

SEA-LEVEL RISE POLICY:
AN ILLUSTRATED GUIDE

TASK 6, REPORT #8: ILLUSTRATED REGULATORY GUIDE FOR SEA-LEVEL RISE

Suggested Reference:

Cook, B., Cheng, A. & Fernandez, S. (2021). Land Regulatory Response to Sea-level Rise: Illustrated Regulatory Guide for Sea-Level Rise (Report #8). For the City of Tampa.



INTRODUCTION

This *Sea-Level Rise Policy: An Illustrated Guide* is an accompanying document to the “Land Use Regulatory Response to Sea-Level Rise” project, funded by the Florida Department of Environmental Protection (Agreement #R2129) and commissioned by the City of Tampa. This project investigates sea-level rise policy options to form a consolidated toolkit for municipal use. To make the information accessible, a few of the main strategies are shown with 3-dimensional illustrations. Policies that affect or could be used by homeowners are also shown and noted.

Information on the following pages are not specific recommendations. Each community should evaluate their risk from sea-level rise, their particular geography, and their capacities for change in order to select appropriate policies. More information about that topic is addressed in Report #7 for this project, the *Implementation Plan*.

Information and organization of policies is based on regulatory documents used in Tampa, Florida (shown at right). This list may vary in other municipalities.

Existing Code

Each municipality will have its own set of codes that relate to sea-level rise, to varying degrees. However, this study found no examples where a comprehensive approach has been established. Many municipalities are in the assessment and decision-making phase but have not yet created a complete package of regulations and planning strategies

The following pages refer to existing code, as found to be typical for most municipalities, depicting the policy's impact on spatial form and character.

Within the City of Tampa, documents include:
The Comprehensive Plan

The Code of Ordinances:

Ch. 5: Building Code

Ch. 16: Parks and Rec

Ch. 19: Property Maintenance and Structural Standards

Ch. 21: Stormwater Management

Ch. 22: Streets and Sidewalks

Ch. 25: Transportation

Ch. 26: Utilities

Ch. 27: Land Development Code

Stormwater Technical Standards

Transportation Technical Manual

Regionally, policy documents include:
Policies under the Environmental Protection Commission (EPC)

The Local Mitigation Strategy (LMS)

The Post Disaster Redevelopment Plan (PDRP)

Example Page

TITLE <i>Policy Location</i>  ← Homeowner's Icon (If Applicable)	
<div style="border: 1px solid black; width: 100%; height: 100%; text-align: center; vertical-align: middle;">Introduction</div>	ASSOCIATED POLICIES <i>Policy Description</i> <i>Policy Example and Sources</i>  ← Homeowner's Icon (If Applicable)
Existing or Proposed Policy	Proposed Policy
<div style="border: 1px solid black; width: 100%; height: 100%; text-align: center; vertical-align: middle;">Illustration</div>	<div style="border: 1px solid black; width: 100%; height: 100%; text-align: center; vertical-align: middle;">Illustration</div>

SEA LEVEL RISE SCENARIOS IN TAMPA

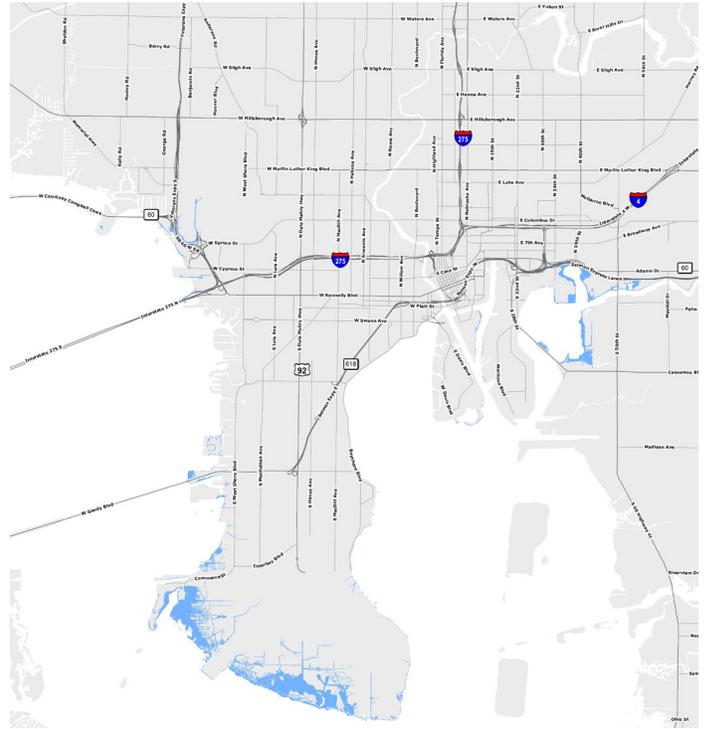
Based on the St. Petersburg tidal gauge, coastal waters have risen 7.8 inches since 1946 (CSAP, 2019). Going forward, the Tampa Bay Regional Resilience Coalition suggests that Tampa can expect 1.15 to 3.48 feet of change by the year 2060 and 2 to 8.5 feet by the year 2100 (CSAP, 2019). The chart below shows projected change in ten-year increments, from the year 2000.

Year	NOAA Int-Low (feet)	NOAA Intermediate (feet)	NOAA High (feet)
2000 ³	0	0	0
2030	0.56	0.79	1.25
2040	0.72	1.08	1.77
2050	0.95	1.44	2.56
2060	1.15	1.87	3.48
2070	1.35	2.33	4.56
2080	1.54	2.82	5.71
2090	1.71	3.38	7.05
2100	1.90	3.90	8.50

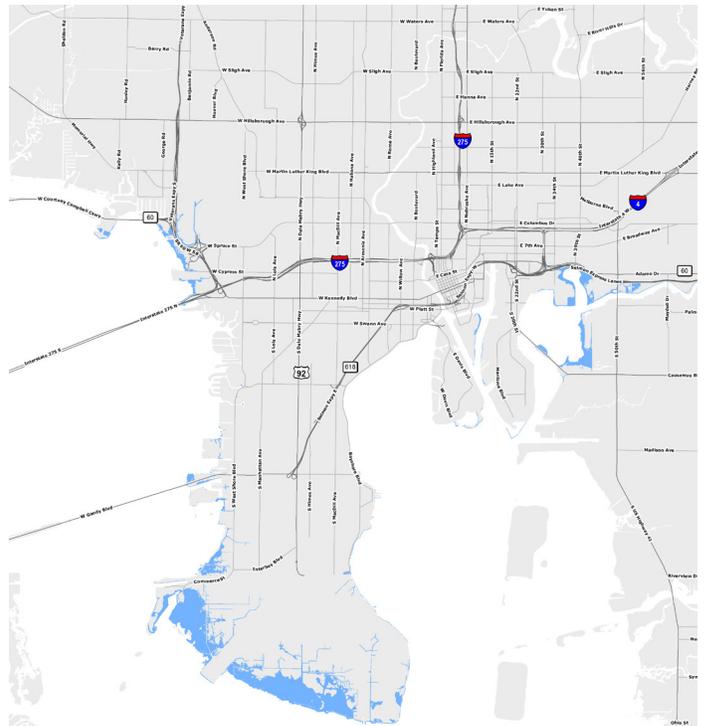
According to the *Recommended Projections of Sea Level Rise in the Tampa Bay Region* report (CSAP, 2019), the heights and likelihood of each scenario are as follows:

- “NOAA Intermediate Low (1.9 feet by 2100): This scenario represents a slight increase in the rate of SLR. Low end of very likely range if greenhouse gas emissions continue current trends (RCP8.5).
- NOAA Intermediate (3.9 feet by 2100): This scenario represents a moderate increase in the rate of SLR. High end of likely range if greenhouse gas emissions continue current trends (RCP8.5).
- NOAA High (8.5 feet by 2100): This scenario represents a significant increase in the rate of SLR. High end of very likely range if greenhouse gas emissions continue current trends (RCP8.5) and when accounting for possible ice sheet instabilities.” (CSAP, 2019)

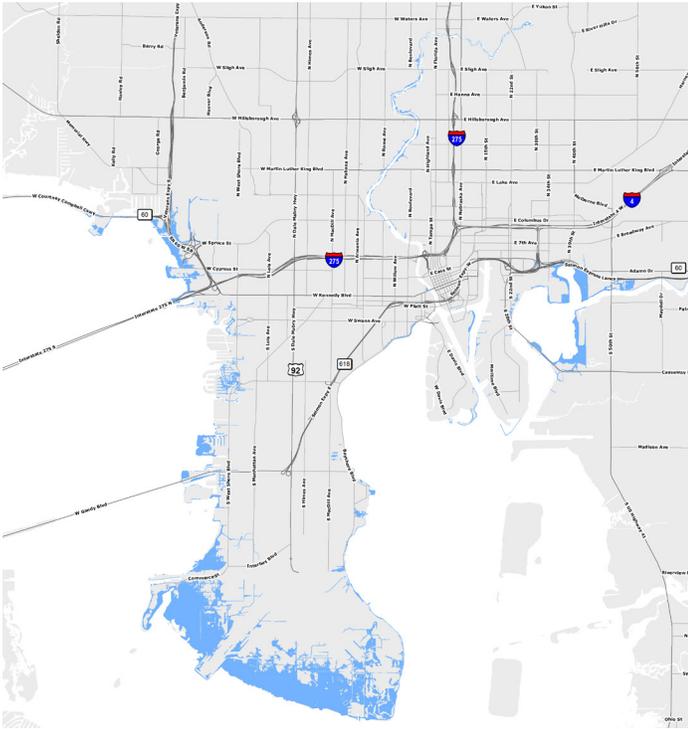
2045 Intermediate



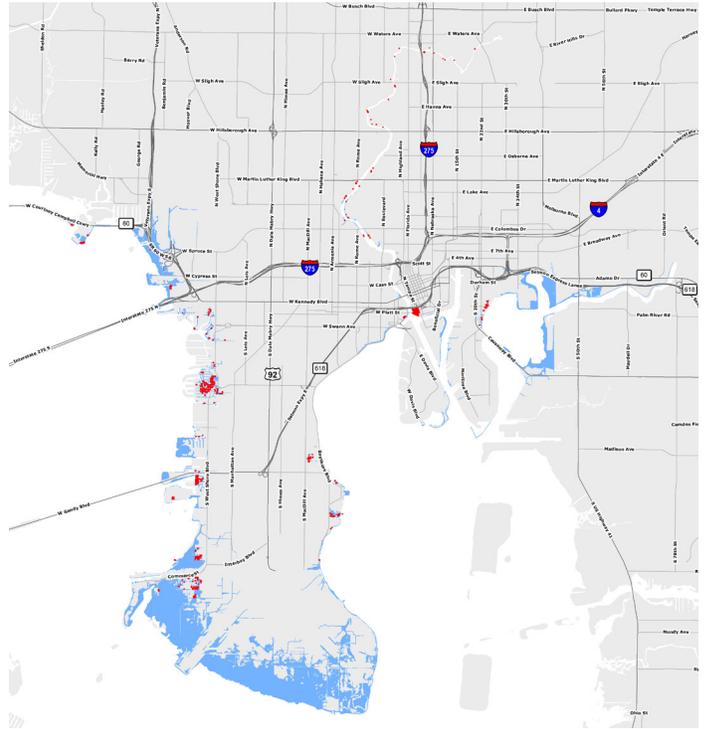
2045 High / 2060 Intermediate



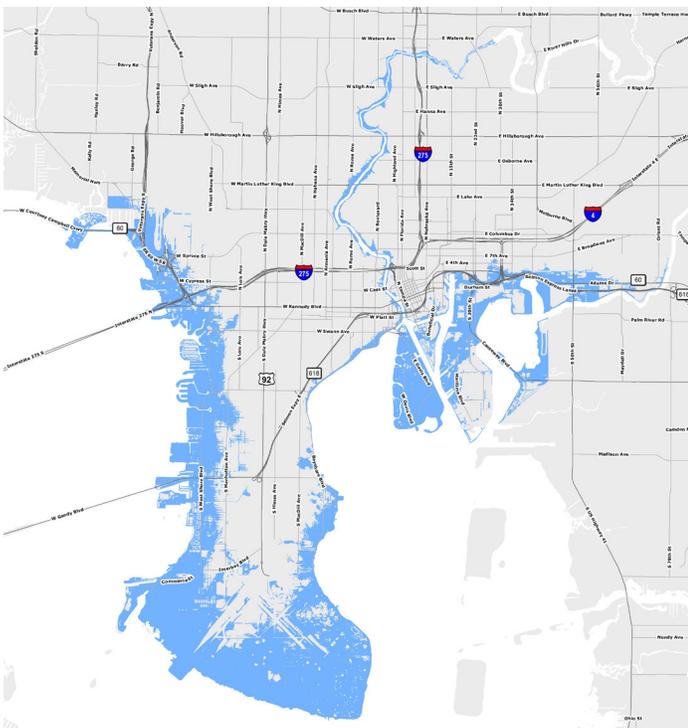
2060 High / 2100 Intermediate



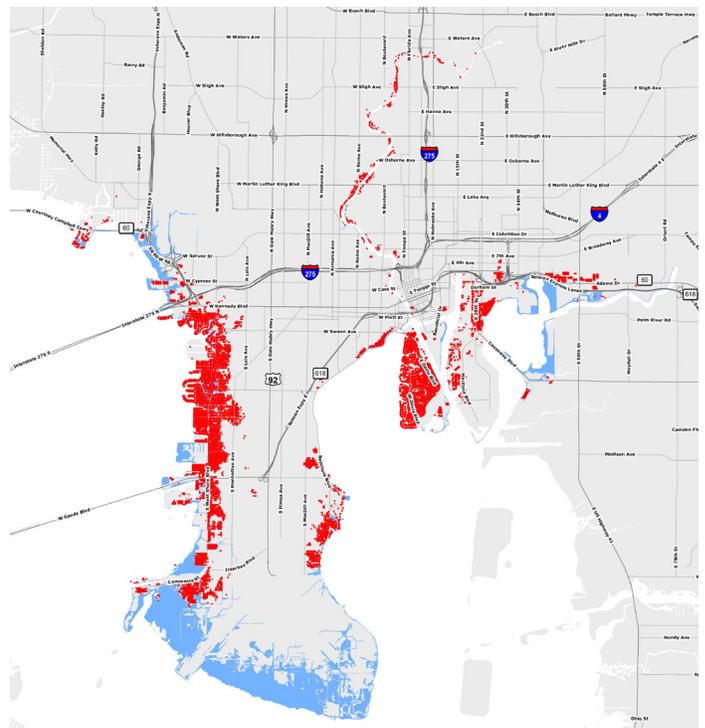
... with Buildings Impacted



2100 High



... with Buildings Impacted

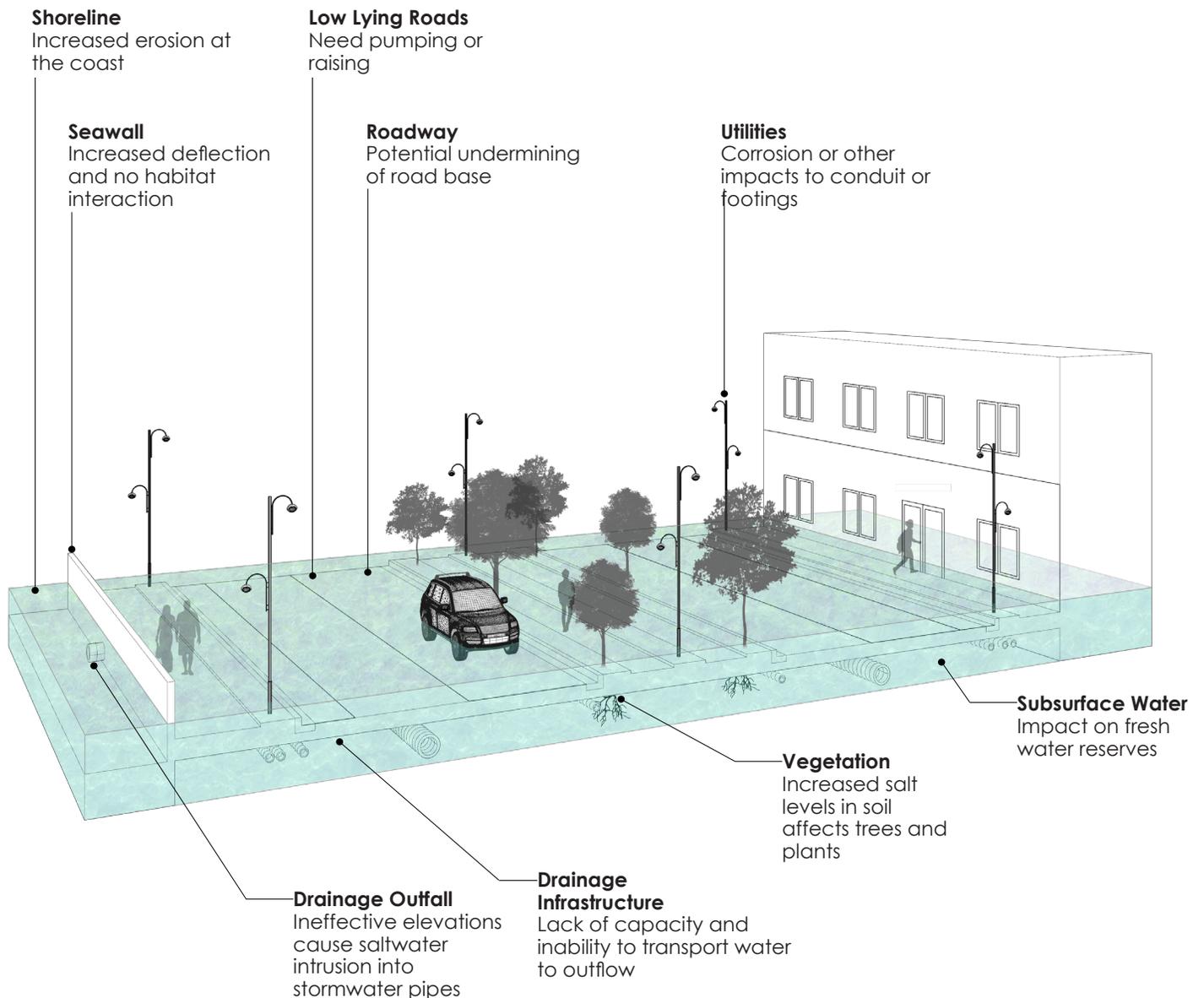


POTENTIAL IMPACTS

Before roads are flooded and structures are damaged (elements that are mapped in this study), there are other and less obvious impacts that relate to sea-level rise. Increased groundwater elevations can impact drainage pipes and outfalls, water detention storage volumes, soils, plant roots, and utilities (Applied Sciences, 2020; Sherwood et al., 2019; ESA, 2016; Davtalan et al., 2020). Especially with Tampa's regionally porous soil and high water table, sea-level rise poses risk from below as much as it does in overtopping at the edges.

Coastal armoring is often considered as an approach to mitigation. This may help to protect

from storm surge during event-based flooding. Higher surge heights are a compounding factor of sea-level rise. However, it will not stop the impacts of increased groundwater heights. Consequently, coastal armoring has its limits as a mitigation strategy. For example, with the flooding that occurred last year at Shore Acres, in St. Petersburg, water was concentrated in inland roadways and not at the coast (Fernandez, 2020). Structures such as sea walls also inhibit habitat migration as the coastal gradient is disrupted, and amplify wave action causing increased scouring, erosion and sediment transport.



EXAMPLE REGULATORY POLICIES TO ADDRESS SEA LEVEL RISE

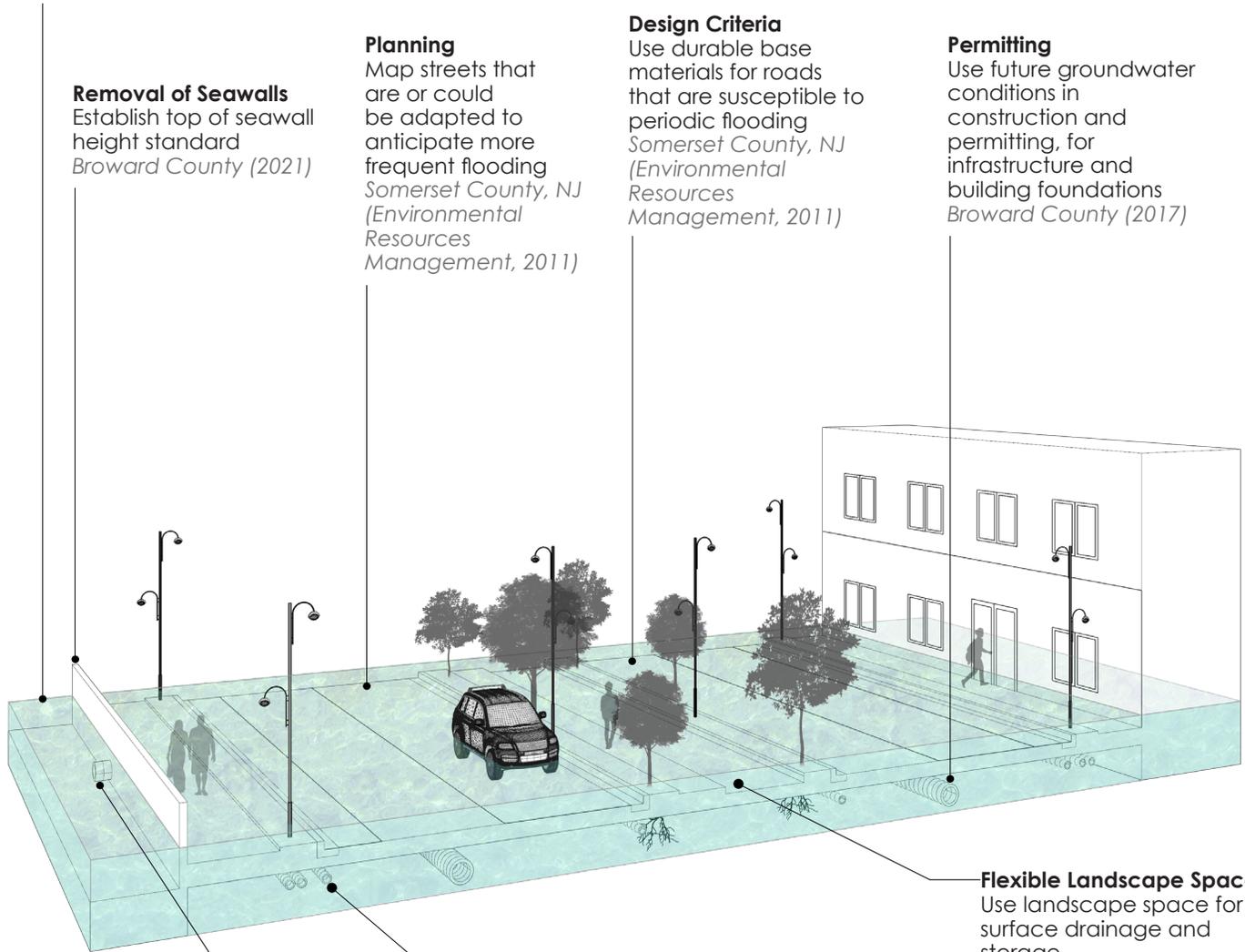
Natural Shoreline
 Integrate soft armoring
 (natural infrastructure)
 on water's edge
*The Florida Adaptation
 Planning Guidebook
 (Donaldson, 2019)*

Removal of Seawalls
 Establish top of seawall
 height standard
Broward County (2021)

Planning
 Map streets that
 are or could
 be adapted to
 anticipate more
 frequent flooding
*Somerset County, NJ
 (Environmental
 Resources
 Management, 2011)*

Design Criteria
 Use durable base
 materials for roads
 that are susceptible to
 periodic flooding
*Somerset County, NJ
 (Environmental
 Resources
 Management, 2011)*

Permitting
 Use future groundwater
 conditions in
 construction and
 permitting, for
 infrastructure and
 building foundations
Broward County (2017)



Drainage
 Increase tailwater
 elevations
*City of Tampa
 (Applied
 Sciences, 2020)*

Design Criteria
 Require stormwater
 drainage facilities and
 systems to be designed
 to an established level of
 service standard in order
 to provide protection
 from flooding
Pinellas County (2017)

Flexible Landscape Space
 Use landscape space for
 surface drainage and
 storage
City of Boston (2019)

PLANNING POLICY

Some policies will not directly impact physical property, but will change planning and permitting processes or will help to educate the community. These types of structural regulatory options are described in the following pages.

PLANNING FOR A FUTURE SCENARIO

Comprehensive Plan

The most fundamental regulatory change involves acknowledging that sea-level rise is occurring and using an agreed-upon future forecasted scenario, or set of scenarios, for planning and capital improvements. The most common outlook uses a 50 year horizon for actionable policy with an eye on potential conditions in the year 2100 (Broward County, 2021; Charleston, 2019; San Francisco Planning, 2021; City of Norfolk, 2016; Ankersen, 2010). This would affect standards for construction, land use, drainage, building heights and other aspects of the built environment.

San Francisco: Future Conditions Flood Map



San Francisco acknowledges that "Sea-level rise is a slow-moving threat, but it demands immediate action." (San Francisco Planning, 2021) In order to begin planning and assessment work toward the future, the municipality has instituted the use of a Sea-Level Rise Action Plan and identifies their "vulnerability zone" as the area that is within 108 inches above today's high tide line. This includes measurements associated with storm surge with the addition of sea-level rise in the year 2100, with the High scenario. This map is used to create a 'Vulnerability and Consequences Assessment.' (San Francisco Planning, 2021) The zone is also used to identify and frame goals for capital projects.

PLANNING POLICY

ASSOCIATED POLICIES:

Support local and regional mapping, modeling and monitoring programs to assure the most current and locally-specific data on climate change vulnerability and sea-level rise is available.

This includes impacts on groundwater levels, saltwater intrusion, and drainage infrastructure.

(Tampa Bay Estuary Program, 2020)

Include an agreed upon sea-level rise scenario, or scenarios, on the Future Land Use Map.



Create community funding streams for mitigation or adapting to future challenges due to sea-level rise.

Require stormwater drainage facilities and systems to be designed to the established level of service standard in order to provide protection from flooding.

This should include impacts from reduced storage and percolation from increased groundwater levels and outflow tail water elevations.

(Pinellas County, 2017; Broward County, 2017)



Require mechanical, electrical and plumbing (MEP) systems to be designed and installed to recognize anticipated flooding and groundwater conditions.

Somerset County Rising Sea Level Guidance. Maryland Jurisdictions (Environmental Resources Management, 2011)

Coordinate between agencies, within and external to government, and within and external to specific governmental departments, to address sea-level rise.



Educate the public about climate and environmental change. Establish neighborhood level planning groups and/or representation. Create an online digital database for flood elevation certificates.

Set targets and reduce greenhouse gas emissions.

Consider issues of equity, (climate) gentrification and other social factors of coastal communities when creating sea-level rise policy.

Plans for bridges shall be submitted to the City for approval and evaluated against a target sea-level rise scenario.

Exclude heavy industrial use sites in areas vulnerable to sea-level rise or future levels of storm surge due to sea-level rise.

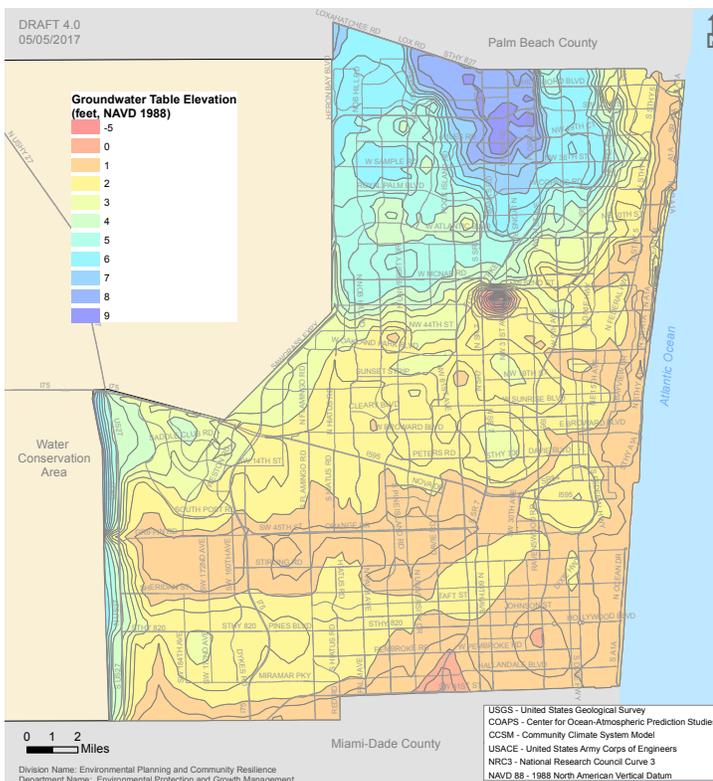
GROUNDWATER

Comprehensive Plan

As sea-levels rise, water in the soils does also. It should be considered as a big plane, continuous where it is and isn't visible. This can create multiple problems for our built environment. Increased ground water levels affect the soil's capacity to hold water, which infiltrates from the surface. This decreases the efficiency of retention and detention ponds, and exfiltration vaults. Groundwater can also fill stormwater sewer systems, eventually spilling into streets, and it can change the composition of soils, harming plant roots subsurface and utilities (Applied Sciences, 2020; Sherwood et al., 2019; ESA, 2016; Davtalab et al., 2020). Especially with Tampa's regionally porous soil and high water table, sea-level rise poses risk from below as much as it does in overtopping at the edges.

Getting an idea of future groundwater heights can help to build for future conditions and to maintain functionality.

Broward County: Future Conditions Groundwater Map



The 'Broward County Future Groundwater Elevations' map represents the projected average wet season groundwater elevations for Broward County. The average is based on model outputs for the months of May through October over the period of 2060-2069. The models used are the Broward County Inundation Model and the Broward County Northern Variable Density model, both developed by the USGS and MODFLOW based.

PLANNING POLICY

ASSOCIATED POLICIES:

Identify areas to remove septic and consider higher groundwater elevations for future installation.

Groundwater can intrude into septic or other hazardous stored materials, causing leaching into the soils and failure within the system.

Worcester County Sea Level Rise Guidance. Maryland Jurisdictions (Environmental Resources Management, 2011); Recommendation from Florida International University (Harris, 2019)

Require stormwater drainage facilities and systems to be designed to the established level of service standard in order to provide protection from flooding.

This should include impacts from reduced storage and percolation from increased groundwater levels and outflow tail water elevations.

(Pinellas County, 2017; Broward County, 2017)

Demonstrate that drainage or pumping will not deplete groundwater or cause saltwater intrusion, in residential development on shorelines subject to tidal action.

Pacific County, Washington: SMP Ocean Coast Requirements (Land Use Law Center)

Use more durable base materials for roads to withstand periodic flooding and improve road bedding as groundwater levels rise.

Somerset County Rising Sea Level Guidance. Maryland Jurisdictions (Environmental Resources Management, 2011)

Develop a regional hydrologic model that measures groundwater underflow.

Long Island South Shore Estuary Reserve Act; Long Island South Shore Reserve's Comprehensive Management Plan: Implementation Chapter (Land Use Law Center)

FLEXIBLE LANDSCAPE SPACE



| Comprehensive Plan, Land Use Code

Sea-level projections have a wide range of expectations; in Tampa anywhere between 1.9 to 8.5 feet by the year 2100. In order to minimize future risk to this changing condition, cities will benefit by creating flexibility at the edge of hydrologic systems. This strategy has multiple benefits. Giving room for landscape can help to maintain ecosystem functionality, which is responsible for nutrient reduction, habitat, climate stabilization and can be used as recreational space. If coordinated, open space at the shoreline can provide value while also mitigating future flood conditions.

Climate Ready Boston



Climate Ready Boston's completed a vulnerability assessment to identify communities in the region that are most at risk to sea-level rise. In East Boston and Charlestown, the team led by Stoss Urbanism, developed coastal resilience plans that prioritized flexibility, value creation and creating new infrastructure. The plans mitigate flooding issues from sea-level rise while also solving some of the day-to-day problems expressed through the community engagement process.

ASSOCIATED POLICIES:

Place a high priority on acquiring and preserving open space lands for purposes of recreation, habitat protection and enhancement, flood hazard management, public safety, and water resources protection.

This includes potential buyouts for repetitive loss properties, especially where conservation goals can be met.

Climate Ready Boston (City of Boston, 2017)

Restore hydrologic eco-hydric function in the ecosystem, as feasible.

Consider landscape ecosystems as a partner is confronting the challenge of sea-level rise. Healthy habitats can play a large role in mitigating erosion and can provide higher levels of accretion in coastal soils, over time. (FCCDR, 2020)

Leverage the landscape area trust fund for the purchase and maintenance of parks in mitigating the effects of sea-level rise.

Consider passive educational opportunities in public parks.

Provide mitigation credits for stormwater improvement through natural systems.

City of Tampa (2021a)

Set roads back from wetlands and waterways to account for determined future sea-level rise scenario.

CLUSTERED DEVELOPMENT

 | Comprehensive Plan, Land Use Code

Clustering development allows flexibility in water management. Whether at the scale shown below, or at a much larger scale, coordinating concentrations of housing can create opportunities to increase the greater area of landscape space and also physical adaptability to future conditions.

ASSOCIATED POLICIES:

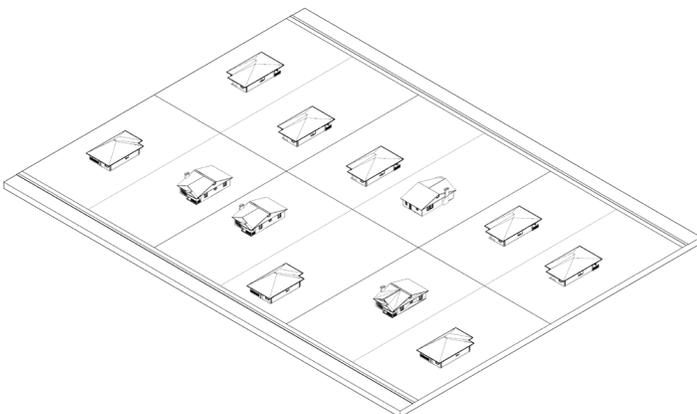
Require a significant portion of the subdivision be set aside for open space (e.g., at least 50% for a subdivision with sewer lines), and include wetland buffers, among other requirements.

Scarborough, Maine (Center for Coastal Resources Management, 2020)

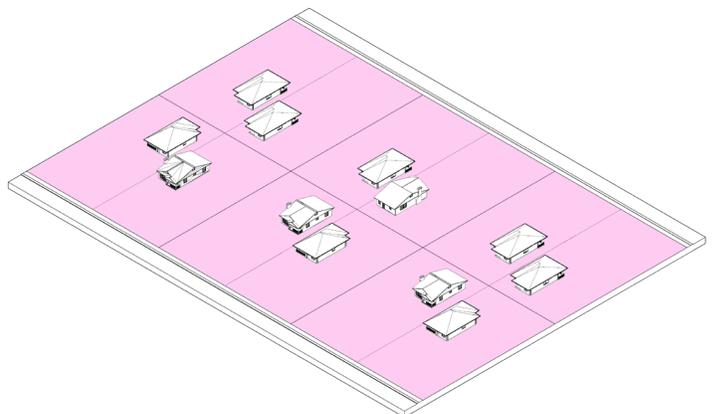
Promote clustered, mixed-use development, site development around infrastructure, and preservation of open space.

Maryland Growth Act and Smart Growth Initiative (Grannis, 2011)

Existing Policy



Proposed Policy



SEA LEVEL RISE VULNERABILITY AREAS AND OVERLAY ZONES

Land Development Code

Distinct geographic areas, or zones, impacted by sea-level rise are recognizable within the maps. Similarities in topography and spatial distribution create clusters of property that will be similarly impacted, and have common community characteristics.

Acknowledging this may assist in creating place-based approaches and can be incorporated into a regulatory approach that creates overlay zones, similar to what is applied in other areas of the City. Neighborhood specific overlays allow communities to develop consensus around common understandings of impact and develop future goals, which can be coordinated. There are three possible overlay zones to apply:

- Areas for Protection;
- Areas for Accommodation; and
- Areas for Density Decrease and Habitat Restoration (also called "conservation zone," "managed relocation zone" or "area for retreat")

Birds-Eye Showing Extent of 2060 High and 2100 High Sea Level Rise Scenario



SEA LEVEL RISE VULNERABILITY AREAS AND OVERLAY ZONES

Land Development Code

ASSOCIATED POLICIES:

A few key concepts that may be associated with each sea-level rise overlay zone include:

Protection

- Committing to engineered solutions and community planning, with associated high cost burden.
- Establishing building standards, so that buildings and infrastructure will withstand a minimum service life of 50 years.
- Compensating for the loss of ecosystem services resulting from hard shoreline stabilization.

Accommodation

- Facilitating tidal wetland migration into upland areas, only implementing hardened shoreline stabilization where critical or where there is no other alternative.
- Increasing setback requirements
- Incentivizing or regulating density reduction. This includes transfer of development rights and rolling easements
- Purchasing of or incentivizing relocation of ownership for repetitive loss properties.
- Raising the design flood elevation to account for tide induced flooding and increased heights of storm surge.

Decreased Density and Habitat Restoration (Conservation)

- Incentivizing reduction of density through the programs described in areas for Accommodation, such as transfer of development rights and rolling easements.
- Restricting shoreline armoring to soft or natural solutions.
- Place a priority on coastal land acquisition through various funding or program opportunities.
- Prohibit densification
- Enacting post-storm measures that include building moratoria and a program for rapid acquisition of land.

Areas that opt for Decreased Density may live in a state of 'Accommodation' while monitoring the change of sea-level. Raising houses and living with water temporary inundation may allow property owners to maintain habitability. However, permanent flooding will make matters very difficult and in some locations community members will have to choose between either protectionist strategies through infrastructure, with a high cost burden, or vacating the area.

Regulatory options such as tax credits, purchased conservation easements and trade-offs in development rights can help to support citizens that find themselves in a precarious situation. These strategies will be described further throughout this report.

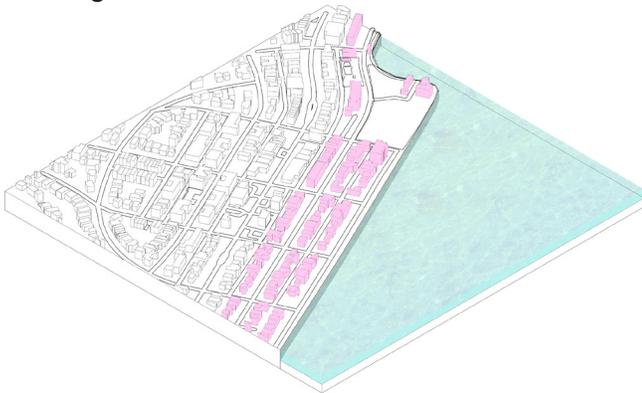
TRANSFER OF DEVELOPMENT RIGHTS

 | Land Development Code

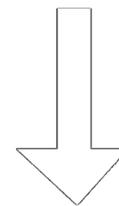
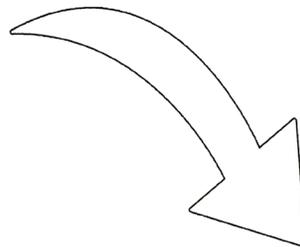
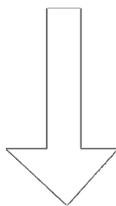
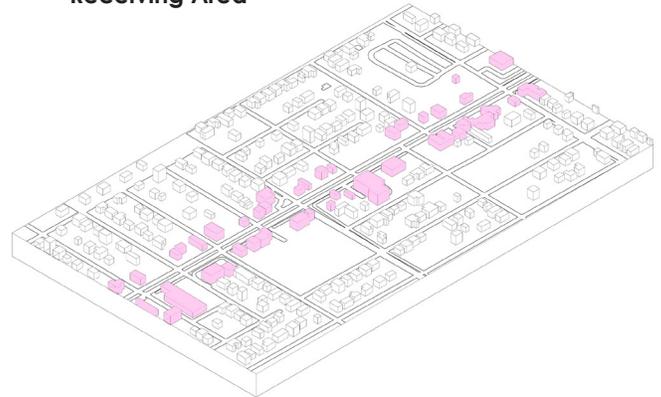
Transfer of development rights offer a unique strategy to support property owners through this difficult process while creating value in other parts of the city. A transfer of development right (TDR) program establishes “sending zones,” in locations where the goal is to reduce density. In other areas, near transportation hubs or commercial districts for instance, “receiving zones” are created.

Density bonuses and other incentives can be associated with properties in sending areas. If purchased, a density bonus, for example, could be applied in another location within the city giving a developer opportunity to build higher with more units. This creates additional financial opportunity and the clustering of population density can stimulate commercial and transportation opportunities. This provides additional value for the sale and subsequent conservation of properties in areas vulnerable to sea-level rise, offsetting value lost.

Sending Area



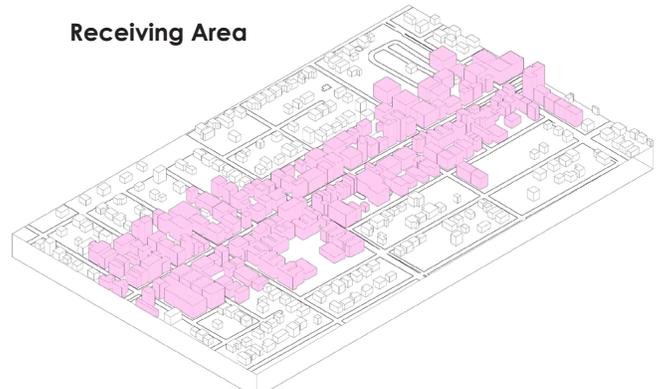
Receiving Area



Sending Area



Receiving Area



PLANNING POLICY

ASSOCIATED POLICIES:

Establish and calibrate a development credit market in a manner that gives affected landowners an incentive to transfer their development rights rather than build on threatened properties.

Implementation of Transferable Development Credits in a SLR Context (Grannis, 2011)

Consider using transferable development rights to compensate landowners for development restrictions (used in conjunction with land-use regulations), as financial compensation or as incentives.

Dade County, Florida (Grannis, 2011); (Southeast Florida Regional Climate Compact, 2019; Donaldson, 2019)

Require developers to acquire and extinguish a TDR from a substandard lot before they can get approval for a new subdivision.

Malibu, California (Grannis, 2011)

Utilize a development credit bank to facilitate transfer of credits and ensure a floor price for credits.

New Jersey Pinelands Program (Grannis, 2011)

Provide bonuses in receiving areas for suburban communities that can support more intense or dense uses in specific areas.

Massachusetts (Grannis, 2011)

ROLLING EASEMENTS



| Land Development Code

Through the regulatory concept of “Rolling Easements,” property is purchased for conservation purposes by the municipality (or a part of the property), or it is purchased by another entity and transferred to municipal ownership. However the occupant is able to stay until the property is unsuitable for inhabitation. Rather than losing all value for the property owner, or succumbing to the high cost of protective measures, this strategy provides assurances for both the owner and the municipality, and can be factored into future sea-level rise planning. If the municipality purchases the land, in order to mitigate their own financial hardship they may charge an annual rent at or below fair market value. This rent would generate funds to clean up the site and restore habitats once structures are abandoned (remember the long timeline associated with this process of sea-level rise) (Titus, 2011).

Other incentives can be added, such as tax benefits for putting land into conservation (for more information, see Titus, 2011). Rolling easements can also work in conjunction with transfer of development rights. In that scenario, the developer would buy the property rights and transfer them to the municipality, but the occupant could stay until the property is substantially inundated.

This strategy also allows the individual to make their own decision about comparable risk and value. A program can be structured so that the municipality offers price options, which are graduated over time, with initial planning efforts. This would incentivize property owners to comply with the program, if deemed the most suitable response. Similar to how flood insurance works, if land-holders are not concerned about their risk they could abstain from the program. However, their potential compensation would decrease over time (see diagram).

ASSOCIATED POLICIES:

Reevaluate the existing conservation easement programs to ensure that properties in vulnerable areas are eligible to receive tax credits, to ensure that property owners have sufficient incentive to sell or dedicate easements and acquire additional conservation easements along the coast to reduce development in flood prone areas that impedes the migration of coastal resources.

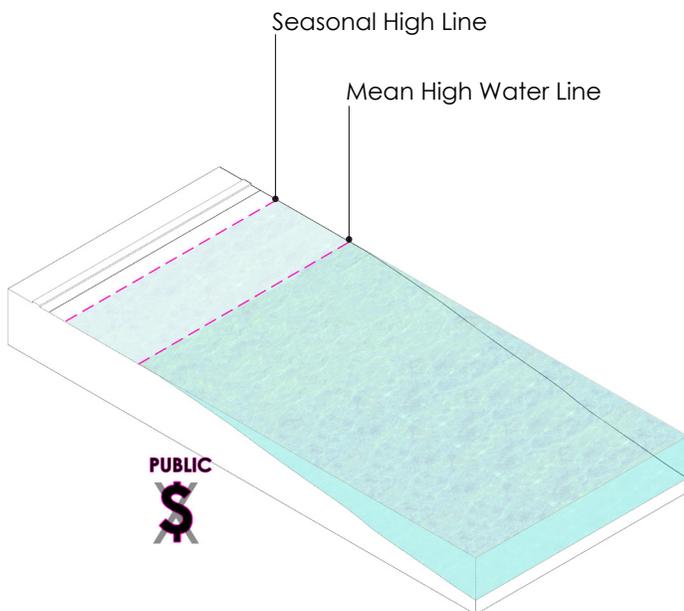
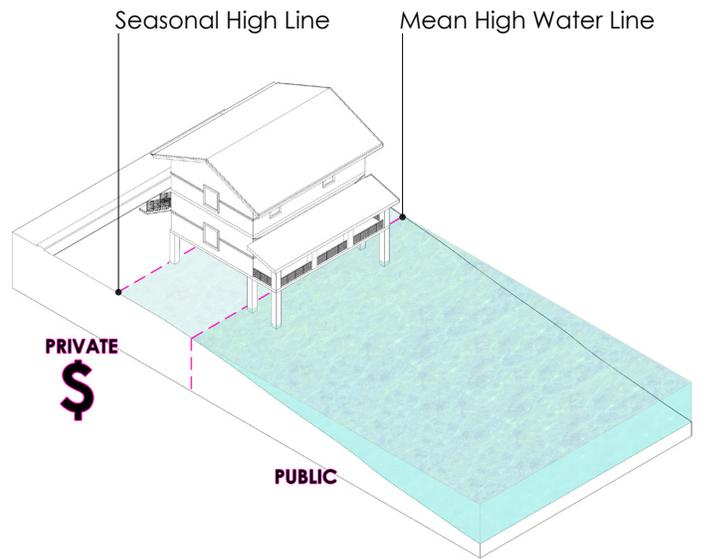
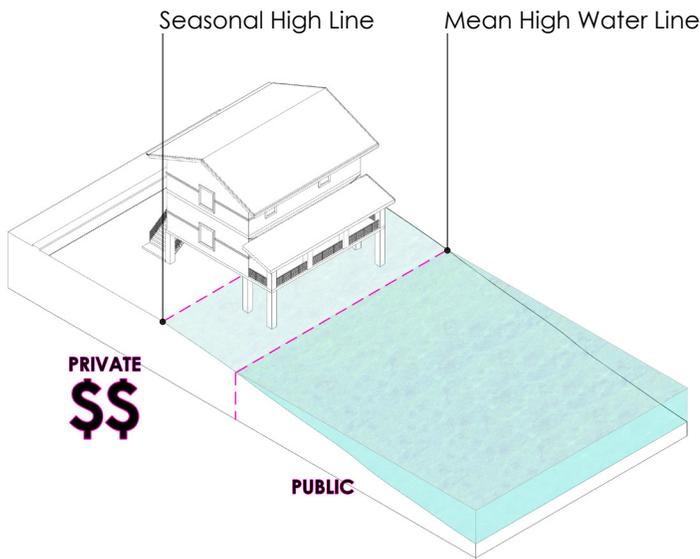
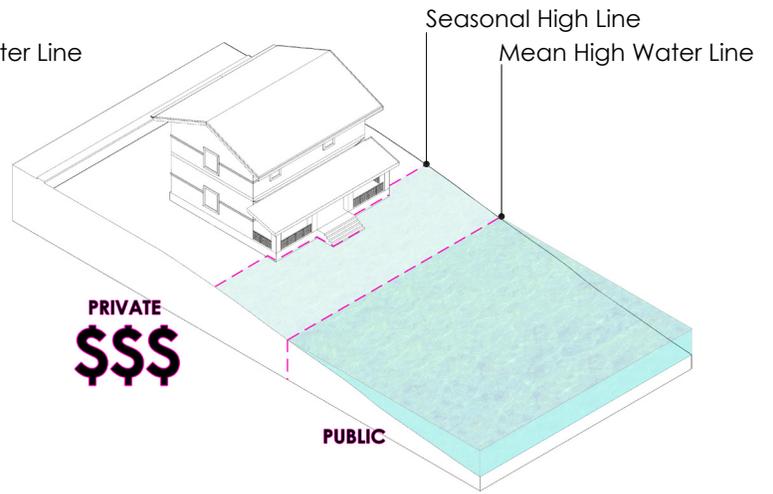
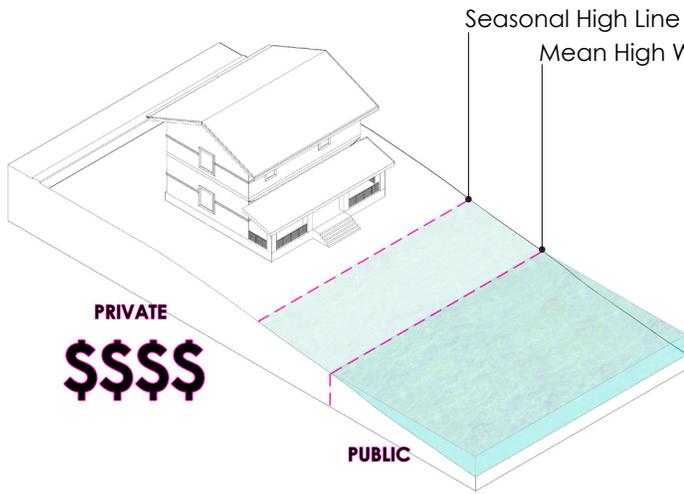
North Carolina Steering Committee; Maryland Environmental Trust (Grannis, 2011)

Utilize matching federal funds from NOAA Coastal and Estuarine Land Conservation Program (CELCP) to purchase conservation easements from coastal property owners.

NOAA Coastal and Estuarine Land Conservation Program (CELCP) (Grannis, 2011)

Offer preferential assessments to landowners who agree to conserve their property for flood control or open space purposes.

Landowners who donate easements would be assessed lesser property taxes based upon the loss of value caused by the easement terms limiting uses of the property. (Grannis, 2011)



PROPERTY POLICY

Many of these policies directly affect the ability to build, or guide building, on a parcel of land. This includes structural guidance but also siting and site development.

BUILDING HEIGHT



Current building height requirements are established through the FEMA Flood Insurance guidelines and are reinforced through the Florida Building Code. In Florida, buildings have to be constructed one foot above base flood elevation, which is associated with the 1% chance of flooding. If they are in a velocity zone (V zones according to FEMA) the bottom of the lowest horizontal structural member must be above that mark.

These codes are useful in temporary flooding conditions. However, with the onset of permanent flooding due to sea-level rise they will be less effective, since their surroundings will be under water.

Sea-level rise is a slow occurring, and properties will not immediately be in this dire situation. In the meantime, raising buildings may help with the compounding impacts from storm induced flooding, with the small addition of height from sea-level rise. Also, raising buildings will keep interiors dry during extreme high tide events.

The following drawings and descriptions explain the circumstances, requirements and options for raising buildings. Many other property regulations are involved, but when approached comprehensively they can help to mitigate near-term risk.

ASSOCIATED POLICIES:

Increase building height 1' from what is required by Florida Building Code in flood-prone areas, to 2 feet above the base flood elevation.

This strategy mitigates impacts from storm surge and flooding for future conditions, however sea-levels are expected to increase one foot in the next 20-50 years (CSAP, 2019).

Somerset County Rising Sea Level Guidance. Maryland Jurisdictions (Environmental Resources Management, 2011); Sea Level Rise: Technical Guidance for Dorchester County. Worcester County Sea Level Rise Guidance Document (Environmental Resources Management, 2011); (Harris, 2019)

Provide incentives such as a rebate of \$500 on building permit fees for inclusion of increased freeboard in the building design.

Sea Level Rise Zoning Overlay in Hull, Massachusetts (Center for Coastal Resources Management, 2020)

Allow structures to exceed the existing 25 foot height limit by the number of feet needed to raise the house to the base flood elevation, plus a maximum credit of up to 4 feet above the base flood elevation. The maximum height for any structure is set at 40 feet (15 feet above current limit).

Flood Protection Building Height exception in the zoning regulations: Key West, Florida (Center for Coastal Resources Management, 2020)

Allow height to be measured from the design flood elevation, rather than from grade, to allow buildings to meet flood-resistant construction standards.

In areas in which the base flood elevation above grade equals or exceeds four feet, rules allow height restrictions to be measured from a reference plane located higher than the design flood elevation— nine, 10 or 12 feet above grade depending on the building's use.

(New York City Planning, 2017)

PLANNING POLICY

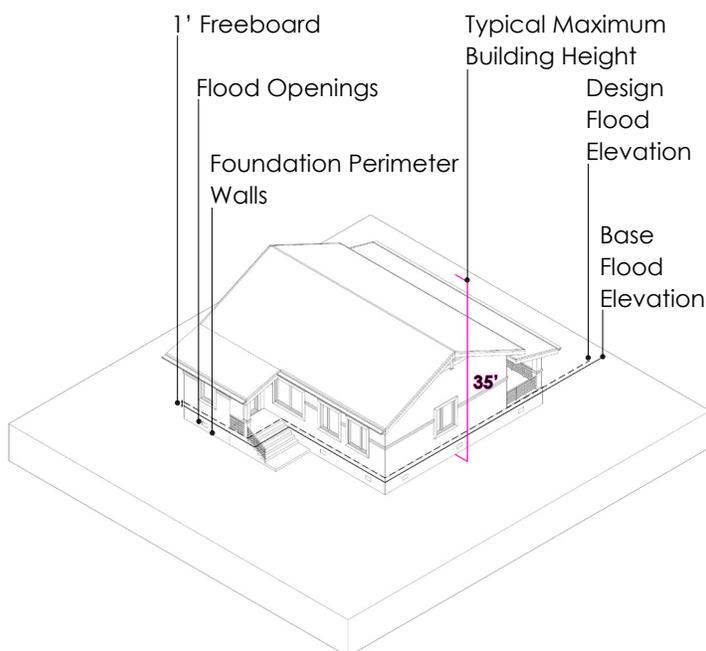
Existing Policy for FEMA A Zones

The lowest floor elevation, including basements, must be above the BFE plus 1 foot or at DFE, whichever is higher.

Building can be elevated by means of fill or solid foundation perimeter walls with opening sufficient to facilitate the movement of floodwaters. However, they cannot raise their site.

In unnumbered A zones, the lowest floor of any new construction and substantial improvement shall be located at a minimum of two (2) feet above the elevation of the highest adjacent grade.

The area below elevated dwellings may be enclosed by foundation walls or framed walls, however flood openings are required.



Existing Policy for FEMA V Zones

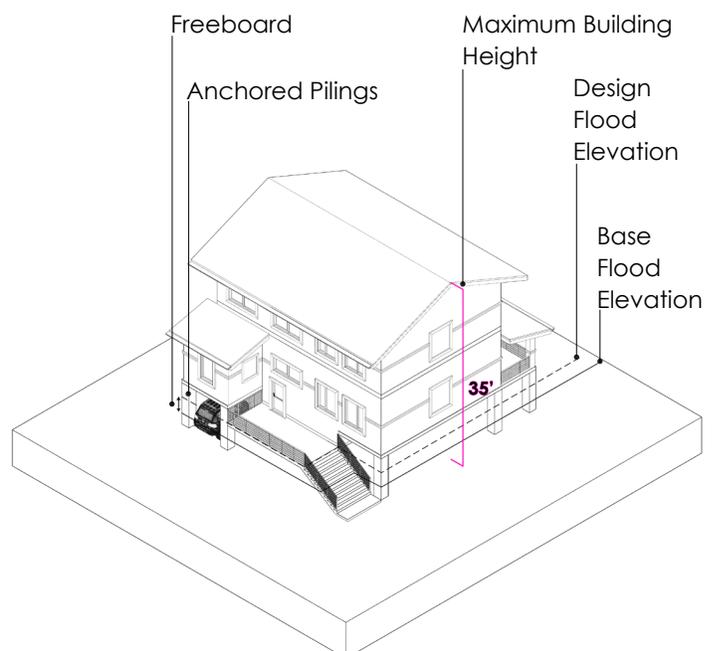
The bottom of the lowest horizontal structural member of the elevated floor shall be elevated to meet or exceed the design flood elevation

No stem walls or fixed walls are allowed.

No fill shall be used as structural support, however, non-compacted fill may be used around the perimeter of a building for landscaping/aesthetic purposes

Areas below the design flood elevation can only be enclosed with breakaway walls and cannot be used for living space. Flood openings are required in breakaway walls.

Electrical, heating ventilation, plumbing, air conditioning equipment and other service facilities must be elevated to or above the BFE and cannot be mounted on breakaway walls or structures.



DESIGN STANDARDS FOR ELEVATED BUILDINGS

| Building Code

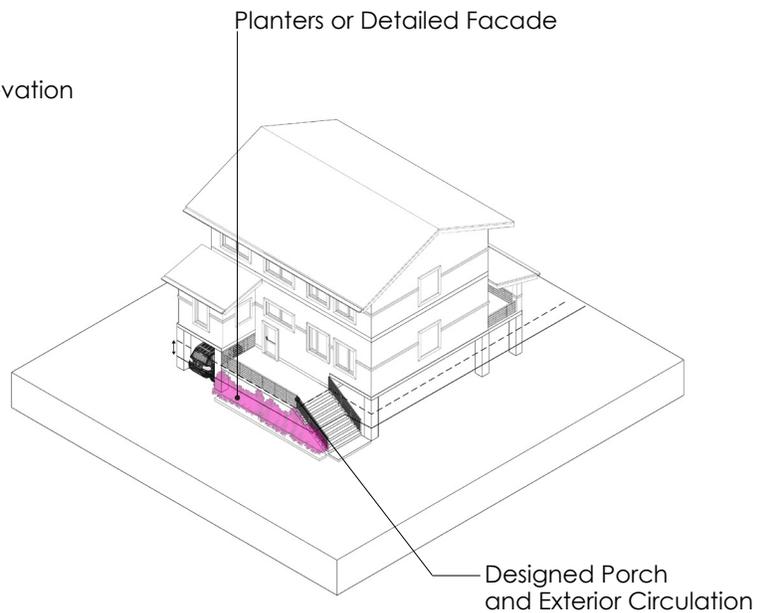
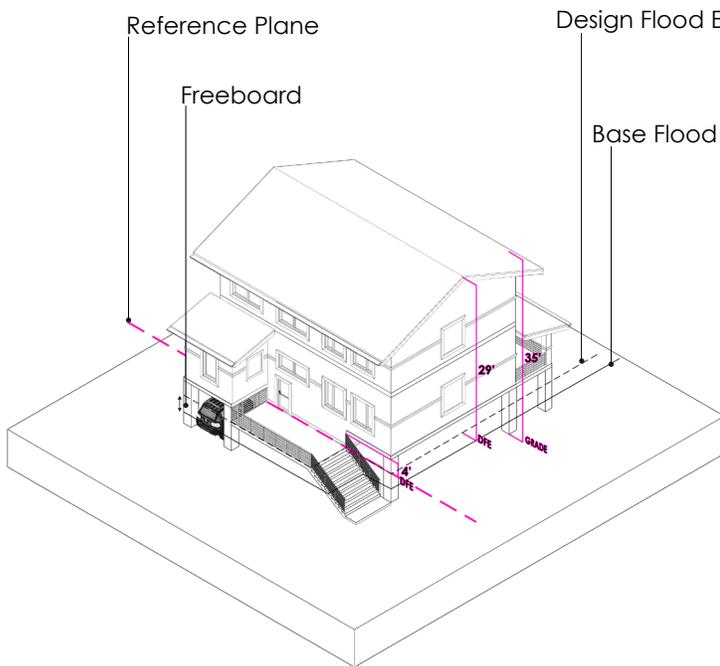
It is important to consider the impacts to the street environment when raising buildings. Height and other exterior elements can drastically change the 'feel' of the neighborhood.

Proposed Policy

Measure height limit from design flood elevation or reference plane

Proposed Policy

Establish design standards for raised buildings



PLANNING POLICY

ASSOCIATED POLICIES:

Provide exterior circulation.

(City of Boston, 2019); (New York City Planning, 2020)

Single and two-family homes that elevate their first occupiable floor at or above five feet must either raise and plant the front yard, design a porch in front of the building, or design a stair turn and install planters to help alleviate blank walls.

(New York City Planning, 2020)

Elevate buildings and their utilities to consider changing water elevations at the coast.

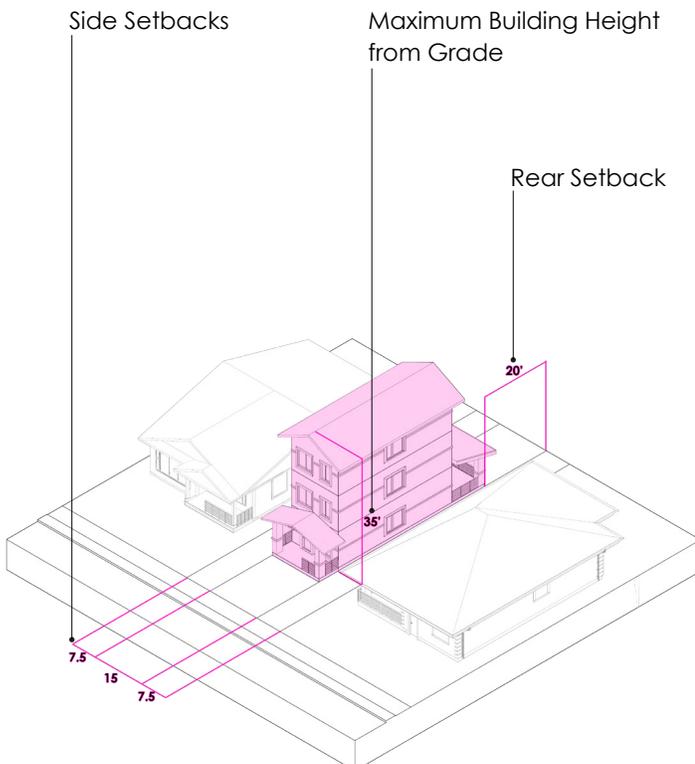
Allow buildings that modify their ground floor or MEP components to trade FAR or provide other incentives that can make this a reasonable trade-off in value.

BUILDING ENVELOPE

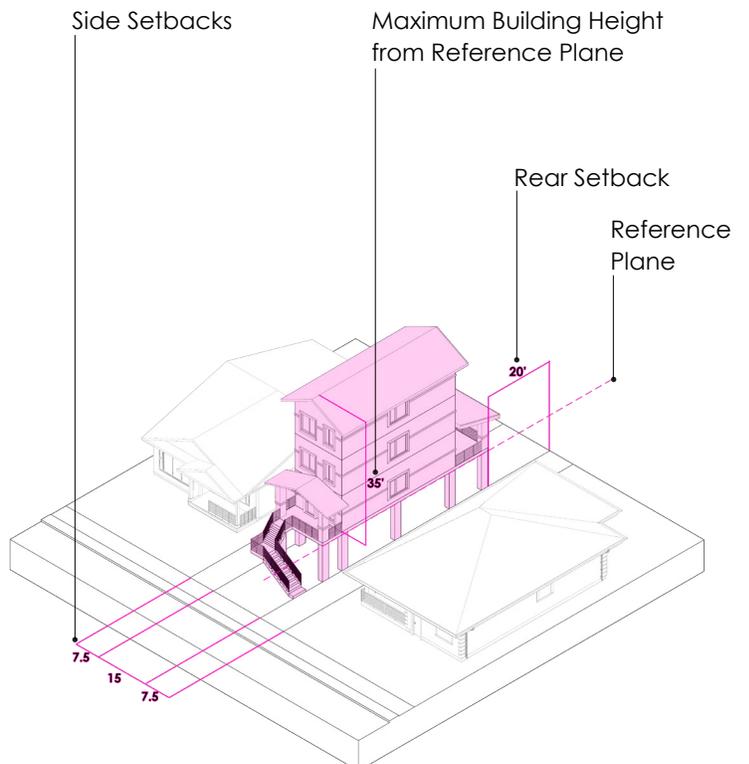
 | Land Development Code

Increased building constraints, especially when raised, can create awkward structure configurations. In an effort to mitigate risk while also allowing for reasonable development footprints, policy can be created to provide guidance. For example, on small lots, parameters can be set to allow buildings to encroach into setbacks. This creates clarity residents and their neighbors.

Existing Policy



Existing Policy for a Raised Building



PLANNING POLICY

ASSOCIATED POLICIES:

Reduce side yard requirements if the lot is narrow (for example, when less than 30 feet to a minimum of three feet)

(New York City Planning, 2020)

Reduce rear yard requirements if the lot is shallow (for example, when less than 95 feet to a minimum of 10 feet)

(New York City Planning, 2020)

Meet front yards and setbacks of neighboring buildings, to best align to surrounding neighborhood context.

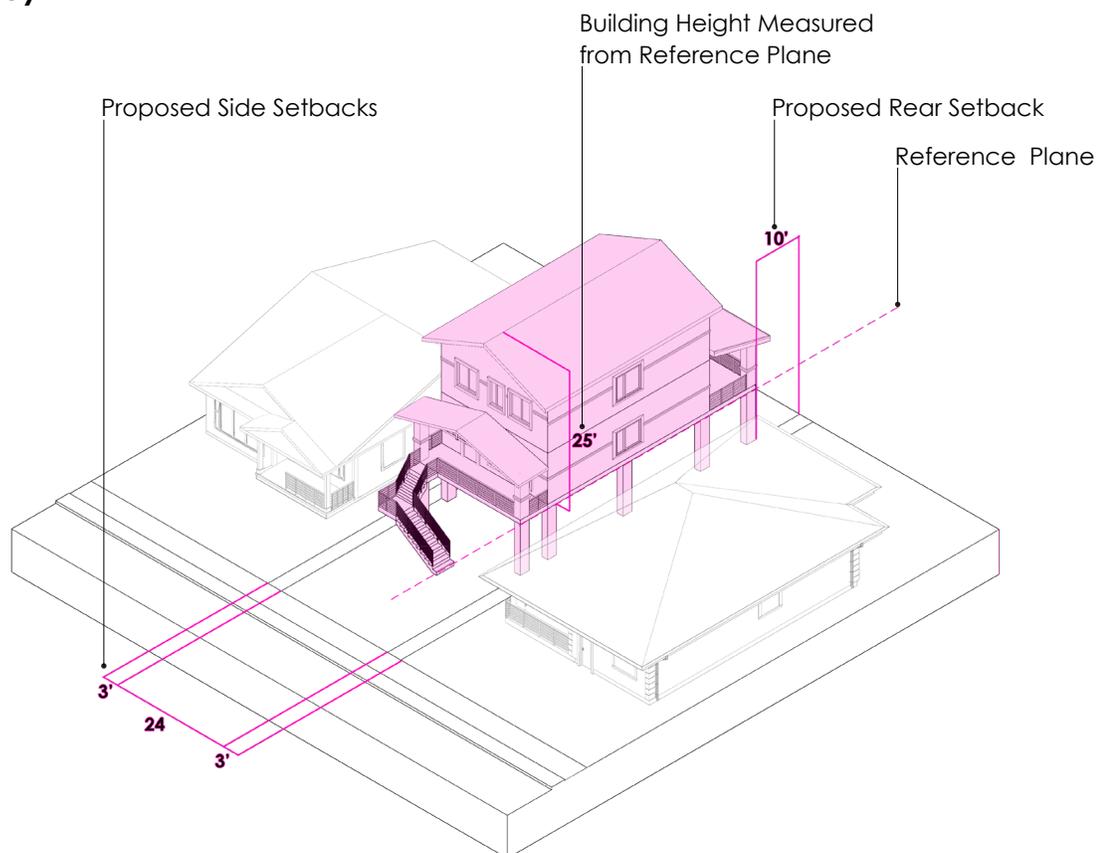
In exchange for this flexibility, the building would be limited to a maximum height of 25 feet, as measured from the reference plane, instead of 35 feet (most common maximum height in low-density districts).

(New York City Planning, 2020)

Allow for a variance if the lot does not have 30 feet of buildable space in either dimension, when abiding by required setbacks.

Maui, Hawaii (Grannis, 2011)

Proposed Policy



BUFFERS AND SETBACKS

 | Land Development Code

If topographic elevations are gained within a buffer or setback, it offers extra protection against rising seas. This space is important in allowing habitats to migrate upslope and in creating a barrier to future conditions. Buffers are not only useful for protecting property and structures, they help to alleviate pressures put on important coastal ecosystems.

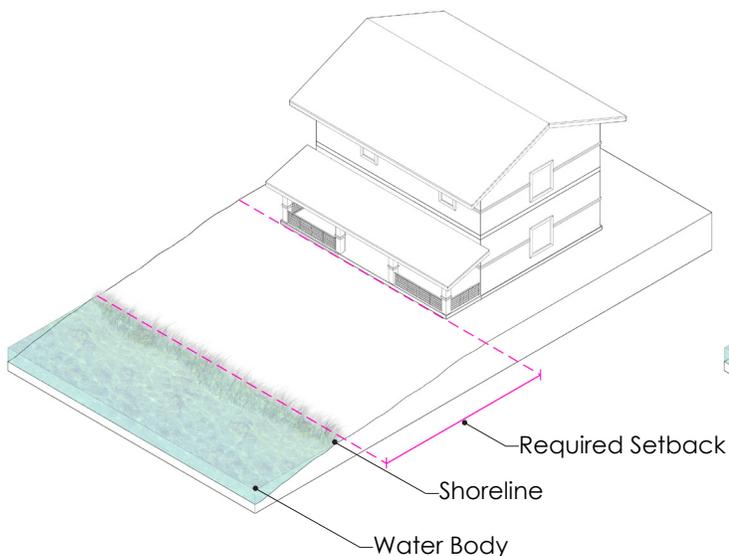
There are many options for buffers and setbacks. However, understanding that they may change, to coincide with environmental change, is important.

PROPOSED POLICY: STANDARDIZED SETBACKS

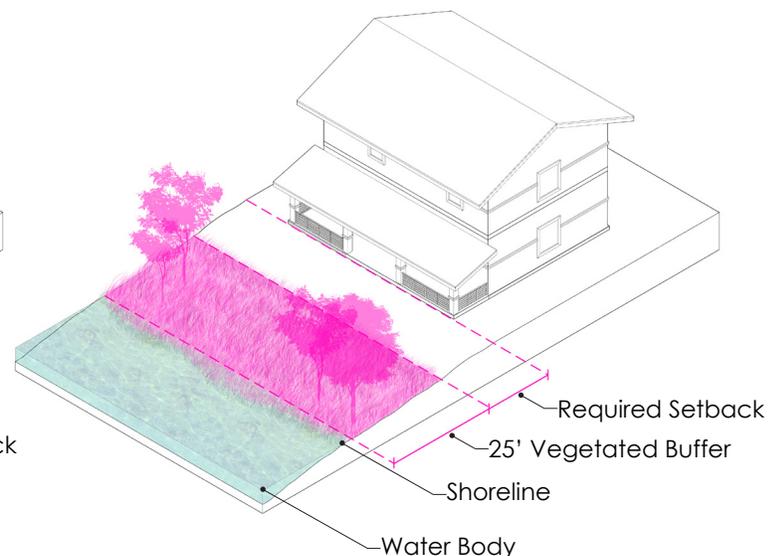
Require a 25-foot minimum vegetated buffer for all new non-beachfront shoreline development in the Coastal zones.

South Carolina Shoreline Change Advisory Committee (Grannis, 2011)

Existing Policy



Proposed Policy

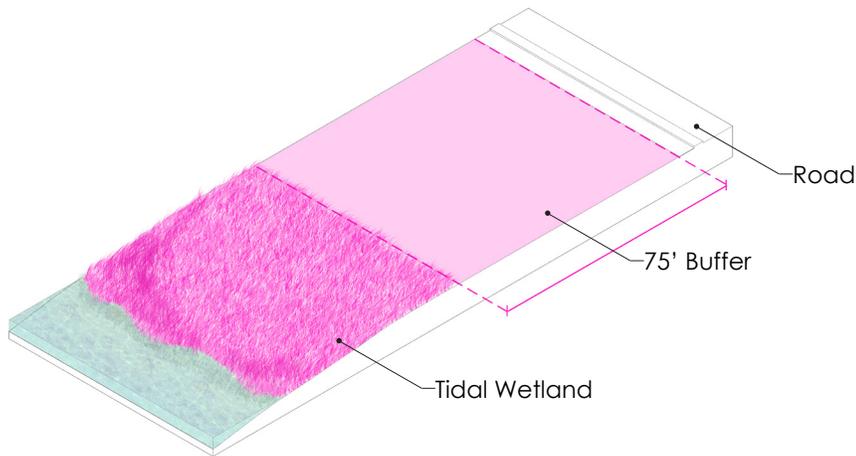


PLANNING POLICY

PROPOSED POLICY: BUFFERS NEAR TIDAL WETLANDS

Situate roads other infrastructure and most new construction at least 75 feet from a tidal wetland.

New York State Tidal Wetlands Act (Land Use Law Center)

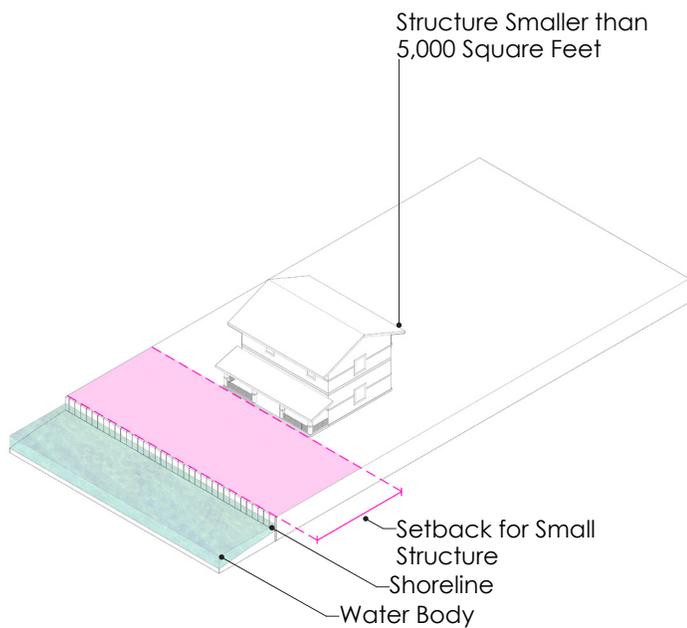


PROPOSED POLICY: TIERED SETBACK

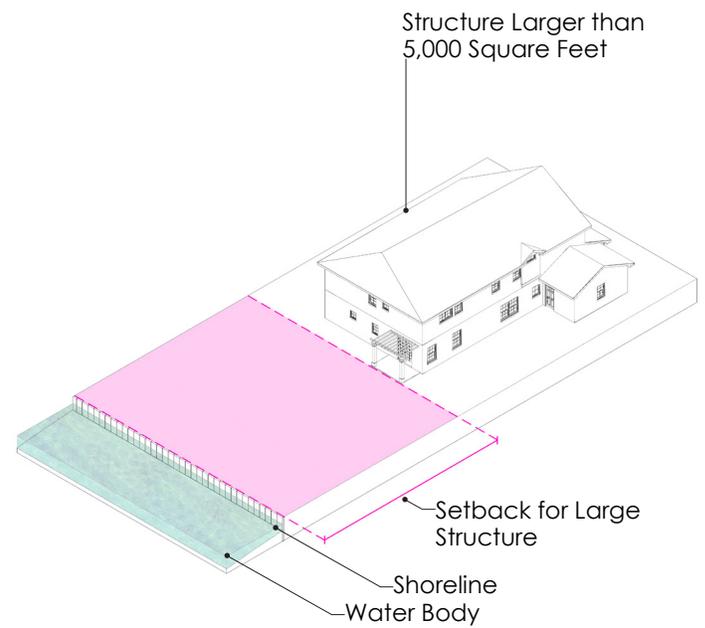
Setback smaller structures (less than 5,000 square feet) 30 times the erosion rate; larger structures must be set back 60 to 90 times the erosion rate based upon the size of the structure.

North Carolina; Grannis, 2011

Proposed Policy



Proposed Policy



PLANNING POLICY

ASSOCIATED POLICIES:

Reduce rear yard requirements if the lot is shallow (for example, when less than 95 feet to a minimum of 10 feet)

(New York City Planning, 2020)

Meet front yards and setbacks of neighboring buildings, to best align to surrounding neighborhood context.

In exchange for this flexibility, the building would be limited to a maximum height of 25 feet, as measured from the reference plane, instead of 35 feet (most common maximum height in low-density districts).

(New York City Planning, 2020)

Allow for a variance if the lot does not have 30 feet of buildable space in either dimension, when abiding by required setbacks.

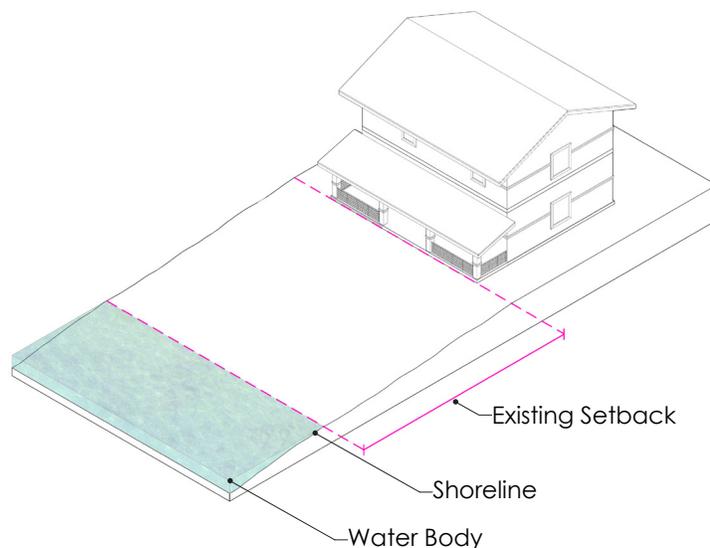
Maui, Hawaii (Grannis, 2011)

PROPOSED POLICY: EROSION-BASED SETBACK

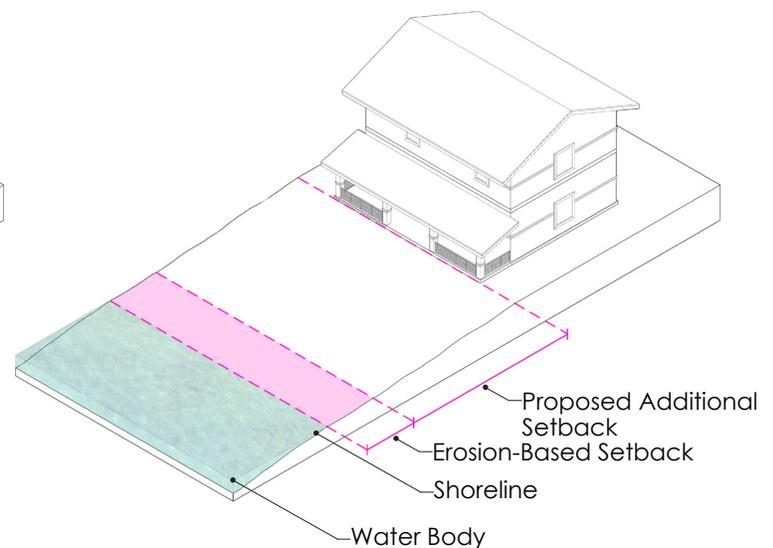
Establish an erosion-based minimum setback for shoreline development based upon the (annual coastal erosion rate) x (a planning period representing the economic lifetime of the coastal structure) + (an additional buffer).

The City of Lewes Hazard Mitigation and Climate Adaptation Action Plan, North Carolina (Grannis, 2011)

Existing Policy



Proposed Policy



LOW MAINTENANCE ZONE (LMZ)



| Land Development Code

The gradient edge is one of its most important and productive zones within, or near, a water body. This area is responsible for sediment and nutrient reduction into the waterway, soil stabilization, and structural habitat. The displacement of this zone impacts the water system, and if replaced with high maintenance plantings, can dramatically increase pollution and de-stabilization of the coastal edge. As a compounding factor, this decreases the functionality and productivity of the shoreline and adds susceptibility to erosion. The elimination of this habitat edge also decreases the opportunity for ecosystem migration, as sea-levels push upward and inland.

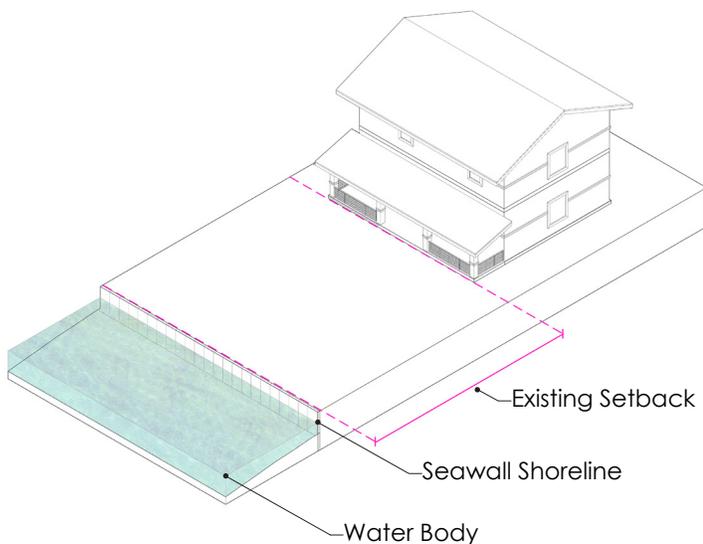
PROPOSED POLICY:

Require Low Maintenance Zones (LMZ) to be established between developed areas and shorelines, contiguous to any waterbody, wetland or seawall.

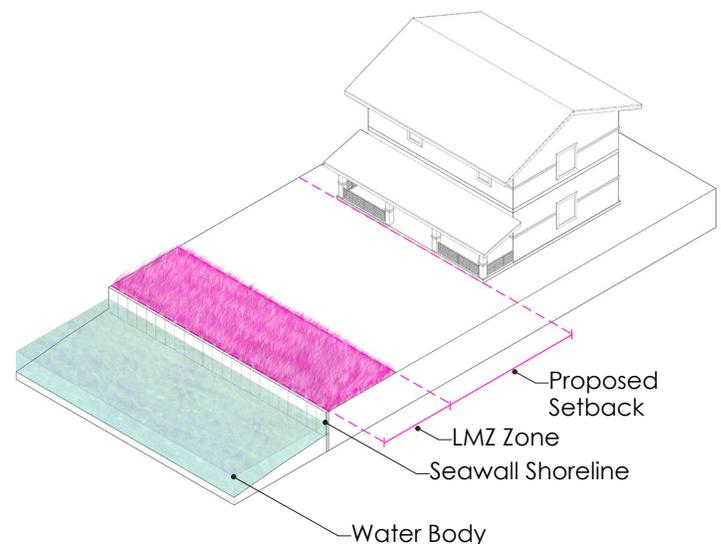
This helps to reduce impacts of climate change, the destructive forces from storm surge and tidal velocity, and the erosive effects of sea-level rise and wave action.

(FCCDR, 2020)

Existing Policy



Proposed Policy



TREE CANOPY

 | Comprehensive Plan

Trees can collectively help to reduce greenhouse gases, which in turn have a relationship with climate change and sea-level rise (CSAP, 2019). Individually, trees dissipate rainwater and alleviate stormwater requirements. As groundwater levels increase, stormwater capacities will be reduced. This simple strategy is one of many small things that can be done to mitigate future conditions.

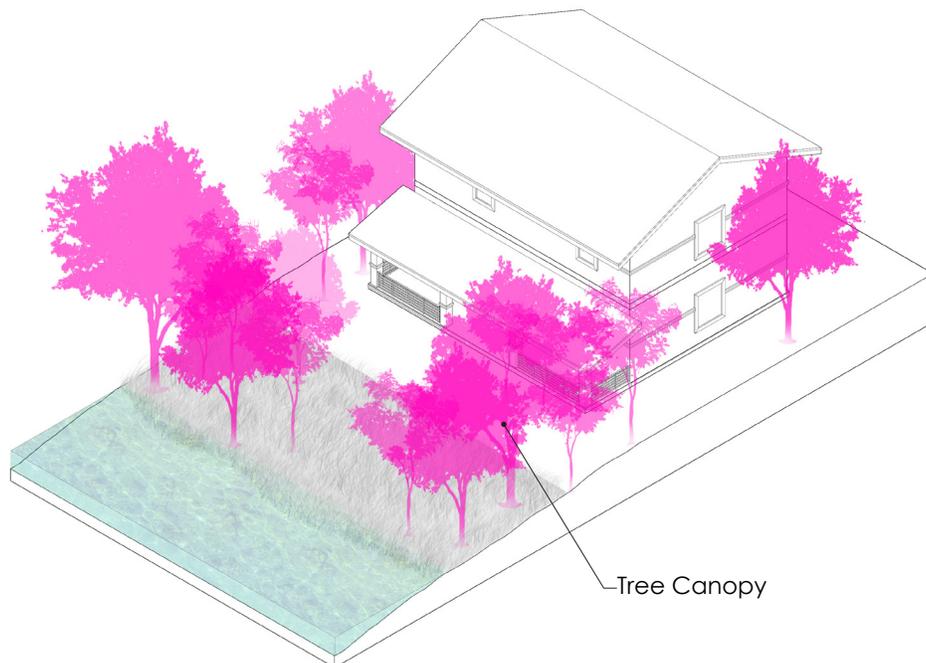
PROPOSED POLICY:

Promote and maintain tree plantings as a means for water absorption.

Charleston, 2019

Proposed Policy

Tree Canopy for Improving Hydrology



CONTINUOUS COASTAL HABITATS

 | Comprehensive Plan

Sea-level rise will increase exposure to the impacts of storm surge, especially at the coast. Where feasible, promoting storm barriers in open space can help to mitigate this situation. However, inland areas are only as strong as their lowest point. To create a formidable obstacle for future storm waters a continuous landscape can mitigate this risk.

This continuity of habitats also helps to strengthen ecosystems, providing an uninterrupted ecological edge.

PROPOSED POLICY:

Place a priority on coastal land acquisition through the Florida Forever program.

Acquisition efforts should be strategically targeted to protect coastal resources, reduce insured risk, and reduce the impacts of climate change on both ecosystems and community. Continuous park space may create optimal configurations for water storage and transference. These parks become green absorptive landscapes for collecting, filtering and dispersing waters. Regional stormwater system. Having floodable parks and green spaces alongside new and existing neighborhoods and development provides new amenities and elevates property values.

(Southeast Florida Regional Climate Compact, 2019); (FEMA, 2013); (City of Boston, 2019)

Existing Policy
Coastal Habitat



Proposed Policy
Continuous Coastal Habitat



SEA WALLS

 | Comprehensive Plan | Building Code

Coastal armoring is often considered as an approach to sea-level rise mitigation. However, since groundwater levels rise at the same time as sea-levels, sea walls do not keep the water out. Consequently, coastal armoring has its limits as a mitigation strategy. In fact, as sea-levels rise, hardened shorelines inhibit habitat migration, amplify wave energy, scouring and erosion.

Sea wall policy, in regards to sea-level rise, can help to:

- Mitigate increased levels of storm surge
- Remove sea walls, through coordination or incentivization.

PROPOSED POLICY:

Find clusters of properties where it is possible to remove sea walls. Work with property owners to remove walls and establish living shorelines.

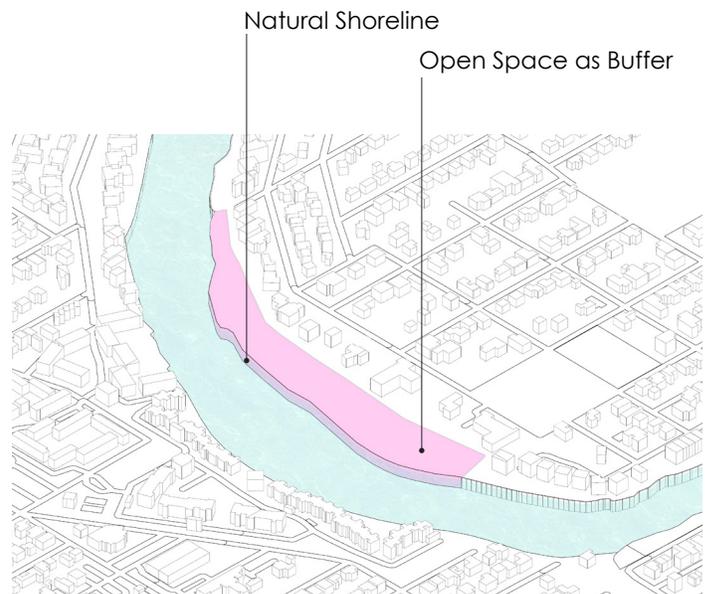
Existing Policy

Sea Wall and Shoreline Properties



Proposed Policy

Natural Shoreline with Removal of Properties



PROPOSED POLICY:

Establish a top of sea wall standard that must be implemented by a specific year.

In Broward County, structures must be at least 5 feet above NAVD88.

(Broward County, 2021)

Seawalls must be in good repair or property owners will receive fines.

(Broward County, 2021)

Existing Policy



Proposed Policy



INCREASE LIVING SHORELINES



| Land Development Code | Comprehensive Plan

Sea-level rise can have cumulative affects on coastal habitats as waters deepen and inland areas become submerged. If space is not provided for this to occur, valuable ecosystems can decline as pieces are removed and important biotic relationships are lost.

Increasing living shorelines can happen by removing hardened erosion control structures, but they can also be constructed in front of such structures.

The Tampa Bay Estuary Program has created a tool to identify opportunity areas for living shorelines: The Living Shoreline Suitability Model (TBEP, 2021). This tool and other analyses can help to find areas for living shorelines. As a policy, the municipality can support these efforts and commit to targeted goals.

PROPOSED POLICIES:

To compensate for the loss of ecosystem services resulting from hard shoreline stabilization, require adequate mitigation through the construction of living shorelines in front of hard shoreline stabilization structures where feasible.

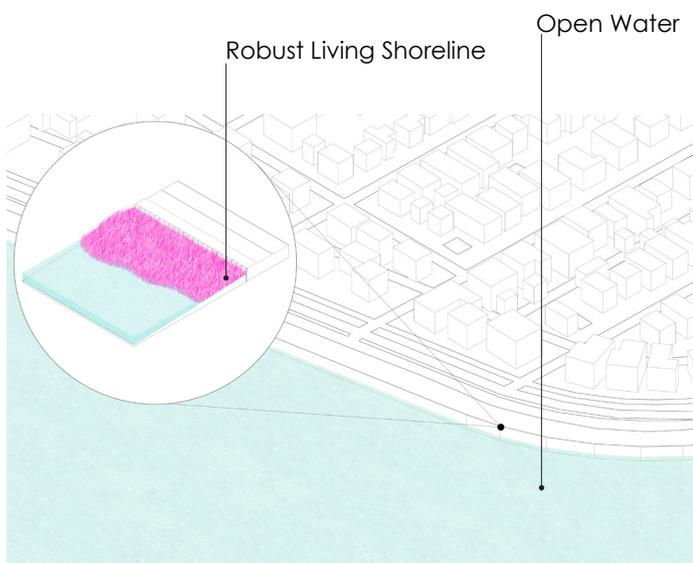
Collier County, FL (Ankersen et al., 2013)

Require a living shorelines buffer where appropriate and ecologically feasible.

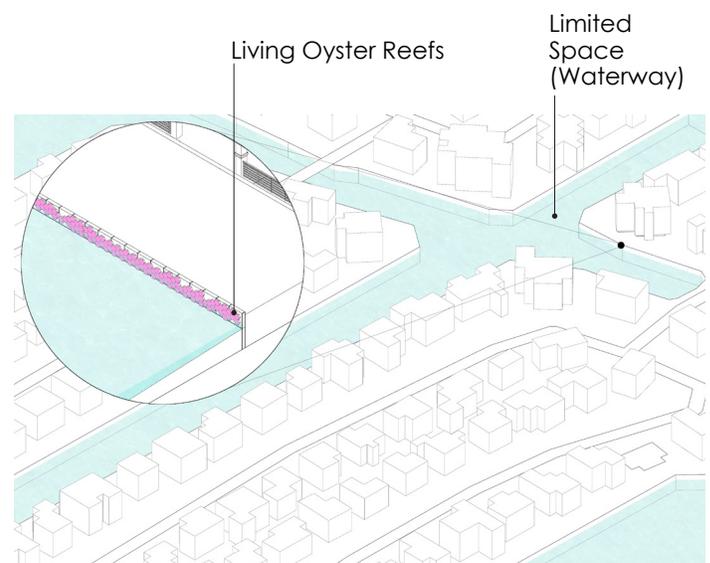
For example:

- a. Provide robust living shorelines in areas with access to open waters
 - b. Provide infrastructure for oysters in limited waterways such as canals
- (Ankersen et al., 2010); (Boland, 2019)*

Proposed Policy: Expansive Coastlines



Proposed Policy: Narrow Coastlines



CONCLUSION

The policies shown represent a sampling of regulatory options available to municipalities when confronting the issues of sea-level rise. These policies represent frameworks for future work, which should be matched to the will and adaptive capacities of the community.

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