

SEA LEVEL RISE PLANNING GUIDE FOR COASTAL OREGON

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OREGON
Department of
Land Conservation
& Development



OCMP
Oregon Coastal
Management Program

HIGHWAY 101 AND NORTHFORK ROAD INTERSECTION IN DOWNTOWN NEHALEM DURNING A KING TIDE.
PHOTO BY @PASCOPDX, 2022

Sea Level Rise Planning Guide for Coastal Oregon

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Commonly Used Acronyms and Agency Names

DLCD – Oregon Department of Land Conservation and Development

DOGAMI – Oregon Department of Geology and Mineral Industries

EPA – Environmental Protection Agency

FEMA – Federal Emergency Management Agency

LCEP – Lower Columbia Estuary Partnership

NFIP – National Flood Insurance Program

NOAA – National Oceanic and Atmospheric Administration

OCMP – Oregon Coastal Management Program

OPRD – Oregon Parks and Recreation Department

SLR – Sea level rise

USACE – United States Army Corps of Engineers

I. Introduction



LANDSLIDE ACTIVITY ON COASTAL HEADLAND IN NEWPORT. PHOTO BY HAILEY BOND, 2021.

Oregon is experiencing the pervasive effects of the changing climate and ocean conditions. Statewide, air temperatures are rising; winter snowpacks are decreasing; and ocean chemistry is shifting. These drivers have cascading impacts to both our communities and the environment on which we depend. Climate impacts do not affect all regions and communities equally. Underserved populations, rural communities, and fragile ecosystems are already bearing the brunt of climate impacts. The future is likely to have:

- More summer droughts
- More frequent extreme heat days
- More frequent and longer forest fires
- Greater vulnerability of forests to insects and disease
- More water resource conflicts
- Decreased water quality and quantity
- More stress on fish
- Higher sea levels and more erosion and flooding in coastal areas
- More frequent and damaging floods
- Changing precipitation patterns
- Increased invasive and non-native species
- Longer and more intense allergy seasons

People of Oregon must act now to reduce future impacts and address social and financial inequities. This Guide is focused on how Oregon’s coastal communities can address the anticipated impacts from sea level rise, both on the outer coast and along estuaries and tidal rivers.

Local governments and tribes are on the frontlines responding to these impacts. Cities and counties are confronting the perpetual challenge of balancing multiple competing public and private interests in coastal resources, made more acute by climate change. Jurisdictions will need to identify tools and options for mitigating harm to people, property, and coastal ecosystems. Cities and counties will need flexible frameworks to address coastal development subject to advancing climate impacts.

More information about the anticipated effects of climate change in Oregon can be found at the Oregon Climate



**FLOODING DURING A KING TIDE ON 7TH ST AND HIGHWAY 101, NEHALEM.
PHOTO BY TYLER SLOAN, 2021.**

Change Research Institute’s [website](#). More information about what the Oregon Department of Land Conservation and Development is doing to address mitigation and adaptation to other impacts of climate change can be found at the agency’s [website](#).

Guidebook Purpose and Audience

This document is:	This document is NOT :
Guidance	Regulatory
Dynamic	Static
Multi-purpose for multiple audiences	Meant to be read cover-to-cover
A menu of options	A checklist

This Guide and associated resources, developed by the Oregon Coastal Management Program (OCMP), provides a suggested approach to evaluate the assets at risk from the impacts of sea level rise and offer potential adaptation strategies to adapt to those impacts. The Guide can be used by a city, a county, a Tribal Nation, a neighborhood, a Chamber of Commerce, a school district, a special district, or others to evaluate a specific geographic region. OCMP staff are available to assist any entity looking to utilize this Guide and will continue to revise this resource as more information is learned.

Local government and tribal staff, especially land use planners, natural resource specialists, public works staff, and floodplain managers, may find the Guide useful in preparing local communities for the impacts of sea level rise. Consultants, businesses, organizations, school districts, and others might find this guidebook useful for its adaptation planning process, list of potential strategies, and resource and reference list. This document is intended to guide local planning and development decisions on the Oregon Coast to support community resilience and ensure effective coastal management actions. It is OCMP’s effort to keep ahead of the hazards with a clear approach and continually refined tools. It does not alter or supersede existing legal requirements, such as the policies of the Statewide Land Use Planning Goals, Oregon Revised Statutes, Oregon Administrative Rules, state agency permitting requirements, or local government plans, policies, and ordinances.

Sea Level Rise Impacts

It is anticipated that sea level rise (SLR) will exacerbate existing erosion and flooding patterns in coastal regions and put pressure on already stressed ecosystems and freshwater resources, including water quality and available quantity. Below is a summary of some of the impacts of sea level rise and important considerations for addressing these impacts.

Sea level rise will result in widespread beach erosion. For example, SLR will cause waves to reach the back of the beach more frequently which may lead to a loss of protective dune features, such as dune width, height, and vegetation. Sea level rise will reduce the stability of hard protective structures, such as seawalls and riprap revetments. In some cases, dunes and structures may be overtopped. With reduced stability, these hard structures will no longer provide the same level of protection to the surrounding areas. Additionally, SLR may increase coastal water pollution by causing saltwater intrusion to freshwater aquifers in dunes, cause septic system failures, and impact other piped infrastructure such as stormwater outfalls. Increased erosion due to rising sea levels, flooding, and king tides also can remove sediment that is rich with cultural material, including archaeological sites, locations of great significance to Tribes, and historic properties such as the Yaquina Head Lighthouse. These effects impact not only Oregon’s cultural resources, but recreational opportunities to experience this cultural heritage and the special places they represent.

Many factors contribute to an ecosystem’s response to SLR, including the ecosystem type, the rate of SLR, potential changes in water quality, and the ability of the ecosystem to migrate landward. Faster rates of SLR, such as those projected over the next 50 to 100 years, may exacerbate saltwater intrusion into freshwater habitats and make it challenging for these habitats to maintain their protective functions. In addition, structures and infrastructure can prevent the landward migration of many habitats, such as tidal wetlands.

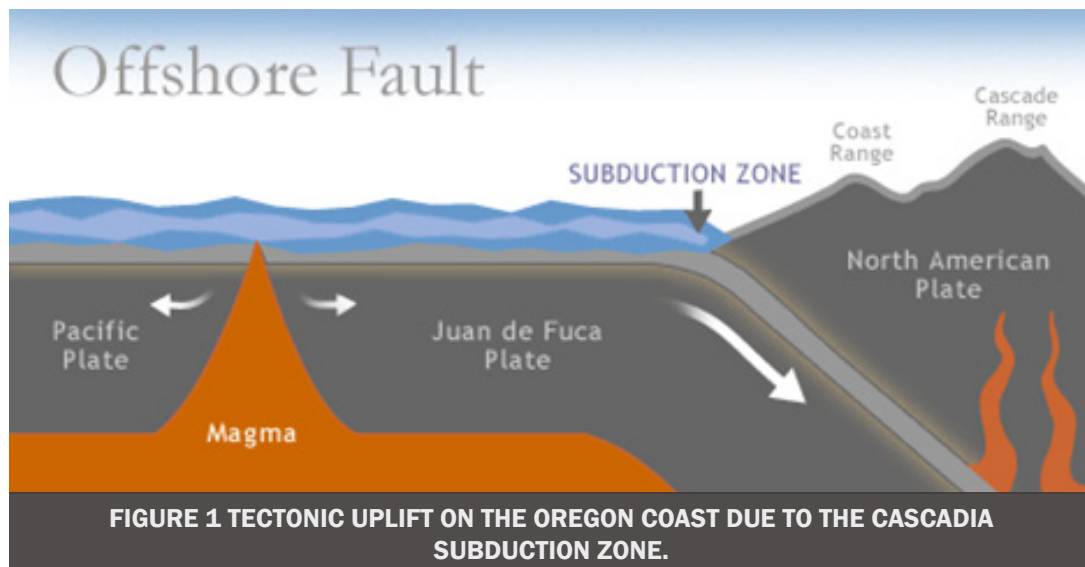
Navigation projects in Oregon may experience SLR impacts on multiple fronts. Increases in storm surge and wave height can lead to increased wave runup and overtopping of navigation structures and reduce the overall performance of those structures. Sea level increases can lead to changes in navigation channels and increased scouring at structure foundations. SLR will also cause decreased clearance under bridges and port infrastructure because water levels will be higher.

Public access is one of the coastal resources most at risk from accelerating sea level rise. Beaches, accessways, recreational amenities (e.g., parking lots, bathrooms, signage), and even surfing resources may be dramatically impacted by rising seas. Public access to the coast is important to the economic viability, quality of life, and health and well-being of members of the community, including low-income and underserved populations. By providing low-cost outdoor recreational opportunities through public access to Oregon’s beaches and estuaries, communities can improve their overall economic and health outcomes. Where development already exists, and particularly where there is substantial shoreline armoring to protect this development, Oregon may lose significant recreational beach areas. Additional shoreline armoring can decrease access to sandy recreational beaches, remove or impact public access locations to the water, diminish the ability to include accessibility features at public access sites, require increased costs and maintenance of public access amenities, and contribute to a general loss of public access locations. These places that are at increased risk provide economic, health, and environmental benefits for everyone. The potential loss of beach and shoreline recreation areas represents a significant potential impact to an important and treasured resource.



Oregon's Sea Level Trends

Sea level rise in Oregon is influenced by both local tectonics and global-scale changes in the volume of water.¹ The Oregon coast is situated along the Cascadia Subduction Zone, defined by the subduction of the Juan de Fuca Plate under the North American plate (Figure 1). As such, Oregon has and will continue to experience powerful and devastating earthquakes. These large earthquakes occur under the ocean just offshore of the coast and cause destructive tsunamis that can strike the coast 15 to 20 minutes after the earthquake.² The state's tectonic setting plays a significant role in shaping the regions' exposure to chronic coastal hazards through its influence on geomorphology and relative sea-level rise rates (RSLR).^{3,4}



Compared to many other coastal regions of the country, relative sea-level rise (RSLR) rates are slower in Oregon due primarily to tectonic uplift. While in some areas of the Oregon coast this uplift has kept pace with increases in sea level, much of the Oregon coast is experiencing RSLR rates of at least 1mm/year less than the present global average (~3.4 mm/year).⁵ For example, while southern Oregon (Coos Bay and south) and northern Oregon (Cannon Beach and north) experience either slight relative sea-level fall or close to no change, central Oregon has been experiencing RSLR rates of between 1-3 mm/yr since at least the 1970s.⁵ Therefore, developing high resolution estimates of varying vertical uplift rates alongshore is of high priority for Oregon's coastal communities, as the estimates will continue to impact local RSLR projections (and resultant chronic coastal hazards) for decades to come.

The National Oceanic and Atmospheric Administration (NOAA) recently released a [national scale report](#) projecting regional SLR scenarios from 2000-2150 that incorporate current best estimates of uplift for the US coastline. A key takeaway from this new set of projections is that by 2050, the expected rise in sea level will cause total water levels to increase and will lead to changes in coastal flood regimes throughout the US, **with major and moderate high tide flood events occurring at the frequency of today's moderate and minor high tide flood events.** The report stresses that without adaptive risk-reduction measures, U.S. coastal infrastructure, communities, and

1 Institute for Water Resources. US Army Corps of Engineers. 2022. Pacific Northwest Shoreline Management Study. Alexandria, VA.

2 OSSPAC. 2013. The Oregon Resilience Plan. Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Report to the 77th Legislative Assembly.

3 Burgette, RJ, Weldon II, RJ, and Schmidt, DA. 2009. Interseismic uplift rates for western Oregon and along-strike variation in locking on the Cascadia subduction zone. *Journal of Geophysical Research*. Vol 114, Issue B1.

4 Komar, P, Allan, J, and Ruggiero, P. 2011. Sea Level Variations along the U.S. Pacific Northwest Coast: Tectonic and Climate Controls. *Journal of Coastal Research*. Vol 27, Issue 5. pp 808-823.

5 Sweet, W.V., et al. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD.

ecosystems will face significant consequences. SLR projections included in the report represent probabilistic scenarios based on levels of global carbon emissions: low, intermediate-low, intermediate, intermediate-high, and high. The projections (Table 1), combined with observed SLR at two NOAA tide gauges in Oregon (Newport and Astoria), highlight the large range of expected SLR along this tectonically active coastline (Figure 2). These projections are for sea level rise only and do not account for factors that affect total water levels, such as storm surge, high river flow events, seasonal weather patterns, or high tides. These projections are provided to show the range of potential impacts and uncertainty for the Oregon coast to help inform short- and long-term planning.

	2040 (ft)			2070 (ft)			2100 (ft)		
	<i>low</i>	<i>int</i>	<i>high</i>	<i>low</i>	<i>int</i>	<i>high</i>	<i>low</i>	<i>int</i>	<i>high</i>
Astoria	0.10	0.23	0.39	0.20	0.82	2.23	0.30	2.26	5.48
Newport	0.30	0.46	0.62	0.56	1.21	2.69	0.82	2.85	6.14
Charleston	0.23	0.36	0.56	0.43	1.08	2.56	0.59	2.66	6.00
Port Orford	0.20	0.36	0.52	0.36	1.05	2.56	0.52	2.59	5.97

TABLE 1 SEA LEVEL RISE PROJECTIONS FOR THE LOW, INTERMEDIATE, AND HIGH GLOBAL EMISSIONS SCENARIOS (SWEET ET AL., 2022).

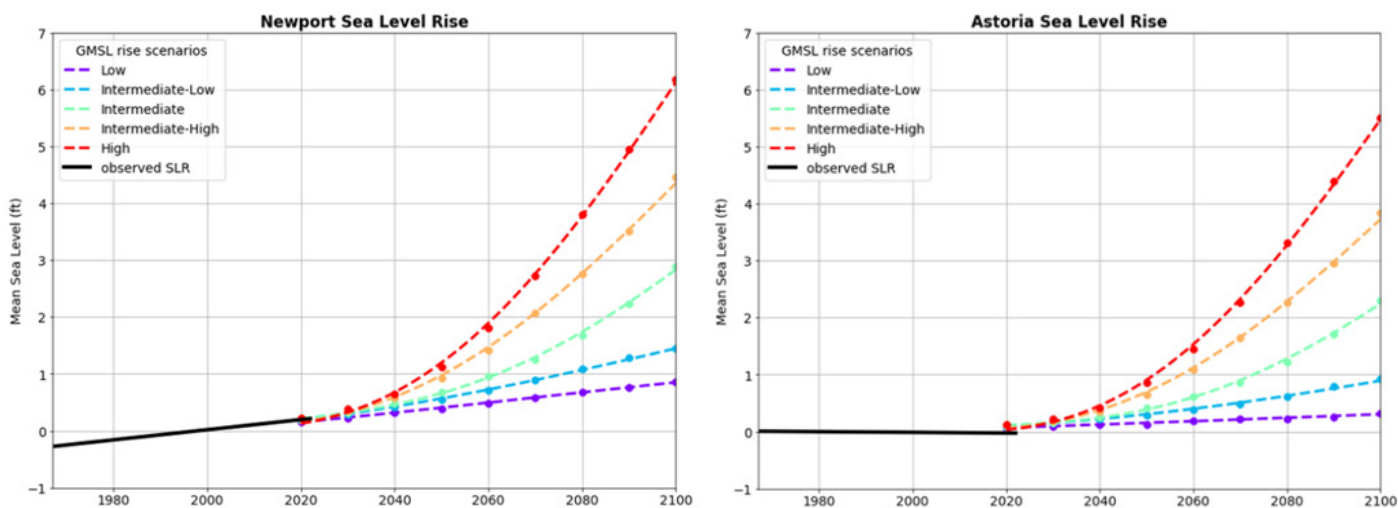


FIGURE 2 OBSERVED AND PROJECTED REGIONAL SEA LEVEL RISE AT TWO TIDE GAUGES IN OREGON DEMONSTRATE THE VARIABILITY IN SEA LEVEL RISE RATES DUE TO LOCAL TECTONIC AND HYDRODYNAMIC PROCESSES (SWEET ET AL., 2022).

These projections represent the best available science for Oregon and take into consideration local factors.⁶ **We highly encourage all entities to utilize these numbers for planning and project purposes.** It is important to keep in mind the threshold in which water impacts will become problematic or challenging instead of the timing of those amounts as shown in the graph above. A house or road may not be permanently inundated but when SLR combines with a high tide and storm surge, that house or road may be damaged or impacted more frequently. And in some areas, once SLR reaches a certain elevation, impacts may happen all at once and have large impacts (e.g., a whole neighborhood or road network). For planning and project purposes, the SLR projection that will have an impact on the population or asset regardless of the predicted time horizon should be used because it is difficult to predict global carbon emissions. Additionally, many public facilities, infrastructure systems, and private development are utilized for far longer than their original time horizons.

⁶ Sweet, W.V., et al. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD.

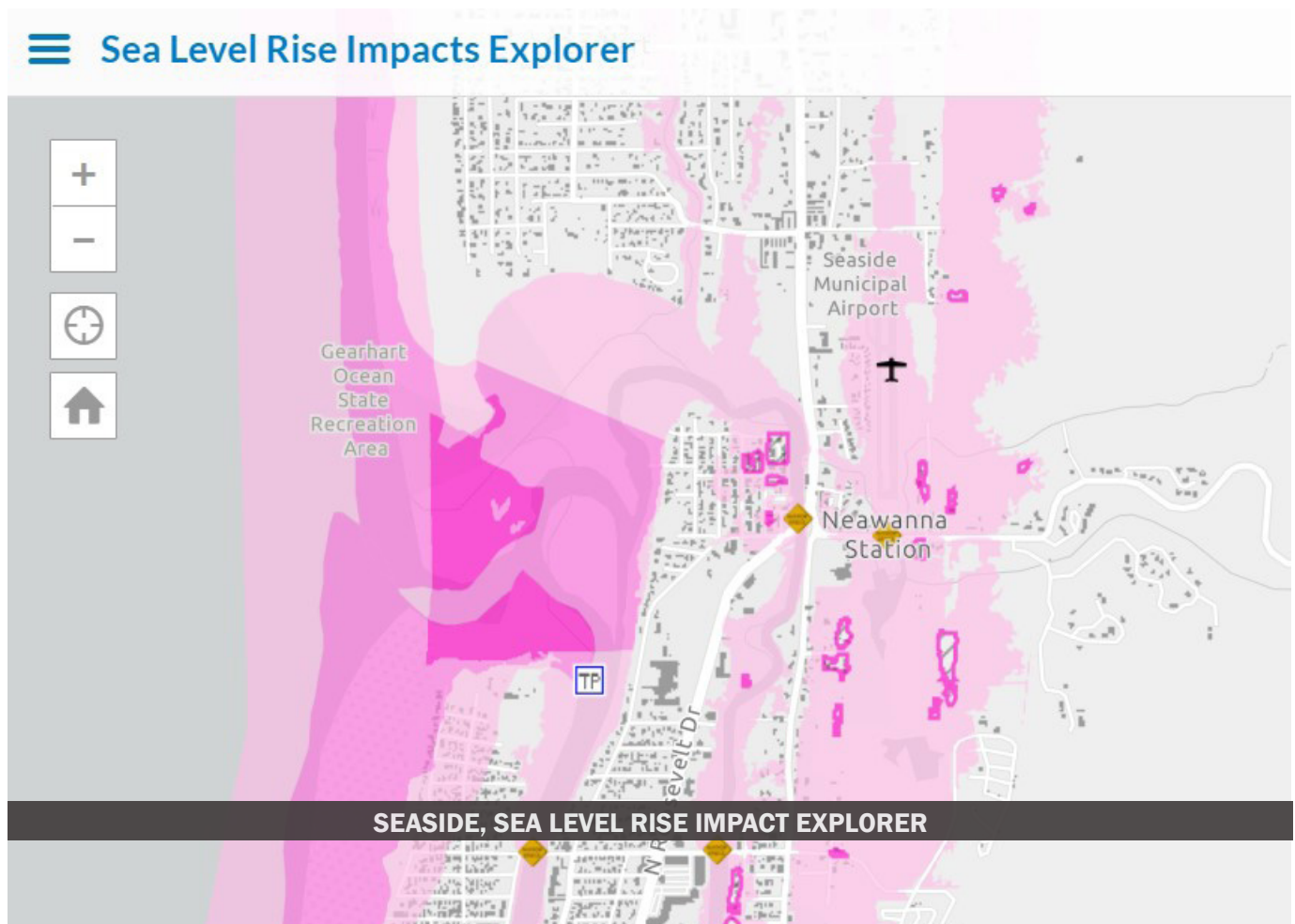
II. Sea Level Rise Impact Explorer



FLOODING IN ROCKAWAY BEACH DURING A KING TIDE. PHOTO BY BILL HASSELL, 2021.

To help assess the locations at risk from sea level rise in Oregon, OCMP put together a planning tool on the Coastal Atlas, called the **Sea Level Rise Impact Explorer**. This mapping tool provides graphical estimates of the expected locations of sea water inundation and coastal erosion 30-50 years into the future. This planning horizon is long enough for cities and counties to execute remedial actions, yet short enough to provide a reasonably accurate view of future conditions.

The Sea Level Rise Impact Explorer is a combination of multiple data sources and is meant to serve as a planning tool. **The dataset is not regulatory unless a jurisdiction adopts it.** There are three main geographies covered by the sea level rise planning area: outer coast, estuaries, and Columbia River. A mix of datasets are displayed for these three geographies and are meant to approximate the areas that will be impacted by sea level rise, using the current best available data. Inclusion of an area in the SLR planning area could mean permanent inundation or that the area will be impacted by high tide flooding, storm surge, or erosion events. This is an active area of continued research, and OCMP will continue to update these data resources as more data and information become available.



The outer coast planning area includes a combination of coastal velocity flood zones from Flood Insurance Rate Maps published by the Federal Emergency Management Agency (FEMA) and coastal erosion zones published by the Oregon Department of Geology and Mineral Industries (DOGAMI). These two datasets account for flood, storm waves, and coastal erosion hazard zones. FEMA defines the coastal velocity zone as “coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage.” The coastal erosion dataset has gaps in its coverage, though most of the developed areas of the Oregon Coast are covered. It is anticipated that these hazard zones may experience more frequent erosion or flood events as sea levels continue to rise. The data layer includes attributes

about which hazard is present (erosion, flood, or both) and the data citation.

The estuary planning area includes 1.5 feet of sea level rise with a flood event water level. The flood event is a 1% chance annual flood from FEMA flood insurance rate maps, which means there is a 1% chance of a flood of that magnitude every year. This combination dataset is from a study that OCMP completed in 2017 for all of Oregon’s estuaries except for the Columbia River Estuary. While this study was completed in 2017, the data still represents an accurate portrayal of SLR and its impacts in Oregon’s estuaries when compared to the 2022 NOAA SLR Technical Report described above. The only difference is that this water level may not be reached until about 2080 or later, depending on location and global carbon emissions.⁷ This dataset also shows a flood event on top of SLR. The coastal flood event water levels were taken from NOAA’s extreme water level calculations at the Crescent City, Charleston, Newport, and Astoria tide stations. For more information about the methodology behind this dataset, please read the 2017 OCMP Report, “Sea Level Rise Exposure Inventory for Oregon’s Estuaries.”⁸

The Columbia River planning area includes sea level rise estimates modeled by the Lower Columbia Estuary Partnership (LCEP) in 2018. LCEP modeled sea level rise using three different sea level rise scenarios: 1.65ft, 3.28ft, and 4.92ft but did not include storm surge or flood events in their modeling. Therefore, to be consistent with the sea level rise modeling in the other estuaries that use a 1% chance annual flood event on top of 1.5ft of sea level rise, we selected the 4.92ft sea level rise scenario for the Columbia River Estuary to include in the Sea Level Rise Planning Area. This is a conservative approach to try to capture the full area in this region that may be impacted by sea level rise and its associated hazards for planning purposes.

OCMP overlaid the datasets described above in a geographic information system (GIS) viewer (the Sea Level Rise Impact Explorer) to produce a data layer for sea level rise hazard areas. This layer is color coded based on the underlying data to show areas with the presence of one hazard, two hazards, or three hazards, or areas surrounded by hazard(s). The sea level rise planning area can then be overlaid with other GIS layers such as land uses, buildings, roads, and other infrastructure. Seeing the layers in combination allows land use planners, public works professionals, and others to identify parts of their jurisdictions that are likely to be affected by sea level rise and the activities currently taking place at those locations. The viewer provides some of these public datasets now such as building footprints, land use zones, essential facilities, and shoreline access points. Your local jurisdiction or entity may have additional datasets that can be added to further refine local conditions for your planning purposes.

Uncertainty: Planning for the impacts of climate change means planning for uncertainty. We have included information about the projected sea level rise for the Oregon coast. However, these projections have large uncertainty ranges because we do not know the exact amount of global carbon emissions in the future, nor how they will interact to produce different levels of SLR. As described earlier, there are also several local factors that influence water levels across the coast, such as tectonic uplift, cyclical weather patterns like El Niño, and global-scale changes in the volume of water. **This uncertainty should not prevent us from planning for sea level rise.** We can embrace this opportunity to be adaptable and incorporate new information as it is developed and learned, because the one thing that is certain is that sea levels are rising.

Legend

Potentially Impacted Development

- Airport
- Bridge
- City Hall
- Coast Guard
- Electric Substation
- Fire Station
- Heliport
- Hospital
- Law Enforcement
- Municipal Water Intake
- Park
- Potential Contaminant Source
- School
- Tsunami Siren
- Tunnel
- Wastewater Treatment Facility

Sea Level Rise Planning Area

- Surrounded by Hazard
- Impacted by 1 Hazard
- Impacted by 2 Hazard
- Impacted by 3 Hazard

Building Footprints

- Building Footprints

LEGEND, SEA LEVEL RISE IMPACT EXPLORER

Find the **Sea Level Rise Impact Explorer** on the Coastal Atlas: www.coastalatlantlas.net/sealevelrise.

7 Sweet, W.V., et al. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD.

8 Sea Level Rise Impact Explorer: coastalatlantlas.net/sealevelrise/

III. Assessing Sea Level Rise Vulnerability



FLOODING ALONG SIUSLAW RIVER AT VETERAN'S MEMORIAL PARK, FLORENCE.
PHOTO BY BRIAN PARMELEE, 2020.

Planning for sea level rise is essential for communities to prepare for the impacts of this hazard and to identify adaptation strategies that best fit their communities. Sea level rise planning efforts require cities and counties to know where water is likely to inundate currently dry land temporarily (e.g., during a king tide or storm event) or permanently, and where erosion caused by rising seas is likely to take place. Land use planners also need to know what people, infrastructure, and services are located within affected areas. Vulnerability assessments can be relatively comprehensive studies of a jurisdiction's shoreline and infrastructure to identify, quantify, and prioritize vulnerabilities and determine the level of risk. Vulnerability assessments can also be more narrowly focused and consider specific sites or facilities, such as wastewater systems.

Guidebook Toolkit

OCMP prepared a sea level rise planning area [mapping tool](#) (as described in Section II), using currently available cartographic information, to aid in the identification of affected areas. Communities and organizations are also encouraged to use their own data and information to further refine this planning area.

Additionally, OCMP prepared a set of spreadsheets designed to help users inventory what activities take place within affected areas, assess vulnerability to harm, and prioritize further investigation into remedial and adaptive actions. This process can serve as the jurisdiction's or organization's vulnerability assessment. Instructions for how to use the spreadsheets, in conjunction with the Sea Level Rise Impact Explorer, are in Appendix 1.

Equitable Community Engagement

Assessing a community's or organization's vulnerability to sea level rise will require engagement with those affected – those who live, work, play, learn, and visit in the spaces where sea level rise is and will be impacting. Across Oregon, the country, and beyond we have seen how climate change amplifies the pre-existing inequities in society. But, if we have honest conversations about adapting to the impacts of sea level rise and climate change with those most affected, grounded in a community-led planning process, we can reduce harm, save lives, and create equitable responses that lead to better futures for impacted communities.⁹

The vulnerability assessment spreadsheets offer an avenue to engage the community in sea level rise assessment and planning, which is described in Appendix 1. Additionally, there are various ways in which meaningful and equitable community engagement can be approached, and there are many existing resources that can help guide this work. We offer some considerations and resources here, but this is not meant to be prescriptive or exhaustive. The [Climigration Network](#) created a resource that we have taken important ideas from: [Lead with Listening: A Guidebook for Community Conversations on Climate Migration](#). Some of those ideas are:

- Center community members as experts;
- Earn trust;
- Consider culture, not just buildings;
- Acknowledge trauma;
- Speak to the fear and anxiety;
- Recognize power structures;
- Use language that speaks to people's everyday lives.

There is value in slowing down and making the time to convene and converse as a community. It helps to develop thoughtful and coordinated responses to the changes that will affect us, our communities, and the places we love. Decisionmakers cannot develop appropriate adaptation and communication strategies without the right participatory processes. Given the importance of community specific information, adaptation planning processes require bottom-up participatory mechanisms. Such participatory processes are important not only to obtain critical

⁹ The Climigration Network. 2021. Lead with Listening. A Guidebook for Community Conversations on Climate Migration.

information, but to provide marginalized communities with a voice in difficult political decisions.¹⁰

If possible, also plan to provide support for participants. This can include: financial compensation for their time spent working on a project; childcare offerings during meetings; multiple meeting opportunities; translation and accessibility services; or providing meals.

It may be worthwhile to stand-up a new or utilize an existing advisory committee of experts, community leaders, and stakeholders to guide community engagement and sea level rise adaptation action planning. This kind of group may also be able to take on more than just sea level rise adaptation planning, and plan more broadly for all potential climate change impacts in a community.

Other useful resources that can help guide equitable community planning process are:

- Oregon Climate Equity Blueprint: www.oregon.gov/lcd/CL/Documents/Climate-Equity-Blueprint-January-2021.pdf.
- The Planner's Playbook: A Community-Centered Approach to Improving Health & Equity: <https://www.changelabsolutions.org/product/planners-playbook>.



changelabsolutions.org/product/planners-playbook.

Provides planners and policymakers with the background and context, resources, community examples, and practical steps to incorporate equity into planning practice.

Build Support for Internal Action

Foster interdepartmental communication and collaboration on the topic of sea level rise.

¹⁰ Kaswan, A. 2012. Seven Principles for Equitable Adaptation. Sustainable Development Law & Policy, Vol. 13, Issue 1, pp. 41-46, 67-69.

Formal and informal conversations, meetings, and workshops between departments and agencies can be instrumental in raising questions about sea level rise and helping jurisdictions begin to plan for its impacts. For example, the planning department for a jurisdiction could sponsor and coordinate a joint learning workshop focused on developing a common understanding of terms and concepts about sea level rise across departments. Initial sea level rise planning considerations can also be sparked by informal questions and conversations between members of the planning and public works departments.

Using local projects and public infrastructure as action drivers.

Local governments or tribes can initially focus sea level rise planning on publicly owned assets such as infrastructure, parks, public access, cultural and historic resources, utilities, and other key investments. These projects help to jump-start sea level rise planning conversations within jurisdictions and provide important learning opportunities.

Create feedback loops for adaptively managing sea level rise policies and regulations.



YOUTH INVOLVEMENT IN LAND USE PLANNING. PHOTO BY DLCD.

Sea level rise planning cannot be a static process. Policies and regulations will need to be adjusted as new science becomes available, impacts are felt, and community needs shift. By creating a comprehensive and adaptable planning system that can evaluate new data and learn from projects and people subject to sea level rise provisions, local jurisdictions can make adjustments to their plans, ordinances, and policies to suit the community's needs. Undesirable planning and policy outcomes can be recognized and corrected in a timely manner to minimize impacts to individual projects and larger community adaptation goals.

IV. Existing Policy

Landscape: Statewide

Land Use Planning Goals



MOUTH OF THE ROGUE RIVER. OREGON SHOREZONE, 2011.

None of the 19 Statewide Planning Goals specifically addresses climate change, nor do they expressly require local governments to address climate change or sea level rise. However, the definition of comprehensive plan, as defined in [ORS 197.015\(5\)](#), is broad enough that a local government can and should address sea level rise if the impacts of SLR occur within a jurisdiction's planning area.

Some high-level ideas to keep in mind:

- An interest in SLR preparedness may motivate a community to initiate a complete update of its comprehensive plan. A community may also choose to incorporate climate change and SLR response measures incrementally as elements of the comprehensive plan are updated over time.
- Local governments should think about adopting policies and implementing ordinance language prohibiting or limiting development activities in areas that are or will be severely impacted by sea level rise. Doing so will benefit local governments in the future, as fewer public resources will have to be devoted to a limited amount of people and property in these high hazard areas, where the costs of protecting development will only rise.
- For areas that continue to be developed, local governments should incorporate design criteria and mitigation measures to match the life span of any new structure with conditions of approval to address potential futures. For example, for a property in the floodplain, the conditions of approval can include greater buffer zones or additional freeboard to accommodate future flooding (Figure 3).



The Statewide Planning Goals support these efforts.

Goal 7: Areas Subject to Natural Hazards

Perhaps the most relevant goal to sea level rise planning is [Goal 7: Areas Subject to Natural Hazards](#).¹¹ Goal 7 provides a pathway for local governments to consider new hazard inventory information and adopt or amend plans to address the risks highlighted by this new information. With new information becoming increasingly available for sea level rise and its associated hazards, there is opportunity for local governments to address the risk through the plan amendment process.¹² For example, communities may want to limit or prohibit the siting of new essential facilities, major structures, hazardous facilities, and special occupancy structures in the most hazardous areas. **This is also a good way to address multiple natural hazards at once for maximum co-benefits.** For example, some areas may be subject to flooding, sea level rise, and tsunami inundation. Avoiding the siting of critical and essential facilities in these areas would mitigate multiple risks.

¹¹ Goal 7: <https://www.oregon.gov/lcd/OP/Pages/Goal-7.aspx>.

¹² How to Implement Goal 7: www.oregon.gov/lcd/Publications/Implement_Goal7_Guide.pdf.

While sea level rise is not specifically called out as a hazard to plan for within Goal 7, the goal does allow a local government to identify and plan for other natural hazards. Additionally, sea level rise will exacerbate many of the hazards highlighted by Goal 7, such as flooding and coastal erosion. Planning to reduce threats to life and property from SLR could be considered an inherent objective of and supported by Goal 7.

It is good practice for local governments to stay up-to-date about the risks of SLR, climate change, and other natural hazards and to disclose that information to constituents. Incorporating the best available information into policy and ordinances may reduce risk and liability to local government and ensure a more resilient community. Some communities have integrated hazard disclosures into their permitting processes.

A limited amount of planning grant money is available through DLCD ([General Fund Grant Program](#)) to help communities address planning needs, including developing a response to natural hazards and climate change. More on how to use the plan amendment process to address SLR impacts is described in the [Planning & Policy](#) section below.



Goal 16: Estuarine Resources

Sea level rise impacts will directly alter estuarine habitats and their ability to buffer adjacent upland uses and activities. [Goal 16](#)¹³ provides the principal guidance for the planning and management of Oregon’s estuaries and is an important tool for addressing sea level rise impacts in estuarine areas. The goal establishes: detailed

¹³ Goal 16: <https://www.oregon.gov/lcd/OP/Pages/Goal-16.aspx>

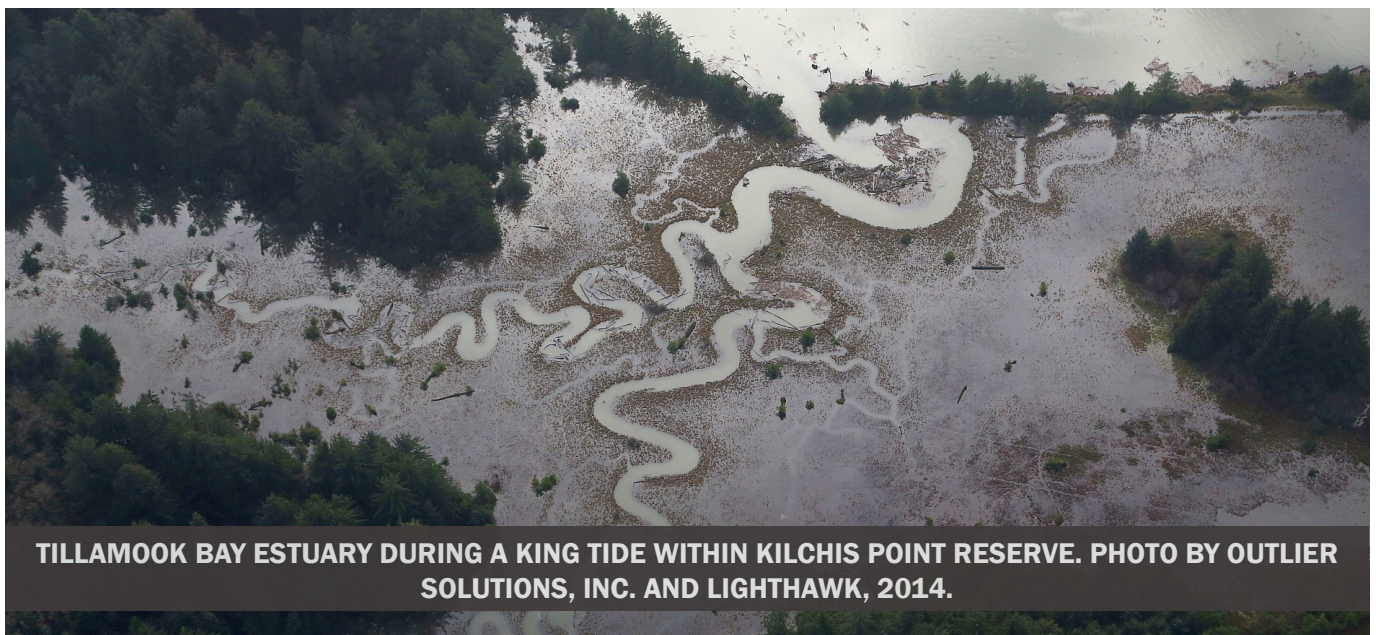
requirements for the preparation of estuary management plans; the review of individual development projects; and coordinated management by local, state, federal, and Tribal entities that regulate or have an interest in Oregon's estuaries. Jurisdictions should review their estuary management plans and corresponding management units to see how they may be affected by the anticipated impacts from sea level rise and climate change. Understanding how different estuarine habitats respond to changing conditions and how adaptive management can continue to provide the resiliency benefits those estuaries provide for adjacent communities and Goal 17 shorelands is critical. For example, wetlands may need space to migrate upland as sea levels and accretion levels rise which can have social and economic impacts. Planning for that migration now will help minimize those future challenges.

Land use planning work around Goal 16 is active. Many jurisdictions have Estuary Management Plans that were completed in the 1980's. Updating these plans is a priority of the OCMP, and there are projects underway that may provide a roadmap for other jurisdictions to utilize and address capacity issues. These efforts are focused on increasing coordination between jurisdictions that share an estuary, utilizing updated data, and better addressing hazards and climate change in estuarine environments. OCMP's exposure inventory and habitat mapping of Oregon's estuaries are tools that jurisdictions can use to determine the assets, populations, and geographies most likely to be affected by flooding and erosion driven by sea level rise.¹⁴ Jurisdictions that have started plan updates may utilize more specific locally developed resources and information to prioritize next steps including vulnerability assessments and the development of adaptation and mitigation strategies.

A priority of the state is to help communities with estuary lands within their jurisdiction to strategically plan for the landward migration of tidal wetlands and to incentivize the conservation and restoration of former tidal wetlands, **with particular attention on those wetlands that offer co-benefits such as reduction in flood impacts, improved water quality, and habitat improvements.**

Related estuary programs and partnerships, include but are not limited to:

- Oregon Global Warming Commission, Carbon Sequestration: www.keeporegoncool.org/.
- Partnership for Coastal Watersheds: oregonexplorer.info/content/partnership-coastal-watersheds.
- Oregon Tide Gate Partnership: oregontidegates.org/.
- Oregon Watershed Enhancement Board: www.oregon.gov/oweb/.
- Tillamook Estuaries Partnership: www.tbnep.org/
- Lower Columbia Estuary Partnership: www.estuarypartnership.org/
- Columbia River Estuary Study Task Force: www.columbiaestuary.org/
- South Slough National Estuarine Research Reserve: www.oregon.gov/dsl/SS/Pages/About.aspx



TILLAMOOK BAY ESTUARY DURING A KING TIDE WITHIN KILCHIS POINT RESERVE. PHOTO BY OUTLIER SOLUTIONS, INC. AND LIGHTHAWK, 2014.

¹⁴ SLR Planning Area Mapping Tool on the Coastal Atlas: www.coastalatlus.net/sealevelrise.

Goal 17: Coastal Shorelands

Statewide Planning [Goal 17¹⁵](#) outlines planning and management requirements for the lands bordering estuaries, as well as lands bordering the ocean shore and coastal lakes. In general, the requirements of Goal 17 direct the appropriate use of shoreland areas. Provisions in Goal 17 focus on the protection and management of resources unique to shoreland areas. Examples of such resources include areas of significant habitat, lands especially suited for water dependent uses, lands providing public access to coastal waters, and potential restoration or mitigation sites. These areas may change over time because of the impacts of sea level rise.

The Goal emphasizes the management of shoreland areas and resources in a manner that is compatible with the characteristics of the adjacent coastal waters. Jurisdictions have inventories and maps describing coastal shoreland planning areas subject to Goal 17 and the appropriate uses of these lands. Jurisdictions should review these areas and their designations to see if they should be updated or changed to reflect anticipated impacts from sea level rise and climate change. In estuaries, for example, tidal wetlands may need space to migrate upland, which could impact the corresponding designations of upland areas. Additionally, shoreline access points may be impacted by SLR and need to be modified or relocated.



Goal 18: Beaches and Dunes

[Goal 18¹⁶](#) focuses on conserving and protecting Oregon's beach and dune resources, and on recognizing and reducing exposure to hazards in this dynamic environment. As seas rise, dunes will become increasingly prone to ocean undercutting and wave overtopping. When comprehensive plans were first acknowledged, Goal 18 required

local governments to inventory beaches and dunes and describe the stability, movement, groundwater resources,

15 Goal 17: <https://www.oregon.gov/lcd/OP/Pages/Goal-17.aspx>

16 Goal 18: <https://www.oregon.gov/lcd/OP/Pages/Goal-18.aspx>.

hazards, and values of the beach, dune, and interdune areas. Local governments apply policies for appropriate uses in these areas. Most of these inventories have not been updated since initial acknowledgement, despite these areas being highly dynamic, sensitive, and hazardous. We recommend more frequent inventories of these shifting and protective critical habitats.

The Goal prohibits the development of residential, commercial, and industrial buildings on dune areas subject to ocean flooding and limits other development in these areas. It also limits the amount of shoreline armoring allowed and regulates dune management. Local governments have the option to expand the application of this planning goal by further restricting development in areas subject to sea level rise (e.g., future flooding) and adopting mitigation measures to offset the impacts of new shoreline armoring. Other policies to consider include measures that encourage open space preservation and habitat restoration and increase shoreline setback requirements for structures. See the next section for additional local planning strategies.



BEACHES AND DUNES FRONTING PACIFIC CITY. PHOTO BY OREGON SHOREZONE, 2011.

Local governments should also evaluate the potential for pollution and discharge from septic systems, stormwater outfalls, and combined sewer overflows in these sensitive and dynamic environments. The use of septic systems is common throughout the Oregon coast, especially in unincorporated developed areas, but also in some cities, which can contaminate freshwater dune aquifers and the beach. In urban areas, contamination from combined sewage overflows, leaking collection pipes (now exposed to seawater) and non-point sources are likely to contribute to continued beach contamination and closures. Moving to sewer systems, upgrading stormwater systems, or increasing monitoring of ocean and groundwater quality can be additional steps a community may want to take, as sea level rise will continue to exacerbate this problem.

V. Identifying Potential Adaptation Strategies



FLOODED ASTORIA RIVER WALK. PHOTO BY OREGON KING TIDES PROJECT, 2022.

This section of the Guide is meant to provide a menu of potential adaptation strategies and principles of equitable adaptation planning. An area, population, or asset exposed to SLR impacts may need more than one strategy for the short- and long-term, depending on the hazard's impact, the community's risk tolerance, underlying socioeconomic factors, and the planning time horizon.

A jurisdiction may decide to develop a sea level rise adaptation action plan to capture appropriate adaptation strategies and how they will be implemented, which should be guided and developed through robust and inclusive community outreach and engagement. Developing a plan will provide detail on the benefits and challenges of adaptation strategies, their equitability, legal viability, and feasibility, as well as their level of support from community members. For the plan to be used in decision-making, it should be adopted into the comprehensive plan, either by reference or as a part of the comprehensive plan's supporting documents. Such a plan could also be incorporated directly into other supporting documents, such as a Capital Improvement Plan or Transportation System Plan. The following sections highlight several potential strategies as a starting point, but it is not exhaustive, nor prescriptive. It is likely that a combination of adaptation strategies will be needed over time, and it is important to tailor approaches to each specific situation. If one strategy does not seem feasible for your community, move on to the next. See [Section VIII. References and Useful Resources](#) for more places to find adaptation strategies, case studies, and resources.

Equitable Adaptation Planning

Like the rest of the United States and the world, Oregon faces growing inequalities that unfairly disadvantage large segments of the population. On top of this, climate change exacerbates existing risks in our communities. The effects of climate change, including sea level rise, will disproportionately affect already poor and disenfranchised people. Policymakers must find ways to focus not only on the physical impacts of climate change, but also on the ways that policies and actions can have a differential impact on certain individuals and communities. For example, ensuring affordable housing does not get placed in high climate risk areas. Ultimately, our goals must go beyond preventing climate harm, but also include approaches that reduce the existing challenges faced by poor and minority communities – such as a lack of economic mobility, racism, and exposure to pollution – that make these groups disproportionately vulnerable.¹⁷

Both physical and social factors determine climate impacts. Substantial evidence demonstrates that climate vulnerability is greater for the poor, the elderly, racial minorities, people with underlying health conditions or disabilities, the socially isolated, immigrants, and communities that are dependent upon vulnerable natural resources.¹⁸

Oregon Tribes are uniquely vulnerable and disproportionately affected by climate change and may be impacted by the types of adaptation actions the State and local governments pursue. The [Tribal Climate Change Project](#) is a rich source of guidance and information regarding consequences of climate change to Tribes in Oregon. This project was a collaborative project at the University of Oregon with support from the USDA Forest Service Pacific Northwest Research Station, the Affiliated Tribes of Northwest Indians, the Bureau of Indian Affairs and the North Pacific Landscape Conservation Cooperative. More information about cultural heritage adaptation planning can be found in the [Oregon Climate Change Adaptation Framework, 2021](#).

The following principles are important (though not exhaustive) for entities to consider when undertaking equitable adaptation planning.

17 Adaptation Equity Portal, Adaptation Clearinghouse, Georgetown Climate Center. www.adaptationclearinghouse.org/networks/adaptation-equity-portal/.

18 Kaswan, A. 2012. Seven Principles for Equitable Adaptation. *Sustainable Development Law & Policy*, Vol. 13, Issue 1, pp. 41-46, 67-69.

Government has an important role to play.

Relying on individual initiative is unlikely to lead to sufficient adaptation, especially given that climate impacts are often seen as remote or distant threats. Additionally, a reliance on private action often fails to protect those without the knowledge or means to act, which will exacerbate risks for more vulnerable populations. Comprehensive government adaptation initiatives are needed.

Design adaptation measures that address vulnerability.

To achieve equitable adaptation, adaptation policies must explicitly address the demographics of affected populations and target interventions to address the needs of the most vulnerable and not treat everyone the same. Disparities in income create many of the most significant disparities in vulnerability to climate change impacts. Elderly and disabled residents, renters, and those with certain occupations also face substantially greater risks to climate impacts.

Provide culturally sensitive communications and services.

Communication is key to effective adaptation. Given the diversity of populations, community and demographic-specific strategies are necessary. In addition to identifying language needs, adaptation planners need to identify culturally appropriate modes of communication, which may include newspapers, radio, television, e-mail, social media, or door-to-door outreach. In addition, agencies could partner with nongovernmental community organizations that could facilitate community outreach, provide information, and help organize vulnerable or impacted communities.

Develop participatory processes.

Given the importance of community specific information, adaptation planning processes require bottom-up participatory mechanisms. Bottom-up participation refers to the process of involving and listening to ideas from community members first and using that to inform government action. Such participatory processes are important not only to obtain critical information, but to provide marginalized communities with a voice in difficult decisions. To be effective, participatory opportunities need to occur early in the process and address local power dynamics. An obligatory public hearing on an already-complete planning document does not constitute real public participation. An extended process of place-based community forums and targeted outreach are more likely to generate meaningful participation.

Reduce underlying non-climate environmental stressors.

As discussed earlier, sea level rise does not always create new risks; it can also exacerbate existing risks. For example, it could increase risks from flooded sewage treatment plants or roads. Many existing environmental problems and risks are often disproportionately located in low-income communities or communities of color. Reducing non-climate environmental stressors will have indirect equity benefits. For example, improving inadequate storm water management, an existing non-climate problem, could mitigate the contamination that could arise from climate-caused increases in sea level or extreme precipitation. **This type of approach is often called a “no regret” policy and provides significant co-benefits.**

Address adaptation and mitigation tradeoffs.

Although climate adaptation (addressing the impacts of climate change) and climate mitigation (reducing GHG emissions to lessen climate change) often involve different regulatory strategies, there are significant interactions between adaptation and mitigation measures. Policymakers need to consider the interplay between mitigation and adaptation to ensure neither are maladaptive. For example, intensifying development and transportation options in urban centers may be a strategy to mitigate carbon emissions, but increased density should be discouraged in areas subject to natural hazards or sea level rise and should incorporate green spaces to minimize urban heat.

Take a comprehensive approach.

Underlying socioeconomic vulnerabilities create numerous related impacts including disparities in the capacity to recover and rebuild from disasters, inequities in the capacity to relocate to avoid future harm, and differences in the public health consequences of increasing heat, pollution, flooding, and disease. A larger climate-minded socioeconomic agenda is critical to achieving equitable adaptation. Successful adaptation will require addressing pervasive issues such as poverty, affordable housing, healthcare, and the voice of currently marginalized communities.

While global climate change is an “environmental” problem, the scope and scale of its impacts is strongly determined by underlying socioeconomic variables. As climate impacts emerge, they have the potential to exacerbate existing inequalities and cause severe hardships for Oregon’s most vulnerable populations – hardships that are not only intrinsically of concern, but also destabilizing to the larger community. These principles provide policymakers with guideposts for achieving equitable adaptation.¹⁹



PADDLE PARK ALONG THE YAQUINA RIVER IN TOLEDO. PHOTO BY OREGON KING TIDES PROJECT, 2012.

Planning & Policy Tools

Zoning is one of the most powerful tools that local governments have to minimize and mitigate hazards. Through planning and zoning, local governments can specify where it is unsafe to build, can shape landowner expectations, and can build support for adaptive measures. Through regulations, local governments can ensure that developers will site and construct new structures to be more resilient to flooding and other hazards. Sea level rise focused planning and regulations lead to fewer people and structures being in harm’s way when impacts occur. Some planning and zoning adaptation strategies are discussed below.

¹⁹ Kaswan, A. 2012. Seven Principles for Equitable Adaptation. Sustainable Development Law & Policy, Vol. 13, Issue 1, pp. 41-46, 67-69.

Join the National Flood Insurance Program:

Participating in the voluntary National Flood Insurance Program (NFIP) provides communities with a framework to regulate development in flood hazard areas. The NFIP is administered by FEMA. NFIP-participating communities are required to adopt flood hazard regulations that set standards for development in the FEMA-mapped Special Flood Hazard Areas (SFHA). The program ensures that development in the SFHA has some level of protection from flooding. Most likely your community already participates in the NFIP. Later in this guide, we discuss the benefits of using information found in FEMA Flood Insurance Studies to adopt higher standards than are required by FEMA.

Comprehensive Plan and Ordinance Audit and Updates:

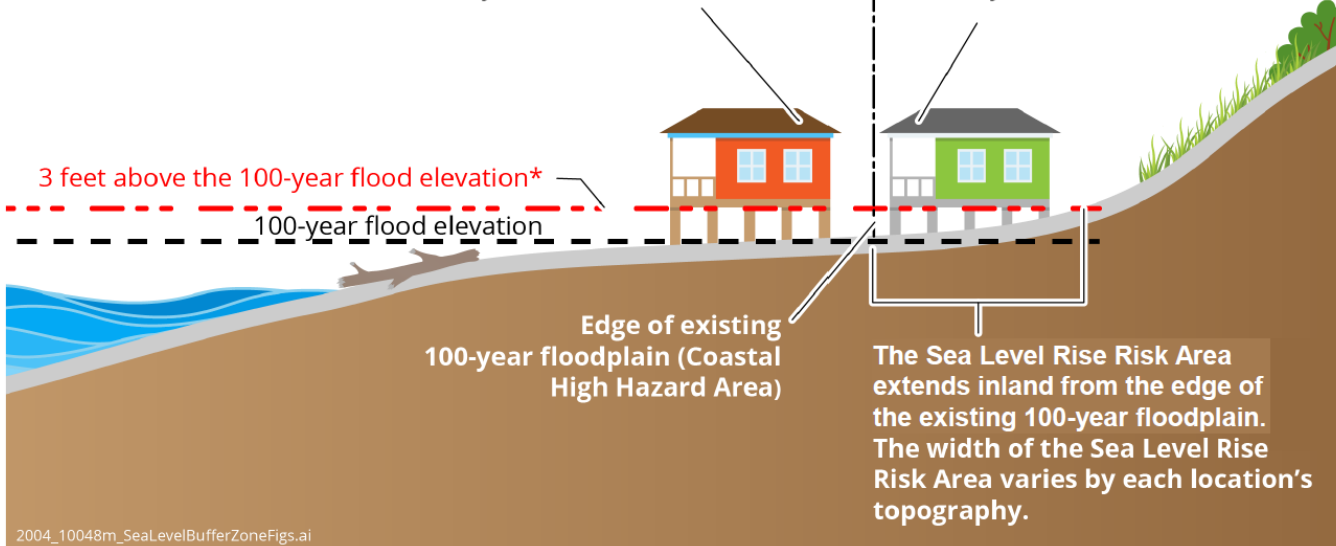
Perform an audit of your jurisdiction's current land use policies and ordinances, particularly those sections related to coastal resources and hazards, such as: flood hazards, geologic hazards, tsunami hazards, beaches and dunes, coastal shorelands, and estuary management. See how these sections of code interact or potentially conflict. Look for ways to reconcile, update, expand upon, and streamline. Think about ways to address impacts of SLR through existing ordinance frameworks. Identify where adoption of higher standards will better protect structures, livelihoods, and people from both flooding and SLR while potentially providing improved ecosystem services.

Based upon outcomes of the code and policy audit, adopt updates to your jurisdiction's comprehensive plan to incorporate new data, new maps, and new policies for addressing natural hazard mitigation needs. Amend or adopt zoning regulations to implement comprehensive plan policies. Examples to consider:

- Adopt new Comprehensive Plan policies to address the impacts of sea level rise and climate change to the community. Be specific about strategies your community should use to address these impacts.
- Seek out the best available datasets for your location and consider adopting these datasets and maps into the comprehensive plan. Having updated data and maps, regardless of whether it takes sea level rise into account, is exceptionally important to inform development decisions. Inventories that serve as the basis for Beach and Dune Overlays in local ordinances are especially outdated in many jurisdictions and should be updated with new information. DOGAMI is completing an updated beach and dune inventory coastwide in 2023 to be used for this purpose.
- Create a joint "Flood and Sea Level Rise Hazard Overlay Zone." Apply existing flood hazard protection standards beyond the existing regulatory floodplain to areas that have been identified as being at risk from SLR. Some modifications and choices will need to be made when using flood standards in this way. Take advantage of the mandatory flood ordinance updates when they are required by FEMA to integrate SLR policies, regulations, and maps at the same time.
- Combine or reference hazard overlays such as the flood and beach and dune overlays, to provide a clear picture of the risk to those developing in these areas and to ensure that regulations do not conflict with each other.
- Update geologic hazard ordinance sections to incorporate the best available data and geologic hazard report requirements to ensure development in hazard areas is incorporating necessary mitigation measures. Geologic hazard reports should be required to account for and address SLR conditions to occur over a 50-year period, or the expected lifespan of the development.
- Consider adopting a prohibition on certain types of new development such as critical and essential facilities in the riskiest areas where other adaptation strategies are not feasible. This could also include a prohibition on community facilities with sleeping or overnight accommodations and other public facilities (like libraries, city halls, or community centers).
- Incorporate higher standards for development in very hazardous areas. For example, downzoning areas to decrease density (and up-zoning outside of hazard areas), setbacks and buffers tied to coastal erosion rates, and rebuilding restrictions. If rebuilding requirements, like flood-proofing codes, add significant costs to rebuilding, then government support for such measure may be needed to ensure that low-income households are not priced out of rebuilding.
- If your jurisdiction does not currently require a permit for shoreline stabilization structures (e.g., riprap, seawall, etc.), add a local permitting process to review these structures, especially if the structure is placed

Existing Coastal Floodplain Regulations

Under current regulations, a new building or a substantially-improved building in the 100-year floodplain is required to be built to 3 feet above the 100-year flood elevation.



2004_10048m_SeaLevelBufferZoneFigs.ai

* The 100-year flood elevation varies by location and specific coastal hazard zone. For maps of King County's coastal high hazard areas, visit: <https://www.kingcounty.gov/services/environment/water-and-land/flooding/maps/flood-insurance-rate-maps.aspx>.

EXAMPLE IN KING COUNTY, WA APPLYING FLOODPLAIN REGULATIONS TO A SEA LEVEL RISE RISK AREA, 2020.

landward of the regulated ocean shore²⁰. With increased erosion, there is high likelihood that structures placed outside of the regulated ocean shore may be affected by inland migration of that zone in the future. Coordination with Oregon Parks and Recreation Department (OPRD) in designing this permitting is strongly recommended.

- As sea level rises, the boundary between private lands and public beaches will be pushed inland. Consider incorporating structure removal requirements into development permits that have climate-based threshold triggers and require such conditions to be recorded on the title so that subsequent purchasers also know the condition. For example, the landowner agrees to remove structures when they become inundated or repeatedly damaged by storms as sea level rises. This type of condition allows landowners to develop property while putting them and future landowners on notice that development will eventually have to cede to the rising seas. It also helps to provide education to the property owner of their responsibilities and the hazards associated with this land.

Capital Improvement Plans and Engineering Standards:

Revise capital improvement plans and engineering standards to address future conditions. Capital improvement planning is a process for projecting, budgeting, and financing the development and maintenance of public infrastructure and other fixed assets. To aid this process, many local jurisdictions use a Capital Improvement Program (CIP) framework, through which future capital needs are systematically identified, budgeted, and prioritized for investment. Typically spanning a five- to ten-year planning horizon and updated annually, CIPs enable jurisdictions to project and account for capital expenditures, align investments with community priorities, and ensure the efficient delivery of critical services.

²⁰ The ocean shore is the land lying between extreme low tide of the Pacific Ocean and the statutory vegetation line as described by ORS 390.770 or the line of established upland shore vegetation, whichever is farther inland.

The CIP framework can be used to identify existing assets that need to be relocated, retrofitted, or assigned altered maintenance regimes based on climate risk. It can also be used to ensure that new facilities and infrastructure – including any climate adaptation projects – are designed and located to be resilient to future SLR conditions.

Engineering standards used to design projects may need to be revised to address future conditions. These could include designing with nature to promote the benefits of natural systems such as wetlands, beaches and dunes, and floodplains. Some communities have embraced an adaptive design practice that turns a long-term problem into a series of short-term problems to incorporate the need for flexibility, affordability, and new information and practices.

Potential Setback Approaches:

Many jurisdictions on the Oregon coast utilize an oceanfront setback line based on viewsheds – no development can be more seaward of the existing structures to the north and south of a property. However, more restrictive setbacks can be adopted to account for erosion, flooding, and SLR. There are several different mechanisms for establishing setbacks:

- *Fixed mandatory setbacks* require that all structures, including sea walls, be set back a specific distance from a predetermined point (e.g., 100 feet from the mean high tide line or the vegetation line).
- *Erosion-based setbacks* are determined by a projected shoreline position that assumes a specific increase in sea level and erosion rates over a specific time frame such as the life of the structure (e.g., sixty times the annual rate of erosion).
- *Tiered setbacks* require a lesser setback for smaller or accessory (e.g., shed) structures and a greater setback for larger structures (e.g., house) that are more difficult to move if they become damaged and put more people at risk.

*In 2008, **Kaua‘i County** adopted what is considered one of the most protective shoreline construction setbacks in the nation. The setback line is the sum of 40 feet plus 70 years times the average annual erosion rate. Seventy years was derived from a Federal Insurance Administration Department of Housing and Urban Development engineering study determining the average life span of wood-framed coastal structures.¹⁹⁷ The planning period for structures 5,000 square feet or greater is 100 years because they are often built using stone or more durable materials.¹⁹⁸ Kaua‘i’s rules provide for a 10% adjustment in the average annual erosion rate for future sea-level rise in some cases,¹⁹⁹ which encompasses principles of adaptive management and planning. Kaua‘i County also incorporated a minimum buildable footprint allowance of 1,500 square feet to avoid potential regulatory takings claims due to increased shoreline construction setbacks associated with the 2008 ordinance.*

*In **Maui County**, the shoreline setback line is the greater of the following two distances, (i) 25 feet plus 50 times the annual erosion rate, or (ii) 25 feet for lots with depths of 100 feet or less, 40 feet for lots with depths between 100 and 160 feet, or 25% of the lot depth for lots with depths greater than 160 feet, up to a maximum 150 feet.²⁰⁰*

*In the **City and County of Honolulu**, the shoreline setback is generally 40 feet inland from the certified shoreline but can be decreased to 20 feet for lots whose depth of buildable area is less than 30 feet.²⁰¹ For new subdivisions, the setback is 60 feet.²⁰²*

***Hawai‘i County** establishes the shoreline setback at a minimum of 40 feet. Exceptions apply to nonconforming lots that are less than 100 feet deep or have less than 50% buildable area remaining.²⁰³*

EXAMPLE OF EROSION SETBACK APPROACHES IN HAWAII. CREDIT: SEA LEVEL RISE AND COASTAL LAND USE IN HAWAII, 2011.

To incorporate considerations of SLR, local governments could adopt regulations that establish coastal setbacks based upon a projected shoreline position that assumes specific increases in sea level or erosion rates over the life of the structure. Local governments could require that new development along dynamic coastal shorelines evaluate potential impacts to the development from a specific rate of SLR. Governments could restrict development where the development cannot include sufficient setbacks to mitigate impacts from SLR over the life of the structure. Be sure to consider private property rights when evaluating such policies. If a jurisdiction has shallow lot sizes along coastlines, a takings claim can be avoided by applying scaled setbacks to smaller parcels based upon average lot depth to ensure parcels retain buildable space. Deed restrictions could also be considered to prohibit shoreline armoring or other actions interfering with natural coastal processes as a variance condition.²¹

Buffer Zones:

Local jurisdictions can create buffer zones along coastal areas to ensure that vulnerable beaches and wetlands have room to migrate inland as sea levels rise. Buffer zones, like setbacks, can be determined based upon erosion and SLR rates for that area over a specified time frame. More extensive buffers could be established in areas where parcels have sufficient buildable space to accommodate a buffer area. Larger buffers could be required for large-scale development projects. Buffers offer multiple benefits not only for mitigating hazard impacts, but also as measures to protect important natural resources or migration corridors.

Insurance:

Provide insurance education to property owners in hazard areas. The National Flood Insurance Program requires flood insurance for homes and businesses with a federally backed mortgage that are in the Special Flood Hazard Areas. Those who own their homes outright may choose whether to get flood insurance. However, anyone can buy flood insurance voluntarily. Flood insurance can also cover tsunami damage and can be an option for those who are located within the tsunami inundation zone. Highlighting flood insurance options can help make people aware of the total costs of ownership in these hazardous and dynamic areas, especially with the rising cost of flood insurance.

Consider requiring proof of flood insurance before issuing certificates of occupancy or final inspection approval for all new homes and businesses already required to have flood insurance under the National Flood Insurance Program. Also, consider strongly recommending proof of flood insurance within the SLR Planning Area if it extends beyond the regulatory flood hazard area.

Recovery Planning:

Plan for post-disaster recovery through adoption of a recovery ordinance. In the immediate days and weeks following a disaster, it may be difficult to assemble a quorum of the governing body to enact emergency authorizations organizing and directing initial recovery efforts. A recovery ordinance can create overall guidance for local post-disaster recovery facilitation and intervention. Guidance from the American Planning Association has model ordinance language²² that can serve as a starting point. Within this ordinance, adopt language that authorizes a temporary post-disaster building moratorium, consistent with state law. A post-disaster moratorium on repairing or rebuilding structures temporarily restricts building activity following a major disaster. Such ordinances can establish the framework for a variety of post-disaster tasks, such as: debris management; stabilization of damaged buildings; identification of other life safety risks; repair of damaged infrastructure; and identifying mitigation options and funding when rebuilding. The intent is to address critical issues regarding rebuilding that will be faced by communities in a post-disaster environment.²³ This is applicable in multiple disaster scenarios such as a wildfire, flood, or major winter storm.

21 Sea Level Rise and Coastal Land Use in Hawaii: A Policy Tool Kit for State and Local Governments Selected Tools for Awareness and Preparation. 2011. Center for Island Climate Adaptation and Policy, Honolulu, HI.

22 American Planning Association: <https://www.planning.org/publications/document/9139474/>

23 Post-disaster building moratorium example: <https://planningforhazards.org/post-disaster-building-moratorium>

Vernonia offers an example of the value of recovery planning. Following the 1996 floods, Jim Tierney developed a detailed disaster recovery process diagram that begins with day 1 of the disaster. As reported in the Ford Family Foundation newsletter *Community Vitality*, Vernonia's recovery team was waved off after a 1996 flood until the immediate rescue phase was over. That almost happened again in a 2007 flood until a city official who had been at the earlier flood insisted on the recovery team's inclusion. Their involvement paid off. From the first day of the 2007 flood, for example, there was one recovery team member whose sole job was to track the use of volunteer resources. Later, that information brought in more than \$300,000 in matching funds. Vernonia's well thought out recovery process allowed the city to buy out or elevate over 300 homes following a 2007 flood. As a result, a major flood in 2015 caused very little damage.

Rebuilding Restrictions:

If a structure, neighborhood, infrastructure, or other development is impacted by the impacts of sea level rise, there may be reason to implement considerations for how to rebuild. Some of these considerations include:

- Does this development or infrastructure have to be in this location, can it be moved?
- If this development or infrastructure should remain in this location, what design elements can be integrated to ensure impacts are minimized, such as elevation, improved drainage, moving as far away from the hazard as possible, or nature-based design?
- Can long-term strategies be integrated into the rebuilding of the development or infrastructure that may support relocation or removal in the future when mitigation may no longer work?

Impacts from natural hazards and SLR may happen over and over again. While private property right should be considered with any rebuilding restrictions, repetitive losses and impacts, as well as the emotional toll of property damage and loss, should also be considered. Upfront mitigation saves money and loss in the longer term. Natural hazard mitigation saves \$6 on average for every \$1 spent.²⁴

Estuary Management Plans:

Your community's estuary management plan can be updated, using new data resources, including those that reflect the impacts of SLR and climate change. Existing wetlands may need room to migrate over time (see *buffer zone/setback* information above). It may be important to change zoning designations and plan for open space and water dependent uses in new ways because of changing floodplain areas.

For ideas and data, see the report produced by the Institute for Applied Ecology:

[Modeling sea level rise impacts to Oregon's tidal wetlands: Maps and prioritization tools to help plan for habitat conservation into the future.](#) December 2017. Laura Brophy and Michael J Ewald.

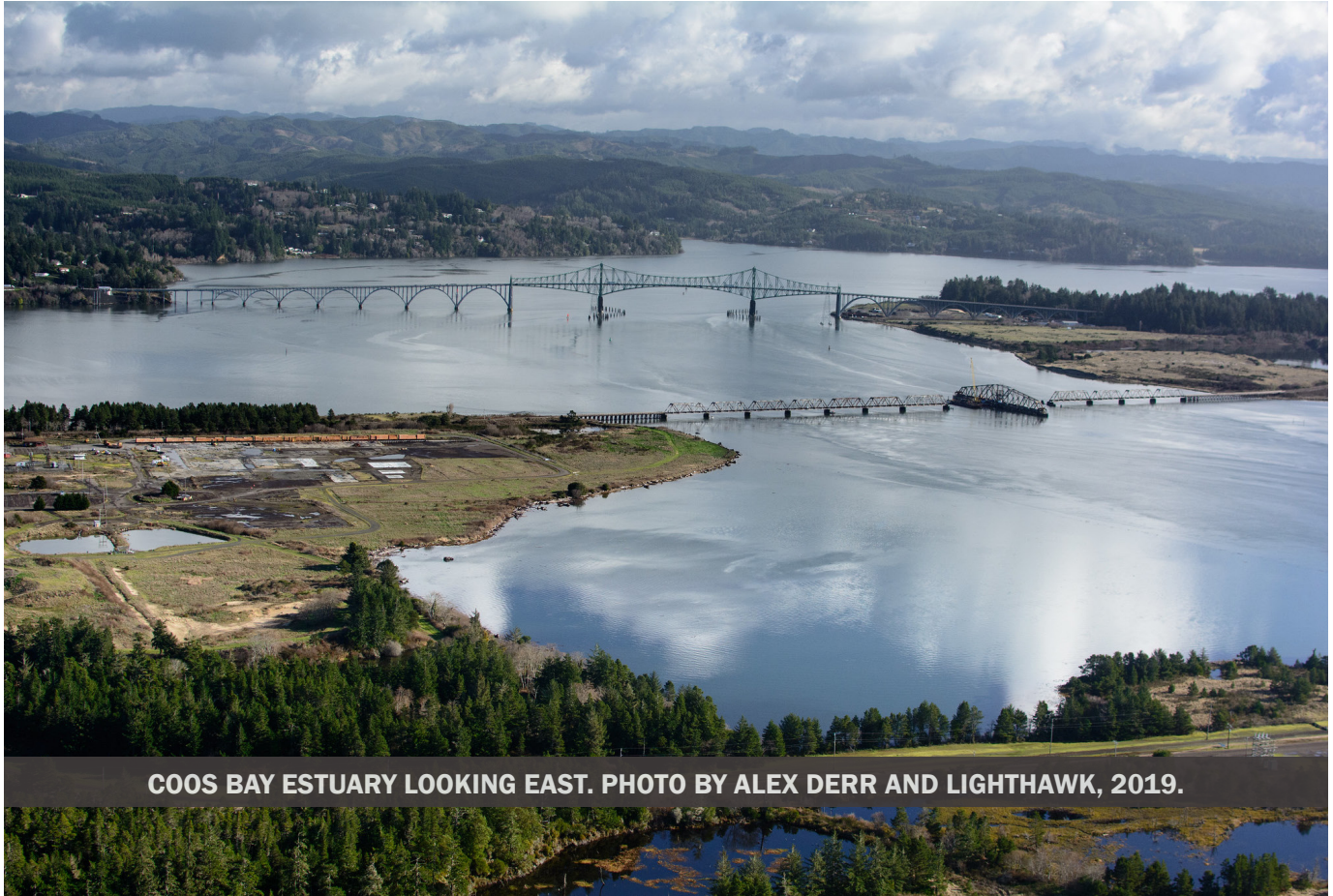
Estuary management plans can be the vehicle to encourage community and stakeholder involvement in how estuaries and associated shorelands can best be utilized to protect and conserve ecosystem values, critical habitats, cultural resources, public access, and recognize the important economic and social values of the estuaries. Balancing all of these needs is the basis for estuary management plans.

As communities initiate estuary management plan updates, the incorporation of sea level rise and climate change impacts will be an important consideration in updates. Ensuring that management plans have established benchmarks or triggers that initiate the review of new information including mapping updates is important in guaranteeing that the plans remain relevant and provide decision makers with the best available information.

Another important feature of the estuary management plans is the recognition of the many ecosystem services that estuaries provide to the environmental, social, and economic values of the surrounding communities as well as to the state of Oregon, and how they can continue to provide benefits under a changing climate if adequately protected.

24 FEMA Natural Hazard Mitigation Saves: https://www.fema.gov/sites/default/files/2020-07/fema_mitsaves-factsheet_2018.pdf

Zoning within estuaries, which is unique to Oregon, determines what uses can take place within each of the management units. As our understanding of sea level rise and the ability of estuaries to mitigate impacts to local communities continues to expand, it may refine our expectations of the types of uses that should be allowed. Impacts to public health, including saltwater intrusion into drinking water sources and inundation of septic systems, and equity within communities should be factored into discussions as sea level rise results in landward migration of tidal habitats. Additionally, newly inundated areas that meet the statutory definitions for “estuary” and “waters of this state” will be subject to state of federal regulatory programs for such areas.²⁵



Plan Integration:

Address SLR in all planning documents, including Transportation System Plans, Capitol Improvement Plans, Public Facility Plans, and Natural Hazard Mitigation Plans. Ensure that these plans are coordinated, utilize the same data resources, and leverage planning processes for updates and implementation.

Address Risk and Uncertainty:

Include a hazard acknowledgement and disclosure statement in code updates for new and re-development in the riskiest areas. Some regulations can only be as good as the adopted data that support them. With climate change, science is always getting more refined and areas identified as at risk of impact from a known hazard can change over time. Consider recognizing that a static map cannot depict all risk for all levels of development into the future. The jurisdiction could also include specific time-based triggers into the comprehensive plan to review hazard datasets on a regular basis (e.g., every five years) to continue to adopt and use the best available information.

²⁵ Definition of estuary and waters of this state, ORS 196.800: https://oregon.public.law/statutes/ors_196.800.

Information sharing and acknowledgement can help to shift responsibility to homeowners, businesses, and developers, so they understand the risks they face. Hazard disclosures could be comprehensive and state whether a property is: in the tsunami zone; eligible for shoreline protection (e.g., riprap) under Goal 18 or Goal 16; near or in a flood zone; near an estuary or tidal water body; subject to a rolling easement if adjacent to the ocean shore; and more. The [Tsunami Land Use Guide](#) includes sample code language for such a disclosure.

Clear and Objective Standards:

Use clear and objective language when setting standards that apply to residential development. Senate Bill 1051, enacted in 2017, amended ORS 197.307. It extended the requirement for clear and objective standards to all housing. The amendment has created challenges for local governments with subjective code provisions related to coastal resource protection and in hazard overlay zones. Prior to SB 1051, review criteria applied in areas identified under Goal 7 and managed from hazard mitigation were not required to be clear and objective. ORS 197.307(6) allows for an optional subjective review path in some situations. One option is to have two pathways for housing application review: a prohibition for certain hazard areas (avoidance) and a more subjective pathway to allow development under a subjective review path. DLCDD staff are available to assist local jurisdictions in addressing these requirements.

Project Design & Building Codes

Coastal Hazard Application:

Develop a Coastal Hazard Application for certain types of projects and developments occurring in areas subject to sea level rise, such as schools, public infrastructure, large subdivisions, etc., to consider SLR during project review and give jurisdictions the ability to monitor what projects are going in and what future issues may arise. For example, Rhode Island's coastal zone management program uses this approach: <http://www.crmc.ri.gov/coastalhazardapp.html>. If these standards are applied to housing, they must also be clear and objective.

Pre-application meetings are already required for certain types of development and offered on an optional basis to other interested parties in many jurisdictions. These consultations are a prime opportunity to educate property owners about sea level rise risks and code language, and to connect them with resources early in the pre-design stages of their projects when design alterations are actionable. Outreach materials, hazard maps, and easily digestible sea level rise data would be key in supporting these conversations.

Additionally, a local government may consider requiring developers to sign an indemnification holding the local government harmless if damage occurs due to hazards. Some jurisdictions in Oregon do this already.

Expand NFIP:

NFIP-participating communities can expand the application of existing flood hazard development code provisions to SLR risk areas. Communities can also adopt higher standards than the NFIP minimums to provide better protection against the combined impacts of flooding and SLR. For example, many of FEMA's Flood Insurance Studies report base flood elevations for the 0.05%, or 500-year flood event for velocity zones.

Update Project Design Standards:

Require the use of SLR projections in the design of public projects subject to the impacts from SLR, such as new or upgraded water or sewer treatment facilities, port projects, beach accessways, recreational trails, roads, utility lines, etc. Coordinate across departments to ensure that everyone is using the same SLR projections and data in their projects and designs. Account for these design standards in municipal fee systems to help to pay for facility and infrastructure upgrades needed to accommodate higher water levels or storm surge. Grants may also be available for integrating SLR into public projects.

Building Codes:

Oregon's statewide building codes contain provisions to ensure that new and substantially improved buildings meet uniform minimum NFIP construction standards. They also provide a means for local jurisdictions to impose higher flood protection standards by the local floodplain administrator providing the building official with the locally approved base flood elevations that exceed NFIP minimum standards. The floodplain section of the building code was modified to give the local floodplain administrator the responsibility to define the location of the floodplain and the design flood elevation (design flood elevation is the Base Flood Elevation plus freeboard). This is codified in the local floodplain regulations. Once the floodplain administrator passes the floodplain determination and design flood elevation to the building official, the construction standards take effect, which are consistent across the state.

Most coastal jurisdictions have adopted the 100-year base flood elevation provided by FEMA plus one foot of freeboard. Two approaches to adopting higher standards are to increase freeboard requirements or to adopt the 0.05%, or 500-year base flood elevations. While the 500-year flood zones are not shown on FEMA Flood Insurance Rate Maps, they are often published in the Flood Insurance Study, even for velocity zones. Adopting a 500-year base flood elevation does not change where purchase of flood insurance is mandatory, which is in the 100-year Special Flood Hazard Area shown on FEMA flood insurance rate maps, but it would help to address additional risk areas from SLR.

If optional building codes exist to address other coastal hazards, consider adopting the standards locally. Because of Oregon's governance structure, only those building codes that have been adopted by the state as optional can be adopted by local governments. Alternatively, incentivize developers to voluntarily utilize these standards in their projects.

FEMA P-499, Home Builder's Guide to Coastal Construction (English and Spanish editions available) is a series of 37 fact sheets providing technical guidance and recommendations concerning the construction of coastal residential buildings. The fact sheets present information aimed at improving the performance of buildings subject to flood and wind forces in coastal environments. Photographs and drawings illustrate the National Flood Insurance Program regulatory requirements, the proper siting of coastal buildings, and recommended design and construction practices for building components, including structural connections, the building envelope, and utilities.



Some ideas to consider in areas that will experience intermittent flooding are planting salt tolerant plants or requiring all parking lots and open space to be pervious (i.e., allowing water to pass through).

Dikes and Levees:

Many of these flood protection techniques exist throughout the coastal zone. Jurisdictions should consider inventorying the status of such structures, including their functionality and ownership and whether they would continue to function with SLR conditions. DOGAMI has a [statewide inventory](#) to start from, but it should be further investigated to ensure accuracy. Some funds may be available to help repair existing dikes and levees; however, it is unlikely that any state or federal funds will be available to create new dikes and levees. Some of these structures and the lands within or behind them may fall within a diking district, which could be used to assist with repairs, though many of these districts are no longer active.

Protecting & Expanding Public Shoreline Access

Public shoreline access is an essential feature of the Oregon coast and protected under Statewide Planning Goal 17. Shoreline access is critical to the economic, health, and environmental wellbeing of coastal communities. These locations tend to be at low elevation and at risk during high tide, king tide, storm, or flood events. As such, these access points should be a high priority for adaptation planning and projects. Jurisdictions may consider adopting new comprehensive plan policies to address shoreline public access more comprehensively and in coordination with other relevant land use goals, such as Goals 5-9, 16, and 18. Such policies may include, but are not limited to, the following ideas:



PUBLIC ACCESS, BANDON. PHOTO BY CLAIRE FIEGENER, 2022.

- Existing public ownerships, rights-of-way, and similar public easements in estuary and ocean shorelands that provide access should be retained or replaced if sold, exchanged or transferred.
- Improve public access to the beach, estuary and coastal lake shores by acquiring land and easements and be willing to accept donations and dedications of land and easements for public access.
- Prioritized list of specific areas to increase or improve public access to coastal waters
- Structural shoreline stabilization permits will require, in addition to other requirements, that the proposed project will not restrict existing public access sites or any potential (or undeveloped) public access sites such as road ends and rights-of-way. Criteria for placement of beach front protective structures shall include requirements that public access to the beach is maintained. Require that proposed structural shoreline stabilization projects that abut street ends and other public rights-of-way, incorporate steps and/or paths or other improvements that improve public access.
- Direct growth so as not to encroach upon or diminish public access sites to coastal waters and public shorelands.
- Incorporate public access into natural hazard planning processes to reduce risks to people and property.
- Require public coastal access as a condition to receive public funding for coastal restoration projects.

Additionally, jurisdictions may consider other strategies discussed throughout this document to help maintain or increase public access, such as open space and conservation easements and limiting shoreline armoring.

Outreach & Education

In areas at risk from SLR and other hazards, educate residents and business owners about risks and the steps they can take to protect themselves, their properties, and their livelihoods. Education and outreach can help save lives during disaster events and prevent damage by influencing the design and location of homes, businesses, and infrastructure. For example, encourage the use of temporary safety measures in areas that are likely to experience intermittent flooding during winter king tide events. These might include early warning systems, detours, alternative routes to safety (non-flooded routes), emergency alerts, signage, and social media campaigns. Support for measures, such as a requirement that structures be located and designed to avoid damage, is more easily achieved when residents are educated about their risks in their communities and the value of hazard protection measures.

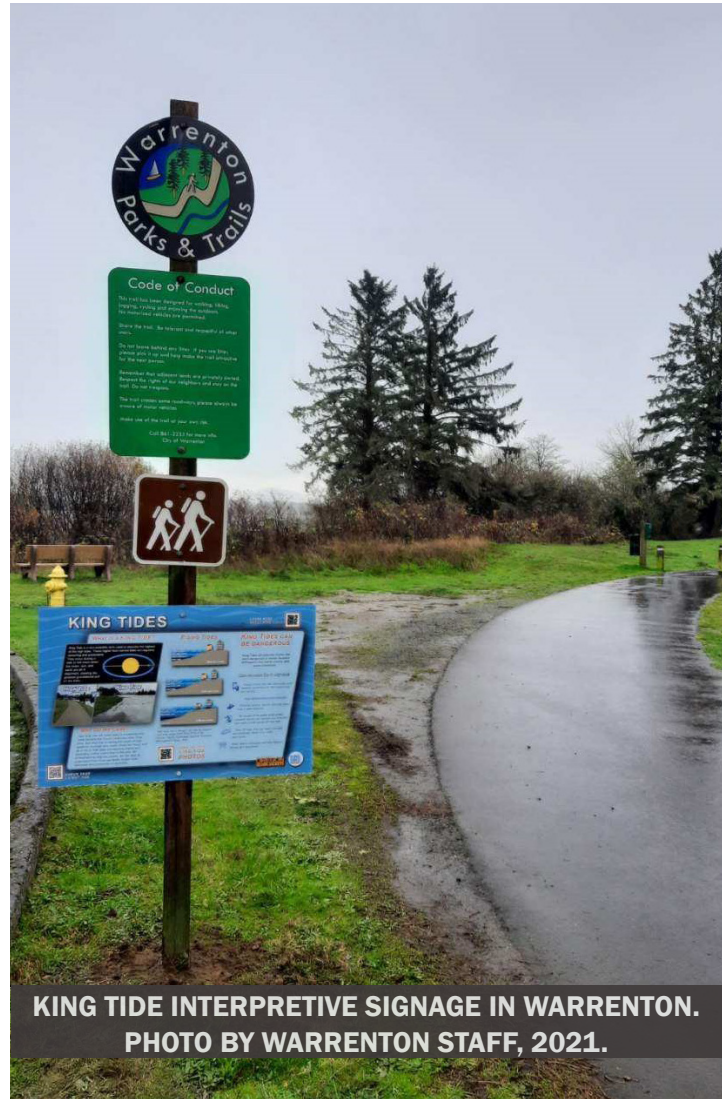


SNEAKER WAVE DURING A KING TIDE, LINCOLN CITY. PHOTO BY J. BOWMAN, 2013.

General Communications and Outreach Ideas:

There are many ways in which outreach and education can occur within a community around topics of sea level rise and climate change impacts. It is important to evaluate your communication objectives and populations within your community to develop an appropriate outreach and education strategy and implementation plan. Some ideas are listed below.

- Letters to property owners within SLR and other hazard risk areas (in multiple languages based on demographics of the community) to inform people of the hazards that affect where they live and work, including links to authoritative information;
- Public meetings and virtual forums to engage residents in conversations about the hazard risks and risk mitigation and preparedness approaches in their community. Make it relevant to their everyday lives and decisions;
- Accessible messaging regarding risk, options to mitigate the risk, and emergency preparedness (accommodate the language and communication needs of local residents):
 - Newsletters,
 - Utility bill inserts,
 - Podcasts,
 - Booths at the local fair or local events,
 - Newspaper articles,
 - YouTube videos,
 - Signs and water level markers,
 - Website content,
 - Social media campaigns,
 - Local school district partnerships to educate youth,
 - Chamber of commerce partnerships to educate business owners,
 - Philanthropy partnerships to get the word out,
 - Whatever other local communication methods exist (local knowledge is especially important in this step).
- Training local staff on effective risk communication and changing the way they talk about hazards;
- Encouraging the purchase of insurance for hazards (e.g., flood) even if not required;
- Targeted outreach for different audiences and languages:
 - Residents (property owners, renters, and all other parties),
 - Realtors,
 - Surveyors,
 - Community staff,
 - Elected officials.



Shoreline Stabilization & Erosion Mitigation Tools

Nature-based:

In some cases, flood or erosion protection can be achieved by protecting, restoring, or creating natural systems such as wetlands, dunes, mudflats, eel grass beds, cobble revetments, or floodplains. This might mean permanently protecting (e.g., through zoning) the natural systems that already serve this function so they cannot be developed. It may also mean enhancing natural areas to restore hazard mitigation functions such as flood storage or erosion buffering (e.g., beach and dune nourishment, vegetation plantings, cobble berms, piling removal, or dike removal). This strategy can be utilized for a single property or asset but is more effective on an area-wide basis to fully realize its benefits.



Open Space Preservation:

In areas that are vulnerable to coastal erosion and sea level rise, open space preservation can be a vital tool for preventing future flood and erosion damages. Open space can be preserved through the use of tools like rolling conservation easements, setbacks, or land acquisition. Communities that protect coastal erosion hazard areas as open space can apply for credit under the [FEMA Community Rating System](#).²⁶

Protecting coastal floodplains as open spaces is especially important when these areas are vulnerable to other hazards like coastal erosion and sea level rise. By preventing development in these coastal erosion hazard areas, loss of life and property due to erosion can be minimized or prevented altogether. Protecting open space from development preserves habitat for fish and wildlife, provides recreational opportunities, increases flood storage capacity, and allows beaches and marshes to migrate over time in response to sea level rise and natural sediment

²⁶ Community Rating System: <https://coast.noaa.gov/digitalcoast/training/crs.html>

transport processes. Finally, maintaining pristine coastal habitat is vital to supporting the fishing economy as recreational and commercial fishes and shellfish rely on coastal habitats.

Structural Accommodations:

In some cases, development can be modified or designed in ways that will withstand the impacts of SLR without damage, such as by elevating buildings or infrastructure, floodproofing structures, and building on floating structures.

Structural Erosion-Control:

As a last resort and for areas that are eligible under the coastal goals (16, 17, and 18), structural erosion control measures may be a suitable strategy. This typically means fixing the shoreline in place in some way to mitigate the impacts of coastal erosion on development. Along the Oregon coast, this most often takes the form of riprap or seawalls. **These structures need to be maintained over time and are the responsibility of the property owner.** With SLR increasing total water levels over time, the cost to maintain these structures may exceed the value of the development they are protecting, and property owners may be unable to afford them over time. The jurisdiction should think about what happens when riprap or other structures can no longer be maintained by their owners.

Structural erosion control techniques should be thought of as short-term strategies, especially because of their impact on the public beach. By fixing the shoreline and trapping sediment, these structures stay in place while sea levels rise. Shoreline armoring can therefore decrease beach accessibility north to south along the public beach so that some areas may no longer be accessible during high, or even low, tides. This is also important to

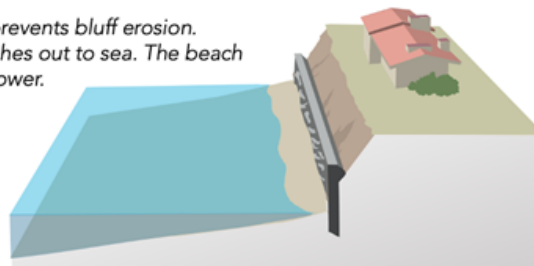
Natural Beach

Naturally eroding bluffs provide steady supply of beach sand.



Beach with Seawall

Seawall prevents bluff erosion. Sand washes out to sea. The beach gets narrower.



Beach Loss

Starved of sand, beach disappears under rising seas.

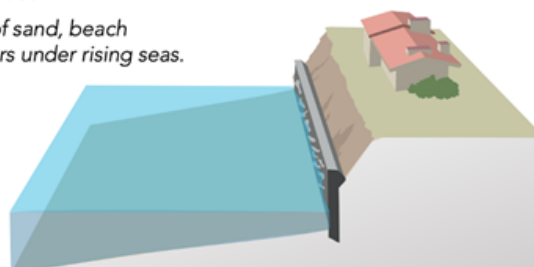


DIAGRAM OF BEACH LOSS DUE TO TRAPPED SEDIMENT SUPPLY BEHIND SHORELINE ARMORING.

note from a public safety perspective if there are public shoreline access points that lead to areas that are no longer safe to walk along during certain times of the day or year. There may additionally be a loss of important beach habitats due to this “coastal squeeze,” such as marine mammal haul-outs, clam beds, and snowy plover nesting habitat.

DLCD has published a detailed guidance document on erosion control practices (both structural and non-structural) used along the outer Oregon coast, including how they work and are regulated. Refer to this [guidance](#) for more information about erosion control practices.²⁷

The challenge with continuing to allow the protection of private property through sea walls or beach nourishment is that it indicates to homeowners that their property will remain valuable and viable, so they continue to invest in their property. More investment means more reason to protect down the road. However, the community may eventually be responsible for cleanup costs when the area can no longer be protected. There is value in re-imagining a different future for the oceanfront and other coastal areas that will continue to experience impacts and damage due to SLR. This could include a gradual removal of infrastructure from areas at risk from continued SLR hazards.

Re-Alignment

Re-alignment is proactive relocation from the shoreline to accommodate increased erosion and flooding due to sea level rise. Also sometimes known as managed retreat, this strategy encompasses a range of options, from individual home buyouts to a broader re-imagining of coastal shoreland development. In the riskiest areas, there may be no other safe choice but to withdraw from the oceanfront or estuary. Having a plan in place can avoid unmanaged retreat under disaster circumstances.

There are a few examples of communities or assets that have been relocated from the shoreline both in Oregon and throughout the country that showcase the different scales of this approach, as well as the successes and challenges. A few case studies are listed here, as well as additional strategies that support this concept.

- Relocation of a house in Coos Bay, OR that was subject to coastal erosion: oregon.surfrider.org/coos-bay-managed-retreat-success-story/.
- Acquisition project in the Village of Valmeyer in the 1990’s: <https://www.fema.gov/case-study/valmeyer-acquisitions-buyouts-create-open-space>.
- Relocation plan for a light rail line in Del Mar, CA: sandiego.surfrider.org/coastal-commission-approves-dmb5-with-conditions/.
- Surfer’s Point Managed Shoreline Retreat Project, Ventura, CA: www.adaptationclearinghouse.org/resources/surfer-s-point-managed-shoreline-retreat-project.html.
- Relocation of the Village of Newtok, AK: www.commerce.alaska.gov/web/dcra/planninglandmanagement/newtokplanninggroup.aspx.



GRAPHIC DEMONSTRATING THE IDEA OF RE-ALIGNMENT, OR THE MOVEMENT AWAY FROM RISKY SHORELINE AREAS. CREDIT: OREGON STATE UNIVERSITY, 2014.

²⁷ DLCD. 2021. Guidebook on Erosion Control Practices of the Oregon Coast: www.oregon.gov/lcd/OCMP/Documents/guidebook_erosion_control_practices.pdf

Conservation easements:

A conservation easement is a voluntary legal agreement between a landowner and a land trust or government agency. Easements can be used to permanently limit the use of land to protect its conservation value and allow landowners to continue to own, use, or sell their land. When a conservation easement is put in place by a landowner, some of the rights associated with the land are given up. For example, in high hazard areas, the right to build certain types of structures could be given up, while retaining some or all the land as open space. Conservation easements are permanent, and future owners are bound by the easement terms. The easement holder is responsible for making sure the easement's terms are followed. Easement holders are typically a land trust or other conservation-oriented organization but may also be governmental entities. While conservation easements are typically focused on preserving important natural resource or open space values, as voluntary, non-regulatory mechanisms for limiting development, conservation easements may also serve to help reduce exposure to coastal erosion and flood risk.

Buy-outs:

An existing tool for both flood-prone and erosion-prone homes is a buyout program. The Federal Emergency Management Agency (FEMA) offers voluntary buyouts to owners of properties covered by federally backed flood insurance that have been repeatedly damaged by flooding, erosion, or other hazards. The program pays 75% of the property value, which is assessed by a third-party evaluation. Once the buyout is completed, the property is transitioned to open space. The land is deeded to the local government and must remain open in perpetuity. This program can be difficult to take advantage of because of a 25% match requirement and the length of time needed to establish eligibility (sometimes up to 5 years long), as well as land management responsibilities. There are also upfront costs to cover, which will be reimbursed from FEMA. Some of Oregon's coastal communities can qualify as "small and impoverished" which means the funding from FEMA can cover 90% of the property value. More information is available through the [State Hazard Mitigation Officer](#) at the Oregon Department of Emergency Management.

Realigning infrastructure:

Transportation and utility infrastructure (e.g., roads, power lines, water/sewer/gas pipes, etc.) are longer-term investments for localities. Re-aligning roads and utilities to safer locations in the long-term – for example, downgrading or removing coastal roads in front of a row of homes, either transferring the property to the adjacent homeowners with prohibitions on development or keeping it public with similar redevelopment restrictions, and upgrading or constructing new roads behind those homes – can have a number of benefits. Utilities and transportation departments can reduce immediate danger to their assets from coastal erosion. Maintenance costs over the medium term could also be reduced. Finally, the reorientation and accompanied easements or legal requirements would reorient future development in the area. This can be done on a larger scale for entire communities or regions, and not just for SLR.



Removable development:

To make up for some of the lost revenue of removing oceanfront homes, consider re-developing high hazard areas with moveable or temporary commercial uses within urban areas, such as food trucks and coffee carts, farmer's markets, amphitheaters, and playing fields.

Water Management

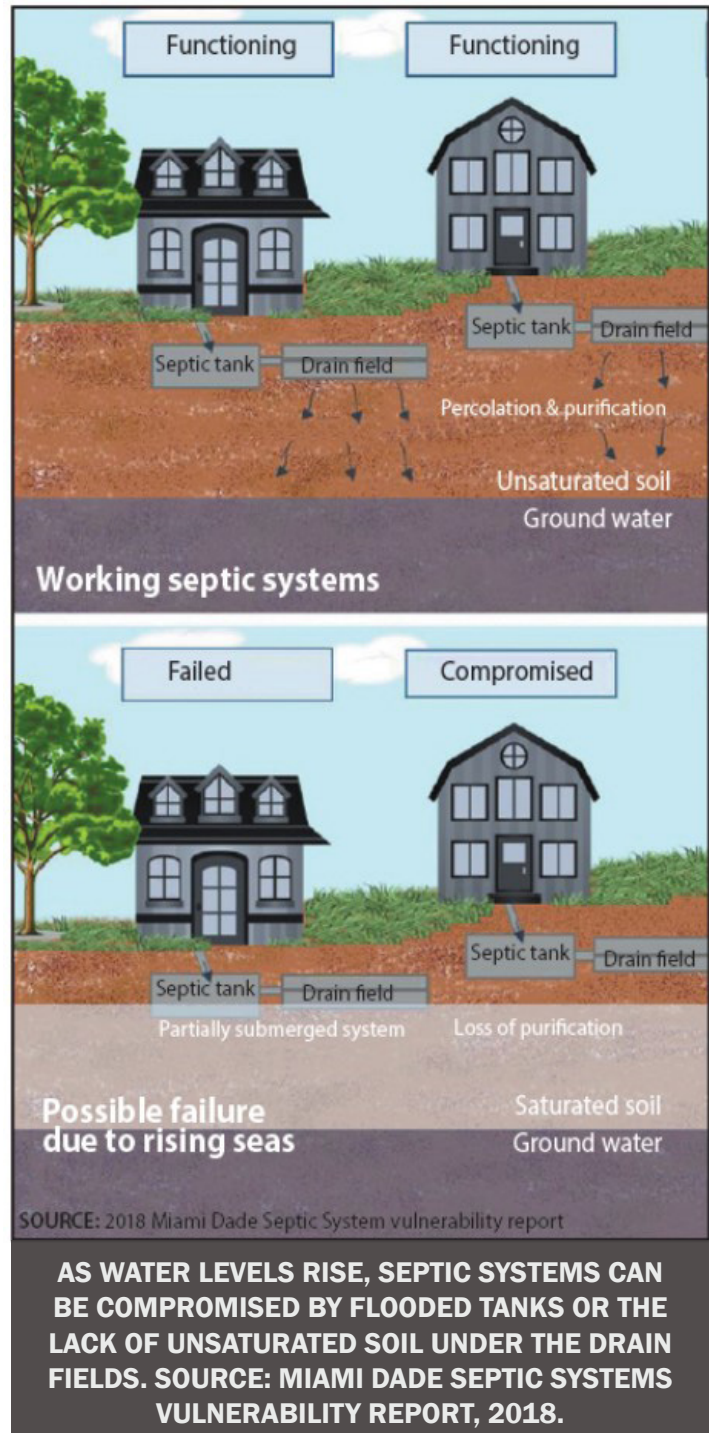
Septic systems:

With rising sea levels, septic systems are at higher risk of surface and inland flooding, causing septic systems to function improperly. Surface flooding occurs as a result of more frequent storm surges and excess rainfall leading to soil saturation and flooding of the drain field, whereas inland flooding is a result of rising groundwater levels, compromising the minimum required vertical separation distance from ground water for properly functioning septic system. Failed septic systems result in many financial risks, such as substantial investment in repairs or decrease in property values. In addition, environmental risks due to contamination are of major concern. Contamination of aquifers relied on for drinking water threatens human health. Contamination of surface water degrades habitat. To reduce the potential for compromised septic systems, local governments can encourage periodic inspection of existing systems and seek out funding to assist low-income residents with needed repairs. Property owners may not know their septic system is failing until their wells are tested and show elevated nitrate levels. A groundwater quality monitoring program may help address this issue. Additionally, new development that will rely on septic systems should be limited in hazardous areas.

Oregon land use law generally prohibits the establishment of new sewer systems on rural lands or the extension of sewer systems outside of Urban Growth Boundaries or unincorporated community boundaries to serve rural lands. Such activity is only allowed when the new or extended system is the only practicable alternative to mitigate a public health hazard or an exception to Statewide Planning Goal 11 is justified.

Stormwater management:

Evaluate and update water quality Best Management Practices (BMPs) to account for changes in water quality and supply issues due to sea level rise, as applicable. Updates could include practices to provide greater infiltration/inflow of rainwater, increased stormwater capture and/or water recycling programs, the use of low impact



development, improved maintenance procedures for public sewer mains, policies to address impaired private sewer laterals, and other proactive measures.

Include consideration of sea level rise in stormwater management plans and development of local standards: Management plans can identify low-lying or other at-risk areas with inadequate stormwater infrastructure and set priorities for system improvement.

Increase capacity of stormwater infrastructure: Actions to reduce impacts from higher water levels include increasing conveyance and storage capacity of stormwater systems. Larger culverts or replacing culverts with bridges may be needed to accommodate instream flows. In areas where levees are used to manage surface water flows, pumps may need to be added. A jurisdiction will also benefit from developing contingency plans for extreme events.

Green stormwater infrastructure management practices can be used to minimize the amount of stormwater that flows into conveyance systems. These strategies include low impact development, green roofs, permeable pavements, bioretention (e.g., vegetated swales, rain gardens) and cisterns. Local regulations can include standards that require green infrastructure be used whenever possible in lieu of hard structures.

NOAA has additional tools about adapting stormwater management for coastal floods online: <https://coast.noaa.gov/stormwater-floods/>.

Fiscal Assessment & Incentive Programs

Sea level rise has the potential to greatly impact a jurisdiction's financial resources. Any adaptation planning or strategy implementation should account for fiscal vulnerability and land use constraints. In most of Oregon's coastal communities, land-based finances (e.g., property taxes) are an important component of a community's revenue. Reliance on land-based revenue may incentivize jurisdictions to continue to put major developments on or near the water to maximize short-term tax revenues despite known risks. Limitations placed on development will need to be crafted so as not to violate state and federal laws, particularly around private property rights.

With this information, local governments should consider the affordability and practicality of keeping existing infrastructure in place and functioning considering climate change and SLR impacts. Based on such analysis, local governments could develop policies and disseminate information that helps to appropriately shape the long-term expectations of property owners about which infrastructure in which areas will likely be able to be maintained.²⁸

Special Districts:

Explore using or establishing a special district to generate funding to support mitigation objectives. As a form of local government, special districts typically have taxing authority. They are created by their constituents to meet specific service needs for their communities. Most perform a single function such as water delivery, fire protection, wastewater, or cemetery maintenance. Some, like county service districts, provide multiple services. Existing or new special districts could be utilized by a community to help address and fund sea level rise adaptation strategies, provided their charters allow for the activities envisioned. Bear in mind that tax rates for special districts that existed prior to 1997 have a permanent tax rate that can't be changed. This may make it difficult to raise enough money to perform new activities envisioned for an existing special district. Creation of new special districts is governed by ORS chapter 198. Most often a new special district will need to be approved by voters or by unanimous consent of all property owners whose parcels are included within the special district boundaries. A permanent tax rate will be established for the new special district during the process of gaining its approval. Examples:

28 Rupert, T. 2018. Castles- And Roads- In the Sand: Do All Roads Lead to a Taking? Environmental law institute, Washington, DC. www.flseagrant.org/wp-content/uploads/Castles-and-Roads-In-the-Sand_2018_48_ELR_10914.pdf

- Tillamook County has used this approach with the Tillamook Bay Flood Improvement District.
- Resilience District in Seattle, WA: <https://greenspace.seattle.gov/2020/12/city-to-create-a-resilience-district-with-award-from-robert-wood-johnson-foundation/#sthash.JK5fGvDc.dpbs>.

Please refer to the Department of Revenue’s Local Budgeting Manual for more information about special districts and their taxing authorities: https://www.oregon.gov/dor/forms/FormsPubs/local-budgeting-manual_504-420.pdf.

System Development Charges:

System development charges (SDCs) offer limited utility for the financing of adaptations to sea level rise. SDCs are one-time charges on new development and certain types of redevelopment to help pay for existing and planned infrastructure to serve that development. SDCs are one means available to local governments for financing growth. SDC revenues may only be used for capital costs; they cannot be used for ongoing facility or system maintenance or for projects that either fix existing system deficiencies or replace existing capacity. They must be directly related to the need for additional facilities or to make use of existing capacity to serve the growth generated by new development.²⁹

Tax & development incentives:

Incentive programs could be used to discourage development in areas likely to be threatened by SLR. Such programs could take the following forms:

- *Relocation/retrofit tax incentives*—Governments could provide a one-time tax credit to property owners who move structures out of at-risk areas (either relocating on the same or a different parcel) or retrofit structures to be more resilient to flooding. Tax credits should be offered when the landowner exceeds the minimum standards required by existing ordinances (i.e., the minimum required setbacks or building elevations).
- *Siting incentives*—Governments could provide tax incentives or density bonuses to encourage developers to site new development in lower-risk areas of a lot or a subdivision. For example, infill tax incentives could be used to encourage clustering of development in already urbanized upland areas.
- *Conservation tax incentives*—Governments could offer preferential assessments to landowners who agree to conserve their property for flood control or open space purposes. Landowners who donate easements would be assessed lesser property taxes based upon the loss of value caused by the easement terms limiting uses of the property.

Grants:

Grants made available by federal and state agencies can contribute significantly to the financing of projects to reduce the impacts of sea level rise. Many state and federal agencies administer grants and loans that can be used to build local resilience to rising seas. The Federal Emergency Management Agency (FEMA) and the National Oceanic and Atmospheric Administration (NOAA) Coastal Program are two important sources of grant funding along the coast. Award of FEMA grants requires that local government have a FEMA-approved Natural Hazard Mitigation Plan. These plans can cover a county or region but included cities must have participated in the planning process. Plans must be updated every five years. Contact DLCD’s Natural Hazard Mitigation Planning Program to learn more about supports available to maintain plans.

Grant programs constantly evolve. The Oregon Department of Emergency Management provides information about FEMA grant opportunities. The Oregon Coastal Management Program offers information about NOAA grant opportunities. The [Oregon Economic Development Districts, Rural Funding Resources webpage](#) is another source of information and grant writing support.

²⁹ System Development Charges Issue Brief. 2020. Oregon Legislative Policy and Research Office: www.oregonlegislature.gov/lpro/Publications/Issue%20Brief%20-%20System%20Development%20Charges.pdf

Revolving Loan Programs:

A revolving loan fund (RLF) is a self-replenishing financing mechanism that can be used to fund a variety of programs, ranging from small business development to clean water infrastructure. For example, U.S. Environmental Protection Agency ([EPA revolving loans](#)) have for years helped states fund clean-water and drinking-water infrastructure projects. Though RLFs can vary greatly depending on their mission and scope, they all share the same basic structure. RLFs start with a base level of capital, often consisting of private investment or grants from the federal government or state. This capital is then loaned out to several borrowers. Over time, as these borrowers make repayments and pay interest on their loans, the capital is replenished. When enough repayments are made, the fund uses its reaccumulated capital to issue new loans. Several examples of RLFs that may be helpful in addressing SLR impacts are listed below.

The Drinking Water State Revolving Fund (DWSRF) provides low-cost loans to community and nonprofit non-community water systems for planning, design and construction of drinking water infrastructure improvements per Section 1452 of the [Safe Drinking Water Act \(SDWA\) Amendments of 1996](#). In Oregon, the DWSRF loan program is funded through the Safe Drinking Water Revolving Loan Fund (SDWRLF) which is administered by Business Oregon. Funds may also be available for drinking water source protection efforts. The [Clean Water State Revolving Fund \(CWSRF\)](#) offers financing to qualified institutions who will make sub-loans to individuals to either 1) repair or replace failing on-site septic systems or 2) replace failing on-site septic systems with connections to an available sewer.

Oregon Department of Environmental Quality, [Clean Water State Revolving Fund Program](#) acts like an environmental infrastructure bank by providing below-market rate loans to eligible recipients for water infrastructure projects. As money is paid back into the state's revolving loan fund, DEQ makes new loans to other recipients for high priority, water quality activities. Repayments of loan principal and interest earnings are recycled back into the program to finance new projects that allow the funds to "revolve" at the state level over time. A wide range of water infrastructure projects are eligible to receive CWSRF assistance.

[The Port Revolving Loan Fund](#) provides loan funding to assist ports in the planning and construction of facilities and infrastructure. The fund covers a wide variety of costs associated with a project, such as flexible manufacturing space including engineering, acquisition, improvement, rehabilitation, construction, operation, and maintenance or pre-project planning. Benefits include a loan term of up to 25 years, low interest rates, and delayed interest accrual and repayment terms.

[Oregon Economic Development Districts, Revolving Loan Fund Overview](#) provides basic information about programs operated in each of Oregon's Economic Development Districts.

City or county funded revolving loan funds, see [City of Corvallis Climate Action Revolving Loan Program](#).

[FEMA Revolving Fund](#): Congress recently gave FEMA authorization to provide a revolving loan fund to provide hazard mitigation assistance to local governments to reduce risks to disasters and natural hazards. The Infrastructure Act provides \$500 million to the STORM Act, or \$100 million per year for five years. This new FEMA grant program may finance water, wastewater, infrastructure, disaster recovery, community, and small business development projects.

Transferable Development Rights:

A transfer of development rights (TDR) program encourages development in urban and developed rural areas while preserving farms, forests, and natural resources. In a TDR program, property owners voluntarily convert their development rights to "credits," which can be sold for use in other areas. Allowing property owners in one area to transfer building rights to a property in another area can be a useful tool for directing development away from resource lands or sensitive areas. This kind of voluntary, incentive-based program allows owners to gain the financial benefits of developing, without actually building anything.

Local governments must amend their comprehensive plans and zoning ordinances to create a TDR program. Typically, special overlay zones are established for receiving areas to allow additional development.

A TDR program could be designed to address sea level rise. Local governments could amend zoning ordinances to (1) restrict development in vulnerable areas and designate them as "sending areas"; (2) designate inland "receiving

areas” where development is appropriate and increased density is desirable; and (3) establish and calibrate a development credit market in a manner that gives affected landowners an incentive to transfer their development rights rather than build on threatened properties.

TDR programs are not without hurdles. Not every community has the right mix of conditions to sustain a program. Overall, TDR programs require thoughtful, collaborative work to succeed. They involve an upfront commitment to local consensus on sending and receiving areas, as well as landowner and developer incentives. Such programs also need a third-party entity to hold and monitor conservation easements for the long term. This will be a county or land trust in most cases. A way of exchanging development credits is also needed. Local planning staff needs to keep records of development rights for each property. Some local planning departments even help facilitate rights transfers by setting up an online exchange or bank to assist buyers and sellers in finding each other.³⁰

If a jurisdiction is contemplating requiring property owners to dedicate open space easements or requiring the payment of fees to mitigate project impacts, the jurisdiction should be careful to adopt findings explaining how requiring the property interest or payment is both logically related to mitigating an adverse impact of the project and roughly proportional to that impact. Legislatively adopting rules that establish the exact criteria for determining when to require these exactions and, if so, their magnitude, may also reduce a jurisdiction’s exposure to takings claims.³¹

State Level Strategies

There are some strategies that the State of Oregon can consider to assist local jurisdictions with sea level rise adaptation planning. Some of these strategies are listed here, but this is not comprehensive. If your jurisdiction or organization has ideas for ways in which state level government can aid in this topic, please let us know!

Policy Mandates:

Currently, there is no mandate for coastal communities to incorporate sea level rise into their planning programs. The State of Oregon could consider adopting such a policy to require its consideration in state and local land use planning, transportation planning, capitol improvement planning, and more. This would support many of the adaption strategies identified in the 2021 Oregon Climate Change Adaptation Framework.³² Maine’s state legislature adopted a policy to discourage growth and new development in coastal areas, where, because of coastal storms, flooding, landslides, or sea level rise, it is hazardous to human safety.

State Buyout Program:

Because the federal buyout program only compensates a homeowner 75% of their home’s value to acquire an at-risk property, the State of Oregon could consider developing a matching fund program or a separate buyout program that more wholly and quickly compensates those in damaged or prone to damage areas. New Jersey has a program that has filled this gap since 1995. The Blue Acres program helps New Jersey residents whose homes have been damaged in flooding events and also guides the strategic acquisition of lands that have been damaged, or may be prone to future damage, due to sea-level rise, storms, or storm-related flooding, or that may buffer or protect other lands from such damage. The program is voluntary for willing sellers only and typically takes 12-18 months to complete a property purchase.

Buy-Rent-Retreat:

The concept is that the state would develop a revolving loan program, allowing local governments to purchase vulnerable coastal properties, then rent those properties out, either to the original homeowner or someone else, and use that money to pay off the loan until the property is no longer safe to live in. This gives a local entity time

30 DLCD, TDR Programs: <https://www.oregon.gov/lcd/FF/Pages/Transfer-of-Development-Rights.aspx>.

31 California Coastal Commission. Sea Level Rise Policy Guidance. 2018 Science Update.

32 Oregon Climate Change Adaptation Framework: www.oregon.gov/lcd/CL/Pages/Adaptation-Framework.aspx

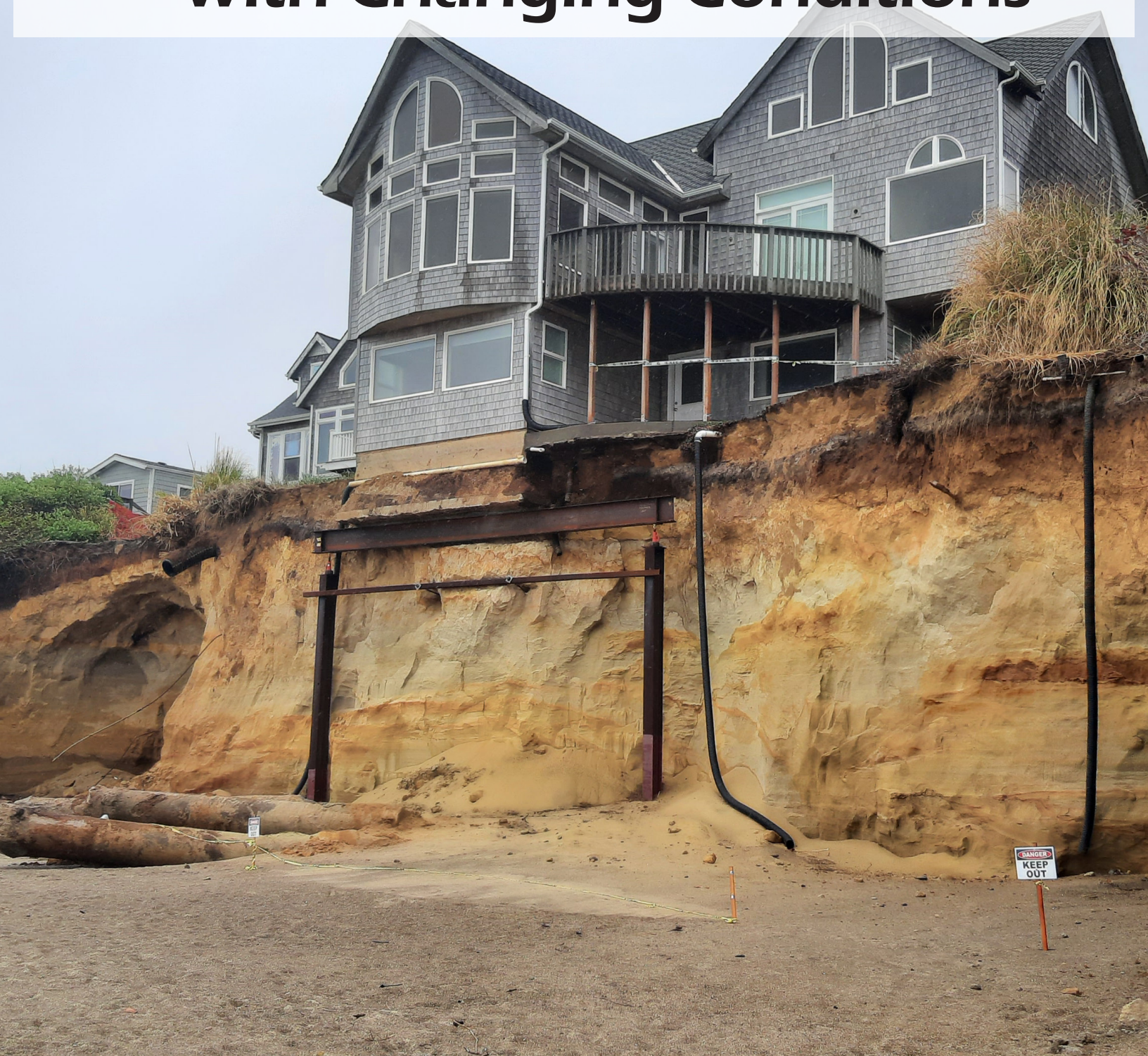
to plan for the eventual phasing out of those properties, the decline in property taxes, and the cleanup costs associated with dismantling and removing the structures and infrastructure. It gives homeowners time to enjoy living on the coastline without the liability of dealing with a major disaster. There are many details that would need to be worked out in such an endeavor, but it is important to begin planning for relocation of the riskiest areas.

Shoreline Armoring Policy Updates:

Currently, the Oregon Parks and Recreation Department permits shoreline protective structures (such as riprap) on the ocean shore. Their permit criteria, which is in Oregon Administrative Rule chapter 736, division 20, could be amended to incorporate SLR and its impacts on the public beach, beach habitat, and development. For instance, new shoreline protective structure permits could be conditioned to prohibit future repairs or expansions of the structure to limit their intrusion on the public beach. Other rule changes could include clarification on relocating a house or trying non-structural protection methods before structural armoring can be approved, incorporating SLR into design and wave run-up calculations, and creation of a mitigation program to offset impacts from any new armoring placed along the shore.



VI. Legal Issues to Consider with Changing Conditions



OCEANFRONT HOME EXPERIENCING EROSION, LINCOLN BEACH. PHOTO BY MEG REED, 2021.

This section is meant to provide some considerations regarding the legal aspects of planning for and implementing adaptation strategies to address sea level rise and other climate change impacts. However, as your community moves forward with adaptation activities, it is important to consult your legal counsel for specific information and advice. In that regard, make sure to budget for work with local legal counsel for adaptation work in your community. Spend time on these topics because they can be complex. There are no easy answers, and the questions keep developing. How do coastal communities plan for coastal infrastructure and protect development from rising seas? When do a coastal property owner’s rights supersede those of the larger community? How do we balance rights of property owners with community values and protection of public resources like beaches and estuaries? Who pays?

Changing Property Boundaries Along Coastlines

Land abutting the ocean and adjacent to rivers and estuaries may not have the fixed boundaries normally associated with upland properties. Their “bundle of property rights” often does not include the right to exclude others from all parts of the property. The ocean-side boundary of many littoral properties, for example, extends to the high watermark, but the public has a customary right to use the area extending from the low watermark to the line of vegetation. As seas rise, the eastern boundary can, and most likely will, move inland over time. Likewise, estuarine and riverine properties, particularly tidally influenced ones, can experience boundary changes



and expansion of areas open to public use. Landowners may feel their privacy is compromised as public uses push towards their waterfront yards and homes. Land use planners may be concerned that the inland push of waves and water threatens harm to structures, roads, wastewater systems, drinking water supplies, and other development. It will be important to think through these challenges as you contemplate and deploy programs and regulations aimed at reducing the potential negative consequences of sea level rise on shoreline adjacent property owners, coastal residents, and the public.

Defined areas of jurisdiction that may be impacted by sea level rise:

Ocean Shore Recreation Area:

The Ocean Shore is defined as “the land lying between extreme low tide of the Pacific Ocean and the statutory vegetation line ... or the line of established upland shore vegetation, whichever is further inland.” ORS 390.605(2). This rolling boundary of the public customary use may change over time, which may impact private property as sea levels rise.³³

Estuary and Tidally Influenced Watercourses:

As seas rise, portions of private property may become inundated either permanently or as the tides ebb and flow. The law provides that the state owns these newly submerged and submersible tidally influenced lands.³⁴

Private Property Rights

The Fifth Amendment to the US Constitution provides that the government may not “take” private property for public use without paying “just compensation.” Case law developed over decades helps us to understand under what circumstances loss of a private property right may be considered a constitutional taking as seas rise. Claims of “takings” can be uncertain, lengthy, expensive, and stigmatizing. Most governments will seek to avoid such claims when possible.³⁵

Various recommendations of this Guide may potentially give rise to takings concerns. The determination of whether a particular regulation may in some circumstances be applied in a way that constitutes a taking is so fact-intensive and context-specific, this Guide cannot provide a simple set of parameters. That said, land use restrictions that prevent all economically beneficial use of the entirety of a property are vulnerable to takings claims unless those uses would qualify as a nuisance or are prohibited by property law principles such as the public trust doctrine. Jurisdictions can work with their legal counsel to minimize the risk of these claims by considering allowing economically beneficial uses on some of the property and by exploring whether legal doctrines regarding nuisance, changing shoreline property lines, or the public trust independently allow for significant limitations on the use of the property.³⁶

Public Use and Public Trust Doctrines

The disposition and management of waterways acquired at statehood is subject to the public trust doctrine, which generally requires the state to protect the public’s use of these waterways for navigation, recreation, commerce, and fisheries. It does not prevent the state from regulating the public’s use of a waterway if necessary to protect these uses. Waterways subject to the public trust doctrine in Oregon include the ocean shore, estuaries, tidally influenced waterways, and navigable waterways.

The Oregon Supreme Court has established a state public use doctrine in non-tidal waterways that are navigable-for-public-use. The public has the right to make certain uses of a waterway whose bed is privately owned if the waterway has the capacity, in terms of length, width, and depth, to enable boats to make successful progress

33 Ocean Shore State Recreation Area: www.oregon.gov/oprd/prp/pages/per-ocean-shore.aspx

34 State-Owned Waterways: www.oregon.gov/dsl/WW/Pages/Waterways.aspx

35 Legal Information Institute: <https://www.law.cornell.edu/wex/takings#>.

36 California Coastal Commission. Sea Level Rise Policy Guidance. 2018 Science Update.

through its waters. Allowed uses include navigation, commerce, or recreation. Recreation includes use of small boats for pleasure and fishing, as well as swimming. The public may use the land adjacent to a waterway that is navigable-for-public use if the use of the adjacent land is “necessary” to the lawful use of the waterway.



AERIAL PHOTO OF ALSEA BAY AND ALSEA SPIT DURING A KING TIDE. PHOTO BY OCMP, 2019.

Liability

There are many uncertainties around what a local government is and is not liable for regarding sea level rise information, providing and maintaining utilities, regulating private property, and more. A jurisdiction’s liability for the planning action it takes (or fails to take) in response to climate hazards is an emerging legal question. Jurisdictions may already face legal challenges related to regulating private property and restricting development. Limiting development in areas vulnerable to future hazards provides an additional subject for legal disputes. A zoning ordinance that restricts development in hazards areas may not constitute a taking if it has the clear goal of protecting people and property, leaves property owners with alternative uses, and is applied fairly to identified mapped areas.³⁷ Conversely, jurisdictions may also face potential liability for failing to act on sea level rise, given the growing body of science and widespread consensus on the existence of the threat. This is an emerging issue, and local legal counsel is the best resource for exploring these concerns.

³⁷ Sea Level Rise and Coastal Land Use in Hawaii: A Policy Tool Kit for State and Local Governments Selected Tools for Awareness and Preparation. 2011. Center for Island Climate Adaptation and Policy, Honolulu, HI.

VII. Conclusions



BEACH GRASS PLANTINGS ON ALSEA SPIT. PHOTO BY OCMP, 2018.

Adaptation planning requires leadership and bold action by Oregon’s state and local governments, to not only address the physical impacts of SLR, but social factors as well. While Oregon will experience less sea level rise relative to other parts of the United States, the impacts will still be felt. The changes along the shoreline may be gradual at first, but as the tide line moves up elevation, upslope, and inland, the impacts will be felt more dramatically and abruptly, especially if we fail to adapt before then. Additionally, because the Oregon coast will likely experience less severe impacts of climate change overall, there may be an influx of people moving to the coast to escape its impacts elsewhere, which will create additional challenges for Oregon’s small, rural, and under resourced coastal communities. SLR planning should focus on those who are socially vulnerable, such as the poor, the elderly, racial minorities, and people with underlying health conditions or disabilities.

We hope this guide and its associated tools provide you with a wide range of possible policy and project strategies to respond to the impacts of sea level rise and address social vulnerabilities, including those which are well established and widely used to those that are emerging and innovative. Any barriers to implementation of these measures should be viewed considering the magnitude of potential harm to Oregon’s social, natural, and cultural resources posed by sea level rise and climate change.

Planning for the impacts of sea level rise is necessary to foster healthy, vibrant, and resilient coastal communities.



VIII. References and Useful Resources



VIEWPOINT FROM SUNSET BAY TO CAPE ARAGO TRAIL. PHOTO BY MEG REED, 2017.

Websites & Online Tools

Association of State Floodplain Managers: floodsciencecenter.org/.

Adaptation Clearinghouse, maintained by the Georgetown Climate Center: www.adaptationclearinghouse.org/.

Coastal Risk Screening Tool: coastal.climatecentral.org/.

Florida Sea Grant, Coastal Planning and Policy Tools: www.flseagrant.org/climate-change/coastalplanning/.

National Conservation Easement Database: www.conservationeasement.us/.

NOAA's Office for Coastal Management: coast.noaa.gov/.

Oregon Dept. of Land Conservation & Development: www.oregon.gov/lcd/CL/Pages/index.aspx.

Oregon Governor's Office: www.oregon.gov/gov/policy/Pages/energy_climatechange.aspx.

Oregon Coastal Hazards Ready (OCHR) Library and Mapper, maintained by Oregon Sea Grant: <https://bit.ly/OCHR-Mapper>.

Oregon's Coastal Atlas, maintained by OCMP: www.coastalatlus.net.

Reduce Flood Risk, hosted by the Association of State Floodplain Managers: www.reducefloodrisk.org/.

Ready to Fund Resilience Toolkit: <https://adaptationprofessionals.org/ready-to-fund-resilience/>.

Surging Seas Risk Finder: www.riskfinder.org.

Wetlands Watch, Virginia. Sea Level Rise Adaptation: wetlandswatch.org/adaptation.

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