risk. This best practices report creates a recommendation table of adaptation practices organized by a time frame of usability and overarching strategy type.

This study uses qualitative methods to examine available strategies and makes recommendations for three types of at-risk coastal districts on Whidbey and Camano Island: historic beach, bluff and canal communities.

1.2 Research Question

The goal of this project is to provide information and cultivate greater preparedness for the impacts of sea level rise to Island County's historic beach communities, canal communities, and shoreline bluff communities in the form of best practices. To accomplish this we asked what are homeowner best practices for sea level rise adaptation in Island County, WA on an individual and neighborhood level?

Best practices will be focused on private assets including:

- Residential structures: setbacks, elevation, etc.
- Septic tanks and drain fields
- Protective structures and devices (bulkheads, bluff retention devices, seawalls, etc.)
- Soft shore armoring

- Private wells
- Private drives

Certain questions must be answered to address the central research question. These supporting questions include:

- What sea level rise adaptation strategies are available?
- How is Island County unique? (Geography, community and other site-specific elements which could influence adaptation strategy choices)
- What adaptation measures or plans are currently in place in Island County?
- What adaptation measures are appropriate for the three types of communities assessed for this study (historic beach, bluff, and canal community)?
- Which adaptation measures are appropriate for each planning scenario (short-term, mid-term, and long-term)?
- What scale can each of these adaptation measures be applied (homeowner, neighborhood, community-scale)?
- What policies and regulations are in place which could impact sea level rise adaptation measure decisions?

1.3 Document Organization

This document is organized into seven sections. It begins in Section 1 with an introduction that broadly discusses the report's context, purpose and defines the research question. Section 2 focuses on the methods used in the creation of this report including scope, data collection and analysis, and limitations. Section 2 also includes sea level rise projections for Island County. Section 3 is comprised of a literature review outlining common sea level rise adaptation strategies and practices. Section 4 recommends best practices for sea level rise adaptation, influencing factors to these recommendations and includes a recommendation table. Section 5 concludes the report with a summary of research outcomes and recommendations, observations on this report's limitations and suggestions for future research. Document sources are listed in section 6 and an appendix in section 7.

2. Methods

This study uses qualitative methods to examine available strategies and makes recommendations for three coastal areas on Whidbey and Camano Island. A qualitative research design was chosen for its open-ended and observation focused analysis style and ability to address emerging issues. This process included interviews, evaluation of adaptation best practices in similar communities and document review.

2.1 Methodology

This report uses case studies, a common qualitative methods approach where a "researcher develops an in-depth analysis of a case, often a program, event, activity, process or one or more individuals… bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained person of time." (Creswell, 14) Sea level rise is one of these emerging questions. As of early 2020 most available English literature relating to sea level rise has been published within the last ten years.

2.2 Procedure

The research was conducted first by assessing the Island County community and local government concerns related to extreme coastal flooding and projected sea level rise in an existing conditions summary. (Please refer to Volume 1 of this report.) Next, the available literature and case-study information were reviewed to identify best practices in sea level rise strategies adaptation implemented in communities with similar shoreline characteristics and coastal resilience goals. Information was consolidated in a matrix for analysis. Finally, sea level rise adaptation best practices specific to Island County were developed through a cross-comparison between literature and case-study outcomes and Island County planning objectives.

Figure 1. A diagram of the sea level rise adaptation strategy research process.

2.3 Data Collection

Data used to assess existing conditions was obtained through a review of Island County demographic and economic information; plans, policies, and regulations related to shoreline development and coastal area management; Island County staff interviews guided by questions outlined in the appendix; and site visits conducted October 11th and 15th, 2019. Further details are provided in the Existing Conditions Summary.

A review of existing literature provided information about sea level rise adaptation tools and processes. The literature review included the historical application of sea level rise adaptation, as well as published sea level rise adaptation processes and publicly available planning tools designed to address coastal resilience and climate change adaptation.

In addition, the data collection process required analysis and interpretation of sea level rise projections for Island County developed as part of the 2018 Projected Sea Level Rise for Washington, a 2018 Assessment by Miller et.al.

2.2.1 Sea Level Rise Analysis

To analyze potential adaptation measures for Island County required identification of sea level rise projections for the area. This analysis, based upon Miller et al. 2018, takes into consideration both time frames and probabilities that sea level will meet or exceed a certain level. The following section describes how to interpret sea level projections developed for Washington State in 2018 and how to apply that information to the development of recommendations for adaptation strategies for homeowners.

2.3.2 Sea Level Rise Projections for Island County

The subsequent tables illustrate sea level rise projections for Island County. These projections are based upon the analysis of Miller, et al. 2018 with the actual projections for Island County found on the Coastal Hazards Resilience Network (CHRN) website.[1] There are 13 different sets of projections covering different locations throughout Island County. These projections have been averaged to create this table which can be used for planning purposes. (Please see Figure 2.) However, any site-specific design should not rely upon these numbers. Projections for the specific location should be applied using the information found on the CHRN website.

Island County Sea Level Rise Average Projections

RCP 4.5 Sea level rise projections averaged for Island County in feet based on Miller, et al. 2018 projections. Probabilities indicate the likelihood sea level will meet or exceed elevations.

	Very Likely 95% Probability to exceed	Likely 50% Probability to exceed	Unlikely 1% Probability to exceed	Mid-Range 17 -83% Probability to exceed
2050	0.3	0.7	1.4	0.5 -1.0
2070	0.5	1.1	2.4	0.7 -1.5
2100	0.7	1.8	4.4	1.1-2.5

RCP 8.5 Sea level rise projections averaged for Island County in feet based on Miller, et al. 2018 projections. Probabilities indicate the likelihood sea level will meet or exceed elevations.

	Very Likely 95% Probability to exceed	Likely 50% Probability to exceed	Unlikely 1% Probability to exceed	Mid-Range 17 -83% Probability to exceed
2050	0.3	0.8	1.5	0.5 -1.0
2070	0.6	1.3	2.6	0.9 -1.7
2100	1.0	2.2	5.0	1.5 -3.0

Figure 2. Island County sea level rise projections in feet from the 2018 Miller et al. report.

The two tables shown in Figure 2 above, represent two different greenhouse gas (GHG)

[1] http://www.wacoastalnetwork.com/wcrp-documents.html

scenarios, Representative Concentration Pathway (RCP) or RCP 4.5 and RCP 8.5. These scenarios affect how quickly the earth warms, and thus how quickly the sea level rises. RCP 4.5 is a low GHG scenario and therefore a slower rate of sea level rise to a lower amount by 2100. This relates to the release of a reduced amount of greenhouse gas emissions into the atmosphere. RCP 8.5 is a high GHG scenario and therefore a faster rate of sea level rise to a higher amount by 2100. This relates to a “business as usual” approach to the release of greenhouse gases. However, sea level rise for the two scenarios is essentially the same through 2050 because warming until mid-century is primarily due to past emissions.

For the purpose of this study, RCP 8.5 was chosen to make recommendations for Island County representing business as usual conditions. As of February 2020, it seems unlikely that GHG emissions will be reduced in the immediate future to warrant planning for RCP 4.5 based on current global trends.

Island County Sea Level Rise Average Projections

RCP 4.5 Sea level rise projections averaged for Island County in feet based on Miller, et al. 2018 projections. Probabilities indicate the likelihood sea level will meet or exceed elevations.

	Very Likely 95% Probability to exceed	Likely 50% Probability to exceed	Unlikely 1% Probability to exceed	Mid-Range 17 -83% Probability to exceed
2050	0.3	0.7	1.4	0.5 -1.0
2070	0.5	1.1	2.4	0.7 -1.5
2100	0.7	1.8	4.4	1.1-2.5

RCP 8.5 Sea level rise projections averaged for Island County in feet based on Miller, et al. 2018 projections. Probabilities indicate the likelihood sea level will meet or exceed elevations.

	Very Likely 95% Probability to exceed	Likely 50% Probability to exceed	Unlikely 1% Probability to exceed	Mid-Range 17 -83% Probability to exceed
2050	0.3	0.8	1.5	0.5 -1.0
2070	0.6	1.3	2.6	0.9 -1.7
2100	1.0	2.2	5.0	1.5 -3.0

Figure 3. Island County sea level rise projections from the 2018 Miller et al. report in feet showing the GHG scenario and projections table utilized for this report.

2.3.3 Time Frame, Risk Probability, and Sea Level Rise Projections

For each of the two tables in Figure 3, the projections are developed based upon time and level

of acceptable risk. The column on the left provides three different time frames for planning consideration 2050, 2070 and 2100. This allows the user to compare projected rises in sea level over different times based upon planning horizons or lifespan of a project. In the case of adaptation measures, the time frame relates to when impacts from sea level rise might reach certain levels that "trigger" the need to take action or reflect the best type of approach to adapting to a certain elevation of projected sea level.

The row across the top allows the user to select a probability that sea levels will reach or exceed a given amount of sea level. For example, the "very likely" column of numbers relates to the high probability (95%) that sea level will exceed the numbers shown on the table for any time frame in that column. By contrast, the "unlikely" column provides numbers where it is highly unlikely (1%), although possible, that sea levels would reach that number at any time frame shown.

Using the two different GHG tables, RCP 4.5 and RCP 8.5, it is possible to see after 2050 how sea level rise projections are different and thus requires a decision about which set of projections to use. For example, in the RCP 4.5 scenario (the top table in Figure 3) there is a very likely chance, or over 95% probability, that sea levels will rise 0.3 feet by 2050, 0.5 feet by 2070 and 0.7 feet by 2100. By contrast, in the RCP 8.5 table (the lower table in Figure 3) there is a very likely chance, or over 95% probability, that sea levels will rise 0.3 feet by 2050, 0.6 feet by 2070 and 1 foot by 2100.

2.3.4 Best Practices Matrix

The literature review provided information about management practices applicable to each of the three adaptation strategies (protect, accommodate, retreat). A matrix was created to identify relevant variables in short form which could be compared to site-specific requirements of the three neighborhood typologies and key indicators in Island County resulting in sea level rise practice recommendations.

This matrix includes a list of common sea level rise adaptation strategies broken down into the three categories recommended by the International Panel on Climate Change (IPCC): protect, accommodate, and retreat. Each strategy is then subdivided into more specific management

practices. Each management practice includes a definition, whether or not the action is permissible in Island County, a sample project, and links to more information.

This matrix also determines whether each management practice would be applicable in each of the three Island County communities examined in this report (historic beach, bluff and canal communities) in the Community Applicability column. This is decided by whether or not a management practice makes sense when considering generic site conditions of the community typologies. Additionally, this report takes into account foreseeable impacts these practices might have in these types of locations. If the practice passes this review it will be represented in the matrix by H for historic beach, B for bluff and C for canal community.

What time frame management practices would be most effectively deployed in was also considered in the matrix. Time frame is split into three options: short-term representing today through the year 2050, mid-term representing 2050 to 2070 and long-term representing 2070 - 2100. These ranges correspond to the sea level rise projection tables seen in Figure 3. These factors are shown in the matrix's Time Frame column and are shown with S for short-term, M for mid-term, and L for long-term.

The following table was compiled to link the time frame designations used by this report and the mid-range sea level rise anticipated from the projection table RCP 8.5.

Time Frame	Time Range	Mid-Range Sea Level Rise Anticipated
Short-term	Now - 2050	0.5 - 1.0'
Mid-term	2050 - 2070	0.9 - 1.7'
Long-term	2070 - 2100	1.5 - 3.0'

Figure 4. Table relating time frame used in this report's recommendations to specific years and projected sea level rise in feet from RCP 8.5 via Miller et al.

The scale of the adaptation management practices is also denoted in the matrix in the Scale column. This speaks to in general terms how many households may be necessary to deploy a type of management practice. Some practices, like installing a floodwall or temporary barrier, could be used by an individual homeowner (represented in the matrix by I), a small group of neighbors (represented by G), or a neighborhood (represented by N).

While all options for adaptation practices are discussed in the literature review, practices not viable for use in Island County were removed from the matrix. This analysis matrix is meant to be available as a quick reference tool that may operate independently from this report.

A sample of this matrix can be seen in Figure 5 below and may also be found in its final form in this report's Appendix.

Strategy	**Practice**	**Descriptio n**	**Community Applicability** H - Historic Beach B - Coastal Bluff C - Canal	**Time Frame** S - Short-term M - Mid-term L - Long-term	**Permissibility** P - permitted X - prohibited C - conditional SED - shoreline environmental designation	**Scale** I - Individual Homeowner S - Small Groups N - Neighborhood	**Example+**	**Location**	**Link**

Figure 5. Example of Best Practices Analysis Matrix not yet filled in.

Using the information from this analysis matrix, this report recommends sea level rise adaptation management practices for the three Island County community typologies: historic beach, bluff and canal communities. Recommendations are presented in a recommendations table. This table includes the specific management actions listed for each of the overall adaptation strategies and determines which ones apply based upon the type of community and time frame.

The sea level rise adaptation practice recommendation table is found in the recommendations portion of this report and the Appendix. A draft of this table is also shown in Figure 6.

PROTECT	ACCOMMODATE	RETREAT
SHORT-TERM STRATEGIES (Now - 2050)		
MID-TERM STRATEGIES (2050 - 2070)		
LONG-TERM STRATEGIES (2070 - 2100)		

Figure 6. Example of Practices Recommendations Table not yet filled in.

2.4 Limitations & Further Research

Limitations to the research process which may bias or influence outcomes and/or recommendations include:

Limited community contact: Community contact was limited to two public engagements held on September 28, 2019, and facilitated by the Island County Marine Resources Committee (MRC), an advisory group comprised of community volunteers and Island County staff. All other information related to community issues referenced in this report was obtained through County staff interviews, which may result in a biased assessment of community issues.

Anecdotal issue identification: Few County and/or community issues and concerns identified during data collection were supported by documentation. County staff interviews and observed community feedback at MRC forums informed these issues and related planning objectives, which also may result in a biased assessment of community objectives.

Limited time frame of precedent monitoring: Sea level rise has yet to occur on the scale scientists project. Although case studies exist where sea level rise adaptation strategies have

been implemented, we have yet to see the long-term effects of these strategies. It is recommended that Island County monitor sea level rise adaptation projects to assess long-term success.

Monitoring program uncertainty: Community coastal resilience plan implementation is partially dependent on a community's ability to monitor sea level and project sea level rise. Island County is developing a monitoring program that may influence the planning framework recommended in this report. Revision of the recommended planning framework proposed in this report may be necessary to incorporate the monitoring program upon establishment.

3. Literature Review of Available Sea Level Rise Adaptation Tools

Best practices around sea level rise are critical for the future of coastal communities. The purpose of this literature review was to gain an understanding of the range of sea level rise adaptation strategies and available practices that could be applied in Island County for the three focus communities. The research found more practices than are included in this report; only those applicable to homeowners or applied on a community scale and relevant to the geology and topography of coastal areas within Island County are included.

3.1 Sea Level Rise Adaptation Strategies

This literature review provides foundational knowledge about adaptation strategies and practices. Adaptation strategies are often broken down into three categories as recommended by the International Panel on Climate Change: protect, accommodate and retreat. For each of these overarching strategies, there are more specific management practices. Additionally, management practices falling under the protection strategy may be further organized by soft and hard practice types; in some literature, these practices are referred to as green or grey.

3.1.1 Strategy: Protect

“Protection” seeks to control natural systems through hard and soft barriers and reduces sea level rise impacts in a “zone that would be impacted without protection.” (Zommers & Alverson, 2018) Soft protection practices include developing soft shorelines, dunes, beach nourishment and floating islands. These measures often have a less adverse environmental impact than hard strategies. Hard protection practices include seawalls, bulkheads, revetments, floodwalls, dikes and surge barriers. Hard protection practices are designed to stop and keep out water and prevent erosion in specific areas completely while soft practices allow more flexibility with where the water goes.

Figure 7. A “protect’ sea level rise strategy diagram.

Source: CoastAdapt Australia, 2019

Soft Protection methods are “green solutions [which] utilize ecological and environmental principles and practices to provide flood protection, as well as reduce erosion and stabilize shorelines, while also enhancing habitats and improving aesthetics (as compared to hard solutions). Often, soft solutions are less expensive than hard solutions and lower in maintenance, but they are not permanent and are subject to erosion.” (AI, 2018) It should be remembered that there are no permanent solutions where sea level rise is concerned.

Figure 8. Hard protection measures (left) and soft protection (right) on neighboring Washington beachfront properties.

Source: Washington Department of Fish & Wildlife, 2016

Hard Protection methods are "often developed by civil and environmental engineers, are flood protection structures that are (almost always) permanent. Hard solutions focus on controlling flooding and sea level rise... The downside of these projects is their disruption of ecological systems. They are generally expensive and require maintenance." (Al, 2018) Hard adaptation practices may also be referred to as grey protection measures. These protection practices often use materials like concrete and stone.

Overall, hard protection practices are rigid and often do not adapt well to a changing environment. They should primarily be considered an adaptation strategy in the near term. The cost of continually upgrading hard protection will eventually become unsustainable for the average homeowner. Additionally, hard protection practices may transform the look of a property and may alter the aesthetic appeal and character of the property if, for example, a bulkhead is required to be elevated higher and higher to protect against rising seas.

3.1.2 Strategy: Accommodate

"Accommodation" allows natural systems to occur and impacts to humans and development "are minimized by adjusting human use of the coastal zone via changing land use/crop types, applying flood resilience measures, etc." (Zommers & Alverson, 2018) This strategy includes techniques like elevating structures, floodproofing and floodable designs. This strategy entails learning to live with rising waters.

Figure 9. An "accommodate" sea level rise strategy diagram.
Source: CoastAdapt Australia, 2019

3.1.3 Strategy: Retreat

"Retreat" or "planned retreat" allows natural systems to occur without human intervention. "Human impacts are minimized by pulling back from the coast via land use planning, development controls, planned migration, etc." (Zommers & Alverson, 2018) Retreat is the only way to entirely eliminate risk to life and property from sea level rise. In some cases, retreat may be an unavoidable response. However, "this option is economically feasible only if it is possible to relocate within [an] existing property, either to higher ground or with a greater setback from a flood source." (Watson & Adams, 2011) The strategy of retreat may be considered at any time frame suggested for sea level rise adaptation planning.

Figure 10. A "retreat" sea level rise strategy diagram.
Source: CoastAdapt Australia, 2019

3.2 Sea Level Rise Adaptation Management Practices

The following section goes into detail about specific management practices available for sea level rise adaptation. Each management practice is organized by which adaptation strategy it falls under. Protection strategies are also classified by soft and hard practice type. For each management practice, pros and cons are listed along with environmental considerations and an example. Links to examples and more information on the following practices are included in the matrix in this report's appendix.

3.2.1 Soft Protection Practices

Soft Shorelines are highly designed coastal areas that reduce shoreline erosions through the use of natural materials. They are often “gently sloping natural banks” that “protect coastal ecosystems, and help reduce storm surge strengths along the coastline.”(AI, 2018) Designers limit the amount and type of hardscape elements used and emphasize the use of plants and sands. The goal is to return to or reinforce natural systems along coastlines.

- Pros: Reduce erosion, create habitat, stabilize shorelines, improve coastal resilience, inexpensive compared to most hard adaptation practices
- Cons: Limited design guidance, not appropriate for high energy environments, a limited number of knowledgeable and licensed contractors
- Environmental Considerations: Soft shorelines can restore habitat and natural ecological processes to a site.
- Time Frame: Practice may be used for all of the time frames because of its ability to adapt to rising seas overtime. However, in the long term, it is possible the site may be too limited in size to accommodate the ever-shifting shoreline and need to retreat away from flooding impacts.
- Example site: Olympic Sculpture Park, Seattle, Washington, USA

Figure 11. Softshore installation along Washington beachfront.

Source: Washington Department of Fish & Wildlife, 2016

Beach Nourishment is the "replacement or augmentation of beach sand removed by ocean waters." (Watson & Adams, 2011) This process may occur naturally or artificially.

- Pros: Protects public and private infrastructure, expands usage by adding area, protects shore ecosystem, reverses erosion, encourages vegetative growth, increases economic and recreational opportunities
- Cons: Challenges finding similar beach material which increases project success, new sediment may bury marine life, limited public access during installation, for success beaches must have regular re-nourishment
- Environmental Considerations: Beaches can benefit from nourishment practices but the application covers existing plants and animals.
- Time Frame: Practice may extend the life of a beach being eroded in the short and mid-term. However, this likely will not be a long term solution as sea level rise is expected to surpass elevation of existing beaches.
- Example Site: Marine Park, Bellingham, Washington, USA

Figure 12. Beach nourishment in progress.
Source: Western Carolina University, 2018

3.2.2 Hard Protection Practices

Bulkheads & Seawalls. Bulkheads are a "wall or other structure, often wood, steel, stone, or concrete, designed to retain or prevent sliding or erosion of the land. Occasionally bulkheads are used to protect against wave action." (Watson & Adams, 2011) Seawalls are extremely similar to bulkheads and have been consolidated under this category.

- Pros: Reduces the impact of wave action on the substrate, stabilizes shoreline, less space required for installation, long lifespan, easily repaired
- Cons: Eliminates intertidal zone, erodes seabed and neighboring unreinforced sites, disrupts natural sediment systems resulting in beach erosion, overtopping may trap water behind a wall and cause damage, expensive installation costs, increases wave energy, designed for erosion protection not flooding
- Environmental Considerations: Negatively impacts the environment by eliminating habitat and speeding erosion around the installation.
- Time Frame: Practice may be effective in the short term but it is likely that the height and width of the seawall will need to be regularly increased to protect against increased coastal flooding. Structural integrity and overtopping will be increased concerns as water levels rise.
- Example Site: The Seawall, Vancouver, Canada

Figure 13. Photo of a bulkhead along Washington's coast.

Source: Shoreline Construction, 2019

Dikes, Levees & Embankments. A dike is "a constructed wall or embankment along a shore to prevent flooding of low-lying land." (Watson & Adams, 2011) Levees are similar to dikes. These

structures sometimes have an access road along their top and are made of earth, stone or other materials. Embankments are a wider version of dikes and levees.

- Pros: Prevents flooding from storm surge and tide fluctuations, manages wave action, stabilizes the shoreline
- Cons: Changes existing ecological systems, disrupts natural sediment systems
- Environmental Considerations: Negatively impacts the environment by disrupting natural ecological systems.
- Time Frame: Practice may be effective in the short term but it is likely that the height and width of the dikes will need to be regularly increased to provide flooding protection. Structural integrity and overtopping will be increased concerns as water levels rise.
- Example Site: Motorway Dike, Netherlands

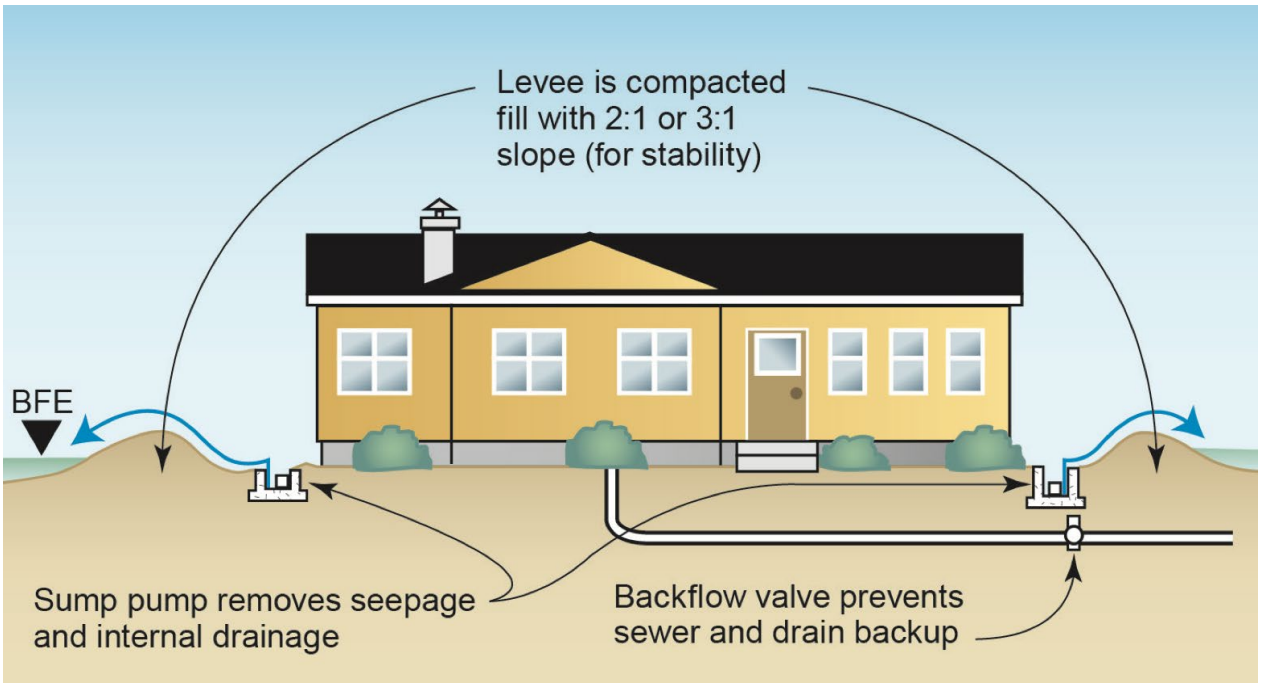

Figure 14. Diagram of levees in a residential context.

Source: FEMA, 2015

Dry Floodproofing "prevents water from entering a structure through watertight designs." (Al, 2018) To do this, building walls must be sealed with waterproof coatings, may use impermeable membranes or an additional layer of masonry or concrete.

- Pros: No additional space needed, maybe funded through FEMA grant programs, inexpensive compared to other retrofitting methods
- Cons: Structure failure if water velocity and height exceeds dry proofing rating
- Environmental Consideration: Impact unknown
- Time Frame: This practice was designed to protect from temporary flooding and should be considered as added protection in the event of storm surge, king tides, or other similar events in the short term and mid-term. The maximum dry floodproof rating is currently 3 feet.
- Example Site: University of Texas Perimeter Wall and Dry Floodproofing Project, Houston, Texas, USA

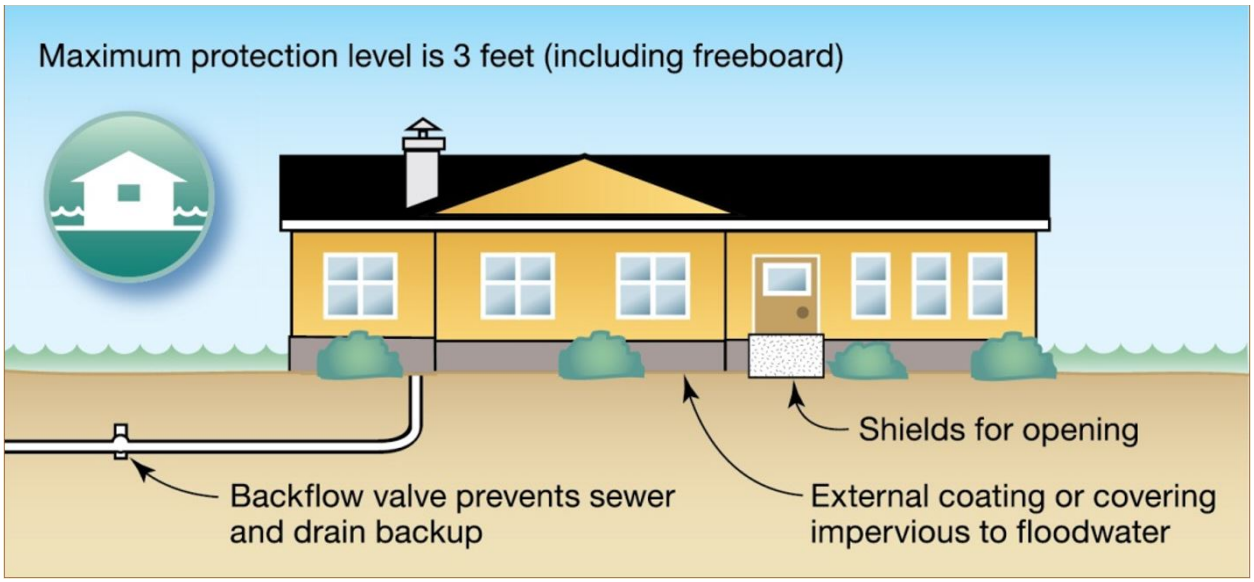

Figure 15. Diagram of dry floodproofing in a residential context.

Source: FEMA, 2015

Floodwalls & Temporary Barriers. Floodwalls are "vertical artificial barriers, either temporary or permanent, designed to withstand waters from a river, waterway or ocean." (AI, 2018) "A floodwall can surround a structure or, depending on flood depths, site topography, and design preferences can protect isolated openings such as doors, windows, and basement entrances, including entry doors and garage doors." (FEMA, 2007) Floodwalls are usually used in open spaces. If floodwalls are temporary, they can be moved and deployed in different locations.

- Pros: Reduces flood risk
- Cons: Large area required, the cost may be prohibitive, can worsen flooding of neighboring properties
- Environmental Considerations: Permanent flood walls may have a similar effect as bulkheads and seawalls on the environment, disrupting the natural sediment systems.
- Time Frame: Practice may be effective in the short term but it is likely that the height and width of the floodwall will need to be regularly increased to protect against coastal flooding. Structural integrity and overtopping will be increased concerns as water levels rise.
- Example Site: Mobile Floodwall, Grein, Austria

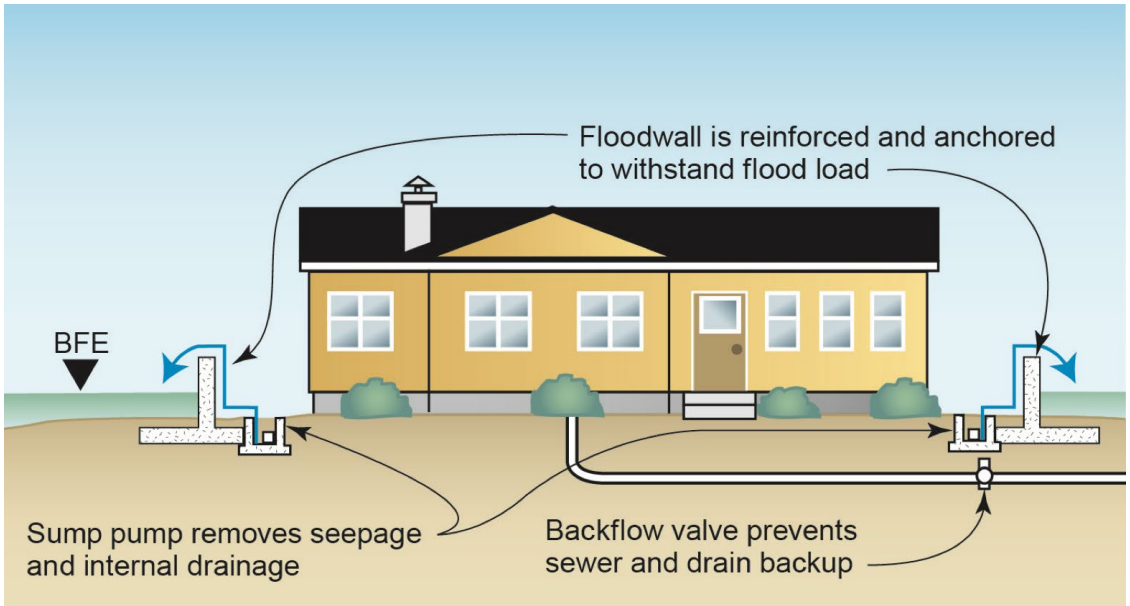

Figure 16. Diagram of floodwalls in a residential context.

Source: FEMA, 2015

Revetment & Riprap. A revetment is "A facing of stone or concrete to protect an embankment or shore structure against erosion by wave action or currents" or "a retaining wall, typically sloped." (Watson & Adams, 2011) These terms often refer to material that is not anchored or has little anchoring like rocks placed on a beach.

- Pros: Reduces wave action, low maintenance, long-lasting
- Cons: Low flood protection effectiveness, disrupts natural sediment systems, a large area required, eliminates intertidal habitat, erosion of neighboring sites, increases water velocity
- Environmental Considerations: Negatively impacts the environment
- Time Frame: This is a short term solution as wave action in addition to increasing sea level rise will likely cause the failure of revetment and riprap.
- Example Site: Cleveleys Coastal Project, Cleveleys, United Kingdom

Figure 17. Photo of Rialto Spit Revetment Repair project in La Push, WA.
Source: Washington Rock Quarries Inc., 2019

Breakwaters are "a structure that forms a harbor and basin to protect the shore from the effects of waves, as well as to provide a safe place for fishing vessels to berth." (AI, 2018) This structure functions to "calm water, reduce wave height, and prevent shoreline erosion." (AI, 2018) Most breakwaters are made of rock and concrete. Breakwaters may be fixed or floating with fixed breakwaters best able to mitigate major wave action.

- Pros: Reduces wave action, prevents shoreline erosion
- Cons: High upfront costs, not a stand-alone manage practice
- Environmental Considerations: The installation of breakwaters may create habitat and increase recreational use through decreased wave action. However, breakwaters may change local habitats and migration patterns.
- Time Frame: Breakwaters become ineffective when submerged so the effectiveness time frame would be dependent on the structure size.
- Example Site: Scape Living Breakwaters, Staten Island, New York, USA

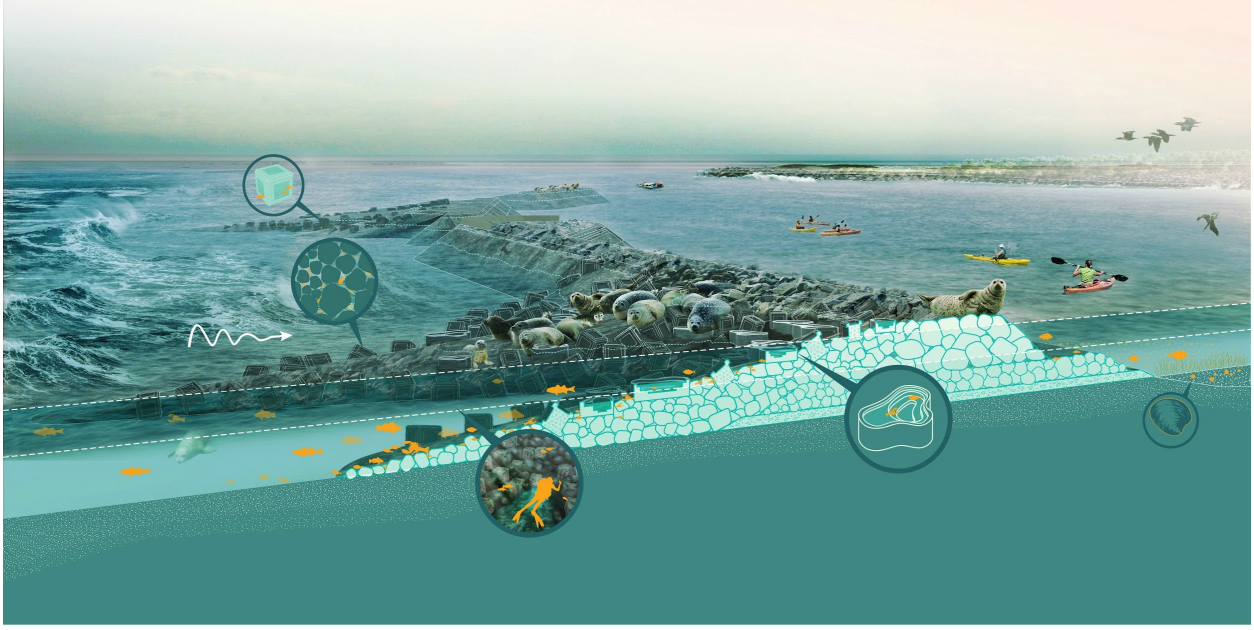

Figure 18. Rendering of Living Breakwaters project meant to protect New York coastline and provide habitat for shellfish and other marine life.

Source: Adapting Cities to Sea Level Rise, 2018

3.2.3 Accommodation Practices

Septic System Improvements. As discussed in the existing conditions report, septic systems pose an increasing risk to public health and the environment as sea levels rise. Two main improvements may reduce the impact of septic systems. First, **advanced septic systems** use a secondary treatment before releasing waste into the leech field and will reduce contaminants discharged into the environment upon inundation. Second, using concrete blocks or other anchoring materials to prevent septic systems from floating up from the ground. This procedure is often called **septic system anchoring**. Septic systems may also be sealed by placing a neoprene gasket between the access cover and its seat and bolting down the access cover. This creates a watertight seal.

- Pros: Protect homeowner infrastructure, reduce environmental impact
- Cons: Expensive upfront cost
- Environmental Considerations: Reduces pollution risk
- Time Frame: Effectiveness of septic improvements depends on the location of the system on a given property. Septic systems need leach fields in order to operate which cannot be permenently submerged by sea level rise.
- Additional Information: Rhode Island Coastal Property Guide

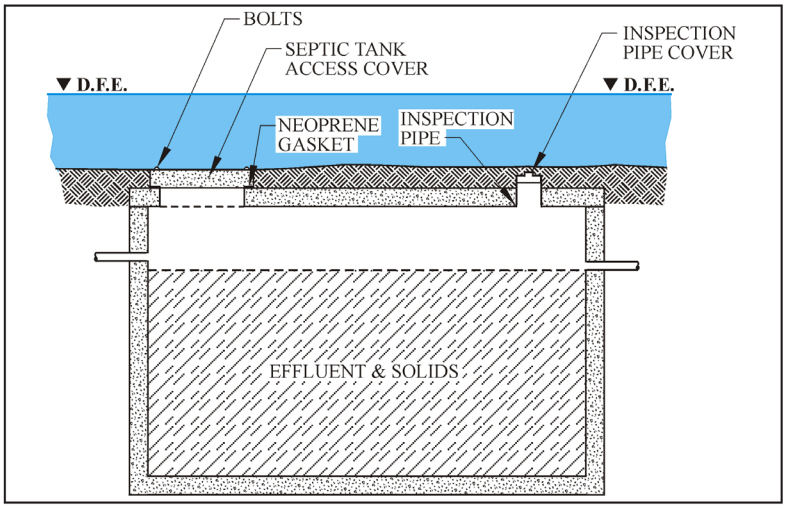

Figure 19. Diagram of a sealed septic system.

Source: FEMA, 1999

Utility Relocation & Consolidation is an umbrella term for numerous practices that may aid sea level rise adaptation. On a property, practices may include **elevating electrical** outlets and lines to reduce the impacts of flooding. In a neighborhood, **relocating freshwater wells** upland may be necessary as saltwater intrusion renders wells inoperable. When relocating a **utility consolidation** with neighbors could reduce overall costs (e.g. **community drain fields**, shared roads & wells).

- Pros: Reduces flood impact on utilities (elevation/relocation), reduces maintenance costs for individuals (consolidation)
- Cons: Expensive
- Environmental Considerations: Reduces pollution risk
- Time Frame: This group of practices are overall resilience measures that may be deployed at any time during sea level rise adaptation.
- Additional Information: University of Rhode Island Cooperative Extension, Rhode Island, USA

Water Supply Diversification reduces the chances of losing access to fresh water through redundancies. This may also decrease coastal groundwater extraction rates. Diversification could include on-site recycled water systems (e.g. rainwater catchment or greywater reuse) and service agreements for increased discharge at upland wells. This is another opportunity for the consolidation of utilities with neighbors which could reduce overall costs.

- Pros: Increased access to freshwater, more dependable source, decreased groundwater extraction in the coastal zone
- Cons: Expensive
- Environmental Considerations: Impact unknown
- Time Frame: This group of practices are overall resilience measures that may be deployed at any time during sea level rise adaptation.
- Additional Information: Sea-Level Rise Impacts on Drinking Water: A Groundwater Modeling Study, Newmarket, NH, USA

Floating Structures are specially designed to "rise and fall with floodwaters." (Al, 2018) These homes are designed on a foundation to float when excessive floodwaters are present.

- Pros: Not susceptible to sea level rise or flooding, minimal space needs, minimal ecological disturbance
- Cons: Expensive design and installation costs
- Environmental Considerations: Impact Unknown
- Time Frame: These structures are meant to float when floodwaters are present but not enough information is available to determine if they would survive permanent inundation from sea level rise.
- Example Site: The Float House - Make it Right / Morphosis Architects, New Orleans, LA, USA

House Boats & Floating Homes. Floating homes are structures built on the water and float like a boat. They are often permanently moored and towed in by boat after construction. Unlike a houseboat, floating homes cannot move under their own power.

- Pros: Not susceptible to sea level rise or flooding, minimal space needs
- Cons: Use restricted by permit in many municipalities
- Environmental Considerations: Floating structures cast shade that changes light conditions in aquatic habitat and may impact natural ecological processes.
- Time Frame: These practices may be utilized at any time frame.
- Example Site: Lake Union, Seattle, WA

Figure 20. Photo of houseboats in Seattle, WA.

Source: Seattle Pi, 2020

Floodable Spaces, like floodable plains and squares, is a multipurpose space built next to water bodies and is allowed to fill with water when flooding occurs.

- Pros: Effective use of space
- Cons: Experimental, possible health risk with polluted floodwaters
- Environmental Considerations: Impact varies based on independent factors including design, materials and construction methods.
- Time Frame: Floodable spaces are commonly designed to flood temporarily but it is likely that they could be adjusted to hold water permanently without much challenge. A floodable space will manage inundation at any time frame.
- Example Site: Cumberland Park, Nashville, TN, USA

Figure 21. Rendering of floodable public space in Copenhagen, Denmark - during summer months this pond is used as an athletic field.

Source: The Guardian, 2016

Raised Ground is a management practice that "invites water to penetrate waterfront districts while elevating infrastructure such as roads to sustain human use during floods. This technique provides the opportunity for development for residential, office, hotel, retail, and transit uses." (AI, 2018) This practice includes **elevating structures**. FEMA recommends elevating structures above base flood elevation (BFE) for this practice to be effective. This places "all or most of vital building infrastructure... above the flood line." (AI, 2018)

- Pros: Reduces risk of damage to property, may reduce flood insurance premiums, often fundable under FEMA grant programs
- Cons: Expensive
- Environmental Considerations: Impact unknown
- Time Frame: Raising structures is a short and possibly mid-term solution. Although a house could be elevated above projected sea level rise, at a certain point, the utilities for a house may no longer function (i.e. electricity, water, sewer) and residents may not be able to access roads in and out of the property.
- Example Site: Perez Art Museum, Miami, FL, USA

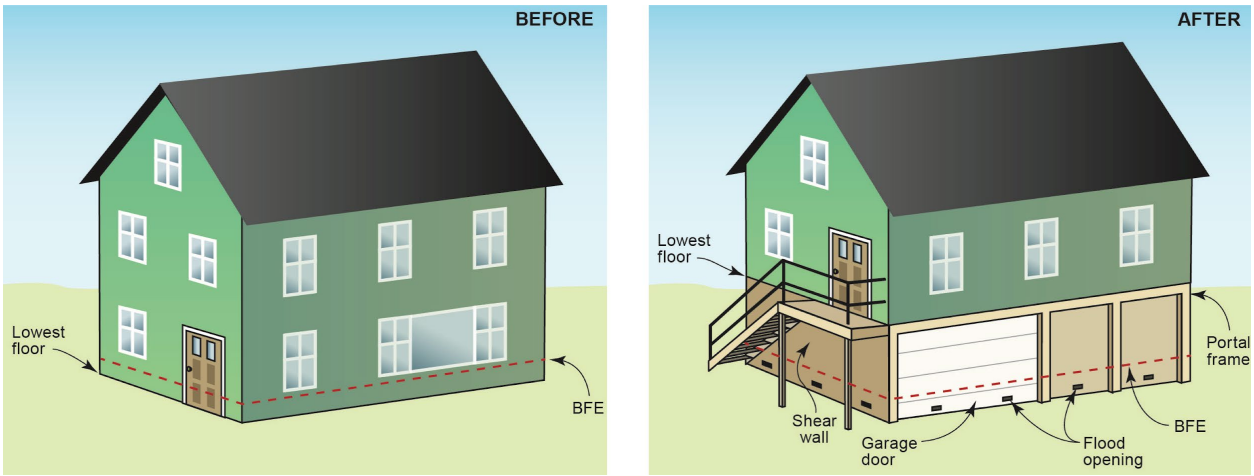

Figure 22. Diagram of elevating structure in a residential context.

Source: FEMA, 2015

Wet Floodproofing "allows floodwater to enter and leave a structure through designated openings and thus requires non occupied space." (AI, 2018) This practice does not protect from other hazards related to floodings like the force of water, erosion and floating debris. The various types of floodproofing are commonly recommended by FEMA.

- Pros: Allowing water to enter reduces the risk of structures floating off foundations
- Cons: Area must remain unused, floodwaters carry contaminants that may be transferred to floodable areas
- Environmental Considerations: Impact unknown
- Time Frame: This practice was designed to protect from temporary flooding and should be considered as added protection in the event of storm surge, king tides, or other similar events in the short and mid-term.
- Example Site: Burham Hall, Lincoln, VT, USA

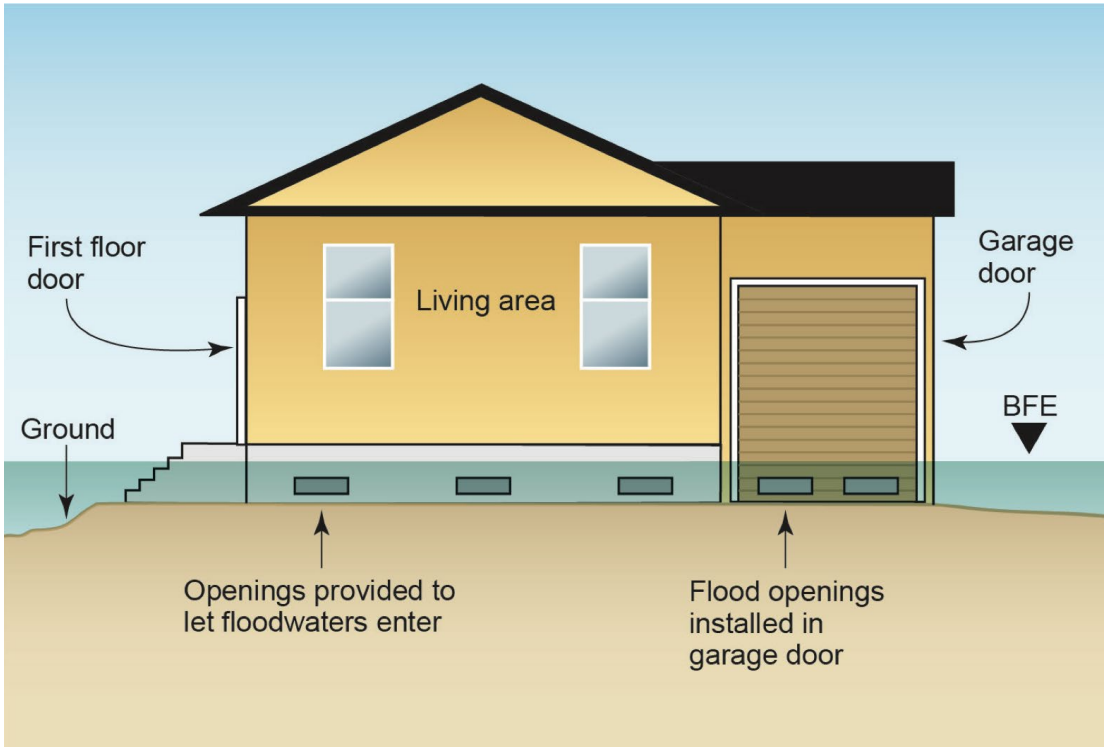

Figure 23. Diagram of wet floodproofing in a residential context.

Source: FEMA, 2015

3.2.4 Retreat Practices

On-Site Retreat involves relocating structures and other important property elements upland away from flood risk but remaining within an existing property.

- Pros: Reduces flood risk
- Cons: Expensive
- Environmental Considerations: Impact varies based on independent factors including design, materials and construction methods. This process may allow more room for habitat if accompanied by removal of hard protection practices.
- Time Frame: The effectiveness of this management practice is extremely site-specific and depends on the parcel size and elevation and ability to relocate the structure and associated utilities.
- Additional Information: Rhode Island Coastal Property Guide, Rhode Island, USA

Figure 24. Photo of a building being moved back from the coastline performed by DB Davis Structural Moving & Raising Company.

Source: Island County Department of Natural Resources, 2019.

Off-Site Retreat entails relocating upland away from flood risk to a different property.

- Pros: Reduces risk of coastal flooding
- Cons: Expensive
- Environmental Considerations: Impact varies based on independent factors including design, materials and construction methods. This process may allow more room for habitat if accompanied by removal of hard protection practices.
- Time Frame: This practice may be used at any time but most likely will not be until later as it requires a large upfront cost.
- Example Site: Managed Retreat at Surfer's Point, Ventura Beach, CA, USA

3.3 Literature Review Conclusion

An abundance of information exists regarding sea level rise adaptation strategies and management practices. Although other strategies and practices exist, protect, accommodate and retreat are the primary adaptation strategies mentioned in available resources examined by this report. Adaptation management practices reviewed were limited to those feasible for homeowners and neighborhoods to tackle without government instigation. This topic would benefit from future research into costs associated with adaptation practices as not much information was available besides general claims that a practice was 'expensive' to implement or maintain.

4. Recommendations

4.1 Factors Influencing Recommendations

A review of literature and analysis of Island County three beach community types led to the creation of a matrix of best practices applicable to each type of community. The matrix (in the Appendix) has been summarized into a set of recommended best practices for sea level rise management practices identified by the overall strategy and time frame. Four key factors influenced this report's recommendation for Island County's historic beach, bluff and canal communities regarding sea level rise adaptation strategies and practices. These are community applicability, time frame, permissibility and scale of the practice. The reasoning for each of these factors, identified in the Best Practices Matrix found in the Appendix, are as follows:

Community Applicability. The following recommendations took into account the suitability of adaptation strategies and practices on the three Island County neighborhood typologies outlined in the report's scope: historic beach, coastal bluff, and canal communities. Whether or not a management practice is actually applicable will ultimately depend on an understanding and analysis of site conditions of these typologies and what impacts the proposed management practice would have on the site. Most of the management practices applied to most if not all of the three community types. The major exception is for breakwaters, which only applied to canal communities because they are the only areas that see boat usage at the scale that this expense might be warranted. Also, beach nourishment is not recommended for canal communities because there is no beach to nourish in those locations.

Time Frame. Recommendations took into account if the strategy or practice would be a short-term, mid-term or long-term solution. This is based upon an analysis of the sea level rise projections for Island County described in Section 2. The time frame refers to the most appropriate time frame for considering a management practice based upon projections for sea level rise and the potential implications of greater flooding. Management practices that are able to withstand greater amounts of flooding and storm impact are identified as mid-term or long-term strategies. For example, soft shore protection is viable for short, mid and long-term time

frames because even if a homeowner eventually leaves the site the ecological systems have been rebuilt and prepared ultimately return to the water.

Time Frame	Time Range	Mid-Range Sea Level Rise Anticipated
Short-term	Now - 2050	0.5 - 1.0’
Mid-term	2050 - 2070	0.9 - 1.7’
Long-term	2070 - 2100	1.5 - 3.0’

Figure 25. Table relating time frame used in recommendations to specific years and projected sea level rise in feet from RCP 8.5.

Permissibility. Projects are limited by Island County municipal ordinances, Washington state law, and federal regulations. Island County Shoreline Master Program designates whether activities are permitted, conditionally permitted or prohibited. Each of the management practices is analyzed as the permit status of that action according to the Island County SMP. Any Adaptation management practices outright prohibited in Island County were excluded from the recommendations.

Scale. This report exclusively focused on solutions homeowners and communities could implement on their own. Each management practice is designated as to whether it applies at the scale of the individual homeowner, a small group of neighbors or an entire neighborhood. This factor limited adaptation strategies and management practices explored and included in the recommendations.

These are the primary factors used in the recommendations. However, there are additional factors that are important, relevant and should be considered. These include:

- The typical cost of a project
- The impact adaptation practices will have on the environment
- The level of risk an individual or neighborhood is open to accepting regarding sea level rise

4.2 Adaptation Strategy Considerations for Island County

Ultimately, homeowners must decide how to approach sea level rise for their homes and in their communities. Individual and community-specific approaches may differ based on risk tolerance and other factors affecting adaptation strategy feasibility such as cost, permitting constraints, implementation timelines, etc. The Island County community-based coastal resilience planning framework included as Volume 3 of this report serves as a guide to assist individuals and communities in planning for adaptation. This process is intended to help homeowners choose the appropriate strategy for sea level rise adaptation based on risk to community values and assets. The Adaptation Management Practices identified in this report are provided as a recommended baseline list of alternatives communities may consider when identifying appropriate adaptation strategies.

4.3 Adaptation Management Practice Considerations for Island County

This section classifies specific sea level rise adaptation management practices by strategy type and recommends which practice to use in the context of each Island County neighborhood typology: historic beach, coastal bluff, and canal communities. The upcoming recommendation table (Figure 25) is a quick reference for this information. The three columns are labeled by strategy type and listed underneath them in rows are the specific practices recommended for use in Island County. Next to each sea level rise adaptation practice is represented with H, B or C signifying which community these practices would be recommended for. H stands for historic beach, B for coastal bluff, and C for canal community. These recommendations are further subdivided by short-term, mid-term or long-term categories. The placement and identification of recommendations found in Figure 25 result from the literature review, consideration of local conditions and projected sea level rise for the community.

Not all of the practices reviewed should be used in Island County. At the start of this exercise, possible practices were taken from the literature review and placed in the analysis matrix. Possibilities were assessed by the information gathered in each column to determine which practice should be recommended for each community. If the column's contents disqualified it from being used it was deleted from the analysis matrix and does not appear in the recommendation table. Disqualification often occurred when an option seemed viable but

could not be permitted in Island County or did not fit the scale prescribed by this project's scope, i.e. was not applicable for a shoreline homeowner or small community.

The following practices are not recommended for Island County as they were not compatible with a specific coastal typology examined for this study:

- **Dikes, levees, and embankments are not recommended for Coastal Bluff Communities.** These barriers would effectively create a bowl environment backed by in many cases critical slopes where water would have trouble draining. Collecting water in this environment seems ill-advised.

- **Beach Nourishment is not recommended for Canal Communities.** In most examples of Canal Communities, no real beach exists to nourish so implementing this adaptation practice makes little sense.

- **Breakwaters are only recommended for Canal Communities.** A breakwater is "a structure that forms a harbor and basin to protect the shore from the effects of waves, as well as to provide a safe place for fishing vessels to berth." (Al, 2018) Canal Communities are the only areas that see boats used to the scale that this type of expense might be warranted.

- **On-Site Retreat is not recommended for Canal Communities.** Island County coastal properties are often small plots. From the examination, via site visits and satellite images canal communities were additionally close to the ordinary high water mark with little topographical elevation on site. For these reasons, it would be more effective for property owners to invest in off-site relocation than relocating structures on-site.

The following practices deviate from their generic time frame recommendations in this report's literature review for Island County:

- **Advanced and Anchored Septic Systems are only recommended as a Short-Term adaptation practice.** The impact of mid-range (0.9 - 1.7') and long-term (1.5 - 3.0') sea level rise projections on septic systems would most likely submerge tanks and leach fields rendering them useless.

- **Community Drain Fields, depending on their location, could be a Long-Term adaptation practice.** For communities that can stay on-site consolidating septic drain fields, or leach fields, upland away from sea level rise could be a long term solution. Investing as a small group or neighborhood in this improvement would likely reduce costs overall but would require additional permitting and oversight.

- **Revetment is only recommended as a Short-Term adaptation practice.** Mid-range and long-term sea level rise may submerge revetment, reducing the effectiveness of this practice. Wave action happening during these ranges of sea level rise will likely dislodge revetment, riprap and other adaptation practices that do not anchor materials.

- **Off-Site Retreat is recommended for Canal Communities and some Beach Communities (Spit Communities) as a Short-Term adaptation practice.** Canal and spit communities, a small subset of historic beach communities, are characterized as having small plots, close to the ordinary high water mark with little topographical elevation on site. Additionally, many of these properties are surrounded by water on both sides making the threat of sea level rise even more dangerous especially in high water events. For these reasons it is recommended for property owners to consider off-site retreat in the short term.

- **Off-Site Retreat is recommended for all communities as Mid and Long-Term adaptation practice.** Island County coastal properties are often small plots with little elevation change within a property boundary which limits the longevity of adaptation practices. Even if individual homes can be fortified, it is unlikely that utilities and infrastructure going to these sites would continue to function without government involvement. Additionally, the impact of mid-range and long-term sea level rise

projections would significantly alter many of these homes and communities, changing the character and culture that adaptation hopes to protect.

Not all management strategies are appropriate for Island County. It should be remembered that these recommendations are general and site-specific characteristics should be considered when planning for sea level rise. The following table presents recommendations by time frame and adaptation strategy for Island County.

Sea Level Rise Adaptation Practice Recommendation Table

PROTECT	ACCOMMODATE	RETREAT
SHORT-TERM STRATEGIES (Now - 2050)		
Soft Shorelines (H, B, C)	Advanced Septic Systems (H, B, C)	On-Site Retreat (H, B)
Beach Nourishment (H, B)	Anchored Septic Systems (H, B, C)	Off-Site Retreat (Some B, C)
Bulkhead/Seawalls (H, B, C)	Community Drain Fields (H, B, C)	
Breakwater (C)	Elevated Structures (H, B, C)	
Dikes/Levees (H, C)	Floodable Spaces (H, B, C)	
Dry Floodproofing (H, B, C)	Raised Ground (H, B, C)	
Floodwall (H, B, C)	Water Supply Diversification (H, B, C)	
Revetment (H, B, C)	Wet Floodproofing (H, B, C)	
	Utility Relocation & Consolidation (H, B, C)	

PROTECT	ACCOMMODATE	RETREAT
MID-TERM STRATEGIES (2050 - 2070)		
Soft Shorelines (H, B, C)	Community Drain Fields (H, B, C)	Off-Site Retreat (H, B, C)
Beach Nourishment (H, B)	Elevated Structures (H, B, C)	
Bulkhead/Seawalls (H, B, C)	Floodable Spaces (H, B, C)	
Dikes/Levees (H)	Raised Ground (H, B, C)	
Dry Floodproofing (H, B, C)	Utility Relocation & Consolidation (H, B, C)	
Floodwall (H, B, C)	Water Supply Diversification (H, B, C)	
	Wet Floodproofing (H, B, C)	

PROTECT	ACCOMMODATE	RETREAT
LONG-TERM STRATEGIES (2070 - 2100)		
Soft Shorelines (H, B, C)	Community Drain Fields (H, B)	Off-Site Retreat (H, B, C)
	Water Supply Diversification (H, B)	
	Utility Relocation & Consolidation (H, B)	
	Floodable Spaces (H, B, C)	

Figure 26. A table of adaptation management practice recommendations for Island County. Initials included refer to the following: H - Historic Beach, B - Coastal Bluff, C - Canal.

5. Conclusion

This report answers the research question what are homeowner best practices for sea level rise adaptation in Island County, WA on an individual and neighborhood level through a comparison of literature review and application of these findings to specific aspects of Island County regulations and physical conditions. Sea level rise projections for Island County exist and vary by probability and timeline. However, all scenarios suggest coastal properties will be impacted by sea level rise and extreme high tides more frequently in the future.

Adaptation strategies and practices are available and may reduce sea level rise impacts. This report outlines adaptation strategies and practices that homeowners may consider for use on their properties. These recommendations are a general approach to the typological communities considered (historic beach, bluff and canal communities) and site-specific characteristics should be taken into account when planning for sea level rise. Although this report hopes to inform and not direct homeowners in their adaptation efforts, it is likely that impacted communities will need to consider retreat options at various points in their futures.

As mentioned in the methods section, sea level rise adaptation is a developing field and the phenomenon has yet to happen on the scale scientists expect. Although case studies exist where sea level rise adaptation strategies have been installed, the long-term effect of some of these strategies is yet to be assessed. It is recommended that Island County monitor sea level rise adaptation projects to assess long-term success and consistently update their adaptation plans.

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Appendix 2A: Best Practices Matrix

Strategy	Practice	Description	Community Applicability H - Historic Beach B - Coastal Bluff C - Canal	Timeframe S - Short-term M - Medium-term L - Long-term	Permitting P - permitted X - prohibited C - conditional SED - shoreline environmental designation	Scale I - Individual Homeowner S - Small Groups N - Neighborhood	Example/+	Location	Link
	PROTECT	"Protection" seeks to control natural systems through hard and soft barriers and reduces impacts on a "zone that would be impacted without protection."							
	Soft Protection Measures	"Green solutions utilize ecological and environmental principles and practices to provide flood protection, as well as reduce erosion and stabilize shorelines, while also enhancing habitats and improving aesthetics (as compared to hard solutions). Often, soft solutions are less expensive than hard solutions and lower in maintenance, but they are not permanent and are subject to erosion." (AI, 2018)							
	Soft Shorelines	Soft Shorelines are designed coastal areas that reduce shoreline erosions through the use of natural materials. They are often "gently sloping natural banks" that "protect coastal ecosystems, and help reduce storm surge strengths along the coastline."(AI, 2018) Designers limit the amount and type of hardscape elements used and emphasize the use of plants and sands. The goal is to return to or reinforce natural systems along coastlines.	H, B, C	S, M, L	P	I, S, N	South Bay Sponge Hampton Roads Sea Level Rise/Flooding Adaptation Forum Oylmpic Sculpture Park More information	Bay Area, CA, USA Hampton Roads, VA, USA Seattle, WA, USA	http://www.resilientbayarea.org/south-bay-sponge https://digitalcommons.odu.edu/hraforum/ http://www.weissmanfredi.com/project/seattle-art-museum-olympic-sculpture-park https://fortress.wa.gov/ecy/publications/publications/1406009.pdf
	Beach Nourishment	"Replacement of augmentation of beach sand removed by ocean waters." (Watson & Adams, 2011) May occur naturally or artificially.	H, B	S, M	P	S, N	Marine Park City of Del Mar Sea-Level Rise Adaptation Plan Local Coastal Program Update, Land Use Plan	Bellingham, WA, USA Del Mar, CA, USA Santa Monica, CA, USA	https://wdfw.wa.gov/sites/default/files/publications/01583/wdfw01583.pdf https://www.delmar.ca.us/DocumentCenter/View/3580/Revised-Adaptation-Plan-per-Council-May-21 https://www.smgov.net/uploadedFiles/Departments/PCD/Plans/Local-Coastal-Plan/LUP%20FINAL%20DRAFT%2011.19.18.pdf
	Hard Protection Measures	"Often developed by civil and environmental engineers, are flood protection structures that are (almost always) permanent. Hard solutions focus on controlling flooding and sea level rise... The downside of these projects is their disruption of ecological systems. They are generally expensive and require maintenance." (AI, 2018)							
	Bulkhead	"Wall or other structure, often wood, steel, stone, or concrete, designed to retain or prevent sliding or erosion of the land. Occasionally bulkheads are used to protect against wave action." (Watson & Adams, 2011) Similar to seawalls.	H, B, C	S, M	P/C	I, S, N	Marine Park Golden Gate National Recreation Area	Bellingham, WA, USA San Francisco, CA, USA	https://wdfw.wa.gov/sites/default/files/publications/01583/wdfw01583.pdf https://www.nps.gov/subjects/climatechange/upload/CAS_Case_Study_22.pdf
	Breakwater	"A structure that forms a harbor and basin to protect the shore from the effects of waves, as well as to provide a safe place for fishing vessels to berth." Functions to "calm water, reduce wave height, and prevent shoreline erosion." (AI, 2018)	C	M	C in Aquatic and High Intensity SED	S, N	Scape Living Breakwaters	Staten Island, NY, USA	https://www.scapestudio.com/projects/living-breakwaters-competition/
	Dikes	"A constructed wall or embankment along a shore to prevent flooding of low-lying land." (Watson & Adams, 2011) Also known as a levee.	H, C	S, M	C/X (in natural SED) P in High Intensity SED	I, S, N	Motorway Dike	Netherlands	https://www.holland.com/global/tourism/destinations/provinces/friesland/the-afsluitdijk.htm
	Dry Floodproofing	"prevents water from entering a structure through watertight designs." (AI, 2018)	H, B, C	S, M	P	I	University of Texas Perimeter Wall and Dry Floodproofing Project	Houston, TX, USA	https://www.fema.gov/media-library-data/1541615774329-170190ea05ddbbb6fdc5f1170a018d41/P-936_11-06-18_508r.pdf
	Floodwall	"Floodwalls are vertical artificial barriers, either temporary or permanent, designed to withstand waters from a river, waterway or ocean." (AI, 2018) "A floodwall can surround a structure or, depending on flood depths, site topography, and design preferences, can protect isolated openings such as doors, windows, and basement entrances, including entry doors and garage doors." (FEMA, 2007)	H, B, C	S, M	P/C	I, S, N	Mobile Floodwall	Grein, Austria	https://interestingengineering.com/mobile-flood-walls-keeps-austrian-town-safe
	Revetment	"(i) A facing of stone or concrete to protect an embankment or shore structure against erosion by wave action or currents; (ii) a retaining wall, typically sloped." (Watson & Adams, 2011) Includes riprap. Often material that is not anchored or has little anchoring like rocks placed on beach.	H, B, C	S, M	P/C	I, S	Cleveleys Coastal Protection	Cleveleys, United Kingdom	https://www.wyre.gov.uk/info/200485/coastal_defence/1293/cleveleys_coastal_defence_scheme
	Seawall	"Seawalls are vertical structures designed to protect habitation from major wave and tidal action." (AI, 2018) See bulkhead.	H, B, C	S, M	P/C	I, S	The Seawall	Vancouver, Canada	https://vancouver.ca/parks-recreation-culture/seawall.aspx
Protect	**Surge barrier**	"Surge barriers, fixed dam structures with movable gates, provide some of the highest levels of protection from coastal storm surge." (AI, 2018)	H, B, C	M	potentially C in aquatic SED	N	Marina Bay Barrage Lake Borgne Storm Surge Barrier	Singapore New Orleans, LA, USA	https://www.pub.gov.sg/marinabarrage/aboutmarinabarrage https://www.floodauthority.org/the-system/lake-borgne-surge-barrier/

Appendix 2A: Best Practices Matrix

Strategy	Practice	Description	Community Applicability H - Historic Beach B - Coastal Bluff C - Canal	Timeframe S - Short-term M - Medium-term L - Long-term	Permitting P - permitted X - prohibited C - conditional SED - shoreline environmental designation	Scale I - Individual Homeowner S - Small Groups N - Neighborhood	Example/+	Location	Link
	ACCOMODATE	Accommodation allows natural systems to occur and "human impacts are minimized by adjusting human use of the coastal zone via changing land use/crop types, applying flood resilience measures, etc." (Zommers & Alverson, 2018)							
	Advanced Septic Systems	A system that uses a secondary treatment before releasing waste into leechfield.	H, B, C	S, M	P	I, S	Rhode Island Coastal Property Guide	Rhode Island, USA	http://climatechange.ri.gov/documents/rhode-island-coastal-property-guide-2014.pdf
	Anchored Septic Systems	Using concrete blocks or other anchoring materials to prevent septic systems from floating up from the ground.	H, B, C	S	P	I, S	Septic Tank Buoyancy Control Workshop, Infiltrator Water Technologies	Connecticut, USA	http://neiwpcc.org/wp-content/uploads/2019/04/Lentz_Septic-Tank-Buoyancy-101_040219.pdf
	Community Drainfield & other alternative on-site sewer systems	Placing septic tanks and drainfields away from coastlines and flood/erosion risk; either through community consolidation (e.g. cluster systems or alternative site design).	H, B, C	S, M, L	P	I, S, N	University of Rhode Island Cooperative Extension	Rhode Island, USA	http://cels.uri.edu/rinemo/publications/WW.CreativeDesignAndManagement.pdf
	Water supply diversification	Diversification of water supply to decrease coastal groundwater extraction rates. Includes on-site recycled water systems and service agreements for increased discharge at upland wells and well relocation.	H, B, C	S, M, L	P	I, S, N	Sea-Level Rise Impacts on Drinking Water: A Groundwater Modeling Study in Newmarket, NH	Newmarkey, NH,USA	http://www.strafford.org/cmsAdmin/uploads/final_groundwater-modeling-report_001.pdf
	Elevated Structures	A structure where "all or most of vital building infrastructure is raised above the flood line." (AI, 2018)	H, B, C	S, M	P	I	Perez Art Museum Seagate Rehabilitation & Nursing Center	Miami, FL, USA Brooklyn, NY, USA	https://www.yaleclimateconnections.org/2018/10/museum-protects-art-from-sea-level-rise/ https://toolkit.climate.gov/case-studies/engaging-stakeholders-planning-sea-level-rise
	Utility Relocation	Elevating or relocating septic and other at risk utilities.	H, B, C	S, M, L	P	I, S, N	Road Elevation	Florida Keys, FL, USA	https://www.miamiherald.com/news/local/environment/article197735369.html
	Floodable Plain	"Flat areas adjacent to a river or body of water that can be flooded when the water body's capacity is exceeded." (AI, 2018)	H, B, C	M, L	P - under ecological restoration	S, N	Cumberland Park	Nashville, TN, USA	https://www.nashville.gov/parks-and-recreation/parks/cumberland-park.aspx
	Floodable Square	"Floodable squares and parks are lowered urban areas that become pools during heavy rainfall or flooding from the sea or river." (AI, 2018)	H, B, C	M, L	P - under ecological restoration	S, N	Benthemplein Water Square	Rotterdam, The Netherlands	https://www.publicspace.org/works/-/project/h034-water-square-in-benthemplein
	Raised Ground (fill)	"A strategy that invites water to penetrate waterfront districts while elevating infrastructure such as roads to sustain human use during floods. This technique provides the opportunity for development for residential, office, hotel, retail, and transit uses." (AI, 2018)	H, B, C	S, M	C/P (grading and fill)	I, S, N	Hafencity	Hamburg, Germany	https://www.urbangreenbluegrids.com/projects/hafencity-hamburg-germany/
Accommodate	**Wet Floodproofing**	"allows floodwater to enter and leave a structure through designated openings and thus requires non occupied space." (AI, 2018)	H, B, C	S, M	P	I	Burnham Hall	Lincoln, VT, USA	https://accd.vermont.gov/sites/accdnew/files/documents/CD/CPR/CPR-VERI-Toolkit-Floodproofing-CaseStudies.pdf
	MANAGED RETREAT	"Retreat" or "planned retreat" allows natural systems to occur without human intervention. "Human impacts are minimized by pulling back from the coast via land use planning, development controls, planned migration, etc." (Zommers & Alverson, 2018) In some cases, retreat many be an unavoidable response. However, "this option is economically feasible only if it is possible to relocate within their existing property, either to higher ground or with a greater setback from a flood source." (Watson & Adams, 2011)							
	On-Site	Relocating upland away from flood risk within property.	H, B, C	S, M	P	I	Rhode Island Coastal Property Guide	Rhode Island, USA	http://climatechange.ri.gov/documents/rhode-island-coastal-property-guide-2014.pdf
Retreat	**Off-Site**	Relocating upland away from flood risk to a different property.	H, B, C	M, L	P - requires land aquisition	I, S, N	Rio Bogota Flood Control Village of Soldiers Grove Managed Retreat at Surfer's Point Isle De Charles Resettlement	Colombia Soldiers Grove, WI, USA Ventura Beach, CA, USA Isle De Charles, LA, USA	http://documents.worldbank.org/curated/en/113621513887766611/Colombia-Rio-Bogota-Environmental-Recuperation-and-Flood-Control-Project-restructuring https://dma.wi.gov/DMA/divisions/wem/mitigation/docs/stories/Soldiers_Grove_LTerm_Benefits_Relocation.pdf https://www.arcgis.com/apps/MapJournal/index.html?appid=bea8d4142fcf47bc90078e845e296d64 http://isledejeancharles.la.gov/

Volume 3

Community-Based Planning Report

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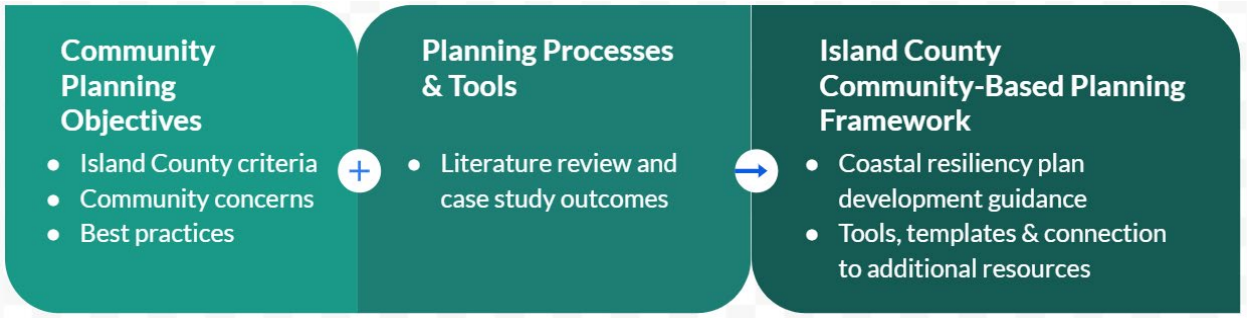
Executive Summary

This report presents a community-based planning framework and accompanying guidebook intended to encourage Island County shoreline community property owners to engage in non-governmental planning processes to improve community resilience to coastal flooding and projected sea level rise.

Qualitative analysis of existing planning processes and tools leveraged in the U.S. and Western Pacific islands of Micronesia revealed a series of planning steps that address Island County coastal resilience objectives and are consistent with community-based planning best practices. These steps form the basis of the community-based coastal resilience planning framework and guidebook.

Community-Based Planning Framework Development Process



Community-Based Planning Framework Components

Step 1: Define planning issues and establish a community planning team
Step 2: Identify community values and vulnerable assets
Step 3: Analyze risk and establish thresholds for action
Step 4: Develop and implement resilience strategies and projects
Step 5: Monitor outcomes to inform future plans

University of Washington Department of Urban Planning students and Washington Sea Grant conducted this research in support of an ongoing Island County initiative to address sea level rise through the development of community-oriented information and planning resources.

1. Introduction

Many Island County shoreline communities face coastal hazards including flooding and erosion due to extreme high tides and storm surge (Island County, 2015). These hazards are anticipated to increase in intensity as projected effects of climate change and sea level rise are realized over the coming decades (Miller et al., 2018). Current County plans, policies, and regulations do not include coastal resilience measures that directly address these projected impacts; nor do they provide guidance on adaptation strategies for individual property owners or communities. Given the absence of local government regulation or actionable guidance related to sea level rise adaptation, and the fact that the majority of developed shoreline properties in Island County are privately owned, property owner interest in the preservation of local community assets and values is the impetus for coastal resilience planning.

As part of an ongoing initiative to address sea level rise, the Island County Department of Planning and Community Development embarked on an effort to identify ways to encourage property owners in vulnerable areas of the county to engage in planning processes to improve community resilience. This initiative includes the development of individual property owner and community guidance on planning and preparing for the effects of projected sea-level rise, as well as a countywide sea level rise monitoring program to inform community-level risk assessments and action plans.

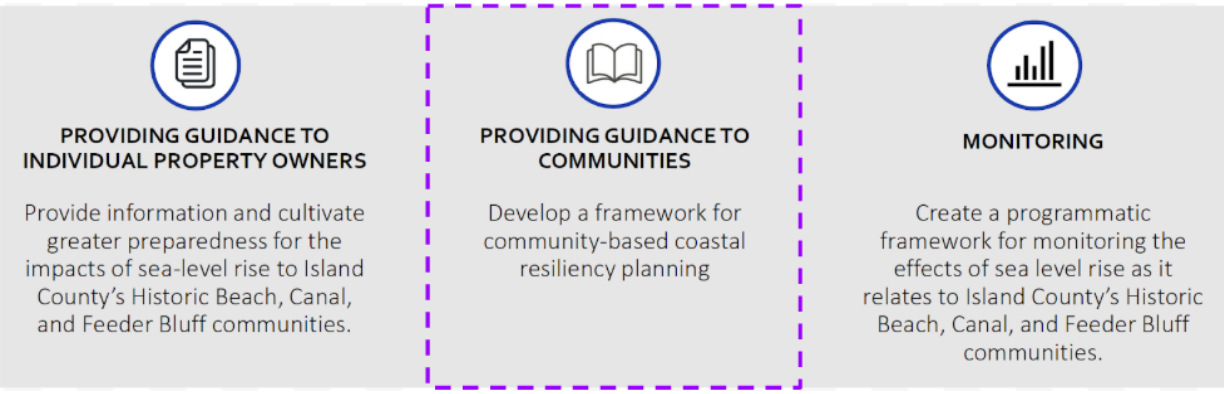


Figure 1.1: Island County Shoreline Master Program Update Sea-Level Rise Considerations
Source: Island County Department of Planning and Community Development (2019)

This report is focused on the community guidance element of the Island County SMP initiative and presents a community-based coastal resilience planning framework and guidebook

intended for use by Island County shoreline communities, as well as the research supporting its development. This section introduces overarching problem statements and research questions, and briefly summarizes the organization and contents of the remainder of the report.

1.1 Purpose Statement

The purpose of this research is to develop a community-based coastal resilience planning framework and guidebook for Island County shoreline communities. The framework and guidebook reflect fundamental coastal resilience planning considerations identified by the Island County Department of Planning and Community Development, address County and community concerns related to coastal flooding and projected sea level rise and incorporate established best practices in community-based planning.

1.2 Research Questions

Research questions underlying this qualitative analysis include:

- What planning issues do Island County shoreline communities face related to extreme flooding events and projected sea level rise?
- Can existing planning methods and tools used in communities with similar shoreline characteristics and coastal resilience goals be leveraged to develop an Island County-specific community-based coastal resilience planning framework?

1.4 Report Organization

This report is organized into seven sections which summarize the planning framework and guidebook development. Sections 1-4 introduce the project scope, explain research methods, highlight existing shoreline community conditions pertinent to framework development, and summarize background literature reviewed in support of this project. Sections 5 and 6 detail the community-based planning framework development process and resulting product. Section 7 concludes the report and identifies future research opportunities which may strengthen the framework and contribute to improved coastal community resilience. In addition to the body of these sections, appendices A and B detail the project data collection and framework development processes, and Appendix C is the community-based coastal resilience planning guidebook.

2. Methods

Qualitative research conducted to address the overarching research questions includes: analysis of existing Island County plans, policies, and regulations; a review of literature related to community-based planning; interviews with Island County staff to identify coastal community planning issues; and comparison of planning processes used by other organizations with Island County planning objectives. This section details the project research methodology and specific methods used to obtain and analyze data.

2.1 Methodology

The project research methodology is based on a qualitative method of inquiry rooted in grounded theory (Glaser & Strauss, 1967). This inductive approach yielded key coastal community planning considerations through Island County staff interviews, shoreline development policy review, and case studies focused on planning practices in the field of coastal resilience and floodplain management. These considerations heavily influenced the development of the community-based planning framework and guidebook.

2.2 Procedure

As indicated in the process diagram below, the project research procedure included three primary steps: existing conditions analysis, literature review, and framework development. The first step summarized Island County plans, policies, and regulations governing coastal development and identified County and shoreline community planning objectives related to projected sea level rise. Volume 1 of this report details the outcomes of this step. The second step included a literature and case study review focused on identifying community-based planning best practices and examples in communities with similar shoreline characteristics and coastal resilience goals to those of Island County. The final step compared the literature review and case study outcomes with Island County planning objectives to inform development of Island County's community-based planning framework.

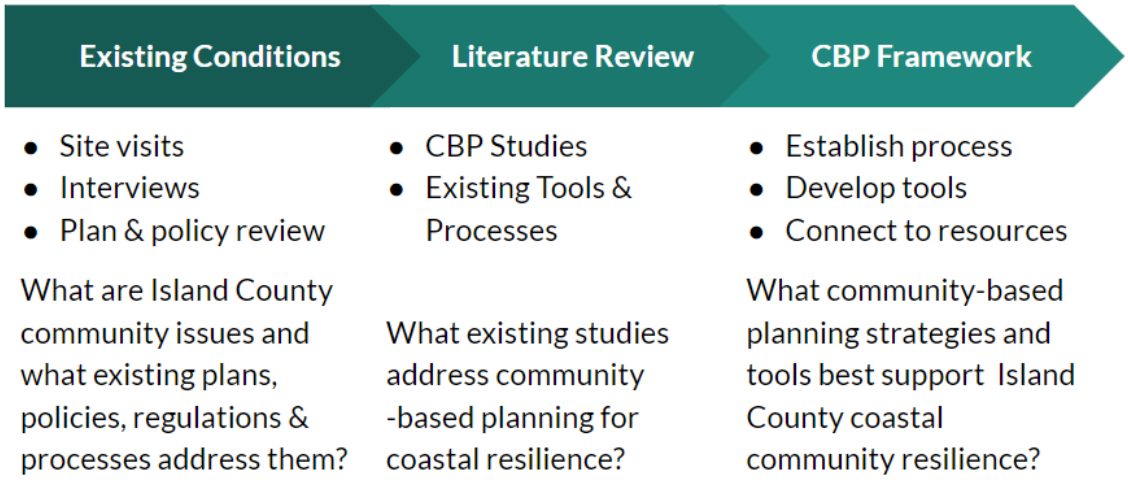


Figure 2.1: Research Procedure

2.2.1 Data Collection

Data used to assess existing conditions includes Island County demographic and economic information; shoreline development plans, policies, and regulations; County staff responses to interview questions outlined in Appendix A; and field notes from site visits conducted October 11th and 15th, 2019.

Data that informed community-based planning examples and best practices include publications related to community-based planning principles; guidelines for established coastal planning and floodplain management processes applicable at the community level; and publicly available planning tools designed to address coastal resilience and climate change adaptation.

2.2.2 Planning Objective Development

Community-based planning framework development is designed to incorporate fundamental components of coastal resilience planning, address Island County and community concerns related to coastal flooding and projected sea level rise and maintain consistency with best practices in community-based planning.

Planning Objective 1: Incorporate fundamental coastal resilience planning components

At the outset of the project, Island County project partners identified the following as fundamental components of coastal resilience planning which must be addressed in the community-based planning framework:

- Identification of vulnerable assets
- Community-based strategies for improving resiliency and preparing for the impacts of sea level rise (e.g. community based larger impact projects)
- Monitoring, thresholds for action, and project/initiative lead times
- Financing options

Planning Objective 2: Address County and community concerns related to coastal flooding and projected sea level rise

Island County staff interviews and review of existing plans, policies, and regulations yielded a distinct set of County and community concerns related to extreme flooding events and potential impacts of projected sea level rise. These concerns are summarized in the below figure and represent the types of planning issues communities may address through the application of the planning framework presented in section 6 of this report.

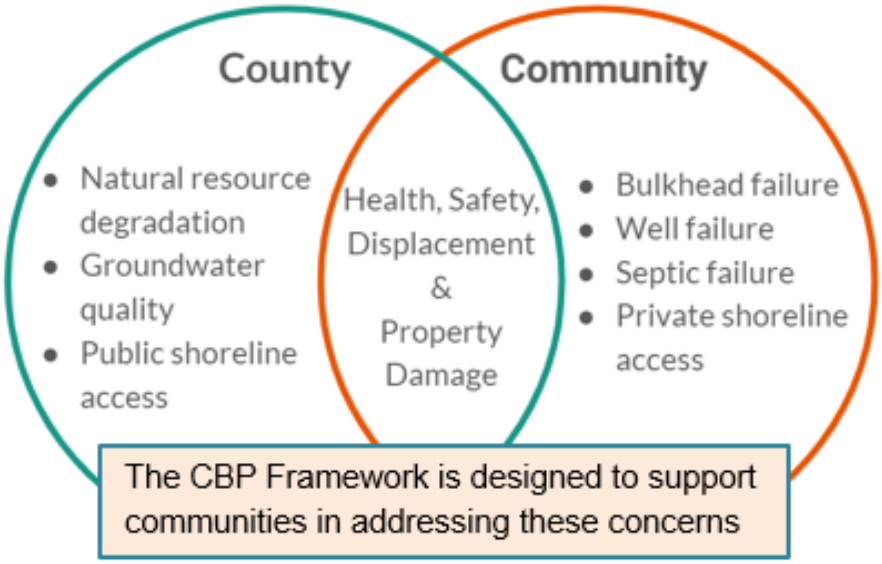


Figure 2.2: County and Community Coastal Flooding Issues & Concerns

Planning Objective 3: Maintain consistency with community-based planning best practices

Review of existing literature related to community-based planning and analysis of processes and tools currently leveraged to facilitate planning in coastal communities introduced a series of best practices that warrant consideration in framework development.

- Community awareness of planning issues
- Community identification of critical assets and values
- Community participation in the planning process
- Effective community-based planning structure
- Adequate implementation resourcing
- Effective post-process evaluation

Collectively, these three objectives form a basis for suitability analysis of potential community-based planning tools and processes which ensures Island County staff and community concerns are addressed in a manner consistent with established best practices in community-based planning.

2.2.3 Data Analysis & Outcomes

A cross-comparison of Island County community planning objectives and existing coastal and floodplain management planning processes identified specific tools for consideration in the development of the Island County-specific community-based planning framework. A data analysis process diagram is presented below.

Figure 2.2: Community-based Planning Framework Development

A matrix comparing components of planning processes identified through literature and case study review with Island County planning objectives is the primary analysis tool applied in this report and is detailed in Appendix B. A matrix summary table identifying the suitability of a given process in terms of ability to address each of the three primary community planning objectives is included in the report. A summary table template is presented below, and a completed table reflecting cross-comparison outcomes is included in section 5 of this report.

Planning Processes

Community-Based Planning Objectives	Process 1	Process 2	Process 3
Island County Planning Criteria			
County & Community Key Issues			
CBP Best Practices			

Color-coded matrix reflecting process suitability to address planning objectives

Suitable | Partially Suitable | Unsuitable

Table 2.1: Community-based Planning Process and Objective Cross-comparison Template

2.2.3 Recommendations

The analysis process resulted in a stepwise list of processes, objectives, and supporting tools that guide the development of community coastal resiliency plans. The list is presented in section 6 of this report as the basic framework for Island County community-based coastal resiliency planning.

2.2.4 Research Limitations

Limitations to the research process which may bias, or influence outcomes and/or recommendations include:

Limited community contact: Community contact was limited to two public engagements held on September 28, 2019 and facilitated by the Island County Marine Resources Committee

(MRC), an advisory group comprised of community volunteers and Island County staff. All other information related to community issues referenced in this report was obtained through County staff interviews, which may result in a biased assessment of community objectives.

Anecdotal issue identification: Few County and/or community issues and concerns identified during data collection were supported by documentation. County staff interviews and observed community feedback at MRC forums informed these issues and related planning objectives, which also may result in a biased assessment of community objectives.

Limited precedent availability: Little literature or case study data documenting purely community-based coastal resiliency planning exists. In most cases, community actions connect to established government plans, programs and resources. Because that is not the case in Island County, the local effectiveness of community-based planning best practices identified in this report may be limited.

Monitoring program uncertainty: Community coastal resilience plan implementation is partially dependent on a community's ability to monitor sea level and project sea level rise. Communities currently have access to citizen science-based shoreline ecosystem monitoring resources through organizations such as the Island County Marine Resources Committee, Sound Water Stewards, and the Puget Sound Partnership. In addition, Island County is developing a monitoring program specific to sea level rise which may influence the planning framework recommended in this report. Revision of the planning framework proposed in this report may be necessary to incorporate the monitoring program upon establishment.

3. Existing Conditions

Existing conditions are detailed in Volume 1 of this report. Key takeaways particularly relevant to the development of a community-based coastal resilience planning framework include:

3.1 Shoreline Community Characterization

At over 196 miles in length, the Island County shoreline is the longest contiguous shoreline in Washington State. The coast is characterized by low lying beaches and spits, dredged canals, wetlands, high unstable bluffs, and residential development. Approximately 63% of the Island County shoreline is designated for residential land use; and approximately 28% of shoreline properties lie within designated Historic Beach and Canal communities, and areas that contain

steep and/or unstable slopes referred to in this report as Feeder Bluff communities (Island County, 2012). These communities are the focus of this report, and variations in environmental designations, community development patterns, and regulations were specifically considered in developing the community-based planning framework.

3.2 Community Character

Island County coastal communities are primarily comprised of homeowners at or above the median income and age without many mobility restrictions; many of whom maintain shoreline properties as second or vacation homes (NOAA, 2019).

3.3 Coastal Flooding Issues

Community member and County concerns based on review of historical coastal flooding events, associated flood damage repair permits, and interview responses from County representatives who regularly engage with community members indicate significant interest in protecting private property from inundation and flood damage; particularly related to structural foundations, water, and wastewater systems (Island County, 2019).

3.4 Current Plans, Policies, and Regulations

Current plans, policies, and regulations base coastal flood risk assessments and development regulations primarily on U.S. Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRMs), which establish base flood elevations reflecting a 100-year, or 1% annual chance flood event. These projections do not account for extreme high tides or projected sea level rise. Potential impacts of projected sea level rise are addressed in some detail in the Island County Shoreline Master Program (SMP) and Hazard Mitigation Plan (HMP). The County shoreline development permitting process effective at the time of this report, however, limits consideration of these projected impacts to required marine and steep slope buffers, shoreline setbacks, and minimum structure bottom floor elevation equivalent to the FEMA base flood elevation for new development (Island County, 2016; 2019).

4. Literature Review

This section provides a review of the literature addressing community-based planning history, foundational elements, best practices, and established processes and tools related to coastal

resilience planning. Outcomes of this review informed selection of community-based planning framework components best suited to support Island County shoreline community planning objectives.

4.1 Background

Though a universal definition of community-based planning has not been established among academics and planning professionals, the definition presented by the Southern Rural Development Center as a “local voluntary planning process that is designed to build, strengthen and support community structure” which involves “individual and associational actors from various social fields coming together to develop and implement an interlinking, comprehensive and coordinated plan of action” perhaps best describes the dynamic process as it applies to Island County coastal resilience planning (Theodori, 2007).

Since the 1980s, community-based planning has gained significant momentum as a method of addressing site and topic-specific planning issues through community engagement. Historically, topics and issues typically addressed through community-based planning include community development, economic revitalization, public safety, and natural resource conservation (ILJ, 2002; Garzón et al., 2012). More recently, community-based planning has emerged as a widely leveraged approach to climate change and sea level rise adaptation in the absence of institutional plans and regulations (Garzón et al., 2012; USAID, 2013; NOAA, 2019). Community-based planning processes exist in many forms; however, a primary objective of developing solutions to local issues representative of community values and priorities is generally consistent across applications (ILJ, 2002; Freitag et al., 2015; Moyo et al., 2016; Etingoff, 2017). This review examines literature and case studies related to community-based planning to identify foundational principles, key elements of successful implementation, and examples of processes related to climate change and sea level rise adaptation. Ultimately, literature review outcomes will be referenced to develop a coastal resilience and sea level rise adaptation community-based planning framework for Island County shoreline communities.

4.2 Community-Based Planning: Foundational Processes

Community-based planning models are plentiful and have led to varying degrees of plan implementation success depending on communities served, process objectives, and circumstances driving the need for community involvement. Most models follow a similar

general structure, which begins with identification of planning issues and stakeholders, followed by collaborative community development of approaches to address these issues, implementation of a selected approach, and outcome assessment to inform future community decisions related to the issues (ILJ, 2002; Theodori, 2007; Etingoff, 2017). Community-based planning processes are applied in many forms and across many fields to address community-specific issues ranging from public health and safety concerns to community development initiatives. A model developed by the U.S. Department of Justice, known as the Scanning, Analysis, Response, and Assessment (SARA) Problem Solving Model, perhaps best describes the foundational process behind CBP processes and tools (ILJ, 2002).

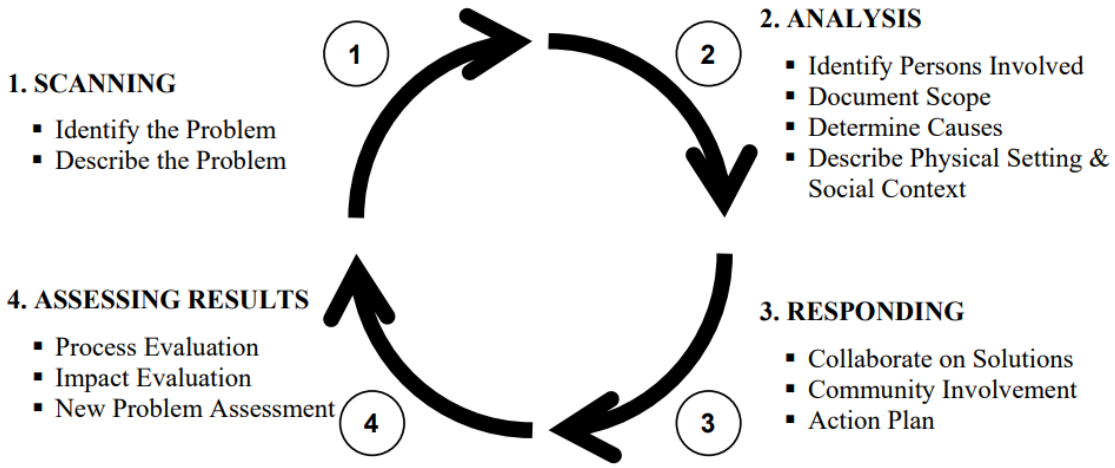


Figure 4.1: Scanning, Analysis, Response, and Assessment (SARA) Model

Source: Office of Community Oriented Policing Services, US Department of Justice

Though the SARA model was designed for and is most commonly applied to community-oriented policing, its principles are generally applicable to many issues a community may face and warrant consideration in the development of issue-focused community-based planning processes. In the case of shoreline planning the SARA model provides a basic framework that community members may reference when addressing issues such as projected sea level rise. Communities may begin by analyzing risks associated with projected sea level rise; develop and implement local action plans to address those risks and assess the results of action taken to inform whether further iterations of the process are necessary to achieve desired outcomes.

4.3 Community-Based Planning: Best Practices

Published literature indicates successful implementation of community-based planning processes and beneficial planning outcomes are related to a multitude of contributing factors; many of which vary by location and specific issues addressed. Despite this variability, there are a number of factors consistently identified as key to success across the spectrum of community-based planning applications, which are presented here as best practices. These practices include establishment of community awareness regarding planning issues (ILJ, 2002; Etingoff, 2017); community identification of assets and values potentially affected by a given planning issue (ILJ, 2002; Walter, 2012; Freitag et al., 2015); robust and equitable community member participation in the planning process (Kent, 1981; ILJ, 2002; Walter, 2012; Etingoff, 2017); effective planning process facilitation (APA, 1998; Svendsen and Campbell, 2008; Wongbusarakum et al., 2015); adequate resourcing of the process itself and implementation of resulting plans (APA, 1998; Theodori, 2007; City of New York, 2019; Svendsen and Campbell, 2008; Moyo and Madlopha, 2016); and meaningful process evaluation to assess effectiveness and inform future community decisions (ILJ, 2002; Theodori, 2007 Garzón et al., 2012; USAID, 2013; Moyo and Madlopha, 2016; Etingoff, 2017). These best practices are further detailed below.

4.3.1 Community awareness of planning issues

Awareness of issues affecting communities that may be addressed through community-based planning occurs in many ways, including through community member experience and third-party outreach and education. In some cases, communities are driven to act based on their experience with a particular issue. In others, community outreach and education conducted by local governments, non-governmental organizations, and/or advocacy groups serve to inform communities about issues that do or may affect them (ILJ, 2002; Etingoff, 2017). In both cases, awareness builds interest and investment in taking action at the community level to address the issue. This interest and investment are fundamental to the success of a community-based planning approach.

4.3.2 Community identification of critical assets and values

Community members best understand local values and priorities, as well as the assets associated with them (Freitag et al., 2015). Community-based asset identification is commonly included in hazard mitigation planning processes and is fundamental to the community-based

planning process. Though personal values and priorities may differ among community members, collective identification of assets which promote overarching community values provides an indication of what issues are likely to generate widespread public interest and result in meaningful planning activities (ILJ, 2002; Walter, 2012; Freitag et al., 2015).

4.3.3 Community member participation in the planning process

Without adequate and equitable community representation, community-based planning processes are unlikely to truly address overarching concerns related to a given issue, and investment in the implementation of solutions generated through the process may prove challenging. Robust participation in community-based planning promotes the accurate definition of community values and critical assets and indicates an increased likelihood of community member interest and investment in the implementation of resulting plans. Though the definition of adequate participation may differ between communities based on size and composition, equitable representation of populations served within a given community forms a baseline standard (Kent, 1981; ILJ, 2002; Walter, 2012; Etingoff, 2017). Participation in CBP processes is often rooted in a community-member interest in preserving community character and influencing public policy which may directly impact their community (Hatley, 2013). In addition to these driving forces for participation, incentives for involvement in CBP processes that support both community and local government goals may be leveraged. Examples of incentives related to land development include free or low-cost expert consultation, permitting fee reduction, and/or project development and implementation process assistance.

4.3.4 Effective community-based planning process structure

While community-based planning processes are intended to be inclusive and collaborative in nature, a need for structure and facilitation exists to ensure productive outcomes. Establishment of the planning process and organizational structure including early identification of community member roles and responsibilities, planning for administrative and logistics requirements, and development of a process schedule promote productive engagements, sustained community interest, and meaningful outcomes (APA, 1998; Svendsen and Campbell, 2008; Wongbusarakum et al., 2015). Community-based planning processes should be facilitated to optimize effectiveness, either internally by community members or externally by third-party government, non-government organization, or advocacy group representatives. In cases involving complex planning issues, third-party facilitation may prove necessary to maintain and

navigate the planning process, organize community input, resolve disputes, and produce actionable plans.

4.3.5 Adequate resourcing

Community-based planning processes may prove resource-intensive in terms of funding and human capital required for the process from start to finish; particularly during plan implementation (Svendsen and Campbell, 2008; Moyo and Madlopha, 2016). At the outset, communities should identify the time commitment expected of CBP organization members and contributors, as well as resources that may be needed for plan development. Plans which identify projects or other actions requiring external funding should include identification of potential funding sources. Plans addressing complex or technical issues should include input from and involvement of subject matter experts, which often requires communities to conduct external outreach to access the necessary expertise (APA, 1998; Theodori, 2007; City of New York, 2019). Without clear funding strategies and access to the expertise necessary to facilitate plan implementation, community-based planning processes risk being rendered ineffective.

4.3.6 Effective post-process evaluation

Post-implementation monitoring of plan outcomes is widely regarded as a critical step in community-based planning processes (ILJ, 2002; Theodori, 2007 Garzón et al., 2012; USAID, 2013; Etingoff, 2017). Community buy-in and confidence in the effectiveness of community planning processes are key to their success. Monitoring of implementation outcomes provides a basis for process evaluation necessary to build this confidence and inform future community plans and decisions (Moyo and Madlopha, 2016, Etingoff, 2017).

4.4 Community-based planning for sea level rise

As climate change and sea level rise adaptation emerge as central community concerns in the U.S. and abroad, the need for effective community-based planning processes and tools designed to improve community preparedness and resilience is increasingly evident. A review of existing literature related to community-based planning introduced a series of best practices that warrant consideration in developing community-based approaches to coastal resilience planning. These include:

- Community awareness of planning issues
- Community identification of critical assets and values

- Community participation in the planning process
- Effective community-based planning structure
- Adequate implementation resourcing
- Effective process evaluation

Further, community approaches to coastal resilience planning should leverage existing, proven planning processes and tools to the extent practical. This report details the development of one such planning approach for Island County shoreline communities in section 5 and presents the resulting community-based planning framework in section 6.

5. Community-based planning process analysis and outcomes

This section details the data analysis component of the research process and presents a summary of the analysis outcomes. For this project, the analysis process included identification of existing community-based planning processes and tools which may be adapted to support Island County community planning objectives; and assessment of the suitability of selected planning processes and tools to achieve those objectives. Community-based planning framework objectives introduced in section 2 of this report include:

- Objective 1: Incorporate fundamental coastal resilience planning components
- Objective 2: Address County and community concerns related to coastal flooding and projected sea level rise
- Objective 3: Maintain consistency with community-based planning best practices

Sections below detail planning processes and tools analyzed for potential use in the community-based planning framework, and outcomes of process, tool, and planning objective cross-comparisons.

5.1 Existing Processes and Tools

Community-based planning framework development considered existing planning processes and tools applied in support of coastal resilience planning in coastal communities across the U.S. and island nations in the western Pacific Ocean. These resources include the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) Community Rating System (CRS) Floodplain Management Planning Process, which encourages local governments to extend flood resilience considerations and development

standards beyond basic regulatory requirements and provides planning guidance applicable at the community level (FEMA, 2017); the National Oceanic and Atmospheric Administration's (NOAA) web-based U.S. Climate Resilience Toolkit, which serves as a repository for information and guidance intended to support communities in planning for projected climate change impacts (NOAA, 2019); and the Local Early Action Planning (LEAP) community-led coastal resilience process gaining international attention based on its application in Micronesia (Wongbusarakum et al., 2015). These tools are not currently leveraged in Island County planning processes and provide valuable information and examples of effective community engagement strategies which should be considered when developing community-based coastal resilience plans. An overview of each process highlighting key components is provided below.

5.2.1 FEMA CRS Floodplain Management Planning

The 2017 *Community Rating System Coordinator's Manual* is a guidance document developed by FEMA to assist local governments in taking floodplain management actions above and beyond the minimum requirements of the National Flood Insurance Program (NFIP) to protect community assets and potentially reduce property owner insurance rates. The manual consists of seven sections that provide a CRS program overview, guidance and regulations governing program administration, and planning guidelines for local governments (FEMA, 2017). Much of the manual is intended for local government use to aid in generating land use and development regulations necessary to establish and maintain CRS eligibility and reduce flood insurance costs; however, the CRS floodplain management planning process may be scaled and adapted to support whole community resilience and adaptive capacity development. This report focuses on the flood damage reduction and planning activities section of the CRS manual, which includes a four-phase, 10-step floodplain management planning process. The below figure and process description highlight key elements relevant to community-based planning.

Figure 5.2: CRS Floodplain Management Planning Process Diagram

Phase 1: Planning Process

This phase initiates CRS planning and consists of three distinct steps: organization, public involvement, and coordination. In the organization step, communities seeking involvement in the CRS develop a team to include a designated facilitation team and subject matter experts as needed to navigate aspects of the plan requiring specialized experience. The public involvement step focuses on gathering citizen input regarding plans and establishing citizen advisory committees to contribute to the planning process. During the coordination step, communities review existing plans, flood protection activities, mapping products, etc. for inclusion in local floodplain management plans.

Phase 2: Risk Assessment

Phase 2 includes assessment of known floodplain-specific hazards, and identification of potential problems associated with those hazards. In assessing hazards, the community identifies sources, frequency, extent, and causes of local flooding based on existing plans and historical flooding data. The community then identifies whether and which natural and/or built assets that support community values and floodplain functions may be affected by flooding under anticipated hazard conditions.

Phase 3: Mitigation Strategy

Mitigation strategy development is organized into three steps: setting goals, reviewing possible activities, and drafting an action plan. In setting goals, community planning groups identify objectives consistent with those of existing formal hazard mitigation plans which address all known flood-related hazards faced by the community. A review of possible activities entails the evaluation of a wide range of alternative mitigation strategies extending beyond traditional solutions. Pros, cons, and implementation considerations related to each potential strategy are documented in this phase to inform mitigation strategy selection. Mitigation strategies are selected in this phase based on available resources and anticipated resulting reduction to community flood risk. Selected mitigation strategies are then aligned with an implementation schedule to develop a draft floodplain management action plan.

Phase 4: Plan Maintenance

In this phase, the community formally adopts the floodplain management plan through a documented approval process, initiates plan implementation, evaluates implementation outcomes, and revises and amends the plan as necessary to reflect changing hazard-related information and/or adjustments necessary to achieve community objectives. CRS program certification requires annual plan evaluations and updates at 5-year intervals to ensure plans remain dynamic and reflect current conditions in the floodplain and local built environment.

Applicability to Island County Community-Based Planning Process

Though the CRS program and associated planning guidance are designed for local government applications, the 10-step floodplain management planning process is applicable to community planning initiatives, directly addresses all three Island County community planning objectives, and is consistent with best practices in community-based planning. Resources supporting each step including maps and planning templates are publicly available and user-friendly. Further, the use of CRS planning guidelines to inform community adaptation decisions aligns proposed actions in established floodplains with existing regulatory standards exceeding those currently required by Island County, which may position property owners to be eligible for flood insurance rate reductions as a result of plan implementation.

5.2.3 U.S. Climate Resilience Toolkit

The NOAA U.S. Climate Resilience Toolkit is a widely referenced resource for climate change adaptation planning at the local community scale. The toolkit serves as a repository for climate change adaptation-related tools and information and includes a basic workflow for building community resilience to hazards associated with climate change, presented below.

Figure 5.3: Steps to Resilience

Source: US Climate Resilience Toolkit, 2019

The U.S. Climate Resilience Toolkit includes case studies from throughout the U.S. in which application of this process yielded community-driven climate change adaptation strategies (NOAA, 2019). Though adaptation strategies developed through this process are generally community-generated, implementation is largely dependent on local, state, or federal government funding and technical assistance in many cases. It should be noted that multiple professional planning organizations have developed community assistance programs intended to provide expertise to communities facing challenging planning issues. Examples of these organizations and programs include the American Planning Association Community Assistance Program comprised of regional Community Planning Assistance Teams (CPAT) which provide pro bono community planning support (APA, 2019); and the Community Assistance for Wildfire (CPAW) initiative established by Headwaters Economics and Wildfire Planning International, and funded by the U.S. Forest Service and private foundations (CPAW, 2019). A brief summary of each step from the Toolkit is provided below (NOAA, 2019).

Step 1: Explore Hazards

This step includes organizing community members interested and invested in preserving local assets and values; evaluating past and projected weather and climate trends and identifying critical assets that may be affected by climate change. This step is characterized by community asset and value identification and leveraging the best available science and third-party expertise to educate community members on the range of likely future climate scenarios. The outcome of this step is a determination of whether climate change projections present a hazard to critical community assets and/or values.

Step 2: Assess Vulnerability & Risks

Vulnerability and risk assessments include the identification of potential climate change-related impacts on community assets and values. This step is intended to encourage communities to engage in risk management by evaluating the probability and severity of potential hazards in terms of impact on community well-being. The outcome of this step is a risk determination in which the community decides whether projected climate risks to assets and value are acceptable or require mitigation.

Step 3: Investigate Options

This step includes identification of alternative mitigation strategies for climate risks to community assets and/or values which were deemed unacceptable. The investigation includes a review of case studies in which similar risks were responded to by other communities to identify a range of potential actions, and evaluation of the feasibility of local implementation of potential actions. The outcome of this step is a list of feasible alternatives the community may consider for further action.

Step 4: Prioritize & Plan

Prioritization includes evaluation and ranking of costs, benefits, and community capacity to complete alternative actions developed in the previous step. During this step, the community integrates the highest-ranking actions for which capacity exists and develops a stepwise plan to complete them. The plan should identify stakeholder roles and responsibilities; and account for timeline, resource, administrative, and logistical actions necessary for objective attainment. The

outcome of this step is a comprehensive implementation plan for the community's favored actions.

Step 5: Take Action

This step involves the implementation of the community-generated plan by stakeholders who accept responsibility and coordinate the resources necessary to accomplish plan objectives. In addition to implementing the plan, this step includes periodic monitoring, reviewing, and reporting on outcomes to identify whether actions effectively increase community resilience and address climate risk to assets and values. This step is ongoing through the completion of an action or project and results in lessons learned which may be used to inform future community planning processes.

Applicability to Island County Community-Based Planning Process

The U.S. Climate Resilience Toolkit *Steps to Resilience* directly address all three Island County community planning objectives and includes user-friendly planning templates designed for use by community members. Additionally, the toolkit includes links to case studies and an extensive repository of tools and resources which may be leveraged by community-based planning facilitators to optimize process effectiveness with limited need for outside expertise. Further, the toolkit serves as a convenient source of location-specific information for use in community outreach and education related to coastal resilience; and provides an opportunity for community feedback and contribution to document local planning actions and process effectiveness.

5.2.3 Local Early Action Planning (LEAP) Process

In 2010 a collaborative group of community organizations and conservation advocacy groups developed a process for coastal community vulnerability assessment and climate change adaptation planning known as the Local Early Action Planning (LEAP) process. The four-step process is outlined below, and a template intended to guide communities through the development of an action plan is available through the US Coral Triangle Initiative Support Program (USAID, 2013).

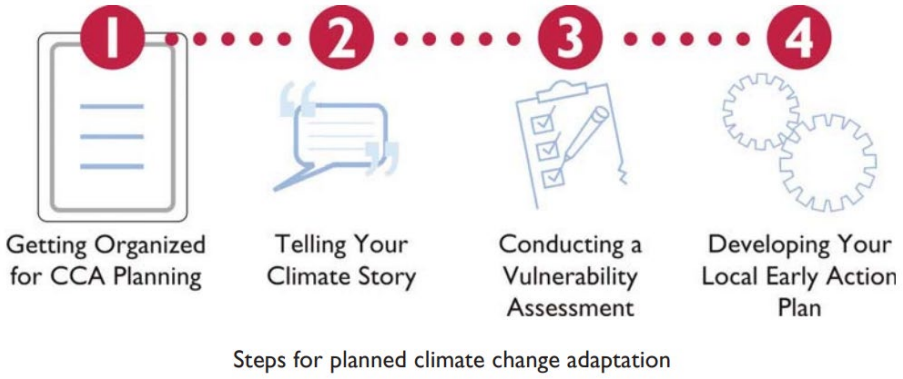


Figure 5.4: Climate Change Adaptation Local Early Action Planning (LEAP) Process

Source: USAID LEAP Guide, 2013

Among communities engaging in the LEAP process, reported benefits include ease of application, the potential for use as a standalone tool, and multidisciplinary stakeholder involvement. Limitations include the time-consuming nature of such a highly participatory process, difficulty scaling to communities with urban development or complex governance structures, limited guidance on plan implementation, and a typical requirement for outside entity technical support to truly understand and adequately address critical vulnerabilities. A brief summary of the LEAP process phases is provided below.

Step 1: Getting Organized for Climate Change Adaptation Planning

In preparation for climate change adaptation planning, communities must identify stakeholders representing local interests and technical expertise necessary to address specific issues that may arise. In this step of the LEAP process, communities must identify process facilitators and ensure adequate information, authority, and resources are available to complete the process (USAID, 2013). The outcome of this step is an established community planning organization with clear roles and responsibilities; and a community background narrative that provides context and describes the community's need for climate change adaptation.

Step 2: Telling Your Climate Story

This step of the LEAP process includes communicating scientific and local knowledge related to potential climate change impacts to the extended community to inform risk decisions. Through telling the climate story, community members are made aware or reminded of potential changes to their physical, ecological, and social environment, and may demonstrate increased interest

and/or investment in adaptation planning. The outcome of this step is a climate story which uses a combination of visualizations, computer-based scenario modeling, and documented local impacts collected through public participation to present past, present, and projected future hazards related to climate change with the potential to affect assets and values identified as key to community well-being.

Step 3: Conducting a Vulnerability Assessment

The vulnerability of a community asset or value is identified by its exposure, sensitivity, and adaptive capacity to climate threats. In this step, vulnerabilities of social, economic, ecological, and infrastructure assets are evaluated together, given their dependency on one another in coastal areas. A vulnerability assessment is initially completed through qualitative evaluation of how likely it is that community values and associated assets will be affected by climate change. The assessment may be expanded to include quantitative analysis where potential impacts can be quantified and evaluated for significant relationships and/or trends. The outcome of this step is a vulnerability assessment that helps explain community vulnerability to climate change impacts and inform risk-based decisions regarding adaptation alternatives.

Step 4: Developing a Local Early Action Plan

The Local Early Action Plan identifies effective and feasible actions communities may take to increase resilience and reduce climate change risks. The LEAP process includes the identification and prioritization of adaptation options based on effectiveness, feasibility, and cost/benefit analysis outcomes. The plan includes an implementation schedule and identifies partners and external resources necessary to complete priority adaptation actions. The plan extends beyond implementation to include benchmarking and monitoring strategies to evaluate plan performance and inform future community planning decisions. The final LEAP includes all products generated in the four-step process. Templates and worksheets for each step of the process are included in the appendices of the 2013 USAID *LEAP Guide* and may be edited to reflect application in areas other than the Coral Triangle, for which the process was initially developed.

Applicability to Island County Community-Based Planning Process

The LEAP process is consistent with best practices in community-based planning and addresses multiple aspects of Island County coastal resilience planning criteria and County and community issues and concerns. The LEAP Guide provides step by step instructions as well as user-friendly worksheets and templates for community-led development of coastal adaptation plans. These worksheets are intended for small island communities and do not necessarily reflect all planning considerations required of complex community organizations; however, LEAP tools and resources may be adapted to reflect Island County-specific planning issues. The LEAP process ends with the development of an action plan and does not directly address the implementation or monitoring of plan outcomes. Despite this limitation, the use of LEAP process guidelines and adapted worksheets in combination with plan implementation and evaluation processes included in other tools referenced in this report may provide a viable and complete planning model for Island County communities.

5.3 Community-based planning process suitability analysis

Cross-comparison of Island County community-based planning objectives and elements of the FEMA CRS Floodplain Management Planning, U.S. Climate Resilience Toolkit, and LEAP processes identifies the suitability of each of the tools for consideration in the Island County community-based planning framework. The below diagram highlights key components of the cross-comparison process and outcomes.

Figure 5.1: Community-based Planning Framework Development Process

The capacity of a given process and its associated tools to address Island County community planning objectives and their sub-components determined suitability for consideration in the community-based planning framework. Section 2 of this report details Island County planning objectives, and a summary is provided below.

Community-Based Planning Objectives

Objective Sub-components	Island County Criteria	County & Community Key Issues	CBP Best Practices
	Identification of vulnerable assets Community based resiliency strategy and project development guidance Monitoring, thresholds for action, and lead times Financing options	Natural resource conservation Private property protection Public property protection Funding availability	Community awareness of planning issues Community identification of critical assets and values Community member participation in the CBP process Effective CBP process structure Adequate resourcing Effective process evaluation

Table 5.1: Community-Based Planning Objectives and Sub-Components

Cross comparison of the three planning processes with Island County planning objectives is detailed in Appendix B. The appendix includes a matrix that identifies planning process components that directly address a given community planning objective sub-component as suitable for consideration in community-based planning framework development (color-coded green). Similarly, the analysis identifies process components that address a given planning objective sub-component but do not provide supporting tools and resources as partially suitable (color-coded yellow); and process components that do not address a given objective sub-component as unsuitable (color-coded red).

Suitability of each process in terms of ability to address the three primary Island County planning objectives was determined as a function of combined sub-category ratings. Processes rated as suitable (green) represent 75% or more suitable (green) sub-component ratings for a given planning objective and no unsuitable (red) ratings. Processes rated as partially suitable

(yellow) represent less than 75% suitable (green) sub-component ratings for a given planning objective and less than 50% unsuitable (red) ratings, as well as those with one or more unsuitable (red) rating. Processes rated as unsuitable (red) represent 50% or more unsuitable (red) sub-component ratings for a given planning objective. The below summary table presents process suitability ratings at the Island County planning objective level.

Community-Based Planning Objectives	Community-Based Planning Processes: FEMA CRS Planning	U.S. Climate Resilience Toolkit	LEAP Process
Island County Planning Criteria	Suitable	Suitable	Partially Suitable
County & Community Key Issues	Suitable	Suitable	Partially Suitable
CBP Best Practices	Suitable	Suitable	Suitable

Suitable | Partially Suitable | Unsuitable

Table 5.2: Community-Based Planning Process and Objective Suitability Matrix

As evidenced by cross-comparison outcomes, each of the processes analyzed contains tools applicable to community-based planning objectives, with FEMA CRS floodplain management guidance and the U.S. Climate Resilience Toolkit demonstrating the capacity to address all objectives. Analysis trends included a limited reference in all three processes to tools supportive of post-implementation plan monitoring and reference to general planning and implementation funding sources such as federal grant programs rather than process-specific funding opportunities. LEAP process shortfalls affecting suitability included the absence of implementation and post-implementation guidance, and limited examples or potential adaptation strategies applicable to Island County community issues and concerns. The strengths of each process include clarity of process guidance, which generally aligns with Island County planning requirements and community-based planning best practices. Specific strengths of the U.S. Climate Resilience Toolkit and LEAP process include the provision of clear and useful planning templates intended for community use in developing location-specific resilience plans. The

community-based coastal resilience planning framework references elements of each process detailed above, selected based on their alignment with Island County planning objectives.

6. Island County CBP Framework

The Island County community-based coastal resilience planning framework establishes a stepwise planning process intended to achieve community planning objectives and guide communities in the development of coastal resilience plans. The framework incorporates adapted elements of the FEMA CRS floodplain management planning, U.S. Climate Resilience Toolkit, and LEAP processes identified as supportive of Island County community planning objectives and connects users to additional resources associated with each planning step.

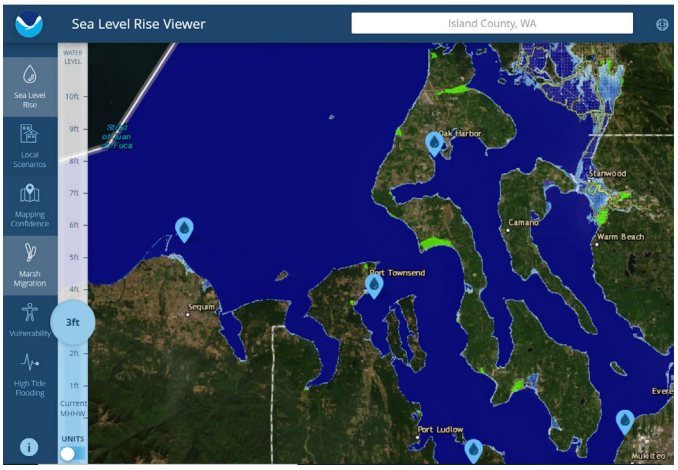
Island County Community-Based Coastal Resilience Planning Framework

Step 1: Define planning issues and establish a community planning team
Step 2: Identify community values and vulnerable assets
Step 3: Analyze risk and establish thresholds for action
Step 4: Develop and implement resilience strategies and projects
Step 5: Monitor outcomes to inform future plans

Step 1a: Define Planning Issues

Objective: This initial step in the community-based planning process is intended to raise community awareness of potential future issues related to projected sea level rise. In many cases in Island County, shoreline property owners have experienced impacts of extreme high tides and have a sense of what sea level rise may mean for them; however, concerted outreach efforts to ensure common public knowledge and access to information are critical to the planning process.

Processes and Tools: Processes and tools which may assist with this step include a review of Washington State sea level rise projections and use of the NOAA Sea-Level Rise Viewer web tool to run user-friendly scenarios reflecting various sea level rise conditions.



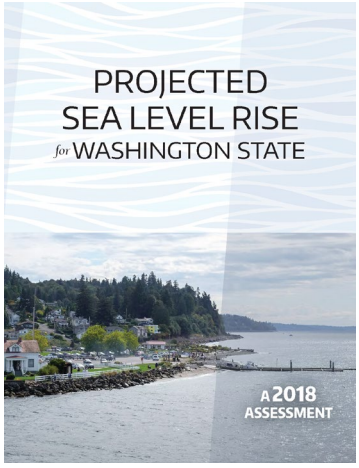
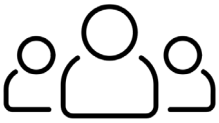


Figure 6.1: NOAA SLR Viewer and WA State SLR Projections

Sources: NOAA; Miller et al., 2018

Supporting Resources: These processes and tools may be leveraged by individuals, but are likely more effective when explored in group settings. Public outreach by advisory groups such as the Island County Marine Resources Committee (MRC), supported by representatives from the Department of Natural Resources, Planning, and Environmental Health has proven an effective mechanism for engagement. Island County provision of an online and physical resource repository with these and other informational tools may bolster the success of these engagements by providing community members easy access to the best available science and technical expertise related to projected sea level rise. Further, communities with established formal and informal representative organizations and/or associations may leverage them, as well as online community notification platforms such as “Nextdoor.”

Step 1b: Establish a Community-based Planning Team



Objective: This step is intended to identify stakeholders representing community demographic profile and interests to act as the primary planning body responsible for coordinating administrative and logistics requirements of the process. This group may vary in size but must provide a holistic representation of the community to optimize effectiveness and identify local expertise which may be helpful in addressing the particular issue.

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 1 (organize & involve the public), U.S.

Climate Resilience Toolkit step 1 (explore hazards) and the LEAP worksheet 3 (stakeholder identification). Applicable planning guidance and templates are included for reference in Appendix C and provide step by step processes to identify groups and interests which should be included in a community-based planning team.

Supporting Resources: As with the previous step, these processes and tools prove most effective when explored in group settings and are facilitated through established formal and informal representative organizations and/or associations, or through input solicitation through online community platforms.

Step 2: Identify Community Values and Vulnerable Assets

Objective: This step is intended to identify community goals, values, and their supporting assets. Goals should be big picture and reflect community aspirations, values should include aspects of the community which members desire to maintain or preserve, and assets should reflect the capital (physical or otherwise) which supports both the values and goals. Though County identification of infrastructure necessary to support accessibility, health, and life-safety in a given community, it is important that this step is completed by community members to document what is important enough to warrant expenditure of time and effort in the planning process.

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 2 (assess the hazard & problem), U.S. Climate Resilience Toolkit step 1 (explore hazards) and the LEAP worksheets 4 and 7 (community profile & target mapping); each of which provide step by step processes to identify what is important to community stakeholders and mapping those values to assets within the community. These worksheets are included in Appendix C.

Supporting Resources: The Island County Hazard Mitigation Plan identifies critical community assets and vulnerabilities but is mostly focused on major public infrastructure systems. Though the scope of HMP critical asset assessment may not align with local community concerns, the document provides a good example of how a community might document this step. In addition, the U.S. Climate Resilience Toolkit includes a link to case studies related to each phase of resilience planning. A review of case studies may prove useful in initiating this step.

Step 3a: Analyze Risk

Objective: This step is intended to assess risk introduced by potential sea level rise to community assets identified in the previous step. The process should account for environmental stressors (flooding, septic system overflow, groundwater contamination, etc.) and non-environmental stressors (evacuation planning, valuable preservation, family concerns, etc.) associated with sea level rise and reflect an overall risk assessment based on probability of occurrence and magnitude of impact if a major flooding event takes place. Probability is relatively objective given sea level rise projections and community experience to date with extreme high tide flooding; however, the magnitude may be more subjective based on a given community's values associated with at-risk assets.

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 2 (risk assessment), U.S. Climate Resilience Toolkit step 2 (assess risks), and LEAP worksheet 8 (threat mapping); each of which provide step by step processes to identify hazard probability and magnitude and develop an overall risk definition. The U.S. Climate Resilience Toolkit Risk Characterization Matrix is pictured below. Other referenced processes and tools are detailed in Appendix C.

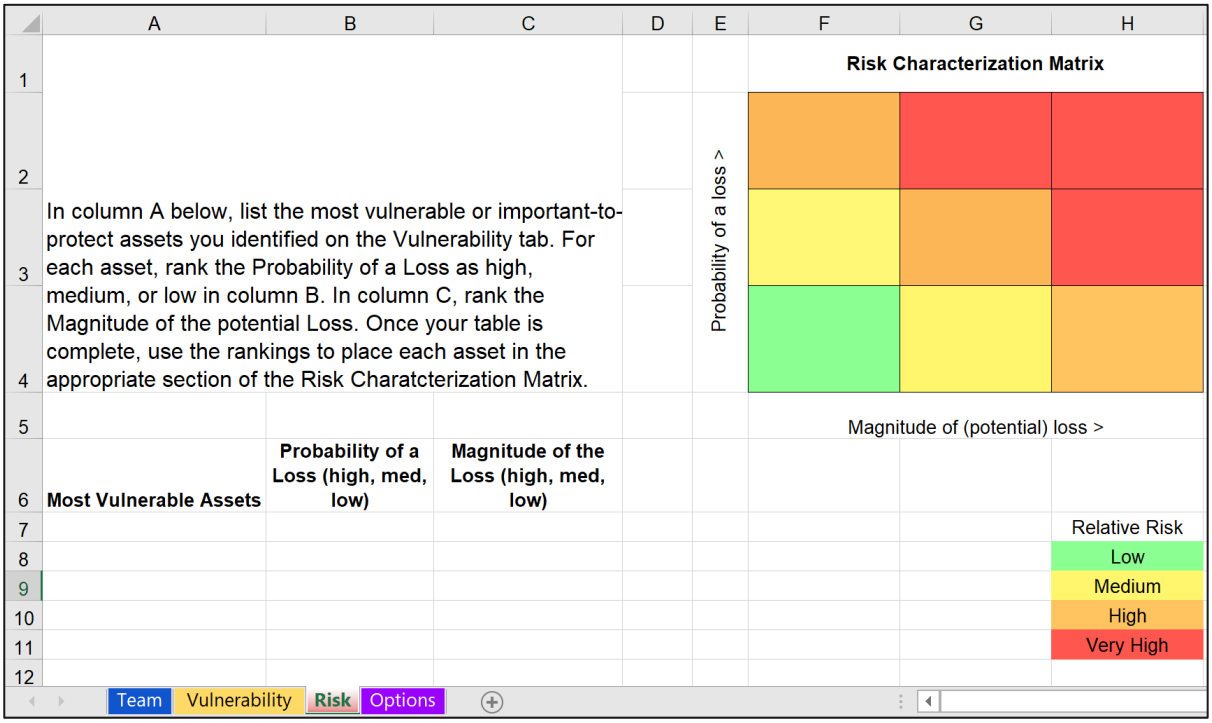
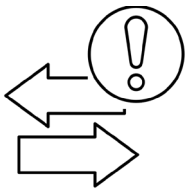


Figure 6.2: Risk Characterization Matrix

Source: U.S. Climate Resilience Toolkit

Supporting Resources: The Island County Hazard Mitigation Plan catalogs risk to critical assets but is mostly focused on those pertaining to public infrastructure and general community groups (vulnerable communities, etc.). Though the scope of HMP critical asset and vulnerable population assessments may not align with local community concerns, the document provides a good example of how a community might document this step. In addition, the U.S. Climate Resilience Toolkit includes a link to case studies related to each phase of resilience planning. A review of case studies may prove useful in initiating this step and as a basis of comparison for outcomes.

Step 3b: Establish Thresholds for Action



Objective: This step is intended to identify acceptable risk at the community asset level and establish thresholds for community action in the event risk becomes unacceptable. This step is heavily dependent on community goals and values and is likely to be specific to each community. For example, the image below shows Camano Island's Livingston Bay under 2050 projected sea level rise and extreme high tide conditions. Under these circumstances, communities may determine that action well in advance of 2050 is necessary to preserve their property.

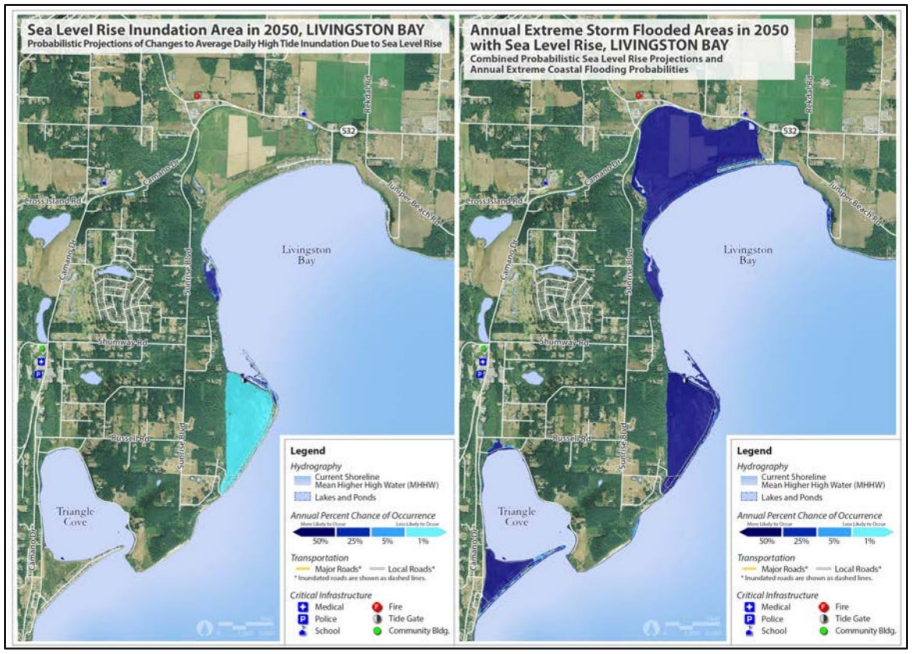


Figure 6.3: Livingston Bay Potential Inundation (2050)

Source: Miller et al., 2016

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 2 (risk assessment), U.S. Climate Resilience Toolkit step 2 (assess risks), and LEAP worksheet 8 (threat mapping). These references and tools provide guidance related to decision points at which community planning groups will need to determine whether to take action to preserve assets and either protect, redefine, or reassign values. Referenced processes and tools are detailed in Appendix C.

Supporting Resources: At the time of this report, the Island County Planning Department is in the process of developing a sea level rise monitoring plan intended to leverage existing tide gauges and other monitoring and relay devices to effectively monitor changing sea levels and inform communities of SLR trends. Once available, this tool may be a valuable resource used by communities to inform future risk decisions. In addition to future sea level rise monitoring, the Island County Hazard Mitigation Plan recommends the development of a comprehensive threat monitoring program and identifies some key elements of what the monitoring plan should include. Communities may use HMP recommendations to inform the development of local monitoring plans. Ultimately, communities must decide the level of risk their communities are willing to accept and take action accordingly.

Step 4a: Develop Solutions

Objective: This step is intended to identify potential sea level rise adaptation strategies and project alternatives capable of mitigating risk to community assets and values while complying with applicable guidelines and regulations. In this step community planning groups will develop a list of local sea level rise adaptation strategies and projects, and assess their effects on community asset resilience, economic viability, local and regional environmental impact, and implementation feasibility, among other factors. This process is intended to result in a prioritized list of viable short, medium, and long-term projects representing applicable protection, accommodation, and managed retreat adaptation strategies for which the community may pursue funding and implementation support.

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 3 (mitigation strategy), U.S. Climate Resilience Toolkit steps 3 & 4 (investigate options, prioritize & plan), and LEAP worksheet 9

(identify early actions). Each tool provides guidance related to identifying key comparable aspects of potential projects, assessing project feasibility given accessible community resources, and prioritizing projects in terms of urgency and implementation feasibility. A sample project feasibility matrix from the U.S. Climate Resilience Toolkit is presented below, and other referenced tools are detailed in Appendix C.

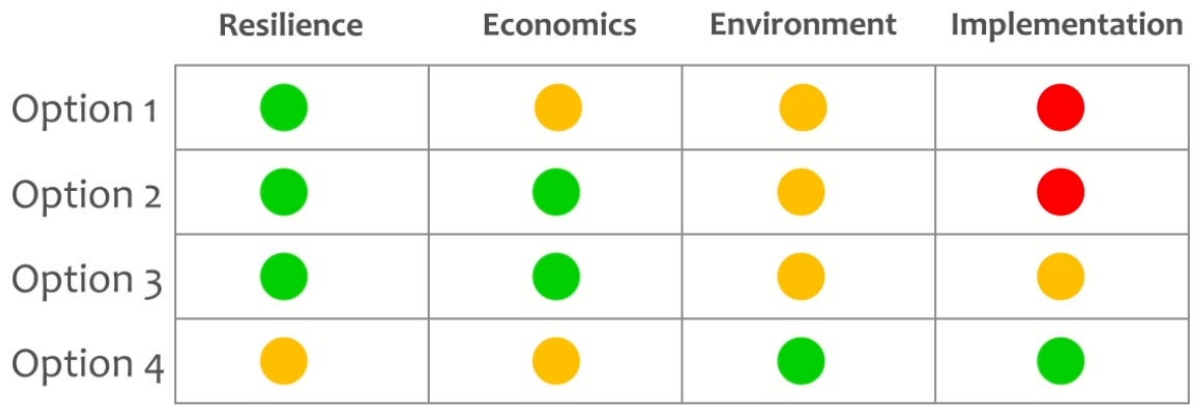
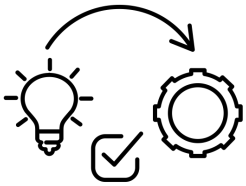


Figure 6.4: Adaptation Project Feasibility Matrix

Source: U.S. Climate Resilience Toolkit

Supporting Resources: Adaptation strategy examples are available through many sources to include the U.S. Climate Resilience Toolkit case studies, Sea Grant coastal property owner guides, and the Washington Department of Fish and Wildlife publication *Your Marine Waterfront: A guide to protecting your property while promoting healthy shorelines* (WDFW, 2016). In addition, organizations and programs such as the Shore Friendly program supported and administered by the Washington Department of Natural Resources, Washington Department of Fish and Wildlife, and the U.S. Environmental Protection Agency, provide planning guidance and resources to support community decisions to pursue nature-based coastal adaptation projects (Shore Friendly, 2019). Most relevant to Island County, however, are shoreline sea level rise adaptation best management practices developed through this project; which represent short, medium, and long-term protection, accommodation, and retreat strategies gleaned from case studies in similar communities throughout the U.S. and abroad.

Step 4b: Implement Solutions

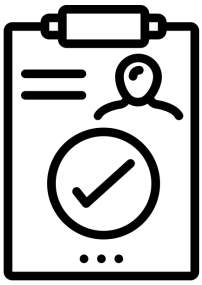


Objective: This step is intended to provide guidance on the implementation of selected community planning actions, to include sea level rise adaptation strategies. Plan implementation relies heavily on funding and enduring community support; therefore it is imperative that strategy or project leads are assigned, a clear project implementation process and timeline are established, and sources of project funding are identified in this step.

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 3 (plan maintenance), U.S. Climate Resilience Toolkit step 5 (take action), LEAP worksheet 19 (work plan), and Island County shoreline development regulations. The first three tools provide general implementation plan development guidance and are detailed in Appendix C. County development regulations specify permitting requirements, timelines, and costs related to shoreline projects, and are available on the Island County website.

Supporting Resources: Federal, state, and local project implementation and funding support may be available for selected adaptation projects in the form of conservation and emergency preparedness grants, conservation district financial assistance, property tax reductions through the Washington State Public Benefit Rating System for natural shoreline restoration, and free or low-cost technical assistance (FEMA, 2019; Washington DNR, 2019). The U.S. Coastal Resilience Toolkit and Shore Friendly program provide listings of nationwide and Island County-specific funding opportunities available today. In the future, Island County may pursue additional incentives for coastal resilience projects.

Step 5: Monitor Outcomes



Objective: This step is intended to provide guidance on community monitoring of adaptation strategy and project outcomes, documentation of project effectiveness, and generation of lessons learned to inform future iterations of the project and/or related planning decisions. Monitoring and feedback allow communities to optimize the effectiveness of the community-based planning process. This step requires community planning group dedication and continuity to ensure lessons learned are effectively passed on and applied to future initiatives.

Processes and Tools: Processes and tools which may assist with this step include those outlined in CRS Floodplain Management Planning Phase 3 (plan maintenance) and U.S. Climate Resilience Toolkit step 5 (Take action). Relatively little related to project monitoring and feedback is included in the LEAP process; however, community-based planning literature consistently identifies this step as critical to project and/or process effectiveness. Referenced processes and tools are detailed in Appendix C.

Supporting Resources: Examples of project monitoring are provided in U.S. Climate Resilience Toolkit case studies; and the U.S. Department of Homeland Security Coastal Hazards Center of Excellence Disaster Recovery Tracking Tool is an example of a tool which may be adapted to the Island County CBP process (NOAA, 2019).

7. Conclusions

This report provides a recommended Island County community-based coastal resilience planning framework and documents supporting research and development. The proposed framework addresses specific planning issues related to extreme flooding events and projected sea level rise faced by Island County shoreline communities; reflects best practices in community-based planning processes and tools specific to coastal flooding and projected sea level rise, and leverages those processes and tools to support coastal resiliency planning.

The research documented in this report indicates methods for communities to engage in planning and implementation of adaptation strategies intended to reduce risk to individual property owner and community assets associated with projected sea level rise. As identified in this report, keys to community-based planning framework success include extensive and equitable community member involvement; access to the expertise necessary to educate community members of planning issues and inform planning decisions; adequate resourcing of implementation plans; and post-implementation monitoring of project outcomes to track performance and inform future planning decisions and projects.

7.1 Next Steps

A community guide to coastal resiliency planning is included as Appendix C to this report. The guide details community actions necessary to complete each step of the planning framework outlined in this report and provides worksheets and additional resources adapted from existing planning processes and tools to facilitate community planning. Completion of these planning

steps and associated worksheets will provide communities with the fundamental components of a coastal resilience plan and assist them in developing and implementing short, medium, and long-term sea level rise adaptation strategies.

7.2 Further Research

Additional research is necessary to provide a comprehensive guide to community coastal resilience planning and is recommended to address the limitations of research documented in this report. This section highlights identified research shortfalls and/or areas that may warrant further research to better position Island County communities to plan for coastal resilience.

7.2.1 Community-based planning incentive opportunities

Identification and evaluation of coastal resilience planning incentives employed in other U.S. communities will inform recommendations for Island County's consideration. Effective incentives for planning participation are key to forming a community-based planning team, and the addition of thoroughly researched incentive recommendations would strengthen the proposed planning framework. Potential incentives to explore include permit fee reductions, streamlined permitting processes, and free technical assistance with planning and design for projects supportive of coastal resilience in communities with established coastal resilience plans.

7.2.2 Sea-level rise monitoring and threshold establishment

Upon establishment of an Island County sea level rise monitoring plan and completion of a scheduled 2020 Island County Shoreline Master Program update, which will include sea level rise considerations, further research into how both can best be incorporated into the proposed community-based planning framework will be necessary.

7.2.3 Adaptation planning for vulnerable populations

The shoreline community in Island County is generally characterized as older, relatively affluent, and generally mobile. Further research into the location and extent of vulnerable shoreline populations and how community-based planning guidance may be effectively leveraged by them is necessary to make this project's deliverable a universally applicable product.

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Appendix 3A: Island County Staff Interview Questions

Island County Sea Level Rise Strategy Study
Initial Interview Questions

Purpose: To familiarize UW student researchers with Island County coastal zone management plans, policies, and processes; and to inform the development of sea level rise adaptation best management practices and a community-based coastal resiliency planning framework.

Questions:

1. What is your role working for Island County related to coastal and canal flooding mitigation, preparedness, response, and/or recovery concerns?

2. (2-part question) Do your department plans, policies, and/or processes (existing and in progress) related to coastal development and resource management address potential impacts of extreme flooding events and projected sea level rise? If not, are there specific barriers to consideration of these topics?

3. In your department, what are the primary (top 3-5) concerns related to extreme flooding events and projected sea level rise in Island County Historic Beach, Coastal Bluff, and Canal Communities?

4. Based on your interactions with community members and coastal property owners, what are the primary (top 3-5) community concerns related to extreme flooding and projected sea level rise in Island County Historic Beach, Coastal Bluff, and Canal Communities?

5. Does your department maintain information and/or resources which may be useful for private property owners and communities in developing coastal resiliency plans (e.g. flood preparedness guidance, coastal development permitting guidelines, etc.)?

6. (2-part question) What residential community and/or private property owner actions do you recommend to address potential impacts of extreme flooding events and projected sea level rise? Are you aware of counties or cities with similar challenges that have adopted sea level rise adaptation strategies which may be applicable to Island County?

7. Are you aware of and/or involved in existing Island County or Washington State programs which provide financial support or incentive for private property owner or community projects which may lessen impacts of bluff erosion, coastal or canal flooding?

Appendix 3B: CBP Process and Objective Cross-comparison

	FEMA CRS Coordinator's Manual (2017)		US Climate Resilience Toolkit		LEAP Tool	
Objective	**Step(s)**	**Tool**	**Step(s)**	**Tool**	**Step**	**Tool**
Island County Criteria						
Identification of vulnerable assets	Step 4 - Assess the Hazard Step 5 - Assess the Problem	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 2 - Assess Vulnerability & Risks	"Documenting Steps to Resilience" Spreadsheet: Vulnerability and Risk tabs NOAA Coastal County Snapshots: https://www.coast.noaa.gov/snapshots/	Step 3 - Carrying Out a Field Based Threat and Vulnerability Assessment	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 15 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Community based resiliency strategy and project development guidance	Step 6 - Set Goals Step 7 - Review Possible Activities Step 8 - Draft an Action Plan	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 3 - Investigate Options Step 4 - Prioriitze and Plan	"Documenting Steps to Resilience" Spreadsheet: Options tab EPA "Coastal Adaptation Toolkit:: https://www.epa.gov/cre/coastal-adaptation-toolkit	Step 4 - Finalizing the LEAP Plan	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Sessions 24-26 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Monitoring, thresholds fo action, and lead times	Step 6 - Set Goals Step 8 - Draft an Action Plan	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 4 - Prioriitze and Plan	"Documenting Steps to Resilience" Spreadsheet: Options tab	N/A - Additional Tools	Reef Resilience Network: monitoring and Assessment: http://reefresilience.org/assessing-and-monitoring-reef-resilience/
Financing options	N/A	FEMA Pre-Disaster Miigation Grants: https://www.fema.gov/pre-disaster-mitigation-grant-program	Step 5 - Take Action	U.S. Climate Resilience Toolkit "Funding Opportunities": https://toolkit.climate.gov/content/funding-opportunities	N/A	N/A (mentioned as a consideration in Step 3 - Vulnerability Assessment)
County & Community Key Issues						
Natural Resource Conservation	Step 7 - Review Possible Activities (Natural Resource Protection)	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Steps 1-5	"Steps to Resilience" tool repository https://toolkit.climate.gov/#steps "Documenting Steps to Resilience" Spreadsheet: https://toolkit.climate.gov/image/1694	Step 3 - Carrying Out a Field Based Threat and Vulnerability Assessment Step 4 - Finalizing the LEAP Plan	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 17 & 26 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Private Property Protection	Step 7 - Review Possible Activities (Property Protection)	CRS Coordinator's Manual:https://www.fema.gov/media	Steps 1-5	"Steps to Resilience" tool repository https://toolkit.climate.gov/#steps "Documenting Steps to Resilience" spreadsheet https://toolkit.climate.gov/image/1694	Step 3 - Carrying Out a Field Based Threat and Vulnerability Assessment Step 4 - Finalizing the LEAP Plan	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 17 & 26 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf

	FEMA CRS Coordinator's Manual (2017)		US Climate Resilience Toolkit		LEAP Tool	
Objective	**Step(s)**	**Tool**	**Step(s)**	**Tool**	**Step**	**Tool**
Public Property Protection	Step 7 - Review Possible Activities (Property Protection)	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Steps 1-5	"Steps to Resilience" tool repository https://toolkit.climate.gov/#steps "Documenting Steps to Resilience" spreadsheet https://toolkit.climate.gov/image/1694	Step 3 - Carrying Out a Field Based Threat and Vulnerability Assessment Step 4 - Finalizing the LEAP Plan	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 17 & 26 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Funding	N/A	FEMA Pre-Disaster Miigation Grants: https://www.fema.gov/pre-disaster-mitigation-grant-program	Step 5 - Take Action	U.S. Climate Resilience Toolkit "Funding Opportunities": https://toolkit.climate.gov/content/funding-opportunities	N/A	N/A (mentioned as a consideration in Step 3 - Vulnerability Assessment)
CBP Best Practices						
Community awareness of planning issues	Step 2 - Involve the Public	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 1 - Explore Hazards	"Documenting Steps to Resilience" Spreadsheet: Team tab NOAA Sea-Level Rise Viewer: https://coast.noaa.gov/slr/ Washington State SLR Projections (2018): http://www.wacoastalnetwork.com/files/theme/wcrp/SLR-Report-Miller-et-al-2018.pdf	Step 1: Getting Organized for Raising Awareness and Planning Step 2: Understanding Climate Change and Your Climate Story	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Sessions 1-12 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Community identification of critical assets and values	Step 4 - Assess the Hazard Step 5 - Assess the Problem	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 2 - Assess Vulnerability & Risks	"Documenting Steps to Resilience" Spreadsheet: Vulnerability and Risk tabs NOAA Coastal County Snapshots: https://www.coast.noaa.gov/snapshots/ Vulnerability, Consequences, and Adaptation Planning Scenarios: http://www.vcapsforplanning.org/	Step 3 - Carrying Out a Field Based Threat and Vulnerability Assessment	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 15 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Community member participation in the CBP process	Step 2 - Involve the Public	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 1 - Explore Hazards	"Documenting Steps to Resilience" Spreadsheet: Team tab	Step 1: Getting Organized for Raising Awareness and Planning Step 2: Understanding Climate Change and Your Climate Story	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Sessions 1-12 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf

	FEMA CRS Coordinator's Manual (2017)		US Climate Resilience Toolkit		LEAP Tool	
Objective	**Step(s)**	**Tool**	**Step(s)**	**Tool**	**Step**	**Tool**
Effective CBP process structure	Step 1 - Organize Step 3 - Coordinate Step 10 - Implement	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Steps 1-5	U.S. Climate Resilience Toolkit "Steps to Resilience": https://toolkit.climate.gov/#steps	Step 1: Getting Organized for Raising Awareness and Planning	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 1 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Adequate resourcing	Step 1 - Organize Step 3 - Coordinate Step 10 - Implement, evaluate, revise	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 1 - Explore hazaeds Step 5 - Take Action	"Documenting Steps to Resilience" Spreadsheet: Team tab U.S. Climate Resilience Toolkit "Funding Opportunities": https://toolkit.climate.gov/content/funding-opportunities	Step 4 - Finalizing the LEAP Plan	Adapting to a Changing Climate: A Guide to Local Early Action Planning - Session 24 http://www.pimpac.org/images/2016_Adapting%20To%20A%20Changing%20Climate.pdf
Effective process evaluation	Step 10 - Implement, evaluate, revise	CRS Coordinator's Manual: https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf	Step 5 - Take Action	U.S. Climate Resilience Toolkit "monitor your results": https://toolkit.climate.gov/steps-to-resilience/take-action	N/A	N/A - LEAP Tool ends at objective development, and does not cover implementation

Appendix 3C: Community-Based Planning Guidebook

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Guidebook Overview

This guidebook is provided as a resource for Island County community members to assist in planning and implementing coastal resilience strategies and projects at the local level. The guidebook provides background information on the concept of community-based planning and the importance of coastal resilience, followed by a stepwise guide to conducting community-level planning complete with planning templates and links to additional information and resources. Through applying the process outlined in this guidebook, Island County residents will have access to the information and resources necessary to develop community-specific coastal resilience plans and improve preparedness for the future.

What is community-based planning?

Community-based planning is, generally, a voluntary local planning process which brings together people and groups from various backgrounds within a community to develop and implement a coordinated plan of action to address a particular issue or set of issues. For Island County residents, community-based planning presents the opportunity for community members to identify and work to resolve issues of concern through local, non-governmental action.

Why is coastal resilience planning important?

As our climate changes, so will many factors which may affect both the shoreline ecosystems and existing properties. These factors include potential sea level rise and increased frequency and intensity of extreme weather events. Current projections indicate Island County may experience between 1-3 feet of sea level rise by 2100 which may, in many cases, result in issues such as increased frequency and extent of coastal flooding, increased coastal erosion, impacts to coastal groundwater quality, and habitat loss. Planning for coastal resilience is something that can take place within communities recognizing the importance to take action to address these issues with or without government policy or direction.

Who should participate in coastal resilience planning?

All Island County shoreline properties may benefit from coastal resilience planning. Research supporting this guidance focuses on three community types identified as most likely to be affected by projected sea level rise. These include designated Historic Beach and Canal communities, and areas that contain steep and/or unstable slopes referred to in this guidebook

as Coastal and Feeder Bluff communities. A brief description of each community type based on the Island County Shoreline Master Program (SMP) is provided below:

Historic Beach Communities

Densely platted small lots with residential structures constructed thirty feet or less from the ordinary high water mark; typically established prior to Washington State's 1972 adoption of the Shoreline Management Act.

Historic Beach Community Example
Source: Island County SMP Guidance

Canal Communities

Residential communities developed along engineered canals. These communities are typified by residential structures constructed above the ordinary high water mark with dedicated waterfront access.

Canal Community Example
Source: Island County SMP Guidance

Feeder Bluff Communities

Coastal and Feeder Bluff communities consist of residential development atop and at the base of steep or unstable slopes that are subject to coastal and surface water erosion as part of natural ecosystem processes.

Coastal (Feeder) Bluff Community Example
Source: WA Coastal Atlas

How does the planning process work?

The Island County community-based coastal resilience planning framework establishes a stepwise planning process intended to achieve community planning objectives and ultimately develop community-specific coastal resilience plans. The framework incorporates adapted elements of existing planning processes and tools developed by the U.S. Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coral Triangle Initiative Support Program; and connects users to additional resources associated with each planning step.

Island County Community-Based Coastal Resilience Planning Framework

The following section of this guidebook details objectives, community actions, and resources related to each step in the planning process. Worksheets associated with each step of the process provide templates that communities may use to document their decisions and actions. Through completing the process steps and worksheets, communities will develop a baseline coastal resilience plan which may be used as a basis for implementing sea level rise adaptation projects. The process is intended to be iterative, and regular review of planning assumptions and process outcomes is necessary to ensure plans consider current information related to climate change and adaptation best practices.

Steps to Community-Based Coastal Resilience Planning

Step 1: Define Planning Issues and Establish a Planning Team

In order to effectively plan, community members must first identify specific issues which need to be addressed through community action and establish a planning team representative of community interests comprised of members who are willing and able to commit to the planning process from beginning to end.

Define Planning Issues

Objective

This initial step is intended to raise awareness of potential issues related to projected sea level rise. In this step, Island County residents concerned with current or future issues related to coastal flooding identify the extent to which sea level rise may affect their community,

Process

1. *Develop a community profile* – Document basic community characteristics (population, community designation, etc.) as well as current and future general coastal resilience concerns. Include physical issues such as property damage and habitat loss, and non-physical issues such as quality of life impacts, and economic impacts. The profile should also identify existing community generated plans that address coastal issues.
2. *Identify local sea level rise projections* - The Washington Coastal Hazards Resilience Network published *Projected Sea Level Rise for Washington State: a 2018 Assessment* which provides a range of sea level rise projections for Island County reflecting various probabilities of exceedance and timelines. Using this resource, communities may identify the different amounts of sea level rise associated with multiple scenarios. Projections used for Island County planning purposes are presented below.

Island County Sea Level Rise Average Projections

RCP 4.5 Sea level rise projections averaged for Island County in feet based on Miller, et al. 2018 projections. Probabilities indicate the likelihood sea level will meet or exceed elevations.

	Very Likely 95% Probability to exceed	Likely 50% Probability to exceed	Unlikely 1% Probability to exceed	Mid-Range 17 -83% Probability to exceed
2050	0.3	0.7	1.4	0.5 -1.0
2070	0.5	1.1	2.4	0.7 -1.5
2100	0.7	1.8	4.4	1.1-2.5

RCP 8.5 Sea level rise projections averaged for Island County in feet based on Miller, et al. 2018 projections. Probabilities indicate the likelihood sea level will meet or exceed elevations.

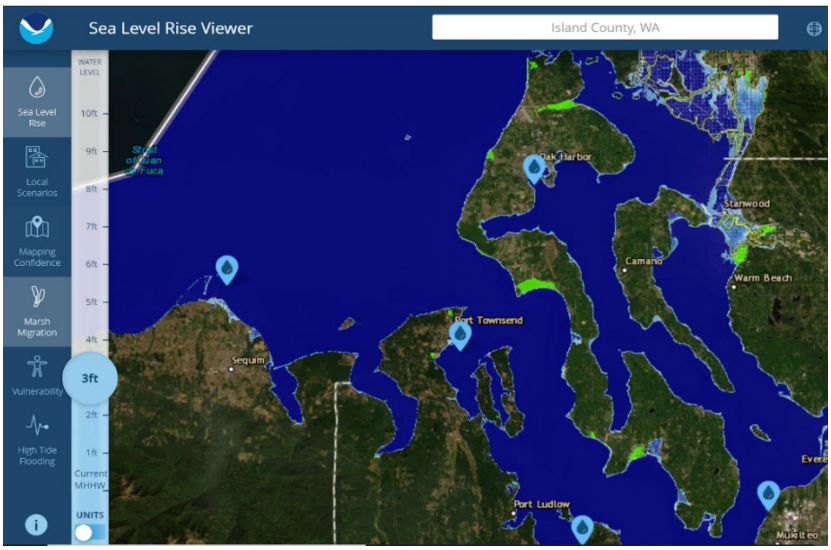
	Very Likely 95% Probability to exceed	Likely 50% Probability to exceed	Unlikely 1% Probability to exceed	Mid-Range 17 -83% Probability to exceed
2050	0.3	0.8	1.5	0.5 -1.0
2070	0.6	1.3	2.6	0.9 -1.7
2100	1.0	2.2	5.0	1.5 -3.0

The two tables shown above, prepared using Miller et al., 2018 sea level rise projections, represent two different greenhouse gas scenarios (RCP 4.5 and RCP 8.5). More information about how to understand sea level projections can be found on the Coastal Hazards Resilience Network website listed under tools and supporting resources below.

The column on the left provides three different time frames for planning consideration. This allows the user to compare projected rises in sea level over different times based upon planning horizons or lifespan of a project.

The row across the top allows the user to select a probability that sea levels will reach or exceed a given amount of sea level. For example, the “very likely” column of numbers relates to the high probability (95%) that sea level will exceed the numbers given. By contrast, the “unlikely” column provides numbers where it is highly unlikely (1%), although possible, that sea levels would reach that number.

3. *Model local sea level rise impacts* - User-friendly online mapping and modeling tools such as the National Oceanic and Atmospheric Administration (NOAA) Sea Level Rise Viewer enable Island County residents to view potential impacts of sea level rise in their communities. Community members should model multiple scenarios representing various sea level rise projections to gain a basic understanding of the likelihood of sea level rise affecting them according to current projections.



NOAA Sea Level Rise Viewer Interactive Mapping Tool

4. *Decide to plan* - Based on the outcome of sea level rise projection modeling, communities will identify what is potentially at risk and decide whether coastal resilience planning is in their best interest. In reaching this decision, communities may want to consult with citizen scientists and advocacy groups working on climate change and sea level rise initiatives, such as the Island County Marine Resources Committee, to review model results and gain insight on related concerns.

Tools and supporting resources

- Washington Coastal Hazards Resilience Network
  http://www.wacoastalnetwork.com
- Projected Sea Level Rise for Washington State: A 2018 Assessment
  http://www.wacoastalnetwork.com/wcrp-documents.html
- NOAA Sea-Level Rise Viewer
  https://coast.noaa.gov/slr/
- Island County Marine Resources Committee website
  https://www.islandcountymrc.org/

Planning template

Use worksheet 1A to build a community profile. Use worksheet 1B to document sea level rise projections, model outputs, and additional information supporting the community's decision to plan.

Worksheet 1A: Community Profile

Instructions and Example:
Describe community characteristics and identify primary concerns and current local plans related to coastal flooding and projected sea level rise.

Community Name & Location: Enter common name of community and general physical location

Community Type: Select Historic Beach Community, Canal Community, Coastal Bluff Community, or Other

Community Population (estimate)**:**

Coastal Resilience Concerns (Existing Conditions): Identify top (1-3) coastal resilience issues your community currently faces. Issues may be physical (property damage, habitat loss, etc.) or non-physical (quality of life impacts, economic impacts, etc.).

Coastal Resilience Concerns (Future Projections): Identify top (1-3) coastal resilience issues your community is concerned may emerge as a result of projected sea level rise. Issues may be physical or non-physical.

Existing Plans: List existing local community generated plans which address coastal flooding issues or development guidelines. Examples include community Covenants, Conditions & Restrictions (CC&Rs), community design guidelines, neighborhood emergency management plans, community environmental conservation plans, water system plans, etc. Do not include local government plans. An example is provided below:

Existing Plan Title	**Plan Created By**	**Plan Date**	**Plan Location** (web link or physical location and contact number)	**Coastal Resilience Considerations**
Neighborhood CC&Rs	Neighborhood Homeowners Association	January 2020	HOA Website: www.website.com	Shoreline development restrictions Private beach maintenance requirements

Worksheet adapted from US Coral Triangle Initiative Local Early Action Planning Tool

Worksheet 1B: Sea Level Rise (SLR) Projections

Instructions and Example:
Document sea level rise model parameters and outcomes for each scenario in the table below. Communities are encouraged to model numerous scenarios spanning the range of sea level rise projections. An example entry is provided for reference.

Global Emissions Scenario (RCP 4.5 or RCP 8.5)	**SLR Projection Timeline**	**SLR Projection Probability of Exceedance** (Very Likely, Likely, Unlikely, Mid-Range)	**Projected SLR* (feet)**	**NOAA SLR Viewer Community Impacts**	**Community Planning Recommendation**
RCP 8.5	2100	Mid-Range (17-83%)	1.5-3.0	Yes – Partial Inundation at 2-3 ft.	Conduct coastal resilience planning

*SLR projection source: Miller et al., 2018, *Projected Sea Level Rise for Washington State - A 2018 Assessment*. Prepared for the Washington Coastal Hazard Resilience Network. Prepared for the Washington Coastal Resilience Project. http://www.wacoastalnetwork.com/files/theme/wcrp/SLR-Report-Miller-et-al-2018.pdf.

Establish a Community Planning Team

Objective

This step is intended to identify community representatives to act as the primary planning group responsible for coordinating administrative and logistics requirements of the coastal resilience planning process. This group may vary in size but must provide a holistic representation of the community to optimize effectiveness

Process

1. *Identify potential stakeholders (groups)* - Identify professional, social, and other groups or organizations which may have an interest in community planning efforts. This stakeholder group must be representative of the demographic and economic spectrum within the community and may include outside individuals or groups with technical expertise relevant to the planning issue(s).
2. *Identify stakeholder representatives (individuals)* - For each stakeholder group, identify a specific candidate to represent the group's interest in the planning process. Include contact information and, when possible, preferred contact days/times.
3. *Conduct outreach* - Contact stakeholder representatives to discuss planning issues and request involvement in the planning process. Obtain agreement to participate and document constraints on availability.
4. *Establish Team Roles* - Identify volunteers for key positions within the planning team to include administrative, logistics, and communication leads. Team members assigned to these positions should be willing and able to commit to involvement for the duration of the planning process and are instrumental in ensuring timely and effective completion. Specific responsibilities of each position may vary based on planning team size and complexity of planning issues addressed.

Tools and supporting resources

Stakeholder identification is most effective when conducted in a group setting. Community members are encouraged to solicit input from formal and informal representative organizations such as the Marine Resources Committee, homeowner's and/or neighborhood associations, and online community platforms such as Nextdoor.

- Island County Marine Resources Committee website
  https://www.islandcountymrc.org/
- Nextdoor website
  https://nextdoor.com/find-neighborhood/wa/

Planning template

Use worksheets 1C and 1D to document stakeholder identification, outreach, and role establishment.

Worksheet 1C: Identifying and Involving Stakeholder Groups

Instructions and Example:
Identify formal and informal groups of people with potential interest in the planning issue and/or process outcomes. Document their interest and importance to the process in the table below. An example entry is provided for reference

What are the main groups of people involved in the community?	Describe their interest	How important is this group to the planning process?	How and when should they be involved in the planning process?
Property owners	Property ownership and community resource access	Very important	From the beginning of the process. Involve them in issue identification, all regular planning meetings, progress updates, and regular feedback opportunities.
Community associations			
Non-governmental organizations			
Community service organizations			
County Departments			
State Agencies			
Federal Agencies			
Other			

Worksheet adapted from US Climate Resilience Toolkit "Documenting Steps to Resilience"

Worksheet 1D: Identifying and Involving Individual Stakeholders

Instructions and Example:
Identify individual representatives for stakeholder groups that should be involved in the planning process Use the below table to document coordination with potential stakeholder group representatives and their involvement in the planning process. An example is provided for reference

Stakeholder Group	**Individual Stakeholder**	**Contact Information** (preferred phone and email)	**Planning Team Role**	**Comments**
Property owners	John Doe	Cell: 555-5555 Email: jdoe@mail.com	Administrative Coordinator	Available M/W evenings 5pm-7pm Has legal experience

Worksheet Adapted from US Climate Resilience Toolkit "Documenting Steps to Resilience"

Step 2: Identify Community Values and Vulnerable Assets

Objective

This step is intended to identify community values, goals, and their supporting assets. Values should include aspects of the community which members desire to maintain or preserve, goals should be big picture and reflect community aspirations, , and assets should reflect the capital (physical or otherwise) which supports community values and goals.

Process

1) *Identify community values and goals* - Stakeholders collectively identify values that contribute to community character, culture, and identity; as well as aspirational goals that reflect and help to achieve the identified values for the future of the community. It is imperative that members of all stakeholder groups are involved in this step to ensure values and goals represent diverse community perspectives.

2) *Identify supporting assets* - Stakeholders identify tangible and intangible assets within the community which support or enable community values and goals. Assets should extend beyond critical infrastructure necessary to maintain basic community services, and include elements such as individual and community property, shared community knowledge, culturally significant sites and activities, and natural resources.

3) *Identify asset vulnerabilities* – Stakeholders document climate and non-climate stressors affecting key community assets and identify the “tipping point” at which an asset will lose its functionality or negatively impact community values and goals. This step includes a vulnerability assessment for each asset in which community members determine whether effects of projected sea level rise for each scenario modeled in step 1 might negatively impact a given asset to the point where it is no longer able to perform its primary function in support of community values and goals. Vulnerability ratings take into account the likelihood sea level rise may affect the asset based on NOAA Sea Level Rise Viewer model output, and the asset’s adaptive capacity, or ability to be modified to maintain its primary function despite projected sea level rise impacts. A matrix identifying vulnerability ratings based on likelihood of sea level rise impact and adaptive capacity is provided below as an aid to completing this step. As shown in the matrix, low likelihood of sea level rise impact combined with high adaptive capacity results in low asset vulnerability; whereas high

likelihood of sea level rise impact and low adaptive capacity result in high asset vulnerability.

Asset Vulnerability Matrix

Likelihood of SLR Impact >		
Very High	Very High	High
Very High	High	Moderate
High	Moderate	Low

Adaptive Capacity >

Tools and supporting resources

Online tools such as the U.S. Climate Resilience Toolkit *Steps to Resilience*, and the University of Kansas *Community Toolbox* provide examples of community asset identification which may assist in beginning a community-specific asset identification process.

- U.S. Climate Resilience Toolkit - *Steps to Resilience (Step 1: Explore Hazards)* https://toolkit.climate.gov/steps-to-resilience/explore-hazards
- University of Kansas - *Community Toolbox* https://ctb.ku.edu/en/table-of-contents/assessment/assessing-community-needs-and-resources/identify-community-assets/main

Planning template

Use worksheet 2A to document community values, goals, and assets. Use worksheet 2B to document asset vulnerability.

Worksheet 2A: Community Values, Goals, and Assets

Instructions and Example:
Document values which define community character, goals related to the values, and assets (physical and non-physical) supporting both the values and goals which may be impacted by projected sea level rise. Include asset condition and comments as applicable. Example provided for reference. An example is provided for reference

Community Value	**Community Goal**	**Asset & Type** (Built Environment, Natural Resource, Social, etc.)	**Asset Condition** (poor, fair, good, excellent)	**Comments**
Connection to natural environment	Improve community access to beach and wetland	Coastal trail network	Good	Trail network exists, but requires clearing and maintenance

Worksheet adapted from US Coral Triangle Initiative Local Early Action Planning Tool and NOAA coastal adaptation guidance

Worksheet 2B: Community Asset Vulnerability

Instructions and Example:

Document issues which may affect community assets as well as climate and non-climate stressors which contribute to their potential impact. An example is provided for reference.

- Identify climate and non-climate stressor trends (improving, worsening, etc.), what the tipping point would be for the asset to be significantly impacted, and the estimated probability that the tipping point scenario will occur.
- Identify the asset adaptive capacity (or ability to be modified to maintain its primary function) over a range of potential impacts.
- Finally, identify the asset vulnerability as a function of probability of tipping point occurrence and adaptive capacity (high probability of occurrence and low adaptive capacity lead to high vulnerability; low probability of occurrence and high adaptive capacity lead to low vulnerability, etc.). Reference the vulnerability matrix included in step 2 process description to assist with rating asset vulnerability.

Community Asset	**Climate Stressor and Trend**	**Non-Climate Stressor and Trend**	**Tipping Point**	**Probability of tipping point occurring** (unlikely, likely, very likely)	**Asset Adaptive Capacity** (low, moderate, high)	**Asset Vulnerability** (low, moderate, high, very high)
Coastal trail network	Sea level rise projected increase of 1-3ft by 2100	Erosion from surface water runoff degrades trail	Trail network inaccessible due to inundation and erosion	Likely	Moderate – trail function is restored once area is drained	Moderate

Worksheet adapted from US Climate Resilience Toolkit "Documenting Steps to Resilience"

Step 3: Analyze Risk and Establish Thresholds for Action

Risk management is a fundamental component of coastal resilience planning. This step of the process includes identification of risk to community assets introduced by projected sea level rise; and establishment of thresholds for community action based on risk tolerance.

Analyze Risk

Objective

This step is intended to assess risk introduced by projected sea level rise to community assets identified in the previous step. The process should account for potential environmental stressors (flooding, septic system overflow, groundwater contamination, etc.) and non-environmental stressors (evacuation planning, property preservation, family concerns, etc.) associated with sea level rise and reflect an overall risk assessment based on probability of occurrence and magnitude of impact if a major flooding event takes place. This process should be conducted for each community asset.

Process

1) *Determine the probability of sea level rise impacts* - Using sea level rise projections and timelines modeled in step 1, estimate the probability of impacts on assets identified in step 2. Categorize probability of exceedance as very likely (95% model), likely (50%), or unlikely (1%). See step 1 for information on how to read and interpret sea level rise probability tables.

2) *Determine the magnitude of projected sea level rise impacts* - Based on the extent of coastal flooding modeled in step 1 and asset condition and characteristics defined in step 2, estimate the magnitude of projected impacts in terms of potential functionality loss. Characterize magnitude of loss as low (asset damaged but functional), moderate (asset functionality degraded but can be recovered), or high (non-functional total asset loss).

3) *Assign relative risk characterization* - Based on cross-comparison of probability and magnitude of projected sea level impacts to community assets, identify the resulting risk characterization for each asset under various modeled scenarios. A sample risk characterization matrix is provided below.

Risk Characterization

Probability of occurrence >			
	High	Very High	Very High
	Moderate	High	Very High
	Low	Moderate	High

Severity of Consequences >

Adapted from the U.S. Climate Resilience Toolkit

Tools and supporting resources

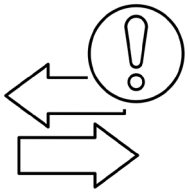
The U.S. Climate Resilience Toolkit and FEMA Community Rating System Floodplain Management Planning Guide (Section 512) provide additional guidance on conducting risk assessments which may prove beneficial to communities undertaking the process.

- U.S. Climate Resilience Toolkit - *Steps to Resilience (Step 2)* https://toolkit.climate.gov/steps-to-resilience/assess-vulnerability-risks
- FEMA CRS Coordinator's Manual - Floodplain Management Planning (Section 512) https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf

Establish Thresholds for Action

Objective

This step is intended to identify acceptable risk at the community asset level, and establish thresholds for community action in the event the level of risk becomes unacceptable. This step is heavily dependent on community goals and values, and thresholds will likely be specific to each community.



Process

1) *Evaluate the effects of asset degradation on community values and goals* - Given the characterization of sea level rise risk to assets developed in the previous step, identify the resulting qualitative impact on community values and goals. Classify outcomes as no effect (values and goals unaffected), attainment challenge (values and goals temporarily impacted), or attainment barrier (values and goals unattainable).

2) *Determine an acceptable level of risk* - Determine an acceptable level of risk for each asset identified in step 2 based on the potential impact on community values and goals. For example, a community may value outdoor recreation (value) made possible by a neighborhood waterfront trail (asset) which has been identified for community-funded improvements (goal), and is unlikely to be impacted by sea level rise and if impacted would only result in a moderate loss (moderate risk characterization). In this scenario, the community may determine that this level of risk is acceptable, as the asset may be repaired and would continue to support community values and goals. Increased probability or magnitude of loss may result in an unacceptable level of risk.

3) *Establish a threshold for action* - Determine a threshold for action relative to the acceptable level of risk for each asset. Communities may elect to establish thresholds lower than their absolute risk tolerance as a proactive measure. Conversely, action thresholds may exceed risk tolerance in cases that require resources beyond those available to the community.

4) *Monitor changing risks* - Regularly review available County, State, and local citizen science resources such as the Washington Coastal Hazards Resilience Network and Island County

Marine Resources Committee for updates to sea level rise projections. Update risk characterization accordingly and monitor risk levels in relation to action thresholds.

Tools and supporting resources

The U.S. Climate Resilience Toolkit and FEMA Community Rating System Floodplain Management Planning Guide (Section 512) provide additional guidance that may inform decisions to take community action.

- U.S. Climate Resilience Toolkit - *Steps to Resilience (Step 2)* https://toolkit.climate.gov/steps-to-resilience/assess-vulnerability-risks

- FEMA CRS Coordinator's Manual - Floodplain Management Planning (Section 512) https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf

The Washington Coastal Hazards Resilience Network and Island County Marine Resources Committee are excellent resources for current information related to sea level rise and best practices in coastal resilience planning.

- Washington Coastal Hazards Resilience Network website http://www.wacoastalnetwork.com/

- Island County Marine Resources Committee website https://www.islandcountymrc.org/

Planning template

Use worksheet 3, sections 1 and 2 to document the probability and severity of risks and potential consequences of sea level rise for community assets.

Use the worksheet 3 sections 2 and 3 to document the overall risk to individual assets and community risk tolerance.

Use the worksheet 3 summary table to consolidate risks and action thresholds across community assets.

Worksheet 3: Risk Assessment and Community Action Threshold

Instructions

Complete a risk assessment worksheet and risk characterization matrix for each community asset evaluated.

- Complete sections 1 and 2 of the risk assessment worksheet for each asset and modeled scenario to identify probability of sea level rise impacts (from Worksheet 1B) and severity of potential consequences of projected sea level rise on the ability of the selected asset to perform its primary function.
- Complete sections 3 and 4 of the worksheet to identify overall risk of sea level rise to the asset using a risk characterization matrix, and community risk tolerance specific to the asset being analyzed
- Enter risk analysis outcomes for each asset and scenario evaluated in the risk assessment summary table. An example is provided for reference.

Worksheet 3: Risk Assessment and Community Action Threshold

Asset:		
SECTION 1: Potential Sea Level Rise Consequences Circle all applicable across the three categories		
Economic	**People & Society**	**Environmental**
Movement of goods impaired **Movement of people impaired** **Employment centers disrupted** **Disproportionate impacts on certain business sectors** **Lost income** **Increased maintenance or repair costs** *Other:*	**Damage to housing and potential displacement** **Loss of recreation opportunities** **Residents unable to obtain key services** **Disproportionate impacts on certain community members** **Loss of cultural or historical resources** **Personal injury or loss of life** **Overall decline in quality of life** *Other:*	**Biodiversity or species loss** **Habitat fragmentation and/or loss** **Loss of flood protection benefits** **Water quality decline** **Loss of carbon sequestration function** *Other:*

SECTION 2: Severity of Consequences Using the descriptions below, identify the OVERALL potential level of impact	
Rating	**Description**
MINOR	Financial costs to the municipality or community are possible but would be minimal. No expected loss of life, minimal decline in quality of life and little disruption to livelihoods. Property and ecosystem damage might occur but could be repaired without substantial cost or time.
MODERATE	Some financial costs to the municipality or community are possible and would be moderate. No expected loss of life, but there could be a decline in quality of life and some disruption to livelihoods. Recovery of property and ecosystem damage would take longer and be more costly.
SEVERE	Large financial costs or significant inconveniences would be incurred by the municipality or community. The possibility of loss of life or livelihood exists. Significant, and potentially permanent, property or ecosystem damage might occur.

Worksheet adapted from NOAA Coastal Resilience Planning Guidance

Worksheet 3: Risk Assessment and Community Action Threshold

Asset:

SECTION 3: Risk Characterization Matrix

Characterize overall risk based on both probability of sea level rise impacts (from Worksheet 1B) and severity of consequences (from Worksheet 3 Section 2) Identify Circle all applicable across the three categories

Risk Characterization

Probability of occurrence > (from Worksheet 1B)			
	High	Very High	Very High
	Moderate	High	Very High
	Low	Moderate	High

Severity of Consequences > (from Worksheet 3 Section 2)

SECTION 4: Risk Tolerance Approach

Circle all applicable across the three categories

Considerations for risk tolerance:

- What you know about the asset – its uniqueness, function(s) or service(s) it provides, how it connects to other assets, etc.
- How risk averse the community is based on the values or culture of the community.
- How much you/the community can afford to be wrong – someone is going to be liable for the asset, how much are we willing to have something bad happen?
- The type and severity of potential consequences identified in sections 1 and 2.

Rating Description

RISK TOLERANT	MODERATE RISK	RISK AVERSE
Asset can adapt or will experience minimal impacts. Consequences are expected to be low or acceptable.	Some level of acceptable risk. Impact will have some consequences, but these will be tolerable and/or can be overcome relatively easily.	Very little acceptable risk. Impact will be difficult to overcome and should try to be avoided. Planning and actions might include worst case scenarios.

Worksheet adapted from the U.S. Climate Resilience Toolkit "Documenting Steps to Resilience" and NOAA Coastal Resilience Planning Guidance

Worksheet 3: Risk Assessment and Community Action Threshold

Risk Assessment Summary Table

For each asset and sea level rise scenario evaluated enter the projected sea level rise and probability of exceedance (from Worksheet 1B), the severity of consequences of projected sea level rise impacts (from Worksheet 3, Section 2), the scenario risk characterization (from Worksheet 3, Section 3), and overall risk tolerance (from Worksheet 3, Section 4).					
Community Asset	**Projected Sea Level Rise** (Worksheet 1B)	**Probability of Exceedance** (Worksheet 1B)	**Severity of Consequences** (Worksheet 3 Section 2)	**Risk Characterization** (Worksheet 3 Section 3)	**Risk Tolerance** (Worksheet 3 Section 4)
Coastal trail network	Sea level rise projected increase of 1-3ft by 2100	Likely	Minor Trail function is restored once area is drained	Moderate	Moderate Community desires to maintain or improve asset

Worksheet adapted from US Climate Resilience Toolkit "Documenting Steps to Resilience" and NOAA Coastal Resilience Planning Guidance

Step 4: Develop and Implement Coastal Resilience Strategies and Projects

This section provides guidance on identifying potential strategies and projects which may address community issues related to sea level rise, evaluating their feasibility, and leveraging available resources for implementation. Throughout this step, communities may seek technical assistance from local government or professional organizations involved in planning, design, construction, and/or environmental conservation to most accurately estimate feasibility of prospective solutions.

Develop Solutions

Objective

This step is intended to identify potential sea level rise adaptation strategies and project alternatives capable of mitigating unacceptable risk to community assets and values while complying with applicable guidelines and regulations. In this step community planning groups will develop a list of local sea level rise adaptation strategies and projects, and assess their effects on community asset resilience, economic viability, local and regional environmental impact, and implementation feasibility, among other factors. This process is intended to result in a prioritized list of viable short, medium, and long-term projects representing applicable protection, accommodation, and managed retreat adaptation strategies for which the community may pursue funding and implementation support.

Process

1) *List potential strategies and projects* - Reference recommended sea level rise adaptation management practices identified in resources such as the 2020 *Island County Sea Level Rise Strategy Study* to identify strategies and/or projects which may address potential impacts of sea level rise in shoreline communities.

2) *Conduct feasibility analysis* - Estimate tangible costs and benefits, environmental impacts, regulatory requirements, and implementation challenges associated with prospective projects or strategies. Evaluate projects across these and any other pertinent areas to determine feasibility. Document feasibility determination in table form (example below) for visual comparison of selected projects. Review of similar past projects and/or subject matter expert consultation may be necessary to analyze complex projects.

Community Asset	Adaptation Strategy	Costs	Benefits	Acceptance	Required Resources	Environmental Impact	Regulatory Requirements	Average Feasibility Rating	Additional Notes
Asset A	Strategy 1	🟢	🟡	🟡	🟢	🟡	🟡	🟡	
Asset A	Strategy 1	🟢	🟢	🟢	🟢	🟡	🟡	🟢	Selected Alternative
Asset A	Strategy 1	🔴	🟢	🟢	🔴	🟢	🟡	🔴	

Feasibility Ratings (copy and paste in matrix): 🟢 Feasible 🟡 Potentially Feasible 🔴 Not Feasible

Adaptation Project Feasibility Matrix
Adapted from the U.S. Climate Resilience Toolkit

3) *Determine strategy urgency* - Identify the timeframe in which potential strategies must be resourced and implemented to maintain an acceptable level of risk to community assets. Classify strategies as immediate (current year), short-term (1-5 yrs.), or long-term (5+ yrs.).

Tools and supporting resources

The U.S. Climate Resilience Toolkit and FEMA Community Rating System Floodplain Management Planning Guide provide additional guidance related to developing and prioritizing resilience projects which may inform community efforts.

- Island County Sea Level Rise Strategy Study (2020) – Recommended Adaptation Management Practices

- U.S. Climate Resilience Toolkit - *Steps to Resilience (Steps 3&4)* https://toolkit.climate.gov/steps-to-resilience/investigate-options

- FEMA CRS Coordinator's Manual - Floodplain Management Planning (Section 512) https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf

The Island County Planning Department, Marine Resources Committee, Washington Department of Fish and Wildlife, and American Planning Association are among the organizations which can provide access to resources, expertise, and in some cases planning assistance for community project development.

- Island County Department of Planning & Community Development (Planning Shorelines) https://www.islandcountywa.gov/Planning/Pages/shorelines.aspx
- Island County Marine Resources Committee website https://www.islandcountymrc.org/
- Washington Department of Fish and Wildlife - *Your Marine Waterfront: A guide to protecting your property while promoting healthy shorelines* https://wdfw.wa.gov/publications/01791
- American Planning Association - Community Planning Assistance Teams website https://www.planning.org/communityassistance/teams/

Planning template

Use worksheet 4A sections 1 and 2 to document proposed projects and project feasibility analyses.

Use worksheet 4A section 3 to summarize viable alternative adaptation strategies.

Worksheet 4A: Develop Solutions

Instructions and Example:

Use this worksheet to identify potential adaptation strategies which may address projected sea level rise impacts to vulnerable community assets; compare feasibility of alternatives and select a preferred strategy for each community asset; and develop a prioritized list of strategies for future implementation. Additional detail on how to complete and document this step are provided below for reference:

- Select potential adaptation strategies specific to each vulnerable community asset (asset vulnerability identified in Worksheet 2B). Refer to the 2020 Island County Sea Level Rise Strategy Study "Adaptation Practice Recommendation Table" presented below for a baseline list of strategies applicable to Island County.

Sea Level Rise Adaptation Practice Recommendation Table

PROTECT	ACCOMMODATE	RETREAT
SHORT-TERM STRATEGIES (Now - 2050)		
Soft Shorelines (H, B, C)	Advanced Septic Systems (H, B, C)	On-Site Retreat (H, B)
Beach Nourishment (H, B)	Anchored Septic Systems (H, B, C)	Off-Site Retreat (Some B, C)
Bulkhead/Seawalls (H, B, C)	Community Drainfields (H, B, C)	
Breakwater (C)	Elevated Structures (H, B, C)	
Dikes/Levees (H, C)	Floodable Spaces (H, B, C)	
Dry Floodproofing (H, B, C)	Raised Ground (H, B, C)	
Floodwall (H, B, C)	Water Supply Diversification (H, B, C)	
Revetment (H, B, C)	Wet Floodproofing (H, B, C)	
	Utility Relocation & Consolidation (H, B, C)	
PROTECT	ACCOMMODATE	RETREAT
MID-TERM STRATEGIES (2050 - 2070)		
Soft Shorelines (H, B, C)	Community Drainfields (H, B, C)	Off-Site Retreat (H, B, C)
Beach Nourishment (H, B)	Elevated Structures (H, B, C)	
Bulkhead/Seawalls (H, B, C)	Floodable Spaces (H, B, C)	
Dikes/Levees (H)	Raised Ground (H, B, C)	
Dry Floodproofing (H, B, C)	Utility Relocation & Consolidation (H, B, C)	
Floodwall (H, B, C)	Water Supply Diversification (H, B, C)	
	Wet Floodproofing (H, B, C)	
PROTECT	ACCOMMODATE	RETREAT
LONG-TERM STRATEGIES (2070 - 2100)		
Soft Shorelines (H, B, C)	Community Drainfields (H, B)	Off-Site Retreat (H, B, C)
	Water Supply Diversification (H, B)	
	Utility Relocation & Consolidation (H, B)	
	Floodable Spaces (H, B, C)	

Parenthesis indicate applicable community type: H - Historic Beach, B - Coastal Bluff, C - Canal

- Complete an adaptation strategy worksheet (Worksheet 4A, Section 1) for each potential strategy.
- Summarize strategy worksheets in a feasibility matrix (Worksheet 4A, Section 2) to compare strategies for each asset.
- Enter the selected strategy(ies) for each asset into a summary table (Worksheet 4A, Section 3). An example entry is provided for reference.

Worksheet 4A: Develop Solutions

Section 1. Adaptation Strategy Development

Asset:						
Strategy:			*What are you hoping to gain by this strategy? How would this reduce vulnerability?*			
Costs	**Benefits**	**Acceptance**	**Required Resources**	**Environmental Impacts**	**Regulatory Requirements**	**Timing/Urgency**
What is the estimated monetary cost of the strategy? High Moderate Low *Estimated Cost:*	*Is this strategy effective for a range of future climate projections?* Yes No; only low scenario No; only high scenario *Why?*	*To what degree is the community likely to accept the adaptation option?* Poor Fair Good Excellent *Why?*	*What County STAFF TIME might be required for this option?* Existing New or Additional *Notes:*	*What impact will the strategy have on the environment?* Natural Resource impacts Cultural Resource impacts Shoreline/Land Use impacts *Other*	*What regulatory requirements apply?* Development permitting Environmental permitting *Other:*	*What is the proposed implementation timeline (start and completion)?* Immediate (current year) Short Term (1-5 years) Long Term (5+ years) *Urgency drivers:*
Are there additional costs associated with this strategy? Social Political *Other:*	*Does this strategy achieve multiple benefits/goals?* Societal Economic *Other:*	*To what degree is there political support for the adaptation option?* Poor Fair Good Excellent *Why?*	*What TECHNICAL EXPERTISE might be required for this option?* Existing New or Additional *Notes:*	*Will potential impacts require SEPA environmental review?* Yes No Unsure *Notes:*	*Will a waiver, variance, or conditional use permit be required?* Yes (type) No Unsure *Notes:*	*If implementation is delayed, what cost(s) might be incurred?*
Are these additional costs anticipated to be: High Medium Low *Notes:*	*Are the costs equitably and justifiably distributed?* Yes No Unsure *Notes:*		*What MAINTENANCE is required for this strategy?* Continuous Periodic None *Notes:*			*Is this strategy contingent on other actions being implemented first? If so, what?*

Worksheet adapted from NOAA Coastal Resilience Planning Guidance

Worksheet 4A: Develop Solutions

Section 2. Adaptation Strategy Feasibility Matrix

Community Asset	Adaptation Strategy	Costs	Benefits	Acceptance	Required Resources	Environmental Impact	Regulatory Requirements	Average Feasibility Rating	Additional Notes
Coastal Trail Network	Coastal Trail Network Reroute	🟢	🟢	🟢	🟢	🟡	🟡	🟢	Permit and SEPA approval required

Feasibility Ratings (copy and paste in matrix): 🟢 Feasible 🟡 Potentially Feasible 🔴 Not Feasible

Worksheet adapted from US Climate Resilience Toolkit "Documenting Steps to Resilience"

Worksheet 4A: Develop Solutions

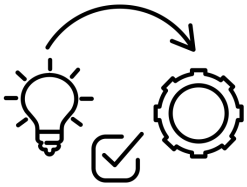
Section 3. Adaptation Strategy Summary

Priority	**Community Asset**	**Adaptation Strategy**	**Overall Feasibility** (Average. feasibility rating)	**Timing/Urgency** (immediate, short-term, long-term)	**Key Considerations** (barriers, contingencies, resource requirements, etc.)
1	Coastal Trail Network	Coastal Trail Network Reroute		Short-term	Permit required

Implement Solutions

Objective

This step provides guidance on implementation of selected community coastal resilience planning actions, to include development of an implementation plan, project permitting, and identification of funding sources.



Process

1) *Develop an Implementation Plan* - Plans should include the mechanism by which coastal resilience strategies are to be implemented (regulatory update, study, project, etc.), potential barriers to implementation, identification of key stakeholders necessary to facilitate the implementation process, and permits and/or approvals necessary for implementation. The plan should also include an implementation timeline as a basis for progress evaluation.

2) *Identify funding sources* - Most strategies will require some form of funding to implement. As part of the implementation process, communities should confirm funding sources as well as processes and timelines associated with accessing available funds.

Tools and supporting resources

Federal, state, and local project implementation and funding support may be available for selected adaptation projects. This may take the form of conservation and emergency preparedness grants including FEMA pre-disaster grants and Island County Salmon Recovery Program funding; conservation district financial assistance; property tax reductions through the Washington State Public Benefit Rating System for natural shoreline restoration; and free or low-cost technical assistance for soft shore projects through the Island County Department of Natural Resources and partner organizations such as the Northwest Straits Foundation. The U.S. Coastal Resilience Toolkit and Shore Friendly program provide listings of nationwide and Island County-specific funding opportunities available today. In the future, Island County may pursue additional incentives for coastal resilience projects.

- Island County Shoreline Development Permits
  https://www.islandcountywa.gov/planning/pages/land_use.aspx
- U.S. Climate Resilience Toolkit (Implementation Resources)
  https://toolkit.climate.gov/steps-to-resilience/take-action

- U.S. Climate Resilience Toolkit (Funding Opportunities)
  https://toolkit.climate.gov/content/funding-opportunities
- FEMA Pre-Disaster Mitigation Grant Program
  https://www.fema.gov/pre-disaster-mitigation-grant-program
- Island County Shore Friendly Program
  http://www.shorefriendly.org/resources/resources-in-your-area/island/
- Public Benefit Open Space Rating System
  https://www.islandcountywa.gov/Planning/Pages/pbrs.aspx

Planning template
Use worksheet 4B to document proposed project implementation plans and funding sources.

Worksheet 4B: Implement Solutions

Instructions and Example:
Use this worksheet to develop an implementation plan for adaptation strategies which may address projected sea level rise impacts to vulnerable community assets. Include implementation mechanisms, implementation process leads, supporting resources such as partnerships and funding sources. Additional detail on how to complete and document this step are provided below for reference:

- Complete a strategy implementation worksheet for each selected strategy and associated vulnerable community asset (selected strategies identified in Worksheet 4A, asset vulnerability identified in Worksheet 2B).
- Enter implementation factors for each strategy in the below summary table. Strategies should be listed in priority order. An example entry is provided for reference.

Worksheet 4B: Implement Solutions

Section 1. Adaptation Strategy Implementation Plan

Strategy:		
Mechanism:		
Circle the primary instrument for implementation: Regulation Legislation Incentive Planning Process Program Project		*The primary instrument is:* New Modification of Existing Existing, No Modification Needed
Potential Barriers to Implementation		
What are possible factors that may hinder implementation?		*What are some actions to overcome these barriers?*
Stakeholders and Partnerships		
Who makes the decision whether to implement the strategy?	*What partnerships can you leverage for implementing the strategy (either internal or external)*	*Which stakeholders will be impacted by implementation of the strategy? How can you engage them in implementation?*
Funding		
Do funding sources already exist? Yes No	*Funding sources are:* Internal External	*What is the process to request funding?*
Steps		
What needs to be completed before implementation can begin? Indicate appropriate timing next to activity. (Examples: data collection, further research, change in policy(s), building awareness, conducting training and/or outreach, etc.)		*Ideas on measuring success and determining the effectiveness of the strategy over time.*

Worksheet adapted from NOAA Coastal Resilience Planning Guidance

Worksheet 4B: Implement Solutions

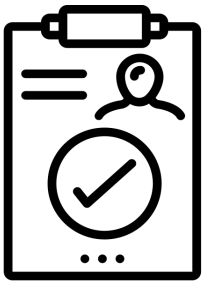
Section 2. Adaptation Strategy Implementation Plan Summary

Priority	Community Asset	Stakeholders	Adaptation Strategy	Implementation Mechanism	Implementation Partners	Implementation Funding Source	Implementation Timeline	Key Considerations (barriers, contingencies, resource requirements, etc.)
1	Coastal Trail Network	Community Property Owners	Coastal Trail Network Reroute	New Project	Shore Friendly Program	50% Community funds 50% Conservation Grant	Start < 6mo. Complete < 1 yr.	Permit and SEPA approval required

Step 5: Monitor Outcomes

Objective

This step is intended to provide guidance on community monitoring of adaptation strategies and project outcomes, documentation of project effectiveness, and identification of lessons learned to inform future iterations of the planning process. Effective monitoring and feedback allow communities to optimize the community-based planning process. This step requires community planning group dedication and continuity to ensure lessons learned are effectively passed on and applied to future initiatives.



Process

1) *Establish a project monitoring team* - Identify community planning team members responsible for periodic follow-up to ensure projects are on track and to document outcomes.

2) *Conduct periodic evaluation of adaptation strategy implementation* - Document progress of adaptation strategy implementation based on the schedule and milestones established in the implementation plan. Identify primary causes for delays if encountered, as well as key factors contributing to timely completion.

3) *Evaluate strategy outcomes* - Continue periodic post-implementation monitoring to determine whether strategy or project objectives are achieved. Use this evaluation to inform continued and/or future planning efforts.

4) *Document lessons learned* - Identify things that worked well and challenges encountered throughout the implementation process and post-implementation period. Ensure lessons learned are made publicly available to inform future community planning efforts.

Tools and supporting resources

Tools and resources which may assist with this step include CRS Floodplain Management Planning guidance on plan maintenance and U.S. Climate Resilience Toolkit guidance on post-implementation monitoring.

- U.S. Climate Resilience Toolkit - *Monitoring Guidance*
  https://toolkit.climate.gov/steps-to-resilience/take-action
- FEMA CRS Coordinator's Manual - Floodplain Management Planning (Section 512)
  https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf

Planning template

Use worksheet 5 to outline a post-implementation monitoring plan and capture lessons learned.

Worksheet 5: Monitor Outcomes

Instructions and Example:
Use this worksheet to document implementation progress and post-implementation outcomes. Capture best practices, challenges, and lessons learned to inform future plans. An example is provided for reference.

Adaptation Strategy Implementation Plan Summary

Priority	Community Asset	Adaptation Strategy	Implementation Status (Planned, In Progress, Complete, Delayed)	Implementation Challenges	Implementation Best Practices	Post-Implementation Asset Vulnerability (low, moderate, high)	Lessons Learned	Future Planning Recommendations	Date of Update
1	Coastal Trail Network	Coastal Trail Network Reroute	Complete	Permitting delay (1mo.)	Regular (monthly) community updates	Low	Ensure permitting requirements and timelines are confirmed prior to project start	Project complete. No further action.	1/24/20
2									
3									
4									
5									

Finalizing the Coastal Resilience Plan

With the initial coastal resilience planning process complete, community planning teams have a basis from which to move forward with prioritized implementation of coastal adaptation strategies. The final plan should be a consolidated document which includes the completed contents of worksheets 1-5 and a plan cover sheet which includes the following information:

Island County, WA
Community Coastal Resilience Plan
(Community Name and Location)
(Date of Report and revision number)

Part 1: Community Planning Issues and Team

Community Profile (Worksheet 1A)

Basis for Planning: Sea Level Rise Projections (Worksheet 1B)

Planning Team: Stakeholder Groups and Representatives (Worksheets 1C &1D)

Part 2: Community Values and Vulnerable Assets

Community Values, Goals, and Assets (Worksheet 2A)

Community Asset Vulnerability (Worksheet 2B)

Part 3: Risk Analysis and Threshold for Community Action

Community Risks and Thresholds for Action (Worksheet 3)

Part 4: Resilience Strategy Development and Implementation

Proposed Adaptation Strategies (Worksheet 4A)

Implementation Plan (Worksheet 4B)

Part 5: Post-Implementation Monitoring and Lessons Learned

Adaptation Strategy Implementation Plan Monitoring Summary (Worksheet 5)

Completed plans should be made publicly available to community members and shared with the Island County Planning Department. The planning process is iterative and requires regular review of factors that led to decision points related to risks, thresholds for action, and implementation timelines. As implementation and monitoring plans progress, it is imperative that planning process leads remain engaged with County and community organizations involved in shoreline planning to incorporate updated information pertinent to coastal resilience plans as it becomes available.

Additional Information and Resources

For additional information related to Island County shoreline planning and development regulations, please visit the Island County Planning Department "Shorelines" website: https://www.islandcountywa.gov/Planning/pages/shorelines.aspx

A consolidated list of online tools and resources referenced throughout this guidebook is provided below:

Sea Level Rise Projections and Modeling

- Projected Sea Level Rise for Washington State: a 2018 Assessment
  http://www.wacoastalnetwork.com/wcrp-documents.html
- NOAA Sea-Level Rise Viewer
  https://coast.noaa.gov/slr/

Planning Aids

- U.S. Climate Resilience Toolkit Steps to Resilience
  https://toolkit.climate.gov/#steps
- FEMA CRS Coordinator's Manual - Floodplain Management Planning (Section 512)
  https://www.fema.gov/media-library-data/1493905477815-d794671adeed5beab6a6304d8ba0b207/633300_2017_CRS_Coordinators_Manual_508.pdf
- Washington Department of Fish and Wildlife - *Your Marine Waterfront: A guide to protecting your property while promoting healthy shorelines*
  https://wdfw.wa.gov/publications/01791
- American Planning Association - Community Planning Assistance Teams website
  https://www.planning.org/communityassistance/teams/
- University of Kansas - *Community Toolbox*
  https://ctb.ku.edu/en/table-of-contents/assessment/assessing-community-needs-and-resources/identify-community-assets/main

Shoreline Permitting

- Island County Shoreline Development Permits
  https://www.islandcountywa.gov/planning/pages/land_use.aspx

Funding & Incentive Programs

- U.S. Climate Resilience Toolkit (Funding Opportunities) https://toolkit.climate.gov/content/funding-opportunities
- FEMA Pre-Disaster Mitigation Grant Program https://www.fema.gov/pre-disaster-mitigation-grant-program
- Island County Shore Friendly Program http://www.shorefriendly.org/resources/resources-in-your-area/island/
- Public Benefit Open Space Rating System https://www.islandcountywa.gov/Planning/Pages/pbrs.aspx

Community Organizations and Citizen Science

- Island County Marine Resources Committee website https://www.islandcountymrc.org/
- Washington Coastal Hazards Resilience Network website http://www.wacoastalnetwork.com/
- Nextdoor website https://nextdoor.com/find-neighborhood/wa/

Glossary

Glossary Terms

Adaptation = Measures to reduce the vulnerability of natural and human systems to actual or expected climate change effects. (Watson & Adams, 2011)

Accommodate SLR Strategy = Accommodation allows natural systems to occur and human impacts are minimized by adjusting human use of the coastal zone via changing land use/crop types, applying flood resilience measures, etc. (Zommers & Alverson, 2018) This strategy includes techniques like elevating structures, floodproofing and floodable designs.

Attack SLR Strategy = An active strategy that expands land in coastal areas by building up and out along the water. Historically, a land claim has been used in large coastal cities to overcome land constraints. This strategy is currently in use in Dubai, Singapore, the Maldives and other areas where investment can sustain the large cost. Island building would fall into this category. (For more on this look at Dubai's constructed island the Palm Island.) (Zommers & Alverson, 2018)

Bathtub Mapping of Sea-Level Rise = Sea-level rise mapping using a single value of water level rise in all locations. This method does not take into account storm tide, waves or wind. (Washington Coastal Resilience Project, 2019)

Barrier beach = Spits of sand that form parallel to the shore. (Watson & Adams, 2011)

Base flood = In *National Flood Insurance Program (NFIP)*, defined as a flood that has a 1% probability of being equaled or exceeded in any given year. Also known as the 100-year flood. (Watson & Adams, 2011)

Base Flood Elevation (BFE) = Elevation of the base flood in relation to a specific datum, such as the National Geodetic Vertical Datum (NGVD) or the North American Vertical Datum (NAVD). The BFE is the basis of the insurance and floodplain management regulations of the NFIP. (Watson & Adams, 2011)

Beach = Area within the low water line and to an area of a marked change in material or physiographic form or the permanent vegetation line. (Watson & Adams, 2011)

Beach nourishment = Replacement of augmentation of beach sand removed by ocean waters. It may occur naturally by longshore transport or be brought about artificially by the deposition of dredged materials or material from upland sites. (Watson & Adams, 2011)

BMP (Best Management Practices) = State-of-the-art method or measure for achieving the desired benefit, such as improved water quality. (Watson & Adams, 2011)

Breakwater = A structure that forms a harbor and basin to protect the shore from the effects of waves, as well as to provide a safe place for fishing vessels to berth. Functions to calm water, reduce wave height, and prevent shoreline erosion. (Al, 2018) Usually made of rock and concrete.

Buffer = A vegetated strip immediately adjacent to a stream, river, or water body intended to protect the water from sediment and pollutant runoff and siltation from upstream areas. Other benefits may include rainfall infiltration and habitat enhancement. (Watson & Adams, 2011)

Bulkhead = Wall or other structures, often wood, steel, stone, or concrete, designed to retain or prevent sliding or erosion of the land. Occasionally bulkheads are used to protect against wave action. (Watson & Adams, 2011)

Climate Projections = A range of plausible pathways, scenarios or targets that capture the relationships between human choices, emissions, concentrations and temperature changes. (Washington Coastal Resilience Project, 2019)

Climate Change= (i) Change in temperature and weather patterns (ii) defined in the United Nations Framework Convention on Climate Change as 'a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere in addition to natural climate variability observed over comparable time periods. (Watson & Adams, 2011)

Coastal Barrier = Dispositional geologic feature such as a bay barrier, tombolo, spit, or barrier island that consists of unconsolidated sedimentary materials; is subject to wave, tidal and wind energies; and protects landward aquatic habitats from direct waves. (Watson & Adams, 2011)

Coastal Erosion = The wearing away of land, or the removal of beach or dune sediments by wave action, tidal currents, wave currents or drainage. A combination of episodic inundation events and relative sea-level rise will serve to accelerate coastal erosion. (Washington Coastal Resilience Project, 2019)

Coastal Flood Hazard Area (CFHA) = Under the NFIP, an area -- usually along an open coast, bay, or inlet -- that is subject to flood by storm surge and, in some instances, wave action caused by storms or seismic forces. (Watson & Adams, 2011)

Coastal High Hazard Area (CHHA) = Under the NFIP, an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave action from storms tsunami, or seismic sources. On a Flood Insurance Rate Map (FIRM), the CHHA is designated as a V zone, indicating the area is subject to a base flood with wave heights or wave run-up depths greater than or equal to 3.0 feet. (Watson & Adams, 2011)

Coastal Inundation = Water covering land that was once historically tidal but has been disconnected from flow due to natural or anthropomorphic causes.(Washington Coastal Resilience Project, 2019)

Coastal Zone Management = Integrated and general development of the coastal zone. Coastal zone management is not restricted to coastal defense works but includes development in economic, ecological, and social terms. (Watson & Adams, 2011)

Coastline = (i) Technically, the line that forms the boundary between the coast and the shore; (ii) commonly, the line that forms the boundary between the land and the water (e.g., the water of sea or ocean). (Watson & Adams, 2011)

Design storm = Hypothetical extreme storm for which coastal protection structures will often be designed to withstand. The severity of the storm (i.e. return period) is chosen in view of the acceptable level of risk of damage or failure. (Watson & Adams, 2011)

Design Flood Elevation (DFE) = Elevation that is referenced for design, specified by local regulatory authorities, which establishes the elevation of the lowest floor member or horizontal structural components. The DFE may be the same as the BFE, or higher, as an additional safety factor at the discretion of local communities. (Watson & Adams, 2011)

Dike / Dyke = A constructed wall or embankment along a shore to prevent flooding of low-lying land. Also, see levee. (Watson & Adams, 2011)

Dune = A low hill or ridge of drifted sand in coastal areas that can be bare or covered with vegetation. The primary dune, also called the primary frontal dune, is the critical first line of coastal defense exposed to harshest conditions of erosion, wind, waves, salt air, requiring hardy vegetation for stabilization. (Watson & Adams, 2011)

Elevated Structures = A structure where all or most of the vital building infrastructure is raised above the flood line. (Al, 2018) Expensive.

Embankment = An elevated human-made or natural deposit of soil, rock or other materials placed with sloping sides and with a length greater than its height. Usually, an embankment is wider than a dike. (Watson & Adams, 2011)

Encroachment = Any physical object placed in a floodplain that hinders the passage of water or otherwise affects flood flows. (Watson & Adams, 2011)

Erosion = Process of the gradual wearing away of land or landmasses. In general, erosion involves the detachment and movement of soil and rock fragments, during flood or storm over a period of years, through the action of wind, water, or other geologic processes. (Watson & Adams, 2011)

Estuary = (i) A semi-enclosed body of water that has a free connection to the open sea or river that is affected by tides; (ii) region near a river mouth in which freshwater of the river mixes with the saltwater of the sea and that receives both fluvial and littoral sediment influx. (Watson & Adams, 2011)

Extreme Water Level (EWL) = Future extreme water levels are the sum of the water level associated with multiple processes; tides, storm surge and wave run-up. (Washington Coastal Resilience Project, 2019)

Federal Emergency Management Agency (FEMA) = Federal agency created in 1979 to provide a single point of accountability for all federal activities related to disaster mitigation and emergency preparedness, response, and recovery. FEMA administers the National Flood Insurance Program. (NFIP). (Watson & Adams, 2011)

500-Year Flood = Flood that has a 0.2% probability of being equaled or exceeded in any given year. (Watson & Adams, 2011)

Floating Island = Artificial floating islands are typically constructed of a thick, floating organic mat that can support plant growth. The islands help dampen wave energy in sheltered water bodies-- although this is as yet relatively untested-- and environmentally remediate water. (Al, 2018)

Floating Structure = Floating structures rise and fall with floodwaters. (Al, 2018) Expensive.

Flood = A general or temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters; unusual and rapid accumulation of runoff of surface waters from any source; or mudslides (mudflows) caused by flooding. (Watson & Adams, 2011)

Floodable Plain = Flat areas that are adjacent to a river or body of water that can be flooded when the water body's capacity is exceeded. Floodable plains use existing natural or urban environments to catch stormwater and control for floods. During nonflood times, the floodable plains can be dry and used for other purposes, such as recreation. (Al, 2018)

Floodable Square = Floodable squares and parks are lowered urban areas that become pools during heavy rainfall or flooding from the sea or river. (Al, 2018) Space may be used for recreation during dry conditions.

Flood Elevation = Height of the water surface above an established elevation datum such as the NGVD, NAVD, or mean sea level. (Watson & Adams, 2011)

Flood Insurance Rate Map (FIRM) = under the NFIP, an official map of a community, on which the Federal Emergency Management Agency has delineated both special flood hazard areas (SFHA) and the insurance risk premium zones applicable to the community. (Watson & Adams, 2011)

Floodplain = (i) Area that is flooded periodically by the lateral overflow of rivers; (ii) in hydrology, the entire area that is flooded at a reoccurrence interval of 100 years; (iii) under the NFIP, synonymous with 100-year floodplain, any land area susceptible to being inundated by water from any source, with a 1% probability of being equaled or exceeded in any given year. (Watson & Adams, 2011)

Floodplain Management Regulations = Under the NFIP, any and all zoning ordinances, subdivision regulations, building codes, health regulations, special-purpose ordinances, and other applications of police power, which provide standards for flood damage prevention and mitigation. (Watson & Adams, 2011)

Floodproofing = A common technique to prevent flooding of individual structures. There are four different types of floodproofing: 1) wet floodproofing, 2) dry floodproofing, 3) elevating the structure, and 4) amphibious or floating structures. (Al, 2018)

**Wet Floodproofing = allows floodwater to enter and leave a structure through designated openings and thus requires non occupied space. (Al, 2018)

**Dry Floodproofing = prevents water from entering a structure through watertight designs and is technically a protection strategy. This strategy allows for more usable space than wet floodproofing but cannot support extended periods of flooding, as leakage is bound to occur. (Al, 2018)

Floodwall = Floodwalls are vertical artificial barriers, either temporary or permanent, designed to withstand waters from a river, waterway or ocean. They are typically built of concrete or masonry, but glass versions exist as well. (Al, 2018) They may be used in open spaces.

Freeboard = (i) Under the NFIP, a factor of safety above the base flood elevation (BFE), usually expressed in feet. Freeboard is intended to plan for many unaccounted or unknown factors that could contribute to flood elevations greater than the BFE calculated for a selected condition; (ii) on a ship, the distance from the waterline to the main deck or gunwale. (Watson & Adams, 2011)

Freshwater Marsh = Grassy wetlands that occur along rivers and lakes, typically dominated by grasses, reeds, rushes, and sedges. (Watson & Adams, 2011)

Green Solutions = Green solutions utilize ecological and environmental principles and practices to provide flood protection, as well as reduce erosion and stabilize shorelines, while also enhancing habitats and improving aesthetics (as compared to hard solutions). Often, soft solutions are less expensive than hard solutions and lower in maintenance, but they are not permanent and are subject to erosion. (AI, 2018) Also, see soft protection.

Grey Solutions = Often developed by civil and environmental engineers, are flood protection structures that are (almost always) permanent. Hard solutions focus on controlling flooding and sea-level rise. Examples of hard solutions are seawalls, floodwalls, and revetments. The downside of these projects is the disruption of ecological systems. They are generally expensive and require maintenance. (AI, 2018) Also, see hard protection.

Groin = Narrow structure built perpendicular to the coastline to reduce longshore currents and/or to trap and retain littoral material. Most groins are of timber or rock and extend from a seawall, or the backshore, well onto the foreshore and rarely farther offshore. (Watson & Adams, 2011)

Groundwater = Water contained below ground in soil and rock. (Watson & Adams, 2011)

Hard Protection = Often developed by civil and environmental engineers, are flood protection structures that are (almost always) permanent. Hard solutions focus on controlling flooding and sea-level rise. Examples of hard solutions are seawalls, floodwalls, and revetments. The downside of these projects is the disruption of ecological systems. They are generally expensive and require maintenance. (AI, 2018) Also, see grey solution.

High Water Line = Maximum height reached by each rising tide. The height may be solely due to the periodic tidal forces or it may have superimposed on it the effects of prevailing meteorological conditions. Also called high tide. The shoreline delineated on the nautical charts of the National Ocean Service is an approximation of the high water line. (Watson & Adams, 2011)

100-Year Flood = Flood that has a 1% probability of being equaled or exceeded in any given year. (Watson & Adams, 2011)

Intergovernmental Panel on Climate Change (IPCC) = The United Nations body for assessing the science related to climate change. Through its assessments, the IPCC determines the state of knowledge on climate change. It identifies where there is an agreement in the scientific community on topics related to climate change, and where future research is needed. The reports are drafted and reviewed in several stages, thus guaranteeing objectivity and transparency. The IPCC does not conduct its own research. IPCC reports are neutral, policy-relevant but not policy-prescriptive. The assessment reports are a key input into the international negotiations to tackle climate change. Created by the United Nations Environment Programme (UN Environment) and the World Meteorological Organization (WMO) in 1988, the IPCC has 195 members. (Washington Coastal Resilience Project, 2019)

Intermediate Marsh = A marsh occurring where the salinity is about 3 parts per 1,000 (ppt); a transition area between fresh and brackish marshes. (Watson & Adams, 2011)

Intertidal = Alternately flooded and exposed by tides. (Watson & Adams, 2011)

Jetty = Wall built out into the water to restrain currents or protect coastline or structure, to present shoaling of a channel by littoral materials, and/or to direct and confine the stream or tidal flow. Jetties may also be built at the mouths of rivers or tidal inlets to help deepen and stabilize a channel. (Watson & Adams, 2011) A jetty is usually longer and narrower than a groin and is not part of a series.

King Tide = a common term, not scientific in origin, that describes an exceptionally high tide.

Levee = (i) A long, low ridge or embankment built up by a stream on its floodplain along one or both banks of its channel, deposited by flooding; (ii) a linear mound of earth or stone, often having an access road along the top, constructed to present a river from overflowing. Also see dike. (Watson & Adams, 2011)

Living Shoreline = Living shorelines are gently sloping natural banks that reduce shoreline erosion, protect coastal ecosystems, and help reduce storm surge strengths along the coastline. Living shorelines use plants, sands, and limited hard landscape (hardscape) approaches such as concrete and rocks to ensure and maintain the natural habitat. (Al, 2018)

Low Water Line = The minimum elevation reached by each falling tide. Nontechnically also called low tide. (Watson & Adams, 2011)

Marsh = Wetland periodically or continuously flooded to a shallow depth, where terrestrial and aquatic habitats overlap dominated by herbaceous or nonwoody grasses, cattails, and other low plants, often emerging in shallow ponds or depressions, river margins, tidal areas, and estuaries. (Watson & Adams, 2011)

Mean Sea Level (MSL) = Average height of the sea for all stages of the tide, usually determined from hourly height observations over a 19-year period on an open coast or adjacent waters having free access to the sea; the average sea level that would exist in the absence of tides. (Watson & Adams, 2011)

Mitigation = (i) Action taken to reduce or permanently eliminate the long-term risk to life and property from natural hazards; (ii) replacement of functional values lost when an ecosystem is altered. Mitigation can include a replacement, restoration, and enhancement of functional values. (Watson & Adams, 2011)

Mudflat = Shallow water benthic zone of coastline alternately covered or uncovered by the tide, comprised of extremely fine sediment, typically fine silt and clay. (Watson & Adams, 2011)

National Flood Insurance Program (NFIP) = Federal program created by Congress in 1968 that makes flood insurance available in communities that enact and enforce satisfactory floodplain management regulations. (Watson & Adams, 2011)

Near Shore Vegetation = Kelps and seagrasses can stabilize shores when grown nearby. In addition to providing rich habitat, aquatic vegetation dampens wave energy and anchor sediment. (Freitag, 2019)

Protect SLR Strategy = protection seeks to control natural systems through hard and soft barriers and reduces human impacts in that zone that would be impacted without protection. (Zommers & Alverson, 2018) Hard accommodation measures include seawalls, revetments, floodwalls, dikes and surge barriers. Soft measures include developing living shorelines, dunes and beach nourishment and floating islands.

Raised Ground = A strategy that invites water to penetrate waterfront districts while elevating infrastructure such as roads to sustain human use during floods. This technique provides the opportunity for development for residential, office, hotel, retail, and transit uses. (Al, 2018)

Relative Sea Level Change = The sum of the sinking of the land (subsidence) and eustatic sea-level change; the change in average water level with respect to the surface. (Watson & Adams, 2011)

Resilience = The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change. (Watson & Adams, 2011)

Retreat SLR Strategy = Retreat or planned retreat allows natural systems to occur without human intervention. Human impacts are minimized by pulling back from the coast via land use planning, development controls, planned migration, etc. (Zommers & Alverson, 2018) Retreat is

the only way to eliminate life and property risks associated with sea-level rise. In some cases, retreat many be an unavoidable response. However, this option is economically feasible only if it is possible to relocate within their existing property, either to higher ground or with a greater setback from a flood source. (Watson & Adams, 2011)

Revetment = (i) A facing of stone or concrete to protect an embankment or shore structure against erosion by wave action or currents; (ii) a retaining wall, typically sloped. (Watson & Adams, 2011)

Riparian = Pertaining to the banks and edges of a stream or river (Watson & Adams, 2011)

Riprap = Broken stone, cut stone blocks, or rubble layered on slopes as protection from erosion or scour caused by flood or wave action. (Watson & Adams, 2011)

Risk = The probability of harmful consequences or expected losses (death and injury, losses of property and livelihood, economic disruption, or environmental damage) resulting from interactions between natural or human-induced hazards and vulnerable conditions. (Washington Coastal Resilience Project, 2019)

Saltwater intrusion = Displacement of fresh surface water or groundwater by the advance of saltwater due to its greater density. This usually occurs in coastal and estuarine areas due to reducing land-based influence (e.g. from reduced runoff and associated groundwater recharge, or from excessive water withdrawal from aquifers) or increasing marine influence (e.g. relative sea-level rise). (Watson & Adams, 2011)

Scarp = An almost vertical slope along the beach caused by erosion by wave action and the nature and composition of the beach. (Watson & Adams, 2011)

Scour = Removal of soil or fill material by waves and currents and/or the flow of floodwaters, especially at the base or toe of a shore structure. (Watson & Adams, 2011)

Sea-Level Rise (SLR) = Sea level change, both globally and locally, due to changes in the shape of ocean basins, in the total mass of water, and in water density. Factors due to global warming include an increase in the total amount and mass of water from the melting of land-based snow and ice, and a decrease in water density due to thermal expansion from an increase in ocean temperatures and salinity changes. (Watson & Adams, 2011)

Seawall = Seawalls are vertical structures designed to protect habitation from major wave and tidal action. These structures, which are generally made of concrete but also of stone, create a stark boundary at the shoreline and help present upland erosion and storm-surge flooding. Although seawalls are effective barriers, they can obliterate the relationship between water and land and cause erosion by disrupting sediment movement and often require beach nourishment as beaches disappear. (AI, 2018)

Setback = In planning regulations, a limiting distance for the location of construction, typically from the edge of a water body within which development is either prohibited or regulated and subject to specific plan approval or variance. Setbacks are established by local regulation for the purpose of maintaining open space next to wetlands, streams, lakes, coastlines, and other water bodies. The sea within setbacks is the frequency used for flood control, recreation, preservation of drinking water supply, and wildlife habitat enhancement. (Watson & Adams, 2011)

Shoreline = The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines. Also used in a general sense to mean the coastline. The line delineating the shoreline on NOAA nautical charts and surveys approximates the mean high water line. (Watson & Adams, 2011)

Shoreline Retreat = Progressive movement of the shoreline in a landward direction caused by the composite effect of all storms considered over the decades and centuries (expressed as an annual average erosion rate). Shoreline retreat considers the horizontal component of erosion and is relevant to long term land-use decisions and the siting of buildings. (Watson & Adams, 2011)

Soft Protection = Green solutions utilize ecological and environmental principles and practices to provide flood protection, as well as reduce erosion and stabilize shorelines, while also enhancing habitats and improving aesthetics (as compared to hard solutions). Often, soft solutions are less expensive than hard solutions and lower in maintenance, but they are not permanent and are subject to erosion. (AI, 2018) Also, see green solutions.

Special Flood Hazard Area (SFHA) = Under the NFIP, an area having special flood, mudslide, and/or flood-related erosion hazards and shown on Flood Insurance Rate Map (FIRM) as a Zone A, AO, A1-A30, AE, A99, AH, or Zone V, V1-30, VE, M or E. (Watson & Adams, 2011)

Storm Surge = Water that is pushed toward the shore by the force of the winds swirling around the storm. (Washington Coastal Resilience Project, 2019)

Subsidence = A gradual sinking of land with respect to its previous level. (Watson & Adams, 2011)

Substantial damage = In the NFIP, damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged conditions would equal or exceed 50% of the market value of the structure before the damage occurred. (Watson & Adams, 2011)

Surge Barrier = Surge barriers, fixed dam structures with movable gates, provide some of the highest levels of protection from coastal storm surge. Surge barriers protect best when coupled with protection measures such as shoreline levees, seawalls, and/or pumps. During dry conditions, a surge barrier's gates will remain open to allow the free flow of water, and vessels. However, prior to a storm, the gates will be closed. (Al, 2018) Types of surge barriers include sector gates, vertical lifting gates, and, on a smaller scale, tide gates. High maintenance and require monitoring.

Thermal Expansion = When the ocean warms, seawater becomes less dense and expands, raising sea-level. (Washington Coastal Resilience Project, 2019)

Vegetative Shore Protection = Some plants protect coastal areas from erosion, storm surge, and tsunamis. For example, The mangroves' massive root systems are efficient at dissipating wave energy… slow down tidal water enough that its sediment is deposited as the tide comes in, leaving all except fine particles when the tide ebbs. In this way, mangroves build their own environment. (Freitag, 2019)

Weir = Low-head dam or wall placed across a canal or river to raise, divert, regulate, or measure the flow of water. (Watson & Adams, 2011)

Wetland = Defined in the Code of Federal Regulations as an area inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (Watson & Adams, 2011)

Glossary References

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