



COASTAL ADAPTATION STRATEGY
TOWN OF COUPEVILLE
FINAL DRAFT
June 2025



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EXECUTIVE SUMMARY

This Coastal Adaptation Strategy (CAS) for the Town of Coupeville offers a science-based, community-informed roadmap for addressing the growing risks of coastal hazards driven by sea level rise. Coupeville has already experienced 3.6 inches of SLR over the past 50 years, and projections indicate that this trend will accelerate significantly by 2050 and 2100. As sea level rise accelerates, the Town’s shoreline faces increasing risks from flooding, erosion, and infrastructure vulnerability. With much of the Town’s infrastructure, historic buildings, and high valued habitats located near the shoreline, taking early action is critical to preserving the Town’s character, functionality, and safety.

This strategy builds upon the 2023 SLR vulnerability assessment and outlines a phased approach for mitigating these risks through targeted adaptation measures. The 2023 vulnerability assessment identified several key assets that are most at risk. Among them, town roads—such as NW Madrona Way and Front Street—are threatened by bluff erosion, which could render sections impassable over time. Historic overwater buildings in the downtown area face flood risks from rising sea levels and storm surge, requiring floodproofing, structural reinforcements, or elevation to preserve their cultural and economic value. The Town’s wastewater treatment plant (WWTP) and sanitary sewer lines are also highly vulnerable, as inundation or infrastructure failure could result in significant environmental and public health concerns and impact many people. Other assets, including the Thomas Coupe Boat Ramp and the Moore Place neighborhood, are at risk from wave-induced erosion and periodic marine flooding, requiring targeted adaptation strategies.

To address these challenges, this adaptation strategy incorporates a suite of potential measures:

- ▶ Passive Management Techniques – Surface and groundwater management, vegetation management, and non-structural erosion control.
- ▶ Protection – Soft shore protection (e.g., beach nourishment, large wood placement) and hard shoreline defenses (e.g., groins, revetments, bulkheads).
- ▶ Accommodation – Elevation of structures, floodproofing, and infrastructure modifications.
- ▶ Retreat & Development Restrictions – Managed relocation of at-risk structures and regulatory measures to limit new development in vulnerable areas.

For roads, strategies include bluff stabilization with vegetation and drainage improvements, soft shore or hybrid bluff toe protection through beach nourishment, and, where necessary, planning for mid- to long-term road relocation or realignment. Historic overwater buildings may require a combination of floodproofing, elevation, and the repair of existing shore armor to mitigate storm impacts while preserving historical integrity and coordinating with property owners, local businesses, and preservation groups. The wastewater treatment plant will need a phased approach, beginning with short-term floodproofing of critical components, while evaluating long-term relocation options. Sewer infrastructure upgrades, including watertight manhole covers and backflow prevention systems, will reduce the risk of system failures during extreme weather events along with bank toe protection in conjunction with protecting other assets.

For the Thomas Coupe Boat Ramp, structural reinforcement such as strengthening the boat ramp and adjacent shore armor and extending the ramp will help maintain public access. In the Moore Place neighborhood, a combination of soft shore protection, structure elevation, and improved vegetation and stormwater drainage systems will help mitigate flood risks, though managed retreat may be necessary in the long term.

The adaptation strategy is structured around three planning horizons: near-term (2035), mid-term (2050), and long-term (2100). Immediate actions focus on stabilizing critical infrastructure, further assessing floodproofing strategies for historic buildings and bank toe protection strategies, securing funding, and implementing community engagement initiatives. By 2050, the Town should advance projects to elevate and retrofit structures, while exploring funding and relocation options for high-risk assets. By 2100, broader measures such as elevation of much of the downtown buildings and roads, reconstruction of structures, managed retreat, and/or large-scale shoreline protection may be necessary.

To support these initiatives, the strategy identifies potential funding sources, including state and federal grants. Community engagement and coordination with stakeholders, and tribal partners, will also play a key role in guiding the next steps and implementation.

This Coastal Adaptation Strategy provides a comprehensive roadmap for the Town of Coupeville to strengthen its resilience to sea level rise by integrating nature-based solutions, targeted infrastructure investments, and proactive long-term planning. These approaches are designed to reduce the Town's vulnerability to coastal hazards while preserving the character and function of its shoreline. In doing so, the strategy aims to protect critical community assets—including the local economy, cultural and historic resources, and the natural environment—so that future generations can continue to live, work, and recreate along Coupeville's shores.

While the strategy presents a suite of recommended adaptation actions, the specific measures ultimately implemented—and the overall effectiveness of the plan—will depend on the leadership, collaboration, and sustained engagement of Town staff, residents, and local property and business owners working together to carry this vision forward.

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ACRONYMS

ADA	Americans with Disabilities Act
BFE	Base Flood Elevation
CAS	Coastal Adaptation Strategy
CCTV	Closed-Circuit Television
FEMA	Federal Emergency Management Agency
FT	Feet
GIS	Geographic Information System
GPS	Global Positioning System
HDPE	High-Density Polyethylene
HPA	Hydraulic Project Approval
I/I	Infiltration/Inflow
IPCC	Intergovernmental Panel on Climate Change
JARPA	Joint Aquatic Resources Permit Application
LIDAR	Light Detection and Ranging
LF	Linear Feet
MHHW	Mean Higher High Water
NAVD88	North American Vertical Datum 1988
NPDES	National Pollutant Discharge Elimination System
NOAA	National Oceanic and Atmospheric Administration
NTR	Non-Tidal Residual
OHWL	Ordinary High Water Mark
RCP	Representative Concentration Pathway
SEPA	State Environmental Policy Act
SERP	State Environmental Review Process
SMP	Shoreline Master Programs
SOP	Standard Operating Procedure
SLR	Sea Level Rise
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, Environmental
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WWTP	Wastewater Treatment Plant

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1 INTRODUCTION AND BACKGROUND

The Town of Coupeville (Town) includes approximately 2.5 miles of shoreline. To date the Town has experienced a relatively small magnitude of sea level rise (SLR), approximately 3.6 inches in the last 50 years¹, however SLR is projected to accelerate in the coming decades. As a result of SLR, the Town’s shores will be subjected to changes in the magnitude and frequency of coastal flooding, with cascading effects of accelerated erosion, infrastructure damage, habitat loss, and other impacts on the local scale. The Town must seek to understand the potential risk of SLR to their communities and plan to mitigate those risks.

In 2023, the Town completed a SLR vulnerability assessment that identified several assets within the Town that are vulnerable to SLR via flooding and erosion in the short and long term (Coastal Geologic Services et al., 2023). The technical assessment coupled recently developed localized SLR projections from the Washington Coastal Resilience Project team (Miller et al., 2018), high resolution land elevation data from Island County, and other publicly available regional data in GIS and performed a quantitative assessment of SLR vulnerability for the Town’s shores. The analysis was applied to critical assets within the Town which include buildings (historic, non-historic, critical infrastructure), roads, utilities (sewer, storm, water), and parks and community assets.

The overall framework used in the technical vulnerability assessment was to define vulnerability as a function of exposure and sensitivity to SLR hazards (vulnerability = exposure + sensitivity). The exposure assessment quantified the two main impacts from SLR, which are flooding and shoreline recession. The SLR scenarios chosen were all associated with an RCP 8.5 or high emissions scenario for 2050 and 2100 (Table 1). Choosing the RCP 8.5 scenario for this assessment is somewhat conservative because it represents the high end of the range of possible emissions; however, current emissions trends continue to remain on the higher end of projections (IPCC et al., 2021). The assessment utilized the 50% and 1% probability of exceedance, which represents the percent chance that absolute sea level will rise by at least that amount. The 50% exceedance scenarios were chosen to analyze a moderate scenario, or a “likely” range of SLR. The 1% exceedance scenarios were chosen to analyze a more extreme scenario, but with a lower likelihood of occurring. Inundation along the Town was modeled during an extreme coastal water level event relative to mean higher high water (MHHW) for each SLR scenario. We chose to use the maximum historic non-tidal residual (NTR) modeled for the Town which is 2.7 FT (Yang et al., 2020). The NTR is defined as the instantaneous difference between the measured or hindcasted water level and the predicted astronomical tide, or put simply, the NTR is the storm surge or the increased water level during storms from a combination of strong winds and lower atmospheric pressure.

Table 1. Sea level rise scenarios and their components utilized in the 2023 vulnerability assessment.

SLR SCENARIO	CURRENT MHHW (FT NAVD88)	SLR PROJECTION (FT)	MAX NTR (STORM SURGE) (FT)	INUNDATION HEIGHT (FT NAVD88)
2050 Mod (50%)	9.07	0.8	2.7	12.57
2050 High (1%)		1.9		13.67
2100 Mod (50%)		2.4		14.17
2100 High (1%)		5.4		17.17

¹ Based on the [NOAA Port Townsend gauge](#)

Future coastal recession² was estimated by mapping the shore (bluff or bank crest) from the most recent topographic survey, estimating the historic erosion rates, and then projecting the future position of the shore by integrating the vertical change in SLR for each scenario. The areas of inundation and bluff recession under each scenario were then used to identify potentially at-risk assets.

It should be noted that the exposure to elevated groundwater from sea level rise was not evaluated in the vulnerability assessment. When that assessment was completed, models of groundwater changes from sea level rise were not available. Since then, the USGS has released this data for all Puget Sound (Befus et al., 2024).

The sensitivity of each asset, or the degree to which an asset is susceptible to impacts due to coastal flooding or a combination of flooding and recession, was qualitatively assessed based on known conditions of each asset and input from the Town. The final vulnerability assessment evaluated the most exposed assets and factored in their sensitivity to SLR impacts to assess their overall vulnerability. The three most vulnerable assets within the Town were found to be roads, historic buildings, and sewer lines. The wastewater treatment plant was also noted as being vulnerable due to its critical nature and difficulty to relocate. Generally, the vulnerability assessment found that the impacts of direct flooding from SLR are limited while impacts of SLR from shore recession are more widespread along the Town's shores and is therefore critical to include in hazard planning for the Town.

With funding from the Department of Ecology's (Ecology) Shoreline Planning Competitive Grant Program, the Town is taking the next step to develop a Coastal Adaptation Strategy (CAS) and coordinate a comprehensive adaptation plan to identify and evaluate future actions and measures that further climate resilience along the coast of Coupeville. The purpose of this Coastal Adaptation Strategy is to give the Town the information and tools it needs to take steps to develop a more protected and resilient shoreline in the face of rising seas. The strategy follows the guidance outlined in NOAA's *Adapting to Climate Change: A Planning Guide for State Coastal Managers* including 1) setting goals and priorities, 2) identifying feasible actions, 3) evaluating and selecting actions, and 4) creating actions plans for prioritized actions (NOAA, 2010).

The study area includes the entire bounds of the Town that are projected to be impacted by SLR-related hazards through the year 2100. This plan provides a framework for decision making in the short-, mid-, and long-term with multiple options and actions identified at each of these planning horizons. Specific recommendations are focused on the short term, or approximately the next 10 years, and mid to long term plans presented here should be reevaluated when substantial changes in the best available science or conditions within the Town occur.

The development of this Coastal Adaptation Strategy was a community effort which involved creating a Public Participation and Stakeholder Engagement Plan and sharing information and receiving input from a broad cross section of the community and stakeholders through several meetings, a targeted public survey, and presentations. Public engagement supported prioritization efforts as well as provided on-the-ground local knowledge of conditions. Additionally, engagement provides a foundation for future discussions and decisions surrounding SLR impacts in the Town. See attached Engagement Report (Maul Foster & Alongi, 2024) detailing the engagement efforts completed to support this effort.

² The terms "bluff recession" and "erosion" are sometimes used interchangeably, however recession is the net landward movement of the landform due to both erosion and mass wasting (landslides) and is expressed as a horizontal change in distance.

2 GOALS AND PRIORITIES

2.1 Goal Setting

The Federal Emergency Management Association (FEMA) defines goals in the context of coastal adaptation strategies as “general guidelines that explain what the planning team wants to accomplish. They are usually long-term (but may also be short-term), broad statements.” This is an important part of the adaptation strategy planning as including input from the community and stakeholders allows for incorporation of their informed knowledge of conditions and issues, helps keep them engaged, and may increase the likelihood that they will be supportive of the plans and actions taken following the plan. During our initial public outreach and stakeholder engagement efforts, proposed goals related to SLR resiliency were presented and feedback and support were solicited. The goals were presented to the Coupeville Climate Committee in a virtual meeting and during a public open house, and the team received written comments by community members and stakeholders (Maul Foster & Alongi, 2024).

The participants expressed overall support for the proposed goals for the Coastal Adaptation Strategy:

- ▶ Reduce the vulnerability of the built environment to sea level rise
- ▶ Monitor and maintain functioning and healthy coastal ecosystems
- ▶ Minimize economic losses attributable to the impacts of climate change including disaster response and recovery
- ▶ Adapt to climate change in a manner that provides benefits to the natural environment and maintains or improves public access
- ▶ Protect critical infrastructure such as the wastewater treatment plant from the impacts of SLR
- ▶ Retrofit historic buildings to better withstand the effects of SLR
- ▶ Regularly update sea level rise predictions in planning to reflect the latest science

2.2 Prioritized Assets

During the vulnerability assessment we identified highly vulnerable assets and areas within the Town to prioritize for future efforts based on their exposure and sensitivity to SLR-related hazards. These were identified as the historic overwater buildings and specific segments of roads and sewer lines. We also identified the wastewater treatment plant (WWTP), the Moore Place neighborhood (previously referred to as Parker Road), and the boat ramp at Thomas Coupe Park as priorities to include in this adaptation strategy (Coastal Geologic Services et al., 2023). The rationale for including each of these assets or areas is summarized below.

Town roads – There are over 12,000 FT of road in the Town within the 200 FT shoreline jurisdiction. This includes approximately 4,000 FT of footpaths (sidewalks and paths). While only a very small length of roads is expected to be exposed to flooding within the Town, many roads are in close proximity to the bluff crest. By 2100, approximately 50% of the roads and 60% of the footpaths are within the mapped recession zone (including the 20 FT buffer of safety). Roads were ranked as having the overall highest vulnerability compared to other assets within the Town due to the high exposure to shore recession, the importance of the roads to the

Town, and the time and expense to relocate or repair roads and associated infrastructure. Specific sections of road such as along NW Madrona Way and NE Front Street are especially vulnerable and need to be prioritized for near-term action.

Historic waterfront buildings – There are 47 historic structures inside the 200 FT shoreline jurisdiction within the Town, mostly located along Front Street. These buildings were ranked as highly vulnerable to SLR-related hazards with risks from both flooding and coastal erosion with approximately 25% of the buildings along NE Front Street expected to be impacted in the near term and up to almost 40% in the long term. Due to age, construction type, and condition, most historic buildings are not conducive to relocating. The general feasibility of these and other actions was assessed by structural and civil engineers and detailed in Section 4.3 of this report. These buildings are the heart of the Town’s economic downtown and have high cultural/historical value. Therefore, effective strategies to protect these buildings in place were prioritized. It is important to note that the Coupeville Wharf, a historic building managed by the Port of Coupeville, is not included in this assessment as the Port is already planning to raise the wharf by 4.5 FT and has recently undergone retrofitting³.

Wastewater treatment plant (WWTP) – There is one WWTP in the Town, located adjacent to Thomas Coupe Park. The WWTP serves approximately 1,928 people (Department of Ecology, 2019). Commercial users include restaurants, the county jail, a hospital, an assisted living center, and public schools. The WWTP was ranked as highly sensitive with at least six of the main structures predicted to be flooded during a moderate storm event by 2100 or with water levels over 14.2 FT NAVD88. This asset would be expensive to repair or replace and has very limited ability to be relocated without completely rebuilding it. Therefore, prioritizing the identification of specific strategies and feasible actions as early as possible will give the Town time to plan and acquire necessary funding.

Boat ramp at Thomas Coupe Park – The boat ramp, ramp to the dock, and the floating dock at Thomas Coupe Park are threatened by SLR and wave induced erosion. This area is also considered an emergency access point for the Town and therefore needs to be prioritized for strategic planning. The boat ramp is a valuable public access point which allows access for commercial and recreational fishing.

Sewer lines along Front Street – There are almost 9,000 FT of sewer lines within the 200 FT shoreline jurisdiction in the Town and just over half are mapped as within the 2100 High scenario bluff recession buffer (including the 20 FT buffer of safety). Therefore, the sewer line conveyance system was ranked as highly vulnerable to SLR-related hazards. However, it should be noted that the accuracy of the sewer mapping is unclear. Over 30% of the Town’s sewage flows down Front Street to the treatment plant, and this line is in very close proximity to the bluff crest. Sewer lines are not easily moved and much like the wastewater treatment plant, impacts to these assets can affect many facilities and people in the Town.

The collection system is considerably older than the present WWTP and has been known to have infiltration and inflow (I/I) problems (Department of Ecology, 2019). Coupeville has been working on identification and removal of excess I/I in their system, and annual reports submitted to Ecology indicate that reductions of I/I are being realized. Coupeville has taken action to investigate and minimize I/I including hiring a collection systems specialist, jetting, videoing and smoke testing sewer lines, inspecting manholes, and installing time-release stormwater pans in approximately 30% of manhole covers.

As of 2015, the collection system had four lift stations, or a pumping station that elevates wastewater from a lower to a high elevation: the Front Street lift station which serves customers on the north end of Town, Front Street, and west of Main Street (LS No. 1), the South Main lift station, which serves all the Town south of Third Street (LS No. 2), the Lauren Street lift station that serves the southwest portion of the Town and the Laurens

³ <https://portoc.org/project/coupeville-wharf-rehabilitation-project/>

Woods areas (LS No. 3), and the Vine Street lift station that serves the northwest area of Town (LS No. 4). LS No. All lift stations have automatic start backup generators.

Moore Place neighborhood – This is a low-lying neighborhood on the eastern side of the Town. Several structures are at risk of flooding and marine storm damage in the near term in this neighborhood. Creating a neighborhood plan should be prioritized. It should be noted that this was previously called the Parker Road Neighborhood in the 2023 SLR vulnerability assessment.

2.3 Guiding Priorities & Principles

During the initial engagement efforts that occurred between May and September 2024, participants were invited to provide input on a series of prompts aimed at formulating goals and guiding principles that reflect the community's values and priorities around coastal adaptation. The goals set provided overarching outcomes that the Town wants to achieve, and the guiding principles offer community-driven values that inform how those goals should be pursued. These discussions centered on key areas where the CAS should focus its efforts, including reducing the impacts of SLR on critical infrastructure, historic buildings, and natural ecosystem. Participants emphasized the need for proactive measures that not only protect key assets but also encourage coordination among various stakeholders, and sustainable planning and development practices. Additionally, they highlighted the importance of anticipating changing climate impacts and prioritizing equity, ensuring that the needs of vulnerable populations and small businesses are addressed throughout the adaptation process. These principles were utilized in the evaluation of proposed adaptation actions. A summary of the responses to each prompt is included below. Note that these are not listed in order of importance.

1. **The CAS should reduce the impacts of SLR hazards on:**
 - a. Critical infrastructure and utilities (e.g., water, sewer, power, communications).
 - b. Historic buildings and essential community landmarks (e.g., the Wharf, public access).
 - c. Transportation networks (e.g., roads, evacuation routes).
 - d. Natural habitats and ecosystems, especially shoreline areas.
 - e. Wastewater and septic systems to protect marine and human life.
 - f. Homes and businesses, particularly those with fewer financial resources.
 - g. Economic vitality of the community (e.g., businesses, property values).
2. **The CAS should encourage:**
 - a. Community participation and clear communication on plans and progress.
 - b. Coordination across property owners and sectors for unified efforts.
 - c. Limiting further development in high-risk or buffer zones.
 - d. Investment in long-term, sustainable solutions, not just short-term fixes.
 - e. Environmental conservation and restoration of habitats and natural areas.
 - f. Innovative and flexible approaches, including creative funding and redevelopment strategies.
 - g. Proactive planning for infrastructure improvements, such as transportation and utilities.
3. **The CAS should anticipate:**
 - a. Changing climate impacts (e.g., saltwater intrusion, bluff degradation, increased flooding).

- b. Rising costs and financial challenges related to climate adaptation.
 - c. Potential population shifts (e.g., climate refugees, demographic changes).
 - d. Tension between different adaptation approaches, like armoring vs. natural solutions.
 - e. Need for partnerships with neighboring areas, state, and federal agencies.
 - f. Growing demand for public education on climate impacts and adaptation strategies.
 - g. Technological and infrastructure challenges, such as electrification and resource management.
- 4. The CAS should prioritize:**
- a. The protection of vital infrastructure (e.g., wastewater treatment, roads, utilities).
 - b. Investments in nature-based solutions (e.g., habitat restoration, rainwater collection).
 - c. Public-private partnerships to leverage expertise and funding.
 - d. The protection of historical assets and cultural landmarks (e.g., Front Street, the Wharf).
 - e. Clear communication and community education on adaptation strategies.
 - f. Funding for long-term resilience projects, including high-risk properties and critical assets.
 - g. Equity considerations, especially for vulnerable populations and small businesses.

2.4 Planning Horizons

This coastal adaptation plan evaluates three planning horizons consistent with the vulnerability assessment based on projected SLR and a future year:

- ▶ Near-term: up to 1.2 FT SLR (2035)
- ▶ Mid-term: up to 2.4 FT SLR (2050)
- ▶ Long-term: up to 5.4 FT SLR (2100)

These SLR scenarios come from updated SLR projections for Washington State from the 2018 Washington Coastal Resilience Project (Miller et al., 2018). All projections are associated with RCP 8.5 or high emission scenarios for the years 2035, 2050, and 2100. The current baseline, with no additional measures to cut emission or reduce impacts, lies between RCP 6.0 and RCP 8.5, therefore we use RCP 8.5 as a conservative estimate. We opted to use the 1% probability of exceedance, or the percent chance that absolute sea level will rise by at least that amount. The 1% exceedance scenario was chosen to analyze a more conservative scenario for planning purposes in light of new ice shelf instability and other findings.

We assessed vulnerability during an extreme water level event relative to mean higher high water (MHHW). We used the maximum historic non-tidal residual (NTR) modeled for the Town which is 2.7 FT (Yang et al., 2020) but did not add wave run-up to this modeled scenario as those data are not available for the Town.

3 POTENTIAL ACTIONS

This section describes the general actions or techniques in terms of SLR adaptation strategies that may be applied to the Town as summarized in Table 2. Each general action is further explained and discussed in the following subsections. These can be considered tools in the toolbox that we can pull from, but we also looked more broadly to include the possibility of applying novel approaches. Actions are not “one-design fits all” and the most appropriate management approach for a given site or asset should ideally:

- ▶ Address the cause of the issue
- ▶ Be appropriate for the risk at the site
- ▶ Avoid impacts to nearshore ecosystem processes and habitats and cultural resources
- ▶ Have public/stakeholder/tribal support

The spectrum of existing shore management actions related to SLR adaptation can be generalized as encompassing passive management techniques, protection, accommodation, and retreat. Each of these actions has several design techniques that fall within these general categories. Due to the unique characteristics of Puget Sound shores compared to the open coast, there is a somewhat limited number of commonly applied techniques. Each of the potential actions that may be applicable to the Town are described below (Table 2). The *Marine Shoreline Design Guidelines* describes many of these actions in more detail (Johannessen et al., 2014). These actions can and should be used in conjunction with each other which may result in a “hybrid” approach.

Historic preservation must be considered when evaluating potential actions. Several regulatory requirements exist such as those involved in obtaining a U.S. Army Corps of Engineers (Corps) permit for work below mean high tide line. The Corps is the lead federal agency responsible for complying with Section 106 of the National Historic Preservation Act of 1966, which requires all federal agencies involved in an undertaking with the potential to affect historic properties to consider the effects of their actions and consult with affected parties. This includes carrying out surface inspections, subsurface testing, and reporting to identify any report surface and/or buried historic properties within the project area. Impacts to a historic property must be avoided, minimized or mitigated based on recommendations by a professional archaeologist and consult with appropriate tribal staff. Presence of archeological resources may constrain what actions are allowable.

Table 2. Matrix of potential actions for sea level rise adaptation for assets in Coupeville.

GENERAL ACTION	SPECIFIC DESIGN TECHNIQUE		KEY ELEMENTS	
Passive Management Techniques	Surface and Groundwater Management		Non-engineered approaches such as planting of native vegetation and managing surface and groundwater.	
	Vegetation Management			
Protect	Soft Shore Protection	Beach Nourishment	Use of natural materials, preserving or enhancing natural coastal processes and habitats, slowing not eliminating erosion/flooding.	
		Large Wood		
		Reslope-Revegetation		
	Hard Shore Protection – Shore Parallel	Rock Revetment		Attempts to eliminate erosion or flooding, hindering natural processes, creating a static shoreline, loss of beach area and substrate, end-effects.
		Seawalls, Bulkheads, Floodwalls, Levees		
		Detached Breakwaters		
Hard Shore Protection – Shore Perpendicular	Drift Sills and Groins	Structures to interrupt sediment transport and trap sediment to build/rebuild beaches and/or stabilize navigational channels and inlets.		

GENERAL ACTION	SPECIFIC DESIGN TECHNIQUE	KEY ELEMENTS
Accommodate	Structure Elevation	Raising infrastructure up to reduce the threat from flooding and storms and allows the resident/business to remain on the property preserving existing structure/housing. This also may include abandoning the existing first floor or ground-floor level below the established flood risk level and adapting it into a wet or dry floodproofed space.
	Temporary Protective Measures	Use of materials or systems that can be deployed or activated when flooding is predicted and removed when flood waters have receded such as sandbags or plastic shields.
	Floodproofing/Retrofitting	Establishing a watertight seal on the exterior of the foundation and sealing all interior spaces below the established flood risk level (Dry Floodproofing). Allows water to enter a historic building during a flood event and drain out as the flood waters receded (Wet Floodproofing).
Structure Relocation	Relocation	Moving coastal infrastructure inland to reduce risk of erosion and flooding and allow the shore to recede naturally. Also known as “managed retreat”.
	Development Setbacks	Setting back infrastructure far enough inland from the shoreline or bluff crest so that it will not be threatened by erosion or flooding during the estimated life of the development. Setbacks may be regulated at the state or local level, or both.
	Limit Substantial Redevelopment	Restrict redevelopment of structures destroyed or substantially damaged within at-risk areas.
	Limit Construction of New Development in Vulnerable Areas	Restrict or prohibit development in vulnerable areas.

3.1 Passive Management Techniques

Passive Management Techniques are techniques that generally help manage some types of erosion without using engineered approaches. These techniques can be less expensive than engineered shore protection while also having less impact on beach processes and habitat and can typically improve nearshore habitat function. These techniques should be considered when evaluating actions for managing shore erosion at the property either solely or in conjunction with other techniques. Passive Management Techniques for shorelines include surface and groundwater management and vegetation management.

Surface and Groundwater Management

The goal of drainage management is to reduce additional drainage input that is caused by clearing and development to reduce the risk of bank failure (Johannessen et al., 2014). Developed and cleared/unforested areas require additional drainage management above natural conditions due to:

- ▶ Decreased amount of rainwater intercepted by tree canopy/vegetation or absorbed into the ground due to impervious grounds
- ▶ Infrastructure such as stormwater drainage outfalls, septic drainfields, and irrigation systems increases water input into concentrated areas
- ▶ Drainage systems that route stormwater runoff into the ground without adequate consideration of the soil characteristics which may result in slope instability

Proper drainage management is one of the most efficient and practical ways to reduce bank erosion on unstable banks. If water is being collected and concentrated, it needs to be expelled appropriately as concentrating water near a bank crest or face can promote bank instability.

Because each site is unique, drainage management requires site specific solutions and evaluation/design conducted by qualified professionals. Water management techniques include routing water landward rather than waterward where possible or the creation of rain swales where appropriate to address slope stability issues. Other water management techniques include routing water over a bluff in a tightline, however this must be done properly to prevent erosion problems to the beach, bank, and marine riparian zone and limit water quality issues (Figure 1). Typically, an outfall control structure is used to dissipate the energy of flow at the outlet such as a diffuser tee. An outfall structure will require a Hydraulic Project Approval (HPA) permit from WDFW, and other permits may apply such as Town, County, or Army Corps of Engineers.



Figure 1. Example of a drainage tightline routed over a bluff (Photo Credit: Avery Maverick, 2021).

Vegetation

Vegetation adds root strength, helps intercept rainfall and runoff, and increases evapotranspiration which helps to increase slope stability and the risk of slope failure. Preserving and expanding existing native vegetation maintains or increases these functions when done appropriately. Additionally, marine riparian vegetation or vegetation that grows adjacent to the beach, provides many habitat benefits including connecting the marine and terrestrial ecosystems, dropping insect and leaf litter, slowing water movement, providing shade, and supplying large wood to the beach.

Vegetation management is an effective method to control surficial erosion on sloped surfaces such as rills, gullies, and shallow landslides. Deep-seated landslides due to subsurface geology, groundwater and/or bank toe erosion are not effectively managed by vegetation.

A properly vegetated slope and adjacent uplands provides a more natural look than many engineered solutions and also can provide considerable stability. Due to the more natural approach, it also supports beach processes by allowing for some amount of erosion to occur. Lastly, vegetation is typically a more cost-effective technique than highly engineered solutions.

The Department of Ecology has a guide for this technique called *Vegetation Management: A Guide for Puget Sound Bluff Property Owners* (Menashe, 1993).

3.2 Protect

3.2.1 Soft Shore Protection/Nature-based Designs

Soft shore protection is a sustainable alternative to bulkheads or other “hard” shore protection techniques that uses aesthetic, natural, non-toxic, and “shore-friendly” approaches and materials – for both people and wildlife. These designs are typically less expensive than traditional bulkheads, minimize maintenance and off-site impacts, and can provide easy beach access. Permitting soft shore protection is less difficult than permitting hard armor. The main techniques applied in soft shore designs are beach nourishment, placement of large wood, and resloping and revegetation, and many are used together. Best practice guidelines for soft shore protection are detailed in the *Marine Shoreline Design Guidelines* (Johannessen et al., 2014).

Beach Nourishment

Beach nourishment is the artificial supply of sand or gravel to the beach (Bird, 2000). Locally in the Pacific Northwest gravel beach nourishment has been referred to as “constructing a protective berm” by early local practitioner Wolf Bauer. Beach nourishment projects are typically intended to mimic natural processes, but sediment grain size larger than native sediment is utilized to increase the longevity of the design (Figure 2). Gravel beaches can dissipate a significant amount of wave energy (Finlayson, 2006; Komar et al., 2003) and the use of slightly coarser sediment than native beach sediment can help form a high berm for storm protection (storm berm). The berm then dissipates storm wave energy by reducing wave runup as well as reducing backwash water volume and velocity (Finlayson, 2006; Komar et al., 2003). Beaches that have been nourished are intended to adjust through time due to wave action and long-term accretion unlike hard shore protection.



Figure 2. Example of large-scale beach nourishment project in Birch Bay, WA to mitigate coastal flooding and erosion. Larger than native sediment was utilized to dissipate wave energy and help to form a high berm for storm protection (Photo Credit: Jim Johannessen, 2020).

Site specific analysis is required for a successful project design as the region has a wide range of beach conditions, wave fetch distance, drift cells length, and littoral transport rates that affect if a site is appropriate for beach nourishment. Sites that are most favorable are swash-aligned beaches where beaches directly face the predominant wave direction. Sites that are very small, rapidly eroding, where the risk to structures is high, or where the beach is drift-aligned are typically not favorable sites for beach nourishment. Some drift-aligned sites can be viable for beach nourishment if other measures such as rock drift sills are constructed to hold the sediment on site. For reference, the Town of Coupeville’s shoreline is drift-aligned (not swash-aligned).

Drift sills are shore perpendicular structures that are relatively low-elevation and short for the purpose of retaining placed sediment at nourished beaches, where at least one side of the drift sill has beach nourishment filled to close to the crest height of the sill. These are used in degraded urban settings where fill has pushed the shore into deeper water and there are very limited, or no sources of up-drift sediment.

Dynamic revetments (also called cobble berms) are a type of beach nourishment that is becoming more common along the Pacific Northwest’s open coast (Allan et al., 2005, 2003; Bayle et al., 2021). The design uses cobble or small angular rock to mimic a natural cobble beach. They function because of the asymmetric nature of wave swash velocities that have more energy to push cobbles up the beach face where they form a berm than pull the cobble down slope. With sufficient volume, particle size, and wave energy, dynamic revetments can be more resistant to wave attack than a natural sandy beach. However, within Puget Sound and along the Town of Coupeville, wave energy is not strong enough for a dynamic revetment to work as intended for shore protection.

Large Wood

Historically, natural large wood along the beach was much more common on Puget Sound shores than at present (Maser and Sedell, 1994) which helped protect beaches and marine banks from erosion and trap sediment and encourage backshore vegetation growth. Large wood placement designs consist of placing large tree trunks, with or without rootwads onto the beach to diminish or reduce wave induced erosion (Figure 3).

Typically, large wood placement is used in combination with other actions such as beach nourishment and revegetation. Large wood can be simply placed on top of the beach, partially buried, or anchored, in groups or placed individually. In addition to providing shore erosion protection, large wood has ecological benefits including adding habitat complexity, shade, and enhancing marine riparian ecotone. Generally, barrier beaches, pocket beaches, embayment shores or bluff backed beaches with low wave exposure are feasible for large wood depending on the drivers of erosion. Sites with high erosion, moderate to high risk to structures, high wave energy, or a small backshore width are not suitable. This technique does not include large rigid log structures such as crib walls that function as log bulkheads.



Figure 3. Example of large wood anchored on the beach to protect adjacent houses from coastal erosion (Photo Credit: Adam Tullis, 2024).

Reslope-Revegetation

Resloping and revegetating involves lowering the gradient of the slope in order to increase slope stability and planting the slope, preferably with native riparian vegetation. This technique is appropriate for mitigating slope instability where upland causes and toe erosion have created an oversteepened, unstable upper slope or bank face. Resloping is not appropriate for sites where wave attack is the sole or primary factor contributing to erosion. Adding vegetation helps intercept precipitation, reduces surface water runoff and associated erosion, while also creating a root network to physically hold bank sediments. More conventional slope stabilization includes engineered structural components such as geosynthetic bags, crib walls, or other soil-retaining structures for higher risk and problematic sites (MacDonald et al., 1994). Resloping and revegetating requires sufficient upland area to lay the slope back to an appropriate and more stable slope.

If archaeological resources are present, such as a shell midden, resloping may not be feasible and a cultural resources assessment and consultation with appropriate tribal staff would be necessary.

3.2.2 Hard Armor

Hard armor is a common form of coastal erosion control structures and is typically used to try to stop wave attack and erosion or to reclaim tidelands for upland uses. Locally in the Puget Sound region, the terms “bulkhead”, “revetment”, “rockery”, and “seawall” are commonly used for hard armor structures that are oriented shore parallel. To differentiate between the two main types of hard armor, “revetment” is used for structures made of sloping and stacked armor rocks while “vertical bulkhead” is used for all vertical structures. Groins, sills, and jetties are also forms of hard armor, but these structures are oriented shore perpendicular and are typically used to trap and hold sediment rather than directly inhibiting erosion. Hard armor techniques should only be selected as a last resort after considering least impactful alternatives.

Hard armor has the highest impacts relative to other design techniques including:

- ▶ Reduction in natural sediment input that maintains beaches
- ▶ Loss of beach functions and habitat by direct burial
- ▶ Alteration of hydraulic processes
- ▶ End-effects or exacerbated erosion adjacent to armor
- ▶ Potentially increased beach-face erosion and coarsening of beaches
- ▶ Loss of nearshore vegetation
- ▶ Reduced connectivity between riparian and nearshore habitats
- ▶ Inability to accommodate or adapt to rising sea level

Additionally, hard armor has become increasingly difficult to permit through all agencies and municipalities as there is increasing evidence and acceptance of the negative impacts of this technique. Generally, hard armor is only permitted when primary infrastructure is in imminent danger, soft shore protection is infeasible, erosion is chronic, and infrastructure cannot be relocated. Ongoing sea level rise will reduce the efficacy shore armor in the mid- to long-term as rising seas will increase the risk of structural failure over time with scour at the foot of the structure and potential overtopping.

Revetment

This hard armor technique uses rocks to construct a sloped and permeable structure (i.e., not for flood protection) (Figure 4). The rough surface of the revetment armor rock reduces wave runup more than smoother types of hard armor making it possible to create a shorter structure than vertical bulkheads. The typical design includes an outer rock face with the rock sized appropriately that when subjected to wave energy rocks remain in place with a second layer of rock beneath to allow for energy dissipation and drainage behind the structures. A common variation of the rock revetment is an almost vertical rock wall which combines characteristics of revetments and vertical bulkheads, locally called “rock wall”. This technique generally uses larger rocks than revetments which can be an advantage as they cover less beach area and therefore reduces the burial of nearshore habitat and can be constructed in areas with less available space. Revetments are only appropriate for sites of low to medium bank heights with adequate backshore width.



Figure 4. Examples of different forms of rock revetments (Photo Credit: Avery Maverick, 2024)

Vertical Bulkhead

Vertical bulkheads are rigid and vertical structures used as shore protection to stop bank erosion by reflecting waves and retaining upland sediment and can be constructed out of several materials. Typically, vertical bulkheads are constructed out of either cantilevered (vertical) concrete walls, anchored sheet pile walls, or wood soldier piles. Historically, soldier piles walls are more economical than concrete or vinyl walls but have the shortest life span (approx. 25 years) due to wood decay. Creosoted wood should never be used and is not permissible due to the vast ecological effects from harmful toxins. The structural integrity of these structures comes from ground penetration which makes depth of embedment of the structure an important design element. The majority of the time imported backfill gravel material must be placed behind the structure for drainage. Vertical bulkheads are only appropriate where there is a very narrow or no backshore width available and sites that are between or adjacent to other vertical shore armor. A floodwall is a different form of wall (typically concrete) constructed *away* from the shore to keep flood waters (from any source) out of a particular area (see Section 3.3.2).



Figure 5. Example of property with a hard armor (Photo Credit: Avery Maverick, 2024).

Groins

Groins are shore perpendicular structures constructed to trap sediment and reduce longshore sediment transport (National Park Service, 2019) (Figure 6). By trapping sediment on one side of the structure, it protects a section of the shore on the updrift side from further recession. However, this depletes the sediment supply to the adjacent down-drift area. This can cause adjacent owners to construct additional groins to counteract increased erosion leading to a domino effect of groin installation. These can be constructed from a wide range of materials including rock, concrete blocks, metal sheet piles, timber sheet piles, but are most commonly composed of rock.



Figure 6. Example of a rock groin at Marine Park in Bellingham, WA (Photo Credit: Adam Tullis, 2021).

Flood Barrier Measures

Barriers include floodwalls and levees and can be built around a structure to contain or control floodwater (FEMA, 2015) (Figure 7). Levees are manmade structures usually made of compacted soil with a clay or concrete core. A floodwall is a structure typically made of reinforced concrete and/or masonry and varies in height from 1 FT – 6 FT or more. There are several types of floodwalls including gravity, cantilever, buttress, and counterfort (more information and design considerations can be found in Chapter 5F of FEMA’s Engineering Principles and Practices document⁴).

⁴ https://www.fema.gov/sites/default/files/2020-08/fema259_complete_rev.pdf

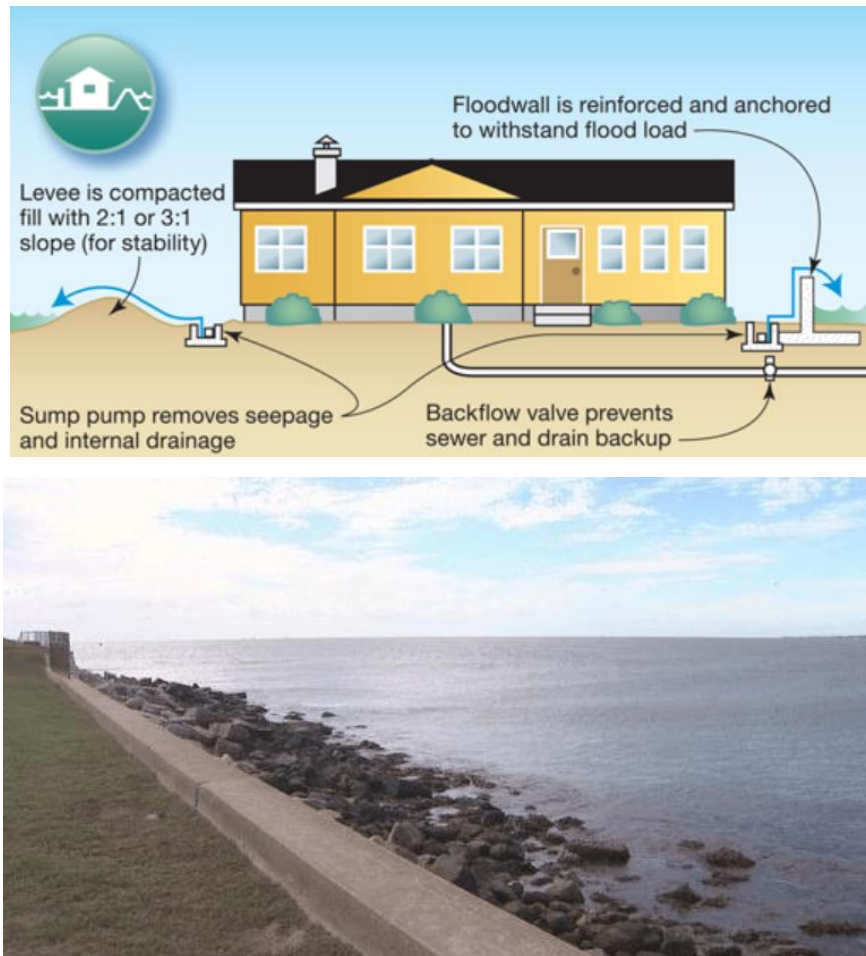


Figure 7. Illustration of a structure protected by a floodwall and levee (FEMA, 2015) (top) and photo of flood wall in Rhode Island (bottom).

Due to hydrostatic pressures caused by floodwater behind flood barriers, floodwalls and levees require proper drainage systems such as flood gates that are designed to open or close automatically. Sump pumps or an internal storage system are required to collect and remove floodwater or rain that collects behind floodwalls, along with a back-up emergency power supply.

Flood barriers are subject to local regulations and design restrictions. Site conditions may limit the feasibility of a floodwall or levee such as construction of a vehicle ramp or building entry and exit. This action is generally considered a relatively high-cost measure with extensive annual maintenance costs needed to maintain and inspect the barrier and an expected useful life of approximately 50 years. The overall cost of this action can vary based on the size of the structure, specific site features, size and number of openings, type of soils, needs for professionally designed plans that meet floodplain management requirements, need to ensure that the barrier will not divert floodwaters or adversely impact neighboring properties, and that the barrier and its supporting drainage system will meet the intended flood protections design standards.

3.3 Accommodate

3.3.1 Elevate

Accommodating SLR can be achieved by locating structures and critical infrastructure above flood levels. Critical infrastructure that can be elevated includes features like electrical transformers, motor control centers, and other infrastructure, especially when redundancy is lacking. Elevating this type of infrastructure, or placing it on a second floor, may be an effective method of retrofitting existing systems. This can be done for mechanical, electrical, and plumbing systems, and can be applied to both indoor and outdoor spaces.

Elevating the most critical elements of infrastructure such as utilities can yield beneficial results without substantial costs; however, elevating entire structures as applicable is the most effective, though at higher cost. Some existing structures can be elevated in situ by raising the building on jacks and either modifying an existing foundation system or constructing a new foundation. A contractor familiar with the design and implementation of a building lift would be needed to properly elevate the buildings.

The feasibility of elevating structures needs to be evaluated on a case-by-case basis because aspects such as the age and structural condition, configuration, or size can make elevating a structure infeasible. Evaluating the ability to elevate several buildings at once can help maintain cohesion between buildings as well as providing some cost saving. Some potential issues with elevation include access to buildings, as doors will be raised with the building, necessitating ramps and stairs. Such modifications may result in changes to building footprints. This could also require constructing new foundation supports over the upper beach.

Abandoning lower floors is also characterized as a structure elevation technique that involves abandoning or repurposing (e.g., converting to parking) the lowest floor of a two or more-story slab-on-grade building (Figure 8). The lowest floor walls must be retrofitted with flood openings that allow entry and exit of floodwater automatically. Additionally, utility systems on the lowest floor must be elevated to protect utilities from damage or loss of function from flooding. This action may lead to a loss of usable space within an existing building which may not be economically feasible for some owners.

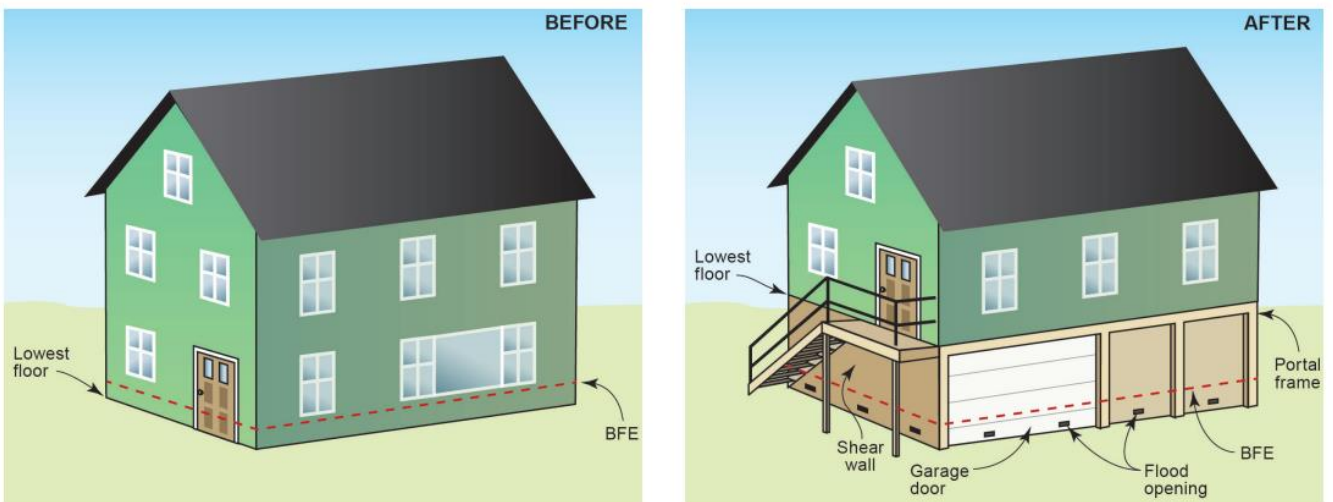


Figure 8. Example of abandoning the lowest floor for primary use and converting it into garage space to reduce the damage from flooding (FEMA, 2015).

Elevating the lowest interior floor is also considered an elevation technique for buildings with high ceilings (Figure 9). The space below the lowest elevated interior floor walls must be either filled to create a stem wall or retrofitted with flood opening that allow entry and/or exit of flood waters.

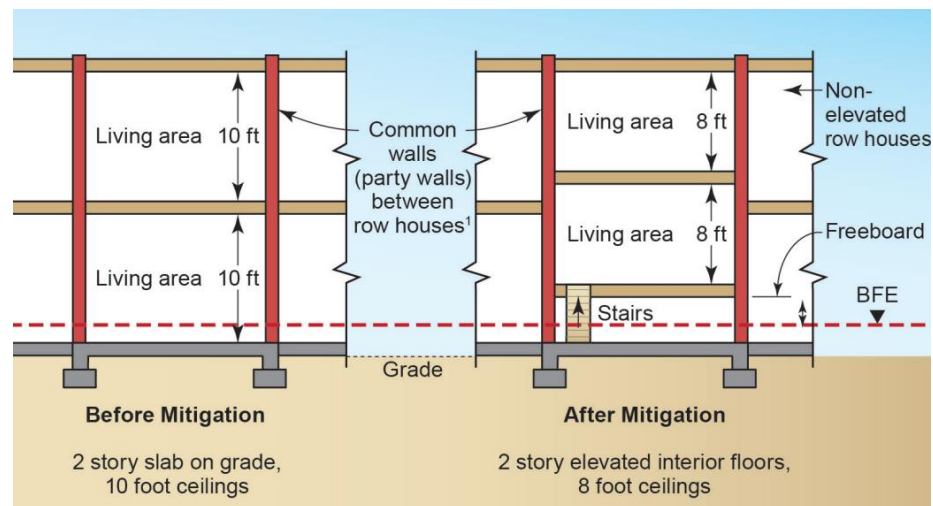


Figure 9. Example of elevating the lowest interior floor before and after flood mitigation (FEMA, 2015).

Basement infill or importing compacted soils to grade is another action that has been proven to be effective at reducing damages to building elements and contents located below base flood elevation (Figure 10). This action requires flood openings to allow entry and exit of floodwater. This action may also lead to a loss of usable space within an existing building which may not be economically feasible for some owners.

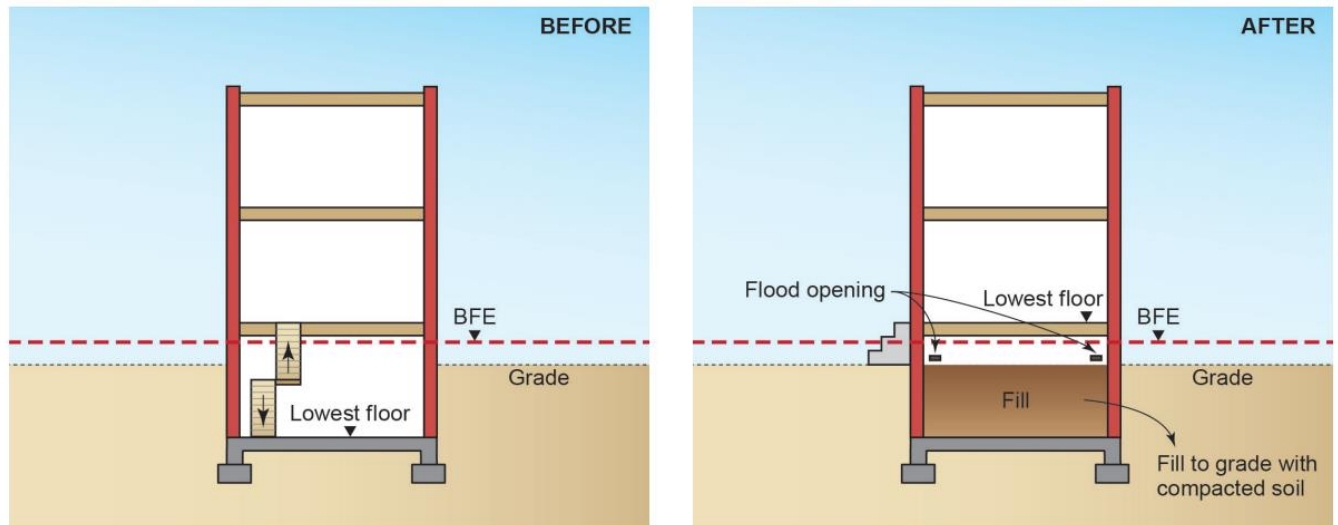


Figure 10. Basement infill before and after filling (FEMA, 2015).

3.3.2 Floodproofing/Retrofitting

Dry floodproofing are measures taken to seal the portion of the building below the established flood risk (Figure 11). Significant efforts are needed to keep the targeted area completely dry including sealing of any penetrations or openings, use of vapor barriers or other waterproofing materials, proper drainage systems, and using concrete as the predominate construction material for any surfaces that are below the flood elevation. For buildings along the shoreline, this action may also function as hard shore stabilization and impacts should be evaluated.

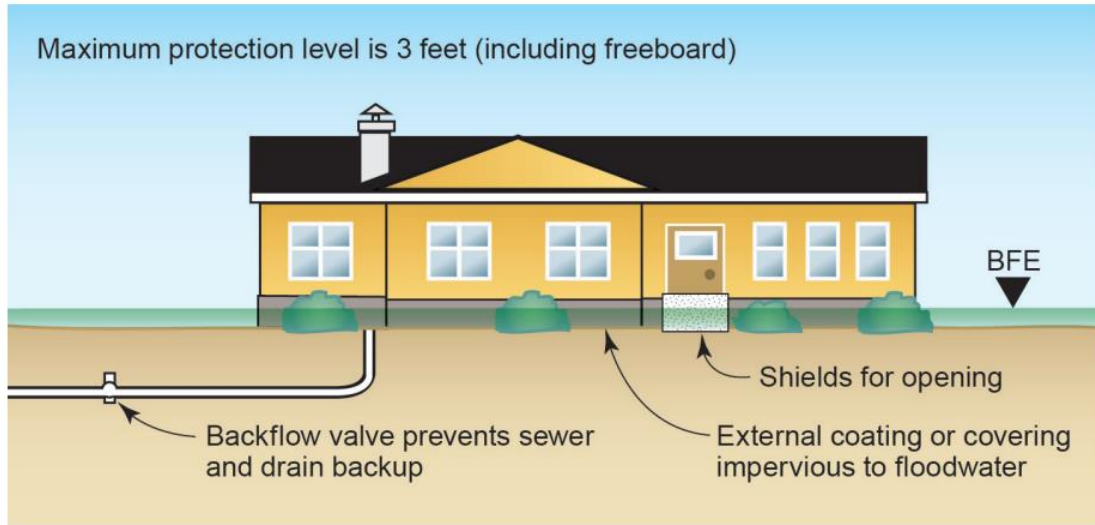


Figure 11. Dry floodproofed building (FEMA, 2015).

Wet floodproofing involves making a portion of the structure resistant to damage through use of flood damage-resistant materials and allowing water to enter the building during a flood event and drain out once flood waters recede (Figure 12). This can be a more cost-effective option than dry floodproofing, but it should be noted that critical utilities and infrastructure will need to be protected from flooding.

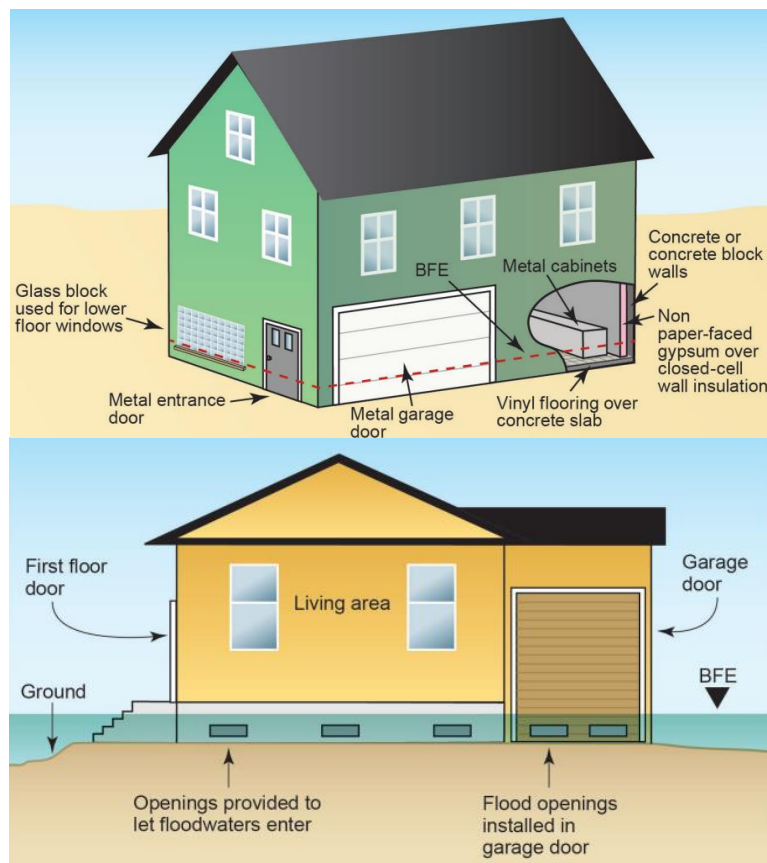


Figure 12. Flood damage-resistant materials to provide wet floodproofing (top) and flood openings to allow water to flow in and out (bottom) (FEMA, 2015).

Additionally, collection systems for wastewater and stormwater can also be floodproofed. Utilizing watertight manhole lids can prevent inflow of floodwaters into below-grade manholes that are located within areas of potential flooding. This keeps stormwater or wastewater that is supposed to be within the collection system inside, and groundwater and floodwater outside of the collection system. Additionally, I/I reduction efforts are recommended; infiltration is likely to be exasperated by surface flooding and will contribute to higher flows to the WWTP.

For stormwater applications, outfalls can allow backflow to occur, allowing water levels within the collection system to match that of the outfall. In high water elevation scenarios, this can result in flooding within the collection system. This can be mitigated by installing backflow prevention on stormwater outfalls. Ten outfalls discharge collected stormwater to Penn Cove as noted in Appendix H of the 2023 Coupeville Comprehensive Plan.

3.4 Structure Relocation

Relocation involves moving coastal infrastructure inland to allow natural erosion to occur (Figure 13). For example, moving a house or a road back from an eroding bluff rather than trying to stabilize the bluff. This requires the availability of an appropriate place for relocation. Relocation has fewer impacts on nearshore ecology and coastal processes as compared to protecting in place via hard armor construction. This is especially true on feeder bluffs where installing a bulkhead reduces or eliminates a sediment source and can affect down-drift property owners and shore habitats. Relocation in low lying areas can also allow tidal water to flood into a former marsh or backshore areas or allow sea level to rise unimpeded.



Figure 13. Example of structure relocation on Whidbey Island (Photo Credit: DB Davis LLC).

Structure relocation may not be feasible in all cases due to condition and configuration of a structure and can be costly. However, while relocation may have a large up-front cost, if sited property away from the shore there will be no additional costs to protect the home in the future. Bulkheads on the other hand involve initials costs, periodic maintenance and replacement costs since a typical bulkhead lasts 15 to 40 years (Clancy et al., 2009) and so it is often more cost effective in the long run to relocate structure landward than to permit, build, mitigate, and maintain shore armor.

Relocation of roads is often a practical alternative to protecting the road in place. Local roads are more feasible for relocation than State highways, since State highways are often a part of a complex web of other roads, utility networks, and access points.

The Shoreline Master Program policies requires that actions such as relocation are explored before other shoreline modifications – *“Allow shoreline modifications or other measures to protect existing primary structures only when they are demonstrated to be necessary, when **no alternatives including relocation** or reconstruction of existing primary structures are found to be feasible, and when the modifications are found to comply with the policies and regulations of this master program for modifications as well as the requirements of WAC 173-26-231 (shoreline modification requirements). Preference should be given to those types of shoreline modifications that have a lesser impact on ecological functions. Assure that modifications individually and cumulatively will result in no net loss of ecological functions” (16.30.340 – General regulations).*

3.5 Development Restrictions

The avoidance of hazards during development or redevelopment of coastal lands can be facilitated through a number of development restrictions such as setback rules to reduce the need for future relocation or shore protection, and limits on substantial redevelopment or new construction in vulnerable areas.

The Shoreline Master Program (SMP) of the Town of Coupeville, Critical Areas Ordinances, and Flood Damage Prevention Codes, contains shoreline use and development policies applicable to all areas of Coupeville which fall under the jurisdiction of the master program. The following lists key policies around development standards when considering SLR-related hazards such as flooding and erosion and ecosystems impacts. Enforcement of these codes should restrict building development in hazardous areas, however putting more regulations on substantial redevelopment in hazardous areas should be considered.

The following are a few key pieces of code from Coupeville’s Shoreline Master Program on development restrictions within the Town that are applicable to this action. Changes to code may occur following the development of this document. The user should reference the SMP in effect at the time to ensure consistency with the code.

16.30.340 – General regulations

- ▶ All uses and developments within the local shoreline shall be located, designed and constructed to avoid disturbance of and detrimental effects on aquatic habitats, water circulation and erosion-accretion processes.
- ▶ All shoreline development and activity shall be located, designed, constructed, and managed in a manner that avoids, minimizes and/or mitigates adverse impacts to the environment. The preferred mitigation sequence (avoid, minimize, rectify, reduce, or compensate for the environmental impact) shall follow that listed in WAC 173-26-0201(2)(e), see also definition of "mitigation," listed in this master program).
- ▶ Ensure that new development or the creation of new lots does not cause any foreseeable risk from geological conditions to people or improvements during the life of the development.
- ▶ Permit development in such a manner and only in locations where no slope protection (e.g. bulkheads, rip-rap, retaining walls, etc.) is necessary or where nonstructural protection (e.g., vegetated buffers) is sufficient for the life of the project (seventy-five (75) years).
- ▶ Ensure that proposals are designed and constructed in a manner that does not increase or result in slope instability or sloughing.

16.30.460 – Residential development

- ▶ New and/or expanded residential development shall be located and designed to preclude the need for shoreline stabilization structures. Stabilization structures shall not be allowed for new development.
- ▶ Multifamily residential development which will require bulkheads or other structural fortification at the time of construction or in the foreseeable future is prohibited.
- ▶ Single-family residences and appurtenant structures, including driveways, shall be located at least seventy-five (75) feet landward from the OHWM unless existing dwellings within two hundred (200) feet of side property lines have a lesser average shoreline setback. In such cases the minimum setback required shall be the average established by existing dwellings within two hundred (200) feet, with a minimum fifty-foot setback. A reduction below fifty (50) feet shall require a shoreline variance. Setbacks are measured landward, on a horizontal plane, perpendicular to the shoreline. Multifamily development shall be located at least seventy-five (75) feet landward of the OHWM and the public access requirements as set forth in the master program shall apply. Additional setbacks or buffers may be required for both single family and multifamily residential development, in conformance with the Town's critical area ordinance and or the critical area regulations of the master program. In all cases the setback/buffer that provides the greater protection takes precedence.

16.30.260 – Frequently flooded areas

- ▶ Policies ensure that new development in areas prone to periodic flooding comply with the Town's flood damage preventions standards to minimize health hazards and property damage due to flooding.
- ▶ Policies encourage development of acquisition and management strategies to preserve open space for flood mitigation, fish habitat, and water quality in frequently flooded areas.

16.34.510 – Performance standards – Specific hazards

- ▶ Requirements within erosion and landslide hazard areas such as buffer requirements, design standards, vegetation retention, seasonal restrictions, utility lines and pipes regulations, allowable point discharges, restriction on the division of land, and prohibited development.

16.45.070.B – Provisions for flood hazard reduction

- ▶ Specific standards for all areas of special flood hazard where base flood elevation data base been provided such as for residential construction, nonresidential construction, manufactured homes, recreational vehicles, enclosed areas below the lowest floor, and appurtenant structures.

Additionally, in 2023 the state legislature directed the Washington Department of Ecology to update guidelines to require local SMPs to address the impact of SLR. Ecology is in the process of this update, aiming to have the new requirements for local SMPs adopted before the next round of SMP periodic reviews. Coupeville's next SMP periodic review will likely involve updating policies and regulations for areas projected to be impacted by SLR-related hazards to align with new state requirements. At such time, the user should consider new or changed SMP policies and regulations when using this document.

4 ACTION EVALUATION AND PLANS

This section summarizes how the previously described actions can be applied to support adaptation efforts for the most vulnerable assets and areas within the Town: roads, overwater buildings, the WWTP, Thomas Coupe Park boat ramp, sanitary sewer lines, and the Moore Place neighborhood. An evaluation methodology developed by NOAA and principles developed during public and stakeholder engagement were utilized to assess what actions are advised in the short, mid, and long-term. It is important to note that several assets are threatened by the same hazard – bluff recession along Front Street. This allows for the development of actions that will be co-beneficial.

4.1 Evaluation Methodology - Principles and Criteria

The set of principles developed by the Coupeville Climate Committee, in consultation with Town staff and the project team (Section 2.3) were used to evaluate potential actions and the selection of adaptation strategies for each asset. These principles should also inform future decision making.

Additionally, we evaluated the proposed actions using the methodology called the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) opportunities and constraints for each action (NOAA, 2010). For this assessment we focus and expand the technical evaluation and use most elements of the STAPLEE methodology to evaluate and determine which actions are recommended for the Town’s specific assets. The STAPLEE criteria are summarized as follows:

- ▶ **Social:** Will the action be socially acceptable? Analyze if the action will disproportionately affect a certain segment of the Town’s population and if the action is compatible with community values.
- ▶ **Technical:** Will the action be feasible and effective in the defined goals of the action? Analyze the actions long-term effectiveness (sustainability), any unintended/negative consequences, and if the action solves the problem and/or the symptom. Additionally, the actions should be analyzed based on the critical nature of the asset, the technical complexity, and considerations for near-, mid-, and long-term actions.
- ▶ **Administrative:** Can the action be accomplished by the Town staff and budget, or will additional funds be required?
- ▶ **Political:** Is there political support to implement and maintain the action? The action’s assumed public support. ***Note that we did not assess the political support in this assessment and included assumed and stated public support in the “social” criteria.***
- ▶ **Legal:** How likely the action is to be permissible and how difficult the permit pathway will be. Are there any likely stakeholders who will challenge the action?
- ▶ **Economic:** Is the action cost effective? Will it pass a cost-benefit analysis? Are there funds likely available for the action?
- ▶ **Environmental:** How will the action affect the environment such as nearshore processes and habitats?

4.2 Town Roads

Roads and associated infrastructure in Coupeville are at risk of damage from shore recession and erosion, processes worsened by climate change and specifically SLR. Erosion and slope instability could damage roadway surfaces or cause partial or total failure through landslide events. Such damage and subsequent closures could pose a danger to or affect access for individuals, businesses, and emergency operations. Due to the location of roads atop coastal bluffs, direct flooding is not a significant issue for most Town roads. As such, this section will focus on potential mitigation and adaptation measures for roads as they relate to shore recession. This discussion prioritizes roads over footpaths to devote planning resources to the highest priority assets. However, the vulnerability of roads and nearby footpaths as well as potential mitigation or adaptation measures that can be applied are often coincident. Additionally, the shore protection alternatives described within this section also apply to the overwater buildings and sanitary sewer lines as they are also threatened by bluff recession along the same shore reach.

Three roads are particularly vulnerable to shore recession: NW Madrona Way, Front Street, and NE 9th Street (Figure 14). Front Street has been divided into two distinct areas with unique mitigation and adaptation considerations. Strategies for “Front Street – Downtown Area”, which includes most of Coupeville’s downtown, must consider the road’s direct connection to waterfront businesses, historic buildings, and therefore the unique character of downtown Coupeville. Strategies for “Front Street – Residential Area” must consider factors that relate primarily to residential use and access.

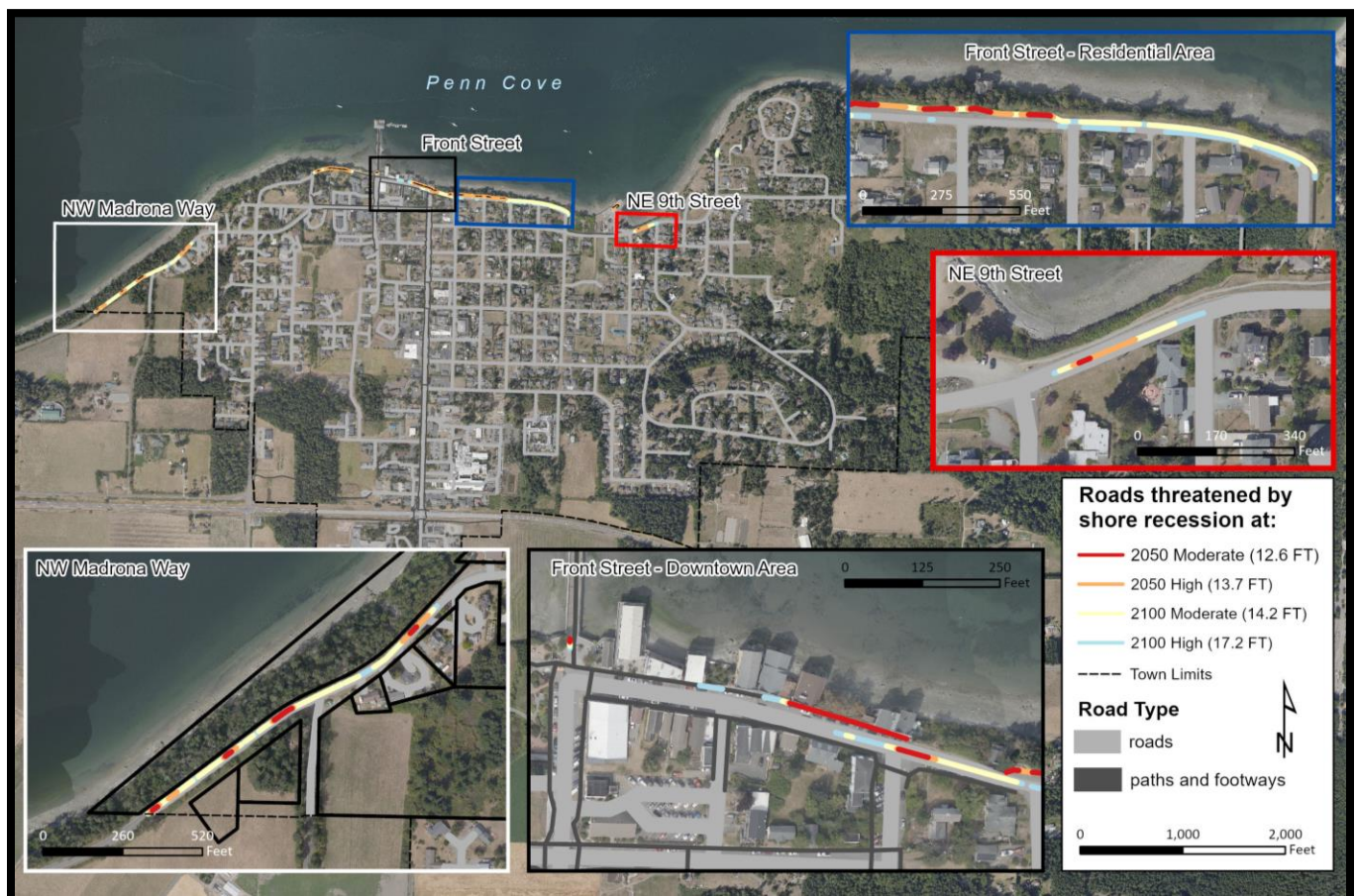


Figure 14. Overview of Coupeville road sections threatened by shore recession under analyzed sea level rise scenarios (Coastal Geologic Services et al., 2023).

Mitigation techniques for shore recession range from passive management techniques (vegetative stabilization and stormwater improvements) to soft shore protection (beach nourishment) and hard armoring (revetments and bulkheads), among others. Adaptation to avoid the impacts of shore recession can be accomplished through roadway realignment, relocation, or functional modification (e.g. reduction to one lane, use/access limitation, decommissioning, etc.). The Town of Coupeville has already demonstrated a willingness to adapt by modifying a portion of Front Street by reducing the road from bidirectional traffic to one-way travel. However, such road modifications can be costly, complex, and/or constrained to the point that relocation is not always practical. Planning and implementation of both mitigation and adaptation measures should include a robust alternatives analysis and input from various stakeholders and the least impactful solution applied appropriate for the issue.

NW Madrona Way

Madrona Way connects the Town of Coupeville to the community of Coveland over a 3.2 mile stretch along Penn Cove. While Route 20 provides an alternative major route to connect the same points, Madrona Way provides access to numerous residential properties in addition to several commercial properties and Mueller Park beach. Many of these properties lie beyond the Coupeville Town limit. According to Town asset data, public sewer and drinking water utilities exist beneath the vulnerable roadway section. Stormwater along this stretch of NW Madrona Way appears to be managed by catch basins with unknown outfall locations.

Madrona Way becomes NW Madrona Way at the intersection with N Sherman Road, approximately one-third mile west of the NW Madrona Way - NW Coveland Street intersection (Figure 15). Along the threatened portion of NW Madrona Way within Coupeville town limits, there are 8-10 private parcels of both residential and agricultural use. The entirety of the shoreline along this stretch appears to be enveloped by one privately-owned parcel. Access to the threatened section of NW Madrona Way is currently from NW Madrona Way to the east and west, and Vine Street to the south. While the analysis completed for this report was limited to the Town of Coupeville, it is likely that other sections of NW Madrona Way to the west of the Town limits are also threatened by shore recession. As such, any actions proposed for NW Madrona Way should account for actions proposed or lack thereof for Madrona Way beyond Town limits by Island County.

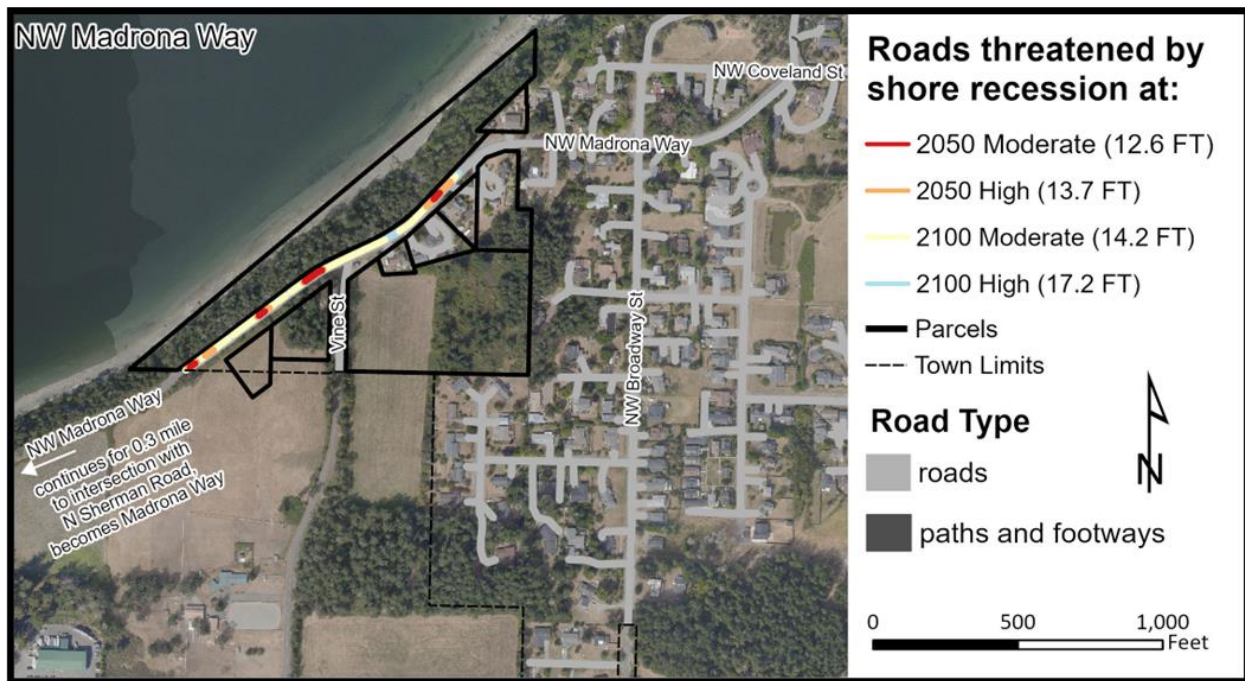


Figure 15. Aerial view of threatened sections of NW Madrona Way and surrounding area.

The most vulnerable stretches of NW Madrona Way are to the west of Vine Street, where at least three sections of the roadway are vulnerable to shore recession under the 2050 Moderate scenario. An additional short section is vulnerable to the 2050 Moderate scenario near 701 NW Madrona Way (east of Vine St). Longer sections of the roadway in these same areas are vulnerable to the 2050 High scenario, while nearly the entirety of the roadway through this stretch is vulnerable to both the 2100 Moderate and 2100 High scenarios. These data indicate that the focus for NW Madrona Way should be centered on near-term mitigation and long-term adaptation. Near-term mitigation along NW Madrona Way could be accomplished in a variety of ways ranging from passive management (i.e. monitoring and targeted plantings or other improvements to the existing slope) to soft and/or hard shore protection (e.g. beach nourishment, drift sills, and/or rock armoring). Long-term adaptation could consist of roadway narrowing to one lane (i.e. one way road) and/or strategic relocation or decommissioning of the road.

Front Street – Downtown Area

The downtown section of Front Street extends from NW Alexander Street to NE Center Street (Figure 16). This east-west roadway section serves the Coupeville downtown waterfront area and is approximately 770 FT long. Numerous commercial properties and community assets are located in this area, nearly all of which occupy designated historic buildings within the Ebey’s Landing National Historical Reserve. This stretch of Front Street also provides access to the Coupeville Wharf. Two additional streets connect to Front Street including NW Grace Street and N Main Street. Utilities connected to various downtown businesses are buried within the Front Street corridor.

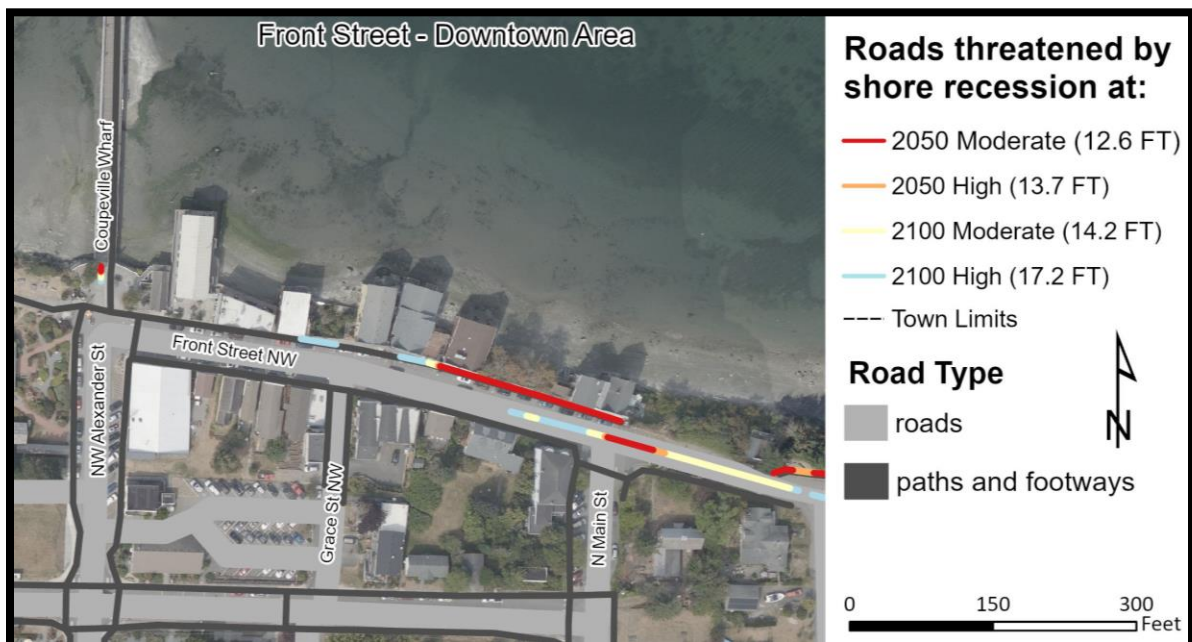


Figure 16. Aerial view of threatened sections of Front Street - Downtown Area and surroundings.

The most vulnerable section of Front Street through Coupeville’s downtown is near the N Main Street intersection (Figure 16). This area is vulnerable to shore recession for both the 2050 Moderate scenario and the 2050 High scenario. A larger section of the Front Street roadway on either side of this intersection is vulnerable to the 2100 Moderate and 2100 High scenarios. Similarly, an adjacent section of the sidewalk along several waterfront buildings north of the roadway is vulnerable to shore recession.

Given the cultural and economic significance of this area, the considerations for mitigation and adaptation may necessarily be different than other road sections. Even if relocation of the road were possible, relocation of the

buildings and infrastructure that constitute the historic overwater may not be possible. Adaptation strategies for historic overwater buildings are discussed in Section 4.3. As such, this section focuses primarily on considerations for the roadway itself while acknowledging that protective measures for the Front Street shoreline would provide coincidental, but not comprehensive, protections for overwater buildings.

Front Street – Residential Area

The residential portion of Front Street begins at the intersection of Front Street and NE Center Street and stretches approximately one-third mile east to the NE Front Street intersection with NE Gould Street (Figure 17). Three additional streets connect to Front Street in this area including NE Haller Street, NE Kinney Street, and NE Clapp Street. While several homes are located on or adjacent to Front Street through this area, it appears only three driveways connect to Front Street with additional space for residential parking near the NE Gould Street intersection. In 2016 after significant damage due to bluff erosion, NE Front Street was reduced to one lane between NE Kinney Street and NE Gould St. This single lane now serves traffic traveling west to east only. Public utilities remain within the roadway and should be a primary consideration in any mitigation or adaptation measures proposed.



Figure 17. Aerial view of threatened section of NE Front Street - Residential Area and surroundings.

The most vulnerable section of Front Street through the residential area is the stretch between NE Kinney Street and NE Gould Street (note: red areas in Figure 17 represent threatened footpaths). This is the same section that was previously reduced to one lane. It remains relatively close to the bluff. The 2023 Vulnerability Assessment suggests it is vulnerable to shore recession under the 2100 High scenario. As such, adaptation strategies for this area can likely be focused on near-term and mid-term mitigation and long-term adaptation.

NE 9th Street

NE 9th Street connects N Main Street near downtown Coupeville to Parker Road at the intersection of NE 9th Street, NE Leach Street, and Parker Road. It provides east-west access to several residential properties, the Town WWTP, and Thomas Coupe Park. The section of NE 9th Street that is vulnerable to shore recession lies between NE Otis Street and Perkins Street (Figure 18), near Thomas Coupe Park and the WWTP. For approximately 300 FT, NE 9th Street is situated particularly close to the existing low-elevation bluff, which has already been armored with a rock revetment. While the WWTP and Thomas Coupe Park boat ramp are also vulnerable to

shore recession and/or flooding associated with SLR, those community assets are discussed in separate sections of this report. Mitigation and adaptation strategies for NE 9th Street should consider any potential effect on access to the WWTP and Thomas Coupe Park.



Figure 18. Aerial view of the threatened section of NE 9th Street and surrounding area.

Priorities & Goals

Each section of road being considered requires a unique and catered approach to mitigation and adaptation planning for predicted shore recession. The ideal combination of practices for each road would maintain their existing function in a cost-effective and sustainable manner that allows natural sediment transport processes to occur and promotes healthy habitat for terrestrial and aquatic species. The reality is that each road section will likely require a careful balancing of these priorities based on local values and resources alongside physical and environmental constraints. Further, the specific cause of potential bluff erosion (e.g., bluff toe erosion, upland drainage issues etc.) should be evaluated in each location to determine appropriate protective measures. Depending on the specific cause, certain protective measures may not be effective.

From our public engagement, it became evident that the most critical roadway to protect in its current location is the stretch of Front Street through downtown Coupeville. Through outreach conducted as part of the 2023 Vulnerability Assessment and this Coastal Adaptation Strategy, the historic waterfront was clearly the most frequent location indicated as “important” to respondents and was the second ranking community asset prioritized only behind sewer and wastewater infrastructure. In alignment with measures recommended to protect existing historic overwater buildings and acknowledging those already planned for Coupeville Wharf (Port of Coupeville, 2023), it would be logical to provide overlapping and related protection of Front Street to maintain access in its current location. The balance of priorities for Front Street could change if the community were to decide against the protection of waterfront buildings.

In other areas, options for realignment, change in function (e.g. lane reduction), and/or decommissioning of roads represent important considerations for the mid- to long-term future. Those sections of road that provide access to a limited number of properties should be prioritized for modification or decommissioning. Such a process would require coordination with property owners, businesses, emergency officials, and utility services, among other stakeholders.

Action Identification & Evaluation

Several potential strategies have been identified for mitigation of and adaptation to shore recession predicted by the 2023 Vulnerability Assessment. These actions are discussed in terms of their general advantages and disadvantages and will be included or excluded as possibilities from specific roadway sections based on localized requirements and constraints.

Action 1. No action – would simply be a continuation of present conditions leaving segments of NW Madrona Way, Front Street, and NE 9th Street exposed to current and/or future risk of shore recession and erosion. Periodic bluff erosion and/or failures could be expected to continually decrease the distance between the road and the bluff edge, increasing vulnerability to damage and risk of failure. Eventually bluff erosion will progress to the point that functional modification of the roadway (e.g. conversion to one lane, conversion to walking path, etc.) is required, roadway closures are necessary to reduce hazards, and/or roadway failure occurs. “No action” is generally not considered an advisable approach for the priority road sections.

Action 2. Passive management – would include vegetation management such as tree evaluation and targeted planting in key areas including the bluff crest and face below at-risk road areas. This would also include assessment and management of surface water through improvement of roadside and stormwater drainage infrastructure ensuring minimal surface water contributions to slope instability. Additionally, passive management would include monitoring of conditions such as semi-annual topographic surveys, road-bed stability assessments, and/or aerial imagery of the at-risk areas. Monitoring could be paired with a set of defined triggers for various mitigation or adaptation steps based on rate of recession, distance from edge of road to top of bluff, etc. Passive management is recommended to varying degrees for all priority road sections as it provides valuable short- to mid-term protections in addition to monitoring data that can be used to inform future actions. However, passive management is likely not a long-term solution for the priority road sections.

Action 3. Soft shore protection – would include placement of beach nourishment sand at the bluff toe below and in the vicinity of the at-risk road segments to reduce bluff toe erosion. The sediment size used for beach nourishment should be carefully chosen to balance environmental benefits with coastal protection. In addition, along appropriate shore reaches a series of attached gravel/sand spits could be constructed and configured to protect the shoreline from wave action (Figure 19). These spits would also capture and retain sediment, creating a more stable nearshore habitat and promoting the establishment of emergent vegetation. Planting of native vegetation would be included in the uppermost beach area and at upper elevations of the spits. For areas where the major driver of bluff recession is bank toe erosion, soft shore protection would represent a protective mechanism that allows for natural processes and habitat. However, soft shore protection typically allows for some level of continued shore erosion or sediment transport that could be exacerbated by extreme storm events. Additional beach nourishment could be necessary on a periodic basis to maintain protection of the bluff toe. This action is considered a nature-based solution that could enhance nearshore habitats and coastal processes.

Action 4. Hybrid soft and hard shore protection – would include the construction of a series of rock drift sills (typically low elevation rock cross-shore structure with adjacent beach nourishment areas) spanning from the bluff toe across intertidal elevations (Figure 20). The drift sills would be composed of boulders below and in the vicinity of the at-risk road segments. This action would also include the placement of beach nourishment in the upper beach and bluff toe area. Similar to Action 3, a hybrid protection approach would mitigate toe erosion while allowing for a continuation of most natural processes. However, the sills would constitute more permanent features that provide a higher level of stability than gravel/sand spits. Consequently, rock sills would not have the same level of flexibility for adjustment with natural sediment transport as compared to beach nourishment by itself and may require maintenance over a long-time interval to retain their design geometry or elevation.



Figure 19. Conceptual depiction of soft shore protection along Front Street – Residential Area.

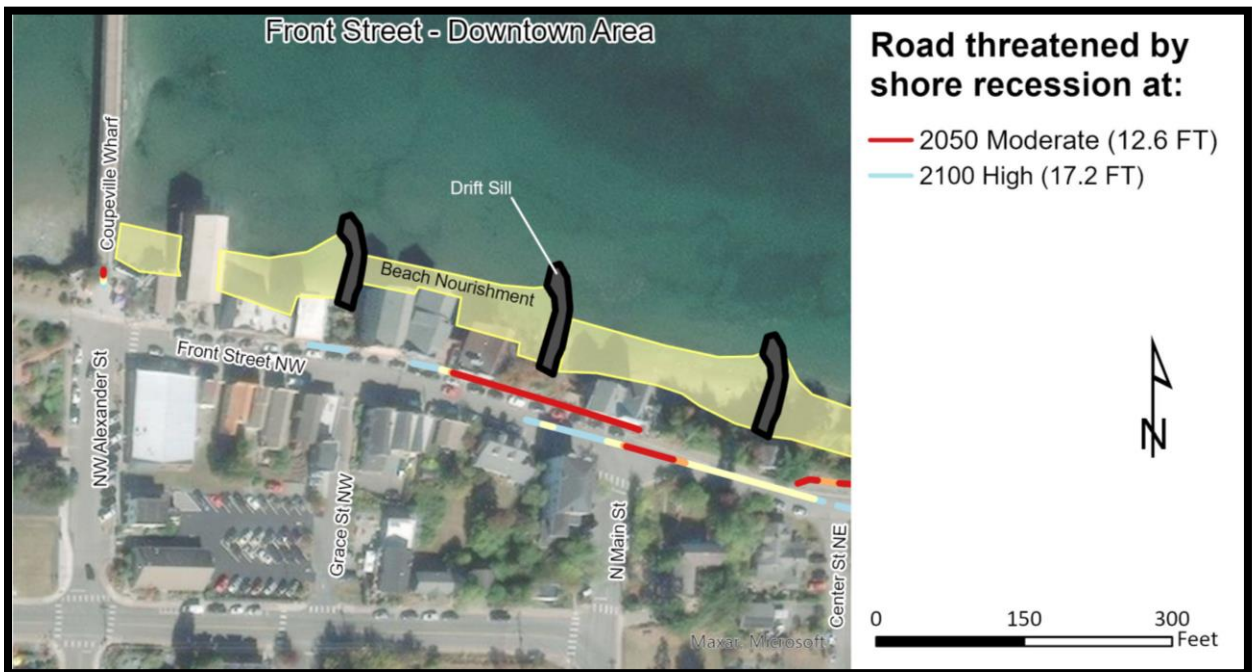


Figure 20. Conceptual depiction of hybrid shore protection along Front Street and the historic waterfront.

Action 5. Hard shore protection – could be implemented in the form of a rockery or, in certain circumstances or sections, a vertical wall at the bluff toe along at-risk road segments. Beach nourishment material would be placed at the toe of the structure. Rock revetments and vertical hard armor techniques provide a high level of immediate erosion protection but are a permanent alteration of the shoreline that should be reserved for cases of last resort to protect immovable assets considered functionally, economically, or culturally critical. While likely to be effective in protecting against present-day erosion, hard shore protection is comparably expensive and difficult to adjust as climatic conditions change. Further, rock revetments and vertical walls are detrimental to natural sediment transport processes and near-shore habitats. The primary use for hard shore protection is to control erosion and not prevent flooding.

Action 6. Functional modification and/or relocation – would include a range of options in which the current use, configuration, or location of the roadway would be altered. As an initial option, realigning roads in a way that maintains all current use and access would be preferred. If physical constraints or other limitations make simple realignment impractical, lane reduction represents an alternative. Traffic patterns, emergency routes, and property access would require consideration as part of potential lane reductions. Partial to full decommissioning and rerouting of access would be an option for roads that are at elevated risk or for which disruptions to access or traffic patterns would be minimal. Conversion of decommissioned road sections to trails or footpaths could be considered. Property acquisition to reduce access conflicts with proposed road alterations could facilitate this transition. Roadway modifications will require adequate planning and funding that may prevent their implementation before the mid- to long-term planning horizons.

Potential actions are summarized in Table 3 and evaluated using STAPLEE criteria and the guiding principles (Section 2.3). Similar to the descriptions above, the various potential actions have been evaluated in Table 3 based on their general benefits and drawbacks. The Action Plan section (below) recommends specific actions for individual road sections based on further discussion of their applicability.

Table 3. Evaluation of potential actions for the roads using the STAPLEE methodology.

ACTION	SOCIAL	TECHNICAL	ADMINISTRATIVE	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
No Action	Low	Not effective	None	NA	No initial cost, short-to-long-term maintenance and damage cost	No benefit	NA	Not recommended due to present vulnerability and costs increasing long-term
Passive Management	High	Limited effectiveness	Public works could lead	Likely permissible	Low to moderate cost	Low benefit	1c, 1d, 2e, 3a, 4b	Recommended for near term in conjunction with other actions
Soft Shore Protection	Moderate	Effective if bluff toe erosion major driver of erosion	Necessitates funding and contractors	Likely permissible	Moderate to high cost; likely around \$300-\$750/LF. The full reach would cost around \$325k.	Highest benefit	1c, 1d, 2b, 2e, 2f, 3a, 4a, 4b	Recommended in some areas with additional feasibility study needed; likely not a long-term solution
Hybrid Soft and Hard Shore Protection	Moderate	Effective if bluff toe erosion major driver of erosion	Necessitates funding and contractors	May not be permissible	Moderate to high cost; likely \$100-200k more than soft shore protection only.	Low benefit	1c, 1d, 2b, 2d, 2e, 2f, 3a, 4a, 4b	Recommended over hard shore protection where feasible, lower cost and likely more favorable for environmental permitting than hard shore protection

ACTION	SOCIAL	TECHNICAL	ADMINISTRATIVE	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
Hard Shore Protection	Moderate	Effective in near- to mid-term, reduced effectiveness in future	Necessitates funding and contractors	May not be permissible	High cost; likely to cost between \$500 and \$2,000/LF here, which equates to around \$50k for a 40-FT wide parcel. The full 650-FT reach would cost around \$800k.	Negative benefit	1c, 2b, 4a	Recommended only for last resort protection of immovable critical infrastructure and assets
Functional modification and/or relocation	Moderate	Most effective long-term	Public works could lead, necessitates funding	Likely permissible	Moderate to high cost	High benefit	1c, 1d, 2c, 2d, 2e, 2f, 2g, 3a, 3d, 4f	Recommended as mid- to long-term solution for some road sections, may not be feasible for others

ACTION PLAN

The recommended action plan for each priority road section and their respective recommended strategies are discussed below.

NW Madrona Way

NW Madrona Way provides access to several homes and multiple agricultural properties near the western Coupeville Town line. While they will be an important consideration for any strategies applied at NW Madrona Way, the properties along the vulnerable road section are not known to be critical to the Town or larger community. Any adaptation measures implemented along NW Madrona Way should be coordinated with actions proposed for public sewer, drinking water, and stormwater infrastructure. Additionally, it is prudent to partner with Island County to evaluate and plan for the entirety of Madrona Way.

As a near- to mid-term mitigation strategy, passive management should be applied to the vulnerable stretch of NW Madrona Way. Bluff recession and any significant slumping or landslide events should be measured and documented to inform both the continuous rate of recession and the need for any immediate action. This could include mapping the bluff crest using a high accuracy GPS or total station every 2-5 years. In addition, photos taken from the same location and angle with defined, permanent reference objects (e.g. large trees, edge of road, building foundation, etc.) would complement topographic measurements. A set of trigger points could be established for various planning and action steps based on measured rates of recession, distance from edge of road to top of bluff, etc. The bluff appears to be well-vegetated, which will likely contribute to near- to mid-term stability. Removal of vegetation on the slope should be prevented. Further, the health of existing vegetation should be monitored and maintained, including the tracking and eradication of invasive species that could harm native plant species. Targeted planting with native plants such as snowberry (*Symphoricarpos albus*), Nootka rose (*Rosa nutkana*), ocean spray (*Holodiscus discolor*) and Douglas fir (*Pseudotsuga menziesii*) could be an important practice in areas with exposed soils or sparse vegetation.

Additionally, proper drainage collection and management is one of the most efficient ways to reduce bank erosion. In the near term, road drainage and any other drainage infrastructure such as existing outfalls should be surveyed for their current condition. Improvements should be prioritized to ensure no excess stormwater is

being conveyed to the bluff crest or face. If water is being routed to the bluff, the conveyance systems should either be rerouted to the uplands if feasible or extend all the way to the base of the bank. Drainage systems require regular monitoring as any pipe failure and discharge of collected water near a bank crest or on the bank face can be more detrimental than having no drainage collection system at all. The only material suitable for safe installation of a drainage systems and use on high and/or unstable bluffs is high-density polyethylene (HDPE). While HDPE installation is considerably more expensive, it will greatly outlast single-walled pipes and is the only system that will last decades. Tightline pipes should be routed to the base of the bluff, about 2-3 FT above beach grade and have an energy diffuser Tee at the bottom.

According to Island County’s parcel map, the bluff starting on the road right-of-way and extending down to the beach is in private ownership under one parcel with a single-family home and associated infrastructure located at the bluff crest. Near- to mid-term management of this vulnerable stretch of NW Madrona Way should include coordination with this landowner to ensure best management practices for drainage, vegetation, and other developments (e.g. septic infrastructure) are being implemented. Programs like Shore Friendly can provide free technical assistance site visits to private homeowners to develop and explain management practices specifically tailored for their property.

In the longer term, the Town should seek opportunities for land conservation to strategically acquire properties or obtain conservation easements that protect certain properties for ecological purposes. An easement would allow for formal vegetation and drainage management outside of fee simple ownership. Property acquisition or easements may be necessary for possible road decommissioning in the future as discussed below.

Despite the importance of near-term passive management techniques, the bluff alongside NW Madrona Way will continue to slowly, but episodically, recede without additional protection. Further analysis of this shoreline reach should be conducted to understand the primary driver of bluff recession. If it is confirmed that toe erosion is the primary factor in bluff recession, soft shore protection (Figure 19) or hybrid shore protection (Figure 20) could be effective mid- to long-term measures to slow the rate of recession and provide time for long-term adaptation. The decision to design and construct soft or hybrid shore protection will depend on the length of time required to implement long-term adaptation strategies. If the coordination and funding of long-term solutions is expected to proceed quickly (i.e. in the next 5-10 years), soft shore protection is likely a viable near- to mid-term strategy. If the planning period for long-term solutions extends toward the 2050 SLR horizon, hybrid protection may be warranted.

While near- and mid-term solutions may be effective for a period at NW Madrona Way, the Town should place a strong emphasis on the eventual rerouting or decommissioning of a portion of the road for long-term management. Multiple options are discussed here while recognizing that a range of alternatives and iterations exist for rerouting or reconfiguring NW Madrona Way (Figure 21). These options, among other possibilities, should be evaluated alongside each other as part of a feasibility analysis that considers funding mechanisms, timelines, environmental permitting, stakeholder interests, and utility requirements, among other project factors.

- **Potential Reroute 1:** It appears that with a minor reroute of traffic via the existing N Sherman Road, Black Road, and Vine Street, the most threatened portion of NW Madrona Way between N Sherman Road and Vine Street could be decommissioned. Agricultural properties along this portion appear to be accessible from Vine Street and may not require access from NW Madrona Way. This could also allow full decommissioning of the threatened portion of NW Madrona Way with a new access created for properties east of Vine St and/or acquisition of the shoreline property along this stretch of NW Madrona Way.
- **Potential Reroute 2:** As a means of rerouting NW Madrona Way away from the bluff crest, this option considers a new right-of-way through multiple private, undeveloped properties ending at the existing

right-of-way for NW Snomont St. This could allow for partial decommissioning of NW Madrona Way to the east of Vine Street, or full decommissioning of the threatened portion of NW Madrona Way with a new access created for properties east of Vine Street and/or acquisition of the shoreline property along this stretch of NW Madrona Way.

- Potential New Access:** Full decommissioning of the vulnerable stretch of NW Madrona Way could be possible through the creation of a new access at the end of NW 7th Street to parcels R13233-310-1640 and R13233-305-1520, as well as to the Town sewer pump station. This new access would also be contingent upon negotiations with the owner of parcel R13233-286-1670 to establish a new public right-of-way. Acquisition of key shoreline parcels could be a necessary and logical component for decommissioning of NW Madrona Way in this area. The Town's acquisition of property would also provide greater flexibility in the monitoring and management of the shoreline along NW Madrona Way.

Numerous iterations of reroutes, access, and modifications (including lane reduction) exist for NW Madrona Way. Alternatives should be evaluated to determine a preferred design as part of a future feasibility analysis in coordination with Island County. Table 4 summarizes potential actions and planning horizons identified for mitigation and adaptation measures at NW Madrona Way.

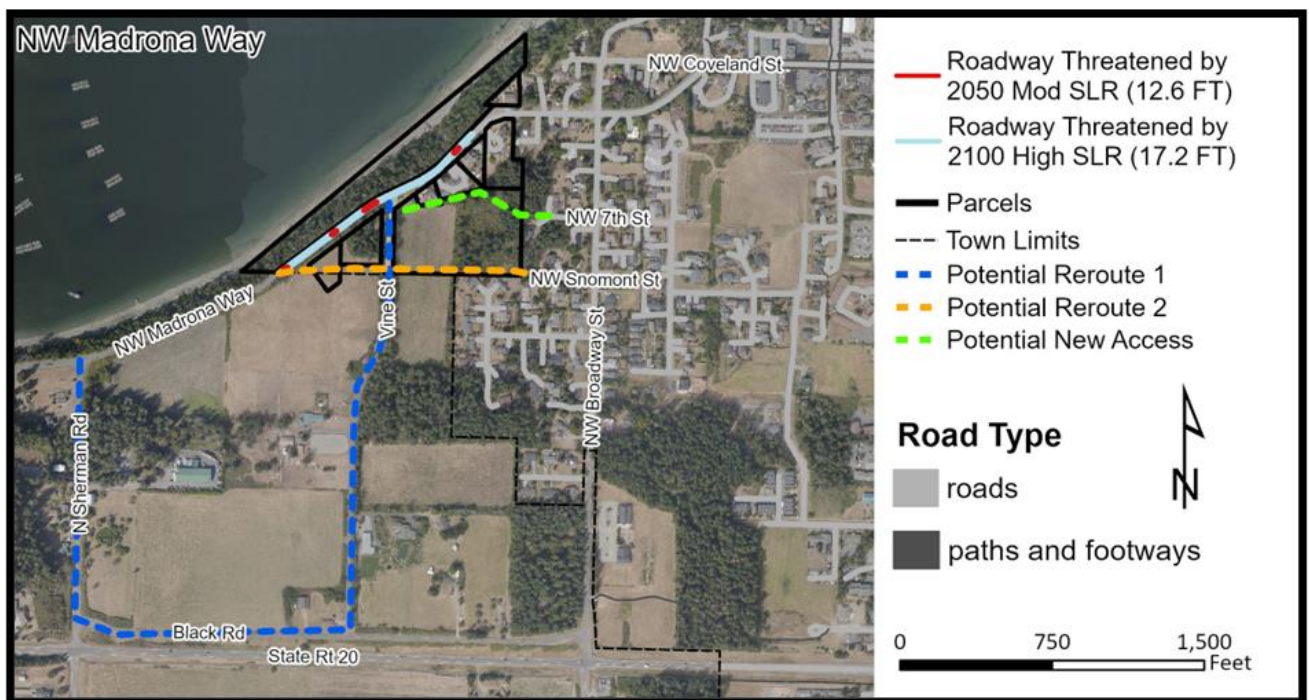


Figure 21. Potential adaptation options for NW Madrona Way.

Table 4. Summary of the proposed Action Plan for NW Madrona Way.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Passive management	Vegetation and drainage evaluation, erosion monitoring of bank toe and bank crest, management as necessary through targeted plantings and stormwater improvements, invasive species control, establish trigger points for future action based on monitoring	Could help to decrease bluff recession rates but will not be enough to protect at-risk road segments for long-term. Simple but precise methods for erosion tracking must be used as changes may be very small in short time frames.
	Soft shore protection	Recommend additional feasibility study for beach nourishment to include consideration of adding artificial spits	May be challenging to permit, may need to be modified with ongoing SLR or maintained on periodic basis
	Hybrid shore protection	Construction of series of created spits or drift sills along with gravel and sand beach nourishment to protect bluff toe	Stronger consideration if planning timeline for long-term solutions extends toward 2050, will need to recreate existing intertidal habitat and/or mitigate on site or nearby
	Lane Reduction	May be required in mid- to long-term timeline without shore protection or decommissioning	Could be carried out as a mid-term measure, but emphasis should be placed on rerouting and/or decommissioning to avoid increased costs associated with multiple projects
Long-term	Decommissioning and relocation of road	Will be necessary in long term without other actions, will be most cost-effective	Access can be provided landward for affected residential properties, may require ROW and property acquisition, utility coordination and/or relocation, would affect traffic patterns

Front Street - Downtown Area

The downtown stretch of Front Street represents the most physically constrained priority road section and perhaps that with the most limited range of mitigation and adaptation options. Rerouting or decommissioning this road could only be achieved alongside significant changes to the Coupeville waterfront, including the relocation or abandonment of several historic structures.

While abandonment or major reconfiguration of the most vulnerable areas of the downtown waterfront area may be an unavoidable reality at some point in the future, this analysis acknowledges the intention and desires of the local community to protect and maintain the historic downtown area for as long as reasonably possible.

Near-term measures should include monitoring of shore recession rates in addition to the assessment of potential stormwater improvements. Much of the shoreline is developed and/or armored with rock revetments leaving little room for existing or proposed vegetative stabilization. Still, an assessment of existing vegetative health and a program to protect or enhance existing vegetation would be worthwhile. The condition and effectiveness of existing rock armoring should be evaluated, and maintenance of the revetment could be performed where necessary. In addition to these limited measures, the near-term planning horizon should

include a robust community dialogue regarding priorities and intentions for the downtown Coupeville waterfront in the face of sea level rise, as well as potential trigger points for adaptation measures.

The economic and cultural criticality of the Coupeville waterfront makes it a stronger candidate for shore protection in the mid- to long-term future. Because much of the existing shoreline is armored and/or developed, soft shore protection measures alone may not be possible or effective in this area. Further study should be conducted to determine if there are other drivers of bluff recession beyond bluff toe erosion and therefore whether soft or hybrid shore protection would be successful. This study should also consider sediment transport processes and wave action, including how each has been altered by the developed shoreline and what implications this has for potential protection measures.

It appears the shoreline bluff near the most vulnerable stretch of Front Street in downtown (at its intersection with N Main Street) is well-vegetated relative to other areas nearby and could provide additional options for shore protection as compared with the developed western stretch. One example of potential hybrid shore protection along Front Street through downtown would be a series of rock or cobble drift sills in addition to beach nourishment (Figure 20). Drift sills are low-elevation, cross shore features placed along with beach nourishment, that are built perpendicular to the shore to limit littoral sediment away from area. The most logical places to install these structures would be gaps in development along the downtown waterfront. Beach nourishment would supplement any existing sediments in the area and would provide some protection for the banks. However, this series of structures would require careful design to prevent longshore impacts to the east. Further, while shore protection would provide protection for the banks supporting overwater buildings and Front Street, additional measures will be necessary to provide comprehensive protection for buildings as discussed in Section 4.3

If assessments of existing shore recession along Front Street in downtown Coupeville indicate the primary contributing factor is not bank toe erosion, soft and hybrid shore protection may not be effective. In this case, the remaining options for mid- to long-term mitigation or adaptation strategies for Front Street through downtown include hard armoring and decommissioning or repurposing.

Hard armoring could include maintenance and/or improvement of the existing armoring, or reconstruction of existing rock armor based on updated design standards that account for future climatic conditions. This design may require an increase in rock size used within the revetment in addition to construction at higher elevations. A vertical concrete wall would represent a more robust hard armor mechanism but carries significant additional costs and complexity. Obtaining the necessary environmental permits for such a structure may not be possible. As discussed previously, hard armoring should be considered a last resort only once other options have been investigated and ruled not feasible. A vertical wall would constitute a permanent and unadaptable piece of infrastructure that would disrupt any existing natural processes that have not already been degraded by previous development and armoring.

While acknowledging the community's desire to protect the existing character and function of Coupeville's downtown waterfront, it is worth discussing what alternatives might exist for modification, rerouting, or decommissioning of Front Street should the community choose or be forced to consider them in the future. The most straightforward options for modification of Front Street include reducing the width of the roadway through lane reduction (i.e. converting to one-way traffic) and/or the removal of street parking on one or both sides of the road. This was already completed to a degree, as the Town recently converted the south side of Front Street through this area to diagonal parking with one travel lane for westbound traffic. In the future, alternative parking could be provided away from the shoreline, potentially resulting in a more pedestrian-friendly waterfront area. These modifications should consider emergency access, business access, and pedestrian accessibility needs.

The most vulnerable section of Front Street in downtown is at its intersection with N Main Street. A traffic analysis could be conducted to determine what options exist for modification or decommissioning of this intersection while retaining other portions of Front Street that are less vulnerable to shore recession. Alternatively, decommissioning and restoration of approximately 110 linear feet of roadway to the east of the N Main Street intersection would appear to address a significant portion of the most vulnerable area while resulting in only minor alterations to existing traffic patterns. The Town could also consider seeking funding for strategic buyouts of the most at-risk waterfront properties to allow for partial or full decommissioning of this stretch of Front Street. Additional acquisition and restoration of shoreline property in this area would increase the options and space available for adaptation. Table 5 summarizes proposed actions and planning horizons identified for mitigation and adaptation measures along the downtown section of Front Street.

Table 5. Summary of the proposed Action Plan for Front Street - Downtown Area.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Passive management	Vegetation and drainage evaluation, erosion monitoring of bank toe and bank crest, management where possible through targeted plantings and stormwater improvements, invasive species control, establish trigger points for adaptation options.	Could help to decrease bluff recession rates, but will not be enough to protect at-risk road segments for long-term. Simple but precise methods for erosion tracking must be used as changes may be very small in short time frames.
	Maintenance of existing shore protection	Recommended as a near-term measure while a community dialogue determines next steps for Front Street through downtown.	Permits/design will be required and the decision to maintain hard armor should be made with consideration for what future actions are planned in the area.
Mid-term	Hybrid shore protection	Beach nourishment and retention structures (Figure 20) are recommended as a mid-term measure over soft shore protection given the criticality of the downtown waterfront.	May be challenging to permit, will need to recreate existing intertidal habitat covered by drift sills and/or mitigate on site or nearby, may not provide protection for waterfront buildings. Best completed along the entire length, would not be appropriate for individual, disconnected segments.
	Hard armor	Only as a last resort if the community has determined protection of the existing waterfront to be of highest priority and all other options have been exhausted.	Would provide the most permanent erosion protection, but the most expensive. Will likely be difficult to permit, will need to recreate existing intertidal habitat and/or mitigate on site or nearby, will limit options for future adaptation. Will be challenging technically due to wide variety of existing conditions and configurations of buildings.
	Parking Reduction	Recommended with analysis of traffic patterns and access needs for downtown waterfront.	Consider how actions for waterfront buildings and Front Street might align or conflict.
Long-term	Decommission road	May be necessary in long term, Town would benefit from considering options in advance.	Access can be provided landward for affected residential properties, would affect character of historic waterfront in addition to existing traffic/use patterns, would be moderately high cost.

Front Street – Residential Area

The Town of Coupeville has already indicated a willingness to adapt public infrastructure in response to a landslide and loss of the buffer and road edge. The Town reduced the width of the eastern extent of Front Street to a one lane, one way road in 2015. NE Front Street appears to be a prime candidate for near-term monitoring coupled with minor protective measures that will allow time for planning and funding of mid- to long-term adaptation measures. The 2023 Vulnerability Assessment indicated that only about half the total length of this stretch of Front Street is vulnerable to shore recession under the 2100 High scenario. About 25 linear feet of the road between NE Clapp Street and NE Gould Street are vulnerable to the 2100 Moderate scenario, along with a short stretch near the intersection of NE Center Street.

Similar to NW Madrona Way, passive management should be implemented as a near- to mid-term mitigation strategy. Shore recession and any significant slumping or landslide events should be measured and documented to inform both the continuous rate of recession and the need for any immediate action. The bluff appears to be mostly vegetated, which will contribute to near- to mid-term stability. Removal of vegetation on the slope should be prevented. Further, the health of existing vegetation should be monitored and maintained, including the tracking and eradication of invasive species that could harm native plant species. Targeted planting with native plants such as snowberry, Nootka rose, and conifers such as Douglas fir could be an important practice in areas with exposed soils or sparse vegetation.

Further study should be conducted to understand the different drivers of bluff recession along NE Front Street. If it is determined that toe erosion is the primary factor in bluff recession, soft shore protection (Figure 19) could be effective in reducing the rate of recession. The decision to design and construct soft or hybrid shore protections will depend on the length of time required to implement long-term adaptation strategies.

The Town should make the eventual decommissioning of a portion or all of NE Front Street a priority. It appears only a small number of properties use NE Front Street for primary access. This group includes one structure on the north side of Front Street, which could be prioritized for acquisition and restoration. Alternatively, access could be provided to this property via the end of NE Haller Street. Access to many of the other residences along NE Front Street is already provided or could in the future be provided by side streets (e.g. NE Haller St, NE Kinney St, NE Clapp St, NE Gould St). Remaining properties with access from NE Front Street may require new driveway easements and/or special consideration in adaptation planning. These options should be evaluated alongside each other as part of a feasibility analysis that considers funding mechanisms, timelines, environmental permitting, stakeholder interests, and utility requirements, among other project factors. Table 6 summarizes potential actions and planning horizons identified for mitigation and adaptation measures along the residential section of Front Street.

Table 6. Summary of the proposed Action Plan for Front Street - Residential Area.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Passive management	Vegetation and drainage evaluation, erosion monitoring of bank toe and bank crest, management as necessary through targeted plantings and stormwater improvements, invasive species control.	Could help to decrease bluff recession rates but will not be enough to protect at-risk road segments for long-term. Simple but precise methods for erosion tracking must be used as changes may be very small in short time frames.
Mid-term	Road decommissioning	Reroute traffic and access via existing roads/new driveways. Restore upland areas in place of existing roadway where possible.	Recommended as highest priority for mid-term. Access can be provided landward for affected residential properties, may require property acquisition and/or ROW/easement negotiations, utility

			coordination and/or relocation, would result in only minor disruptions to current traffic patterns.
	Soft shore protection	Intermittent gravel and sand beach nourishment as necessary to protect bluff toe.	Stronger consideration if road decommissioning is not possible in the near- to mid-term. May be challenging to permit, may need to be modified with ongoing SLR or maintained on periodic basis.
	Hybrid shore protection	Place beach nourishment with series of constructed spits to protect bluff toe (Figure 19, Figure 20).	Stronger consideration if planning timeline for road decommissioning extends toward 2050, will need to recreate existing intertidal habitat and/or mitigate on site or nearby (more challenging to permit than without created spits).
Long-term	Road decommissioning	Recommended if not completed in near- to mid-term.	May be required without other protective/adaptive actions. Access can be provided landward for affected residential properties, may require property acquisition and/or ROW/easement negotiations, utility coordination and/or relocation, would result in only minor disruptions to current traffic patterns.

NE 9th Street

NE 9th Street includes the shortest priority road section threatened by shore recession in the Town of Coupeville. Approximately 230 linear feet are vulnerable to the 2100 High scenario, while just 25 FT are vulnerable to the 2050 Moderate scenario. The vulnerable section is situated between NE Otis Street and NE Perkins Street, running directly along a low-elevation (relative to roads to the west) bluff crest. In at least one area, the edge of roadway along NE 9th Street appears to be as little as 10 FT from the bluff crest. The existing shoreline is armored with a rock revetment along the full extent of NE 9th Street between NE Otis Street and NE Perkins St. This rock revetment was constructed in multiple phases: one portion as a vertical rockery wall and one portion as a sloped revetment. Bluff erosion appears to be continuing despite the armoring as documented during a site visit on October 29, 2024 (Figure 22). The presence of this revetment and the space between NE 9th Street and the top of bluff reduce alternatives for mitigation and adaptation along the vulnerable road section.

Along with other road sections discussed, the Town should begin monitoring and assessing shore recession and any factors contributing



Figure 22. Site photos of eroded bluff above existing rock revetment (top) and the stormwater outlet associated with erosion above the rock revetment along NE 9th Street (bottom).

to exacerbated recession (e.g. stormwater deficiencies leading to runoff over the slope, unhealthy or damaged vegetation, invasive species, etc.). One stormwater outlet of concern was documented during the October 2024 site visit (Figure 22). The corrugated metal pipe overhangs the beach and flow either leaking from the pipe or from surrounding areas has undermined the pipe end.

Given the lack of space for alternative, nature-based solutions, emphasis for near- to mid-term planning should be placed on improving or replacing the existing shore protection. Replacement could include removal and resetting of existing rock and additional rock armoring as part of a revetment design that provides better protection now and in the future. Any rock revetment or rockery wall design should include beach nourishment to support nearshore processes and habitat. Beach nourishment will also provide an additional layer of protection for the bluff toe.

Rerouting or decommissioning of NE 9th Street would be complex, but possible in the mid- to long-term. A setback alignment of the existing road appears to be achievable through easements and/or private property acquisition to the south of NE 9th Street (Potential Setback Alignment, Figure 23). A full reroute of traffic away from the threatened section of NE 9th St (allowing for decommissioning along this stretch) may be possible via NE Otis Street, E 6th Street NE, and Perkins Street NE (Potential Reroute 1, Figure 23). Alternatively, through traffic could be rerouted via 7th Street NE to NE 6th Street along a new right-of-way through currently undeveloped residential property (Potential Reroute 2, Figure 23). Design criteria and associated physical constraints (particularly through existing residential neighborhoods), property acquisition, and local opposition to altered traffic patterns could represent significant challenges to rerouting traffic and decommissioning the vulnerable section of NE 9th Street. Traffic studies should be conducted to better understand potential impacts to travel patterns, property access, and emergency routes, among other factors.



Figure 23. Aerial view of potential adaptation options for NE 9th Street.

Table 7 summarizes potential actions and planning horizons identified for mitigation and adaptation measures along the residential section of Front Street.

Table 7. Summary of the proposed Action Plan for NE 9th Street.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Passive management	Vegetation and drainage evaluation, erosion monitoring of bank toe and bank crest, management where possible through targeted plantings and stormwater improvements, invasive species control	Will help to decrease bluff recession rates but will not be enough to protect at-risk road segments for long-term. Simple but precise methods for erosion tracking must be used as changes may be very small in short time frames.
	Improvement and/or replacement of existing shore protection	Supplement or redesign and reconstruct existing rock revetment/rock wall to provide more effective and sustainable protection	Recommended as a near-term measure while planning for mid- to long-term adaptation measures. Structures would likely need to be in the same footprint. The decision to maintain hard armor should be made with consideration for what future actions are planned in the area.
Mid-term	Soft shore protection	Gravel and sand beach nourishment to complement existing or improved rock revetment/rock wall	Would reduce bank erosion and add longevity to hard armor; could augment intertidal beach habitat.
	Lane Reduction	Evaluate effects of and consider reducing to one way traffic	Going to one lane could be required in mid- to long-term timeline without improved/replaced shore protection or decommissioning. Could be carried out as a mid-term measure if shore armor repair is not allowed or is not sufficient to control bank crest recession.
Long-term	Decommission and reroute, or realign/setback road	Will likely be necessary in long term without other actions, will be most cost-effective over long-term	Analysis should be conducted to understand traffic and emergency impacts, utility coordination and/or relocation. Road setback would likely require acquisition of at least one nearby house/property, and potential easements/ROW acquisition elsewhere.

4.3 Historic Overwater Buildings

Coupeville’s waterfront is adorned with several historic buildings dated to the 1890s, many of which are built largely as overwater structures. The Town has identified these buildings as priorities due to their cultural, historic, and economic significance. Excluding the wharf, there are a total of ten waterfront buildings within the commercial downtown area, nine of which are considered historic. There are two types of foundations for overwater buildings: concrete or wood pilings that allow inundation below the building, and continuous concrete foundations (Figure 24). Actions for these buildings should address both shore recession and potential flooding.



Figure 24. Example showing structures built with concrete foundation (left) and a structure on pilings (right).

As a part of the 2023 Vulnerability Assessment, we surveyed the approximate lowest floor elevation for each overwater building (Figure 25). Measurement locations for the lowest floor elevation of each overwater building type are indicated with the red arrows shown on Figure 24.



Figure 25. Approximate lowest floor elevations (NAVD88) for the overwater buildings in downtown Coupeville. Note: elevations were not surveyed using high accuracy survey equipment and should be resurveyed for future planning.

As illustrated in Figure 26, two buildings on the north side of downtown Front Street are expected to be flooded during the 2050 Moderate scenario, two during the 2050 High scenario, and three during the 2100 High scenario. Three overwater buildings are not predicted to be flooded under the scenarios considered.

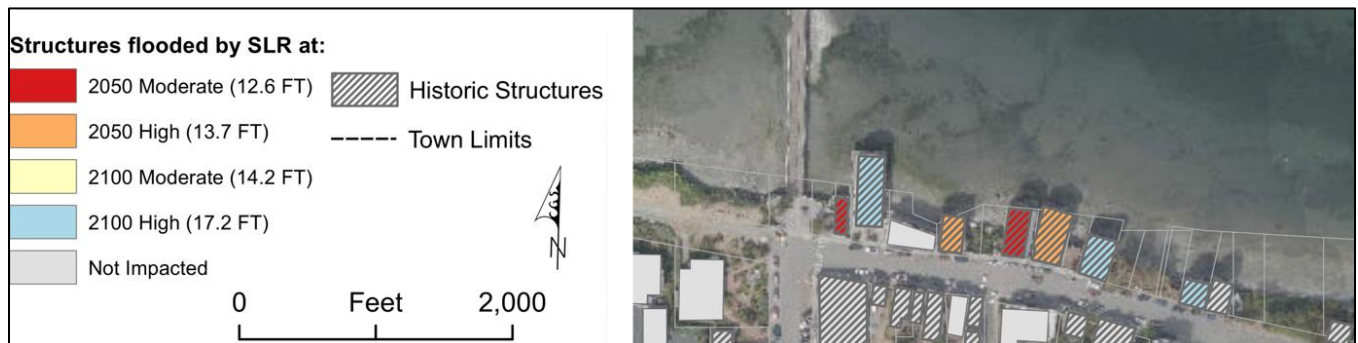


Figure 26. Structures at risk of flooding from different levels of sea level rise.

All overwater structures are threatened by shore recession beginning with the 2050 Moderate scenario, as shown in Figure 27. Most, if not all, of the buildings in question have an entrance along Front Street, with a lower level following the natural terrain of the bluff. As a result, these structures are generally situated partially atop an existing bluff crest with the roadway and sidewalk immediately adjacent to the structures. The lack of setback from the road makes any landward relocation of the buildings within their current parcel impractical.



Figure 27. Structures at risk of shore recession from different levels of sea level rise.

Shore recession and flooding are not a new hazard for these buildings. High water levels have impacted the buildings in the past, including during the regionally historic December 27, 2022, high water event. Figure 28 shows flood damage from the 2022 storm inside one of the overwater commercial buildings. The condition of existing buildings is heavily influenced by sea level and the harsh marine environment. In addition to the potential for direct damage to the buildings, high water events contribute to erosion and bluff recession.



Figure 28. Flood level (see arrow) within one of the Front Street commercial buildings lower floors from the December 27, 2022, regionally historic high-water event (Photo Credit: Avery Maverick, 2023).

Priorities & Goals

The Town has identified maintaining the historic over-water buildings along the waterfront as a primary goal due to their economic and cultural importance. These buildings constitute the historic and economic core of the Town and are an important part of the Town’s identity. Maintaining and protecting the buildings will preserve an active street and sidewalk along Front Street. As a secondary priority, the Town would like to maintain existing beach access in downtown Coupeville which is also a statewide priority under the Shoreline Management Act.

Action Identification & Evaluation

Seven main actions were considered for the historic overwater buildings. These actions primarily aim to address flooding. Actions to address bank recession and erosion along the downtown stretch of Front Street are detailed in Section 4.2 and may be implemented concurrently with flood protection measures.

1. No Action
2. Floodproofing and/or abandonment of lowest floors
3. Elevation of structures
4. Reconstruction
5. Repair/construction of hard armor
6. Floodwall
7. Structure relocation

Action 1. No Action – would be a continuation of the existing conditions. As sea levels rise, low elevation structures or individual floors will continue to experience flooding and damage. Some buildings are already impacted by occasional flooding, which is expected to increase in frequency. Several foundation pilings are undermined and periodic repairs have been necessary. Existing shore protection structures on the beach in some areas are damaged, which further contributes to shore recession. With no action, structural foundation failures could become more likely, threatening the buildings as well as segments of the Front Street sidewalk or roadway.

Action 2. Floodproofing and/or abandonment lowest floors – would offer flood protection for the structures in their current locations by directly preventing flooding (dry floodproofing) or by improving the lowest floor(s) such that minimal damage occurs during flooding (wet floodproofing). The condition of the existing structures will dictate if floodproofing is economically feasible.

Dry floodproofing, as discussed in Section 3.3.2, would involve a concrete wall and floor system that would prohibit water from entering the lowest level of a building (Figure 11). Concrete walls would require robust design and construction to resist wave and hydrostatic forces resulting from rising water and would essentially function like a vertical bulkhead. All construction joints would be designed to prevent water infiltration. The lower levels would become basements without doors or windows. This would most likely require additional structural and foundation improvements to support new walls.

Wet floodproofing allows water to enter and drain from a structure (Figure 12). Individual property owners would limit their use of bottom floors either proactively or in response to floods. Adequate drainage would be necessary to prevent water from accumulating within the structure when waters recede. Raising building utilities above flood risk elevation is a key part of wet floodproofing. Wet floodproofing is not recommended as it allows the structure to continue to deteriorate, which results in a high risk of failure due to the harsh nature of seawater and the age of the buildings.

Abandoning or converting the use of the lowest elevation floor levels could be necessary for certain buildings to allow for floodproofing (Figure 8). Buildings with bottom floor elevations less than approximately 15 FT NAVD88 or those who have already flooded should consider this action in the near- to mid-term as it relates to the 2050 High sea level scenarios, whereas buildings with floor elevations above approximately 15 FT NAVD88 should consider this in the mid- to long-term (Figure 25). All lower elevation openings (cable utilities, drain lines, exterior hose bibs, etc.) should be sealed. This alternative could alter the historic character of the lower levels of the buildings, would be costly, and could require other building upgrades.

It should be noted that major improvements to these structures may trigger certain building code requirements. The specifics of the requirements will depend on interpretation and application by the Town's Building Department, as well as other local and state code requirements. It is likely that these structures would be required to incorporate seismic upgrades alongside concrete work to floodproof the lower levels.

Action 3. Elevation of structures – would elevate structures to provide a new foundation that sets the building above a particular flood elevation. Targeting at least 2 FT (3 FT recommended) of freeboard (the distance between the high water and the ground floor level) above the projected 2100 High sea level of 17.2 FT, buildings would need to be raised anywhere from 1.7 FT to 7.4 FT. Based on access requirements, including Americans with Disabilities Act (ADA) standards (discussed below), raising a building more than 3 FT is likely to be impractical without raising the street level as well.

Building elevation would involve jacking the building up and using a temporary foundation while a new foundation is constructed. Entrances to the building would be raised, which would require stairs and/or ramps to maintain access from street level. Alternatively, the street and sidewalk could be raised to address this. This may prove challenging, as the front wall of the structures is in close proximity to the right-of-way. Additionally, access meeting ADA standards would be required for commercial buildings, including the potential for ramps placed in the right-of-way. ADA ramps require a slope no greater than 12 Horizontal:1 Vertical, landings 5 FT in

length, and a thirty-inch maximum rise per run. A 3 FT elevation difference would require two separate rises with an overall ramp footprint of 28 FT in length and up to 6.5 FT in total width. A ramp with a single riser would provide a maximum height of 2.5 FT, and measure 40 FT long when accounting for ramps and handrails. It may be possible to regrade within the right-of-way to reduce the access elevation requirements, but this is likely to be limited. These challenges are illustrated in Figure 29, which depicts a cross section of a building between Front Street and Penn Cove.

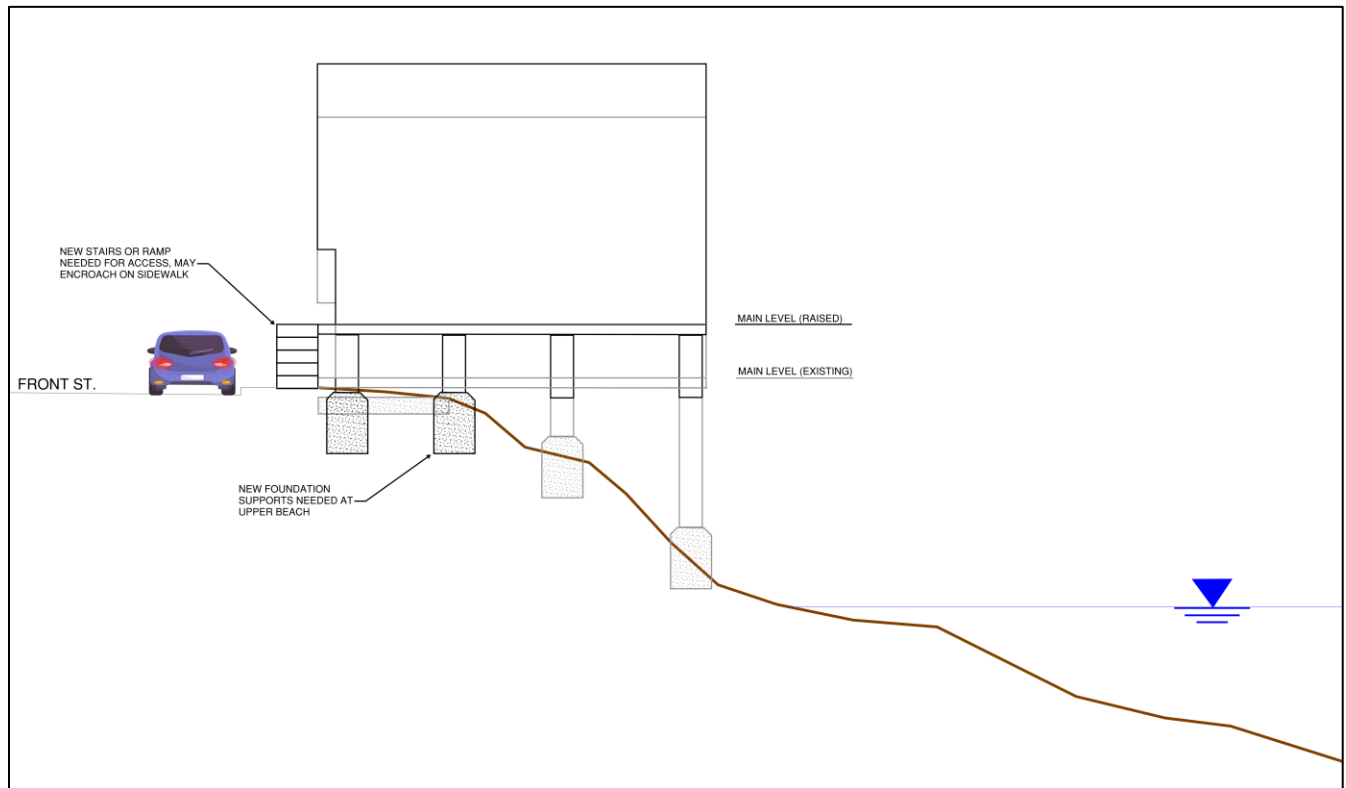


Figure 29. Example cross-section view of structure elevation at Front Street.

With elevation, continuous concrete foundations (Figure 24) would be replaced in kind. The concrete wall foundation would function as a vertical bulkhead. Piling style foundations could be replaced with a continuous concrete foundation, which may reduce the need for and extent of additional shore recession mitigation because it would function as hard shore stabilization, though at higher cost than replacement with new pilings. Additionally, depending on the available freeboard, structures on piling foundations would likely need to install a system of panels beneath the joists facing the ground to absorb any wave energy and prevent damage to the structure.

Elevation of structures on pilings is substantially cheaper than the equivalent building on a continuous concrete foundation because major joists are accessible, facilitating a more streamlined installation of temporary supports. Additionally, construction of a new foundation while temporary supports are in place is more straightforward for pile foundations than for continuous concrete foundations.

Alternatively, internal elevation of the lowest floor could be considered if it can be accommodated by the ceiling height (Figure 9).

Importantly, residents of the Town have voiced the desire to maintain a cohesive character of the commercial center on Front Street. Many constraints listed above and the very old and irregular shape of some of the buildings will present challenges to achieving this goal through elevation of buildings. It would be critical for

private property owners to agree on and effectively implement a shared vision to avoid a piecemeal approach due to the varying foundation types, floor elevations, and structure conditions.

Action 4. Reconstruction – would involve the partial or complete reconstruction of certain overwater structures. Some of the existing buildings are aging and their structural condition is likely poor due to outdated original designs coupled with impacts of the harsh marine environment. On a case-by-case basis, existing buildings could be demolished with the façade persevered and incorporated into the new buildings. This would allow a new structure to be built to modern standards that considers flooding from the start. Buildings would be more resilient to seismic events, more energy efficient, and could include more modern amenities. As the existing façade would remain intact, the buildings would maintain some of their aesthetic character. If less than 50% of any given structure requires new construction, building permits may consider the activity to be a remodel. This may alleviate permitting challenges that are typical of greenfield development (building from scratch) in a critical area. Otherwise, if more than 50% of a building is reconstructed, it is considered new construction under local codes.

Action 5. Repair/construction of hard armor – the options of repairing existing hard armor versus constructing new and more robust hard armor are similar but separate approaches to mitigate bank erosion. Repairs would rehabilitate existing armor structures where structural integrity is threatened and could include constructing a deeper foundation where beach lowering has occurred. Any new hard armor would be required to be built to modern standards and would be more robust. New hard armor would not be appropriate or effective for buildings currently on pilings.

Action 6. Floodwall – would entail designing and constructing a floodwall or multiple floodwalls around the existing structures to prevent marine waters from damaging structures. A floodwall would be composed of a reinforced concrete wall, sheetpile wall, or both, and necessitates an appropriate drainage system (with back-up emergency power) to manage hydrostatic pressure and mitigate storm and groundwater pooling. Design and construction of floodwalls is generally considered a relatively high-cost mitigation strategy with an expected useful life of 50 years if properly maintained.

Floodwall height is the most important factor to consider during design because as height increases, the floodwalls foundation typically increases in size. A properly built floodwall has almost as much structure below ground as above. Current regulations stipulate that the structure would need to be built at least 1 FT above base flood elevation or 15 FT NAVD88. Based on the most recent LiDAR elevation data from Island County (2014), the wall would need to be built *at least* 6 FT above beach grade. However, to be an effective long-term flood mitigation strategy the wall would need to be built several feet higher to account for sea level rise. Once again, this would require a sizeable foundation with internal reinforcement accounting for the force of water and the impact of floating debris during storms.

Action 7. Structure relocation – would either adjust building locations within their current parcel or move them to a different property. Adjusting location within the parcel may be challenging, as buildings typically need to be moved further from the water, which would conflict with the Front Street roadway. Moving the buildings to another site would likely not be feasible and would not meet the Town’s desire to maintain the character and culture of the existing downtown area. Additionally, it would be challenging to find a suitable location for the unique overwater structures, as they are located partially atop a bluff, and any new location would need to accommodate the structures’ unique elevations.

Potential actions are summarized in Table 8 and evaluated using STAPLEE criteria and the guiding principles (Section 2.3).

Table 8. Evaluation of potential actions for the historic overwater buildings using the STAPLEE methodology.

ACTION	SOCIAL	TECHNICAL	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
No Action	Moderate	Not effective	No permitting necessary	No initial cost – potentially high cost if shoreline recession extends into and damages buildings or flooding occurs.	No benefit	NA	Not Recommended
Floodproofing Structures and/or Abandonment of Lowest Floors	Moderate	Allows existing buildings to remain in place; fewer concerns with needing to modify access from Front St.	Permitting challenges exist due to shoreline proximity. Likely to be considered as modifications to an existing structure. Building permit may require additional improvements to meet modern building codes.	Lower cost, likely in the range of \$100k to \$300k per building. Total cost will depend on size of basement level.	Roughly net neutral for buildings already on concrete foundation. May be negative benefit for building on pilings if converted to concrete foundation as part of floodproofing. Some temporary environmental negative externalities due to construction.	1b, 1f, 1g, 4d	Recommended to implement as needed.
Elevation of Structures	High	Raising smaller buildings is regularly accomplished and well understood. However, the age, design, and location of the buildings will make this challenging.	Same considerations as floodproofing structures.	Depending on the building, the cost to raise the foundation and address access issues ranges from \$500k to \$1M per building. Buildings on pilings would be at the lower end of this range, while seawall style foundations would likely be higher. It may not be feasible for the Town to provide funds that benefit private owners.	Roughly net neutral. Some temporary environmental negative externalities due to construction.	1b, 1f, 1g, 2d, 4d, 4f	Recommended if feasible and a cohesive downtown appearance can be maintained.
Reconstruction	Low	Rebuilding with the existing façade is commonly done. Provides building with modern standards and amenities.	Permitting challenges do exist due to shoreline proximity. Considered as modifications to an existing structure if less than 50% new.	High cost; essentially the cost to construct a new building.	Some benefit due to improved energy efficiency. Some temporary environmental negative externalities due to construction.	1b, 1f, 1g, 2d, 2f, 4f	Recommended if socially acceptable.

ACTION	SOCIAL	TECHNICAL	LEGAL	ECONOMIC	ENVIORNMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
Repair/Construction of Hard Armor	High, especially if additional sediment is brought in periodically to maintain the beach	Effective at reducing erosion and stabilizing foundations; would not address flooding	Permitting challenges due to shoreline proximity; long and difficult permitting process	Construction of new hard armor would be expensive; likely \$700 to \$2,000/LF here. High mobilization cost for any reach	Negative benefit	1a, 1b, 1g, 2b, 4d	Repair recommended to extend life of buildings where needed. Construction of a new hard armor is not recommend as it would not address flooding.
Floodwall	Mixed	Effective if built properly, technically very challenging	May not be permissible or complex permitting process	Very high costs from design, permitting, and construction	Negative benefit	1b, 1f, 1g, 2b, 4d	Not Recommended
Structure relocation	Mixed	May not be feasible to move some buildings, and would not solve issue of shoreline recession on Front St.	Lots of permitting	High cost, likely \$500k+ per building plus cost of new location.	Return shoreline to natural state; very beneficial	2c, 2d, 3d, 4b	Recommended for further feasibility and public approval.

Action 1. No action was not selected because buildings would continue to be damaged by flooding events, and the bank would continue to erode toward Front Street.

Action 2. Floodproofing structures and/or abandonment of lowest floors was selected for application on an as-needed basis, which will be dependent on the economic circumstances of the property owner and the specific character or condition of the structure. Depending on the extent to which each structure is at risk of flooding, it may make sense to floodproof structures. However, due to the age of these structures, dry floodproofing may present several technical and administrative challenges as some techniques will essentially function as hard armor.

Action 3. Elevation of structures was selected for further detailed evaluation because it would retain the character of the downtown area. There would be challenges in maintaining access to each building, which would likely limit the feasibility of this action for specific buildings unless Front Street was also modified. An option to raise a series or all of the Front Street buildings could involve raising the level of Front Street and sidewalk. Additional analysis of grades along Front Street would be needed to verify the feasibility. This is only recommended if a holistic approach can be agreed upon to maintain a unified character of the downtown.

Action 4. Reconstruction in place was initially selected because it works to retain the character of the downtown area and improves the quality and resiliency of the buildings. While more costly than other alternatives, new structures would keep the same façade but add seismic reinforcing and energy efficiency improvements and be the longest-term solution. Reconstruction designs would need to consider future water levels. Through the public engagement efforts, we understand that this has very low social acceptance and therefore we recommend further exploring other recommended options first.

Action 5. Repair/Construction of hard armor was selected for the repair approach in the near-term but not for the construction of new hard armor. Hard armor repair would be appropriate on a case-by-case basis (by

building or by small group of buildings) as needed to maintain the structural integrity of individual buildings. This may be needed as the existing hard armor is very old and was not constructed to modern engineering standards.

Action 6. Floodwall was not selected because, while it may be technically possible to construct a wall that provides adequate flood protection for the commercial downtown, it is likely impractical for this specific application. The main challenges would be very high design and construction costs, considerable negative impacts to nearshore habitats and coastal processes, off-site impacts, and an extremely cumbersome or infeasible permitting process. It is particularly important that floodwalls are built properly because waves can overtop floodwalls, water often finds a way through any voids at joints – including where these structures meet land – and additionally, precipitation is often heavy during high-water events and can result in pooling of water on the landward side of walls. Hydrostatic pressure from water against the landward side of hard armor is a common cause of wall failure and can be very difficult to mitigate within design.

Action 7. Structure relocation was not selected as a primary action because it does not meet the Town’s goals of maintaining the downtown character, and it would be very challenging or infeasible to move these buildings and locate suitable sites upon which to place the buildings. Additionally, the costs for structure relocation are expected to be far higher than those of simply elevating or reconstructing the existing structures in place. If there is strong interest in this action, recommend additional feasibility into this action and survey of public and private support. This may be the only option on the table for the very long-term due to bluff recession progressing and water levels increasing, but it currently does not meet the Town’s goals.

ACTION PLAN

In the near-term, continue coordination and planning with all stakeholders to address flooding and shore recession concerns. This includes additional feasibility assessment to determine what is required for individual buildings, to include the potential for floodproofing or elevating structures. This will require evaluation of building codes, which may trigger additional upgrades to bring the aging buildings into compliance. Additionally, access to each building will be an important consideration when evaluating whether to raise buildings, as the street and sidewalk level may be difficult to adjust. This plan will also need to account for shore recession mitigation measures and how the costs will be shared amongst stakeholders. Actions taken should consider applications and effects on the entire downtown area. Ideally, private property owners would unite in a coordinated approach that results in a cohesive and comprehensive solution. Broad participation by waterfront building owners would make any project far more affordable and effective.

In the mid-term, address flooding concerns with lower elevation structures anticipated to be affected by flooding in the 2050 High scenario. Repair existing protective measures against shore recession (see Section 4.2). As this affects all property owners, further coordination and design will be necessary as a near-term action, with execution occurring as a mid-term action.

In the long term, finalize an approach to address flood risk with remaining structures, either through elevation, floodproofing, or reconstruction/retrofitting. Table 9 summarizes the proposed Action Plan for the overwater buildings.

Table 9. Summary of the proposed Action Plan for the overwater buildings.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Cohesive planning effort amongst stakeholders to determine if there is consensus to evaluate and explore the best approaches and	Begin planning before 2030 to include more detailed feasibility and cost	Acquiring broad participation by waterfront building owners would make this study far more affordable and effective for

	costs of different major actions as a group.	evaluation for major actions listed above such as structure elevation.	these owners. This would require access to building plans, examination of on-site features including foundations, wall structure, access configurations, and uses of individual levels.
Mid-term	Address flooding concerns by floodproofing or abandonment of specific lower levels	Evaluate and implement dry floodproofing for lower elevation structures. Abandon primary use of lower at-risk levels to mitigate potential damage for certain buildings.	Dry floodproofing would only be practical for large and important lower floor areas. Dry floodproofing for buildings on pilings would require additional structural support.
	Elevate certain buildings or ideally group(s) of buildings, if feasible	Detailed feasibility study including structural, access, and cost analysis would first be required first.	The structural design of individual buildings, stability of the Front St. sidewalk, building access including ADA access, cost benefit analysis regarding the extensive work required versus the utility of small lower floor areas.
	Repair existing hard armor where needed	Case by case evaluation needed, but mobilization costs would be best shared if work occurs.	This would be similar to business as usual with individual owners addressing individual building needs. Permitting of any shoreline work requires many steps and often requires mitigation, which would likely need to be off site or paid into a mitigation fund for these small sites.
Long-term	Elevate all Front Street downtown buildings as well as roads and associated infrastructure.	Detailed feasibility study including structural, access, and cost analysis required.	This would include elevating the entire downtown area, including the buildings on the south side of Front Street and the road to maintain a unified character in the commercial area. All property owners would have to be onboard, which would be very difficult to achieve.
	Reconstruct buildings to modern standards preserving the building façades and potentially eliminating the lowest of the lower levels. We recognize that this may have low social acceptance but provides a long-term option that wouldn't necessitate achieving full property owner coordination.	Building reconstruction is recommended for long term use of these sites, and would require motivated owners. Some buildings with poor structural integrity may not be suitable for this and building abandonment and demolition may be required.	This would constitute high investments, and would involve extensive design and permitting. This is the most viable option over the long term as all other measures include a number of compromises. There would be efficiency in addressing multiple building reconstructions at the same time.

4.4 Wastewater Treatment Plant

The wastewater treatment plant (WWTP) is located at 600 NE 9th Street, Coupeville, WA (Figure 30) adjacent to Thomas Coupe Park and south of the public boat ramp. The facility utilizes biological treatment in oxidation ditches and includes headworks, secondary clarification, and UV disinfection. The disinfected effluent is discharged to Penn Cove through an outfall pipe.

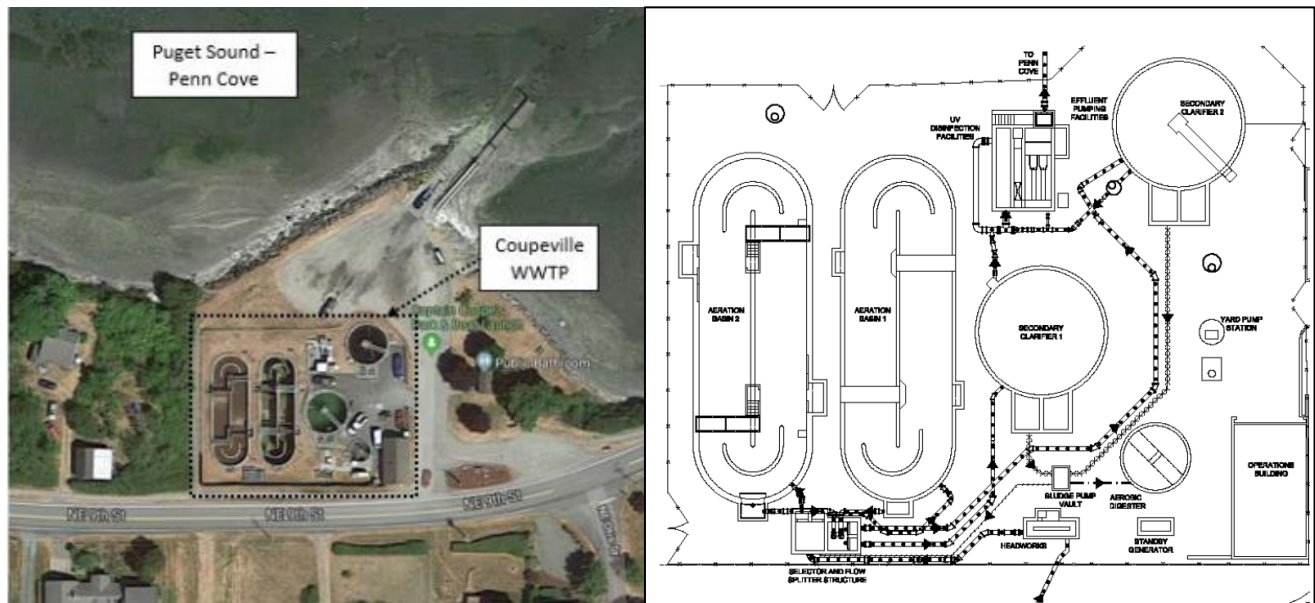


Figure 30. Imagery of Coupeville's wastewater treatment plant (left: Department of Ecology, 2019) and the layout diagram of the facility (right: WA Department of Ecology, 2009).

The WWTP does not appear to be in need of additional capacity in the short term based on discharge monitoring report data provided to the Department of Ecology. Long-term planning is already underway by the Town to investigate any potential increases to future flow projections, as well as future improvements to produce reclaimed water. While no comprehensive planning has been completed in recent years, growth within the Town appears to be limited, suggesting that the facility will not experience capacity restraints within the next several decades. As a result, a WWTP expansion does not appear to be necessary, with the only major expenses expected to be replacement of equipment and structures as they reach the end of their useful service life.

Previous mitigation efforts at the site include armoring along the shore to the north of the WWTP and extending on both sides of the existing boat ramp as shown in Figure 30. The rock armoring is at least 30 years old, and its effectiveness has diminished over time due to erosion, flanking, and dislodged armor rocks. A small amount of armor appears to have been initially placed to raise the elevation of the more waterward portions of the plant. Aside from this, no other mitigation measures have been implemented at the WWTP to the best of the project team's knowledge.

The WWTP shoreline location and low elevation make it particularly vulnerable to rising sea levels and high-water events. Major concrete tanks used for treatment at the WWTP have top of wall elevations ranging from approximately 16.7 to 19.2 FT MHHW, which provides some freeboard above the present-day 9.1 FT MHHW. *Criteria for Sewage Works Design (Orange Book)* (WA Department of Ecology, 2023) requires that WWTP unit processes are located above the 100-year flood or wave action, or that they are otherwise protected against damage from the 100-year flood or wave action. For this analysis, it is assumed that the projected water

elevation under the 2100 High scenario is equal to the 100-year wave action. Thus, no additional sources of inundation were included in this analysis.

In the near- and mid-term, the scenarios evaluated do not indicate any risk of flooding at the WWTP. However, both scenarios in 2100 suggest floodwaters will breach the WWTP site to different extents between the 2100 Moderate and High scenarios as shown in Figure 31. The 2100 Moderate scenario suggests that Secondary Clarifier No. 2 (Figure 30) will be surrounded by flood waters, though the clarifier walls, with a top of wall elevation of 17.1 FT, will keep seawater out of the clarifier itself. In the 2100 High scenario, floodwaters encompass nearly the entire site, leaving only the headworks, flow splitter structure, standby generator, and operations building out of the flood zone. In this scenario, floodwater would overtop the effluent disinfection structure (top of wall at 16.7 FT) as well as the secondary clarifier structures. The elevations of the aforementioned structures are based on the WWTP hydraulic profile and should be field verified by a surveyor. The impacts of intrusion of floodwaters are National Pollutant Discharge Elimination System (NPDES) permit violations and the loss of mixed liquor (sludge) that is needed for biological treatment. This could result in the loss of treatment for several weeks while sludge inventory is increased. Additionally, salt water is corrosive and its intrusion into WWTP processes may be damaging to mechanical equipment and piping. High salinity can impact biological processes and reduce treatment efficiency.

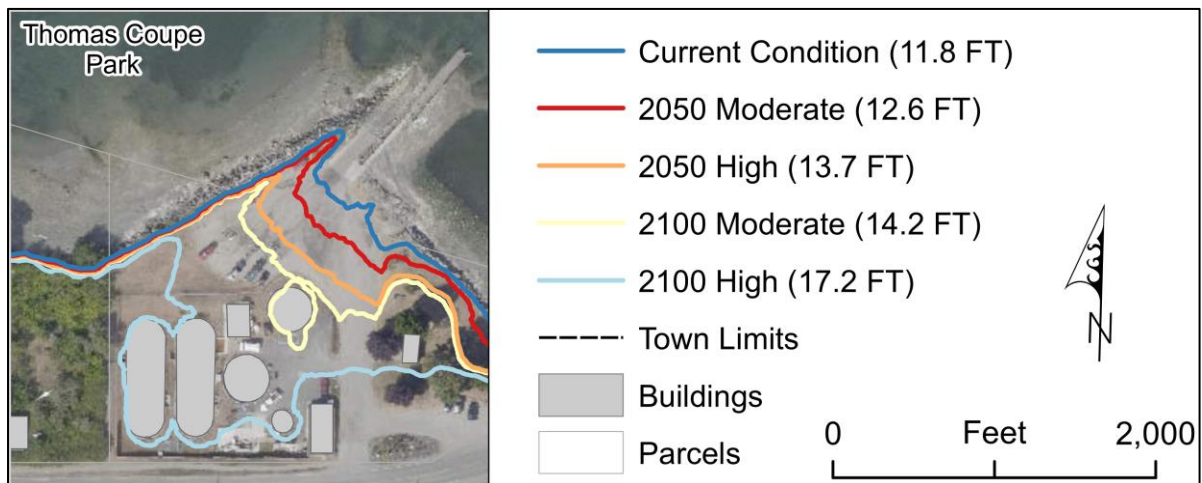


Figure 31. Projected shoreline inundation under analyzed sea level rise scenarios.

Priorities & Goals

Protecting the WWTP from SLR is crucial for public health and protecting coastal ecosystems. The goals identified for the WWTP are essential to maintain treatment and discharge of wastewater in compliance with the NPDES permit while ensuring the WWTP remains completely operational through the 2100 High scenario, to maintain compliance with the Orange Book. In addition to this, access to Thomas Coupe Park and boat ramp may be affected (see Section 4.5).

It should be noted that the WWTP has received an “Wastewater Treatment Plant Outstanding Performance” award for 15 consecutive years and is one of 125 plants statewide that achieved full compliance with its NPDES permit in 2019 (Town of Coupeville, 2021) and has achieved full compliance from 2010-2024.

Action Identification & Evaluation

Eight potential actions were identified for the WWTP as follows:

1. No action
2. Emergency response plan for WWTP
3. Integrate SLR considerations into WWTP improvement projects
4. Floodproof existing WWTP
5. Construct levee or floodwall
6. Raise existing WWTP elevation
7. Design and construction of a new WWTP (Phase 1 and 2)

Action 1. No action – With no action taken, the WWTP will continue to operate with possible impacts in both the short term and long term due to high water events and SLR. This includes disruptions to WWTP operations, increases in the risk of physical damage to the infrastructure, treatment failures due to saltwater intrusion, and loss of mixed liquor (a combination of wastewater and activated sludge used in a secondary treatment of wastewater) during high sea level or storm events. In the short-term, storm events will continue to damage the shoreline revetment surrounding the WWTP. A reactive approach would be taken, in which regulatory compliance would be the ultimate driver for improvements.

Action 2. Emergency response plan for WWTP – This action involves developing or revising an emergency response plan and standard operating procedures (SOP) for extreme weather events or high flow events. A thorough assessment would be conducted to identify areas of the WWTP most vulnerable to SLR. Shutdown procedures for systems would be developed to reduce the risk of damage to critical infrastructure. Although an emergency response plan could reduce the short-term impacts of SLR, additional actions are necessary to mitigate the long-term impacts of SLR.

Action 3. Integrate sea level rise considerations into WWTP Improvements – This action entails detailed evaluation of the current system and incorporating SLR projections into planning. Any proposed improvements would account for future sea level projections. Major upgrades to the WWTP with a lifespan extending beyond 2100 would consider the potential impacts of rising sea levels on both the specific improvements and the overall plant, potentially including the construction of a new WWTP. A specific example of this, which is currently being studied by the Town, is planning for the production of reclaimed water for reuse or aquifer recharge. This study includes an investigation into a new WWTP to treat portion of flows on the south side of the Town. The new WWTP design would also consider future expansion to accommodate the full flow of the Town in the long term.

Action 4. Floodproof existing WWTP – This action includes floodproofing critical WWTP facilities which are low lying to ensure their resilience during extreme weather events. This may include using specialized concrete formulations for structure foundations or hydrophobic coatings for building structures and sealing openings. Nearby catch basins and sewer manholes would be sealed to manage flooding and water infiltration in the area. This action should be viewed as an intermediate step; the goals of this action are to allow the WWTP to operate throughout the 2100 Moderate scenario with no major capital projects needed for implementation.

Action 5. Construct levee or floodwall – A levee or floodwall would be built around the WWTP to prevent seawater intrusion into plant treatment basins and subterranean structures. A levee is a large berm constructed from soil, designed to prevent floodwaters from inundating an area. A floodwall would be a separate vertical structure built out of concrete. This alternative would include a thorough site assessment to understand the topography, soil conditions and flood risk.

Soil required for levee construction would need to meet specific engineering criteria and may need to be imported from off-site. A levee would need to be designed to reduce potential impacts to existing habitats. A floodwall would similarly raise the elevation around the plant. Rehabilitating the existing revetment at the shore of Thomas Coupe Park and boat ramp is discussed in Section 4.5.

A new drainage system with a pump station behind the levee or floodwall may be required to prevent flooding around the WWTP structures due to rainfall if grade behind the levee or floodwall is not uniformly raised to be above the flooding elevation. Due to the extensive amount of regrading that would be needed, a small pump station may be more cost effective. It is recommended that the WWTP, Thomas Coupe Park, and boat ramp are all considered holistically. Improvements to address flooding at one location should avoid exacerbating flooding at another. Additionally, any capital project undertaken would be more cost effective as a unit than individual pieces.

Action 6. Raise existing WWTP elevation – This action involves importing fill and increasing grade to prevent flooding and promote drainage. Structure elevations would be raised by approximately 1 FT to 3 FT to provide 3 FT of freeboard above the 2100 High scenario and mitigate potential for floodwaters to enter the treatment process. Raised structures would include key components of the WWTP such as lift stations, emergency generators and treatment tanks. Assessment of the existing structure walls and foundations would be necessary to ensure their ability to support new construction and associated changes in exterior loading. Modifications and improvements, such as additional reinforcement or wider foundations may be required.

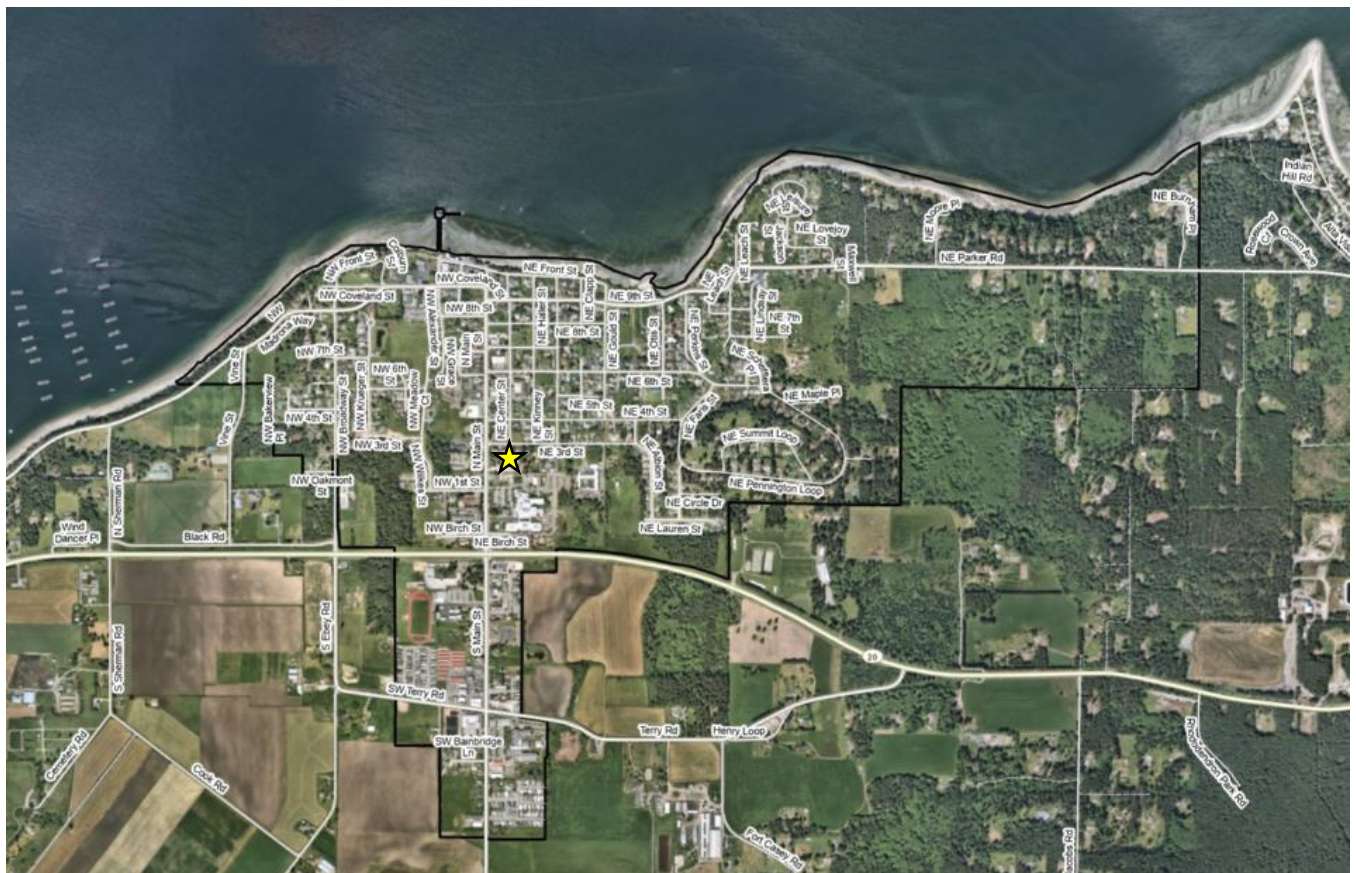


Figure 32. Potential location of new wastewater treatment plant (yellow star).

Action 7. New WWTP – This action entails design and construction of a new WWTP that is located away from the shore (Figure 32). Constructing a WWTP further inland reduces the vulnerability to SLR, flooding events, and

saltwater intrusion. The treatment plant could use membrane bioreactor (MBR) technology to treat flows. MBRs were selected for this high-level analysis as they produce high quality effluent that is suitable for use as reclaimed water, which can be beneficially reused for irrigation or aquifer recharge. The cost of an MBR system is likely to be higher than that of other technologies, which provides a more conservative estimation of potential costs.

A preliminary approximate location of a potential new WWTP is shown in (Figure 32). Some of the main considerations for siting a new treatment plant include the proximity to the existing collection system, proximity to residential areas to avoid odor or noise issues, proximity to view corridors, and distance from a discharge location where an outfall can be routed that avoids passing through private property.

Construction of a new WWTP and decommissioning of the existing plant would likely be completed in phases to make overall cost more manageable. The first phase would involve construction of a new WWTP to treat a portion of the Town’s flows. Construction of a new WWTP would also require constructing lift station(s) and new gravity sewer pipes throughout the Town to route flows from the existing collection system to the new WWTP. For the first phase, the existing WWTP would continue to operate, treating a smaller portion of the Town’s sewage. As a result, the Town would have higher operational expenses during this period.

The second phase would involve using the new WWTP to treat all of the Town’s effluent. A portion of the existing WWTP footprint would be converted into a pump station to pump sewage to the new WWTP. The existing WWTP, which is vulnerable to SLR, would be decommissioned after the new WWTP is fully operational with treatment of the entirety of the Town’s flows. After decommissioning, the existing WWTP would be demolished, and the land could be restored and converted to recreational uses.

Potential actions are summarized in Table 10 and evaluated using STAPLEE criteria and the guiding principles (Section 2.3).

Table 10. Evaluation of potential actions for the wastewater treatment plant using the STAPLEE methodology.

ACTION	SOCIAL	TECHNICAL	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
No Action	Low social acceptance – Town has indicated WWTP is a high priority item.	Not effective	May result in NPDES permit violations in future, legal concerns with Ecology.	No immediate cost	Negative benefit- Does not solve the SLR issue	NA	Not recommended. Considerations for SLR need to be made for the WWTP.
Emergency Response Planning	High social acceptance – planning now helps the Town prepare to respond to emergencies.	Effective, though minimal impacts to WWTP.	No legal concerns.	Minimal costs	Net neutral	2b, 2g, 4a	Recommended that the Town plan for and design long-term improvements targeted at mitigating impacts of 2100 SLR projections before SLR begins to impact the WWTP.
Integrate SLR considerations into WWTP sewer comprehensive plan	High social acceptance – planning now helps the Town to make the right decisions for cost	Effective, though minimal impacts to WWTP.	Planning is already a legal requirement.	Planning costs are much lower than construction, and WWTPs are required to plan for the future by law. A typical General Sewer Plan may	Planning is the first step to solve the SLR issue	3a, 3g	Recommended that the Town plan future WWTP capital improvements that align with reducing WWTP

ACTION	SOCIAL	TECHNICAL	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
	effective treatment.			cost anywhere from 100k-400k.			vulnerability in the long-term.
Floodproof existing WWTP	High social Acceptance	Does not impact treatment at WWTP	Minimal permitting required, may help with NPDES permit compliance by reducing I/I	Low cost	Net positive, as it increases resiliency of WWTP	1a, 1e, 2g, 3a, 4a	Recommended for all existing and new WWTP infrastructure
Construct levee/floodwall	High social acceptance – construction would be a minimal visible change	Effective when built and maintained properly	Permitting of new levees or floodwalls can be challenging. Permitting is expected to take at least several years.	Moderate costs (estimated \$2-3M)	Negative impacts to nearshore habitats and coastal processes. Typically small impacts away from shore and in unvegetated area	1a, 1e, 3a, 4a	Recommended if floodproofing is ineffective and flooding impairs function of the existing plant and a new WWTP cannot be constructed within an adequate time frame.
Raise elevation at WWTP and increase height of structures	High social acceptance	Complex design affects hydraulics of entire WWTP. Stormwater runoff needs to be effectively managed to maintain drainage. Would require protection to prevent erosion of newly placed fill.	Low legal risk. Permitting challenges are expected since the WWTP is within 200 ft of shoreline/wetlands. Long permitting timelines, likely around 5+ years.	High initial costs. Likely to be less than new WWTP, but on a similar order of magnitude (\$5-10M)	No need to develop new parcel of land compared to new plant, but the existing WWTP adjacent to the shore would require significant work in shoreline buffer zone.	1a, 1e, 2d, 2g, 3a,	Recommend feasibility to increase height of tankage
New WWTP	Moderate social acceptance – any new location likely to meet some level of resistance. Production of reclaimed water is considered environmentally friendly which can be viewed positively. Outfall or new tightlines might be routed through private properties which can increase opposition. Repurpose land from existing WWTP to recreational use viewed highly.	Significant engineering needed, but feasible and highly effective	Long permitting timeline. The construction of a new WWTP requires a substantial number of permits.	High costs for construction of new WWTP. Phase 1 costs are estimated to be in the range of \$30M-35M based on similar projects. Phase 2 costs are estimated to be in the range of \$25M-30M. Costs for each phase are dependent on scope.	Positive benefits if current facility could be restored or enhanced. Reclaimed water production is environmentally beneficial as it can reduce Town’s reliance on well water. Some negative impacts to environment from construction.	1a, 1e, 2c, 2d, 2g, 3a, 3c, 4a, 4f	Recommended that the Town construct a new WWTP in phases to reduce initial cost for long-term solution.

Action 1. No action was not selected since it does not resolve current nor projected future impacts of storms or SLR for the WWTP.

Action 2. Emergency response plan is highly recommended to prepare the WWTP staff for SLR related events and includes the shutdown procedures and coordination with emergency evacuation routes. Having an emergency response plan in place would decrease potential operational failures caused by SLR.

Action 3. Integrate sea level rise considerations into WWTP improvement projects is the first step to manage SLR and is recommended to ensure long term sustainability and safety of WWTP infrastructure. Without proper planning to handle SLR, the WWTP could face operational disruptions that results in discharge permit violations.

Action 4. Floodproof existing WWTP is recommended for all existing and new infrastructure due to the low costs involved with the action, relatively minor permitting requirements, and effectiveness to minimize damage from flooding events in the near- and short-term.

Action 5. Constructing a levee or floodwall is recommended only in the scenarios that flooding impairs the function of the existing plant and a new WWTP cannot be constructed within an adequate timeframe. Construction of a new, relocated WWTP would allow for improvements to the treatment process to produce reclaimed water whereas the existing site is not likely to be feasible for reclaimed water production due to limited footprint. Therefore, the level of investment the Town places into the existing site needs to consider future treatment goals. If the Town decides that improvements to the existing treatment process are not a priority, construction of a levee or floodwall may be a more appealing option. Any proposed structure would be designed to reduce potential impacts to existing habitat, though impacts appear to be limited.

Action 6. Raise existing WWTP elevation is not recommended due to concerns with existing structures being able to accommodate an increased load from both wall extensions and soils pressures. A thorough assessment of WWTP structures would need to be completed to identify the structures that can be elevated, as not all slab-on-grade buildings can be raised and some of them might have to be demolished and rebuilt. This action involves a high initial construction cost, increased maintenance costs over time, and long permitting timelines. Additionally, investments in the existing WWTP would affect potential long-term improvements due to limited available footprint.

Action 7. New WWTP is preferred, since the construction of a WWTP at a new location is the most effective long-term solution to SLR. Although the cost of constructing the WWTP is high and involves an extensive permitting process, this is a favorable option to deal with chronic flooding and ongoing SLR. The high cost can be managed by splitting the project into various phases. From an environmental perspective, constructing a new WWTP is beneficial as reclaimed water can be produced, which would reduce Town's reliance on well water for irrigation purposes, and potentially allow for aquifer recharge. The existing WWTP could be decommissioned after the new WWTP is fully operational, which would allow for the possibility of shore enhancement and expansion of recreational space.

The construction of a new WWTP requires a substantial number of permits and regulatory processes including but not limited to a NPDES permit from Ecology, a Washington State Environmental Policy Act (SEPA) process, State Environmental Review Process (SERP), building permit(s), electrical permit(s), floodplain permit, construction stormwater permit, a complete Environmental Impact Statement and a biological assessment. The construction of a new outfall would require a Joint Aquatic Resources Permit Application (JARPA) process.

ACTION PLAN

Future planning studies and actions occurring for all planning horizons should account for ongoing SLR. Capital improvements or WWTP upgrades should incorporate resilience to SLR and should consider long-term plans for the Town's treatment goals. In the near-term, the Town should prepare (or modify existing) emergency

response plans and standard operating procedures for WWTP to handle extreme weather events or high-water events exacerbated by SLR.

In the mid-term, actions should be taken to floodproof low-lying facilities within the WWTP to reduce damage if flooding occurs. A detailed assessment of the WWTP should occur to understand what specific floodproofing actions would be most effective for each component of the system. Improvement may include enhancing or expanding structure foundations, sealing openings, and constructing waterproof enclosures for essential equipment. If flooding becomes problematic and floodproofing of the plant does not provide adequate protection, the Town should construct a levee or floodwall around the existing plant. This could occur in conjunction with improvements to the adjacent boat ramp.

Additionally in the mid-term, the Town should begin planning, designing, permitting, and construction of a new WWTP to treat a portion of flows from the south side of Town (Figure 32). The new WWTP would produce reclaimed water for reuse or aquifer recharge and would be Phase 1 of an expansion. The new WWTP would be designed to treat all of the Town’s flows in phases, which requires careful planning and design around the collection system to ensure that improvements are constructed and sequenced in a feasible manner.

In the long-term, executing plans for conversion of a new WWTP to treat all wastewater from service area should be completed as the second phase of the project. This will entail decommissioning of the existing WWTP and converting it to a pump station as needed to convey flows to the new WWTP. The new pump station will need to be designed to reduce infiltration and inflow, with generator gear and structures placed at an elevation that avoids flooding. This may require a small section of regrading to elevate a pump station. Any remaining land from the WWTP can be used to expand Thomas Coupe Park, maintain access for the boat ramp, and provide enhancement opportunities for the area. Table 11 summarized the proposed Action Plan for the WWTP.

Table 11. Summary of the proposed Action Plan for the wastewater treatment plant.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Plan for SLR in future studies	Recommended	Planning is already a regulatory requirement. Incorporating SLR into planning ensures that any future improvements consider resiliency to SLR.
	Prepare an emergency response plan and standard operating procedures (SOP) for WWTP	Highly Recommended	Added information in existing WWTP SOPs optimizes responses to climate change driven emergencies and helps maintain permit compliance to the maximum extent possible.
Mid-term	Floodproof existing WWTP	Recommended	Floodproof storm drain system and prevent water from backing up onto site. Regrade as needed to prevent flooding to below grade structures.
	New WWTP Phase 1 to treat portion of flows from south side of Town.	Highly Recommended	Site new WWTP with consideration for longer distance piping connections for new outfall and to allow wastewater to be pumped from old WWTP to new.
	Construct levee or floodwall	Recommended on as-needed basis	Only needed if flooding impacts the existing WWTP and a new WWTP cannot be constructed in adequate timeframe to decommission the existing.
Long-term	New WWTP Phase 2 to treat entirety of Town’s flows. Decommission existing WWTP.	Highly Recommended	Consider modifications to collection system when locating new WWTP and developing phasing plan.

4.5 Thomas Coupe Boat Ramp

The Town identified the public boat ramp and appurtenant infrastructure (Figure 33) at Thomas Coupe Park within the 2023 Vulnerability Assessment as priorities for further development of adaptation strategies. The park is a community resource that provides beach and water access for recreational purposes. Additionally, the boat ramp serves as an informal emergency access point for the community (Joshua Engelbrecht, pers. com, August 2024).



Figure 33. Aerial view and context for Thomas Coupe Park (top left) and boat ramp (top right); site photos of boat ramp (bottom left) and deteriorating rock revetment to west of boat ramp (bottom right).

Access to the park and boat ramp exists via a gravel driveway from NE 9th Street that also serves the adjacent WWTP. At the top of the boat launch is a gravel parking and turnaround area that extends to an armored bank at the northwest edge of the property. The existing boat ramp is approximately 145 FT long and 15 to 17 FT wide, as affected in places by concrete blocks and rock armoring. A floating dock anchored by a series of piers runs alongside the boat ramp for approximately 80 FT. Access to the floating dock is provided by a metal gangway measuring approximately 60 FT in length. As the floating dock rises and falls with the tide, metal hinges at the gangway's landward end allow it to rise and fall accordingly until it rests on a series of concrete blocks at low water levels. These hinges connect to a concrete ramp from the gravel parking area.

Previous mitigation activities at the site include rock armoring of the majority of shoreline extending on both sides of the boat ramp. The effectiveness of these revetments has been reduced since their construction (prior to 1977) as rocks have been dislodged and settled down with wave overtopping leading to continued erosion of the bank landward of the revetment. A historical concrete boat ramp and concrete stabilization remain in place on the park's northeastern shoreline, approximately 60 FT south of the primary boat ramp. The concrete at this historical ramp is cracked and broken.

Thomas Coupe Park also provides amenities in its southeastern corner including additional gravel parking, public beach access, picnic tables, and a public bathroom. These amenities are situated among the only remaining trees on the property.

As shown in Figure 34, the existing boat ramp and surrounding infrastructure are threatened by SLR. Several spot elevations are depicted to inform the height of various site features as they relate to previously analyzed SLR scenarios. Under current sea level conditions, the boat ramp is projected to be completely inundated during the MHHW plus 20-year storm surge (elevation 11.8 FT NAVD88). This inundation is projected to increase in the future to the point that nearly the entire gravel parking area would be affected during the 2100 Moderate scenario, and the access driveway would be subjected to flooding during the 2100 High scenario. It appears the most substantial flooding would take place via the low-lying eastern side of the park, including the boat ramp. The western shoreline appears to be at an elevation that would otherwise prevent flooding of the parking area through the 2050 Moderate scenario.

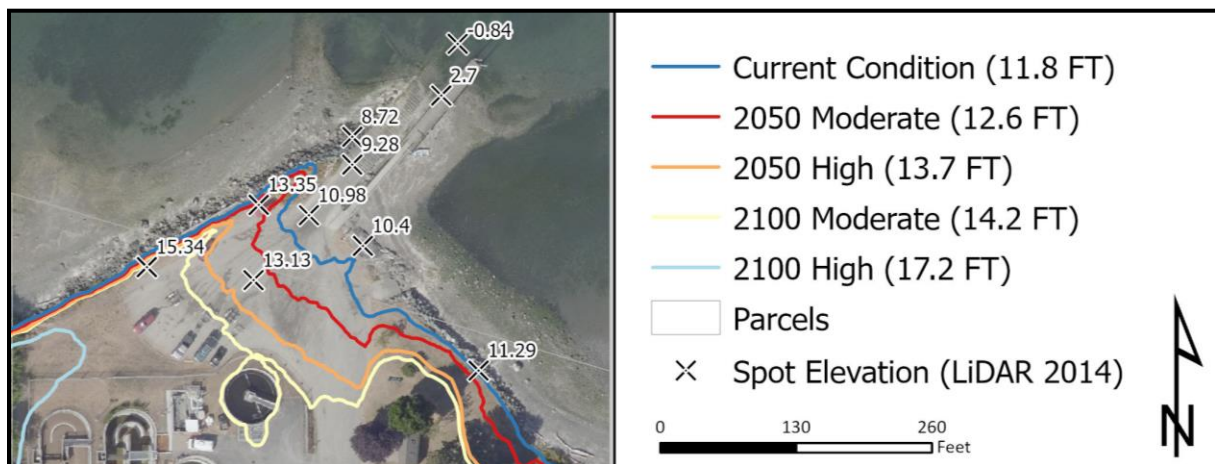


Figure 34. Spot elevations at Thomas Coupe Park with projected shoreline inundation under analyzed sea level rise scenarios.

Shoreline erosion is projected to affect the entirety of the park despite some degree of mitigation enacted by the existing rock revetments. Erosion has already occurred along both the western and eastern banks. The revetments have deteriorated and are not constructed to elevations that account for future storms, wave levels, or future SLR. Overtopping and associated erosion should be expected at an increasing rate, leaving the banks that are currently armored vulnerable without intervention.

The picnic area, public bathroom, and nearby gravel parking are situated on higher ground and only the public bathroom to the east is threatened by the most extreme scenario considered. For this reason, and given that they are not critical assets, this assessment did not focus directly on those park facilities. The Town should initiate planning in some decades for how the services provided by these facilities support public access and how this will be sustained for the long-term.

Priorities & Goals

The goals identified for Thomas Coupe Park, the boat ramp, and the nearby infrastructure center on maintaining their current function as public resources and emergency water access even with projected SLR and shoreline erosion. The boat ramp is not formally part of an emergency response plan for water access at this time; however it appears that this boat ramp is a critical access point in the event of the loss of access to major roads, the Deception Pass Bridge, or WA State Ferry access in the event of a major earthquake, or in a smaller event such as a major windstorm or flood with road blockages. While seeking alternative sites for a public boat ramp

may be worthwhile, such infrastructure is necessarily situated at and in the shore with full water access and these issues cannot be fully avoided.

As a result of anticipated erosion and flooding hazards, a boat ramp in any location will require design to mitigate or adapt to future sea level conditions. Further, while this report discusses the adjacent WWTP separately (Section 4.4), it is important to consider potential efficiencies gained from modifications to the boat ramp and its access, which could provide concurrent protection for the WWTP. If such co-benefits are not achieved, modifications proposed for Thomas Coupe Park and the boat ramp must still function alongside modifications proposed for the plant, and vice-versa.

Action Identification & Evaluation

Three main actions were considered for Thomas Coupe Park and the boat ramp area:

1. No action
2. Maintain the existing boat ramp and surrounding area
3. Extend the boat ramp and modify surrounding infrastructure accordingly

Action 1. No action – With no action taken, the boat ramp may continue to function as it currently does for up to 10-20 years. However, access to the boat ramp may be temporarily or intermittently disrupted during high water events and/or as a result of associated damage. The existing rock revetments have already deteriorated to the point that large sections of bank soil are exposed which are vulnerable to wave attack. A significant present-day storm event could both flood the parking lot and result in erosion that compromises boat ramp access. Additionally, postponing repairs or replacement of site facilities will likely make future work more involved and expensive.

Action 2. Maintain the existing boat ramp and surrounding area – The existing boat ramp appears to be in fair to good condition, with cracks developing in the concrete. Further, the revetment that protects the northwestern side of the ramp has deteriorated resulting in exposed and eroded bank soils. Continued erosion could threaten access to the ramp and/or undermine the ramp itself. Rock revetments would be repaired to provide adequate protection from wave attack and coastal erosion. The highest priority of these maintenance and/or improvement activities would be the western revetment. Maintenance or improvement of the rock revetments could include the placement of additional rock protection, slope angle modification to mitigate wave energy at the bank and to improve the stability of rock/soil, or redesign of the revetments to incorporate nature-based processes.

Maintenance of the boat ramp could be accomplished by sealing existing cracks and any additional cracks that develop to prevent further water seepage and resultant damage. In addition, the Town should consider raising the elevation of revetment crests (moving the crest slightly landward) and underlying berms to protect against exacerbated flooding and erosion expected with SLR. However, the boat ramp would remain at its current elevation and would therefore allow flooding into the parking lot and beyond. Further, flooding or flood damage may intermittently disrupt access to and use of the boat ramp, something that would be especially problematic in emergency scenarios.

Action 3. Extend the boat ramp and modify surrounding infrastructure – In order to maintain the current functions of the boat ramp and surrounding area as sea levels rise, the boat ramp will require extension to higher elevations. As a result, the gravel parking lot, turnaround area, and access drive will require modifications to accommodate the extended boat ramp. Physical constraints enacted by the shoreline and adjacent WWTP may require reduction of the gravel parking and turnaround area proportional to the additional area necessary for an extended boat ramp and corresponding fill slopes. This action could warrant improvement or modification

of the existing rock revetments as discussed in Action 2 to provide stability and protection from coastal erosion at higher elevations.

Potential actions are summarized in Table 12 and evaluated using STAPLEE criteria and the guiding principles (Section 2.3).

Table 12. Evaluation of potential actions for the Thomas Coupe Boat Ramp using the STAPLEE methodology.

ACTION	SOCIAL	TECHNICAL	ADMIN	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
No Action	Low to moderate acceptance	Not effective	N/A	No permitting constraints	No initial cost, but costs in form of future damages	Negative benefit as shoreline continues to erode	NA	Not recommended
Maintain boat ramp and shoreline	Moderate to high acceptance	Limited effectiveness depending on level of maintenance	Necessitates funding and contractors	Likely permissible based on specific actions taken	Moderate cost depending on level of maintenance	Moderate benefit depending on level of maintenance and improvement	1a, 1c, 4a	Recommended as a near-term measure as future design and planning takes place
Extend boat ramp	High acceptance	Effective, if site constraints allow	Necessitates funding and contractors	Likely permissible	Moderate to high cost depending on scenario targeted	Moderate benefit depending on shoreline stabilization	1a, 1c, 2d, 2g, 3a, 4a, 4f	Recommended, design criteria based on criticality rating and Town priorities

Action 1. No action is not recommended because there is evidence of ongoing erosion along the Thomas Coupe Park shoreline. At a minimum, the Town should protect and maintain the existing boat ramp and nearby revetments if they remain components of the Town’s emergency response plan and/or are determined priorities for the community.

Action 2. Maintain the existing boat ramp and surrounding area is recommended in the near term to address documented revetment deterioration, shoreline erosion, and concrete cracking in the boat ramp itself. It is likely the ramp and surrounding area could then continue to function for several years at its current elevation. However, future SLR and associated issues could undermine the boat ramp’s function as part of the Town’s informal emergency access plan and as a public recreational resource. As such, this action may serve only as a near-term solution depending on the community’s priorities.

Action 3. Extend the boat ramp and modify surrounding infrastructure is recommended if the boat ramp is a part of the Town’s emergency response plan and if the community views the public recreational resource as a priority for the future. An extended boat ramp and corresponding modifications to the surrounding infrastructure could be designed for a range of scenarios based on the site’s determined criticality. Further, modifications to and around the boat ramp could provide concurrent protections for the nearby WWTP.

ACTION PLAN

In the near-term, the Town should discuss and decide on the criticality of the boat ramp at Thomas Coupe Park. If the Town determines protection of this asset is important for emergency operations or because it is a significant resource for the community, it would be beneficial to begin planning for maintenance of the boat ramp and nearby rock revetments. Maintenance activities, such as placement of additional rock, should be considered alongside long-term adaptation measures that could affect the design or utility of near-term actions.

For example, maintenance or improvement of the rock revetments should be carried out in a manner that aligns with potential extension of the boat ramp and raising of the parking and turnaround area.

For the mid-term planning horizon, the Town should perform a cost-benefit analysis for modifications to the boat ramp. Depending on the level of protection desired at the boat ramp, the top of the ramp may require raising by between 1.6 FT (2050 Moderate scenario) and 6.2 FT (2100 High scenario). It may not be necessary or practical to design the boat ramp in its current location to accommodate the 2100 High scenario unless the ramp and surrounding area are designed and modified to provide concurrent protections for the adjacent WWTP.

The existing ramp is composed of two distinct sections. The upper section of the ramp measures approximately 45 FT at an approximate 4% grade and serves as a transition between the lower ramp section and parking/turnaround area. The lower ramp section measures approximately 100 FT at an approximate 10% slope. This 10% slope is slightly lower than the typical range of 12 – 15% noted by Washington State statute (WAC 220-660-39, 2015) and recommended by the Oregon State Marine Board (Oregon State Marine Board, 2011). However, both texts acknowledge that ramp slopes may vary based on site characteristics.

This assessment considered the 2100 Moderate (elevation 14.2 FT NAVD88) scenario as a conservative mid-range design criterion for potential extension of the boat ramp. Figure 35 provides a conceptual depiction of the extended boat ramp and other related site modifications. Assuming the 10% slope is maintained for the lower ramp to reach a “top of ramp” elevation of 14.2 FT, the boat ramp would require extension by about 32 FT. If the maximum slope were applied to the lower section, the extension could be reduced to about 22 FT. The transitional upper ramp would likely still be necessary to account for accessibility standards and to provide a smooth transition between the extended lower ramp and elevated parking and turnaround area. The floating dock would require extension, potentially including additional support piers, allowing for relocation of the existing gangway. The existing piers appear to be relatively new. While more costly, the existing parking and turnaround area could potentially be retained through the construction of retaining walls. However, retaining walls are not recommended in this location because they may ultimately function as seawalls that reduce adaptability of the site and further undermine natural shoreline processes and habitat. Figure 35 depicts potential fill slopes and the resultant reduction in parking/turnaround area.

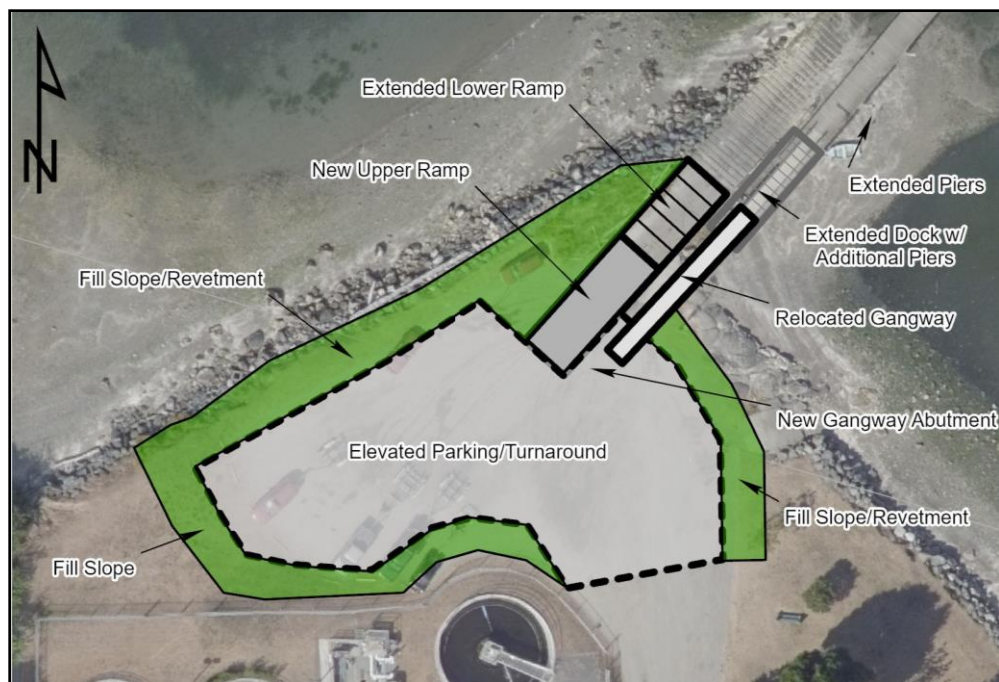


Figure 35. Conceptual depiction of boat ramp extension and associated work at Thomas Coupe Park.

Figure 35 provides a high-level overview of the various site modifications for an extended boat ramp. Planning and design should consider other factors including, but not limited to:

- ▶ Accessibility requirements
- ▶ Level and frequency of parking and access requirements for recreational users
- ▶ Effect modifications to the access road might have on access to the WWTP
- ▶ Effect modifications might have on existing or future emergency plans/procedures
- ▶ Need for debris protection by way of debris deflection boom(s)

While this report discusses Thomas Coupe Park and the public boat ramp separately from the adjacent WWTP, as a mid- to long-term planning objective it will be important to consider how modifications at either site will impact or benefit the other. For example, the extended boat ramp and corresponding raised parking area might provide flood protection for the WWTP. However, raising the parking area will require modifications to the access drive profile that could have implications for access to the WWTP. If necessary, the Town could consider a new access for the boat ramp along the eastern shoreline of Thomas Coupe Park such that the existing WWTP access continues to function as it does currently. Given that the eastern shoreline is currently at a lower elevation than the western shoreline, a new raised access along its edge might double as a flood protection measure for the WWTP. Such modifications would necessarily alter the current nature of the park and public shoreline access. The Town should therefore consider this alongside the determined criticality and level of protection required for the boat ramp extension and access. An alternative would be to raise the boat ramp and access to a specific target scenario based on their criticality, while providing separate flood protection measures for the WWTP based on its respective criticality.

In addition to considerations for how boat ramp modifications might affect the WWTP plant, planning for Thomas Coupe Park should account for the possibility of the WWTP's future relocation. While an action that would take place toward the end of the current planning period, if at all, the removal of this infrastructure at Thomas Coupe Park would provide significant additional space for boat ramp extension and corresponding parking lot modifications.

Table 13 summarizes potential actions and planning horizons identified for mitigation and adaptation measures for the Thomas Coupe Boat Ramp.

Table 13. Summary of the proposed Action Plan for the Thomas Coupe Boat Ramp.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Maintain existing boat ramp	Recommended to prevent additional deterioration of concrete	Could be carried out by Coupeville public works department and should be performed soon
	Maintain and/or improve existing shoreline revetments	Recommended to prevent further deterioration of existing revetments and associated threat to boat ramp/other nearby infrastructure	Permits/design will be required and the decision to maintain hard armor should be made with consideration for what future actions are planned in the area
Mid-term	Extend boat ramp and modify surrounding infrastructure	Recommended based on Town's determination of boat ramp criticality for public use and/or emergency operations	Perform cost-benefit analysis to balance protective actions with current and future costs, consider how extension of the boat ramp and raised parking/turnaround might also provide protection for WWTP
Long-term	Plan for additional boat ramp modifications if WWTP is relocated	Recommended if it becomes clear that WWTP will be relocated	Would provide additional space and flexibility for boat ramp extension/configuration

4.6 Sanitary Sewer Lines

The role of the sanitary sewer system is to convey wastewater to treatment plants without leaking effluent or overflowing through manholes. Leaks or overflow can cause contamination of groundwater or nearby water bodies and can drive slope instability through bank saturation or surface water flow. Additionally, the sewer systems must prevent inflow and infiltration (I/I), which can occur when water enters through cracks in pipes and leaks in manhole covers. Extra water entering the system can put extra pressure and cost on the treatment processes. Cracks in the lines can be caused by a number of issues ranging from aging pipes, root intrusion, clogs, corrosion, poor maintenance, and unstable or shifting ground. Shifting ground through slope failure is the main SLR-related hazard to the Town's sanitary sewer system due to the proximity to the dynamic marine bluffs.

There are approximately 9,000 FT of sewer lines within the 200 FT bluff top buffer within the Town limits. Approximately 1,000 FT of those lines, or over 30% of the Town's sewage, flows under Front Street down to the WWTP. While only 4% of these sewer lines were found to be vulnerable to bluff instability considering the 2050 Moderate scenario, over half (53%) are within the 2100 High scenario plus a 20 FT buffer (Figure 36; Coastal Geologic Services et al., 2023).



Figure 36. Sewer lines within the Town of Coupeville threatened by shore recession under four sea level rise scenarios (Coastal Geologic Services et al., 2023).

Since this utility is a part of an interconnected network, impacts to one part of the system could lead to impacts in other parts of the conveyance system as well as the WWTP so even discrete sections of damage could affect the entire system. However, it is important to acknowledge that this analysis relied on existing and available mapping of the sewer system which may not be spatially accurate across the Town.

Adaptation strategies for this asset are relatively limited due to the configuration of the system. These include multiple forms of bank protection to reduce the risk of bank failure along the location of the sewer lines or relocation/realignment of the lines to increase the setback to the bluff. Sewer lines are not easily moved, and relocation can be costly, however impacts to this asset can affect a large number of people in the Town and therefore careful planning and protection is critical.

Priorities & Goals

It is imperative that the Town works to identify a long-term plan for properly maintaining the functionality of the sanitary sewer lines. If left unaddressed, coastal erosion impacts to the system could lead to significant environmental issues from leaks which would compromise public and ecological health as well as increase the potential for slope instability. Reducing the impacts of SLR hazards on critical infrastructure and utilities, and specifically wastewater was defined as a key priority during the stakeholder and public engagement.

Action Identification & Evaluation

Four main actions were considered for the threatened sewer lines:

1. No action
2. Evaluation and survey of sewer lines
3. Bank protection (hard or soft)
4. Relocation/realignment

Action 1. No action – The sewer lines would continue to function as they currently do. However, present-day storm events including high water and waves undercutting the bank toe, heavy and prolonged rain events that oversaturates the bank, or freeze-thaw cycles could induce a bank failure that directly impacts the sewer lines (as well as the roads). Ongoing maintenance and repair would need to continue.

Action 2. Evaluate and survey sewer lines – This would involve conducting a spatial survey to better constrain the location of the sewer lines, especially adjacent to the bluffs. Since it appears that the current mapping may be simplified from real-life conditions, this would help identify and narrow down the most threatened, or closest segments to the bluff crest. This may be conducted by surveying the sewer manholes along the roads, which could be accomplished without significant effort using a high-quality GPS device.

Additionally, evaluating the condition of the sewer lines would also help inform future decision making. For example, if a section of the lines is already exhibiting issues and may need to be replaced in the near future, it would be advantageous to consider replacing the line farther landward. This would depend on other factors such as what buildings the line services and the overall configuration of the system, but with any major repairs to parts of the system, planning for longer-term impacts of natural bank erosion and SLR should be considered such that infrastructure is not being replaced or substantially repaired in at-risk locations. To evaluate a municipality's sewer line system, a comprehensive assessment is typically conducted using a combination of methods including CCTV (closed circuit television), flow monitoring, smoke testing, manhole inspections, GIS mapping, and analysis of infiltration/inflow. Creating a digital map of the sewer system, including pipe size, material, location, and elevation will facilitate planning. Consideration of factors like pipe material, age, condition, and potential future developments can be used to identify areas of concern and periodize repairs and/or upgrades.

Action 3. Bank protection (soft, hybrid, hard) – The biggest hazard to the sewer lines is bank recession and failures along the bluff of NE Front Street. This hazard is also the primary hazard to the at-risk road segments and overwater buildings and therefore the series of possible bank protection actions that were developed within Section 4.2 applies to this asset as well. Briefly, these include soft shore protection with the placement of beach

nourishment material at the bluff toe and/or a series of attached spits, a hybrid soft and hard shore protection design that would include a series of rock drift sills and beach nourishment, or hard shore protection which would involve a series of rock revetments or vertical walls with beach nourishment at the toe.

Action 4. Relocation/realignment – This would include physically moving existing sewer lines further inland, such as on the landward side of the NE Front Street and NW, NE 9th Street, and NW Madrona Way. Other sections may only need to be realigned, such as the end of NE Leach Street and the western end of NW Front Street since they appear to bend toward the bluff crest. The section of sewer line on NW Front Street, to the west of the Wharf where the road has been turned into a trail, should be evaluated to see if it has or can be decommissioned. The residences and businesses between NE Alexander Street and Colburn may be able to be connected to the system via the line under NW Coveland Street if they are in fact serviced by the line along NW Front Street. Implementation would include assessment to determine the best location to relocate the lines, carefully excavating the existing pipes and digging new trenches further inland, installing new pipes in the new trenches and connected to the existing system, and then properly backfilling and restoring the excavated sites.

Potential actions are summarized in Table 14 and evaluated using STAPLEE criteria and the guiding principles (Section 2.3).

Table 14. Evaluation of potential actions for the sewer lines using the STAPLEE methodology.

ACTION	SOCIAL	TECHNICAL	ADMINISTRATIVE	LEGAL	ECONOMIC	ENVIRONMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
No Action	Low	Not effective	None	NA	No initial cost, short to long-term maintenance and damage cost	Possible negative benefit if system is damaged	NA	Not recommended due to present vulnerability and costs increasing long-term
Evaluate and Survey System	High	Limited effectiveness at directly addressing problem, but would aid in planning	Public works could lead	NA	Low cost	No benefit	2g	Recommended for near term in conjunction with other actions
Soft Shore Protection	Moderate	Effective but not permanent	Necessitates funding and contractors	Likely permissible	Moderate cost	Highest benefit	1a, 1d, 1e, 2b, 2e, 4a, 4b	Recommended in some areas with additional feasibility study needed; likely not a long-term solution
Hybrid Soft and Hard Shore Protection	Moderate	Effective but not permanent	Necessitates funding and contractors	May not be permissible	Moderate to high cost	Moderate benefit	2b, 2d, 2f, 4a, 4b, 4f	Recommended over hard shore protection where feasible, lower cost and likely more favorable for environmental permitting than hard shore protection
Hard Shore Protection	Low-Moderate	Effective in near- to mid-term, reduced effectiveness in future	Necessitates funding and contractors	May not be permissible	High cost	Negative benefit	1a, 1e, 2b, 4a	Recommended if only feasible option for immovable critical infrastructure and assets, i.e., soft and hybrid solutions deemed ineffective
Relocation/Realignment	Low-Moderate	Most effective long-term	Public works could lead, necessitates funding	Likely permissible	Moderate to high cost	Moderate benefit	1a, 1e, 2c, 2d, 2g, 3a, 3d, 4a, 4f	Recommended as mid- to long-term solution for some road sections, may not be feasible for others

Action 1. No action is not recommended because the sewer lines are considered critical infrastructure and are vulnerable to current and future hazards including slope instability. The Town needs to protect and maintain the functionality of the system in the short and long term.

Action 2. Evaluate and survey system is recommended in the near term to better understand the vulnerability of the system and the priority areas. This will also allow the Town to make informed decisions when considering replacement versus relocation. This action is relatively low-cost and simple and should be conducted before other longer-term actions are taken.

Action 3. Bank protection (soft, hybrid, hard) is recommended if it is confirmed that bluff toe erosion is the major driver of bank instability along the Town core and sewer lines are located well and are identified as directly threatened. We recommend using the least environmentally impactful alternative that will provide the necessary protection. Further evaluation of different types of bank protection is within the Section 4.2 of this report. A soft shore solution such as beach nourishment and the construction of spits would be environmentally friendly and help slow bank toe erosion in the short to medium term but is not considered a long-term solution. This action would require renourishment as periodic maintenance due to the limited supply of natural sediment input locally. A hybrid solution with rock drift sills would be moderately environmentally friendly as compared to hard shore protection and is considered a longer-term solution than soft shore protection. The construction of rock drift sills and import of beach nourishment sediment would help contain placed and natural beach sediment more effectively than spits. Hard shore protection is only recommended as a last resort for existing critical infrastructure due to its negative environmental impacts, higher costs, and difficulty of permitting.

Action 4. Relocation/Realignment is recommended for consideration after the system has been evaluated and surveyed or if any substantial repairs or replacement are necessary. The overwater buildings need to remain connected to the system through lateral pipes, however the main sewer line under Front Street and the short segment close to the bluff on NE 9th Street could be relocated to the landward (south) side of the roads. If survey of the sewer lines reveals line sections are further away from the bank than mapped and in acceptable condition, maintaining them in place and considering the implementation of bank protection is recommended.

ACTION PLAN

In the near term, we recommend surveying and evaluating the sanitary sewer lines within the Town, with a focus on the lines within 200 FT of the bluffs. This includes accurate data for the location of existing sewer infrastructure including lines, pumping stations, monitoring and control facilities, discharges, and overflow areas. Information that would be useful includes the pipe material, age, size, direction of flow, capacity, and general condition of the systems. During this first step, a process for organizing and housing this data should be developed such as in an Asset Management Plan. Any future projects involving the sewer system would require detailed drawings and specifications so this action would make future efforts more efficient. This step should be taken before any significant modifications are made to the system (unless for emergency efforts) and will guide the need for other actions.

The need and appropriate type of bank protection for the bluffs along Front Street should also be further analyzed in the near term. While this high-level report provides general recommendations for types of bank protection, additional engineering analyses and development of detailed designs would be the next step toward pursuing bank protection. This includes geotechnical bluff assessments along specific reaches as well as studies to understand the marine forces acting upon bluffs. This should be followed by a thorough alternatives analysis considering several forms of bank protection. The goal of this step is to develop the least environmentally harmful alternative that would provide the needed protection and be permissible. Once an appropriate design is developed, funding will need to be secured, and permits acquired.

Bank toe protection should be implemented in the short to mid-term to protect the sewer lines as well as the historic buildings and roads. Simpler actions such as beach nourishment, or the import of sediment to the upper beach, could be implemented in the short term. More technically challenging solutions, including a hybrid solution with rock drift sills or a hard armor solution, will take additional time to design, permit, and construct.

Relocation or realignment of the sewer lines of the most vulnerable sections of the sewer lines should occur in the mid-term. This action will take a significant amount of coordination and funds, so planning should start once the system is evaluated and vulnerable areas are more precisely identified.

In the mid to long-term, maintenance of bank protection will be necessary including actions such as maintenance beach nourishment, enlarging drift sills and/or improving hard armor. Due to the limited sediment input into the beach system, ongoing beach nourishment is likely necessary on a regular but infrequent basis (once every 15-25 years or so).

In the long term, additional sections of the sewer lines should be relocated or realigned to gradually remove this system from hazardous areas. Bluff recession will continue to occur to some degree along the Town's bluffs even with bank toe protection, so the most cost-effective solution will likely be relocating parts of the system where needed. Table 15 summarizes potential actions and planning horizons identified for mitigation and adaptation measures for the Thomas Coupe Boat Ramp.

Table 15. Summary of the proposed Action Plan for the sanitary sewer lines.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Evaluate and survey system	Recommended to more precisely understand the vulnerability of the system and make informed decisions on adaptation measures.	Factors to consider during evaluation include pipe material, age, size, and slope as well as joint conditions and ground conditions such as ground movement impacting the sewer system.
	Soft shore protection	Recommend additional feasibility study for applicability of soft shore protection (beach nourishment) versus hybrid solution (in combination with roads near bank edge)	Feasibility study should consider effectiveness, cost, difficulty to permit, and the effects to the environment. Not effective if bluff toe erosion not primary driver of erosion, may need to be modified with ongoing SLR or maintained on periodic basis.
Mid-term	Soft shore protection	Intermittent (although infrequent) beach nourishment as necessary to protect bluff toe if action implemented.	Same considerations as above
	Hybrid shore protection	Recommend additional feasibility on construction of series of drift sills and beach nourishment to protect bluff toe	Stronger consideration if planning timeline for long-term solutions extends toward 2050, will need to recreate existing intertidal habitat and/or mitigate on site or nearby
	Relocation/Realignment	Will be required in mid-term timeline without shore protection or decommissioning of most vulnerable sections	Could be carried out as a short or mid-term measure, but emphasis should be placed on relocation and/or decommissioning most vulnerable segments as determined during evaluation of system in the near-term
Long-term	Relocation/Realignment	Relocate or realign segments as necessary in the future	Will require utility coordination, increased costs to relocate system

4.7 Moore Place Neighborhood

The Moore Place neighborhood⁵ on the eastern side of Coupeville is threatened by current coastal flooding, storms and related hazards which will be exacerbated with ongoing SLR. The neighborhood of approximately a dozen parcels is accessed by a series of individual private driveways and NE Moore Place which extends north from NE Parker Road. NE Moore Place and private driveways traverse down a forested slope to a generally unforested low-lying and flat area near Penn Cove.

This area is considered an accretionary shoreform composed of Holocene-aged beach deposits, which indicates that it has historically been an area of deposition and developed waterward of the original coastline. Bluff recession and sediment transport from local bluffs, such as from bluffs at nearby Lovejoy Point, contributes the majority of beach sediment to this shore reach through net shore-drift processes. The shore is predominantly unarmored with a small amount of armor mapped on the western edge of the neighborhood (Coastal Geologic Services, 2017). This armor appears fairly old (at least since 1993 based on imagery) and constructed out of vertical and horizontal wood pilings (Figure 37). Most of the upper shore contains a slightly elevated backshore berm composed of beach sediment, a wide band of drift logs, and backshore vegetation with a slightly lower landward side composed of lawn grass in the adjacent uplands. A derelict concrete boat ramp extends from the central shoreline which appears to partially interrupt natural sediment transport from west to east, with indication of sediment built up on the west side of the upper boat ramp structure (Figure 37).



Figure 37. Oblique imagery of the Moore Place neighborhood from 2020 (Island County).

The main threat to this neighborhood is direct impacts from marine inundation. Four private structures were identified as being at risk of inundation during the 2050 Moderate scenario, one of which is registered as a historic building (Figure 38). Two homes are at slightly higher elevations with the main homes being threatened by the 2050 High scenario and the detached garages located further landward threatened during the 2100 High scenario. Another detached and relatively large outbuilding is threatened by the 2100 Moderate scenario. While we do not have mapping of the septic infrastructure, it is assumed that there are septic drainfields that are also in danger of inundation by current and future storm events in this neighborhood. Investigation of the septic records on the Island County website revealed that most of the parcels were marked as having no as-builts on file or drainfield reserve areas established, likely because a reserve area was not required at the time of construction. The status of the septic systems available were either “deficient” or “OK”. Some reports also noted

⁵ This area was identified as the “Parker Road Neighborhood” in the 2023 Vulnerability Assessment.

that the properties are vacation houses, so the systems are used lightly. Inundation of septic drainfields can pose a water quality issue or damage this type of system.

It is important to note that the 2023 Vulnerability Assessment did not include information on individual structure foundation elevations and instead considered a structure at risk of flooding if the ground elevation around structure was projected to be inundated based on the most recent and available topographic data. Some structures or drainfields may be elevated, which would decrease their risk of flooding and should be evaluated at the individual property level scale.

Five structures have a setback to backshore area of less than 20 FT with two of these homes having essentially no setback to the shore. This puts these structures at risk of shore recession as well as damage from floating drift logs and other debris during storms or high-water events in current conditions.

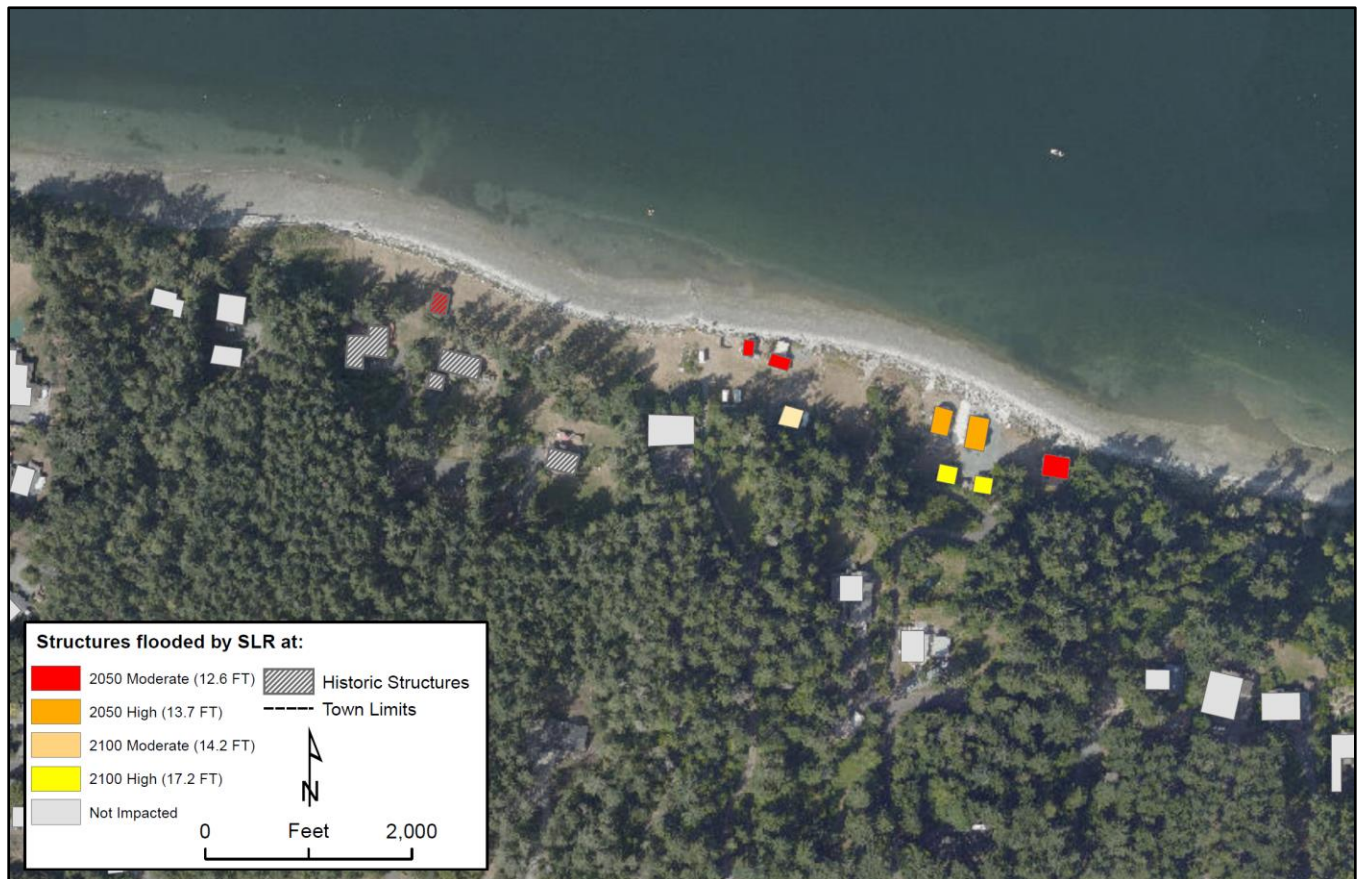


Figure 38. Structures flooded by four sea level rise scenarios with storm surge at MHW within the Moore Place neighborhood (Coastal Geologic Services et al., 2023).

There are a range of possible adaptation actions to mitigate impacts from current and future storms and ongoing SLR for the Moore Place neighborhood. These include vegetation and drainage management and enhancement, soft shore protection (e.g., construction of a berm), hard armoring (seawall or bulkhead), and structure relocation and/or elevation. Hybrid approaches should be considered, where multiple actions are implemented.

Priorities & Goals

The ideal adaptation strategy for this neighborhood would be one that allows for continued current uses of the properties into the future while reducing the risk to existing infrastructure and preserving or enhancing

nearshore processes and habitat. While each property contains unique characteristics, management on one property inherently affects surrounding properties. In addition, solutions are typically far more physically and cost effective if completed at the neighborhood or community level rather than at the individual parcel scale. Coordination and planning between property owners in this neighborhood should be a primary goal when seeking to improve the resiliency of this neighborhood from the ongoing risk of natural hazards and climate related impacts such as SLR. For example, if one neighbor decides to build a seawall to combat flooding, it is likely that flood waters will still enter the property from neighboring properties.

Action Identification & Evaluation

Four main actions were considered for this specific asset:

1. No action
2. Passive management techniques
3. Soft shore protection
4. Hard shore protection
5. Structure elevation or relocation +/- soft shore protection

Action 1. No action – would simply be a continuation of the present conditions leaving several structures vulnerable to flooding during current storm and high-water events such as the high-water event that occurred on December 27, 2022. Flood related impacts would continue to occur such as damage to infrastructure from water damage to foundations and lower living levels, drift logs impacting structures, and potential damage to septic infrastructure. Predicted increased storminess in the region may also increase the rate of shore recession, creating reduced structure setbacks. These impacts will progress in frequency and severity with SLR and other climate related hazards such as increased heavy rain events.

Action 2. Passive management – would include enhancing vegetation along the shore and in the upland areas. This option alone would not be adequate to stop flooding and coastal erosion, but it is a relatively simple action that would provide a small amount of flood protection and slow erosion while enhancing nearshore habitats. Specifically creating or enhancing backshore vegetation through the planting of native vegetation.

Action 3. Structure elevation or relocation +/- soft shore protection – the ideal long-term management solution for the neighborhood that would protect the homes as well as enhance coastal processes and nearshore habitats is to either relocate the at-risk structures to higher ground or elevate the structures in place if adequate setback is present, while at the same time considering an enhanced backshore berm using gravel, sand, and vegetation. Each structure and property configuration would need to be evaluated separately in terms of erosion rate and coastal geomorphic process by a licensed professional geologist. The age, construction type, and configuration of each structure could be assessed by a qualified professional experienced in structural elevation (e.g., Nickel Brothers, D.B. David LLC, locally) to understand if elevation or relocation is possible. In some cases, single story homes without basements are relatively simple to elevate or relocate whereas older and larger homes or homes on a slab or with basements can be more challenging or infeasible to modify substantially. In those cases, it may be more efficient to build a new structure. It appears that most structures in this neighborhood are smaller single-story cabins and may be relatively simple to elevate or relocate. Coordinating all interested neighbors to have a company evaluate the feasibility and cost of elevating or relocating homes and performing the work at the same time would provide some efficiencies.

Structure relocation should be considered in conjunction with elevation, especially for the structures that are 30 FT or less from the backshore area. Relocation alone in the lower area of the parcels will not be sufficient to protect against flooding since the area is mostly below 12 FT elevation, but relocation will help mitigate the risks posed by erosion and direct wave action during storms. Several parcels also extend south and include high

elevation forested uplands. Relocating structures to higher elevation areas or rebuilding would provide the longest-term solution for those properties.

Structure elevation and relocation is becoming more common in the greater Puget Sound area (Kinney et al., 2021) and offers owners more security and the ability to work on other long-term issues. Structure elevation may also allow habitats like beaches to migrate landward through time and with SLR. This action would be permissible as agencies at all levels are wanting property owners to be proactive to increase their resilience to climate-related hazards.

Soft shore protection techniques could occur at the same time as elevating/relocating the structures and may include beach nourishment (placement of imported sediment), placement or anchoring of large wood, and revegetation. If a soft shore berm were constructed, it would likely be located on the landward edge of the natural berm and ideally span the entire neighborhood or a long length (100’s of FT). Removal of the existing shore armor should be investigated with this option.

Action 3. Hard Shore Protection – Town, county, state and federal codes have become exceedingly more stringent on shore armor construction. Permits are required from the Washington Department of Fish and Wildlife (WDFW), the Town of Coupeville, and possibly federal permitting depending on the waterward extent of the structure. It would be difficult and very expensive to permit a bulkhead through all three of these agencies as typically the purpose of a bulkhead is to prevent erosion and not coastal flooding, which appears to be the primary cause for concern. A true flood protection wall would require a structure extending in front and around all sides and would need to be made of concrete or other impervious materials with appropriate drainage. Other types of shore armor such as rock walls or revetments would not provide flood protection as water can move through these structures.

Based on our experience and knowledge of current regulations, a formal flood protection structure would likely not be permissible on the property. Agencies only permit the least environmentally impactful alternative that is appropriate for the issues. Therefore, property owners would be required to consider structure elevation, structure relocation, and soft shore protection before any form of hard armor were allowed.

Potential actions are summarized in Table 16 and evaluated using STAPLEE criteria and the guiding principles (Section 2.3).

Table 16. Evaluation of potential actions for the Moore Place neighborhood using the STAPLEE methodology.

ACTION	SOCIAL	TECHNICAL	ADMIN	LEGAL	ECONOMIC	ENVIORNMENTAL	GUIDING PRINCIPLES	RECOMMENDATION
No Action	Moderate	Not effective	NA	NA	No initial cost – short to long-term maintenance and damage cost	No benefit, negative benefit depending on septic infrastructure damage	NA	No recommended
Passive Management	High	Limited effectiveness	NA	Permittable	Low cost	Moderate benefit	1d, 1f, 2b, 2e, 4b	Recommended in short-term or in conjunction with other actions such as relocation/elevation of structures
Structure relocation or elevation +/- soft shore protection	High	Most effective	NA	Permittable	Moderate-high initial cost, little to no long-term cost	Highest benefit	1d, 1f, 2b, 2d, 2e, 2g, 3a, 2b, 4f	Recommended for mid- to long- term use of properties

Hard shore armor	Low	Not effective long-term, may not be effective for near-term flooding	NA	May not be permissible	High cost upfront, ongoing maintenance	Harmful to environment	1f, 2b	Not recommended as it will only provide erosion protection in the short term and some flood protection, negative impact to nearshore habitat and natural coastal processes.
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Action 1. No action was not selected because this would not solve the issue of flooding and would also not allow nearshore habitats to migrate landward with ongoing SLR. At a minimum, property owners should have their septic systems evaluated, investigate establishing a community-wide septic drainfield reserve area for future efforts, as well as develop an emergency response plan for large storm and flood events.

Action 2. Passive management in the form of vegetation enhancement is recommended in the near-term to provide a small level of flood and erosion protection with a relatively low amount of effort and cost. This could be targeted to lower and less vegetated areas of the backshore or conducted across the whole neighborhood. This action alone will not solve the issue of flooding in the short or long term but will increase the natural resiliency of the shore.

Action 3. Structure relocation or elevation +/- soft shore protection is the preferred mid-to long-term solution for the neighborhood. This would provide the maximum protection for existing structures and allow the shoreline to move dynamically with time. While specific analysis is necessary for each structure, generally, structures located within 30 FT of the OHWM should be relocated and elevated, while those further back may be elevated in place. Elevating in place or moving septic drainfields to higher ground should be accompanied with this action. A community septic drainfield could be constructed which may prove to be more cost effective than each property owner working individually.

Action 4. Hard shore armor is not recommended because it would be technically challenging to provide long-term flood protection. Coastal flood water tends to find ways around fixed, narrow structures, whether it is around the ends, through wave overtopping, or simply through the porous gravelly ground and elevated groundwater tables. Additionally, it would be very expensive to build and would most likely not be permissible. Seawall and other forms of shore armor are not a long-term solution in light of SLR, and therefore it would be more practical and effective to elevate and/or relocate the existing structures.

ACTION PLAN

In the near-term, the action of enhancing native vegetation near the beach berm would help with erosion control and may enhance natural sediment accretion. Species such as native dunegrass (*Leymus mollis*) helps retain sediment through its extensive root network as well as to trap drift logs which also help raise the elevation of the beach. Other appropriate species to add in the backshore area include species that match the native species growing successfully nearby and those that have some degree of salt tolerance. These include species such as Nootka rose (*Rosa nutkana*), snowberry (*Symphoricarpos albus*), ocean spray (*Holodiscus discolor*), and shore pine (*Pinus contorta*). The grassy lawn areas would also benefit from planting more erosion-resistant vegetation consisting of native groundcovers, shrubs, and trees. Replacing grass in these areas would add root strength, help intercept rainfall and runoff (Gray and Sotir, 1996; Menashe, 1993) and increase evapotranspiration as well as provide habitat benefits such as improved riparian to marine connection (Brennan, 2007).

We also advise conducting a study to understand the need for soft shore protection in the near term if erosion has been an issue in recent years. The study should be conducted by a qualified professional such as a licensed geologist and should help to understand if and what type of protection is necessary and the least

environmentally impactful. Hiring a septic system professional to conduct an assessment of existing systems as well as the feasibility of constructing a community drainfield that would be resilient to flooding is recommended.

More generally, we recommend limiting development or substantial redevelopment in current and future flood areas in the near- to long-term due to ongoing SLR. Limiting the amount of development in this low-lying area will help reduce the risk of future damages and limit environmental impacts. More intensive development in this vulnerable area would not be advisable and could begin to reduce adaptation option or make adaption more costly and difficult.

In the near- to mid-term, elevation and relocation of structures is the most critical element of preventing future damage. The elevation that structures should be raised to needs to be evaluated based on the local planning codes (currently 1 FT above BFE is the minimum code requirement), FEMA 100-year flood base flood elevation, SLR projections, storm surge, waves, the properties owners risk tolerance, and the planned longevity of the structure. This neighborhood is in FEMA flood Zone AE 14 FT (NAVD88), which is the designation for high-risk flood zone where there is a 1% change of flooding each year or a 26% chance over the life of a 30-year mortgage—in past conditions without considering SLR or changes in forces affecting the properties. Building in one of these high-risk zones comes with numerous regulations including but not limited to the lowest floor in the structure being built at or above the base flood elevation (14 FT NAVD88). Based on the 2023 Vulnerability Assessment, the combination of current water levels, SLR projections, and storm surge is predicted to cause inundation at elevation between 12.6 FT and 13.7 FT by 2050, and 14.2 and 17.2 FT by 2100, based on the high emissions scenario (RCP 8.5).

Taking a conservative approach to planning for longer planning horizons and higher SLR scenarios is advised to provide greater long-term protection of structures and homeowner peace of mind. The difference in price between elevating the house just one foot versus several or more feet is not substantial and mostly depends largely on the cost of rebuilding the foundation and utility hookups. Septic drainfields can also be elevated or relocated and that should be considered in any substantial septic work or when building a new system.

Soft shore protection solutions would be beneficial to reduce erosion and some amount of flooding (depending on how it was designed) along with relocation and/or elevation but would not be a formal flood protection solution. Therefore, we recommend relocation and elevation in conjunction with soft shore techniques. Further studies to assess existing conditions and shore erosion or accretion patterns would be beneficial to understand the need for a soft shore protection berm.

In the long term, the continued use of the waterfront properties in the Moore Place area could require significant actions using a combination of the above actions. A high amount of SLR would likely require significant landward relocation combined with a more landward and higher backshore berm to try to avoid having to abandon the low elevation portions of these properties. Moving to the more landward and higher elevation areas of the properties may be needed to avoid excessive amounts of work and maintenance and negative effects of continued protection of these structures. Table 17 summarizes potential actions and planning horizons identified for mitigation and adaptation measures for the Moore Place neighborhood.

Table 17. Summary of the proposed Action Plan for the Moore Place neighborhood.

PLANNING HORIZON	ACTION	RECOMMENDATION	KEY CONSIDERATIONS
Near-term	Passive management through vegetation enhancement	Plant additional native species along the backshore across the neighborhood, replace as much grass as possible.	Plant species should be appropriate for the area, including salt tolerant. Target planting species that help bind soil and trap sand such as native dunegrass, Nookta rose, and snowberry. Consider seeking input from qualified landscape professional.
	Evaluate septic systems within the neighborhood	Hire qualified professionals to evaluate septic systems across the community and provide recommendations to improve system and possibly detail plan to construct a community septic system.	Evaluation should consider elevating drianfields, relocating to high ground, and locations of septic reserve or community drainfield location for future planning.
	Coordinate assessment of structures by professionals experienced in structure relocation and elevation	Recommend having a company experienced in structure relocation and elevation assess the feasibility and cost of elevating or moving structures.	Efficiencies such as cost savings if multiple homeowners decided to relocate or raise structures at the same time.
	Evaluate feasibility and need for soft shore protection	Recommend conducting a study to understand the need for shore protection. This is typically done by a licensed geologist.	Study should evaluate if structures are at risk from erosion in the near-term, and if so, what is the least environmentally impactful solution appropriate. Typically, the longer, or more properties included in shoreline protection, the more effective, permissible, and cost efficient.
	Limit development or substantial redevelopment in current and future flood areas	Recommended to limit damage to improvements from current and future flooding.	New or substantial redevelopment within this neighborhood should consider SLR projects in design.
Mid-term	Structure elevation and/or relocation of at-risk structures and septic systems	Recommended to reduce damage to existing structures as well as limit impacts to local water quality.	Where or how much a structure is raised to should consider current and future predicted flood levels with SLR, storm surge, and waves.
	Construct soft shore protection berm if deemed necessary	Recommended if shore erosion is deemed a significant issue along this stretch of shore.	Soft shore protection will help slow erosion but are typically not designed to stop flooding.
Long-term	Structure relocation or rebuilding in nearby uplands and abandonment of low-lying structures	Recommended if feasible locations exists or if structures are substantially damaged.	Rebuilding in the uplands would provide an opportunity to restore shoreline areas and improve habitat conditions.

5 PUBLIC ENGAGEMENT SUMMARY

The development of the Town of Coupeville’s Climate Adaptation Strategy (CAS) included a robust community and stakeholder engagement process to align the plan with local values, priorities, and knowledge led by Maul Foster & Alongi. Engagement efforts focused on informing the public about the CAS, involving a diverse range of voices in its development, and gathering input on guiding principles, goals, and adaptation strategies. This input was integrated with technical analysis to develop a balanced and feasible strategy for protecting the Town’s assets most vulnerable to sea level rise and related coastal hazards.

Between May 2024 and May 2025, the Town own Coupeville (Town) led multiple engagement activities, including meetings with the Coupeville Climate Committee (CCC), two public open houses, a community survey, and targeted outreach to Tribes and stakeholders. These forums offered residents, business owners, environmental groups, and others the chance to review draft goals and strategies, share their support and concerns, and propose priorities.

Key themes from early engagement emphasized the importance of protecting critical infrastructure, historic buildings, natural habitats, and transportation networks, while also prioritizing equity, community participation, and long-term sustainability. This feedback shaped the CAS’s guiding principles and goals, which stress proactive planning, cross-sector coordination, and flexible strategies that can respond to evolving climate risks and community needs.

Later input focused on adaptation strategies for specific assets. Community preferences generally favored hybrid or soft shore protection methods in residential areas, lane reduction for certain roadways, floodproofing or hard armoring for historic buildings, and floodproofing or relocating the wastewater plant.

Participants stressed the need to evaluate each asset individually and avoid one-size-fits-all solutions. Mixed feedback on strategies for certain assets, such as historic overwater buildings, highlighted the need for further collaboration, flexibility, and feasibility assessments prior to implementing strategies.

Community input played a key role in shaping the CAS recommendations to reflect local values while drawing on technical expertise. Moving forward, the Town is committed to ongoing engagement to adapt the CAS as new information and circumstances arise.

See attached Engagement Report for more details (Maul Foster & Alongi, 2024).

6 POSSIBLE FUNDING SOURCES

The Town and its residents should seek to utilize external funding sources as much as possible to implement this Coastal Adaptation Strategy. Investing in the increased resiliency of the Town will help avoid future climate related costs and impacts to the community and will bring other benefits such as improved public health, job/economic security, and a more livable community. Currently the Town relies on grants from the state (Transportation Improvement Program (TIP), WSDOT) for construction projects and has obtained FEMA grants related to the Town’s water lines as well as USDA loans when needed. Funding and financing sources to explore include:

- ▶ Town general funds
- ▶ Bonds
- ▶ Taxes, fees, and utility revenues
- ▶ Federal and state grants
- ▶ Private grants/investments and public/private partnerships

- ▶ Revolving loan funds

Note that at the time of the assessment, there is significant uncertainty about the continuity of federal grant programs focused on climate resilience, and that some of these listed may cease to exist, be in the process of being cancelled, or change focus.

Federal Funding:

- ▶ [FEMA Flood Mitigation Assistance \(FMA\) Program](#): Funds to reduce risk of flooding damage to buildings insured under the National Flood Insurance Program.
- ▶ [FEMA Hazard Mitigation Assistance Grants](#): Funds to eligible mitigation measures that reduce disaster losses. Can also assist with the acquisition of at-risk properties.
- ▶ [FEMA Building Resilient Infrastructure Communities \(BRIC\)](#): Funds for tribes, local communities, and states to complete hazard mitigation projects. This has recently been cancelled, although it is possible that it could be brought back to some capacity in the future.
- ▶ [EPA Environmental Justice Small Grants Program](#): Supports communities working on solutions to local environmental and public health issues. These grants fund projects up to \$100,000 depending on the availability of funds in a given year.
- ▶ [CZM Habitat Protection and Restoration Competitions](#): Funding focusing on ecosystem conservation and habitat restoration planning, engineering, design and project implementation with key considerations for funding including projects that address climate change through habitat restoration and reconnecting. One more year of funding with the notice of funding opportunity (NOFO) in May or June 2025.
- ▶ [NMFS Transformation Habitat Restoration and Coastal Resilience Grant](#): Supports large scale efforts to sustain fisheries, advance species recovery, and improve climate hazard protections for coastal communities and ecosystems. Supports projects such as building living shorelines and restoring habitat function while protecting communities from impacts of climate change.
- ▶ [NMFS Coastal Habitat Restoration and Resilience Grants for Tribal and Underserved Communities](#): Supports community-driven habitat restoration and helps support the capacity of Tribes and underserved communities to lead their own restoration activities. NOFO Winter 2025.
- ▶ [National Coastal Resilience Fund](#): Fund invests in the implementation of nature-based solutions to enhance coastal communities and ecosystems facing impacts from coastal hazards. NOFO Spring 2025.
- ▶ [PROTECT Discretionary Grant Program](#): Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) is a competitive grant program that prioritizes strengthening ground transportation to be more resilient to natural hazards, including climate change, SLR, flooding, extreme weather, and other natural disasters. Program has two more years left, with \$576M available for this final year and \$300M for the final year in 2026. US DOT to hold a series of webinars for potential applicants to review application processes and prepare a cost-benefit analysis.

- ▶ [Kresge Foundation Environmental Program](#): Helps cities combat and adapt to climate change while advancing racial and economic justice.
- ▶ [EPA Thriving Communities Grant Program](#): Funding to organizations for assessment, planning, and project development activities addressing the unequal impacts of environmental justice issues in local communities throughout the Pacific Northwest.
- ▶ [Climate Smart Communities Initiative](#): Grants for climate adaptation and resilience professionals to create or advance a climate resilience plan in collaboration with a community that is on the frontlines of the climate crisis.

State Funding:

- ▶ [WA Department of Ecology Shoreline Master Program \(SMP\) Competitive Grant Pilot Program](#): Funding for local jurisdictions with a SMP to support projects such as shoreline permit monitoring, channel migration zones studies, improving SMP implementation, climate resilience planning, updating restoration plans, and public access planning.
- ▶ [WA Department of Commerce Growth Management Grants](#): Funds for local jurisdictions for a number of projects that aid community planning and development such as climate planning grants that provide technical assistance to plan for climate change.
- ▶ [Ecology Climate Resilient Riparian Systems Grant](#): EPA awarded Ecology and WA State Conservation Commission \$17M in funding to improve climate resiliency for riparian systems in WRIA 1-19.
- ▶ [Stormwater SIL](#): funding three programs; climate resilience in stormwater, stormwater park and regional facilities planning, and mega-toxics to address toxins in fish.
- ▶ [WA Coastal Restoration and Resilience Initiative \(WCCRI\)](#): goal to proactively address the state’s highest priority restoration and resiliency needs while restoring coastal wetlands and waters, and stimulating economic growth in coastal communities.
- ▶ [The Estuary and Salmon Restoration Program \(ESRP\)](#): ESRP is an RCO-administered program that provides funds for projects and provides technical assistance in the Puget Sound nearshore. The program prioritizes projects that ensure Washington’s nearshore systems are intact and resilient to climate change, with eligible projects including nearshore habitat restoration and conservation. Funding is available on a biannual basis.
- ▶ The Shore Friendly Program: Funding program under ESRP. Shore Friendly priorities are to prevent or remove hard armoring from Puget Sound shoreline. Technical assistance available such as feasibility, design, permitting, and project implementation is offered through this program. The [Island County Shore Friendly](#) program and the [Northwest Straits Foundations Shore Friendly](#) program supports the Town of Coupeville.
- ▶ [WA Department of Archaeology and Historic Preservation](#): Funds projects which preserve or restore historical cultural elements. Various grants, loans, easement and tax credits.

Funding databases are available which include:

- ▶ [National Wildlife Federation Nature-based Solutions Funding Database](#)
- ▶ [Puget Sound Recovery Acceleration Funding Tool](#)
- ▶ [US Climate Resilience Toolkit](#)
- ▶ [Fund Hub WA](#)

Technical assistance for pursuing funding includes:

- ▶ [EPA Environmental Justice Thriving Communities Technical Assistance Program](#): Goal is addressing technical assistance and federal funding needs in underserved communities to meet environmental justice goals. Coupeville is in Region 10 with Philanthropy Northwest based out of UW as the grant makers. To receive assistance, fill out a relatively short google [form](#).
- ▶ [Coastal Hazards Organizational Resilience Team](#) (COHORT): Interagency team (EMD, WSG, Ecology, WSU Extension) to provide technical assistance.

7 CONCLUSIONS

This *Coastal Adaptation Strategy* for the Town of Coupeville provides a science-based, community-informed framework for addressing the challenges posed by sea level rise and coastal hazards. By identifying the Town’s most vulnerable assets – including roads, historic buildings, sewer infrastructure, and public shore access points – the strategy outlines targeted adaptation measures that balance protection, accommodation, and managed retreat. Through a phased approach, Coupeville can implement near-term actions such as retrofitting infrastructure and floodproofing while planning for long-term resilience strategies, including potential relocations of certain assets. Community engagement and collaboration with state and federal agencies will be critical in securing the necessary funding and support to implement these initiatives effectively.

It is important to recognize that this strategy serves as a guiding framework and set of recommendations; however, implementation of specific adaptation actions will ultimately depend on the leadership and engagement of Town staff, residents, and local property and business owners.

Key takeaways from this Coastal Adaptation Strategy are as follows:

- **Sea level rise (SLR) is an ongoing threat** – Coupeville has already experienced measurable sea level rise, and projections indicate significant increases by 2050 and 2100. This will lead to increased coastal flooding, shoreline erosion, and infrastructure vulnerability, over what has already been experienced historically requiring urgent planning and action.
- **Critical assets at risk** – The most vulnerable assets include Town roads (particularly NW Madrona Way and Front Street), historic overwater buildings, sanitary sewer lines, the wastewater treatment plant (WWTP), the Thomas Coupe Boat Ramp, and the Moore Place neighborhood. Each of these assets faces different risks, from bluff erosion to direct inundation.
- **A multi-layered adaptation approach is needed** – The strategy outlines a mix of protection, accommodation, and retreat measures to address sea level rise-related risks. This includes soft shore and hybrid protection (beach nourishment, groins or spits, vegetation management), floodproofing and elevating structures, reinforcing or relocating infrastructure, and implementing zoning regulations to reduce future development in high-risk areas.

- **Infrastructure and historic preservation must be balanced** – Historic buildings are particularly vulnerable to flooding, requiring tailored solutions such as elevation, floodproofing, and rebuilding while maintaining their historical integrity. Meanwhile, critical infrastructure such as the WWTP and sewer lines must be reinforced or eventually relocated to ensure long-term functionality.
- **Planning horizons guide implementation** – The strategy breaks down adaptation actions into near-term (2035), mid-term (2050), and long-term (2100) planning horizons to ensure that actions are phased appropriately based on risk levels and available funding.
- **Community and stakeholder engagement is key** – Since the overwater buildings are central to Coupeville’s identity and economy, engaging property owners, local businesses, and preservation groups will ensure support for adaptation measures. Public-private partnerships may help facilitate funding and coordinated implementation.
- **Proactive planning enhances resilience** – The strategy underlines the importance of regularly updating sea level rise projections and integrating adaptation measures into local planning policies. By taking early action, Coupeville can reduce future costs, protect its cultural and economic assets, and create a more sustainable and resilient coastal community.

8 NEXT STEPS

The following actions represent the most urgent steps necessary to implement this adaptation strategy and protect the Town’s most at-risk assets.

1. **Continue to foster community and stakeholder engagement in resilience planning** – The Town, key stakeholders and potentially the Coupeville Climate Committee should continue to work to find a unified approach for downtown Coupeville and work to implement this strategy. A unified approach will lead to more effective, efficient, and sustainable solutions.
2. **Reinforce and protect vulnerable roads (NW Madrona Way & Front Street)** – Immediate nature-based stabilization measures such as vegetation management and drainage improvements. Planning should begin for potential soft/hybrid bank toe protection measures and road realignments in high-risk areas.
3. **Implement floodproofing for historic overwater buildings** – Property owners should be supported in adopting short-term flood protection measures, such as sealing foundations, using water-resistant materials, and abandoning lower levels.
4. **Conduct site-specific assessments of feasibility of elevating over-water buildings** – Further site-specific assessments by qualified companies should determine if buildings can be elevated or retrofitted for mid and long-term adaptation.
5. **Enhance protection for sewer infrastructure** – The Town should survey and evaluate the sewer lines. Additionally, the Town should install watertight manhole covers and backflow prevention systems to reduce the risk of storm-driven flooding infiltrating the sewer system where appropriate.
6. **Stabilize shorelines with soft shore or hybrid protection measures** – Further evaluate and plan for the use beach nourishment, drift sills, spits, and erosion control plantings for key erosion-prone areas to better understand their effectiveness in reducing shoreline recession and protecting infrastructure.
7. **Secure funding and strengthen policy frameworks** – The Town, businesses, and residents should pursue state and federal grants for climate adaptation, historic preservation, and infrastructure resilience. At the same time, zoning and building codes should be reviewed and updated to integrate SLR adaptation requirements, ensuring future development aligns with climate resilience goals.

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ATTACHMENT

Town of Coupeville Coastal Adaptation Strategy Engagement Report May 2024 – May 2025 (MFA, 2025)

Town of Coupeville Coastal Adaptation Strategy Engagement Report

May 2024 – May 2025

Prepared for:

Natural Systems Design

May 23, 2025

Prepared by:

Maul Foster & Alongi, Inc.

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Appendices

Appendix A

August 26, 2024 CCC Meeting Notes

Appendix B

September 11, 2024 Public Open House Notes

Appendix C

February – April 2025 Survey

Appendix D

February – April 2025 Survey Summary

Appendix E

February 26, 2025 CCC Meeting Notes

Appendix F

April 23, 2025 Public Open House Notes

Appendix G

Written Comments

Summary

The development of the Town of Coupeville's Climate Adaptation Strategy (CAS) included a robust community and stakeholder engagement process to align the plan with local values, priorities, and knowledge. Engagement efforts focused on informing the public about the CAS, involving a diverse range of voices in its development, and gathering input on guiding principles, goals, and adaptation strategies. This input was integrated with technical analysis to develop a balanced and feasible strategy for protecting the Town's assets most vulnerable to sea level rise and related coastal hazards.

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Key themes from early engagement emphasized the importance of protecting critical infrastructure, historic buildings, natural habitats, and transportation networks, while also prioritizing equity, community participation, and long-term sustainability. This feedback shaped the CAS's guiding principles and goals, which stress proactive planning, cross-sector coordination, and flexible strategies that can respond to evolving climate risks and community needs.

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Community input played a key role in shaping the CAS recommendations to reflect local values while drawing on technical expertise. Moving forward, the Town is committed to ongoing engagement to adapt the CAS as new information and circumstances arise.

1 Introduction

As part of its Shoreline Management Program, the Town of Coupeville, Washington (Town), developed a Coastal Adaptation Strategy (CAS) to address the risks posed by sea level rise (SLR) and related coastal hazards. Coupeville hugs the eastern shoreline of Whidbey Island, which is located in Puget Sound, north of Seattle, Washington. Town officials engaged Maul Foster & Alongi, Inc. (MFA) to conduct community outreach and gather input on the SLR adaptation alternatives most preferred for key affected areas in town. This report summarizes the engagement activities conducted and how community input helped shape the resulting strategy.

1.1 Overview of Coastal Adaptation Strategy

The CAS provides a science-based, community-informed framework for addressing the challenges posed by SLR and related coastal hazards. Coupeville has experienced 3.6 inches of SLR over the past 50 years, and projections indicate that both the rate and magnitude of SLR will increase significantly by 2050 and 2100. As sea levels rise, the Town's shoreline faces growing risks from flooding, erosion, and infrastructure vulnerability. With much of the Town's infrastructure, historic buildings, and high valued habitats located near the shoreline, early action is key to preserving the Town's character, functionality, and safety.

Building on the 2023 Coupeville Sea Level Rise Vulnerability Assessment, the CAS outlines a phased approach to mitigating these risks through targeted adaptation strategies for the most at-risk assets. These assets include several road segments and the sewer lines adjacent to them, the wastewater treatment plant, and the historic overwater buildings on NW Front Street.

The CAS was developed by Town planning staff in coordination with consultants from Natural Systems Design (NSD), BHC, and MFA. NSD led the assessment of adaptation strategies and the development of the CAS. BHC provided civil engineering support, while MFA led public engagement efforts.

1.2 Purpose of Engagement

The engagement strategy aimed at ensuring the CAS reflects community values, priorities, and local knowledge. Specifically, it was designed to:

- Inform stakeholders and community members about the progress and outcomes of the CAS process.
- Meaningfully engage a diverse and inclusive group of stakeholders throughout the project.
- Gather input from Coupeville residents, Tribes, and other key stakeholders on the guiding principles, goals, and adaptation strategies.
- Integrate that input into the final CAS to ensure it is grounded in both technical analysis and community perspectives.

2 Engagement Activities

This section summarizes the outreach and engagement efforts led by the Town, with support from the consultant team, to involve stakeholders and community members in the development of the CAS. All engagement activities were conducted between May 2024 and May 2025.

From May to September 2024, engagement activities focused on informing the public about the project and gathering initial input from Coupeville residents, Tribes, and other key stakeholders on coastal adaptation principles, goals, and strategies to help shape the draft CAS. From October 2024 to May 2025, the focus shifted to gathering feedback on the draft adaptation strategies and the overall draft CAS to guide the development of the final version, completed in May 2025. Section 3 of this report summarizes the input and feedback gathered through the engagement opportunities.

2.1 CCC Meetings

The Town convened the Coupeville Climate Committee (CCC)—a group of local residents, business owners, government representatives, and environmental organization staff—to provide guidance on the CAS and other climate planning efforts. The CCC met twice during the CAS development process to review goals, provide feedback on adaptation strategies, and help shape the final plan.

- **August 26, 2024:** The first CCC meeting was held via Zoom and attended by ten members. The Town and consultant team presented the CAS’s purpose, focus areas, and development timeline. Committee members provided input on the draft adaptation goals and guiding principles. A full summary of comments is included in Appendix A.
- **February 26, 2025:** The second CCC meeting was held via Zoom and attended by six members. The Town and the consultant team presented the draft CAS, including background information, adaptation options for specific assets, and recommended action plans. Time was provided for questions and discussion. A full list of questions and comments is included in Appendix E.

2.2 Public Open Houses

Two in-person public open houses were hosted by the Town and the consultant team to gather feedback from the broader Coupeville community:

- **September 11, 2024:** The first open house introduced the CAS and gathered community input on local priorities and concerns. The Town and consultant team presented an overview of the CAS’s purpose, focus areas, and development process, along with a summary of local coastal vulnerabilities. Following the presentation, attendees shared feedback on their concerns, values, and adaptation priorities for Coupeville. Sixteen community members attended. A video recording of the meeting was posted online for public viewing. Meeting notes, including participant feedback, can be found in Appendix B.
- **April 23, 2025:** The second open house focused on gathering feedback to refine the draft CAS. The Town and consultant team provided an overview of the CAS’s purpose and progress and presented the recommended adaptation alternatives included in the draft for each asset under consideration. Following the presentation, attendees asked clarifying questions and shared additional feedback on the proposed alternatives for roads and sewers, the wastewater

treatment plant, and overwater buildings. Eight community members attended. Meeting notes, including participant feedback, are provided in Appendix F.

2.3 Community Survey

Between February 7 and April 3, 2025, a community survey collected input from 71 respondents on preferred SLR adaptation alternatives for key vulnerable areas in Coupeville. Participants could respond online or complete a paper survey, which could be mailed or delivered to the Town's municipal offices. Recruitment efforts included email outreach and distribution of physical flyers, with paper surveys made available at Town Hall. Of the total responses, 70 were submitted online and one was received as a paper survey. The full survey is provided in Appendix C, and the survey results are summarized in Appendix D.

2.4 Tribal Engagement

The Town of Coupeville informed the Stillaguamish and Swinomish Tribes of the CAS project and opportunities for engagement in August 2024 and followed up with an advanced copy of the draft CAS in March 2025. Representatives from the Tribes were invited to attend CCC meetings but indicated they would prefer to engage separately. Town planning staff reached out to representatives from the Stillaguamish and Swinomish Tribes on one additional occasion to coordinate a discussion on the impacts of sea level rise on cultural sites in Coupeville, and best practices for consulting the Tribes when such sites are uncovered. Town staff did not receive a response.

2.5 Stakeholder Conversations

Town planning staff held an additional stakeholder meeting on April 16, 2025 with overwater building and business owners. Seven attendees participated in a discussion of the draft recommended options, sharing their perspectives on the practicality of floodproofing, abandonment, and elevating individual structures. Attendees were interested in hard armor seawall structures as a potential avenue of action, despite several challenges and constraints outlined in the draft CAS.

Town staff also hosted an outreach tent at the Penn Cove Water Festival on May 10, 2025, where they spoke directly with 20 small groups (ranging from 1 to 3 people each) to raise awareness about the availability of the draft CAS for review and comment.

3 Summary of Input

This section provides a summary of the input collected through the engagement activities described in Section 2 and outlines how community feedback shaped the development of the CAS.

3.1 Guiding Principles and Goals

During the August 2024 CCC meeting and September 2024 public open house, participants offered input on draft guiding principles and goals to reflect community values and priorities for coastal adaptation. The guiding principles, developed from community input and refined by the consultant team and the Town, were incorporated into the CAS. The goals, initially drafted by the Town and consultant team, were further refined based on this feedback.

3.1.1 Guiding Principles

A set of guiding principles was incorporated into the CAS and used, alongside other criteria, to evaluate potential adaptation strategies for each asset. Participants in the initial CCC meeting and open house responded to several prompts that helped shape these principles. Key recommendations included that the CAS should:

- **Reduce impacts of SLR hazards on:** critical infrastructure and utilities; historic and cultural landmarks; transportation networks; natural habitats; wastewater systems; homes and businesses; and the community's economic vitality.
- **Encourage:** community participation and communication; coordination among property owners and sectors; limiting development in high-risk zones; long-term, sustainable investments; habitat conservation and restoration; innovation and flexibility in approaches; and proactive infrastructure planning.
- **Anticipate:** changing climate impacts; rising costs and financial challenges related to climate adaptation; population shifts; tension between different adaptation approaches; the need for partnerships with neighboring areas, state, and federal agencies; growing demand for public education on climate impacts and adaptation strategies, and technological and infrastructure challenges.
- **Prioritize:** protection of vital infrastructure; nature-based solutions (e.g., habitat restoration, rainwater collection); public-private partnerships to leverage expertise and funding; protection of historical assets and cultural landmarks; clear communication and community education on adaptation strategies; funding for long-term resilience projects; equity considerations, especially for vulnerable populations and small businesses.

3.1.2 Goals

An initial set of goals for the CAS was drafted by the Town and the consultant team to guide the overall approach to adaptation planning. These goals were then shared with the CCC and the public during the August 2024 CCC meeting and the September 2024 open house to gather feedback and refine them. Participants expressed support for the proposed goals, which focused on:

- Reducing the vulnerability of the built environment to SLR;
- Maintaining healthy and functioning coastal ecosystems;
- Minimizing economic losses related to climate change impacts, including disaster response and recovery;
- Adapting to climate change in ways that minimize harm to natural environments and preserve public access;

- Protecting critical infrastructure, such as the wastewater treatment plant, from the impacts of SLR;
- Retrofitting historic buildings to withstand SLR impacts.

Feedback from participants emphasized the importance of framing goals with positive, opportunity-oriented language. For example, they recommended replacing phrases like “minimize harm” with language that highlights proactive or beneficial outcomes. Additionally, participants suggested adding a goal to regularly update SLR projections to incorporate the latest scientific research and help keep the CAS current and responsive to emerging data.

3.1.3 Additional Recommendations

In addition to feedback on guiding principles and goals, participants offered a range of broader recommendations to guide the CAS. Themes included:

- Partnering with scientists, universities, and Indigenous communities to integrate both scientific data and traditional ecological knowledge into coastal adaptation planning.
- Prioritizing long-range planning that looks beyond short-term solutions and considers impacts and adaptation needs through 2050 and 2100.
- Ensuring that coastal adaptation does not occur in isolation but is closely coordinated with broader infrastructure improvements to address current and future challenges.
- Exploring multi-municipality and agency collaboration to share resources, align strategies, and strengthen regional resilience efforts.
- Maximizing efficiency and avoiding redundancy by aligning CAS actions with ongoing local, regional, and state initiatives.
- Communicating with and involving residents throughout implementation and future updates to the CAS to build community buy-in and transparency.
- Looking to successful examples from other regions and countries to identify innovative strategies and avoid common pitfalls in coastal adaptation planning.

3.2 Feedback on Adaptation Strategies

This section summarizes community feedback on the feasibility, desirability, and priorities of the proposed medium- to long-term adaptation strategies for key vulnerable assets in Coupeville. Feedback was collected through the February 2025 CCC meeting, the April 2025 public open house, and the community survey. Community input helped inform adjustments to the final recommended actions in the CAS.

3.2.1 Preferred Strategies by Asset

Feedback gathered through the community survey, February CCC meeting, and April open house helped shape medium- to long-term adaptation strategies for specific assets. Across all three engagement activities, the most frequently discussed and prioritized assets, along with the most supported strategies, included:

- **NW Front Street (downtown area):** Participants favored hybrid or hard shore protection strategies to address SLR impacts in this commercial area. Feedback emphasized the importance of protecting critical infrastructure and maintaining access and economic activity along this corridor.
- **NW Front Street (residential area) and NE 9th Street:** Feedback for these areas leaned toward hybrid or soft shore protection strategies, reflecting a community preference for less intrusive solutions in residential contexts. Participants supported vegetation and drainage improvements and recommended ongoing evaluation of existing infrastructure.
- **NW Madrona Way:** Lane reduction emerged as the preferred approach for adapting this transportation corridor. Community members supported this strategy as a way to provide additional space for protection measures while maintaining function and connectivity. Additional support was noted for evaluating the condition of associated sewer lines and planning upgrades in tandem.
- **Historical overwater buildings:** Feedback favored floodproofing, particularly in combination with abandoning lower levels of structures where feasible. Repair of the existing hard shoreline protection and expansion of hard shore protection also received strong support from some overwater building owners, despite the significant constraints identified by consultants.
- **Wastewater treatment plant:** Feedback showed community interest in floodproofing the existing facility and support for relocating the plant inland over the long-term. Participants noted that relocation could offer long-term resilience, take advantage of Town-owned properties, and open shoreline areas for habitat restoration and public recreation. Attendees also emphasized that, given the plant's expected lifespan and infrastructure replacement timeline, relocation can be a strategic investment.

3.2.2 Additional Feedback

Participants emphasized the importance of evaluating each asset and geographic area individually rather than applying one-size-fits-all solutions. For example, one comment cautioned that road relocation may not be suitable for all neighborhoods.

In some cases, feedback revealed a range of perspectives that highlighted the need for continued discussion, collaboration, and flexibility. One example was the mixed input regarding adaptation options for the Town's historical overwater buildings, including concerns about feasibility and compliance with local regulations. In response, the CAS recommends near-term actions to explore these options further, such as stakeholder collaboration, feasibility assessments, and ongoing monitoring and planning, rather than prescribing specific long-term strategies. This approach allows the Town to remain adaptive and ensure that future decisions are informed by evolving conditions and grounded in all relevant contexts.

4 Conclusion

Input and feedback gathered through community and stakeholder engagement played a central role in shaping the CAS. Participants expressed support for the proposed goals and offered insights into the values and priorities that should guide local adaptation efforts. These perspectives were used to

finalize CAS goals and develop a set of guiding principles, which the consultant team incorporated into the CAS evaluation framework alongside technical and feasibility criteria.

Following the release of the draft CAS, community members and stakeholders reviewed and responded to proposed medium- and long-term adaptation strategies for each vulnerable coastal asset. This feedback influenced the refinement and prioritization of actions, helping to ensure the final CAS aligns with local values while remaining technically sound and implementable. Concerns raised by the community were documented and reviewed by the technical team. Where appropriate, strategies were revised or flagged for further discussion and evaluation.

Looking ahead, the Town remains committed to continued engagement and collaboration. The CAS is a living strategy designed to evolve as new data, funding opportunities, and community needs emerge. Ongoing dialogue will be needed to make sure the CAS remains responsive, equitable, and effective in protecting Coupeville's coastal assets into the future.

Limitations

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.



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Appendix A

August 26, 2024 CCC Meeting Notes



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Meeting Details

Meeting Title: Coupeville Climate Committee Meeting

Date: August 26, 2024

Time: 9:30 AM - 11:00 AM

Location: Virtual Meeting via Zoom

Attendees

- Attendees omitted for privacy.
- Meeting facilitated by Town staff and consultants from Facet NW and Maul Foster & Alongi (MFA)

Notes

Meeting Start

The meeting commenced at 9:30 AM.

Joshua Engelbrecht (Community Development Director, Town of Coupeville) began the meeting with introductions and an overview of the Coupeville Climate Committee's (CCC) role in advising on the Comprehensive Plan Update Climate Element and Coastal Adaptation Strategy (CAS).

Introduction to the Climate Element

Facet NW presented their work on developing the Climate Element for the Coupeville Comprehensive Plan Update, which will cover the period from 2025 to 2045. The updated plan will include various elements such as Land Use, Housing, Transportation, Capital Facilities, Utilities, Parks, Recreation & Open Space, Economic Stability, Natural Systems, and a new Climate Change and Resiliency Element (per HB 1181 requirements). Part of Facet's work will involve reviewing related documents, including the Island County Hazard Mitigation Plan, to identify any additional strategies that may need to be incorporated into the Climate Element.

The CCC will provide input on areas of focus and recommend climate goals and policies for inclusion in the Comprehensive Plan. At the next meeting, Facet will review each priority climate hazard relevant to Coupeville. The group will engage in discussions regarding goals and policies to address the risks these hazards pose to assets within the community.

Outreach Discussion

While the CCC serves as one avenue for input, additional opportunities for community engagement include public open houses, a survey, and focused outreach to local Tribes. The success of these engagement efforts will depend on effective outreach and advertising. Planned outreach methods include utility mailers, posters, the Town website, local news, and leveraging the networks of CCC members.

Town staff requested assistance from CCC members to support outreach. Several CCC members volunteered to support outreach by utilizing their newsletters and community organizations. They requested outreach materials and guidance on sharing information through social media. One



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member suggested engaging high schools to tap into the strong interest in climate change among younger residents.

One member pointed out that residents of multifamily buildings, whose utilities are paid by landlords, do not receive their own copy of the utility newsletter. Joshua will verify with the online bill pay system that each utility customer receives a physical or digital copy of the newsletter. He will also collaborate with the consultant team to find ways to reach residents of multifamily buildings.

Attendees also stressed the importance of ensuring a diversity of voices are included in engagement efforts.

Introduction to the Coastal Adaptation Strategy

Consultants from MFA presented their work on the CAS. The primary purpose of the CAS is to establish goals and identify priority actions aimed at enhancing the community's resilience to sea level rise and other coastal hazards. The CAS builds upon the 2023 Sea Level Rise Vulnerability Assessment, which identified community assets most at risk from sea level rise and shoreline recession. During the presentation, MFA reviewed the results of this analysis. Attendees were directed to the relevant webpage and report for further information.

Input for CAS Guiding Principles

MFA facilitated an exercise to gather input for the CAS Guiding Principles, which will be used to evaluate potential coastal adaptation actions. Input on various prompts was collected and is included verbatim below.

Prompt	Verbatim input (* = stars added by participants for emphasis)
<p>The CAS should reduce the impacts of sea level rise hazards on....</p>	<ul style="list-style-type: none"> • Historic Buildings, critical infrastructure, utilities, roads, dwellings*** • Critical infrastructure, utilities (water, sewer, communications), power (coordinate with PSE), historic buildings • Septic and sewer infrastructure to protect human and marine life ** • Transportation infrastructure • Food infrastructure and farming* • Shoreline habitat areas • Waste water treatment plant! * • Historic buildings and coastal infrastructure, utilities (sewer, power, water) • Shoreline protection, over water historic structures, natural habitats • Medical facilities and essential needs • Existing structures, shoreline habitats, critical infrastructure • Habitat and intact ecosystems, with an eye to what the future of habitat will be for survival of native species* • Businesses and economic vitality • Natural habitats and ecosystems • Shelter and housing for long-term residents first, especially those with lower financial means (i.e. renters, first homeowners vs. second homes)* • Essential transportation and housing for safety/evacuation*
<p>The CAS should encourage...</p>	<ul style="list-style-type: none"> • Improve power, utilities, transportation, food networks* • Expand habitat areas so that dynamic beaches can form where erosion takes place vs. building a moat** • Limit further development in buffer area*



	<ul style="list-style-type: none"> • Variety of approaches (toolbox) • Community input and communication of progress/recommendations to public • Consider elevating buildings • Strategic relocation of sensitive buildings (up and back)* • Environmentally friendly tourism • Longer term planning, thinking 200 years vs 20 years out* • Funding for mid to long term infrastructure improvements or replacements • Think through what local food, power, transport can look like during climate consequences • Encourage development away from risk areas • Community input • Consistent community communication and outreach • Coordination across private property owners for a unified approach • Mitigation of development in sensitive areas* • Think about what we want to create, paint a picture of a resilient community circa 2100 for our kids and grandkids • Spend more now to invest in truly sustainable (200 year) projects • Moratoria on development in at-risk areas • Use words like “strategic redevelopment” vs “managed retreat” so it doesn’t sound like defeat • Essential transportation and housing for safety/evacuation
<p>The CAS should anticipate....</p>	<ul style="list-style-type: none"> • Need to consider solutions on a holistic level, not just individual properties • Tension between hard armoring vs. no armoring solutions • What costs most now might be what saves most in the long run, including public acquisition of at-risk property for preservation and restoration • How state regulations encourage specific courses of action • Additional climate refugees coming here from off-island • More electrification (cars, homes, government buildings), prepare for this. Solar plus storage should be top priority • Required partnership with neighbors – Port Townsend, Skagit County • Changing ecosystem including invasive plants, fire danger* • Pushback from owners and developers of means who wish to invest in private solutions • Support from a state and federal level • Risk of food insecurity, freshwater shortages, fear and health risks • A need for funding sources, access to engineering and professional planning support* • Money=power. What we invest in shows what we value • Slower progress on actions than desired • Partnering across sectors, identities, backgrounds, values for our common goals • Honoring treaty rights and tribal fisheries under changing conditions!!! • Saltwater intrusion* • Bluff degradation* • Investigate funding sources • Difficult decisions on prioritizing • Investigate best practices what other communities have done • Qualified contractors and employee shortage to do climate projects • Risks impacting those furthest from race/class/citizenship justice first • Inland ponding • Need for public education for climate literacy and need for financial incentives for landowners



<p>The CAS should prioritize....</p>	<ul style="list-style-type: none"> • Invest in small rapid experiments based in community expertise • Public/private/nonprofit partnerships • Need to identify the most important, most impactful, and the easiest (low hanging fruit) improvements • Travel routes, infrastructure, shoreline ecosystems • Wastewater treatment plant will likely need to be moved • Wastewater treatment plant and underground utilities* • Food, farming, permaculture, ecosystem-based solutions • Work with Island County, Washington State departments, inter-jurisdiction grant opportunities • Acquire at-risk property and restore habitat for coastal resilience* • Center on shared values, keeping us all safe, rather than us vs. them • Front Street, Wharf * • Education so people aren't surprised, utility (all of them) infrastructure • What will be the salt marshes and lagoons of the future? Think about endangered species and habitat • Encourage more rainwater collection for homeowners to save water • Prohibit development/redevelopment in 100-year inundation zone except on stilts • Move septic/sewer infrastructure up and back* • Government behavior must be clear, consistent, values-first, transparent • Save the Wharf!* • Emergency response resourcing and plans for high-risk properties • Ebey's Reserve to prioritize clean energy (solar) in planning • All amazing ideas, but funding needs to be on the radar* • Development policies • Move/protect water and sewer treatment • Think about requiring removal insurance for shoreline properties • Get the word out - let people know the problems we face • Solar for all government buildings - lead the way.*
<p>Any other thoughts....</p>	<ul style="list-style-type: none"> • What do farmers need and how can farming be enhanced and diversified? • Survival is not political, counter polarization by looking for common values • Community needs as much info as possible on costs and options to prioritize • Thank you for this forum to share, good facilitation and technology • Use tools like this for all our community! • Who can't afford to relocate, who gets left out? Strengthen social supports. • Will we eventually have to move all of Front Street? • Need to try hard to imagine the situation in 2050 and 2100 and "focus" on long-term planning • Tribes are our first experts on living in balance with place, sustainability/mutuality • Get honest about what this will look like and don't sugar coat it • Adaptation to climate change doesn't mean giving up on reduction of impacts. VOTE • Would it be beneficial to work with other surrounding municipalities such as city of Oak Harbor, city of Port Townsend, and Skagit County to bolster financial support when needed? • Look for ways to hold elected officials accountable and to demonstrate more urgency • Think about who isn't in the conversation, who can't participate? • Partner with tribes to ground our work in indigenous knowledge • Manage fears by offering solutions and funding ideas so we can really do it



	<ul style="list-style-type: none"> • Invite the Climate Tech ecosystem of companies to embrace Coupeville as a leader! • Add more monitoring infrastructure so we can gather data • We don't have time to move at the pace of government unless government gets nimbler. Invest in private and nonprofit projects/partnerships. • Think outside the box • Encourage people to trust science • Partner with scientists and universities to ground our work in science • Work to include as many voices as we can in this process!
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Feedback on the Proposed Draft CAS Goals

The consultant team requested feedback on the following proposed goals for the CAS:

1. Reduce the vulnerability of the built environment to sea level rise
2. Monitor and maintain functioning and healthy coastal ecosystems
3. Minimize economic losses attributable to the impacts of climate change including disaster response and recovery
4. Adapt to climate change in a manner that minimizes harm to the natural environment and loss of public access
5. Protect critical infrastructure such as the wastewater treatment plant from the impacts of sea level rise
6. Retrofit historic buildings to better withstand the effects of sea level rise

Participants expressed support for the goals as written, with several comments:

- One attendee suggested using more proactive and positive language, proposing that instead of "minimize harm," the goal should focus on "maximizing benefits to the environment and enhancing public access to renewed or relocated resources and spaces."
- Another participant echoed the need for a positive, opportunities-focused framing, emphasizing the potential to embrace these challenges as a chance to modernize and accelerate innovation, particularly in climate technology, within the Town.
- A participant expressed a desire to shift from a reactive "triage" approach to a proactive "creativity" mode, noting that this transition would require significant funding and extensive public education and engagement. They also voiced hope that Coupeville could become a model community recognized globally for its early adoption of resilience and innovation strategies.
- Another attendee highlighted that Puget Sound Energy's (PSE) electrical infrastructure could be impacted by these changes, suggesting that PSE should be included in adaptation discussions.

Recent Coastal Hazard Response Discussion

Multiple participants referenced the flooding on December 27, 2022, noting that the response was inadequate. Neighbors provided sandbags to protect historic buildings, but significant damage occurred, highlighting the need for improved response strategies. One participant suggested implementing practical improvements, such as conducting practice flood response exercises as part of the planning process. Another participant expressed interest in exploring creative solutions used



by other communities and inquired about the feasibility of setting up temporary barriers in anticipation of flooding.

One participant reported that in February of this year, an area of Front Street west of the causeway experienced bank erosion and collapse, as projected in the Sea Level Rise Vulnerability Assessment maps. Repairs are currently ongoing.

Another participant, who lives on a bluff outside the Town, mentioned that staff from the Conservation District and Town assessed the bluff and suggested measures to prevent further destabilization. They were advised that the most cost-effective solution would be to relocate their house further back; however, this participant expressed concerns about the high costs of this option, particularly since multiple homes are affected. They inquired about potential funding sources, and staff indicated that funding options will be explored in the CAS report.

The meeting adjourned at 11:03 am.



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Appendix B

September 11, 2024 Public Open House Notes



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Meeting Details

Date: September 11, 2024

Time: 6:00 PM-7:30 PM

Location: In-Person at the Coupeville Recreation Hall

Attendees

- Attendees omitted for privacy.
- Meeting facilitated by Town staff and consultants from Maul Foster & Alongi (MFA)

Notes

Meeting Start

The meeting commenced at 6:05pm.

Joshua Engelbrecht (Community Development Director, Town of Coupeville) began the meeting with introductions and an overview of the Coastal Adaptation Strategy (CAS).

Introduction to the Coastal Adaptation Strategy

Consultants from MFA introduced their work on the CAS and reviewed the results of the 2023 Sea Level Rise Vulnerability Assessment, which identified the community assets most vulnerable to sea level rise and shoreline recession. The purpose of the CAS is to set goals and identify priority actions to improve the resilience of the community to sea level rise and other coastal hazards.

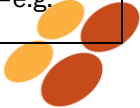
Input for CAS Guiding Principles

The MFA team facilitated an exercise to gather input for the CAS Guiding Principles, which will be used to evaluate potential coastal adaptation actions. Input on various prompts was collected and is included verbatim below.

Prompt	Verbatim input (* = stars added by participants for emphasis)
The CAS should reduce the impacts of sea level rise hazards on....	<ul style="list-style-type: none">• Vital infrastructure and discourage/disincentivize development• Historic assets (land and buildings), property owners• Individual property owners facing extraordinary costs• Economic vitality, business viability• Reduce impacts on historic structures AND economic mainstays (cultural AND commercial properties)• Save the Wharf!• Identify best practices being used in other coastal communities• Businesses services that impact the community• Public infrastructure• Infrastructure
The CAS should encourage...	<ul style="list-style-type: none">• Equal weight given to public and private property• Homeowners to help with their water runoff and direct it• The community to participate• Community action, not leave mitigation up to individual landowners• Creativity and imaginative solutions – how can we leapfrog progress?• POC and TOC Planning• Communication to the broader community



	<ul style="list-style-type: none"> • Realtors to be honest with prospective buyers • Dealing with general infrastructure improvements/ upgrades along with SLR projects • Property owners' education and action • Participation from community members with backgrounds in subject to extend education and reach island-wide • The town to participate proactively now/soon, rather than reacting later • A holistic approach to broad strategies for protecting both public and private assets • Keeping the value of historic assets front of mind
<p>The CAS should anticipate....</p>	<ul style="list-style-type: none"> • The worst • This to get worse faster than the plan • That the estimates and predictions of sea level rise impacts will change over time • Compromised economic vitality • Loss or degradation of identified historic assets • Investigating foreign approaches to adaptation strategies, not just US approaches • Managed retreat and adaptation • Stranded assets • Flooded infrastructure • Identify aid organizations or entities which can give financial help to people affected • Community petulance—marketing by persuasion, not alarmism • Push back on projections, many scenarios within the moderate to high recession • How the Town and County Comp Plans and codes should address the wishes of homeowners to build hard armoring • Costs of adaptation • Town needs to be proactive in helping individual businesses/ homeowners prepare • Changes in how downtown will be used. More pedestrian? Narrower road? Car-free zone? Raising or moving businesses and reconfiguration of town culture as well as street plan.
<p>The CAS should prioritize....</p>	<ul style="list-style-type: none"> • Existing or proposed roads and ferry lines • Historical buildings on Front St. • Projects that reduce upland runoff during heavy storms and poorly maintained drainage need to be upgraded and encourage support for rain gardens • Educating the community and businesses that serve the community (insurance, sewer, water) on our proactive approach to keep rates low • Prioritize according to an agreed upon strategy • \$\$ • Emergency response for anomalous events-- King tides/Low pressure • Getting big grant \$ now • Sewer lines. Water treatment plant, roads • Assist with buildings • Elected official engagement
<p>Any other thoughts....</p>	<ul style="list-style-type: none"> • CAS works with the Wharf to maximize dollars for the communities – leverage existing commitments • What strategies exist to protect shorelines – groins, built beaches, etc. –e.g. what does Holland do? Applicable? Gabions?



	<ul style="list-style-type: none"> • Try not to look at climate change responses as a standalone – put it into the bigger picture of ongoing infrastructure
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Feedback on the Proposed Draft CAS Goals

MFA requested feedback on the following proposed goals for the CAS:

7. Reduce the vulnerability of the built environment to sea level rise
8. Monitor and maintain functioning and healthy coastal ecosystems
9. Minimize economic losses attributable to the impacts of climate change including disaster response and recovery
10. Adapt to climate change in a manner that minimizes harm to the natural environment and loss of public access
11. Protect critical infrastructure such as the wastewater treatment plant from the impacts of sea level rise
12. Retrofit historic buildings to better withstand the effects of sea level rise

Participants provided the following comments for consideration in updating the draft goals:

- Continuously monitor actual sea level rise and storms to adjust the 2050 and 2100 predictions as needed.
- Consider options for moving or raising some historic buildings to manage costs effectively.
- Focus on minimizing costs to residents, particularly in public use areas.
- Determine a reasonable balance between maintaining ecosystems and current land use practices.
- Include all infrastructure improvements to maximize cost savings and minimize disruption to economic activity.
- Implement measures to stop runoff from houses and streets.
- Identify potential funding sources to support initiatives.
- Emphasize that advanced planning should aim to prevent economic losses; simply aiming to "reduce or minimize" these losses is insufficient. The goal should be to ensure stable business taxes.

Questions and Comments

- **Question:** Is storm surge present in all displayed scenarios?
Answer: Yes, it measures 2.7 feet.
- **Question:** Do moderate versus high scenarios vary based on different climate change warming scenarios?
Answer: Yes.
- **Question:** Is sea level rise information available to homeowners and insurance companies?
Answer: Yes, it is publicly available, but it is not necessarily integrated into insurance policies yet.



- **Question:** What sources of funding will support the necessary changes?
Answer: The CAS will examine potential funding sources.
- **Question:** Will the CAS clarify what the state requires and what obligations coastal communities have?
Answer: We will note to include a look at coastal adaptation policy requirements in the CAS.

The meeting adjourned at 7:15pm.



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Appendix C

February – April 2025 Survey



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Welcome to the Coupeville Coastal Adaptation Survey!

With support from the Department of Ecology's Shoreline Competitive Grant Program, the Town of Coupeville is developing a Coastal Adaptation Strategy to address the risks posed by sea level rise (SLR). Your input will help shape actions to protect what matters most to our community—like our homes, businesses, natural resources, and infrastructure.

The survey will take about 10 - 30 minutes to complete, depending on how many sections you opt-in to.

Complete this online survey or fill out a paper copy available at Town Hall.

Survey open: February 21 – March 21, 2025

Eligibility: If you live, work, own property, or attend school in Coupeville, we encourage your participation.

Confidentiality: Your responses are confidential and will be stored securely. Results will be shared in aggregate form only.

Submit Paper Surveys:

- Mail to: Attn: Joshua Engelbrecht, Town of Coupeville, 4 NE Seventh St., Coupeville, WA 98239
- Drop off at Town Hall front desk or in the drop box.

Need help or have questions?

Contact Joshua Engelbrecht at planner@townofcoupeville.org or 360-678-4461 ext. 103.

Please share this survey with others in Coupeville!

Thank you for helping shape our community's future!

Relationship to Coupeville

To start, we want to ask a few questions about your history and current relationship with the Town of Coupeville.

1. Which of the following describes your current connection to Coupeville? Please select all that apply.

- I live in Coupeville
- I own property in Coupeville
- I own waterfront property in Coupeville
- I own a business in Coupeville



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- I work in Coupeville
- I go to school in Coupeville
- Other _____

2. Do you own property in any of the following locations? Please select all that apply.

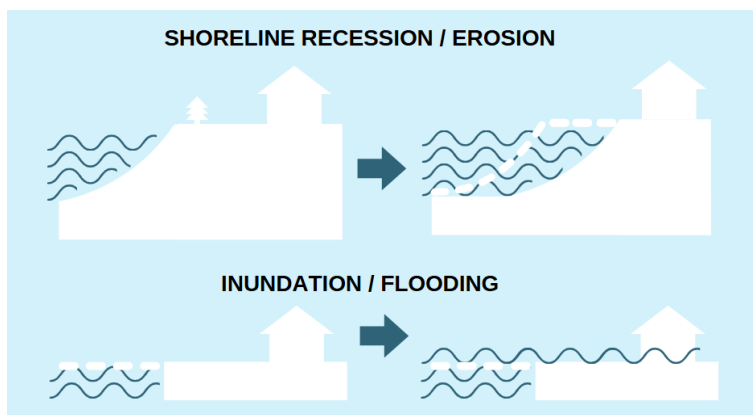
- Yes, along NW Madrona Way
- Yes, along NW Front Street (downtown area)
- Yes, along NE Front Street (residential area)
- Yes, along NE 9th Street
- Not applicable

3. How concerned are you about the effects of sea level rise and coastal erosion along the Coupeville waterfront? ([learn more about sea level rise in Coupeville here](#)).

- Very concerned
- Somewhat concerned
- Not concerned
- Unsure

Background Information

In 2023, the Town completed a sea level rise vulnerability assessment that identified several assets within the Town that are vulnerable to sea level rise via flooding and erosion ([see more information here](#)). Assets close to sea level are most vulnerable to flooding. Assets higher above sea level may not be likely to flood directly but can be vulnerable to erosion if they are set on coastal bluffs. Some assets are vulnerable to both hazards.



Vulnerable Assets and Areas

4. Please choose which of the vulnerable assets and areas from the list below that you would like to provide feedback on. Then skip to the pages with the sections you are interested in. You may select as many as you would like.

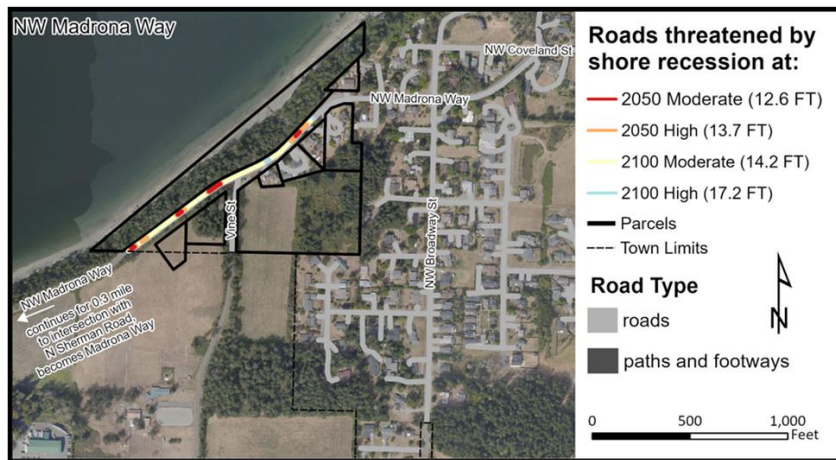


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1. NW Madrona Way–Page 3
2. NW Front Street (Downtown Area)–Page 4
3. NE Front Street (Residential Area)–Page 7
4. NE 9th Street–Page 9
5. Historic Overwater Buildings–Page 11
6. Wastewater Treatment Plant (WWTP)–Page 15

NW Madrona Way

- **Situation:** NW Madrona Way provides access to several homes and multiple agricultural properties near the western Coupeville town boundary. While they will be an important consideration for any strategies applied at NW Madrona Way, the properties along the vulnerable road section are not known to be critical to the Town or larger community. Several sections of this road are vulnerable to shore recession by 2050, and almost the entire stretch of road shown below is vulnerable by 2100.



- **Considerations:** Any adaptation measures implemented along NW Madrona Way should be coordinated with actions proposed for public sewer, drinking water, and stormwater infrastructure.
- **Options:** In the near- to midterm, passive management strategies like maintaining and planting vegetation, and ensuring proper drainage can slow erosion at this location but will not be sufficient for the long-term. Near-term actions such as installing soft shore protection or hybrid (hard and soft) shore protection along the bluff toe are recommended.

Mid-term (2050) and long-term (2100) actions:

Planning horizon	Action	Expert Recommendation	Key considerations
Mid-term	Lane reduction	May be required in the mid- to long-term timeline without shore	Could be carried out as a mid-term measure, but it may



		protection or road decommissioning	be more expensive to first reduce lanes, then also eventually decommission the road fully
Long-term	Decommissioning and relocation of road	Will be necessary in the long term without other actions	Access can be provided landward for affected properties; may require rights-of-way and property acquisition, utility coordination and/or relocation; would affect traffic patterns

5. Please write in numbers to rank the mid-term and long-term adaptation options by most to least preferable (1= most preferable).

__ Lane reduction

__ Decommissioning and relocation of road

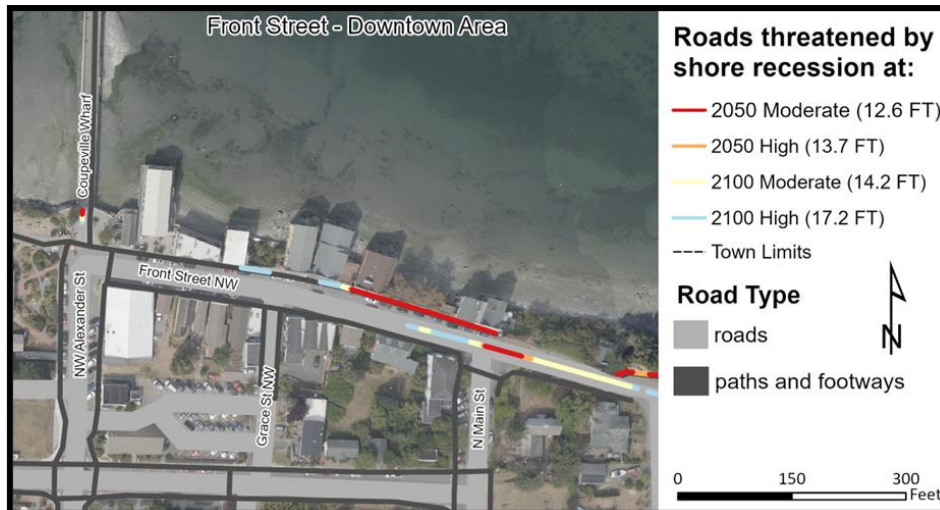
6. Please provide any other feedback on the alternatives for NW Madrona Way below. (Optional)

NW Front Street – Downtown Area

Situation: The section of Front Street near the N Main Street intersection is vulnerable to shore recession by 2050. A larger section of the Front Street roadway on either side of this intersection is vulnerable by 2100. The downtown section of Front Street extends from NW Alexander Street to NE Center Street. This roadway section serves the Coupeville downtown waterfront area, with its numerous commercial properties and community assets, nearly all of which occupy designated historic buildings within the Ebey’s Landing National Historic Reserve.



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Considerations: Given the cultural and economic significance of this area, the considerations for mitigation and adaptation may necessarily be different than other road sections. Even if relocation of the road were possible, relocation of the buildings and infrastructure that constitute the historic overwater may not be possible. Adaptation strategies for historic overwater buildings are discussed in a later section of this survey. As such, this section focuses primarily on considerations for the roadway itself while acknowledging that protective measures for the Front Street shoreline would provide coincidental, but not comprehensive, protections for overwater buildings.

Options: In the near- to midterm, passive management strategies like vegetation and drainage management, and maintenance of existing shore protection structures can slow erosion at this location but will not be sufficient for the long-term.

Mid-term (2050) and long-term (2100) actions:

Planning horizon	Action	Expert recommendation	Key considerations
Mid-term	Hybrid shore protection*	Beach nourishment and retention structures (drift sills) are recommended as a mid-term measure over soft shore protection given the criticality of the downtown waterfront	May be challenging to permit, will need to recreate existing intertidal habitat covered by drift sills and/or mitigate on site or nearby, may not provide protection for waterfront buildings. Best completed along the entire length, would not be appropriate for individual, disconnected segments.
	Hard shore protection (armoring)*	Only as a last resort if the community has determined protection of the existing waterfront to be of highest priority and all other options have been exhausted	Would provide the most permanent protection, but the most expensive. Will likely be difficult to permit, will need to recreate existing intertidal habitat and/or mitigate on site or nearby, will limit options for future adaptation. Will be challenging technically due to wide variety of

			existing conditions and configurations of buildings.
	Parking reduction to remove parking on south side of Front Street	Recommended with analysis of traffic patterns and access needs for downtown waterfront	Consider how actions for waterfront buildings and Front Street might align or conflict
Long-term	Road decommissioning	May be necessary in the long term. The Town would benefit from considering options in advance	Access can be provided landward for affected residential properties, would affect the character of the historic waterfront in addition to existing traffic/use patterns and would be moderately high cost. Could convert to a pedestrian-only street.

* **Soft shore protection:** Use of natural materials like large wood and sand, to slow but not eliminate erosion/flooding.

* **Hard shore protection:** Use of hard structures like concrete or rock walls parallel or perpendicular to shore, to stop erosion or trap sediment. This can include bulkheads, detached breakwaters, rock revetments, drift sills, and groins. Hard armor has negative impacts to the natural environment including nearshore habitats and coastal processes.

* **Hybrid shore protection:** A mix of soft and hard protection options. In the figure below, drift sills made of boulders are placed perpendicular to shore, to help keep in place added sand (beach nourishment). This approach is more permanent than spits created with gravel or sand (soft shore protection) but allows natural coastal processes to continue better than fully hard shore protection options.



Figure: Conceptual depiction of hybrid shore protection along Front Street and the historic waterfront.



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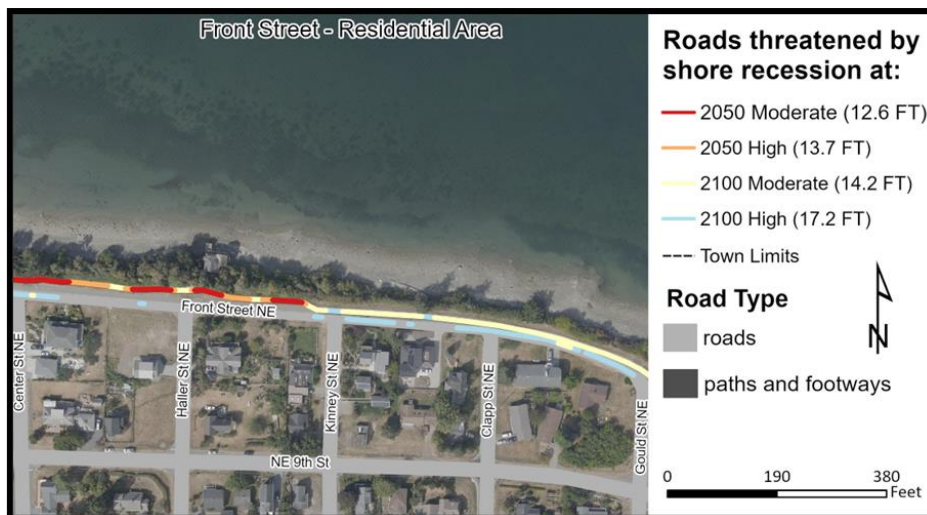
7. Please write in numbers to rank the mid-term and long-term adaptation options by most to least preferable (1= most preferable).

- Hybrid shore protection
- Hard shore protection (armoring)
- Parking reduction
- Road decommissioning

8. Please provide any other feedback on the alternatives for the NW Front Street – Downtown Area below. (Optional)

NE Front Street – Residential Area

Situation: The section of Front Street between Clapp Street NE and Gould Street NE is vulnerable in 2100 scenarios, as is a section at the Center Street NE intersection. The section marked in red and orange between Kinney Street NE and Center Street NE is a footpath vulnerable in 2050 scenarios. This footpath is from a previous reduction of the road to one lane, in response to a landslide. Only a small number of properties use Front Street NE for primary access. Access to many of the other residences along Front Street NE is already provided or could in the future be provided by side streets, or new driveway easements.



Considerations: Given that this road has already been narrowed due to coastal erosion, and the minimal required impacts to property access, the Town should make the eventual decommissioning of a portion or all of Front Street NE a priority.

Options: In the near term, passive management strategies like vegetation and drainage management can help slow erosion but will not be sufficient for the long term.

Mid-term (2050) and long-term (2100) actions:

Planning horizon	Action	Expert recommendation	Key considerations
Mid-term	Road decommissioning	Recommended as highest priority for mid-term. Reroute traffic and access via existing roads/new driveways. Restore upland areas in place of existing roadway where possible.	Access can be provided landward for affected residential properties, may require property acquisition and/or right-of-way/easement negotiations, utility coordination and/or relocation, would result in minor disruptions to current traffic patterns. Could convert to a pedestrian only street.
	Soft shore protection	Stronger consideration if road decommissioning is not possible in the near- to mid-term. Use intermittent gravel and sand beach nourishment as necessary to protect bluff toe.	May be challenging to permit, may need to be modified with ongoing sea level rise or maintained on periodic basis.
	Hybrid shore protection	Stronger consideration if planning timeline for road decommissioning extends toward 2050. Place beach nourishment with series of constructed spits to protect bluff toe	Will need to recreate existing intertidal habitat and/or mitigate on site or nearby (more challenging to permit than without created spits).
Long-term	Road decommissioning	Recommended if not completed in near- to mid-term.	May be required without other protective/adaptive actions. Access can be provided landward for affected residential properties, may require property acquisition and/or right-of-way/easement negotiations, utility coordination and/or relocation, would result in minor disruptions to current traffic patterns. Could convert to a pedestrian only street.

9. Please write in numbers to rank the mid-term and long-term adaptation options by most to least preferable (1= most preferable).

___ Road decommissioning



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- ___ Soft shore protection
- ___ Hybrid shore protection

10. Please provide any other feedback on the alternatives for the NE Front Street- Residential Area below. (Optional)

NE 9th Street

Situation: The section of this road vulnerable to shore recession lies between NE Otis Street and Perkins Street near Thomas Coupe Park and the Wastewater Treatment Plant. NE 9th Street connects N Main Street near downtown Coupeville to Parker Road. It provides east-west access to several residential properties, the WWTP, and Thomas Coupe Park.



Considerations: For approximately 300 feet, NE 9th Street is situated particularly close to the existing low-elevation bluff, which has already been armored with a rock revetment. Mitigation and adaptation strategies for NE 9th Street should consider any potential effect on access to the WWTP and Thomas Coupe Park.

Options: Near-term measures include vegetation and drainage management and improving or replacing the existing shore protection structure (rock revetment).

Mid-term (2050) and long-term (2100) actions:



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Planning horizon	Action	Expert recommendation	Key considerations
Mid-term	Soft shore protection	Gravel and sand beach nourishment to complement existing or improved rock revetment/rock wall.	Would reduce bank erosion and add longevity to existing hard armor; could augment intertidal beach habitat.
	Lane reduction	Going to one lane could be required in mid- to long-term timeline without improved/replaced shore protection or decommissioning. Evaluate effects of and consider reducing to one way traffic.	Could be carried out as a mid-term measure if shore armor repair is not allowed or is not sufficient to control bank crest recession.
	Hybrid shore protection	Stronger consideration if the planning timeline for road decommissioning extends toward 2050. Place beach nourishment with a series of constructed spits to protect the bluff toe.	Will need to recreate existing intertidal habitat and/or mitigate on-site or nearby (more challenging to permit than without created spits).
Long-term	Decommission and reroute, or realign/setback road	Will likely be necessary in the long term without other actions, will be most cost-effective over the long-term.	Analysis should be conducted to understand traffic and emergency impacts, utility coordination, and/or relocation. Road setback would likely require the acquisition of at least one nearby house/property and potential easements/ROW acquisition elsewhere.

11. Please write in numbers to rank the mid-term and long-term adaptation options by most to least preferable (1= most preferable).

- Soft shore protection
- Lane reduction
- Hybrid shore protection
- Road decommissioning or setback

12. Please provide any other feedback on the alternatives for NE 9th St below. (Optional)

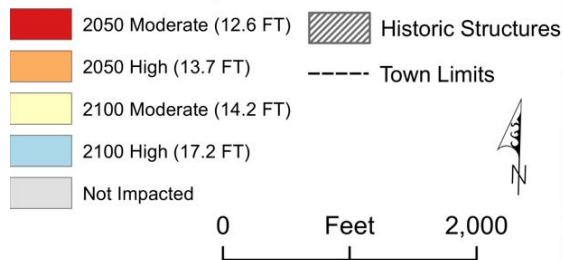


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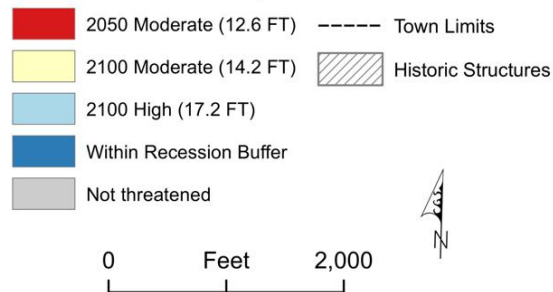
Overwater Buildings

Situation: Coupeville’s waterfront is adorned with several historic buildings originally constructed between the 1860s and 1910s, many of which are built largely as overwater structures. Most of these overwater buildings are vulnerable to shoreline recession by 2050, and some are also vulnerable to flooding of at least lower building floors by 2050 or 2100. High water levels have impacted the buildings in the past such as during the regionally historic December 27, 2022, high water event. The Town has identified these buildings as priorities due to their cultural, historical, and economic significance. Maintaining and protecting the buildings will preserve a busy street and sidewalk along Front Street.

Structures flooded by SLR at:



Structures threatened by shore recession at:



Considerations: Without any action, these buildings will continue to be damaged by flooding events, and the bank will continue to erode toward Front Street. Alternatives to address bank erosion on Front Street are presented in the Front Street—Downtown Area section of this survey. The alternatives presented in this section focus on addressing flooding of the buildings.

Options: Near-term actions will include a cohesive planning effort amongst stakeholders. Experts recommend planning to begin before 2030 and include a more detailed feasibility and cost

evaluation for major actions. This planning will need to account for how the costs will be shared amongst stakeholders and will ideally reach a coordinated mid-term and long-term approach for the downtown area.

Mid-term (2050) and long-term (2100) actions:

Floodproofing structures and/or abandon lowest floors – would maintain the structures in their current locations by preventing flooding of the structures, or by constructing improvements to allow the bottom floor(s) of the structures to flood with minimal damage. Some lower building levels may need to be abandoned for primary usage. The condition of the existing structures will dictate if floodproofing is economically feasible. This option allows existing buildings to remain in place and poses fewer concerns with needing to modify access from Front St as compared to actions such as elevation of structures.

Elevating structures – would raise each structure as needed to provide a new foundation that sets the building above the flood elevation. Building elevation would involve jacking the building up and using a temporary foundation while a new foundation is constructed. Entrances to the building would be raised, which would require stairs and/or ramps to maintain access from street level or raising the level of the street and sidewalk would be another way to address this. This option may not be feasible in this very constrained location with very old and irregularly shaped buildings. Maintaining a cohesive relationship between the buildings would be preferred. Major discussion of elevating should be looked at as a district wide project, not individual buildings.

Repairing hard shore armor - would be appropriate on a case-by-case basis (by building or by small group of buildings) as needed to maintain the structural integrity of individual buildings. This may be needed as the existing hard armor are very old and were not built to modern engineering standards. A new hard armor helps reduce coastal erosion, but, even if built to meet a certain potential flood elevation, is typically not effective in preventing coastal flooding. This is because waves can overtop hard armor, water often finds a way through voids at joints – including where these structures meet land, and additionally, precipitation is often heavy during high-water events and can serve to retain water on the landward side of walls.

Constructing a floodwall - would entail designing and constructing a floodwall or multiple floodwalls around the existing structures to prevent marine waters from damaging structures. A floodwall would be composed of a reinforced concrete wall, sheetpile wall, or both, and likely necessitates an appropriate drainage system (with back-up emergency power) to manage hydrostatic pressure and mitigate storm and groundwater pooling. Design and construction of floodwalls is generally considered a relatively high-cost mitigation strategy with an expected useful life of 50 years if properly maintained.

While it may be technically possible to construct a wall that provides adequate flood protection for the commercial downtown, it is likely impractical for this specific application. The main challenges would be very high design and construction costs, considerable negative impacts to nearshore habitats and coastal processes, off-site impacts, and an extremely cumbersome or infeasible permitting process. It is particularly important that floodwalls are built properly because waves can overtop floodwalls, water often finds a way through any voids at joints – including where these structures meet land – and additionally, precipitation is often heavy during high-water events and can result in pooling of water on the landward side of walls. Hydrostatic pressure from water against the landward side of hard armor is a common cause of wall failure and can be very difficult to mitigate within design. Due to the above reasons, this action is not recommended based on this high-level analysis.



Relocating structures – would either adjust building locations within their parcel or move them to a different property. Adjusting location within the parcel may be challenging, as buildings typically need to be moved further from the water, which would conflict with the Front Street roadway. Moving the buildings to another site would likely not be feasible and would not meet the Town’s desire to maintain the character and culture of the existing downtown area. Additionally, it would be challenging to find a suitable location for the unique overwater structures, as they are located partially atop a bluff, and any new location would need to accommodate the structures’ unique elevations. The structural condition of each building would need to be assessed to understand if relocation techniques are feasible. Maintaining a cohesive relationship between the buildings would be preferred. Major discussion of relocation should be looked at as a district wide project, not individual buildings.

Reconstructing buildings – the existing buildings, built over 100 years ago, are aging and the structural condition is likely to be poor due to the original designs and the harsh marine environment. On a case-by-case basis, existing buildings could be demolished or extensively remodeled with the façade preserved and incorporated into the new buildings. This would allow a new structure to be built to modern standards that consider flooding from the start. Buildings would be more resilient to seismic events, more energy efficient, and could include more modern amenities. Maintaining a cohesive relationship between the buildings would be preferred. Major discussion of relocation should be looked at as a district wide project, not individual buildings.

Planning horizon	Action	Expert recommendation	Key considerations
Mid-term	Floodproofing and/or abandonment of lower building levels	Recommended approach. Evaluate and implement floodproofing for lower elevation structures and building levels. May be necessary to abandon or limit primary use of lower building levels.	Costs range \$100k to \$300k per building. Floodproofing would only be practical for large and important lower-floor areas. Allows buildings to stay in place, but limits uses of lower floors.
	Elevate certain buildings, if feasible	Recommended only if building owners can agree on this unified approach, however, may not be feasible for all buildings. Detailed feasibility study including structural, access, and cost analysis would first be required.	Costs range from \$500k to \$1 million per building. May not be feasible for certain buildings, preventing a unified approach for downtown May require raising Front Street (unlikely), or additional changes to building access. Allows buildings to stay in place with the use of lower floors.
	Repair existing hard armor where needed	Repair is recommended to extend the life of buildings where needed. Construction of new hard	High cost – depends on how many properties involved.



		armor is not recommended as it would not address flooding.	Extensive permitting and may be un-permittable. Would reduce erosion but not address flooding for buildings in the mid to long-term.
	Construct floodwall(s)	Not recommended	Very high cost. Extensive or infeasible permitting. Could address flooding, for useful life of 50 years. Considerable negative impacts to the environment.
Long-term	Relocate structures	Not recommended	Costs for structure relocation are expected to be far higher than those of simply elevating the existing structures in place. Would be very challenging or infeasible to move these buildings and locate suitable sites upon which to place the buildings. Does not allow structures to stay in place and meet the Town's goals of maintaining the downtown character. Taking a uniform approach for downtown and maintaining a cohesive relationship between the buildings would be preferred.
	Reconstruct buildings to modern standards	This is the most long-term solution. Some buildings with poor structural integrity may not be suitable for this and building abandonment and demolition may be required.	High cost- essentially the cost to construct a new building. Extensive design and permitting. There would be efficiency in addressing multiple building reconstructions at the same time. May not be socially acceptable due to potential loss of building character.

13. Please write in numbers to rank the mid-term and long-term adaptation options by most to least preferable (1= most preferable).

___ Floodproofing and abandoning lower floors



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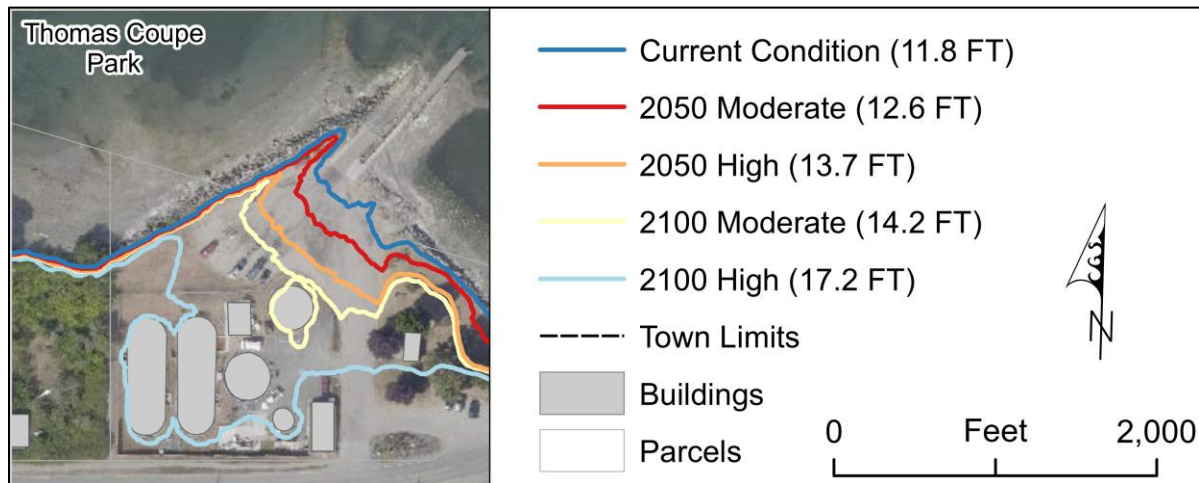
- Elevate certain buildings (if feasible)
- Repair hard armor where needed
- Construct floodwall(s)
- Relocate structures
- Reconstruct buildings

14. Please provide any other feedback on the alternatives for the Overwater Buildings below. If you own an overwater building or a business within one, please note that here. (Optional)

Wastewater Treatment Plant (WWTP)

Situation: The wastewater treatment plant (WWTP) is located at 600 NE 9th Street adjacent to Thomas Coupe Park and south of the public boat ramp. The WWTP shoreline location and low elevation make it particularly vulnerable to rising sea levels and high-water events. Both scenarios in 2100 suggest floodwaters will breach the WWTP site. The image below shows projected shoreline inundation in projected sea level rise scenarios along the WWTP.

Protecting the WWTP from SLR is crucial for public health and protecting coastal ecosystems. The goals identified for the WWTP are essential to maintain the treatment and discharge of wastewater in compliance with permits while ensuring the WWTP remains completely operational through the 2100 High scenario.



Considerations: With no action taken, the WWTP will continue to operate with possible impacts in both the short term and long term due to high water events and SLR.

Options: Short-term actions include developing or revising an emergency response plan for extreme weather events or high flow events, to reduce the risk of damage to critical infrastructure. Mid- and

long-term options involve either protecting the WWTP in its current location or moving it further inland.

Mid-term (2050) and long-term (2100) actions:

Floodproof existing WWTP – This action includes floodproofing critical WWTP facilities which are low lying to ensure their resilience during extreme weather events. This action should be viewed as an intermediate step; the goals of this action are to allow the WWTP to operate throughout the 2100 Moderate scenario, with no major capital projects needed for implementation.

Construct levee or floodwall – A levee or floodwall would be built around the WWTP to prevent seawater intrusion into plant treatment basins and subterranean structures. This alternative would include a thorough site assessment to understand the topography, soil conditions and flood risk. A levee or floodwall would be more practical and less environmentally impactful for this asset compared to overwater buildings, as it could be constructed along the shoreline or in the uplands surrounding the plant rather than on the beach in the intertidal zone.

Raise existing WWTP elevation – This action involves importing fill and increasing grade to prevent flooding and promote drainage, structure elevations would be raised above the levels of the 2100 High scenario.

New WWTP – This action entails the design and construction of a new WWTP that is located away from the shore, adapting to SLR through relocation. Constructing a WWTP further inland reduces the vulnerability to SLR and flooding events. The WWTP would be more resilient to climate impacts and would not require frequent repairs to adapt to flooding events or saltwater intrusions. Construction of a new WWTP and decommissioning of the existing plant would likely be completed in phases to make overall costs more manageable. Construction of a new WWTP would also require the construction of lift station(s) and new gravity sewer pipes throughout the Town to route flows from the existing collection system to the new WWTP.

Planning horizon	Action	Expert recommendation	Key considerations
Mid-term	Floodproofing existing WWTP	Recommended	Low cost No impact on water treatment Makes WWTP more resilient
	Raise elevation at WWTP and increase the height of structures	Not Recommended	High initial costs—\$5-10M A new WWTP may be constructed offsite to produce reclaimed water, which could not be done at the existing site
	Construct levee or floodwall	Recommended on as-needed basis if floodproofing is ineffective or instead of phased new treatment plant	Moderate costs—estimated \$2-3M. Only needed if flooding impacts the existing WWTP and a new WWTP cannot be constructed fast enough or new WWTP not constructed.



			Minimal visible change and impact on environment. Permitting would take several years.
	New (inland) WWTP Phase 1 to treat a portion of flows	Highly Recommended	High costs-- \$30M-35M in Phase 1. Environmental benefits from new plant producing reclaimed water. Increases resilience of water system.
Long-term	New WWTP Phase 2 to treat entirety of Town's flows and decommission existing WWTP	Highly Recommended	High costs-- \$25-30M. Environmental benefits from new plant producing reclaimed water. Fully addresses coastal hazards. Old site could be repurposed for recreational use.

15. Please write in numbers to rank the mid-term and long-term adaptation options by most to least preferable (1= most preferable).

- Floodproofing existing WWTP
- Raise elevation at existing WWTP and increase the height of structures
- Construct levee or floodwall
- New WWTP Phase 1 to treat a portion of flows.
- New WWTP Phase 2 to treat the entirety of the Town's flows and decommission existing WWTP.

16. Please provide any other feedback on the alternatives for the WWTP below. (Optional)

Closing

17. Do you have any additional comments or suggestions regarding coastal adaptation in Coupeville? (Optional)



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Thank you for completing the survey! Your response has been recorded. Public input will shape the assessment of adaptation options in the Coastal Adaptation Strategy.

The draft Coastal Adaptation Strategy will be available for public review in April 2025. An open house will be hosted in late April 2025 to collect further input.

Learn more about the Coastal Adaptation Strategy at: www.townofcoupeville.org/coastal-adaptation-strategy/.



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Appendix D

February – April 2025 Survey Summary



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As part of its Shoreline Management Program, the Town of Coupeville, Washington (Coupeville), is developing a coastal adaptation strategy to address the risks posed by sea level rise and related coastal hazards. Coupeville hugs the eastern shoreline of Whidbey Island, which is located in Puget Sound, north of Seattle, Washington. Town officials engaged Maul Foster & Alongi, Inc., to reach out to members of the community to gather input on what sea level rise adaptation alternatives are most preferable for key affected areas in town.

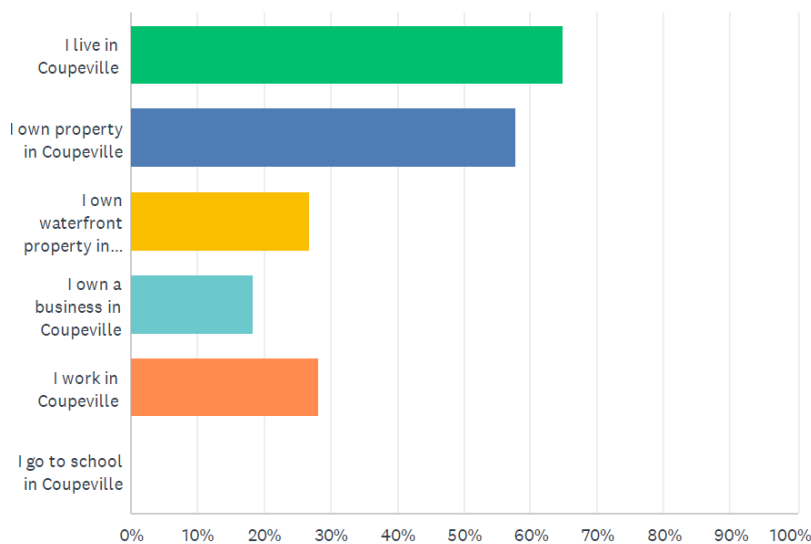
Background

The survey, administered between February 7 and April 3, 2025, was conducted in a manner similar to a virtual open house, with background information on vulnerable infrastructure, such as roads and buildings, and menus of actions and recommendations from which respondents could choose (Questions 4 through 16). The survey gathered responses from 71 respondents. Respondents were recruited by email and physical flyers, and paper surveys were made available at Town Hall. Respondents could participate online or fill out the paper survey and mail or deliver it to the Town’s municipal offices. 70 responses were provided through the online survey. One paper survey was received and the data were entered on April 3, 2025. Not all 71 respondents gave answers to each question and response categories were not mutually exclusive; therefore, the denominator (n) varies and the categories may not tally to 100 percent.

Relationship to Coupeville

The majority of respondents (nearly 65 percent) live in Coupeville and more than half (58 percent) own property in the town (Figure 1). Approximately one-quarter of respondents (19) own waterfront property. Of those 19, most (15) own property along NW Front Street, near Coupeville’s downtown; others own properties along NW Madrona Way or NE Front Street. One property owner provided a property location on the north side of Penn Cove and one of the respondents owns a business closely connected to tourism.

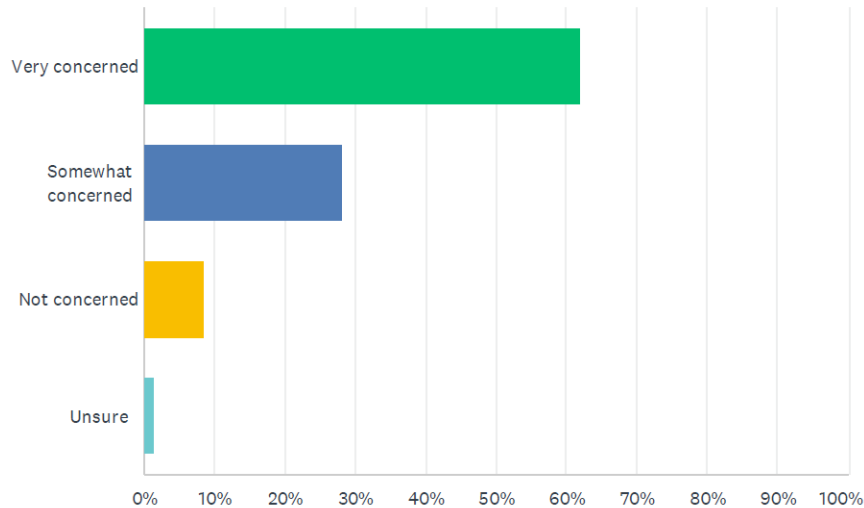
Figure 1. Ownership, Residency, and Residency



Concern Regarding Sea Level Rise and Coastal Erosion in Coupeville

Nearly all respondents (90 percent) responded that they were very or somewhat concerned about sea level rise and coastal erosion along the Coupeville waterfront (Figure 2).

Figure 2. Concern for Sea Level Rise and Coastal Erosion Along the Coupeville Waterfront



Vulnerable Assets and Areas

Respondents indicated the vulnerable assets and areas for which they would like to provide feedback (Figure 3). Leading concerns included NW Front Street in the downtown area, historical overwater buildings, and the town's wastewater treatment plant, located north of downtown at the Penn Cove park Sewer District facility (Table 1). Of note is that, while 21 respondents chose one vulnerable asset or area as being of interest, nearly one-quarter (15 respondents) chose four or five vulnerable assets or areas as being of interest, indicating high overall concern for multiple areas.



Figure 3. Interest in Vulnerable Assets and Areas

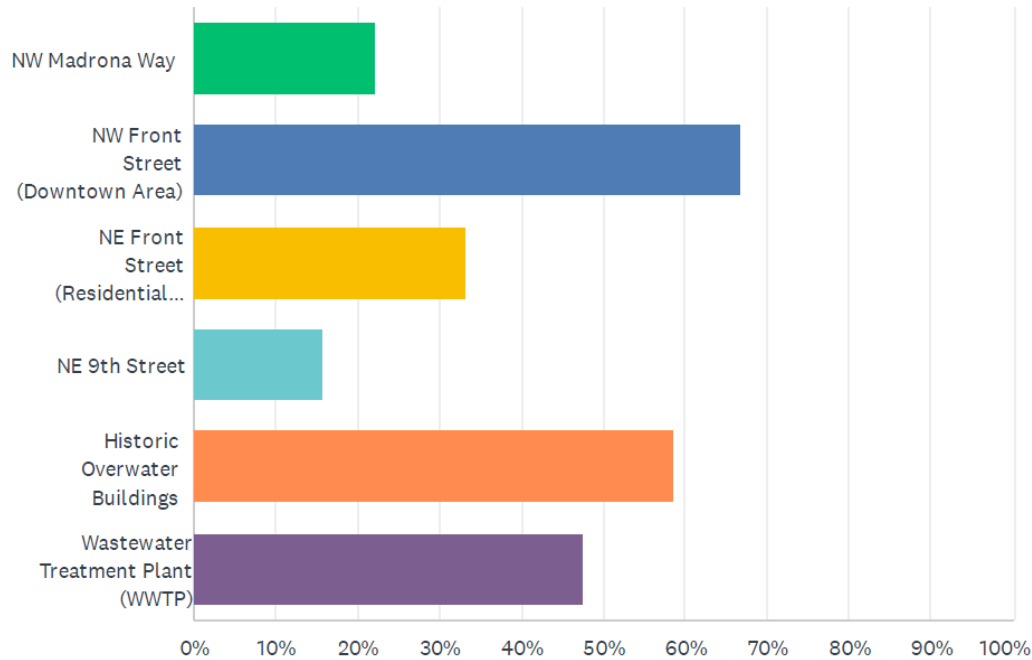


Table 1. Interest in Vulnerable Assets and Areas

Vulnerable Asset or Area	Responses	Number
NW Front Street (Downtown Area)	67%	42
Historical Overwater Buildings	59%	37
Wastewater Treatment Plant	48%	30
NE Front Street (Residential Area)	33%	21
NE 9th Street	16%	10
NW Madrona Way	22%	14

The survey was designed so that, once a respondent indicated interest in a vulnerable asset or area, they would then see key facts about each area in (1) a situation analysis, (2) a figure showing the location of the asset or area, and (3) considerations for adaptation, options, and actions for each vulnerable asset or area. The information that was provided is available in the survey instrument attached as Attachment A. Note that the total number of respondents for each vulnerable asset or area varies and is noted in each of the following subsections.

NW Madrona Way

Of the nine respondents that ranked mid-term and long-term adaptation options, the majority (7 of 9) ranked lane reduction as the most preferable option. One respondent noted that the roadway was a major thoroughfare and should be protected; another said the road should be made safer.

NW Front Street—Downtown Area

Of the 30 respondents that ranked mid-term and long-term adaptation options, the majority ranked hybrid shore protection and hard shore protection as the most preferable options (Table 2).



Table 2. Most Preferable Mid-Term and Long-Term Options, NW Front Street–Downtown

Vulnerable Asset or Area	Responses	Number
Hybrid Shore Protection	80%	24
Hard Shore Protection (Armoring)	77%	23
Parking Reduction	33%	10
Road Decommissioning	10%	3

Notes
Responses column shows percentage of respondents ranking the option as most preferable (1) or second-most preferable (2) on a 1 to 4 scale.
Total n is 30 for all categories.

This question garnered 14 comments, summarized in Table 3 below. Most often mentioned were comments to allow hard shore armoring and to address parking and ensuring accessibility to the waterfront and businesses.

Table 3. Comments on Options for NW Front Street–Downtown

Comment	Number
Allow hard shore armoring	4
Address parking	4
Plan for accessing businesses and waterfront (such as with a shuttle or tram)	3
Conduct work in phases	2
Comments on other technical issues to address such as stormwater management and flooding as a threat to existing structures	2
Other	
Implement a plan soon	1
Preserve historical buildings	1
Protect the environment before protecting businesses	1
Use a seawall and breakwater	1
The Town is overthinking the issue	1
The analysis is biased and does not take other conditions in Penn Cove into account	1

NW Front Street–Residential Area

Of the 13 respondents that ranked mid-term and long-term adaptation options, the majority ranked soft shore protection and hybrid shore protection as the most preferable options (Table 4).

Table 4. Most Preferable Mid-Term and Long-Term Options, NW Front Street–Residential

Vulnerable Asset or Area	Responses	Number
Soft Shore Protection	77%	10
Hybrid Shore Protection	69%	9
Lane Reduction	38%	5
Road Decommissioning or Setback	15%	2

Notes
Responses column shows percentage of respondents ranking the option as most preferable (1) or second-most preferable (2) on a 1 to 4 scale.
Total n is 13 for all categories.



This question garnered comments from five respondents:

- Implement hybrid shore protection in the short term to allow for “intermixing hard and soft shore protection in the long term to places where is most needed. Road should be redone, providing a one-lane road plus a paved path for pedestrians, removing the gravel path closer to the shoreline and filling in with stabilizing plants. During this construction road should be reappointed to limit northside drainage over the bluff. Water mitigation strategies would be helpful here.”
- Plant vegetation upslope of Front and 9th Street to address groundwater.
- Armor waterfront buildings and save waterfront buildings were mentioned by two commenters.
- One commenter expressed concerns about costs to residential property owners.

NE 9th Street

Of the eight respondents that ranked mid-term and long-term adaptation options, soft and hybrid shore protection were both ranked as the most preferable options (Table 5).

Table 5. Most Preferable Mid-Term and Long-Term Options, NE 9th Street

Vulnerable Asset or Area	Responses	Number
Soft Shore Protection	88%	7
Hybrid Shore Protection	88%	7
Lane Reduction	25%	2
Road Decommissioning or Setback	0%	0

Notes
 Responses column shows percentage of respondents ranking the option as most preferable (1) or second-most preferable (2) on a 1 to 4 scale.
 Total n is 8 for all categories.

This question garnered comments from three respondents. As with the responses regarding other areas, one comment discussed potential technical aspects, another recommended upslope vegetation planting, and a third reiterated the importance of preserving historical buildings. The technical comment is reproduced here:

- “The inward cove rock wall needs to be restrengthened. A further man-made spit might help protect the bluff. Entire parking area needs to be re-done, raising it up while also managing drainage. FEMA predicts the northeast end of the water-treatment plant to be submerged by 2050. Town should plan for relocation or renovation of the plant to protect the structure. Reducing or closing 9th is ill-advised as there is no other road connecting Coupeville to Parker Road. This is a main throughfare, and channeling traffic through neighborhoods would be less than ideal. However, the Town should put on the radar to locate and add additional routes in case they become needed (i.e. washout, construction, etc.).”



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Overwater Historical Buildings

Of the 21 respondents that ranked mid-term and long-term adaptation options, floodproofing and abandoning lower levels and repairing existing hard armor where needed both ranked as the most preferable options (Table 6).

Table 6. Most Preferable Mid-Term and Long-Term Options, Overwater Historical Buildings

Vulnerable Asset or Area	Responses	Number
Floodproofing and Abandoning Lower Levels	57%	12
Repair Existing Hard Armor Where Needed	57%	12
Elevate Buildings (If Feasible)	38%	8
Construct Floodwall	29%	6
Relocate Structures	10%	2
Reconstruct Buildings to Modern Standards	10%	2

Notes

Responses column shows percentage of respondents ranking the option as most preferable (1) or second-most preferable (2) on a 1 to 4 scale.
Total n is 21 for all categories.

This question garnered comments from eight respondents (Table 7). The common comment offered was the need to revise Town permitting policies or the strategy with regard to historical buildings so that owners could take incremental steps to protect properties, collaborate with owners of adjacent structures, or develop solutions for historical buildings based on each structure’s unique conditions and needs.

Table 7. Comments on Options for Overwater Historical Buildings

Comment	Number
Revise permitting, policies, or strategy with regard to historical buildings	3
Allow hard armoring	2
Protect historical area, keep buildings accessible	2
Elevate waterfront (as a last option)	2
Don’t reconstruct historical buildings (or don’t reconstruct without also protecting)	2
Do reconstruct historical buildings considering that each building is unique	2
Raise existing seawalls or build a seawall	2
Other	
Options or analysis are incomplete, incorrect, or insufficient	2
Look for funding for construction costs	1
Install aquarium glass in buildings	1

Wastewater Treatment Plant

Of the 17 respondents that ranked mid-term and long-term adaptation options, floodproofing the existing wastewater treatment plant and developing a new plant to treat a portion or all flows were ranked as the most preferable options (Table 8).



Table 8. Most Preferable Mid-Term and Long-Term Options, Wastewater Treatment Plant

Vulnerable Asset or Area	Responses	Number
Floodproofing the existing WWTP	52%	11
New WWTP Phase 1 to treat a portion of flows	33%	7
New WWTP Phase 2 to treat the entirety of the Town's flows and decommission existing WWTP	29%	6
Raise elevation at existing WWTP and increase the heights of structures	24%	5
Construct levee or floodwall	24%	5
Notes		
WWTP = wastewater treatment plant.		
Responses column shows percentage of respondents ranking the option as most preferable (1) or second-most preferable (2) on a 1 to 4 scale.		
Total n is 17 for all categories.		

Comments about the options ranged from support for a new facility in a new location (one person noted that the Town should “learn from the mistakes of Oak Harbor and do it right”), acknowledgment that alternatives need to be implemented “sooner than expected,” and suggestions to use grants for implementation.

Additional Comments or Suggestions Regarding Coastal Adaptation

The request for additional comments garnered comments from 14 respondents, summarized in Table 9.

Table 9. Additional Comments or Suggesting Regarding Coastal Adaptation

Comment	Number
Ensure protection of Front Street and historical buildings	2
Act soon, save shoreline areas	2
Revise policies and strategy to address unique conditions of historical buildings	1
Request to keep costs to residents in mind	1
Implement environmentally sensitive solutions	1
Install riprap and use sand	1
Involve building owners now	1
Get funding	1
Make plans and take actions that consider the future	1
Save historical areas	1
Prevent groundwater flow with a holistic vegetation plan	1
Other	1
Poor survey	1



Appendix E

February 26, 2025 CCC Meeting Notes



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Meeting Details

Meeting Title: Coupeville Climate Committee Meeting

Date: February 26, 2024

Time: 9:30 AM - 11:00 AM

Location: Virtual Meeting via Zoom

Attendees

- Attendees omitted for privacy.
- Meeting facilitated by Town staff and consultants from Natural Systems Design (NSD) and Facet NW.

Notes

The meeting commenced at 9:30 AM.

Joshua Engelbrecht (Community Development Director, Town of Coupeville) began the meeting with introductions of the consultant teams and CCC members.

Overview of the CAS

NSD presented a review of the CAS project, including background on preceding Sea Level Rise Vulnerability Study and 2024 engagement on Coastal Adaptation Strategy (CAS) goals and guiding principles.

Then, NSD consultants provided an overview of the adaptation strategies considered for the vulnerable assets and areas. These included passive management techniques of vegetation and drainage, soft shore protection and hard armoring, accommodation (elevating or floodproofing/retrofitting), relocation, and development restrictions.

Q&A

NSD responded to several attendee questions.

Question	Answer
You talked about the probability of different climate estimates, but didn't mention RCP 8.5. There's some conservatism built into that model, correct?	Yes. In the other work we've done, RCP 8.5 is the standard, "business-as-usual" scenario. In a public setting, we can explain our use of the higher emissions scenario.
I wanted to ask whether the consideration of vegetation has been approached primarily for the stabilization and mitigation of threats to the human-built environment, or if there's also some consideration of revegetation as a habitat enhancement technique beyond the built environment?	Most of the focus here, especially for the public has been on nature-based solutions and old-school "protect" solutions for preventing erosion. Using vegetation strategically to prevent erosion. If the action were to take place, you'd have to permit the project, and you'd have to include more vegetation enhancement as part of that. It would be required in some way through mitigation down

	the line. For some of these actions, there are co-benefits, like vegetation enhancement.
For the subset of the community very concerned about SLR impacts on coastal habitats and estuarine environments, I think it would be a wonderful benefit for their understanding to accentuate those co-benefits.	Great point. We can certainly mention that.

Actions by Asset

NSD consultants provided an explanation of the STAPLEE method for evaluating potential actions, and a more in-depth explanation of the evaluation and recommended actions for each asset: overwater buildings, roads and sewer lines, wastewater treatment plant and boat launch.

Overwater Buildings Q&A

Question	Answer
Is relocating only the overwater buildings less extreme than relocating all of downtown? Can we maintain Front Street, keep commercial retail on the landward side, and create a water-oriented public promenade on the water-side?	Yes, one option is to turn Front Street into a pedestrian-only road. Business owners are may be able to relocate within the same parcels or elsewhere in town. This could range from accommodating and changing some buildings in place to, in the long term, abandoning and moving some buildings, or even relocating all of downtown.
How does the timeline of the action plan account for the need to plan for sea level rise impacts by 2050, considering the damage seen during recent storms?	The damage a few years ago was extensive in some buildings, like Kingfisher bookstore, where the lower floor was flooded. It's reasonable to abandon and change the use of those lower floors over the coming decades, to buy more time for long-term solutions. Planning long-term solutions can take 5 years, and another 5 years to implement. Relocation is not necessary in the short-term.
My concern is that if we look at elevating the water-side structures, we may also have to look at raising the land-side structures and utilities, just to keep everything congruent. There's got to come a point where you can't just keep raising structures. From my perspective, we may need to consider relocating all of downtown (in a very long-term range). I'm also concerned about these structures having to abandon lower floors. With businesses like Salty Von having invested millions into its lower floor, having to vacate would not be financially	One of the near-term actions we have is further preliminary assessments, looking at individual buildings to see if it's feasible to move them. That is part of the near-term solution. One of our key findings is that elevating these older buildings would be very problematic. In general, it will be a lot easier to deal with the lower floors separately.



feasible. I worry that making changes in 2050 may be too late.	
Can we consider the region's tribal history when planning? Could abandoned lower floors become wet zones for paddlecraft, enhancing Coupeville as a destination for kayaks and canoers? Have the lower Skagit and Snohomish people been consulted about their tradition of water travel and Coupeville's historical significance?	That's a good idea. The Town invited tribal representatives to CCC meetings, but they couldn't attend. We're coordinating separately with them. Our outreach focuses on the shoreline as an archaeological and cultural resource, and best practices for when sea level rise and erosion uncover cultural sites. Repurposing lower floors for boat storage is an interesting idea that could be investigated further.
Are the owners of the overwater buildings being consulted?	Yes. We had some building owners on the CCC originally, but they had scheduling conflicts. Part of this next phase, with the survey and beyond, will include reaching out to them to present what we have and get their ideas about what actions they see as viable. Some of the building owners were involved in the vulnerability assessment engagement, and have been invited to participate in these meetings, the open houses and the survey.
How will the City handle privately-owned buildings differently from municipal assets like roads and sewers? Will it involve zoning or purchasing properties?	One of the big takeaways is that we need to do our own further planning for the downtown area, in collaboration with property-owners.
I'm curious—when presenting recommendations like this with such long-time horizons to building owners in their 60s and 70s, how have they responded?	Some people familiar with the code and environmental issues want to think long term and jump to the final solution. However, building owners facing expensive projects often just want to buy another ten years before selling their business. This is new ground locally.

Roads and sewer lines

Question/Comment	Answer
Would the beach nourishment be done with infill from other beaches on Whidbey Island, or would it be imported from off-Island?	Generally, gravel and sand from upland pits would be used.
I would strongly caution that beach nourishment be done with incredible caution if done at all. It may smother organisms already there, or add silt to the water that could harm shellfish.	Those are all considerations. Silt would generally never be imported. We don't want to cause turbidity. The other side of the coin is that this is a long-term degraded beach due to lack of natural sediment inputs. If designed



	properly, beach nourishment could actually help forage fish spawning.
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Wastewater Treatment Plant

Question/Comment	Answer
I was pleasantly surprised at how well prepared the WWTP is. It's not really threatened until 2100. That's great to see.	Noted.
I think the whole CAS was very well done. I appreciate each recommendation being screened through the different lenses, and allowing potential objections to the various courses of action to be alleviated before the reader gets to the summation. Kudos for that. I would maybe add some caution on using language like "not recommended" on options that people may choose anyway. Consider how lawmakers can incentivize socially responsible behavior.	Great point. The SMP is in process of being updated to include SLR planning within the code. Hopefully that continues to happen.

Survey

Consultants told the group about the community survey and encouraged them to share it with their networks.

Climate Element Update

Consultants from Facet NW provided an update on their development of the Town's Comprehensive Plan Climate Element and set up the next CCC meeting which will focus on their work.

The meeting concluded at 11:30 a.m.



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Appendix F

April 23, 2025 Public Open House Notes



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Meeting Details

Date: April 23, 2025

Time: 6:00 PM-7:30 PM

Location: In-Person at the Coupeville Recreation Hall

Attendees

- Attendees omitted for privacy.
- Meeting facilitated by Town staff and consultants from Natural Systems Design (NSD) and Maul Foster & Alongi (MFA)

Notes

The meeting commenced at 6:05pm.

Introduction

Joshua Engelbrecht (Community Development Director, Town of Coupeville) began the meeting with introductions and an overview of the Coastal Adaptation Strategy (CAS).

Overview of the CAS

Consultants from MFA and NSD reviewed the purpose of the Coastal Adaptation Strategy and the project schedule. They provided an overview of the adaptation strategies recommended in the draft Strategy and welcomed questions from attendees.

Feedback on Draft CAS

Consultants led an interactive feedback session in which attendees visited posters for three vulnerable assets explored in the CAS, indicated support for their preferred course of action through a dot poll, and left comments on sticky notes.

Asset	Dot poll votes	Comments
Roads and sewer lines	<ul style="list-style-type: none">• Soft shore protection: 2 dots• Hybrid protection: 1 dot• Vegetation and drainage improvements: 1 dot• Evaluation and survey of sewer lines and roads: 1 dot	<ul style="list-style-type: none">• Relocation of roads might not be ideal for some neighborhoods• What is the impact of drift sills on invertebrate, animal, and plant movement?
Wastewater Treatment Plant	<ul style="list-style-type: none">• Construct new WWTP away from shore: 4 dots	<ul style="list-style-type: none">• Funding from state in conjunction with habitat restoration?• Properties already owned by Town would provide good placement for plant• Removal of old plant means opportunity for more recreation• If sewer infrastructure will need replacement within the next 30

		years, we should just go ahead and move the WWTP now.
Overwater Buildings	<ul style="list-style-type: none"> • Floodproofing structures: 3 dots • Increase elevation of buildings: 3 dots • Repair/construction of hard armor: 1 dot 	<ul style="list-style-type: none"> • Reconstruction is an absolute no go- Buildings are too important • Dead last alternative [placed on reconstruction option]



Appendix G

Written Comments



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Additional written comments related to the Coupeville Adaptation Strategy received by the Town of Coupeville over the course of the project are included below.

Written Comment #1

Date: 10/03/2024

Summary:

The comment from an overwater building owner emphasizes the need for viable solutions to address sea level rise. They highlight the importance of adhering to WAC 173-26-231, which allows structural shoreline modifications to protect primary structures or legally existing shoreline uses in danger of loss or substantial damage. The commenter insists that solutions must include options waterward of the ordinary high-water mark and consider the construction of existing overwater buildings. They also stress the impracticality and harm of raising existing buildings and the need to recognize existing armoring in the HLC, especially given Penn Cove's status as a travel zone and the associated difference in armoring impact.

Written Comment #2

Date: 3/21/2025

Summary:

The comment from an overwater building owner voices dissatisfaction with the framing of the available options presented in the public survey. They emphasize the need to consider the different states of each overwater building, and consider remedies as unique as the buildings themselves. They wish to ensure that despite the recommendations in the Strategy, that the Town does not create policies that require overwater building owners to take steps as drastic as abandoning lower floors, or that prevent them from using the strategies available to them within the bounds of state law to protect their properties.



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